Education-Based Simulation Training for Ultrasound-Guided Anesthesia: Improving Confidence Among Anesthesia Providers

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Author Note

There is no known conflict of interest to disclose.

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

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Abstract

Ultrasound-guided anesthesia is becoming increasingly popular for healthcare providers throughout the world. Some advantages attributed to ultrasound use include improved patient outcomes, rapid clinical diagnoses, and enhanced anesthesia procedural techniques. However, even with increased popularity many Certified Registered Nurse Anesthetists are not routinely incorporating ultrasounds into their clinical practice due to lack of confidence and knowledge. Education-based ultrasound simulation is a strategy that would help to educate current anesthesia providers on the advantages and different techniques of ultrasound-guided anesthesia. The purpose of this Doctor of Nursing Practice project is to implement an educational intervention regarding ultrasound-guided anesthesia for current Certified Registered Nurse Anesthetists. The main objectives and goals for the project will be for anesthesia providers to have enhanced ultrasound knowledge, confidence, and incorporation of ultrasound use within clinical practice settings. An education-based simulation was utilized with a pre-intervention and post-intervention approach for outcome measurement. Data was collected with descriptive statistics and then analyzed using paired *t*-tests. Last, the information was disseminated to anesthesia providers across various hospital settings.

Keywords: ultrasound simulation, POCUS, education-based simulation, anesthesia, CRNA

Education-Based Simulation Training for Ultrasound-Guided Anesthesia: Improving Confidence Among Anesthesia Providers

Healthcare professionals need to be versatile and adapt to changes within hospital systems. Some of these changes occur due to advancements in technology. One new technological advancement is the point-of-care ultrasound (POCUS). The POCUS allows healthcare providers who work in fast-paced environments, such as anesthesia, to use ultrasound technology to quickly evaluate patients and diagnose patient conditions without the need for further invasive measures. Even with the increase in POCUS popularity, many anesthesia providers are not incorporating ultrasound into their clinical practice due to lack of education, knowledge, and confidence in ultrasound use (Singh et al., 2022). It has been shown that education-based simulation is an effective approach to teach the necessary fundamentals of POCUS for medical professionals in hopes to increase ultrasound incorporation within the clinical setting (Singh et al., 2022). With the current research available an education-based simulation intervention is necessary to ensure that POCUS is incorporated into current clinical practice.

Chapter 1: Introduction and Overview of the Problem of Interest

Background and Significance

The utilization of ultrasound within the healthcare clinical setting has increased in popularity within the last two decades due to the introduction of POCUS. Ultrasounds can commonly be used in the intensive care, emergency department, and perioperative settings (Smallwood & Dachsel, 2018). When used, appropriately POCUS has been shown to improve patient outcomes as it facilitates real time image acquisition allowing for prompt diagnosis of a specific clinical conditions (Naji et al., 2021). For anesthesia providers POCUS is easy and safe

to use for daily perioperative assessments such as heart and airway assessments along with assistance of more invasive procedures with high sensitivity and specificity. Additionally, it has been demonstrated that there are no absolute patient contraindications to POCUS use or major complications associated with POCUS implementation (Smallwood & Dachsel, 2018). For these reasons, POCUS has become a favorable piece of technology that can be used in the perioperative setting to enhance clinical practice. However, even with the advantages, it has been shown that many anesthesia providers are not incorporating POCUS into their current practice.

Despite the reported benefits of using ultrasound as an integral part of anesthesia management, the United States has no formal POCUS curriculum incorporated into anesthesia programs. Only 36% of anesthesia providers have received formal POCUS training either in their medical degree educations or within the practice setting. Of those providers less than 10% have received POCUS training for specialized populations such as cardiac patients or obstetrical patients (Cannon et al., 2018). The lack of standard ultrasound curriculum leads to a lack of ultrasound use within clinical practice settings. The American Board of Anesthesiologists encourages POCUS training for all anesthesia programs, yet there remains a lack of formal curriculum. The lack of training within school curriculums is partly due to the lack of availability of adequately trained anesthesia providers (Cannon et al., 2018). Therefore, there needs to be an increase in anesthesia providers who are trained in POCUS use.

Based on the evidence presented, one of the most efficient ways to increase knowledge of ultrasound-guided anesthesia is through education-based simulation. This type of simulation is often incorporated into higher medical education settings to enhance understanding and skills of healthcare providers. Simulation allows for healthcare workers to gain education, knowledge,

and skills on different domains within their scope of practice (Chernikova et al., 2020). An education-based ultrasound simulation is shown to increase confidence, knowledge, and incorporation of POCUS within clinical practice settings for anesthesia providers (Singh et al., 2022). There are many ultrasound-guided anesthesia skills that can be educated through a simulation. One skill that can have increased success with ultrasound use consists of utilizing the ultrasound phantom simulators.

Ultrasound phantom simulators are widely used to enhance the training of medical and surgical procedures. These simulators are used for training purposes to mimic human tissue and vascular structures. This technique allows learners to train needle-guided procedures without the need to expose actual patients to the pain and discomfort associated with repeated attempts at proper needle insertion (Blanford, 2017). The simulators are often performed to train novice learners on a variety of different clinical skills they will encounter in hospital settings. The goal of these simulators is to improve confidence levels and technical ultrasound skills for new learners prior to using an ultrasound on patients in the clinical setting (Pepley et al., 2019). One of the most populator simulators is the Blue Phantom simulator.

The Blue Phantom simulator is made from an elastomeric rubber with a firm texture to provide tactile feel. This simulator gained popularity as it is considered one of the most durable and reliable simulators available (Kim, 2016). It is important that new learners have a considerable amount of practice using phantoms prior to performing invasive procedures on patients. Therefore, these phantom simulators are increasing in popularity for ultrasound training (Pepley et al., 2019). Currently there is a need to increase ultrasound use within the clinical setting, so hospital systems need to find a way to train people quickly and safely on ultrasound use. In the past, new learners were often trained on cadavers to practice first-time needle

placement. However, due to the cost and lack of accessibility the incidence of using cadavers has decreased. With the decline of cadaver use, it has been shown that utilizing these ultrasound phantoms are more beneficial (Kim, 2016). Additionally, ultrasound simulators are affordable, easy to use with distinguishable targets, and reproduce the texture and resistance of human tissue. Overall, by practicing on phantom simulators it has been shown to enhance hospital performance, decrease hospital costs, and improve patient outcomes (Pepley et al., 2019).

PICO Question Guiding Inquiry

The inadequate education regarding ultrasound-guided anesthesia techniques is a major problem seen within medical education. The lack of education leads to an insufficient use of ultrasounds within clinical practice settings despite the proven advantages seen with ultrasound-guided anesthesia techniques. To increase the clinical use of ultrasounds, it is imperative that anesthesia providers are given educational opportunities to increase their knowledge and skills. Therefore, this project will examine: For Certified Registered Nurse Anesthetists, does the use of an education-based simulation training for ultrasound-guided anesthesia compared to no simulation training improve the knowledge, confidence, and incorporation of ultrasound use within the clinical practice setting? A simulation will be held for Certified Registered Nurse Anesthetists (CRNAs) to learn ultrasound-guided anesthetic techniques involving arterial line placement, intravenous catheter placement, and Blue Phantom simulators. A pre-intervention and a post-intervention study design will be developed to ensure proper evaluation of an education-based ultrasound simulation.

System and Population Impact

Inadequate ultrasound education leads to a lack of ultrasound use. The lack of ultrasound use can lead to delayed clinical diagnoses, delayed treatments, and prolonged anesthesia

procedure times. Overall, hospital systems will benefit as there will be a decrease in anesthesia costs and surgery times due to quicker procedures and quicker clinical diagnosis. The quicker anesthesia procedure times will have cost savings for the hospital systems because the systems will not acquire the charges for delayed anesthesia times. The CRNAs will acquire ultrasound education which will improve knowledge, confidence, and ultrasound incorporation. This project will also positively impact all patients especially those presenting for surgery who require anesthesia and the associated anesthesia procedures such as peripheral catheter insertion or arterial line insertion. Ultrasound use by anesthesia procedures leads to a decrease in time needed for line placement and an overall improvement in patient outcomes with accuracy of line placement. The overall benefit of this Doctor of Nursing Practice (DNP) project is to improve confidence and knowledge among anesthesia providers regarding ultrasound use to improve patient outcomes.

Purpose and Objectives

The purpose of this DNP project is to implement an educational intervention regarding ultrasound-guided anesthesia for current CRNAs. The education-based ultrasound simulation will be an educational intervention with the aim at increasing ultrasound-guided anesthesia use in clinical practice settings. The main objective is to increase knowledge and confidence among ultrasound use to facilitate a practice change from a lack of ultrasound use to increased ultrasound use within clinical settings. Certified Registered Nurse Anesthetists will voluntarily participate in an education-based ultrasound simulation. For the simulation there will be an educational PowerPoint presentation and a skills lab. There will also be a pre-intervention survey and a post-intervention survey to measure the objectives. The surveys will evaluate the knowledge, confidence, and incorporation of ultrasound use within the clinical setting.

The main objectives to achieve this goal for the DNP project are as follows:

1. Certified Registered Nurse Anesthetist's self-perceived confidence and knowledge levels in using ultrasounds will increase after attending the educational-based ultrasound simulation, as indicated with the information provided by the pre-intervention and post-interventions surveys.

2. Incorporation of ultrasound use within clinical practice settings will increase for Certified Registered Nurse Anesthetists who attended the education-based ultrasound simulation, as evidenced by data collected from the post intervention survey.

