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

Candice M. Townsend, RN, BSN, CCRN, SRNA

School of Nursing, Cedar Crest College

Author Note

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

DNP Project Chair: Donna Martonik DNP, ANP, AGACNP-BC

DNP Mentor: Deborah Burnett-Olsen DNAP, CRNA

Correspondence concerning this paper should be addressed to Candice Townsend, Cedar Crest College, 100 College Dr, Allentown, PA 18104. Email: cmtownsend@cedarcrest.edu

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Abstract

Point-of-care ultrasound is a portable, non-invasive diagnostic and procedural imaging tool. Certified Registered Nurse Anesthetists have the capability to utilize ultrasound in their practice, however with no formal training, many providers lack the knowledge and confidence to successfully use ultrasound in the clinical setting. The literature suggests that use of simulation for ultrasound training increases provider's knowledge, confidence, and incorporation into practice. This DNP manuscript discusses the implementation of a simulated training session on the use of ultrasound for specific clinical procedures that are frequently encountered in clinical practice. The goal of the project was to offer a hands-on learning environment to increase Certified Registered Nurse Anesthetists' confidence in performing skills needed to place invasive lines with the aid of ultrasound. Using a pre-test, post-test design, variables measured included self-perceived knowledge, confidence, and self-reported intent to incorporate ultrasound into clinical practice. Data was analyzed using paired t-tests.

Keywords: point-of-care ultrasound, simulation, ultrasound, Certified Registered Nurse Anesthetists, arterial line, radial artery

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Chapter One: Introduction and Overview of the Problem of Interest

Nursing practice is constantly evolving with evidence-based, technological advances to improve patient outcomes and safety. One of the advances that has been growing in popularity within the medical community is point-of-care ultrasound (POCUS). Although POCUS is an emerging, core skill that Certified Registered Nurse Anesthetists (CRNAs) have the knowledge and capability to use, there is no standard ultrasound curriculum for anesthesia providers in the United States. Cannon et al., (2018) found that only 36% of anesthesia providers received formal POCUS training. This lack of education leads to decreased skill proficiency and confidence to utilize this tool in the clinical setting. The American Association of Nurse Anesthesiologists (AANA) released a statement in support of CRNAs advancing their clinical expertise and incorporating POCUS into routine care by gaining competency through various pathways, including didactic and simulation-based methods. Simulation allows a safe environment to become familiar with equipment, practice motor skills, and gain knowledge in interpretation of imagery (McCormick et al., 2018). A simulation intervention is needed to help increase provider's knowledge and confidence in using ultrasound, to ensure its incorporation into routine practice.

Background and Significance

CRNAs are advanced practice nurses who use clinical decision-making skills to safely administer anesthesia to the surgical patient population. The placement of invasive catheters and monitors is a necessary, fundamental skill, within the CRNA's scope of practice. These lines and

monitors provide critical information about a patient's physiological status, and enhances treatment options for hemodynamic stability while maintaining the goal of anesthesia; loss of awareness, analgesia, and lack of movement (Karanjakar et al., 2020). POCUS is a portable, noninvasive, ultrasonography tool that has been shown to improve safety and efficacy of interventions provided in anesthesia care, such as procedural image guidance (AANA, 2020).

Radial arterial catheterization is the preferred site for perioperative hemodynamic monitoring and blood gas analysis. The traditional method of palpation guidance, with a success rate of 15-56% on first attempt, can be complicated by anatomic variations, arterial calcifications, dehydration, low cardiac output, and hypotension (Gopalasingam et al., 2020). These challenges can lead to multiple catheterization attempts, increased procedural time, patient discomfort and untoward events including; nerve injury, hematoma, pseudoaneurysm, total artery occlusion, distal ischemia, and infection. A meta-analysis of 10 randomized controlled trials (RCTs) found that the use of ultrasound for radial arterial line placement was more effective than pulse palpation and other techniques, leading to increased first time success rates, faster placement times, and fewer complications (Lamperti et al., 2020).

With these findings, it is recommended that POCUS be used as a standard of practice, rather than a rescue procedure to increase first time line placement attempts and decrease potential difficulties (Gopalasingam et al., 2020). The Council of Accreditation (COA) of Nurse Anesthesia Programs as of January 2022 added POCUS into the doctoral standards for nurse anesthesia programs to accommodate the rapid escalation of its use in diagnostics, as well as vascular, arterial, and regional access (COA, 2021).

PICO Question Guiding Inquiry

Without structured education on ultrasound and hands-on experience, many CRNAs have not had the opportunity to become proficient in this area of practice. This lack of training decreases provider knowledge, confidence, and decreases the likelihood of POCUS being utilized for diagnostics and invasive procedures. This increases the risk for patient complications, by increasing procedure times, and decreasing treatment and monitoring capabilities, thus hindering the care the patient is receiving. Interventions that provide clinicians the opportunity to learn and practice POCUS in a safe environment are needed to increase comfort level and skill proficiency. This Doctor of Nursing Practice (DNP) project will seek to answer the clinical 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 of ultrasound use within the clinical practice setting?

