Marian University

Leighton School of Nursing

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Pediatric Airway Educational Intervention and Simulation

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Pediatric Airway Educational Intervention and Simulation

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Abstract

Background: The most common causes of morbidity during general anesthesia in pediatrics are airway and respiratory complications that commonly occur in both healthy children and infants. The high stress environment of pediatric anesthesia makes pediatric airway education paramount for the best opportunity of wanted outcomes. Marian University first-year SRNAs enter the clinical field without yet receiving hands on pediatric training. By providing an educational workshop and hands-on simulation training opportunity, SRNAs will have increased knowledge and confidence upon entrance into the clinical field.

Purpose: This DNP project is an educational intervention aimed at improving the knowledge and confidence level of first-year SNRA students to successfully secure a pediatric airway.

Methods: Quantitative data was collected with pre-education intervention test and post-education test questionnaires as well as a three-question pre-simulation self-confidence and post-simulation self-confidence survey. The data was used to assess differences in knowledge scores before and after the educational intervention and self-confidence scores before and after the hands-on simulation.

Implementation Plan/Procedure: First-year Marian University SRNAs received an education module via the campus-wide Canvas learning platform. Once completed, participants were offered an opportunity to participate in a hands-on pediatric airway simulation. The education interventions were evaluated quantitatively for statistical relevance using a pretest and posttest knowledge-based assessment before and after the Canvas module via Qualtrics survey. In addition, a confidence level assessment was made available after the completion of the Canvas module and the post-simulation experience for those who chose to participate.

Implications/Conclusion: A pediatric airway educational intervention via voice-over PowerPoint presentation statistically increased participants knowledge scores ($p < 0.05$) from pre- to post-education. Participants had a significant increase in confidence ($p < 0.05$) in each of three NLN adapted confidence questions demonstrated in a pre- and post-simulation survey.

Keywords: Phrases, keywords, and mesh terms *airway*, *management, anesth$, and pediatric*.

Pediatric Airway Educational Intervention and Simulation

Many of the negative outcomes during airway management are preventable, yet one of the most common causes for mortality in children during the perioperative period is due to respiratory complications (Krishna et al., 2018). The anatomy of a child's airway is unique due to their large tongue and head, small mouth, narrow airway, and low functional residual capacity (Amaha et al., 2021). In addition, their propensity to consume oxygen at a higher rate leads them prone to oxygen desaturation at a more rapid rate (Karsli, 2015). Pediatric anesthesia can prove to be a high stress environment for even the seasoned provider, let alone the student registered nurse anesthetist (SRNA) making pediatric airway education paramount for the best opportunity of wanted outcomes.

Background

The most common causes of morbidity during general anesthesia in pediatrics are airway and respiratory complications that commonly occur in both healthy children and infants (Adewale, 2009). Having a solid foundation in pediatric airway knowledge and management is key to preventing untoward outcomes. With increasing recognition of breathing disorders in the pediatric population, there is an increase in the procedures being performed (McNiece & Dierdorf, 2004). The pediatric population has unique anatomy of the airway, which is ever-changing in size, shape, and position throughout their development (Adewale, 2009). Additional knowledge must be possessed by providers in the management of the airway that starts with a comprehensive assessment and a detailed medical history (Adewale, 2009). These children are not merely "small adults" yet offer a variety of management differences ranging from positioning, physiological, as well as the previously mentioned anatomical differences (Harless et al., 2014). Even with all the pre-mentioned differences, there are still more things to take into consideration such as the increased prevalence of childhood obesity as well as a many congenital and acquired conditions (Best, 2012). In addition to the differences in anatomy, long periods of fasting are not always required before surgery and intravenous access may not be obtained before induction of anesthesia (LeSaint & Hemmen, 1995).

The pediatric patient is at an increased propensity of adverse outcomes with airway and respiratory complications during anesthesia for even the most seasoned provider. So, what does that mean for the SRNA that is entering their first clinical rotation? The pediatric education and simulation units for Marian University SRNAs are not completed until over halfway through the fifth semester, which is two semesters after students have entered their clinical rotations. Unfortunately, some students begin performing pediatric anesthesia in clinical rotations during their junior year before these units have occurred. Having pediatric knowledge and exposure prior to the clinical rotations would better prepare the junior student for success. Although there is no evidence of an association between increased airway and respiratory complications in the pediatric population and SRNAs, additional education could prove beneficial. With a dynamic environment in patient types, equipment, recommendations, and techniques, the knowledge of the pediatric airway and how to manage it are always changing (Harless et al., 2014). In fact, the still-taught anatomical description of a "funnel-shaped" airway that is narrowest at the cricoid ring has even been found to be inaccurate through video bronchoscope images (Dalal et al., 2009).

Problem Statement

Managing the airway of a pediatric patient can be difficult for all providers, especially those who have little to no firsthand training in the matter. This leaves first-year SRNA students as a particularly vulnerable population as they will soon be entering the clinical field while lacking firsthand pediatric training. By providing an educational workshop that includes not only a lesson on pediatric airway differences and pitfalls, but also a hands-on interactive training opportunity, it is believed that these students will be better prepared for the immersion into the clinical field. This will not only give experience and confidence to the SRNA, but more importantly ensure better care and safety for the patients.

This leads to the PICO question:

In first-year SRNAs, what is the effect of having a pediatric airway education and simulation workshop on the competence level of the SRNA, in managing the pediatric airway compared through a pre and post workshop test?

Needs Assessment and Gap Analysis

There is a lack of pediatric airway exposure to the SRNA as evidenced by the current didactic curriculum. SRNAs currently begin clinical rotations during the fourth semester and are required to perform anesthesia on pediatrics patient during this time. Pediatric anesthesia is introduced during the fifth semester at week 11. To be well prepared for performing pediatric anesthesia, the SRNA should be introduced to the anatomical differences, equipment differences, and the navigation of airway problems in this patient population. This knowledge deficit sets the stage for an inept SRNA to successfully manage a pediatric airway and associated complications.

Exposing first-year SRNA students to the differences in anesthesia case management along with the variations of anatomical differences between the pediatric and adult airways may better prepare the student to manage pediatric cases during the clinical setting. Through access via Canvas learning platform and the Marian University simulation lab, students will be provided an ideal setting to acquire techniques on how to manage the pediatric airway. Combined, these two platforms will assist the SRNA with a favorable learning environment to safely practice newly acquired skills. In addition, discussion boards will help facilitate open discussions relating the management of the pediatric airway. Through education and hands-on teaching, the first-year SRNAs will gain competence in their abilities to successfully intubate a pediatric airway by familiarizing themselves with the pediatric equipment and practicing these techniques on the pediatric mannequins.

Literature Review

This literature review was performed to analyze articles concerning pediatric airway anatomy, management of the pediatric airway, and educational interventions to help prepare anesthesia or medical providers.