Chapter 2: Review of Literature

Search Methodology

A literature search was conducted using three databases including Google Scholar, PubMed, and Cumulative Index to Nursing and Allied Health Literature (CINAHL). The main keywords utilized were “ultrasound simulation”, “POCUS”, “education-based simulation”, and “phantom simulators”. Search filters were included, limiting the search to articles between 2017 and 2022. Google Scholar presented 14,300 articles, PubMed presented 23,176, and CINAHL presented 16 for a total of 37,492 articles. Of these articles the titles were quickly reviewed paying close attention to peer-reviewed scientific publications. All articles that were not research publications were excluded. Abstracts of articles that seemed relevant to the PICO question were read to see if the research would answer the PICO question. The main inclusion criteria looked for articles with studies that compared educational based ultrasound simulation with medical professionals to no ultrasound education on the confidence levels, knowledge, and performance. Articles that were published more than five years prior or articles that did not write about ultrasound-based education for medical professionals were excluded. From there, five articles were found that would be applicable to answering the PICO question.

Findings

After a complete evidence synthesis of the five chosen articles there were a few common themes displayed throughout each article (See Appendix A). An overriding theme was that after implementation of an ultrasound simulation the confidence and knowledge increased in the study participants. In the studies by Chernikova et al. (2020), Eroglu & Coskun (2018), and Zawadka et al. (2019), a pre-intervention and post-intervention was a common technique utilized by the researchers. Reported test results from these studies gave positive feedback to show that the

simulation improved the skill and knowledge of the study participants regarding ultrasounds. In contrast the studies by Le et al. (2018) and Kondrashova & Coleman (2017) utilized didactics, PowerPoint presentations, and live demonstrations as part of their educational simulation to enhance the knowledge of the research participants. In addition, the researchers followed up with the participants to see if their skills improved within the clinical setting after the simulation. As for the simulation approach each study had anywhere between a one-to-three-day simulation. Kondrashova & Coleman (2017) had several different ultrasound stations within the simulation so that multiple different ultrasound techniques could be incorporated into the education, including the use of ultrasound simulators. Then, Le et al. (2018) had a control and an intervention group to indicate that simulation enhances clinical skills. In the end, each ultrasound simulation was effective as an educational intervention for POCUS.

While reviewing the literature, there were no studies that were specific to CRNAs, but each research article studied medical education by involving medical students. The reliability and validity of each study was assessed by the John Hopkins Nursing Evidence-Based Practice Quality Rating Scale (Cullen et al., 2022). The studies were made up of one Level I meta-analysis study (Chernikova et al., 2020), one Level II randomized control trial study (Le et al., 2018), and three Level III prospective cohort studies (Eroglu & Coskin, 2018; Kondrashova & Coleman, 2017; Zawadka et al., 2019). The studies by Chernikova et al (2020) and Kondrashov & Coleman (2017), received a high quality rating due to the large sample sizes and good control. While Eroglu & Coskun (2018), Le et al. (2018), and Zawadka et al. (2019) received a moderate quality rating showing each study had reasonably consistent results, sufficient sample size, some control, and fairly definitive conclusions. In the end, all the research shows that ultrasound simulation is effective. The knowledge gained from the evidence synthesis shows that by

incorporating both a pre-intervention and post-intervention survey along with didactics, PowerPoint presentations, and live demonstrations it will lead to the highest level of success to improve knowledge, confidence, and incorporation of ultrasound use within the clinical practice setting.

Limitations

There were no studies specific to CRNAs, but each research article studied medical education by involving medical students. Therefore, the first limitation is that none of the studies involved CRNA education but rather education for medical students. There were also differences in the studies based on how the ultrasound simulation was conducted (Chernikova et al., 2020). The slight variations in the simulation within each study could lead to different outcomes and conclusions for ultrasound knowledge, confidence, and incorporation of use. The study by Eroglu & Coskun (2018), faced budgetary limitations that did not allow the researchers to utilize all ultrasound modules for training within the simulation. Also, several studies utilized small sample sizes and only looked at one medical school (Eroglu & Coskun, 2018; Le et al., 2018). Lastly, there is no set ultrasound curriculum within advanced practice and medical education. Even though the American Board of Anesthesiologists encourages POCUS training there is no formal education. Even with the encouragement from the American Board of Anesthesiologists the continued lack of ultrasound utilization indicates a need for further education to ensure incorporation into clinical use (Cannon et al., 2018).

Conclusion

Point-of-care ultrasounds have been shown to improve patient outcomes in fast-paced clinical practice settings. Throughout the literature there were a few common themes. First, simulations are effective to learn complex skills (Chernikova et al., 2018). Second, education

and practice allow people to learn new skills in a short amount of time (Eroglu & Coskun, 2018). Last, confidence is shown to increase as people were able to practice in a simulation prior to attempting these skills on patients (Kondrashove & Coleman, 2017). Overall, adequate educational interventions on ultrasound-guided anesthesia can lead to increased knowledge, confidence, and incorporation of ultrasounds into clinical practice. Education-based simulation is shown to be an effective approach to help the education of currently practicing CRNAs on ultrasound techniques. Based on the evidence collected, an educational intervention utilizing an education-based ultrasound simulation will be designed to increase knowledge and confidence regarding ultrasounds.

Chapter 3: Organizational Framework of Theory

Conceptual Definitions of Theory or Framework

Evidence based practice models are commonly used with dissemination and implementation research. The models help to provide systemic structure for the development, management and evaluation efforts as well as narrow the study scope to guide constructs needed to be measured (Brownson et al., 2018). The Iowa Model for Sustainability Framework is one type of model that will be utilized for this DNP project. This model has seven steps including, identifying triggering issues or opportunities, stating the purpose, forming a team, synthesizing body of evidence, designing and piloting the practice change, integrating and sustaining the practice change, and disseminating the results (Brownson et al., 2018). These steps within the model are followed to assist with implementation and dissemination. This framework stands out from other frameworks because the strategies utilized within the Iowa framework focus exclusively on the implementation steps within the evidence-based practice processes. The implementation steps are followed while the research is implemented into practice (Cullen et al., 2022).

This model is commonly used throughout healthcare to improve patient care because it focuses on organization and collaboration. It focuses on problem-focused triggers, encourages healthcare workers to question current practices, and helps to determine if patient care can be improved by using current research findings (Cullen et al., 2022). This model was originally created to help evaluate and bring research findings into clinical practice and therefore aligns perfectly with the main focus of the DNP project (Brownson et al., 2018). This main focus of the Iowa model supports this DNP project which is to utilize an ultrasound simulation to increase the knowledge, confidence, and incorporation of ultrasound use into clinical practice settings.

Relationship of Theory/Framework to Scholarly Project

To support the DNP project, the seven steps outline in this framework were utilized throughout the project. The first four steps of the Iowa model were completed as part of the planning initiative of the project. The issue was identified that CRNAs within hospital settings are not using ultrasounds within clinical practice settings. The purpose was stated in the form of a PICO question. After the issue was identified and purpose was stated a team was created and the literature review and synthesis of evidence was completed. Five articles were found that were applicable to answering the PICO question. Once all the necessary research was gathered the process will move onto the fifth step. The fifth step consists of designing and piloting the practice change. For this stage the entire DNP project and education-based ultrasound simulation was put into thought. The idea of an education-based ultrasound simulation was developed along with the intentions on how to run the simulation such as recruitment of CRNAs with flyers, pre-intervention and post-intervention surveys, material needed for the simulation, and educational PowerPoints for simulation. After the planning and implementation ideas were gathered the model moves into discussing how change is appropriate in clinical practice.

Once it was identified that this change should be adopted into clinical practice, the next step in the model discusses how to integrate and sustain the practice change. During this stage, there was a post-intervention follow-up for the CRNAs who participated in the simulation. The information was collected and analyzed to see if ultrasounds are being incorporated into clinical practice. This phase also allowed time to discuss any challenges faced to using ultrasounds in clinical practice. It is important to identify challenges as the project can be re-assessed prior to dissemination to further enhance integration and sustainability. The final poster presentation was created during this step. After step six, the model moves into its final phase which is

dissemination of the results. The dissemination through poster presentation occurred after the data was collected and the findings were evaluated. A detailed outline of the Iowa Model relevant to this DNP project can be found in Appendix B.

Chapter 4: Project Design

Institutional Review Board Approval

Prior to implementing this DNP project, it was required to receive approval from the Institutional Review Board (IRB). For this DNP project it was required to obtain IRB approval form Cedar Crest College's IRB committee. Through Cedar Crest College, the IRB process required a formal online application including a DNP proposal and IRB consent form to be submitted to the Cedar Crest College IRB committee. The DNP proposal had different sections that outlined the objectives of research, methods to be used, recruitment procedures, requirements for participation, possible risks and benefits, assurance of anonymity and confidentiality, and security of data and data destruction. The IRB process took several submissions with the assistance of the DNP chair, Donna Martonik, before the final approval by the IRB committee was received.

The first online application form was submitted to the IRB committee by the DNP group members for review on September 23, 2022. After review by the committee a few modifications needed to be made prior to approval. The appropriate modifications were changed on the IRB proposal document and on October 20, 2022 the application was re-submitted to the IRB committee. After, an expedited review, the chair of the IRB at Cedar Crest College determined our project did not meet research criteria. Final IRB application approval was obtained on October 25, 2022.

The risks of the DNP project were discussed to the IRB committee in the project proposal. For this project it was determined that there is no physical, psychological, or emotional risks for any of the participants during implementation as this is an educational intervention focusing on ultrasound guidance. The ultrasound guidance is combined with

common procedures that are performed by CRNAs such as arterial line catheter placement and intravenous catheter placement. There is also no risk of criminal or civil liability, or damage to participants financial standing or employability. There will be no identifying information obtained from this ultrasound simulation for the participants. One safety concern identified was the potential for a needle stick during skills training. If an inadvertent needle stick were to occur there will be first aid supplies available. Also, participants will be asked to clean the needle stick area with soap and water and will be referred to their primary care provider for a possible tetanus vaccine.

Along with discussion of the risks, there was also discussion of benefits to this DNP project. It was identified that there is no direct benefit for the participants associated with participation. No continuing education credits will be given, but the simulation will be an educational opportunity for CRNAs free of charge. However, for overall hospital systems there are many benefits to having CRNAs adequately trained on ultrasound use. Some of these benefits include enhanced hospital performance, decrease hospital costs, and improved patient outcomes (Pepley et al., 2019).

