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Objective Structured Clinical Examination for Arterial Line Placement

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OBJECTIVE STRUCTURED CLINICAL EXAMINATION FOR ARTERIAL LINE PLACEMENT

by

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A Doctoral Project
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the College of Nursing and Health Professions
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Dr. Mary Jane Collins, Committee Chair
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ABSTRACT

The University of Southern Mississippi (USM) is lacking a uniform guideline for arterial line placement. This DNP project promotes the addition of an objective clinical structured examination into the nurse anesthesia curriculum for future student registered nurse anesthetists (SRNAs) to gain comprehension and clinical experience in a simulation lab prior to practicing on real patients. Peer-reviewed literature and evidence-based practices have been researched and organized into a learning tool and checklist to be used as a step-by-step guideline. Having a guideline such as an OSCE in place can increase student competency and foster a culture of safety leading to better patient outcomes.

The outcome objective of this OSCE is for future SRNAs to gain confidence in their performance, increase patient safety and satisfaction, and be able to identify risks and potential complications of this procedure. The OSCE was evaluated by a group of anonymous SRNAs, nurse anesthesia faculty, and CRNAs in a short survey to make necessary changes or improvements. Results indicated the OSCE would be beneficial and relevant to future SRNAs and was representative of doctoral work and evidence-based literature. An open-ended question at the end of the survey provided positive commentary. Overall, the results were supportive of the OSCE and no changes were made after the results were reviewed.

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ACKNOWLEDGMENTS

I would like to thank Dr. Mary Jane Collins for her support and guidance throughout the program and especially with this project. I would also like to thank Dr. Stephanie Parks for her assistance and counsel.

DEDICATION

I dedicate this project to my daughters, Davi and Dylin. They provide the strength I need to keep going when things get tough, and they deserve nothing less than this dedication. They have sacrificed time with their mother with the understanding of something better for the future. I love you, sweet girls.

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LIST OF ABBREVIATIONS

AANA	American Association of Nurse Anesthetist
CRNA	Certified Registered Nurse Anesthetist
DNP	Doctor of Nursing Practice
IRB	Internal Review Board
NAP	Nurse Anesthesia Program
OSCE	Objective Structured Clinical Examination
SRNA	Student Registered Nurse Anesthetist
USM	The University of Southern Mississippi

CHAPTER I - INTRODUCTION

Student registered nurse anesthetists (SRNAs) obtain many clinical and procedural skills over the course of their program. SRNAs apply these learned values to their clinical work and are kept under immense pressure to perform accurately to maintain patient safety and satisfaction. Being a student in such a rigorous program comes with numerous stressors. A nurse anesthesia program can assist its pupils by providing a structured, uniform evidence-based tool and evaluation set instead of the student being evaluated in a nonuniform format. Ultimately, having a uniform clinical evaluation will improve overall patient safety and satisfaction (Mourad et al. 2011), increase student confidence (Braier-Lorimer & Warren-Miell, 2021, p. 2), and create an available guideline for practicing clinicians at any level to include students, nurse anesthetists, surgeons, and other physicians.

Problem Description

Statement of the Problem

The University of Southern Mississippi's Nurse Anesthesia Program is lacking a uniform guideline and evaluation of arterial line placement. Lack of a uniform structure "can induce states of stress and anxiety in students" (Braier-Lorimer & Warren-Miell, 2021, p. 2) leading to a lack of confidence in their ability to perform this procedure. In effect, students may also miss critical steps that could lead to patient injury and decreased patient satisfaction, affecting "a key indicator of quality care measurement" (Mourad et al., 2011, p. 220). To mitigate such issues, an evidence-based practice tool and evaluation for placement of arterial lines will be developed to be used as an objective structured clinical examination (OSCE). Authors agree that using an OSCE as an assessment tool

helps learners understand the factors that go into clinical processes, as well as the learner's own personal strengths and weaknesses in the skill (Gupta et al., 2010).