System and Population Impact

The population this project will be focusing on is CRNAs. Although the use of ultrasound is within the scope of practice for CRNAs there is a lack of education and training for this tool (Canon et al., 2018). Without structured education on ultrasound and hands-on experience many CRNAs have not had the opportunity to become proficient in this area of their practice. With a growing body of evidence showing POCUS reduces the cost of care, improves patient outcomes, and decreases procedure time it is important to incorporate this technique into the clinical setting (AANA, 2020). Allowing CRNAs to attend an ultrasound simulation to practice and become familiar with POCUS equipment could help bridge the gap between what is currently practiced and the evidence demonstrating POCUS to be used as a standard of care. This in turn could

increase provider confidence in the psychomotor skills required to perform ultrasound guidance and increase patient satisfaction and the degree of safety during procedures.

Purpose, Objectives, and Goals

The goal of this proposed project is to improve CRNAs knowledge about POCUS and increase their confidence to perform procedural ultrasound in the clinical setting. An objective to achieving this goal includes:

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

An expected outcome includes:

1. Self-reported incorporation of ultrasound use within the hospital will increase by 25% for CRNAs who attended the educational-based ultrasound simulation, as evidenced by data that is collected in the post intervention survey.

Chapter Two: Review of the Evidence/Literature

Search Methodology

A literature search was conducted using Google Scholar, the Cumulated Index to Nursing and Allied Health Literature (CINAHL), and PubMed, accessed through Cedar Crest College's Cressman Library database. Keywords used to retrieve articles included "point-of-care ultrasound"; "simulation"; "ultrasound"; "anesthesia"; "CRNA" and "arterial line". The broad initial search yielded 256 articles from Google Scholar; 303 from CINAHL; and 191 from PubMed. To further narrow down the results, a final advanced search including articles published 2018-2022, English language, and peer-reviewed scholarly articles yielded 9 articles

from Google Scholar, 10 articles form CINAHL and 32 articles from PubMed. Inclusion criteria consisted of RCTs, quasi-experimental studies, cohort studies, and quasi-experimental with ultrasound simulation as the intervention, and the measurements of knowledge acquisition, comfort level, confidence, and incorporation into practice as outcomes. The population of focus was CRNAs, but other anesthesia and medical providers were included in the search. Studies excluded focused on Student Registered Nurse Anesthetists as the population, and editorials with weaker evidence. These criteria led to five research articles with the strongest evidence to answer the research question.

Findings

The five research articles chosen had the highest quality and level of strength to address the PICO question. The articles synthesized consisted of one RCT of Level II rating (Oh et al., 2020); two prospective cohort studies (Davis et al., 2021; Zawadka et al., 2019) and two quasi-experimental studies (Bortman et al., 2019; Briggs et al., 2021) of Level II and III ratings. All studies implemented an ultrasound simulation training course for invasive lines (arterial, peripheral, and central) as the intervention. Briggs et al., (2021) and Bortman et al., (2019) study population were CRNAs, while Oh et al., (2020), and Zawadka et al., (2019) included other anesthesia providers, and Davis et al., (2021) studied medical students. The simulation was provided in a one-day course format (Briggs et al., 2021; Davis et al., 2021; Oh et al., 2020; Zawadka et al., 2019) or two-day (Bortman et al., 2019).

A common dependent variable among the studies was provider's confidence level. There was a statistically significant improvement in self-perceived confidence in all the studies. Briggs et al., (2021) found that not only did confidence in using the ultrasound increase ($p<0.05$), but also differentiating arterial and venous anatomy, as well as the likelihood to use in practice

($p<0.05$). To further assess if POCUS was incorporated after the simulation, Bortman et al., (2019) conducted a post-survey two weeks after implementation, finding their course to be effective with participants averaging 1.56 attempts at ultrasound guided vascular access.

Another dependent variable was an increase in knowledge ($p=0.03$, $p<0.05$, $p<0.001$, respectively) (Bortman et al., 2021; Briggs et al., 2019; Zawadka et al., 2019). This knowledge increase included, but was not limited to, ultrasound machinery, principles, and placement techniques for arterial and venous lines (Briggs et al., 2021). Another study by Oh et al., (2020) found that first attempt success rates for radial arterial catheterization was significantly higher in the simulation group, compared to the control group ($p<0.001$). Of note, all studies included a didactic and hands-on portion utilizing different ultrasound machines and models to enhance learning and develop the proper handling techniques for the equipment.