Implementation Plan

The implantation plan for this project involved several steps and followed the Iowa Model of Evidence-Based Practice framework (Cullen et al., 2022). First, CRNAs were recruited from local hospitals by flyers that were placed within the hospital breakrooms. On the flyers there was a quick response (QR) code that CRNAs had to scan to sign up for the simulation. This QR code lead the CRNAs to a Jotform website which gave information about the simulation as well as information regarding their informed consent to participate within the ultrasound simulation. As a part of signing up, the participants had an informed consent to fill

out. The completion of the informed consent indicated the CRNAs consent to participate within the DNP project. Also, through the QR code a pre-intervention survey was given to the participants with instructions to complete prior to the day of the simulation (See Appendix C). To maintain anonymity a Microsoft form link was attached to the Jotform website so the participants can complete the responses anonymously. Also, the simulation coordinator, Adam Hough, was contacted to help identify necessary supplies along with expectations for the simulation center.

The ultrasound simulation was held at Cedar Crest College, School of Nursing simulation center in Allentown, Pennsylvania on January 7th, 2022. The program was two hours in length from 11am to 1pm. The day began with an educational PowerPoint presentation that discussed certain topics such as ultrasound basics and proper positioning techniques. After the presentation the participants were divided into three groups to attend each of the three stations. The three stations included arterial catheterization, peripheral intravenous line insertion, and ultrasound practice with Blue Phantom simulators. Each group had thirty minutes at each skills simulation before rotating to the next station. Each station was designed to reinforce the ultrasound basics about positioning while allowing hands on experience with models provided by the school of nursing simulation center. Immediately following the simulation, a post-intervention survey was completed by all participants (See Appendix D). Also, an ultrasound simulation debriefing form was completed as well (Appendix E).

Data Collection Tools

A pre-intervention and post-intervention survey was utilized for data collection within this DNP project. The surveys were dispersed on Microsoft forms as a way to upload and collect the data surveys while maintaining anonymity among the participants. To measure the

knowledge and confidence of the education-based ultrasound simulation, the CRNAs completed a pre-intervention and post-intervention survey using a 5-point Likert scale. Example of a Likert scale is identified in Appendix F. The Likert scale is commonly used to investigate individual differences regarding motivation, anxiety, and self-confidence, therefore, is beneficial to use to assess confidence and knowledge scales (Nemoto & Beglar, 2014). For the post-intervention survey, a questionnaire was created to help to identify if ultrasound is incorporated into practice. The questionnaire also included open ended areas to discuss any challenges or advantages to ultrasound use. It is important to note that all tools utilized within this DNP project have been researched and assessed by the DNP team members to identify validity, reliability, and suitability for the given DNP project. For these data collection tools there is no permission needed for use of the tools.

Resources Needed

A meeting was held with Cedar Crest College's simulation manager to discuss possible costs involved and resources needed for the project implementation. It was discussed that some resources needed for this simulation include, ultrasound devices, a Blue phantom ultrasound simulator, simulation dummies, arterial catheters and intravenous catheters, and ultrasound gel. Laptops will be needed for creation of the PowerPoint presentation. Last, some miscellaneous resources needed are required to ensure proper disinfection as per the Centers for Disease Control and Prevention (See Appendix G). Some of these items include gloves, disinfectant wipes, hand sanitizer, paper towels, and first aid kits.

Budget Justification

According to the simulation manager, Cedar Crest College's simulation will be able to provide most of the supplies needed for the project. Some of the needed supplies that the

simulation center owns includes a Blue Phantom ultrasound simulator, one ultrasound device, along with five simulation dummies for arterial catheter placement and intravenous catheter line insertion. Also, $2,300 portable Butterfly ultrasound devices were already purchased by the nurse anesthesia students as part of their program costs. Expired arterial line kits and intravenous catheters were supplied from local hospitals to be utilized for the simulation day. Some other necessary equipment that was purchased by the group members included ultrasound gel, gloves, disinfectant wipes, hand sanitizer, paper towels, and a first aid kit. However, due to the available resources provided by Cedar Crest College, the predicted additional expenses for this simulation were expected to be no more than $300 total for the group, or $100 total per person. See Appendix H for cost analysis. The fees were covered out of pocket by the DNP group members with no financial support necessary.

The use of Blue Phantom ultrasound simulators for ultrasound practice is becoming popular within the recent years. Therefore, cost-effectiveness of Blue Phantom ultrasound guidance is still being evaluated. There is no research currently that states the amount that Blue Phantom ultrasound simulators can decrease healthcare associated costs. However, the main outcome from inadequate ultrasound use with anesthesia procedures relates to difficult catheter placements, nerve injuries, multiple needle sticks to the patient, and delays in treatment or surgery times. These outcomes could lead to patient dissatisfaction, poor hospital reputations, and additional hospital costs. Therefore, since Blue Phantom ultrasound simulator use has been shown to enhance hospital performances by training novice ultrasound users, it is estimated that there will be a decrease in surgical delays and ultimately a decrease in healthcare associated costs if Blue Phantom simulators are incorporated into ultrasound trainings (Pepley et al., 2019).

Chapter 5: Implementation Procedures and Processes

For the development and implementation of the education-based ultrasound simulation there were several steps involved in the process. One of the first steps was the creation of the project topic along with the review of the literature. First, the information regarding the need for ultrasound education was obtained. For this project, information was obtained by discussions held with CRNAs at local hospitals. The discussions were brief conversations throughout the clinical day that occurred over a two-week period. Through these discussions it was identified that there is lack of ultrasound education and ultrasound use within the hospital setting. Next, by evaluating current evidence-based research it was discovered that education-based ultrasound simulations can help to improve the knowledge, confidence, and incorporation of ultrasound use into clinical practice.

After, identifying the issue and reviewing literature, a PICO question was created for this project. This project will examine: For Certified Registered Nurse Anesthetists, does the use of an education-based simulation training for ultrasound-guided anesthesia compared to no simulation training improve the knowledge, confidence, and incorporation of ultrasound use within the clinical practice setting? A simulation was held for CRNAs to learn ultrasound-guided anesthetic techniques involving arterial line placement, intravenous catheter placement, and Blue Phantom simulators. A pre-intervention and a post-intervention study design were developed to ensure proper evaluation of an education-based ultrasound simulation.

Recruitment Plan

The implementation of this project was conducted by recruitment of CRNAs at local hospitals. The main mode of recruitment was by placement of an educational ultrasound flyer within the anesthesia breakrooms at these hospitals (See Appendix I). Prior to placement of

flyers within the breakrooms, the anesthesia department chair was given a letter of support to sign for approval to display the flyer (See Appendix J). After the approval from the anesthesia department, the flyer was posted in the hospital anesthesia break room to help create awareness about this educational simulation. The main inclusion criteria for participants for recruitment were CRNAs greater than age 18 who are actively practicing and agree to voluntarily participate in the DNP project. It was identified that Student Registered Nurse Anesthetists (SRNAs) will be excluded due to ultrasound training now being apart of the Nurse Anesthesia program curriculum. Including SRNAs could potentially bias the data collection for self-perceived knowledge and confidence. The simulation day included eight CRNAs.

The flyer contained all the necessary information needed for recruitment of the CRNAs. The flyer included the purpose of the ultrasound-simulation along with the date, time, and location of the simulation. A QR code was attached to the flyer for easy access to sign up for the simulation. When scanned, the QR code lead the CRNAs to a Jotform website for registration. This website is an application useful for creating online forms. On the website there was the date, time, and location listed for the simulation. Also, there was an overview explaining the purpose of the simulation and instructions on how to register. There was also a DNP project description and informed consent that needed to be read to understand the terms and conditions of the DNP project. Then, at the bottom of the registration page there was a link to a Microsoft form. This form contained the anonymous pre-intervention survey that CRNAs were required to fill out (See Appendix C). After the pre-intervention survey was completed the CRNAs hit submit and it registered them for the simulation day. Upon submission of the registration form the CRNAs received a confirmation email stating their participation along with the date, time, and location of the simulation day. There was a limited number of sign-up slots available, as

stated on the flyer, and once all the slots have been filled no more additional CRNAs were able to register for the simulation. Last, an email account was created for communication of any additional questions or concerns that the CRNAs might have had.

Project Site

The project will be implemented at Cedar Crest College, School of Nursing simulation center in Allentown, Pennsylvania. Cedar Crest College is a small liberal arts college discovered in 1867. The addition of a nurse anesthesia simulation center and program was started in 2018. This simulation center was the project site of choice because it is adapted for learning specifically for anesthesia practice. The site is equipped with an entire operating room suite and various different technology pieces to be incorporated into the project such as the ultrasound devices and a Blue Phantom ultrasound simulator. The campus was within close proximity to local hospitals which made it easy for recruitment of CRNAs for participation in the simulation center. The simulation coordinator at Cedar Crest College was involved throughout the planning process to assist with gathering supplies and identifying dates of availability for simulation.

Education-Based Ultrasound Simulation

The simulation day at Cedar Crest College took place on a Saturday and was a total of two hours in length. The simulation day began with a fifteen-minute educational PowerPoint presentation that discussed certain topics of ultrasound basics such as how an ultrasound works, proper handling and movements of ultrasounds, and gain and depth settings. The PowerPoint also went over what is seen on the ultrasound screen such as short axis, long axis, in plane, and out of plain views and how to identify an artery and vein on the ultrasound screen. Last, there was a review in the differences of hyperechoic, hypoechoic, and anechoic structures.