Significance

An objective structured clinical examination (OSCE) is used to evaluate competencies in several areas from communication to clinical procedures. The University of Southern Mississippi does not yet have a uniform clinical evaluation in place for student nurse anesthetists to gain confidence in their abilities to place arterial lines. According to Bonanno (2019), "a single evaluation tool that has core competencies based on COA Standards and allows a program to insert other questions based on their individual program requirements is desirable." Clinical simulation is a valuable tool for the SRNA to practice techniques and gain a better understanding of a skill or procedure. An OSCE may help structure and evaluate the simulation practices in a constructive way prior to dealing with real patients. An OSCE may consist of a guided checklist, video, role-playing activities, and evaluation tools for students to correct mistakes in the simulation setting.

In learning new skills and procedures safely and efficiently, a student should have a tool to turn to for instruction and evaluation that will bridge didactic learning and simulation practice to the clinical setting. Many nurse anesthetists and anesthesiologists perform procedures differently and evaluate the students according to their own practices. To students, performing a procedure differently each time may be confusing as to which method is most correct. The OSCE will provide distinct and evidence-based guidelines for the student to follow, as well as instill confidence in his or her performance under pressure.

This guideline has the potential to benefit students and can also be used as a backup tool for anyone that places arterial lines such as currently licensed anesthetists, physicians, nurse practitioners, and respiratory therapists. A clinician that does not practice arterial line placement often would greatly benefit from the guideline. A guideline increases patient safety by reminding the clinician of often missed steps that could lead to infection, thrombosis, or compromised circulation.

Available Knowledge

Arterial Line and Monitoring

Arterial line placement is a specialized procedure performed by a healthcare professional that requires specific clinical knowledge and skill. A catheter is placed into an artery and connected to a pressure system with a transducer that provides beat-to-beat blood pressure readings. An arterial line is often used in the operative setting in critical patients with labile blood pressure (Nuttal et al., 2016) and to regularly obtain arterial blood gas or lab values (Dahan et al., 2016). “Intermittent non-invasive measurements using oscillometry show clinically significant discrepancies compared to continuous invasive measurements using an arterial catheter and especially overestimate low BP” (Saugel et al., 2020, p. 1). Overestimation of blood pressure with a non-invasive system could result in ischemia to vital organs as treatment is not seen as necessary. Patients undergoing extensive surgeries benefit from this measurement in that the arterial line provides the healthcare provider with an immediate opportunity to intervene if necessary.

Arterial Sites and Placement

Arterial lines can be placed in radial, brachial, axillary, femoral, ulnar, dorsalis pedis, posterior tibial, and temporal arteries; though, most commonly the radial site is

used (Nuttal et al., 2016). Although it seems a smaller artery would more easily occlude with a catheter or possible thrombi, the radial artery is associated with lower risks (Nuttal et al., 2016). In fact, up to 35% of patients with a radial arterial line have asymptomatic temporary occlusion from cannulation (Dahan et al., 2016). If placing a radial line, collateral circulation by the ulnar artery provides the hand with oxygenated blood preventing ischemia. Prior to cannulation, a clinician should check for adequate circulation using the "Allen test" or ultrasound confirmation of arterial blood flow in the artery opposite to the one being cannulized.

The clinician should be aware that each site will produce a slightly different waveform morphology as the site moves from distal peripheral arteries closer to the aorta. Peripheral waveforms will produce a waveform with higher systolic pressure, a steeper systolic upstroke, a lower diastolic pressure, and a lower dicrotic notch as compared with a more medial site (Saugel et al., 2020).

Waveform and Transducer

The arterial line catheter is connected to rigid, fluid-filled tubing that has a static pressure set by a stopcock at the level of the transducer (Figure 1). The tubing should be free of air bubbles to prevent overdamping of the waveform. An intravascular pressure wave is sent with each heartbeat. The wave is converted to a measurement by the transducer and then visualized as a waveform. The arterial waveform (Figure 1) represents the beat-to-beat blood pressure in the arterial vasculature. The upstroke of the waveform embodies the systolic pressure from the heart. As the wave starts to fall, a dicrotic notch can be seen which represents aortic valve closure. The waveform then falls further to what is estimated as the diastolic pressure.