Methods

The review search was conducted using the following phrases, keywords, and mesh terms *airway, management, anesth$, and pediatric*. The review used the PubMed database and was conducted in October and November 2022. The references of pertinent reviews and retrieved articles were checked for further studies, with none being identified. The 168 database results were reduced to 40 after the initial screening to exclude adult patients, product comparison studies, questionnaires, opinion articles, and retrievable articles. The inclusion criteria included studies published within the last seven years, pediatric population, anesthesia, and English language. This reduced the number to 19 research articles as shown in a PRIMSA flow chart (Appendix A) to be used in this literature review.

Results

An initial literature search using PubMed database resulted in 168 original articles that were further screened and reduced to 19. The determination and factors resulting in the final 19 articles can be seen in the PRISMA flow chart in Appendix A. The literature review matrix in Appendix B provides more specific information related to each study.

Anatomy

Five of the 19 research articles utilized were based on pediatric airway anatomy (Holzki et al., 2018; Jain et al., 2020; Liu et al., 2020; Luscan et al., 2020; Kim et al., 2015). Three of the four references focus on the narrowest part of the pediatric airway and the cricoid cartilage shape, with all agreeing that the narrowest portion is the cricoid cartilage, but offered different outcomes on shape (Holzki et al., 2018; Liu et al., 2020; Luscan et al., 2020). Two of the research articles found that the cricoid cartilage is a funnel shape in pediatric patients (Holzki et al., 2018; Liu et al., 2020). A systematic review of published literature, University Libraries, and authoritative textbooks with key search words and phrases utilized 672 pediatric cadavers aged preterm to 17-years-old, and in vivo studies of 553 patients aged one-month-old to 13-years-old found that there was a majority consensus that the cricoid cartilage was funnel-shaped (Holzki et al., 2018). A retrospective study of 1346 pediatric patients aged one-year-old to 20-years-old utilized a radiology database and NEUPACS software to determine the cricoid cartilage shape (Liu et al., 2020). This study found a significant difference in the anteroposterior diameter of the inlet of the cricoid cartilage compared to the anteroposterior diameter of the outlet showing that it is funnel-shaped (Liu et al., 2020). When an LMA is anatomically placed properly into the esophageal inlet, it causes an equal degree of ventral displacement among the arytenoid cartilages (Kim et al., 2015). This placement helps facilitate an adequate seal and proper ventilation (Kim et al., 2015). When an LMA is not properly positioned or rotates it can result in asymmetric elevation of the arytenoid cartilage relative to the LMA and may affect the quality of ventilation (Kim et al., 2015). Unfortunately, when this scenario occurs, the provider should reposition the LMA device (Kim et al., 2015). Kim and colleagues performed an observational study of 100 pediatric patients and evaluated the degree of LMA malposition, rotation, and arytenoid cartilage asymmetry using ultrasound (US) and fiberoptic bronchoscope (FOB) equipment. There was a 50% incidence of asymmetric arytenoid cartilage elevation (95% confidence interval [CI], 40%-60%), LMA malposition was 78% (95% CI, 69%-86%), and LMA rotation was 43% (95% CI, 33%-53%) (Kim et al., 2015). In addition, this study found that there was no change in the shape throughout the development of the participants' lifespan (Liu et al., 2020). In a separate retrospective study utilizing a CT database collection and GE Revolution HD scanner, there was a significant correlation between the airway measurements and patient age with the researchers identifying that the cricoid cartilage is round-shaped independent of the studied age (Luscan et al., 2020). The final anatomy-based study utilized in this literature review was a prospective observational study that found a positive correlation in the 60 participants aged two-years-old through eight-years-old between the incisor-manubriosternal joint length and the incisor to carina length offering valuable information for ETT depth placement (Jain et al., 2020).

Difficult Airway

Four of the 19 articles were focused on pediatric patients with a difficult airway with three focusing on recognizing a potentially difficult airway and the other discussing successful endotracheal intubation despite a difficult airway (Amaha et al., 2021; Burjek et al., 2017; Disma et al., 2021; Park et., 2019). Pediatric patients have several disadvantages that put the anesthesia provider and patient in a challenging position with one being prone to hypoxemia due to their high oxygen consumption, low functional residual capacity, and small closing capacity (Disma et al., 2021). Additional disadvantages include an increased risk of airway collapse after induction of anesthesia as well as the addition of a difficult airway (Disma et al., 2021). The anesthesia provider and the patient are placed in an undesirable position in either of these situations. When compounding these disadvantages with the addition of an unanticipated difficult airway, a provider is put in a very problematic situation. Entering a pediatric unanticipated difficult airway as a junior student with limited firsthand training produces an even more challenging and stressful scene. A prospective observational study of 4,683 planned tracheal intubations in neonates and infants up to 60-weeks post-conceptual age found that 5.8% of patients required three or more attempts for tracheal intubation (Disma et al., 2021). This study also found that there were predictive factors that correlated to this high number of attempts. It found that close to half of these patients had congenital abnormalities and 40% had an ASA class of 3 or greater (Disma et al., 2021). In addition, it found that 13% of the difficult intubations were also difficult to ventilate via face mask before the attempt (Disma et al., 2021). A retrospective comparative study utilized 1295 patients under the age of 18-years-old who were deemed as difficult intubation defined by one of four criteria; grade three or higher Cormack and Lehane Classification, anatomical limitations making direct laryngoscopy impossible, previous failed direct laryngoscopy attempt within six months, and when attending anesthetist deemed direct laryngoscopy as a poor chance of success (Park et al., 2019). The study found a significantly higher initial success rate of intubation with video laryngoscopy compared to direct laryngoscopy (Park et al., 2019). Both studies found that infants that were less than 10 kilograms in weight or less than 60-weeks post-conceptual age had an increased risk of difficult and failed intubations no matter what type of laryngoscope was used (Disma et al., 2021; Park et al., 2019).

A multi-centered cross-sectional study of 290 patients ranging from newborn through five-years-old labeled as ASA class I and II were utilized to determine prevalence and associated factors of a difficult airway (Amaha et al., 2021). An airway was deemed difficult if the anesthetist encountered difficulty with mask ventilation, laryngoscopy, or tracheal intubation (Amaha et al., 2021). The study concluded that 19.7% of patients undergoing surgery were a difficult airway with a significant correlation of the following predictive factors; less than two-years-old, underweight, anticipated difficult airway, history of a difficult airway, and anesthetists with less than four years of pediatric experience (Amaha et al., 2021). The last study was a retrospective study of 1,603 pediatric patients with difficult airways which found that using supraglottic airway devices to facilitate a fiberoptic intubation had higher first-pass success rates and fewer complications in children less than one-year-old compared to intubating using video laryngoscopy, but no differences in pediatric patients greater than one-year-old (Burjek et al., 2017).