After the presentation the participants were divided into three different groups to participate in each of the three different stations. The three stations included ultrasound practice with Blue Phantom ultrasound simulators, arterial catheter insertion, and peripheral intravenous catheter insertion. The stations were guided by different DNP group members to help participants learn different ultrasound uses. Each group had thirty minutes at each skills simulation before rotating to the next station. The Blue Phantom ultrasound simulator station allowed participants to practice technical aspects of ultrasound movements. This station focused on the proper handling and basic maneuvers of the ultrasound probe. Also, the participants practiced how to move the ultrasound probe in the short axis, long axis, in plane, and out of plane views. Last, the participants got to practice the different gain and depth settings on the ultrasound machine. The arterial catheter station consisted of practicing ultrasound-guided arterial catheter placement. For this station there was mannequin arms to help simulate arterial line catheter placement. The last station also used the mannequin arms but gave the participants practice on how to place ultrasound-guided peripheral intravenous catheters.

After the CRNAs completed all three stations there was fifteen minutes left of the simulation day to allow for a debriefing and completion of the post-intervention survey. The debriefing took place first to give the CRNAs time to ask additional questions regarding ultrasound use. After the debriefing portion the CRNAs were asked to complete the post-intervention survey. The survey was anonymous and was given online through a Microsoft forms link by means of a QR code. For the post-intervention survey, a questionnaire was created to identify if confidence of incorporating ultrasound into practice has increased. The questionnaire also included open ended areas to discuss any challenges or advantages to ultrasound use. See Appendix D for post-intervention survey.

Materials and Equipment

A meeting was held with the simulation manager at Cedar Crest College regarding necessary supplies. Most of the resources needed for the simulation will be supplied by Cedar Crest College. Some of these resources include ultrasound devices, a Blue Phantom ultrasound simulator, simulation mannequins, arterial and intravenous catheters, and ultrasound gel. Laptops were needed for creation of the PowerPoint presentation. Some miscellaneous resources that were required to help with disinfection as per the Centers for Disease Control and Prevention (See Appendix G). Some of these items include gloves, disinfectant wipes, hand sanitizer, paper towels, and first aid kits. See Appendix H for a complete list of necessary supplies and a cost analysis.

Data Analysis

The data was collected from the pre-intervention and post-intervention surveys through Microsoft forms. All data collected from the participants remained anonymous and confidential in aggregate form to ensure the rights of the participants are protected. There was no physical data collected from the post-intervention surveys. No data was examined until all data was collected. Once all data was collected, it was only reviewed by the DNP group members and DNP chair faculty members. All electronic data was protected by password protected computers with the passwords only known to the DNP group members and DNP faculty chair members. All data for this project will be stored for a three-year period and then shredded, erased, and destroyed.

For data evaluation, the Statistical Package for the Social Sciences (SPSS) v.25 software in Excel was used to help with data analysis and organizing the statistics. Descriptive statistics can be used to help summarize measures of variability such as mean, standard deviation, and

frequency of the pre-intervention and the post-intervention surveys. Then, based on the sample size a paired *t*-test was utilized to compare data and determine significance between the outcome's measures of the pre-intervention and post-intervention survey. The results of the project were disseminated at Cedar Crest College through presentation format. Additionally, information was disseminated through CRNA Facebook group pages on social media.

Chapter 6: Evaluation and Outcomes

For this project, there were several steps involved within the implementation. First, the recruitment flyer was placed in local hospitals breakrooms on Friday December 2, 2022. This flyer included all the necessary information for participation in the simulation. A QR code was attached that lead to easy registration along with a link for completion of the pre-intervention survey. The flyer was displayed for approximately one month, until the implementation date of January 7, 2023. After the implementation of the ultrasound simulation, a post-intervention survey was completed by all participants. All data collection for surveys was collected through Microsoft forms via a Jotforms website. All information was then transferred into a Microsoft Excel spreadsheet. A paired *t*-test was performed for all questions relating to knowledge, confidence, and incorporation of ultrasound use into clinical practice. Data analysis was conducted using the 2020 Dr. Joshua Lambert's *t*-test calculator.

Sample

For the ultrasound simulation there were a total of eight CRNAs who participated. Prior to implementation, there were a total of 10 CRNAs signed up. However, on the simulation day two CRNAs were unable to participate which left a sample size of eight CRNAs. The pre-intervention survey and post-intervention survey began by asking the participants certain questions that pertained to years of CRNA experience, level of ultrasound experience, number of previous ultrasound uses, barriers to ultrasound use, and reason for ultrasound simulation attendance. There was an overall response rate of 100% for both the pre-intervention and post-intervention survey. Of the participants in this ultrasound simulation, the years of experience being a CRNA are as follows, three CRNAs (37.5%) had 0-2 years of experience, one CRNA (12.5%) had 6-10 years of experience, one CRNA (12.5%) had 11-25 years of experience, and

three CRNAs (37.5%) had 26-50 years of experience. In regard to ultrasound use, it was concluded that two CRNAs (25%) had never used an ultrasound, three CRNAs (37.5%) used the ultrasound less than 10 times, and three CRNAs (37.5%) had used the ultrasound between 11-50 times.

Data Evaluation

For the pre-intervention and post-intervention surveys, a Likert scale was used containing a group of seven questions for comparison of the results. These questions related to the knowledge and confidence of each participant in their ultrasound use and the incorporation of ultrasound into clinical practice. The questions used for the pre-intervention and post-intervention survey were identical to compare if knowledge, confidence, and incorporation of ultrasound use increased following the ultrasound simulation. The pre-intervention and post-intervention means were evaluated using a paired *t*-test. A paired *t*-test was selected as it works with small sample sizes and the data point in one sample was matched with a unique point on a second sample, comparing the dependent groups scores. A paired *t*-test is especially useful when looking at results for pretest/posttest studies when one factor is measured before and after an intervention in the same set of individuals (Gerstman, 2015). The data analysis was completed by the 2020 Dr. Joshua Lambert's *t*-test calculator. A *p* value was used to test for statistical significance. A $p < .05$ was considered statistically significant.

To analyze the pre-intervention and post-intervention mean scores, the Likert scale based questions were converted to numerical form. Each category in the Likert scale ranging from strongly disagree to strongly agree was given a number ranging from 1 to 5. The numbers are as follows: Strongly disagree=1, Disagree=2, Neither Agree Nor Disagree=3, Agree=4, and Strongly Agree=5. Based on the results from the participants surveys, a numerical value for the

sample mean would be able to be obtained. Therefore, an increase in the mean average would indicate that the participants confidence, knowledge, and incorporation of ultrasounds increased post-intervention. Each question in the pre-intervention and post-intervention survey will be analyzed.

Confidence in Knowledge, Experience, and Training

The first question on the surveys consisted of asking the CRNAs if they were confident in their knowledge, experience, and training regarding ultrasound. The sample mean score for the pre-intervention survey was 2.25 with a post-intervention mean of 4.38. From this test, the p = .003.

Ultrasound Machine

The second question assessed if the CRNAs felt comfortable using the ultrasound machine. The sample mean for the pre-intervention survey was 2.50 and a sample mean for the post-intervention survey of 4.38. From this test, the p = .008.

Ultrasound Images

The third question assessed if the CRNAs felt comfortable obtaining ultrasound images. The sample mean for the pre-intervention survey was 2.50 and a sample mean for the post-intervention survey was 4.50. From this test, the p = .007.

Ultrasound Images Interpretation

The fourth question assessed if the CRNAs felt comfortable interpreting ultrasound images. The sample mean for the pre-intervention survey was 2.63 and a sample mean for the post-intervention survey was 4.50. From this test, the p = .008.

Ultrasound Clinical Practice

The fifth question assessed if the CRNAs felt comfortable incorporating ultrasound into clinical practice. The sample mean for the pre-intervention survey was 2.86 and a sample mean for the post-intervention survey was 4.63. From this test, the $p = .009$.

Ultrasound Probe Orientation

The sixth question assessed if the CRNAs felt confident choosing the correct orientation of the ultrasound probe. The sample mean for the pre-intervention survey was 2.75 and a sample mean for the post-intervention survey was 4.50. From this test, the $p = .009$.

Ultrasound Depth and Gain

The seventh question assessed if the CRNAs felt confident when adjusting the gain and depth to maximize picture quality on the ultrasound machine. The sample mean for the pre-intervention survey was 2.63 and the sample mean for the post-intervention survey was 4.63. From this test, the $p = .002$.

Clinical Significance versus Statistical Significance

Statistical significance and clinical significance should be evaluated for all medical related projects. Sometimes project results show statistical significance but do not have clinical significance where other project results show no statistical significant but have clinical relevance (Sharma, 2021). For this project, it was indicated that a $p < .05$ was considered statistically significant. All seven of the questions utilized in the pre-intervention and post-intervention survey regarding knowledge, confidence, and incorporation into clinical practice for ultrasounds proved to be statistically significant as all questions established a $p < .05$. However, this project had a small sample with eight participants and small sizes could indicate problems when analyzing data. It has been shown that on occasion, a sample size that is smaller than necessary can have insufficient statistical power (Andrade, 2020). However, even if a project does not

have statistical power, it does not mean that the results are not clinically significant. When creating projects that aim to improve patient outcomes, such as this project, statistical significance is not the only thing that needs to be evaluated (Sharma, 2021). Therefore, clinical significance is the most important discussion when analyzing this project.

Clinical significance for a project indicates that the findings improve medical care that result in the improvement of patient outcomes. A project can be considered valuable and important to clinical practice when results within the data are interpreted appropriately meaning they will improve patient outcomes (Sharma, 2021). Point-of-care ultrasound use has been shown to improve patient outcomes as it facilitates real time image acquisition allowing for prompt diagnosis of specifical clinical conditions. For anesthesia providers, there is a lack of education of ultrasound use leading to a lack of ultrasound incorporation within clinical practice (Naji et al., 2021).