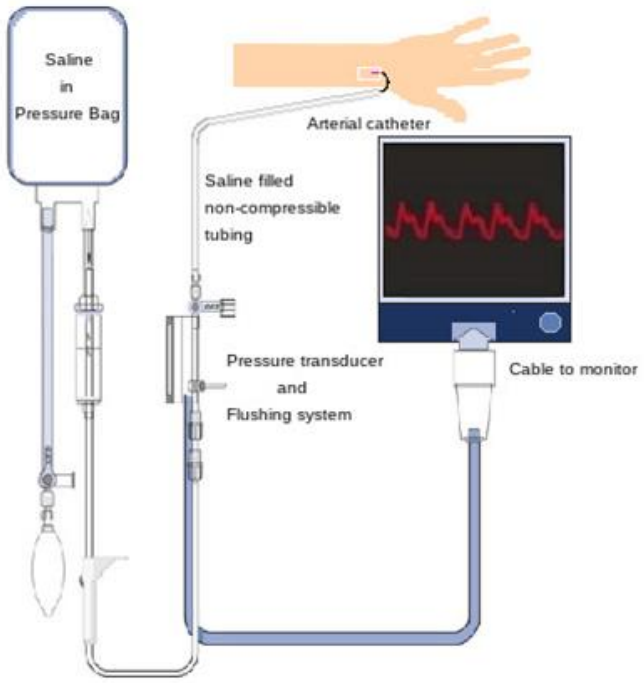


Figure 1. Arterial Line Setup

Example of pressure tubing, transducer, and monitor setup for radial arterial line (Nguyen, 2021).

The transduction system must be *zeroed* for accurate measurements. The stopcock at the transducer level is opened to atmospheric pressure and closed to the patient allowing the clinician to *zero* the sensor on the monitor. A pressure value of 0 will then be viewed on the monitor. “This procedure established the calibration of the sensor and establishes the level of the right atrium as the datum reference point” (Barash, 2017, p. 1778). For the patient lying down, the transducer must be placed at the phlebostatic axis, or at the midaxillary line (Nguyen & Bora, 2021). Because the cerebral pressure is less than at the level of the heart in the patient sitting upright or in *beach chair* position, the position of the transducer is set at the level of the brain or auditory meatus to be sure that the brain is adequately perfused (Nguyen & Bora, 2021).

Accurate measurements depend on an understanding of proper placement, waveform quality, and common falsifying issues. The transduction system and user are not without error. Kinking of tubing, the air in the line, or the level of the transducer not been adjusted with each patient position change can cause erroneous readings. Often a bed will be raised, lowered, or repositioned in some way during the operation or admission, and the transducer will not be leveled and re-zeroed. A height difference of 10 cm between the transducer and desired monitoring height will result in a 7.5mmHg pressure difference (Saugel et al., 2020). A misinterpretation of blood pressure has the potential to lead to an anoxic brain injury. As you can see in Figure 2, the waveform can be underdamped or overdamped producing over and under estimations (Saugel et al., 2020).

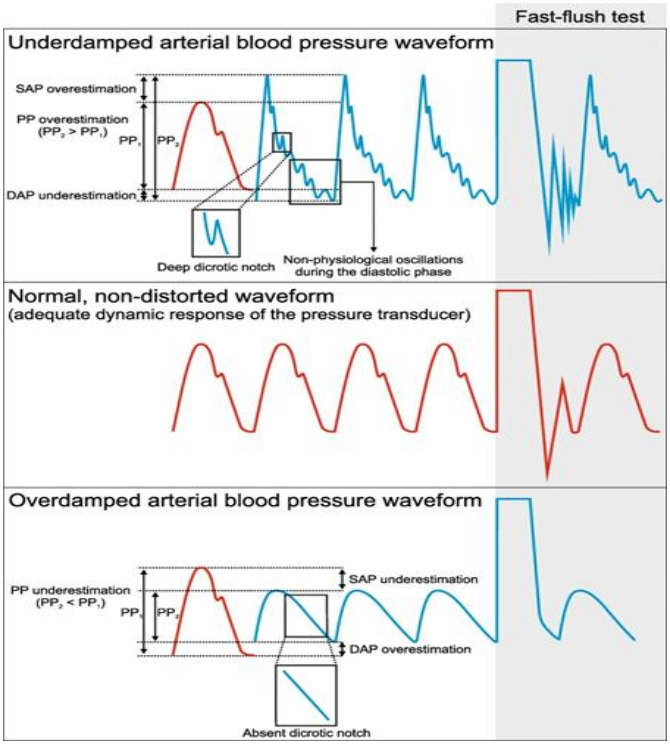


Figure 2. Radial Arterial Waveform and Morphology

(Saugel et al., 2020).