Equipment

Four of the 19 reviewed articles focus on equipment for intubating pediatric patients (Garcia-Marcinkiewicz et al., 2020; Kaji et al., 2020; Lingappan et al., 2018; Park et al., 2019). A systematic review of three randomized control trials compared video laryngoscopy with direct laryngoscopy for endotracheal intubation in newborns by trainees and found that video laryngoscopy increases the success of intubation in the first attempt (Lingappan et al., 2018). In addition, this study found that video laryngoscopy does not decrease the time to intubation nor the number of attempts for intubation (Lingappan et al., 2018). A randomized control trial of 564 infants found significance in the use of video laryngoscopy utilized for endotracheal intubation with fewer esophageal intubations compared to direct laryngoscopy (Garcia-Marcinkiewicz et al., 2020). Another retrospective study of 625 patients comparing direct laryngoscopy and video laryngoscopy found a higher first-time success utilizing video laryngoscopy (Kaji et al., 2020). A third retrospective study of 1,295 pediatric patients came to the same conclusion finding success rates for video laryngoscopy were significantly higher than direct laryngoscopy, while showing no differences in complication rates per attempt compared to direct laryngoscopy (Park et al., 2019).

Teaching and Technique

Six of the 19 studies focused on techniques to utilize during pediatric anesthesia to promote wanted outcomes while one of the 19 studies focused on education before clinical immersion (Aghdashi et al., 2017; Gálvez et al., 2019; Koo et al., 2018; Lee, et al., 2017; Powell et al., 2022; Soneru et al., 2019; Vukovic et al., 2019). A systematic review and meta-analyses of 17 randomized trials of 1881 pediatric patients found significance in the reduction of airway complications and desaturation by utilizing deep extubation over awake extubation (Koo et al., 2018). This study, however, did not find a significant difference in the incidence of laryngospasm and breath-holding between the two groups (deep vs. awake extubation), but did find an increased incidence of airway obstruction in the deep extubation group (Koo et al., 2018). Two of the studies were prospective observational studies regarding the use of apneic nasal oxygenation in preventing hypoxemia (Soneru et al., 2019; Vukovic et al., 2019). Both studies found significance in the reduction of hypoxemia via the apneic nasal oxygenation route when compared to not utilizing apneic nasal oxygenation (Soneru et al., 2019; Vukovic et al., 2019).

A retrospective cross-sectional study of 4,683 planned pediatric tracheal intubations found that although multiple attempts of laryngoscopy are associated with an increased risk of hypoxemia, 35% of all intubations resulted in hypoxemia and 8.9% in bradycardia, verifying the need for a good technique for securing the airway in a quick manner (Gálvez et al., 2019). One randomized control trial of 116 ASA class I and II patients aged two-months-old to eight-years-old undergoing lower abdominal surgery compared insertion techniques of LMAs (classic versus rotary method) finding no significant difference in success rates between them (Aghdashi et al., 2017). A prospective observational study of 154 pediatric patients aged 15 utilized a manometer and fiberoptic bronchoscope to determine a calculation utilizing height and weight (insertion depth of FLMA (cm) = 7.0 + 0.04×height (cm) + 0.05 ×weight (kg)) to best predict insertion depth of a flexible laryngeal mask airway (Lee, et al., 2017). Finally, a cross-sectional study of 20 second and third-year student registered nurse anesthetists focused on high-fidelity pediatric simulation of managing common pediatric complications compared to confidence levels (Powell et al., 2022). Using a Likert scale with ordinal variables, the study showed a significant correlation in the improvement of confidence scores from pre-simulation to post-simulation and post-simulation to pediatric rotation (Powell et al., 2022).

Theoretical or Conceptual Framework

This project's theoretical framework is the Jeffries Simulation Model. In 2005 Jeffries published "A Framework for Designing, Implementing, and Evaluating Simulations Used as Teaching Strategies in Nursing." This framework was selected for guidance in the design, evaluation, and implementation of a simulation-based education project that would promote positive impacts on learning outcomes for student participants. The Jeffries Simulation Model further depicts the importance of combining clinical expertise with a guided simulation to increase learning outcomes for participants (Jeffries et al., 2015). Jeffries lists five components that constitute the framework and consist of: educators, students, educational practices, simulation design characteristics, and outcomes (Jeffries, 2005). Please see Appendix C for a visual representation of Jeffries simulation model. The foundation of this DNP project is focused on improving the readiness and competence of SRNAs in their ability to manage the pediatric airway through active participation in an additional educational simulation.

Project Aims and Objectives

This DNP project's objective is to provide first-year SRNAs with high-quality, high-fidelity simulation-based training that enhances their knowledge and competence in navigating the anatomical nuances associated with the pediatric airway. This project's specific aims are to increase first-year SRNAs' knowledge of the anatomical variations associated with the pediatric airway and increase their competence in managing an unpredicted difficult pediatric airway. The goals of the project are to demonstrate that students who chose to participate in the pediatric airway simulation will exhibit higher posttest knowledge-based scores and possess higher levels of confidence in their abilities to successfully secure a pediatric airway compared to those who follow traditional didactic instruction.

SWOT Analysis

To evaluate the project's strengths, weaknesses, opportunities, and threats, the SWOT Analysis framework was utilized. Please see APPENDIX D to view the table.

Strengths

One great strength of this project is the access to the state-of-the-art simulation lab located on the Marian University campus. Additionally, the technological access granted via

Marian University regarding building a Canvas page for educational instruction and Qualtrics for compilation and quantification of digital data are strengths of this project. Finally, the cohort of 2025 is another strength as they are stakeholders in this project as it will benefit them in preparation for clinical situations.

Weaknesses

Although there is access to a state-of-the-art simulation lab at the disposal of this project, not having the ability for hands-on education on live patients is a weakness of this project as there is a gap between the simulation of a manikin and a live patient. In addition, having a small sample size and utilizing a single cohort is a weakness of this project. Lastly, a lack getting the motivation for participants to partake in the project is a weakness.

Opportunities

The advancement of simulation technology and simulation materials offers an opportunity to improve this project. There is currently one pediatric manikin for educational purposes. Having multiple manikins or greater lifelike capabilities would provide the opportunity for more applicable education and the ability to meet the needs of multiple participants at once. In addition, having an enticement for buy-in from participants, such as bonus points, to get better participation would be an opportunity to better this project. Additional clinical time for project owners with pediatric airway management is another opportunity for the improvement of this project.

Threats

One threat for this project includes inexperience by project designers in utilizing the Canvas education-based technology in distributing the educational material. Another threat is the lack of substantial clinical experience regarding the pediatric airway. Furthermore, the spring semester has proven to be a difficult semester for first-year Marian University SRNAs, which has the potential of leading to less participation. Another threat would be the inaccessibility to the simulation lab as it is being utilized for multiple DNP projects as well as normal class times. Finally, COVID-19 pandemic shutdowns as well as attrition from the cohort of 2025 serve as threats to this project.

Project Design and Methods

Project Design

This DNP project is an educational intervention aimed at improving the knowledge and confidence level of first-year SNRA students to successfully secure a pediatric airway. First-year SRNAs received education on the pediatric airway along with common techniques to increase their success at managing a pediatric airway and common complications. All participants received an education module via the campus-wide Canvas learning platform. Once completed, participants were offered an opportunity to participate in a hands-on pediatric airway simulation following the best practice guidelines set by the International Nursing Association for Clinical Simulation and Learning (INACSL). The education interventions were evaluated quantitatively for statistical relevance using a pretest and posttest knowledge-based assessment before and after the Canvas module. In addition, a confidence level assessment was offered that was made available after the completion of the Canvas module and the post-simulation experience for those who chose to participate.