This project created an ultrasound simulation that helped to educate CRNAs which in turn has the potential to lead to increase ultrasound use in clinical practice settings. These CRNA participants can bring their knowledge of ultrasound use back into the clinical practice setting which will start to improve the outcomes of their patients. Also, the CRNA colleagues might see the benefits of the ultrasound and try to start to incorporate their own ultrasound use into their clinical practice. Therefore, the increase in confidence and knowledge of CRNAs regarding ultrasound use from the pre-intervention to the post-intervention survey show the impact this project will have on the clinical practice setting.

Outcomes

As per discussions with CRNAs, it was identified that the lack of ultrasound use came from a lack of confidence and knowledge. The results from the pre-intervention survey to the

post-intervention survey portray that knowledge and confidence regarding ultrasounds has increased along with the participants comfort in incorporating ultrasound use into clinical practice. Since the results showed an increase in knowledge, confidence, and comfort in incorporation of ultrasound use in the clinical practice setting, it can be concluded that the outcome achieved the objectives of the project.

Discussion

Education-based simulation has been shown to improve the confidence, knowledge, and incorporation of POCUS within clinical practice settings for anesthesia providers (Singh et al., 2022). After the data evaluation and discussion of the outcomes, the results of this project are consistent with current literature that education-based ultrasound simulation can improve confidence, knowledge, and incorporation of ultrasound use in clinical practice settings. As shown by the paired *t*-test, there was a significant difference between the mean scores of the pre-intervention and post-intervention survey therefore, showing that confidence and knowledge increased after participating in the ultrasound simulation. Based on the results, it can be concluded that, even with the small sample size, there is also clinical significance and this educational simulation will improve patient outcomes in clinical settings.

During the implementation of this project it became apparent that ultrasound knowledge varied based on years of experience as a CRNA. In the results, it shows that the CRNAs with more years of experience came into the simulation day with very little ultrasound use (ultrasound used less than 10 times) or no ultrasound use prior. The three CRNAs who stated to using an ultrasound more than 10 times prior to coming to the ultrasound simulation had zero to two years of experience. These results show that CRNAs with more years of experience lack the knowledge to use ultrasounds in clinical practice settings where less years of experience CRNAs

most likely received ultrasound training while in school which increased their knowledge and ultrasound use in clinical practice settings. It also shows why SRNAs were excluded from the project as ultrasound use is already being incorporated into CRNA school education. One way to strengthen this project would be to look at a larger sample of CRNAs that have more experience, such as those with greater than 10 years of experience, to see if this trend of very little ultrasound use to no ultrasound use would continue.

A majority of the CRNAs from one hospital site were recruited which can show limitations within the data evaluation. Based on the interviews with CRNAs from local hospitals, it was found that many were not implementing ultrasound use within their hospital settings. Therefore, these local hospitals were utilized as a main site for recruitment. In the end, educating CRNAs from hospitals that do not routinely use ultrasounds in clinical practice settings helped to support the clinical relevance of this project. In the future, it would be beneficial to recruit CRNAs from multiple hospital sites to strengthen the project and increase the clinical significance. Last, the ultrasound simulation can expand to teaching CRNAs other skills such as ultrasound use for central lines or peripheral nerve blocks. There are many different ultrasound simulations that can be created to help to expand education of ultrasounds to CRNAs. Overall, this education-based ultrasound simulation helped to increase the CRNAs knowledge, confidence, and incorporation of ultrasounds in clinical practice to improve patient outcomes.

Chapter 7: Implications for Nursing Practice

Implications for Practice

A lack of education for CRNAs regarding ultrasound leads to a lack of knowledge, confidence, and incorporation of ultrasound into clinical practice settings. Education-based simulation has been shown to be an effective way to teach healthcare providers new skills (Pepley et al., 2019). This project showed an increase in ultrasound knowledge, confidence, and incorporation in clinical practice for the CRNAs who participated in the education-based ultrasound simulation. This DNP project impacts future nursing practice by utilizing the best evidence-based practice measures such as ultrasound use and education-based simulations to improve patient outcomes. Ultrasounds improve patient outcomes by allowing for prompt diagnosis of specific clinical outcomes along with decreasing surgical delays by efficiently performing anesthesia procedures (Naji et al., 2021). Therefore, this project impacted CRNAs who participated in this simulation along with their future patients which has the potential to impact the entire healthcare system.

This DNP project has a broader impact on the entire healthcare system as it shows that education and hands on simulation skill sessions are vital to help increase knowledge, confidence, and incorporation of ultrasound into clinical practice for nursing practice. Prior to implementation of the education-based ultrasound simulation, the CRNAs showed low levels of ultrasound knowledge, confidence, and incorporation into clinical practice. However, after participation in the simulation, the levels of knowledge, confidence, and ultrasound incorporation increased. Therefore, hospital systems should create education-based simulations when trying to incorporate new skills or new technology into the healthcare setting for healthcare workers to impact a larger group of patients. By utilizing this education-based ultrasound simulation for

anesthesia providers it can lead to an increase knowledge, confidence, and incorporation of ultrasound use in clinical practice settings for future practice which would overall improve patient outcomes.

Strengths of the Project

Several strengths were apparent throughout the implementation of this DNP project. One of the biggest strengths was the cost-effectiveness of this project. Simulation centers that have all the necessary equipment needed for the implementation of this project were utilized. By having essential equipment such as Blue Phantom simulators and simulation mannequins it helped to decrease the overall out of pocket expenses required for this project. Therefore, finding hospitals that have simulation centers or college simulation centers will continue to make this project cost-effective. Also, the utilization of free online websites for survey creation, data collection, and data analysis help to reduce costs as well. It would be easy and cost-effective to replicate this project with the free survey tools used online.

Another major strength of this project dealt with the simplicity of the study design. The pre-intervention survey and post-intervention survey design used for this project can be easily understood by all participants and replicated for future projects. The information for the project and surveys were all found within one website that was accessed by a QR code. The participants could easily scan the QR code which gave them quick access to the surveys for completion. The efficient access to the surveys led to an increase in participation by the CRNAs. Also, the Likert scale is a survey tool that is easy for participants to understand when responding to the surveys. The simplicity of the surveys and the easy ability to access the surveys also helps to increase the strength of this project.

Limitations of the Project

It is important to discuss the limitations of a project when evaluating the effectiveness of projects. One of the main limitations of this study was the sample size being eight participants. The sample size had to be limited due to the size of the simulation center used within the project. The sample size of eight participants can be classified as a small sample size which can cause challenges when analyzing the data. This small sample size can decrease the statistical power of the project and can lead to false negatives, false positives, or other errors within data analysis (Gerstman, 2015). Also, this sample size makes it difficult to make a generalization of an entire population. Therefore, it would be beneficial for future studies to be completed.

Along with the small sample size, the recruitment strategy was also a limitation of this study. A local hospital was utilized as the main form of recruitment for CRNA participation within this project. This hospital was shown to have a lack of ultrasound use by CRNAs which made this hospital appealing to use as the main recruitment place for participation. It is possible that having most of the participants come from one local hospital can skew the data results and lead to bias within the data analysis (Gerstman, 2015). Last, Anesthesiologists were not included in the participants within the project which could change the impact this project has on clinical practice. By incorporating Anesthesiologist into the project it could have allowed a different perspective on ultrasounds which might have not been considered prior to the project. Also, Anesthesiologists work alongside CRNAs so educating them on ultrasounds to increase their knowledge, confidence, and incorporation of ultrasound use in clinical practice would have helped to further impact clinical practice and patient outcomes.

Linkage to DNP Essentials

The DNP essentials need to be incorporated throughout each DNP project to comply with requirements for an advanced practice DNP degree. Through the development and implementation, this DNP project addressed all eight foundational DNP essentials.

Essential I: Scientific Underpinnings for Practice

This essential was utilized from start to finish throughout this DNP project. The literature review analyzed evidence-based practice research and scientific-based theories which were then applied and implemented through the education-based ultrasound simulation utilized within this project. By analyzing scientific-based theories a new clinical practice change such as ultrasound incorporation can be utilized in clinical practice settings.

Essential II: Organizational and Systems Leadership for Quality Improvement and Systems Thinking

This essential was met by the group members identifying a knowledge gap and needs assessment at local hospitals for a lack of ultrasound use in clinical practice settings by CRNAs. After the focus group was identified the group members identified stakeholders and portrayed effective communication with stakeholders to create and implement the DNP project. The advanced communication skills utilized by the group members allowed the simulation to be implemented which will lead to quality improvement and improved patient outcomes in clinical practice settings. Last, the group members were able to evaluate the overall project. The group members analyzed cost-effectiveness of the project and accounted for possible risks by collaborating with DNP chairs and the IRB. The effectiveness of the education-based simulation was evaluated by the pre-intervention and post-intervention survey. Throughout the entire project, the group members identified possible system issues and helped to facilitate the necessary changes.

Essential III: Clinical Scholarship and Analytical Methods for Evidence-Based Practice

Several steps occurred for this essential to be met within this project. First, a literature review was conducted using three different research databases. Analytic methods, such as advanced search settings, were used to appraise the existing literature to identify best practices for implementation. The data collected from the literature review on the benefits of ultrasound use were analyzed to create the outline for the education-based ultrasound simulation. Prior to implementation, a project proposal was constructed and submitted to the IRB for approval. After the implementation of the project, the data was collected and analyzed using Microsoft Excel, paired *t*-tests, and descriptive statistics. The final dissemination of the findings of the project occurred at Cedar Crest College as well as dissemination through social medial.

Essential IV: Informational Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care

This essential was met by utilizing information systems and technology to help support, evaluate, and improve patient care within the healthcare systems. For this project, technology was utilized for many different aspects of this project. The signup, consent, and pre-intervention and post-intervention surveys were distributed with an online platform called Jotform. Microsoft Excel and online t-test calculators were used for all data collection and evaluation. All essential communication for this project occurred using information systems and technological tools.