Prior to any therapeutic intervention, the clinician must be sure that the readings are correct and know how to troubleshoot suspicious waveforms as described. “A key prerequisite for correct invasive blood pressure monitoring using an arterial catheter is an in-depth understanding of the measurement principle, of blood pressure waveform quality criteria, and of common pitfalls that can falsify blood pressure readings” (Saugel et al., 2020, p. 2). Flushing the line, leveling, and re-zeroing the transducer are basic interventions one can perform when there is doubt of reading or waveform. A non-invasive blood pressure reading may also be taken in another extremity to compare values.

Allen’s Test

Allen’s test is a simple exam performed prior to cannulation to determine adequate collateral blood flow as the cannula can occlude the radial artery and decrease perfusion to the hand. The clinician will occlude both the radial and ulnar arteries while the patient makes a fist. Occlusion of blood will cause the hand to blanch. The patient will then open his or her hand and the clinician will release the ulnar artery in hopes that the hand will have adequate return of color indication of adequate circulation. The patient should not hyperextend the fingers while opening the hand. “Hyperextension may cause a decrease in perfusion to the arch, possibly resulting in a false interpretation of the Allen test” (Fuhrman, 1992, p. 30). There are modified Allen’s tests that include doppler ultrasound and digital plethysmography that may assist in the unconscious patient. A comparison between the Allen test and other more objective measurements such as ultrasonography was performed and found that the Allen test had a sensitivity of 73.2%

and specificity 97.1% (Kohenen et al., 2007), indicating that the Allen test is a good measurement of collateral circulation.

Palpation/Landmark/Ultrasound Technique

Currently, arterial lines are placed by palpating the radial pulse or using ultrasound. The ultrasound technique may be more useful and efficient in patients with small arteries and other disease processes. “Recent meta-analyses comparing TBP [blind palpation] with USG [ultrasound-guidance] for radial arterial cannulation all show significantly improved first-attempt success rate with USG, and other improved outcomes, including decreased failure rate, decreased number of attempts, shorter duration, and decreased complications” (Yeap et al., 2019). In fact, Yeap and colleagues (2019) concluded that ultrasound-guided is faster and more successful with first attempts. However, an ultrasound may not always be available in all settings, so student anesthetists must be competent in both practices.

In either method, a sterile field and technique are required. A sterile gown, drape, mask, and gloves will be needed. Healthcare Infection Control Practices Advisory Committee guidelines recommend that the skin is cleansed properly with an alcohol-based >0.5% chlorhexidine prep or another equivalent such as iodine, iodophor, or 70% alcohol (O’Grady et al., 2011) to prevent infection. A board or towel may be placed to support the wrist and bring the artery closer to the surface and aid in the placement of the line, as can be seen in Figure 3 below. The clinician will start distal so that he or she may move more proximal after an unsuccessful attempt. A small skin wheal with one-percent lidocaine may be placed laterally and medially to the radial artery pulsation for the awake

patient to increase comfort upon insertion of the needle and catheter (Tegtmeyer et al., 2006).

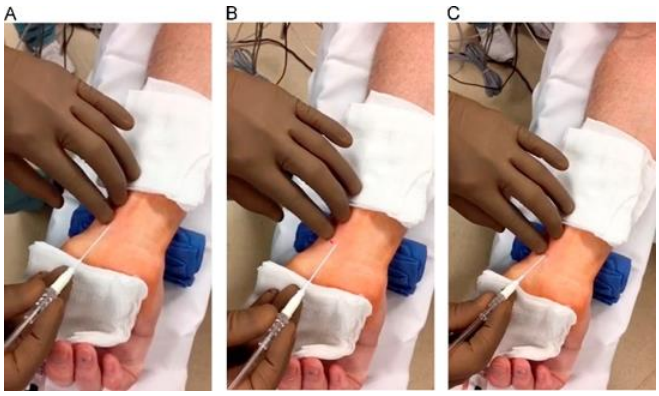


Figure 3. Palpation Technique

Before (A) and after (B) it is slid away from the radial artery point of maximal impulse; then (C) the needle is inserted directly in front of the finger (Chandrashekarappa et al., 2018).