Population and Setting

The project site was located on the main campus at Marian University of Indianapolis. The Marian University Certified Registered Nurse Anesthetist Program

Simulation Lab located on campus was utilized to measure the proposed intervention. There are two simulation labs, two pediatric airway mannequins, and adult mannequins for students to practice skills. Simulation debriefing and posttest survey distribution were done using a small office adjacent to the simulation lab.

The Marian University Certified Registered Nurse Anesthetist Program is a Bachelor of Science in Nursing to DNP in Nurse Anesthesia tract. Following completion of the program, students will be given the ability to obtain their Certified Registered Nurse Anesthetist license by taking the national board exam. The program has one cohort matriculate per year. The cohort that will be studied consists of 36 SRNAs. We recruited participants by utilizing the cohort email list that is provided by the Leighton School of Nursing CRNA Program to all CRNA students. Each student was given the option following completion of the education intervention to participate in an elective pediatric airway simulation to elaborate upon his or her newly acquired knowledge and skills. The students who did participate in the simulation were given an additional posttest to see if they reported higher levels of confidence and recall of knowledge compared to their peers who only received the educational intervention. Participants were required to be SRNAs from the graduating class of 2025 who are enrolled in the Anesthesia Principles Simulation I Course.

Measurement Instruments

This DNP project measured the SRNAs’ knowledge and confidence through administering pretest and posttest questionnaires utilizing Qualtrics software. A personal identifier consisting of the last four numbers of the student ID was used to determine trends based on each participant. The posttest assessment was formulated to determine if there were any measurable changes in students' baseline scoring. The pretest and posttest consisted of 15 educational-based questions assessing for retention of key topics addressed in the Canvas educational module and three questions to measure confidence level post-Canvas module and post-simulation. Students were provided with a voice-over PowerPoint presentation focusing on key topics related to the pediatric airway, management strategies, and techniques to care for the pediatric population. Following completion of the educational intervention, students were offered an additional opportunity to participate in a pediatric airway simulation to solidify their knowledge and skills. There was an infant pediatric airway mannequin, two adult mannequins, and an anesthesia machine utilized for students to practice skills. The students that attended the simulation were asked to complete a post-simulation confidence questionnaire to evaluate for any changes to their baseline results in comparison to non-simulation participants.

Data Collection Procedures

Data collection of information was obtained electronically using Qualtrics software surveys, which was provided via the Canvas module to every participating student. The Canvas module was shared with all CRNA students in the 2025 cohort upon committee chair approval. The pretest and posttest surveys were made available via the module. Email reminders were sent out to the cohort to aid in participation on a weekly basis following granted access to the module via Canvas. Optional pediatric airway simulation training dates were included in the Canvas module and started one week after the module opened with multiple days and times to choose from. Prior to simulation, a QR code was available for students who did not take the post-educational intervention self-confidence survey via Qualtrics. Upon completion of the simulation, participants were given a QR code that took them to the post-simulation self-confidence survey via Qualtrics. An email reminder was sent two days after completion of the final simulation to turn in all survey results and survey collection was concluded six days after the final simulations.

Ethical Considerations

Marian University's IRB approval for this project was sought before commencement and researchers were awarded exempt status due to the nature of the project. Participants' survey responses were kept anonymous to the data collectors. Due to the nature of the teaching, the DNP project team did know the identities of those who participated in the volunteer simulation. The simulation participant identities were kept confidential and their optional responses to the following confidence scale questions were anonymously collected via Qualtrics survey after the simulation. The data collected via password protected Qualtrics was transferred and stored on a personal computer that was password protected and only accessible by the DNP project team. Additionally, only utilizing a personal identifier based on the last four numbers of the participant's student ID concealed the confidentiality of the participants' identity. Raw data will be deleted 24 months after collection.

Data Analysis

The data was analyzed using Microsoft Excel software. The statistical analysis utilized a Wilcoxon Signed Rank Test to compare the 15 knowledge question results from the pre-canvas education test and post-canvas education test. The National League for Nursing's (NLN) Student Satisfaction and Self-Confidence in Learning (SSSL) is a tool that utilizes five questions to determine student satisfaction and eight to measure self-confidence, which has been reliability tested through Cronbach alpha measuring satisfaction of 0.94 and self-confidence of 0.87 (NLN, 2022). The questions use response use a 5-point Likert scale which range from 5 to 1, with 5 =

strongly agree, and 1 = strongly disagree. Questions in each section were totaled and averaged to determine the overall average with higher results correlating with higher satisfaction and self-confidence. This project was granted permission to utilize this tool from the NLN website permissions and used a modified SSSL tool to determine self-confidence using the results of a post-canvas versus post-simulation questionnaire with a Wilcoxon Signed Rank Test. The NLN tool has been modified to fit the project needs. View the original SSSL in Appendix E and the modified version in Appendix F.

Results

Demographics

Due to the nature of the project and small sample size, demographics outside of participants being part of the 2025 Marian University SRNA cohort were not obtained to ensure anonymity of participants. Demographic information was not prevalent for the completion of this study.

Knowledge Test

There were 11 participants who completed the educational intervention portion of this project. This included a 15 question pre-educational intervention knowledge test, a pediatric airway educational intervention via voice-over PowerPoint, followed by a 15 question post-educational intervention knowledge test. Scores were resulted as percentage correct with all participants scores increasing on knowledge test from pre-intervention to post-intervention. The scores were found to be statistically significant through a Wilcoxon Signed Rank Test ($p < 0.05$). Additional descriptive statistics were obtained between the two groups. The mean percent score of the pre-educational intervention group was 55.15 percent (SD =9.03, Mdn=60%, range 40-

66.67%), and the mean of the post educational intervention group mean was 87.27 percent (SD = 8.26, Mdn=86.67, range 73.33-100%). A significant increase in the score between the two groups was observed which further supports findings provided by the Wilcoxon Signed Rank Test. Descriptive statistics between the two groups is listed in Table 2.

Table 1

Pre-Educational Intervention and Post-Educational Intervention Results of 15 Knowledge Based Questions

Participant	Pre-Educational Intervention Knowledge Test (Percentage Correct)	Post -Educational Intervention Knowledge Test (Percentage Correct)	Mean Difference
Participant 1	60	73.33	13.33
Participant 2	66.67	80	13.33
Participant 3	60	80	20
Participant 4	66.67	93.33	26.67
Participant 5	60	86.67	26.67
Participant 6	40	80	40
Participant 7	60	100	40
Participant 8	46.67	86.67	40
Participant 9	53.33	93.33	40
Participant 10	53.33	100	46.67
Participant 11	40	86.67	46.67

*Note. Wilcoxon Signed Rank Test ($p < 0.05$)

Table 2

Pre-Educational Intervention Knowledge Test	Post-Educational Intervention Knowledge Test
Mean = 55.15%	Mean = 87.27%
SD = 9.03	SD = 8.26