Essential V: Health Care Policy for Advocacy in Health Care

This essential was met by creating and implementing an education-based ultrasound simulation that was related to best practice measures from the literature review. This project did not directly use healthcare policy, however, the education by the group members did cause the participants to engage in a practice change to address healthcare needs. It was identified that

ultrasound use leads to improved patient outcomes (Naji et al., 2021). Therefore, there is a healthcare need to increase ultrasound use to improve patient outcomes. By increasing the education of the participants regarding ultrasound use it will lead to a healthcare intervention that will overall improve patient outcomes. Through this essential the group members and participants will take the education they learned to be an advocate for the anesthesia profession to help incorporate ultrasound use into clinical practice settings.

Essential VI: Interprofessional Collaboration for Improving Patient and Population Health Outcomes

This essential was met by utilizing interprofessional collaboration through stakeholders and being a leader to improve patient and population health outcomes. The key stakeholders for this project included the CRNAs, DNP chairs, and the simulation coordinators. The group members had to be leaders with effective collaboration and communication when working with all the stakeholders. Through discussions with CRNAs it was identified that there was a lack of ultrasound use in clinical practice settings. The DNP chair was able to assist with the implementation process while the simulation manager helped organize the simulation center for the day of implementation. It was necessary for the group members to have effective leadership and communication skills during the creation of the project. By being a strong leader, the group members were able to adapt to the challenges faced within the project. By adapting to challenges the stakeholders and group members, who were the leaders, could function together to ensure success of the project. By implementing a successful project the hospital system will see the benefits that ultrasound use has in clinical practice settings when more ultrasounds are used.

Essential VII: Clinical Prevention and Population Health for Improving the Nation's Health

This essential was met by using evidence-based practice measures to prevent clinical problems related to not using ultrasounds and ensure population health services for all individuals and populations. Ultrasound use was shown to improve patient outcomes by facilitating real time image acquisition allowing for prompt diagnosis of specific clinical outcomes. Also, it decreases surgical delays by creating a more efficient way to perform anesthesia procedures (Naji et al., 2021). Education-based simulation was then found as an effective means of educating healthcare workers on new skills (Chernikova et al., 2020). There was a gap in care for surgical patients needing anesthesia procedures which was discovered through consults with CRNAs who are considered experts in anesthesia care. Quickly being able to place arterial lines and peripheral intravenous catheters is especially important for those surgical patients that need emergent surgery or other critical surgical procedures. Therefore, the more efficiently and faster anesthesia procedures can be completed will prevent adverse patient outcomes.

Along with preventing the clinical implications seen when ultrasounds are not used, this project also evaluated the psychological dimensions of anesthesia providers. By not having the knowledge and confidence, CRNAs were not incorporating ultrasounds into clinical practice settings. However, by increasing the ultrasound knowledge and confidence for CRNAs, there will be an increase in ultrasound use in clinical practice settings to improve the patient outcomes. Last, the knowledge can be disseminated to other healthcare providers from the CRNAs who participated in the ultrasound simulation which will further lead to clinical prevention and improvement in population health.

Essential VIII: Advanced Nursing Practice

This essential was met throughout the entire DNP project from the initial needs assessment to the dissemination of the project. The literature review, creation of the PICO question, pre-intervention and post-intervention study design, education-based ultrasound implementation, data evaluation, data analysis, and dissemination of the project. The entire project encompasses this final essential which took scientific-based nursing science and incorporated the evidence into clinical practice to improve patient outcomes. The group members used their education to help guide a practice change for CRNAs which will overall help to achieve excellence within their clinical practice. Throughout the entire project, the group members developed and sustained relationships with the stakeholders for creation of the project to improve patient outcomes.

Chapter 8: Summary of Project

Summary and Conclusions

Point-of-care ultrasound can be used in fast paced anesthesia environments to increase the speed and efficiency of anesthesia procedures. By using ultrasound, it will help to improve patient outcomes, decrease surgical delays, and decrease costs for hospital settings (Naji et al., 2021). It has been shown that a lack of education leads to a lack of ultrasound use within clinical practice settings. The lack of education is directly related to a lack of adequality trained anesthesia providers (Cannon et al., 2018). Education-based simulation has been discovered as one of the most effective ways to increase knowledge, confidence, and incorporation of ultrasound in clinical practice settings for healthcare providers (Chernikova et al., 2020).

The main purpose of this DNP project was to increase the knowledge, confidence, and incorporation of ultrasound use in clinical practice settings for CRNAs. Therefore, an education-based ultrasound simulation was created which involved the participation of eight CRNAs. An in-depth literature review was completed to help with creation of this education-based ultrasound simulation implementation, evaluation, and dissemination. The simulation started with a PowerPoint presentation to discuss ultrasound basics. After the presentation, the participants were divided into three groups to attend three different stations including ultrasound practice with Blue Phantom ultrasound simulators, arterial catheter insertion, and peripheral intravenous catheter insertion. The evaluation process occurred through a pre-intervention and post-intervention survey. The Iowa Model of Evidence-Based Practice framework helped throughout the implementation and dissemination of the project.

The findings of this DNP project identified that education-based ultrasound simulation leads to an increase in the knowledge, confidence, and incorporation of ultrasound use in the

clinical practice setting by CRNAs. The findings concluded within this project are consistent with the findings that were identified within the literature review. There was a significant increase in post-intervention survey scores compared to the pre-intervention survey scores by the CRNA participants. The increase in survey scores indicated there was an increase in knowledge, confidence, and incorporation of ultrasound use for the participants. It would be beneficial to expand this ultrasound simulation to different hospital settings to increase the sample size and further impact patient outcomes.

Dissemination Plans

The dissemination of this DNP scholarly project occurred on April 20th, 2023 at Cedar Crest College for all graduate faculty and current students. A poster presentation was created to outline the project for discussion. After the DNP presentation at Cedar Crest College, there are other ways that education of CRNAs and dissemination of the project can occur.

Social media is one of the best ways to help to disseminate information. Social media has been shown to help improve health information and up-to-date measures and practices due to the availability of the information to the public (Yeung, 2018). Therefore, another way to disseminate the information would be the CRNA Facebook group pages on social media. Within these groups it will allow CRNAs to read about the DNP project and see the results. By disseminating the information, the CRNAs can see the impact that ultrasounds can have in clinical practice and therefore, modify their practice to learn how to use and incorporate ultrasounds into their clinical practice.

Future Ideas

Ultrasounds can be used in a variety of different settings and in a variety of different ways. This project focused on using ultrasounds for arterial line placement and intravenous

catheter placement. However, this project can expand to future projects by creating ultrasound simulation that focuses on other areas of ultrasound use such as for peripheral nerve block or central line placement. Peripheral nerve blocks and central lines are not often placed by CRNAs, therefore, having an education-based ultrasound simulation can help to maintain or increase the knowledge, confidence, and increase of ultrasound use in clinical practice settings for these skills. The continued creation of education-based ultrasound simulations will help to increase the knowledge, confidence, and incorporation of ultrasound into clinical practice settings to improve patient outcomes.

Along with the creation of additional education-based ultrasound simulations, there should be further investigation to identifying other barriers to implementing ultrasound use in clinical practice settings and methods to decrease these barriers by having further discussions or surveys with anesthesia providers. It is important to continue to have these discussions at multiple clinical practice settings with CRNAs to learn all the barriers that might exist. The one barrier identified within this project was due to the lack of education. However, other barriers could include lack of availability of ultrasound equipment, lack of anesthesia providers willingness to change practice, and lack of repeated ultrasound education (Naji et al., 2021). It is important to identify other barriers so that hospital settings can decrease these barriers to help increase ultrasound use in clinical practice settings to improve patient outcomes.

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Appendix A

Evidence Synthesis Table

PICO Question: For Certified Registered Nurse Anesthetists, does the use of education-based simulation training for ultrasound-guided anesthesia compared to no simulation training improve the knowledge, confidence, and incorporation for ultrasound use within the clinical practice setting?								
Author & Date	**Aim & Research Design**	**Sample Size, Population & Setting**	**Methods**	**Measures & Outcomes**	**Study Findings that Answer the PICO**	**Limitations**	**Evidence Rating**	
							Level	**Quality**
Chernikova, O., Heitzmann, N., Stadler, M., Holzberger, D., Seidel, T. & Fischer, F. (2020)	**Aim** Draw inferences regarding the effect of a simulation-based learning environment and instructional support on the development of complex skills **Research Design** Meta-analysis	145 research studies were included, total sample size of 10,532 students participating in medical or teacher stimulation education training	Written or oral knowledge tests, assessment of performance, and quantitative measures such as behavior or procedures performed correctly, and complex measures Articles before April 2018 in PsycINFO, PsychARTICLES, ERIC, and MEDLINE databases	Simulation-based learning had greater effects in live simulations with mannequins being highly effective. Simulation-based learning has large positive overall effects of the advancement of complex skills for higher education.	Simulations are the most effective means to facilitate learning of complex skills across domains. Technical and manual performance is enhanced with simulation training with increased confidence.	Some studies provided little description of the treatment, which lead to insufficient coding. Also, some studies implemented multiple instructional support measures during one treatment	I	High

PICO Question: For Certified Registered Nurse Anesthetists, does the use of education-based simulation training for ultrasound-guided anesthesia compared to no simulation training improve the knowledge, confidence, and incorporation for ultrasound use within the clinical practice setting?								
Author & Date	**Aim & Research Design**	**Sample Size, Population & Setting**	**Methods**	**Measures & Outcomes**	**Study Findings that Answer the PICO**	**Limitations**	**Evidence Rating**	
							Level	**Quality**
			Experimental or quasi-experimental design articles with at least one treatment and one control group. Excel using Covidence, Cohen's d, variance, SE of Cohen's d, and correction factor J. High heterogeneity between studies: Q (409), $p<0.001$.			making it difficult to determine the effects of a specific measure.		
Eroglu, O. & Coskun, F. (2018)	**Aim** To develop the	96 final-year medical students	Ultrasound training program using Sonosim	The mean theoretical exam test score before	The study found that medical	Budgetary limitations did not	III	Moderate