In the palpation technique, the radial artery is identified with the non-dominant hand while the clinician places the cannula with the other. “The needle should enter at a 30-to-45-degree angle to the skin directly over the point at which the pulse is palpated” (Tegtmeyer et al., 2006, p. 13). Intermittent or continuous palpation of the artery is typically necessary for proper placement (Yeap et al., 2019).

In using an ultrasound, the probe will be placed on the wrist typically using an out-of-plane (transverse) approach. After the artery is identified and centered on the screen, the catheter and needle will be placed distally to the probe. Then after the needle has advanced into the skin, it will be visualized and directed into the vessel. Using an in-plane (longitudinal) visual with the probe can be useful when confirming the placement of the catheter. As you can visualize in Figure 4, the catheter can be seen within the vessel in both transverse and longitudinal views giving further confirmation of placement.

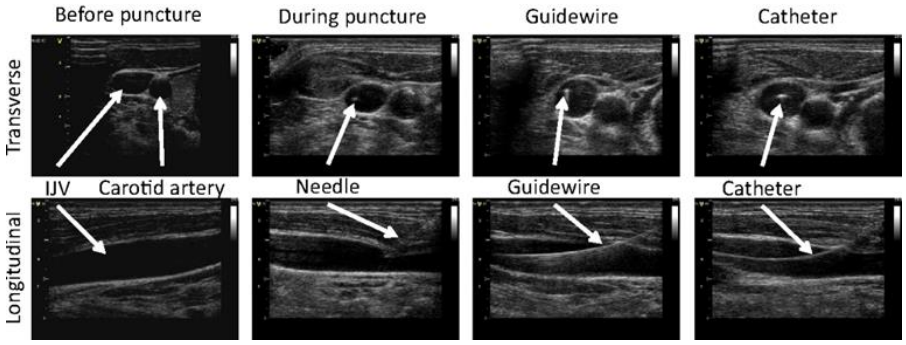


Figure 4. Transverse vs. Longitudinal Ultrasound Approach of Catheter Placement

(Schmidt et al., 2014)

After flash of pulsatile blood is seen in either technique, the guidewire (if applicable) should be advanced. If there is no resistance, the catheter can then be advanced over the wire. If there is no guidewire, the catheter will be advanced over the needle being careful not to dislodge the needle from the artery. Securement of the catheter may include sutures for longer monitoring purposes or simply tape. A useful form of confirming proper placement is by visualizing a waveform when attaching the transducer. Perfusion of the hand should be reassessed frequently while the catheter is in place and any sign of compromise should initiate prompt removal (Tegtmeyer et al., 2006).

Complications

"In a series of 57,787 patients receiving arterial cannulation, 21 patients were identified as having experienced vascular complications or nerve injuries, resulting in a very low complication rate of 3.4/10,000" (Nuttal et al., 2016, p. 591). Although the complication rate of arterial line placement is relatively low (Dahan et al., 2016), it remains a patient safety concern. According to Dahan et al. (2016), the most common complications related to arterial catheterization are thrombosis and vasospasm leading to

loss of circulation in the extremity affected with symptoms including loss of pulse, pain, numbness, paresthesia, cool mottled skin, and cyanosis of that extremity. Nerve damage, hematoma, and pseudoaneurysm are other complications of line placement. If any of these symptoms are present, the arterial line should be discontinued. “Studies suggest that blood flow normalizes in 3 to 70 days” (Barash, 2017, p. 1779). By performing the Allen test prior to cannulation of the radial artery, the clinician ascertains that in the event the radial artery is occluded the ulnar artery will likely continue to perfuse the hand.