Note: n=11

Self-Confidence Test

To determine the self-confidence levels of the first-year students to successfully navigate a pediatric airway, participants reported their confidence level on a 5-point scale that ranged from 1 to 5. There were ten participants who completed the post-educational self-confidence and post-simulation self-confidence assessments. This involved a three-question self-confidence survey taken both before and then after the simulation portion of the project. The first question quantifies the participants confidence in mastering the content presented to them. The second question is aimed to gauge whether participants' confidence of if the content that is critical to the pediatric airway was covered in both the education and simulation setting. The final question was to assess the confidence in the personal development of skills and knowledge in regard to utilizing them in the clinical setting. The three self-confidence questions were broken down individually and each found to have a statistically significant difference in pre- to post-simulation scores demonstrated through the Wilcoxon Signed Rank Test ($p < 0.05$). Individual results to each question can be found below in Tables 3 through 5. Questions utilized can be found in APPENDIX F. Question responses utilized a 5-point Likert scale which ranges from 5 to 1, with 5 = strongly agree, and 1 = strongly disagree. Although confidence level was unchanged between pre- and post-simulation for some participant responses, there was no regression in any participant's results. Additional descriptive statistics for each of the confidence level questions were analyzed and revealed improvements in the participants' overall confidence as the mean, standard deviation, and median results improved. Descriptive data for each question is provided in Table 6.

Table 3

Pre-Simulation and Post-Simulation Results of Self-Confidence Based Question on 5 Point Scale (Question 1 of 3)

Participant	Pre-Simulation Confidence Question 1	Post-Simulation Confidence Question 1	Mean Difference
Participant 1	4	4	0
Participant 2	4	4	0
Participant 3	4	5	1
Participant 4	3	4	1
Participant 5	3	4	1
Participant 6	4	5	1
Participant 7	2	4	2
Participant 8	2	4	2
Participant 9	2	4	2
Participant 10	3	5	2

Table 4

Pre-Simulation and Post-Simulation Results of Self-Confidence Based Question on 5 Point Scale (Question 2 of 3)

Participant	Pre-Simulation Confidence Question 1	Post-Simulation Confidence Question 1	Mean Difference
Participant 1	5	5	0
Participant 2	4	4	0
Participant 3	4	4	0
Participant 4	5	5	0
Participant 5	5	5	0
Participant 6	4	4	0
Participant 7	3	4	1
Participant 8	3	4	1
Participant 9	4	5	1
Participant 10	3	5	2

Table 5

Pre-Simulation and Post-Simulation Results of Self-Confidence Based Question on 5 Point Scale (Question 3 of 3)

Participant	Pre-Simulation Confidence Question 1	Post-Simulation Confidence Question 1	Mean Difference
Participant 1	4	4	0
Participant 2	4	4	0
Participant 3	4	5	1
Participant 4	3	4	1
Participant 5	4	5	1
Participant 6	4	5	1
Participant 7	4	5	1
Participant 8	3	5	2
Participant 9	2	4	2
Participant 10	3	5	2

Table 6

	Pre-Simulation Confidence Score	Post Simulation Confidence Score
Question 1	Mean = 3.1 SD = 0.83 Median = 3	Mean = 4.3 SD = 0.46 Median = 4
Question 2	Mean = 4.0 SD = 0.77 Median = 4	Mean = 4.5 SD = 0.50 Median = 4.5
Question 3	Mean = 3.4 SD = 0.67 Median = 4	Mean = 4.6 SD = 0.49 Median = 5

Note: n=10

Discussion

Demonstrated through this DNP project, the effect of having a pediatric airway education and simulation on the competence level of the SRNA, in managing the pediatric airway compared through a pre- and post-intervention surveys is a statistically significant increase in knowledge and confidence. Each participant's scores improved after receiving the educational portion of the study. Although confidence level was unchanged between pre- and post-simulation for some participant responses, there was no regression in any participant's results. Additionally, there were improvements in the mean and standard deviation of the confidence scoring when analyzed as a group. Analyzed responses through Qualtrics software identified three questions that were commonly missed. The questions ranged in topics and asked students to correctly identify the key anatomical differences between the pediatric and the adult airway, how to calculate the appropriate depth of endotracheal tube in pediatric populations, and the intramuscular dose of Succinylcholine. The question involving the fundamental anatomical variances in the pediatric airway needs further revision, as there were multiple possible correct answers. The importance of education and hands-on training to provide tactical feedback has shown to be beneficial in aiding SRNAs by improving both confidence and competence to secure the pediatric airway.

Strengths and Limitations

Strengths noted in this project are the continued participant anonymity through data collection and offering multiple dates for participation during simulation portion of project. In addition, by utilizing the Canvas platform to implement the educational intervention, participants had the opportunity to complete this portion of the project at their own convenience in a setting of their choice. The project was beneficial in participants' progression and clinical immersions as this topic was not covered prior to the start of clinical. Finally, the location of simulation was convenient for participants as it was on campus in a familiar location (simulation lab).

Limitations of this project include a small sample size and participant fatigue due to other DNP projects asking for participation during the same timeframe. The simulation structure of allowing four participants per group limited the amount of hands-on time per participant. Finally, the timing of the project being near final examinations may have led to a lower amount of participation.

Recommendations

The study would benefit from a higher number of participants. By offering additional opportunities in the simulation lab and lengthening the amount of time the educational intervention portion was open, there may be an increase in participants. Future projects would benefit from better correlation of the timing between the project implementation with participants' final examinations.

Implications for Practice and Future Research

This project demonstrates that online education interventions work and the utilization of hands-on simulation prove to be an effective tool to increase the confidence level of participants' performance of skills. Although it is difficult to ensure all simulation training and education is obtained prior to SRNAs being immersed into their clinical rotations, this project demonstrates that a condensed education and simulation can be effective in building confidence and knowledge. Future research could utilize these interventions to prepare SRNAs for clinical rotation and reconnect with participants after clinical experience to determine the overall benefit gained from the intervention.

Conclusion

This project demonstrates the effectiveness of an educational intervention on the pediatric airway utilizing a voice over PowerPoint presentation on first-year SRNAs that are heading into their first clinical rotation. In addition, it demonstrates the gain of self-confidence through a high-quality, high-fidelity simulation-based training navigating the anatomical nuances associated with the pediatric airway and tools utilized. Heading into the first clinical rotation for an SRNA can be daunting on its own, but the addition of experiencing a pediatric patient without prior hands-on training or didactic education can be overwhelming. The knowledge and confidence gained through a short online education intervention and hands-on simulation can better prepare the SRNA and equip them for success.