Limitations

In the research gathered there were several limitations that need to be noted. A common limitation was a small sample size (Bortman et al., 2019; Briggs et al., 2021; Oh et al., 2020), as well as not observing long term knowledge and skill retention of the participants (Bortman et al., 2019; Davis et al., 2021; Oh et al., 2020). For these studies, with participants practicing in the clinical setting daily, it is difficult to evaluate if improvement of procedural skills is based off the simulation training or more routine use. This DNP project's focus is not evaluating if procedural skills are improved over time, but rather if ultrasound will be incorporated in practice, thus this limitation does not apply. The study by Briggs et al., (2021) discussed that using Likert scales for confidence questions and depending on self-reporting affects the internal validity of the findings. This could be due to inadequate recruiting and smaller sample sizes. With a smaller sample size for this DNP project, this may be a limitation. Another limitation by this study included the use

of various ultrasound machine models. For this project, various ultrasound machines will be utilized. This is beneficial as CRNAs from different facilities participated which allowed a greater chance to practice with a model that is used in their clinical setting.

Conclusions

Per the findings in the evidence synthesis, a one-day ultrasound simulation incorporating a didactic portion and hands-on training can increase knowledge, self-perceived confidence, (Briggs et al., 2021; Davis et al., 2021; Oh et al., 2020; Zawadka et al., 2019) and lead to ultrasound use in the clinical setting (Bortman et al., 2019). With support from the literature, an educational intervention involving ultrasound simulation focusing on increasing provider's self-perceived knowledge and confidence was developed and implemented. This was followed by a post-survey to determine if the participants anticipate utilizing ultrasound in the clinical setting. A focus was placed on radial artery catheterization as Oh et al., (2020) successfully increased provider confidence and ability to improve first time success rates with simulation-based training.

Chapter Three: Organizational Framework of Theory

Conceptual Definitions of Theory or Framework

Theoretical approaches help aid in successful dissemination and implementation outcomes by providing a systematic structure to guide development, management, and evaluation of evidence-based efforts (Brownson et al., 2018). The Iowa Model is a planned action model where implementation is facilitated by practical guidance offered during planning and execution. This guidance comes in the form of steps to follow while research is translated to practice. This model, developed by nurses, was chosen as the framework to serve as a systematic

process to utilize research findings and develop an intervention promoting high quality health care to improve patient outcomes (Iowa Model Collaborative, 2017). In this project, the Iowa Model was utilized due to a lack of training and confidence in CRNAs utilizing ultrasound in the clinical setting. Identifying a clinical problem, issue, or challenge is the first step of this model and is then used to formulate a question hoping to be solved, in this case: seeing if an ultrasound simulation increases provider knowledge, confidence, and utilization.

Relationship of Theory/ Framework to Scholarly project

After the clinical question is stated, a team is formed to search the literature by assembling, appraising, and synthesizing a body of evidence. For this DNP project, the reliability, validity, and strength of the literature was critiqued by three student researchers. With sufficient evidence found that ultrasound increases provider knowledge, confidence, and use in clinical practice, the next step was to design and pilot the educational intervention through the guidance of Cedar Crest College faculty mentors, and the simulation managers. For the implementation of the education-based simulation, engagement of potential participants was vital to find out what learning opportunities were preferred. Ultrasound basics, arterial line placement, and peripheral intravenous catheter placement were areas of interest identified in the CRNA population and were focused on during implementation. Approval, resources, and constraints were considered, as well as an implementation plan for the intervention and data collection to be analyzed and evaluated (Iowa Model Collaborative, 2017).

To integrate and sustain the practice change, the Iowa Model offers evidence-based implementation strategies for sustainability. These include creating awareness and interest, building knowledge and commitment, promoting action and adoption, and pursuing integration and sustained use (Cullen et al., 2018). This was done by the development of a scholarly poster

leading to the final step in the Iowa Model, the dissemination of results. When disseminating via poster presentation, it is important to follow the Iowa Model steps and report the project purpose, synthesis of the evidence, practice change, implementation, and the evaluation of the results (Cullen et al., 2018).

Chapter Four: Project Design

A gap analysis was performed at the clinical site to determine current practice related to POCUS use and nationally accepted best practice recommendations. The facility is a 738 bed, Level I Trauma Center, with 24 surgical suites and eight procedure rooms. There are approximately 30,000 surgeries performed annually, and 60 CRNAs employed. To assess the needs of the organization, the CRNA staff preceptors were interviewed and asked to address any problems or areas of weakness clinically. Ultrasound use, specifically for invasive lines such as arterial catheterization and peripheral intravenous placement was identified as an area of interest due to no formal training being provided from the hospital, and many CRNAs not receiving training in their anesthesia programs. A meeting was held with a key stakeholder, the chief CRNA, about recruiting staff for this DNP project, and full support was obtained. The only resistance was the question of why the simulation needed to be at Cedar Crest College (CCC), not the hospital. The reason for this was due to access to models that will be used for ultrasound practice. Support was also obtained by Cedar Crest SON faculty including the DNP chair, mentor, and simulation center staff.