Patient Safety and Satisfaction

Patient safety is a concern with any healthcare process. Maintaining a culture of safety is one of the standards of the American Association of Nurse Anesthetists (AANA) (2019). Proper training for any invasive procedure is necessary to maintain patient safety. The gap between the educational setting and clinical experience is only best countered with adequate preparation. The new student nurse anesthetist may greatly benefit from having an OSCE in place to gain the confidence and competence to perform this skill, while a senior SRNA may benefit by having a more structured approach to their practice. A well-prepared student on each procedural step and the risks that may be encountered will have more confidence and undoubtedly perform better than one who has not had any structured guidelines. Additionally, having confidence in one’s ability not only benefits him or her but also provides the patient ease of mind that they are in capable hands, increasing patient satisfaction (Mourad et al., 2011).

Conclusion

By having a uniform guideline, the SRNA and any other practicing clinician may be instilled with sufficient knowledge from the beginning to the end of this procedure to

maintain patient safety, and satisfaction, and increase procedural competency and confidence. Understanding each step and how it affects patient safety is important to its application and memory serving purposes.

Rationale

By using an OSCE, a student has the potential to effectively learn from simulation and improve patient outcomes during clinical performances. “The OSCE is a powerful tool for evaluating clinical competence and an effective facilitator for students who are learning to perform clinical nursing skills” (Bartfay et al., 2004, p. 19). The OSCE is also beneficial in that observing clinicians have a tool to properly evaluate SRNA’s competence to maintain the AANA standard of safety. By improving patient safety and satisfaction, this OSCE also has the potential to benefit the hospital organization in which the SRNA is practicing.

Theory

A cognitive learning theory determines how people receive and process knowledge based on internal and external factors. “In the setting of clinical teaching, this theory and its principles can be applied to help learners with the retention and translation of medical knowledge” (McSparron et al., 2018, p. 98). An OSCE bases its learning experiences on this theory in that cognitive learning is based on immersing students in educational processes to learn new processes beyond the surface. By understanding rationales for each step and complication that can arise, the learner will retain information better.

As Witheridge and cohorts emphasized in 2019, the cognitive element of knowledge and application is an essential portion of clinical competency in that to

understand the different facets of a clinical skill is to incorporate diagnostic reasoning and understanding of each step. A well-known framework that aids in the assessment of clinical competence is Miller's Pyramid. The pyramid consists of four tiered levels: the first level begins with the foundation of knowledge, the second level represents the application of knowledge, the third represents clinical skills competency, and the fourth level at the apex represents clinical performance (Witheridge et al., 2019). As Figure 5 shows, an OSCE can be developed and implemented to provide the student opportunity to *show* his or her clinical competence.

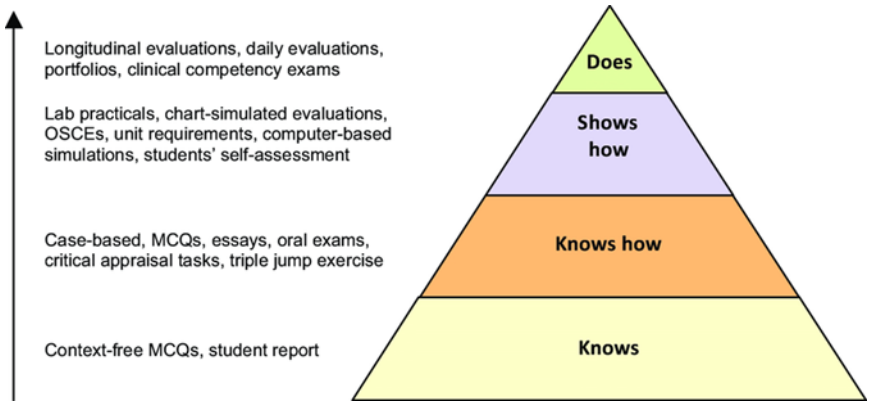


Figure 5. Miller's Pyramid

(Maart & Bitzer., 2013).

DNP Essentials

The Essentials of Doctoral Education for Advanced Nursing Practice was created by the AACN in 2006 to outline the concepts and competencies required by any DNP program seeking accreditation. There are eight foundational essentials that all DNP graduates must meet. Depending on the role the student seeks as an advanced practitioner, the concentration on each core will vary.