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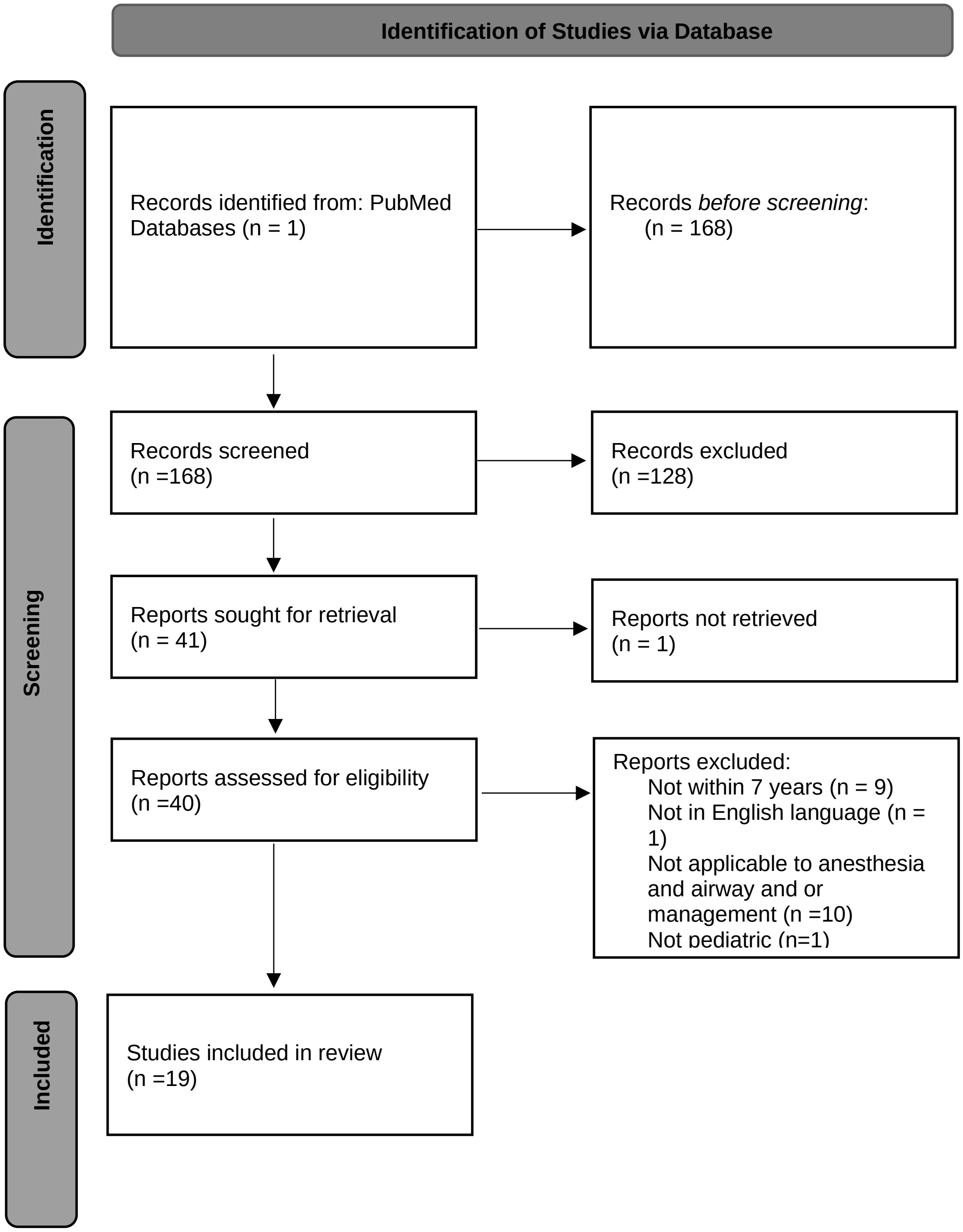
Appendix A



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For more information, visit: http://www.prisma-statement.org/

Appendix B

Literature Review Matrix

Reference	Research Design & Level of Evidence	Purpose / Aim	Population / Sample n=x	Variables	Instruments / Data Collection	Results
Aghdashi et al., 2017	Randomized control trial; level 1	Compare the success rate of, classic versus rotational, in the correct placement of laryngeal mask airway in pediatric patients.	N=116 ASA class I and II aged 2 months to 8 years undergoing lower abdominal surgery.	LMA insertion technique, success rate, patient age, patient gender, and patient weight.	LMA, visual of symmetric chest movement, stethoscope for symmetric sound of both lungs, and ventilator to monitor resistance in ventilation and capnography.	There is no statistical difference between the success rates of the classic LMA insertion technique versus the rotational technique.
Amaha et al., 2021	Cross-sectional study; level 3	Determine prevalence of a difficult airway and associated factors in pediatric patients.	N=290 ASA class I and II newborn to 5 years in age.	Patient age, patient weight, ASA class, Patient sex, provider experience, laryngoscopy difficulty, and difficult airway.	Laryngoscope, endotracheal tube, and face mask.	Close to 20% of patients were labeled as difficult airways. Significant associated of a difficult airway with one or all of following; age less than 2 years, underweight, anticipated difficult airway, history of difficult airway, and anesthetists pediatric experience of less than 4 years.
Burjek et al., 2017	Retrospective observational study; level 3	Compare the success rates of fiber-optic intubation via supraglottic airway to video laryngoscopy in children with difficult airways. Our secondary aim is to compare the	N=1,603 pediatric patients	Patient age, intubation technique, success per attempt, use of continuous ventilation, and complications were recorded for each case. First-attempt success and complications were compared in subjects	Database collection	Fiber-optic intubation via supraglottic airway and video laryngoscopy had similar first-attempt success rates. In subjects less than 1 yr old, fiber-optic intubation via supraglottic airway was more successful on the first attempt than video laryngoscopy.

		complication rates of these techniques.		managed with fiber-optic intubation via supraglottic airway and video laryngoscopy.		
Disma et al., 2021	Prospective Observational study; level 2	Analyze occurrence of difficult intubations (2 failed attempts) and interventions related to anesthesia tracheal intubations and identify their clinical consequences.	N=4,683 planned pediatric tracheal intubations	Age, ASA status, difficult face-mask ventilation, and intubation attempts.	Database collection via secondary analysis from participating European health centers.	Difficult tracheal intubation in children less than 60 weeks post-conceptual age occurred in 5.8% of patients and commonly resulting in severe hypoxemia.
Gálvez et al., 2019	Retrospective cross-sectional cohort study; level 3	Determine the incidence of multiple tracheal intubations attempts in anesthetized infants in an academic children's hospital and the associated risks of hypoxemia or bradycardia.	N=1,341 Infants 12 months or less.	Age, sex, ASA classification, encounter location, induction medication, duration of induction, hypoxemia, bradycardia, laryngoscopy attempts, and baseline vital signs before induction.	Database collection.	84% were intubated with one attempt, hypoxemia occurred in 35%, and bradycardia occurred in 9% of infants. Infants with two or more attempts of laryngoscopy had significantly higher rate of hypoxemia than single attempt.
Garcia-Marcinkiewicz et al., 2020	Randomized controlled trial; level 1	Investigate whether video laryngoscopy improves the first-attempt success rate of orotracheal intubation and reduces the risk of complications when compared with direct laryngoscopy.	N= 564 Infants without difficult airways abnormalities requiring orotracheal intubation.	Age, intubation technique, and gender.	Video laryngoscope and direct laryngoscope.	video laryngoscopy group, infants were more successfully intubated on the first attempt compared with direct laryngoscopy, video laryngoscopy had fewer severe complications, and few esophageal intubations compared to DL.
Holzki et al., 2018	Systematic Review	Clarify the shape of the cricoid cartilage and the location of the narrowest portion of the larynx through systematic review.	9 invitro studies of 672 cadavers aged preterm gestation to 17 years old and 6 in	Study type, age, and condition at time of evaluation.	Comprehensive review	There was a majority consensus that the narrowest portion of the infant larynx is the cricoid cartilage, and it is in fact funnel shaped.