PICO Question: For Certified Registered Nurse Anesthetists, does the use of education-based simulation training for ultrasound-guided anesthesia compared to no simulation training improve the knowledge, confidence, and incorporation for ultrasound use within the clinical practice setting?								
Author & Date	**Aim & Research Design**	**Sample Size, Population & Setting**	**Methods**	**Measures & Outcomes**	**Study Findings that Answer the PICO**	**Limitations**	**Evidence Rating**	
							Level	**Quality**
	knowledge and skills of final year medical students ability to perform ultrasound technology via a simulation-based ultrasound training program. **Research Design** Prospective cohort study	included who came to the Emergency Department of Kirikkale University Faculty of Medicine between July 2015 and July 2016 who have not received ultrasound training. The average age of the students was 24.1 +/- 2.1 years with 57.3% of the students being female.	ultrasound training solution device with before and after theoretical (test) exam and practical application exams 20 hours of training with 4 hours theoretical and 16 hours hands on. Before and after training exam surveys for the students. All data analyzed by Statistical Package for	training was 7.9 ± 2.2 while the after training was 17.1 ± 1.6 with a $p<0.0001$. The mean score obtained in the practical application exam before training was 1.1 ± 0.9 and that after training was 10.9 ± 0.2 points with $p<0.0001$. Tests show that people can learn how to use ultrasounds within a	students can learn to use an ultrasound device within a short period of time via simulation-based training programs.	allow the researchers to purchase all ultrasound modules in the simulation device. The study was also presented at 1 hospital with only 2 emergency training ultrasound trainers.		

PICO Question: For Certified Registered Nurse Anesthetists, does the use of education-based simulation training for ultrasound-guided anesthesia compared to no simulation training improve the knowledge, confidence, and incorporation for ultrasound use within the clinical practice setting?								
Author & Date	**Aim & Research Design**	**Sample Size, Population & Setting**	**Methods**	**Measures & Outcomes**	**Study Findings that Answer the PICO**	**Limitations**	**Evidence Rating**	
							Level	**Quality**
			Social Sciences Inc with paired t-test for comparison of results, $p<0.05$ was considered to be significant.	simulation-based educational setting.				
Kondrashova, T. & Coleman, C. (2017).	**Aim** To assess medical student perception of the impact of incorporating ultrasound training models in a required, second-year clinical ultrasound course	164 second-year osteopathic medical students from a single class	7 ultrasound assignments using CAE Healthcare and Kyoto Kagaku ultrasound training models. Microsoft PowerPoint presentation, live demonstration, and videos before simulation.	155 (94.5%) students agreed the models correlated well with clinical courses and 143 (91.7%) agreed the models aid in development of clinical decision-making skills. 152 (98%) students agreed or strongly agreed to feeling prepared to use	The majority of students in the current study felt prepared to use ultrasound in clinical rotations, residency, and professional practice. These findings suggest that the models enhanced their learning by providing realistic	Some students failed to complete the entire survey. Recall bias for those students completing surveys in third semester rather than second semester. Some	III	High

PICO Question: For Certified Registered Nurse Anesthetists, does the use of education-based simulation training for ultrasound-guided anesthesia compared to no simulation training improve the knowledge, confidence, and incorporation for ultrasound use within the clinical practice setting?								
Author & Date	**Aim & Research Design**	**Sample Size, Population & Setting**	**Methods**	**Measures & Outcomes**	**Study Findings that Answer the PICO**	**Limitations**	**Evidence Rating**	
							Level	**Quality**
	Research Design Prospective cohort study		Anonymous 5-item paper survey using the Likert scale administered after ultrasound assignments. Survey responses summarized using frequency and percentage. Frediman's test to assess differences. Benferroni method for comparisons. Analysis using SAS institute Inc with $p<0.05$ was significant.	ultrasound in clinical rotations, residency training, and professional practice. Overall, simulation-based education prepared students to feel confident to use ultrasound in clinical practice.	training before entering patient care.	students are more comfortable with certain procedures based on area of practice.		

PICO Question: For Certified Registered Nurse Anesthetists, does the use of education-based simulation training for ultrasound-guided anesthesia compared to no simulation training improve the knowledge, confidence, and incorporation for ultrasound use within the clinical practice setting?								
Author & Date	**Aim & Research Design**	**Sample Size, Population & Setting**	**Methods**	**Measures & Outcomes**	**Study Findings that Answer the PICO**	**Limitations**	**Evidence Rating**	
							Level	**Quality**
Le, C., Lewis, J., Steinmetz, P., Dyachenko, A., Oleskevich, S. (2018).	**Aim** Evaluates the use of ultrasound simulators for retaining and improving ultrasound skills acquired in undergraduate ultrasound training. **Research Design** Randomized controlled trial	19 fourth-year medical students at McGill University in Montreal, Canada	4-hour point-of-care ultrasound course with required readings, didactic sessions, and practice Computer generated randomization with 10 students in the study group completed an ultrasound curriculum with simulation experience and 9 students in the control with no simulation experience	80.1% for the visual examination and 77.7% on the practical examination for the study group performed higher. The study group significantly increased their practical and visual examination scores while the control group decreased their scores.	The use of ultrasound simulators is a helpful tool to retain and improve point-of-care ultrasound skills and knowledge for medical professionals.	Small sample size looking at one medical school. 8 different evaluators for the practical exam could have led to bias in grading of exams. One evaluator consistently graded students lower than other evaluators.	II	Moderate

PICO Question: For Certified Registered Nurse Anesthetists, does the use of education-based simulation training for ultrasound-guided anesthesia compared to no simulation training improve the knowledge, confidence, and incorporation for ultrasound use within the clinical practice setting?								
Author & Date	**Aim & Research Design**	**Sample Size, Population & Setting**	**Methods**	**Measures & Outcomes**	**Study Findings that Answer the PICO**	**Limitations**	**Evidence Rating**	
							Level	**Quality**
			Practical and visual examination given immediately after course and again 4 weeks later Linear mixed regression models SAS institute with 2-sided t test, 80% power, and confidence level $p<0.05$, chi-squared test, and confidence intervals					
Zawadka, M., Graczyńska, A.,	**Aim** To assess the effectiveness of a one-day	A one-day POCUS course conducted in a	Ultrasound training using SonoSite X-porte ultrasound	Statistically significant improvement in test results when	A one-day POCUS training course integrated into	Method of enrollment limited number of	III	Moderate

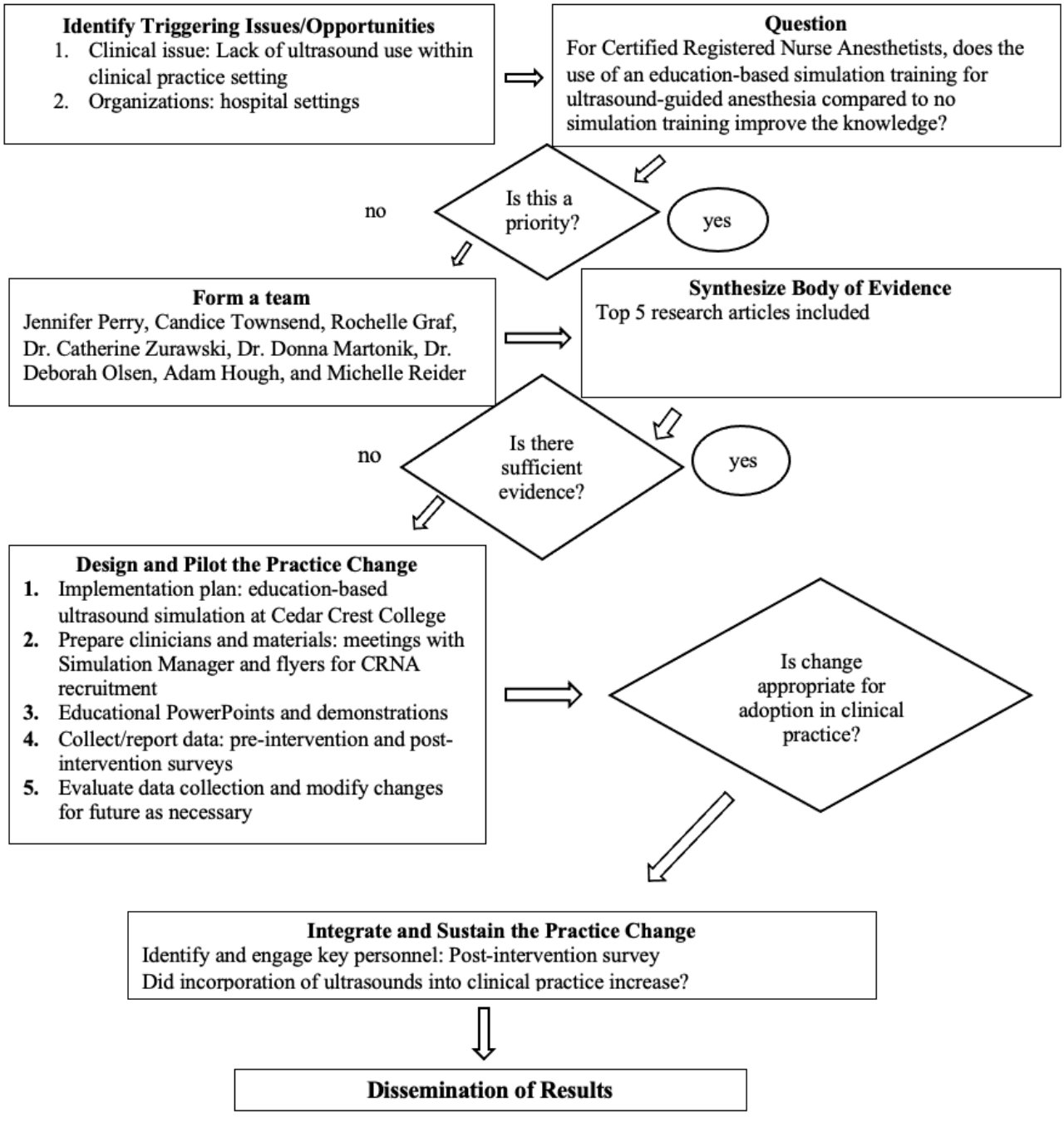
PICO Question: For Certified Registered Nurse Anesthetists, does the use of education-based simulation training for ultrasound-guided anesthesia compared to no simulation training improve the knowledge, confidence, and incorporation for ultrasound use within the clinical practice setting?								
Author & Date	**Aim & Research Design**	**Sample Size, Population & Setting**	**Methods**	**Measures & Outcomes**	**Study Findings that Answer the PICO**	**Limitations**	**Evidence Rating**	
							Level	**Quality**
Janiszewska, A., Ostrowski, A., Michałowski, M., Rykowski, M., & Andruszkiewicz, P. (2019).	point-of-care (POCUS) course in a group of final-year medical students to assess diagnostic ability and confidence levels in making a diagnosis. **Research Design** Prospective cohort study	simulation center in the Central Teaching Hospital in Warsaw. 57 final-year medical students with voluntary participation and no previous experience in ultrasound training.	unit with a curvilinear transducer probe and Philips Sqarq transducer and probe. One-day POCUS training consisted of four lectures, seven practical skill training sessions on models, and one computer-based ultrasound interpretation session. Students divided into groups of five participants and each station was run by an instructor	compared with pre-training results to two weeks results $41.78 \pm 12\%$ vs $58 \pm 13\%$ and $p<0.001$. Overall, the confidence scores in the post-training test were significantly higher when compared to the pre-training test scores.	the anesthesia training curriculum can improve performance in post-training test scores and the scores for the level of confidence in their diagnostic ability.	students included. A previous power analysis was not undertaken to determine the optimum size of the study group. Student testing included only nine questions, which limited sample size and variety of answers.		