Institutional Review Board Approval

An Institutional Review Board's purpose is to protect the safety and rights of the human subjects involved. With this DNP project being implemented at CCC, the Institutional Review

Board (IRB) process was done through the college rather than the clinical site's IRB. An IRB application form and informed consent was submitted to CCC's IRB for expedited review on September 23, 2022. The application form addressed the project's objectives, methods to be used, recruitment procedures, potential risks and benefits, assurance of anonymity and confidentiality, and security of data.

All participants will be adults, greater than 18 years of age, recruited on a volunteer basis, and will be given an informed consent before participating in the simulation. Data collected from the participants will remain anonymous and confidential in aggregate form to ensure their rights are protected. There is minimal risk to participants as this is an educational intervention using models and invasive equipment that is handled by the participants on a regular basis. The safety concern of a potential needle stick will be addressed in the consent form. Universal precautions will be utilized by participants. Each needle will be individual use on the manikin, and the manikins will be disinfected between use using appropriate disinfectant techniques per the Centers for Disease Control and Prevention recommendations. Sharp containers will be provided for disposal of the needles. In the event of an inadvertent needle stick, first aid supplies will be available. The participant will be instructed to wash with soap and water, and referred to their primary care provider for possible tetanus vaccine update if the participant has not had a vaccine within the last 5 years.

Upon first submission, there were several revisions that needed to be completed before approval was obtained. The appropriate changes were made, and the application was re-submitted on October 20, 2022. All revisions were accepted, and final approval for the application and informed consent was granted on October 25, 2022, allowing the project team to proceed with implementation.

Implementation Plan

The site of implementation chosen for this project was the simulation center at CCC SON. The SON simulation center offers state of the art technology and ample space to provide hands-on opportunities to learn ultrasound techniques and line insertion skills. CCC is also centrally located to many local hospitals allowing a greater opportunity for participants to attend, rather than limiting the population to one hospital system.

With IRB approval obtained, the date confirmed with the simulation manager was January 7, 2023. Participants were recruited by placing fliers at local clinical sites in their designated break rooms. The researchers contact information was provided as well as information on how to sign up for a time slot on JotForms. The informed consent was provided on JotForms and signing up for a time slot implied consent to participate. Reminder emails were sent to participants a week before the simulation and the day before, including a link to the pre-implementation survey in the form of a five-point Likert scale on the online platform, Microsoft Forms.

The population this project focused on were CRNAs. Although the use of ultrasound is within the scope of practice for CRNAs there is a lack of education and training for this tool (Canon et al., 2018). Without structured education on ultrasound and hands-on experience many CRNAs have not had the opportunity to become proficient in this area of their practice. After consideration, Student Registered Nurse Anesthetists (SRNAs) were excluded due to POCUS training now being a part of the Nurse Anesthesia Program curriculum. Including SRNAs who have already or are currently receiving ultrasound training could bias the data collected regarding self-perceived knowledge and confidence.

On the simulation day, if not filled out previously, time was allotted for participants to complete the pre-survey on Microsoft Forms before the educational PowerPoint discussing ultrasound basics, proper positioning techniques, and the three individual workshops for practice. From here, participants were split into three groups; radial arterial catheterization, peripheral intravenous line insertion, and ultrasound positioning. Each group had 30 minutes at each skill simulation before rotating through to the next station. Each station reinforced the ultrasound basics about positioning and allowed hands-on experience with models provided by the SON simulation center. After the simulation was complete, the post intervention survey was administered in the form of a Likert scale on Microsoft Forms. Provider knowledge, confidence, and self-reported use in the clinical setting were measured.

Data Collection Tools

As stated, the measurement instrument chosen for this project was the Likert Scale, which did not need permission to be used. This scale is a psychometric tool that measured the attitudes of the participants based on their responses. This tool provided set options and did not include any identifying information, allowing the participants to remain anonymous. A five-point scale was used to analyze levels of confidence and self-perceived knowledge by participants choosing from a series of statements. The responses to the evaluative questions were then rated (Polit and Beck, 2020). A Likert scale was also used to evaluate self-reported use of ultrasound post implementation.

For data analysis, based on our sample size, the paired t-test was used. This statistical test measured perceived knowledge and confidence levels before and after the completion of the simulation. It is best used when there are paired samples, meaning the same group is observed at multiple points in time. Statistical significance is determined by testing whether the mean

difference between the paired samples is zero or not (Polit & Beck, 2020). The data was then processed through an online t-test calculator (Lambert, 2020).