			vivo studies of 553 pediatric patients aged 1 month to 13 years.			
Jain et al., 2020	Prospective observational study; level 2	Determine whether the upper incisor-manubriosternal joint length in the extended head position can be used as a predictor of airway length to guide the depth of insertion of endotracheal tube in children.	N=60 Pediatric patients aged 2-8 years.	Age, weight, upper incisor-carina length, and upper incisor-manubriosternal joint length.	Standard metallic measuring tape, pediatric fiberoptic bronchoscope, and ETT.	The incisor-manubriosternal joint length is a simple surface landmark technique that can be used as a predictor of tracheal length and the depth of insertion of ETT in children.
Kaji et al., 2020	Retrospective comparative study; level 3	Primary outcome was the difference in first-attempt success for DL and augmented DL versus VL. Secondary outcomes included adverse events.	N= 625 Pediatric patients.	Variables patient demographics, body habitus, impression of airway difficulty, intubating position, reduced neck mobility, airway characteristics, device, medications, and operator characteristics.	Database collection	VL was associated with higher first-pass success in this pediatric population.
Kim et al., 2015	Prospective observational study; level 2	Compare the incidence of LMA malposition between US and fiber optic bronchoscopy (FOB)	N= 100 Pediatric patients	Patient age, patient weight, patient height, patient sex, symmetry of the arytenoid cartilages, elevation of an arytenoid cartilage in reference to the glottic midline, LMA size, and success rate.	LMA, ultrasound machine, and fiberoptic bronchoscope.	Incidence of asymmetrical elevation of an arytenoid was 50% With FOB, the incidence of LMA malposition was 78%, and that of LMA rotation was 43%.

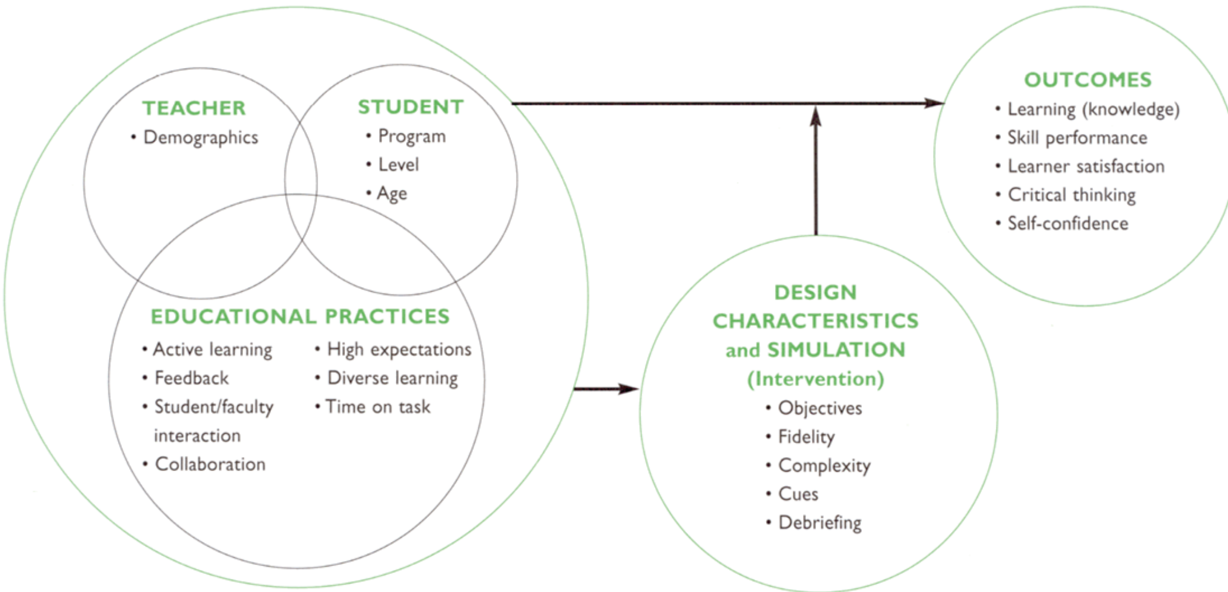
Koo et al., 2018	Systematic review; level 1	Compare the incidence of airway complications between extubation under deep anesthesia (deep extubation) and extubation when fully awake (awake extubation) in pediatric patients after general anesthesia.	N=1881 Pediatric patients.	Cough, airway obstructions, desaturation, breath holding, laryngospasm.	Comprehensive review	Deep extubation reduces the risk of overall airway complications in cough, desaturation in children after general anesthesia. No difference was observed in the incidence of laryngospasm and breath-holding between the two groups.
Lee, et al., 2017	Prospective observational study; level 2	Determine the ideal insertion depth of the flexible laryngeal mask airway (FLMA).	N= 154 ASA I or II patients aged 15 years or younger undergoing ophthalmic surgery.	Patient age, patient weight, patient sex, and FLMA size.	FLMA, manometer, and fiberoptic bronchoscope.	FLMA insertion depth can best be predicted using height and weight with continuous monitoring of intracuff pressure during insertion as a useful alternative when resistance is difficult to sense.
Lingappan et al., 2018	Systematic review; level 1	Determine the efficacy and safety of video laryngoscopy compared to direct laryngoscopy in decreasing the time and attempts required for endotracheal intubation and increasing the success rate at first intubation in neonates.	N= 467 Pediatric patients.	Video laryngoscopy, direct laryngoscopy, and time number of attempts.	Comprehensive review	Video laryngoscopy increases the success of intubation in the first attempt but does not decrease the time to intubation or the number of attempts for intubation
Liu et al., 2020	Retrospective study; level 3	Determine changes in the internal diameter and shape of the cricoid cartilage during development and explore the implications of those changes for the selection of ETT type and size for children.	N=1346 Age 1-20 years.	Age, dimension of cricoid cartilage, gender.	Radiology database collection and NEUPACS software.	Cricoid cartilage remains “funnel shaped” during development without a transition to a "column shape".