PICO Question: For Certified Registered Nurse Anesthetists, does the use of education-based simulation training for ultrasound-guided anesthesia compared to no simulation training improve the knowledge, confidence, and incorporation for ultrasound use within the clinical practice setting?								
Author & Date	**Aim & Research Design**	**Sample Size, Population & Setting**	**Methods**	**Measures & Outcomes**	**Study Findings that Answer the PICO**	**Limitations**	**Evidence Rating**	
							Level	**Quality**
			providing real time feedback. The knowledge of students was tested before and two weeks after the course using image-based testing and self-evaluation surveys. Confidence scoring system designed to rate subjective certainty of answers. Statistical Analysis Software version 9.4, McNemar's test to evaluate					

PICO Question: For Certified Registered Nurse Anesthetists, does the use of education-based simulation training for ultrasound-guided anesthesia compared to no simulation training improve the knowledge, confidence, and incorporation for ultrasound use within the clinical practice setting?								
Author & Date	**Aim & Research Design**	**Sample Size, Population & Setting**	**Methods**	**Measures & Outcomes**	**Study Findings that Answer the PICO**	**Limitations**	**Evidence Rating**	
							Level	**Quality**
			results of before and after test. Wilcoxon rank-sim test to assess confidence scores. Significance represented as p-value <0.05.					

Appendix B

Evidence Based Practice Model: The Iowa Model



(Cullen et al., 2022)

Appendix C

Pre-Intervention Survey

How many years experience do you have as a CRNA?

A. 0-2 years
B. 3-5 years
C. 6-10 years
D. 11-25 years
E. 26-50 years
F. >50 years

Level of ultrasound experience

A. Never used an ultrasound before
B. Minimal/use less than 5 times total
C. Moderate/use greater than 4 times a month
D. Significant/use more than 2 times per week

How many times have you used an ultrasound?

A. 0
B. 1-10
C. 11-50
D. 51-100

What barriers exists to using an ultrasound in your clinical practice (select all that apply)

A. limited availability/access to machines
B. do not know how to use the ultrasound machine
C. takes too much time/not enough time during the case
D. I do not see the need to use an ultrasound
E. I do not know where the ultrasound is located
F. I do not know how to interpret ultrasound images
G. Other
    1. _____

    _____

    _____

What influenced you to attend this ultrasound simulation? (select all that apply)

A. To learn new information regarding ultrasound
B. A review of ultrasound information
C. To develop clinical skills

D. To develop interpretive diagnostic skills
E. To help me to incorporate ultrasound into my clinical practice
F. Other (please explain):
    1. _____

_____

_____

For each of the questions below, choose the response that best characterizes how you feel about the statement

	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
I am confident in my knowledge, experience, and training regarding ultrasound.	1	2	3	4	5
I feel comfortable using the ultrasound machine	1	2	3	4	5
I feel comfortable obtaining ultrasound images	1	2	3	4	5
I feel comfortable interpreting ultrasound images	1	2	3	4	5
I feel comfortable incorporating ultrasound into clinical practice	1	2	3	4	5
I currently use ultrasound in my clinical practice	1	2	3	4	5
I feel confident choosing the correct orientation of the ultrasound probe.	1	2	3	4	5
I feel confident when adjusting the gain and depth to maximize picture quality on the ultrasound machine.	1	2	3	4	5

Appendix D

Post-Intervention Survey

Were you using ultrasound prior to this education-based simulation?
A. yes
B. no

How often do you anticipate using ultrasound in your clinical practice after attending this simulation?
A. Never, I do not plan on using ultrasound
B. Minimal/use less than 25% of the time
C. Moderate/use 26-50% of the time
D. Significant/use more than 50% of the time

For each of the questions below, choose the response that best characterizes how you feel about the statement.

	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
The simulation provided a sufficient opportunity for practicing technical skills for ultrasound.	1	2	3	4	5
The PowerPoint presentation increased my knowledge regarding clinical application of ultrasound.	1	2	3	4	5
I am confident in my knowledge, experience, and training regarding ultrasound.	1	2	3	4	5
I feel comfortable using the ultrasound machine.	1	2	3	4	5
I feel comfortable obtaining ultrasound images	1	2	3	4	5
I feel comfortable interpreting ultrasound images.	1	2	3	4	5
I feel comfortable incorporating ultrasound into clinical practice.	1	2	3	4	5

	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree
I currently use ultrasound in my clinical practice.	1	2	3	4	5
I feel confident choosing the correct orientation of the ultrasound probe.	1	2	3	4	5
I feel confident when adjusting the gain and depth to maximize picture quality on the ultrasound machine.	1	2	3	4	5
I am confident I will start to incorporate ultrasound use within my clinical practice.	1	2	3	4	5

If you do not plan to incorporate ultrasound use into your clinical practice, please elaborate as to why you would not make this change.

_____

_____

_____

_____

_____

_____

Appendix E

Debriefing

Things you enjoyed the most from the ultrasound simulation:

_____

_____

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_____

Things you enjoyed the least from this simulation:

_____

_____

_____

_____

_____

_____

How could this ultrasound simulation be improved?

_____

_____

_____

_____

_____

_____

Appendix F

Likert Scale

1	2	3	4	5	6
Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree

(Nemoto & Beglar, 2014)

Appendix G

Centers for Disease Control and Prevention Disinfection Guidelines

Appendix H

Cost Analysis

Item	**Cost if needed**	**Need to buy: Yes/No**
Butterfly Ultrasounds (3)	$2,000 each	No, already have
Large ultrasound machines	$0	No, 2 provided by CCC
Ultrasound gel	$3.00	Yes
Gloves (x3 S, M, L)	$5.00 each	Yes
Laptops for presentation	$0	No
Mannikins	$0	No, at CCC
Blue phantom ultrasound simulator	$0	No, at CCC
Pen/paper for surveys	$5	Yes
Printing paper	$0	Available at CCC
Disinfectant wipes	$10	Yes
Hand Sanitizer	$10	Yes
Paper Towels	$5	Yes
First aid kit	$15	Yes
Arterial Line Kits	Negotiable	Yes or discuss with clinical sites for expired kits
Peripheral IV Kits	Negotiable	Yes or discuss with clinical sites for expired kits

Appendix I

Educational Ultrasound Flyer

ULTRASOUND SIMULATION

For CRNAs

Doctorate Project Implementation
at Cedar Crest College School of Nursing Simulation Center

Event hosted by:
Rochelle Graf, Jennifer Perry, Candice Townsend

January 7, 2023 | 12-2 pm

CEDAR CREST COLLEGE, SCHOOL OF NURSING
2901 HAMILTON BOULEVARD
ALLENTOWN, PA 18103

Come attend this free simulation to better understand ultrasound. You will get hands on experience placing intravenous peripheral catheters and arterial lines. Also, get a chance to practice technical aspects of ultrasound using a Blue Phantom simulator.

SCAN ME

Limited Spots available.

For additional questions please contact: ultasoundsimCCC@gmail.com

This research project was approved by Cedar Crest College's IRB no. 438 on October 25, 2022

Appendix J

Letter of Support

Reading Tower Health
420 S. 5th Avenue
West Reading, PA 19611

To Whom It May Concern:

We are writing to request your support in displaying an informational flier in Reading Tower Health's anesthesia breakroom. As a requirement for completion of our DNP, we are designing and implementing a quality improvement educational program on the use of ultrasound in anesthesia practice. This educational program will be held at Cedar Crest College's simulation center. This program is based on current best practice guidelines and the goal would be for participants to begin incorporating ultrasound into their current practice. Although this is not a research project, it may contribute to the growing body of evidence on this topic to be used to guide future practice changes in other health care settings. The goal of this educational simulation is to increase the knowledge and confidence of CRNAs utilizing ultrasound. This is a free educational offering and will take approximately four hours to complete.

Participant requirements:

- Must be over 18 years of age
- Be practicing currently as a CRNA

Your signature below indicates your support in displaying the informational flier within Reading Tower Health's breakroom.

Thank you,
Rochelle Graf, Jennifer Perry, & Candice Townsend