Resources Needed and Budget Justification

With permission from Cedar Crest College's Simulation Director, Adam Hough, many of the resources needed for this project were free of cost and supplied by the SON. This includes the classroom used on the day of the DNP project, ultrasound machines, blue phantom vessels, sharp containers, manakins ultrasound gel, gloves, and disinfectant. The authors of this project also own Butterfly IQ portable, ultrasound devices that are smart phone compatible and can be used on models, increasing the amount of available equipment that was used. The simulation director also requested an extra ultrasound machine that was loaned to the SON for the implementation day. When a final count of participants was confirmed, a meeting was held with the simulation director to determine the number of arterial and intravenous (IV) catheters that were needed. Expired arterial line catheters and peripheral IV catheters were also obtained from clinical sites. This helped reduce the overall cost and waste of invasive line materials. Extra materials that were not used were kept by the SON to use for educational purposes. All online platforms for the sign-up and surveys were free, helping to keep the cost of this project low. No additional costs were required by the authors of this project.

Chapter Five: Implementation Procedures and Processes

Recruitment

The implementation process for this project started out with a stakeholder meeting to select a date that was available to host the simulation at Cedar Crest College's School of Nursing Simulation Center. Once the date and time were agreed upon, a recruitment flyer was created to

be displayed at local clinical sites. The sample size for this project was eight participants and inclusion criteria consisted of CRNAs interested in the opportunity to learn more about ultrasound. The flyer contained a brief description of what to expect at the simulation workshop, along with a QR code that linked participants to a sign-up sheet on the online platform, JotForm. This sign-up gave a full project description, the informed consent to be signed, and a link to the pre-intervention survey created through Microsoft Forms. All pre-intervention survey information was anonymous, collected in aggregate form, and developed into an excel spreadsheet for analysis. The authors of this project received names and emails and sent out reminders about the implementation date one week prior, and the day before the simulation on January 7, 2023. A project email, ultrasoundsimccc@gmail.com, was created specifically for this project to keep all gathered data organized, concise, and in one secure location. Participants were also given this email to respond with any questions prior to the simulation day.

Project Implementation

The project was implemented at Cedar Crest College's simulation center. Once the participants arrived, there was time allotted for those who did not complete the pre-intervention survey upon registration. A PowerPoint presentation, 15 minutes long, was presented to give an overview of the ultrasound machine, ultrasound basics, positioning techniques, and the stations the group would be breaking into for hands-on practice. The three stations after the PowerPoint presentation included ultrasound basics and positioning with the Blue Phantom simulator, arterial line placement, and peripheral IV catheter placement. Each station lasted 30 minutes, 25 minutes of instruction and practice, and five minutes for questions before moving to the next station. Each station contained various types of ultrasound machines, and proper equipment for invasive line practice, as well as gloves, sharp boxes, and disinfectant materials. Upon completion of all

three stations, there was an opportunity for further questions from the participants before the link to the post-implementation survey was distributed via a QR code that linked to Microsoft Forms.

Data Analysis

Data collection happened as the participants signed up and during the day of the ultrasound simulation through the Microsoft Forms platform that connects to Microsoft Excel. A five-point scale was used to analyze levels of confidence and self-perceived knowledge by participants choosing from a series of statements. The responses to the evaluative questions were then rated (Polit and Beck, 2020). A Likert scale was also used to evaluate self-reported use of ultrasound post implementation.

With a smaller sample size, the paired t-test was used. This statistical test measured perceived knowledge and confidence levels before and after the completion of the simulation. This test is best used when there are paired samples, meaning the same group is observed at multiple points in time. Statistical significance is determined by testing whether the mean difference between the paired samples is zero or not (Polit & Beck, 2020). The data was then processed by an online t-test calculator and the IBM SPSS v.25 software in Excel.

Data analysis was completed during January 2023. The findings were compiled into a poster disseminated on April 20, 2023 at Cedar Crest College. Beyond the DNP presentation, some possible options to disseminate our project includes the Pennsylvania CRNA/SRNA Facebook page for a broader outreach. Another option is to present our poster at the PANA conference as other students have done in the past. Our DNP group could also host another workshop, if there is further interest in CRNAs and SRNAs who were unable to attend the original project day.

Chapter Six: Evaluation and Outcomes

Demographics

Through the recruitment flyers distributed to CRNAs, a total of 10 participants signed up via the JotForm platform. Due to unforeseen circumstances, two CRNAs were unable to attend the simulation day, making the final, convenience sample size eight participants. The pre-intervention survey was completed anonymously by all participants prior to the start of the simulation. Demographic information was obtained from the survey and included number of years' experience as a CRNA, number of times they have used an ultrasound, barriers to clinical use, and what influenced them to attend the simulation. According to the survey, three participants had 0-2 years of experience, one had 6-10 years, one had 11-25 years, and three had 26-50 years. Two participants have never used an ultrasound, three have used an ultrasound less than 10 times, and three have used the ultrasound moderately, or 11-50 times.