Luscan et al., 2020	Retrospective study; level 3	Determine the anatomical development and size of airway structures from birth to adolescence using high-resolution computed tomography scans.	N= 192 Pediatric patients aged 1 day to 14 years	Age, weight, gender, and airway measurements.	CT database collection utilizing GE Revolution HD scanner.	The cricoid shape is round, regardless of the child's age. Its diameter is smaller than the anteroposterior diameter of the glottic area, but the glottic area is smaller than the cricoid area.
Park et al., 2019	Retrospective comparative study; level 3	aims of comparative success and complication rates between direct laryngoscopy and GlideScope video laryngoscopy, secondary aims, were to evaluate the effect of weight on intubation success and the success of direct laryngoscopy with poor visualization of the laryngeal inlet.	N=1295 Pediatric patients.	Age, body weight, ASA classification, and anticipated airway difficulty.	Database collection	Success rates for GlideScope were significantly higher than direct laryngoscopy and show no differences in complication rates per attempt compared to direct laryngoscopy.
Powell et al., 2022	Cross-sectional study; level 3	Determine if perceived self-confidence level and ability to identify and manage/treat common pediatric anesthesia complications is affected by providing a high-fidelity pediatric simulation for SRNAs prior to their pediatric rotation.	N=20 Second and third year SRNAs.	Confident scores and simulation training.	Likert scales with ordinal variables, Friedman test, and Wilcoxon signed rank tests.	Improvement in confidence scores from pre-simulation to post-simulation and at end of their pediatric rotation.
Soneru et al., 2019	Prospective observational study; level 2	Determine if apneic nasal oxygenation would prolong the time to desaturation during intubation on pediatric patients among inexperienced learners.	N=371 Pediatric patients aged 1.2 to 5 years old.	ASA level, emergent status, age, gender, intubation attempts, premedication, use of paralytic, use of apneic oxygenation, and Sp02 level.	Pulse oximeter, nasal cannula, fisher's Exact test, chi-square test, and Wilcoxon-Mann-Whitney test	Apneic nasal oxygenation improved time to desaturation and all other observed outcomes during endotracheal intubation.

Vukovic et al., 2019	Prospective observational study; level 2	Determine association between apneic oxygenation and hypoxemia in pediatric patients undergoing ETT placement	N=149 Pediatric patients aged 0 to 20.	Age, use of apneic oxygenation, Sp02 before intubation, attempts of intubation, proceduralist training level, and method of intubation.	Pulse oximeter and nasal cannula.	Apneic oxygenation was associated with reduced odds of hypoxemia during endotracheal intubation.

Appendix C

The Jeffries Simulation Model



"Jeffries Simulation Model," by P. R. Jeffries, 2005, Nursing Education Perspectives, 26(2), 96-103. (https://journals.lww.com/neponline/pages/articleviewer.aspx?year=2005&issue=03000&article=00009&type=abstract) Copyright 2005 by National League for Nursing Inc. Reprinted with permission.

Appendix D

SWOT Analysis

Strengths	**Weaknesses**
• State-of-the-art simulation lab • Technological access to Canvas • Access to Qualtrics • Cohort of 2025 (stakeholders)	• No live patients • Small sample size • Motivation for participant buy-in • Dyssynchronous with pediatric didactics
Opportunities	**Threats**
• Additional simulation material and technology • Enticement for participant buy-in (bonus points) • Additional pediatric airway clinical time for project owners • Exposure to previously learned techniques for participants	• Inexperience with developing on Canvas technology • Insubstantial experience in clinical setting with pediatric airway • Lack of functioning equipment • Low participation due to difficult semester for participants • Inaccessibility to simulation lab (used for multiple other purposes) • COVID-19 pandemic shutdowns

Appendix E

Student Satisfaction and Self-Confidence in Learning

Instructions: This questionnaire is a series of statements about your personal attitudes about the instruction you receive during your simulation activity. Each item represents a statement about your attitude toward your satisfaction with learning and self-confidence in obtaining the instruction you need. There are no right or wrong answers. You will probably agree with some of the statements and disagree with others. Please indicate your own personal feelings about each statement below by marking the numbers that best describe your attitude or beliefs. Please be truthful and describe your attitude as it really is, not what you would like for it to be. This is anonymous with the results being compiled as a group, not individually.

Mark:
1 = STRONGLY DISAGREE with the statement
2 = DISAGREE with the statement
3 = UNDECIDED - you neither agree or disagree with the statement
4 = AGREE with the statement
5 = STRONGLY AGREE with the statement

Satisfaction with Current Learning	**SD**	**D**	**UN**	**A**	**SA**
1. The teaching methods used in this simulation were helpful and effective.	○ 1	○ 2	○ 3	○ 4	○ 5
2. The simulation provided me with a variety of learning materials and activities to promote my learning the medical surgical curriculum.	○ 1	○ 2	○ 3	○ 4	○ 5
3. I enjoyed how my instructor taught the simulation.	○ 1	○ 2	○ 3	○ 4	○ 5
4. The teaching materials used in this simulation were motivating and helped me to learn.	○ 1	○ 2	○ 3	○ 4	○ 5
5. The way my instructor(s) taught the simulation was suitable to the way I learn.	○ 1	○ 2	○ 3	○ 4	○ 5
Self-confidence in Learning	**SD**	**D**	**UN**	**A**	**SA**
6. I am confident that I am mastering the content of the simulation activity that my instructors presented to me.	○ 1	○ 2	○ 3	○ 4	○ 5
7. I am confident that this simulation covered critical content necessary for the mastery of medical surgical curriculum.	○ 1	○ 2	○ 3	○ 4	○ 5
8. I am confident that I am developing the skills and obtaining the required knowledge from this simulation to perform necessary tasks in a clinical setting	○ 1	○ 2	○ 3	○ 4	○ 5
9. My instructors used helpful resources to teach the simulation.	○ 1	○ 2	○ 3	○ 4	○ 5
10. It is my responsibility as the student to learn what I need to know from this simulation activity.	○ 1	○ 2	○ 3	○ 4	○ 5
11. I know how to get help when I do not understand the concepts covered in the simulation.	○ 1	○ 2	○ 3	○ 4	○ 5
12. I know how to use simulation activities to learn critical aspects of these skills.	○ 1	○ 2	○ 3	○ 4	○ 5
13. It is the instructor's responsibility to tell me what I need to learn of the simulation activity content during class time..	○ 1	○ 2	○ 3	○ 4	○ 5

 Revised December 22, 2004

Appendix F

Modified Student Satisfaction and Self-Confidence in Learning

Instructions: This questionnaire is a series of statements about your personal attitudes about the instruction you receive during your simulation activity. Each item represents a statement about your attitude toward your satisfaction with learning and self-confidence in obtaining the instruction you need. There are no right or wrong answers. You will probably agree with some of the statements and disagree with others. Please indicate your own personal feelings about each statement below by marking the numbers that best describe your attitude or beliefs. Please be truthful and describe your attitude as it really is, not what you would like for it to be. This is anonymous with the results being compiled as a group, not individually.

Mark:
1 = STRONGLY DISAGREE with the statement
2 = DISAGREE with the statement
3 = UNDECIDED - you neither agree or disagree with the statement
4 = AGREE with the statement
5 = STRONGLY AGREE with the statement

Self-confidence in Learning

1. I am confident that I am mastering the content of the pediatric airway that my instructors presented to me.	○ 1	○ 2	○ 3	○ 4	○ 5
2. I am confident that this education covered critical content necessary for the mastery of the pediatric airway.	○ 1	○ 2	○ 3	○ 4	○ 5
3. I am confident that I am developing the skills and obtaining the required knowledge from this education to perform necessary tasks in a clinical setting	○ 1	○ 2	○ 3	○ 4	○ 5

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