When asked about barriers to using ultrasound in clinical practice, four participants did not know how to use the ultrasound machine, two did not know how to interpret the ultrasound images, one did not have access to an ultrasound machine, one did not see the need for ultrasound use, and one did not have any barriers. The main reason for participants attending the simulation was to gain new information regarding ultrasound, followed by gaining ultrasound skills, reviewing ultrasound information, developing interpretive diagnostic skills, and to help incorporate ultrasound into clinical practice.

Evaluation

A pre/post intervention survey was administered to evaluate the goals of this DNP project: improving CRNAs knowledge about POCUS and increasing their confidence to perform

procedural ultrasound in the clinical setting. The pre and post survey consisted of the same seven questions using the Likert scale for responses. The Likert scale responses included: 0 strongly disagree; 1 disagree; 2 neither disagree nor agree; 3 agree; 4 strongly agree. Data was collected anonymously through Microsoft forms and analysis was completed using the T-test calculator developed by Joshua Lambert PhD (Lambert, 2020). The paired t-test was chosen as the appropriate statistical test due to its use in limited sample sizes and its ability to help determine statistical significance by comparing mean scores from continuous, dependent samples. With a limited sample size, there can be decreased precision and an increased margin of error, thus not giving the best generalizing towards the population analyzed (Nigam, 2018). For this reason, the data cannot be used to determine statistical significance, however it can be used to determine clinical significance through the alpha value of $p<0.05$.

Confidence in Ultrasound Knowledge, Experience, and Training

The first question on the pre-intervention survey assessed the participants' self-perceived confidence in relation to their POCUS knowledge, experience, and training. On the pre-simulation survey, the mean score was 2.3, while on the post-simulation survey the mean was 4.4 with $p=0.003$. This value is less than 0.05 indicating a clinically significant difference.

Comfort Level Using Ultrasound

The second question addressed the participants' self-perceived comfort level with using ultrasound in clinical practice. On the pre-survey, the mean score was 2.5 and the post-survey mean score was 4.4 indicating clinical significance with $p=0.0083$.

Comfort Obtaining Ultrasound Images

The third question on the survey assessed the participants' self-perceived comfort level in obtaining ultrasound images for invasive line placement and diagnostics. The mean score on the pre-survey was 2.5 and the post-survey mean score was 4.5. The alpha level was clinically significant at p=0.0072.

Comfort Interpreting Ultrasound Images

The fourth question survey assessed the participants' self-perceived comfort level in interpreting ultrasound images. The mean score on the pre-survey was 2.6 and the post-survey mean score was 4.5. Clinical significance was found at p=0.0083.

Comfort Incorporating Ultrasound into Clinical Practice

The fifth question assessed the participants' self-perceived comfort level in incorporating ultrasound into clinical practice. The pre-survey mean-score was 2.9 and the post-survey mean score was 4.6. This was clinically significant at p=0.0092.

Confidence in Probe Orientation

The sixth question on the survey assessed the participants' self-perceived confidence in choosing the correct orientation of the ultrasound probe. The pre-survey mean score was 2.8 and the post-survey mean score was 4.5. The alpha value of p=0.0092 was clinically significant.

Confidence in Maximizing Image Quality

The seventh question assessed the participants' self-perceived confidence level in adjusting the gain and depth on the ultrasound machine to maximize the image quality. The mean score on the pre-survey was 2.6 and the post-survey mean was 4.6 indicating clinical significance at p=0.0021.

Outcomes

To determine if the goals of this DNP project were met, the PICO question stated in Chapter One must be revisited. The clinical question was: 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 of ultrasound use within the clinical practice setting? By looking at the pre and post simulation survey data that measured specific items related to ultrasound use, the goals of this project were met by the CRNAs reporting increased confidence, knowledge, and comfort while utilizing ultrasound. On the Likert scale with a mean score of 4.9, participants found the PowerPoint presentation to increase their ultrasound knowledge regarding clinical application. The simulation component also scored a mean of 4.9 for providing a sufficient opportunity to practice technical ultrasound skills.

The second goal of this project was to have a 25% increase in self-reported incorporation of ultrasound use in clinical practice. According to the post survey, there was a 95% increase in self-reported confidence to include ultrasound in clinical practice. Two participants reported a significant increase in use, five reported a moderate increase, and one reported minimal use/incorporation. The clinical significance of this project is demonstrated through the self-reported increase in confidence, knowledge, comfort, and plan to incorporate ultrasound into clinical practice.

Discussion

POCUS is an emerging core skill that is within a CRNAs scope of practice. Without a standard ultrasound curriculum for anesthesia providers, a lack of confidence and skill proficiency

can lead to decreased use of this tool in the clinical setting when it can be used as a diagnostic tool, or to aid first time success rates for invasive line placement. From the literature search in Chapter Two, it has been demonstrated that simulation allows a safe environment for CRNAs to become familiar with equipment and gain confidence while practicing hands on ultrasound skills. The findings from the implementation of this DNP project are consistent with the literature, that a simulation incorporating a didactic portion and hands-on training can increase knowledge, self-perceived confidence, and lead to ultrasound use in the clinical setting. This project has the potential to impact a practice change in the CRNAs who participated, as well as the care provided to future patients. To help improve this project, the simulation could be held over multiple days to allow a larger group of CRNAs to participate. Other models could also be considered for use, so the simulation could be done in the hospital setting, rather than at Cedar Crest College's simulation center, thus reaching a larger audience. One other way to strengthen this project would be to offer Continuing Education credits as an incentive.

Chapter Seven: Implications for Nursing Practice

Implications for Practice

As discussed in the background section of this paper, POCUS is an emerging technological advancement in nursing practice designed to improve patient outcomes and safety. POCUS is within a CRNAs scope of practice but has only recently been added to CRNA programs' curriculum. CRNAs in the United States who completed their education prior to this change did not have formal ultrasound training. This has contributed to the identified problem of this project; CRNAs identifying a lack of knowledge and confidence to use ultrasound. The goal of this project's implementation was to improve knowledge, confidence, and incorporation into

clinical practice. This goal was achieved as demonstrated by the data collection and analysis discussed in Chapter Six.

The implications of this project included the opportunity for CRNAs to learn didactic material and enhance understanding of the concepts using real-life models. Having hands-on practice in a controlled, safe environment allows the CRNA to familiarize themself with equipment and techniques before using these methods in practice. Developing confidence and knowledge related to ultrasound as discussed in the literature review can increase use in the clinical setting (Bortman et al., 2019) as well as first time successful cannulation rates (Oh et al., 2020). According to our data analysis, confidence, knowledge, and current clinical use were self-reported low by the participants, especially in the 26-50 years' experience group. After the post-intervention survey, confidence and knowledge was reported to increase including intent to use ultrasound in the clinical setting. It is plausible that if this simulation were repeated, more CRNAs could familiarize themselves with ultrasound and have the confidence to incorporate it into their practice, improving patient outcomes with invasive line insertion.

Strengths of the Project

This project had many strengths, the first being its cost-effectiveness. The authors used free online platforms for sign-up, consent, and data collection. The implementation site, CCC's SON simulation center, was also free of cost and provided the models used for hands-on practice, gloves, sharp boxes, cleaning materials, ultrasound gel, ultrasound machines, and catheters. The authors provided their personal Butterfly IQ Ultrasound devices that were previously purchased, and the additional ultrasound machine used was a GE Venue Ultrasound that was lent by the company in support of the project. Another strength was the online JotForm platform, allowing the details of the project, the consent form, the sign-up form, and the pre and

post intervention surveys to be all in one convenient place. This site was accessible through a QR code, allowing the participant for quick access on their personal device. The study design utilizing a Likert scale for pre and post surveys was easily understood, allowing a 100% response rate by the participants.

Related to the ease of the online platform, the use of a separate DNP password protected email kept all data in one secure location. The email also allowed communication to the participants, including reminders about the implementation day, and access to the PowerPoint presentation for their personal use after the simulation. A strength, that is also a limitation for this project was the small sample size. Having a smaller sample size allowed the participants to have one on one instruction, and ample practice time with the models.

Limitations of the Project

This project had several limitations. As mentioned, with 8 participants, the sample size was small. This caused the project to have limited statistical power, and statistical significance could not be determined. Instead, the project focused on the clinical significance of the data collected. Another limitation was the population since our sample was recruited from one local clinical site. In the future, opening the sign-up to more clinical sites could allow for more participants to be involved. Hosting the simulation again through a different time slot during either during the original implementation day, or another day entirely could have allowed another chance for CRNAs to participate if they could not attend the initial day and time. Another limitation is the replicability of the project. The project could be implemented again at Cedar Crest College due to the accessibility to the models, and ultrasound equipment. However, if wanting to implement this at clinical sites for anesthesia departments, it may be difficult to get access to models and other equipment that was utilized.

Linkage to DNP Essentials

The DNP essentials are a detailed list of curriculum elements and competencies that comprise the educational requirements of a DNP prepared student (AACN, 2016). These essentials are linked to the aspects of the student's doctoral work including the project's development, implementation, and dissemination. Each DNP essential and its connection to the ultrasound simulation project is listed below.

DNP Essential I

The first DNP essential, scientific underpinnings of practice, has been demonstrated in this project early on through the literature search, review of current evidence-based material, and the synthesis of the literature to construct the PICO question. The evidence-based research findings were used to guide the choice to teach ultrasound didactically and through simulation.

DNP Essential II

The second essential, organizational and systems leadership for quality improvement and systems thinking, was met through conducting a needs assessment at the local clinical site and identifying a clinical problem that could improve quality of care. This essential was also met by collaborating with the project's key stakeholders including the DNP chair, mentor, and the simulation center managers. A project budget was also developed alongside a cost-benefit analysis to keep the project manageable from a financial standpoint.

DNP Essential III

Essential III, clinical scholarship and analytical methods for evidence-based practice, was met throughout this DNP process, from constructing the DNP proposal, attending project

meetings, data collection through pre and post intervention surveys, and the data analysis using the paired t-test. This essential was also met by a professional portfolio being developed and updated with the scholarly work associated with this DNP project.

DNP Essential IV

The fourth essential, information systems/technology and patient care technology for the improvement and transformation of health care, was met through utilizing the digital platform JotForm for recruitment, data collection, and consent. An email using password protection was created for communication purposes and to keep all information in one secure place. Microsoft Forms was used for data collection and helped aid in data analysis along with an online t-test calculator (Lambert, 2020). The educational PowerPoint is also easily accessible to participants through an email attachment as a reference to the information taught during the simulation.

DNP Essential V

In relation to essential V, health care policy for advocacy in health care, although this project did not directly deal with legislation or health care policy, it focused on education about the benefits of using ultrasound in the clinical setting for invasive procedures. This can help improve patient safety outcomes and could translate to future practice recommendations and policy changes.

DNP Essential VI

Essential VI, interprofessional collaboration for improving patient and population health outcomes, was met throughout the entirety of the DNP project. The project authors worked together through each phase, each person contributing ideas and research findings to strengthen

the project. This required continuous communication and collaboration with each other, and with the DNP chair, mentor, and simulation managers. Through various meetings in person and video chats online, the project was able to be implemented successfully.

DNP Essential VII

Clinical prevention and population health for improving the nation's health, is the seventh essential and although this project did not address population health directly, it did disseminate knowledge to other healthcare professionals. A gap analysis was conducted to identify gaps in care in the clinical setting allowing ultrasound knowledge and confidence to be identified as a gap due to no formal training at the clinical site.

DNP Essential VIII

The final essential, advanced nursing practice, encompasses what the DNP project was set out to accomplish. The culmination of the education received in this doctoral program led to the development and implementation of an ultrasound simulation project that increased CRNAs POCUS knowledge and confidence. The CRNAs who participated can use ultrasound in clinical practice and have the opportunity to guide other anesthesia providers in increasing their own confidence in ultrasound corporation.

Chapter Eight: Summary of Project

Summary and Conclusions

Point-of-care ultrasound (POCUS) is a portable, noninvasive tool that has been shown to improve safety and efficacy of interventions provided in anesthesia care (AANA, 2020).

Although the use of ultrasound is within the scope of practice for Certified Registered Nurse Anesthetists (CRNAs), after discussion with these providers, there is a lack of education and training for this tool. This had led to a lack of confidence and utilization. Evidence from a literature search concluded that ultrasound training in the form of simulation was effective in increasing provider knowledge and confidence. With these findings, an educational intervention in the form of an ultrasound simulation workshop was implemented. This one-day simulation was cost effective while providing a didactic and hands-on portion. This allowed the CRNA participants to learn and practice ultrasound in a safe, controlled environment.

This DNP project sought to find out if an ultrasound simulation increased providers knowledge, confidence, and incorporation into clinical practice. A total of eight CRNAs participated in the simulation, consisting of a PowerPoint about ultrasound basics, followed by three hands-on stations to practice the concepts discussed in the didactic portion. Through the data analysis of the pre and post intervention surveys, completed by all participants, it was demonstrated that the CRNAs self-perceived knowledge and confidence increased significantly. The participants also reported that they planned to incorporate ultrasound into clinical practice. These findings were congruent with the literature supporting the use of simulation to increase provider confidence and knowledge related to ultrasound.

Dissemination Plans

Dissemination is a very important step in the DNP process to share the clinically significant results that were found. The initial dissemination was on April 20, 2023 at Cedar Crest College for the graduate faculty and students. The authors of this project then hope to present at upcoming anesthesia conferences and clinical sites that have shown interest in becoming proficient in ultrasound.

Future Ideas

POCUS use is a very desirable skill that is increasing in clinical practice as it is a versatile tool that can be used for invasive procedures as well as diagnostics. While this project focused on ultrasound basics, arterial line placement, and peripheral intravenous catheter placement, future projects to be pursued could include central line placement and neuraxial anesthesia. Another area of anesthesia practice that requires proficiency in POCUS is ultrasound guided peripheral nerve block placement. A project utilizing ultrasound to identify the anatomical structures associated with the various types of nerve blocks that can be performed could be extremely beneficial. Focusing first on ultrasound basics opens future possibilities for knowledge and confidence to be increased in other areas that fall under the scope of a CRNA's practice.

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