This project meets Essentials I and VI. Essential I describes "scientific underpinnings for practice" as using nursing education of health sciences as a foundation

for nursing practices and theories. This project meets Essential I by synthesizing and organizing scientific research into guidelines and rationales to be used for an OSCE. Essential VI, “Interprofessional collaboration for improving patient and population health outcomes”, summarizes the need for safe, effective, and patient-centered care for better patient outcomes under a collaborative healthcare team. By consulting clinicians from the student, faculty, and performing levels, the project meets Essential VI by retrieving input from all levels of experience and inexperience for the development of the OSCE and guidelines that will lead to better patient outcomes.

Specific Aims

This project aims to research evidence-based arterial line placement practices and develop an OSCE as a learning tool for students in The University of Southern Mississippi’s Doctor of Nursing Practice, Nurse Anesthesia Program in the School of Leadership and Advanced Nursing Practice. An OSCE will benefit students by them the opportunity to practice and master clinical skills in a safe, learning environment prior to the clinical setting. Ultimately, there is potential to increase clinical confidence, patient safety, and patient satisfaction.

A mixed methods design will be used to measure qualitative and quantitative data derived from a survey provided to a panel of SRNAs, CRNAs, and USM faculty. Variables may include clinical experience, student level within the program, and adaptability from well-practiced clinicians. The results will direct changes needed to improve and implement the OSCE.

Summary

Problem Statement

The University of Southern Mississippi's Nurse Anesthesia Program is lacking a uniform guideline and evaluation of arterial line placement. Without such structure, students lack confidence in their ability to perform this procedure or can even miss critical steps that could lead to patient injury and decreased patient satisfaction. To mitigate such issues, an evidence-based practice tool and evaluation for placement of arterial lines will be developed to be used as an objective structured clinical examination (OSCE). "The use of OSCE for formative assessment has great potential as the learners can gain insights into the elements making up clinical competencies as well as feedback on personal strengths and weaknesses" (Gupta et al., 2010, p. 917).

CHAPTER II - METHODOLOGY

Introduction

Student registered nurse anesthetists (SRNAs) obtain many clinical and procedural skills over the course of their program. SRNAs apply these learned values to their clinical work and are kept under immense pressure to perform accurately to maintain patient safety and satisfaction. Being a student in such a rigorous program comes with numerous stressors. A nurse anesthesia program can assist its pupils by providing a structured, uniform evidence-based tool and evaluation set instead of the student being evaluated in a nonuniform format. Ultimately, having a uniform clinical evaluation will improve overall patient safety and satisfaction (Mourad et al. 2011), increase student confidence (Braier-Lorimer & Warren-Miell, 2021), and create an available guideline for practicing clinicians at any level to include students, nurse anesthetists, surgeons, and other physicians.

Context

The OSCE may serve any student or practicing clinician in the university and clinical setting. Specifically, this OSCE is proposed for the Doctor of Nursing Practice in the Nurse Anesthesia Program at The University of Southern Mississippi to aid SRNAs in becoming proficient in placing arterial lines. The program has four full-time professors and one part-time professor that currently practices nurse anesthesia. Each cohort begins with 20-25 students. There are 9 semesters equivalating to three years in this program with the first year being didactic courses. The next two years have integrated didactic education and clinical hours allowing SRNAs to practice learned concepts and skills. The University of Southern Mississippi's DNP program is in the process of building an OSCE

collection to aid current and future students in learning skills and other clinical pearls necessary to promote good practice.

A nurse anesthesia program typically front-loads didactic learning in the first year and then fuses didactic and clinical learning in the second and third years. The students build on learned knowledge with clinical and procedural skills under a supervising CRNA or anesthesiologist in the clinical setting. The clinical setting in which this OSCE would apply will most often be in a hospital operating room. Hospitals in southern Mississippi range from small rural establishments to level one trauma centers. The experience and routine practice of arterial line placement may differ among these hospitals.

Interventions

The OSCE for arterial line placement was developed using the interventions listed below:

1) OSCE document on arterial line placement was created using evidence-based and peer-reviewed literature.
2) Informed consent and email announcement were developed.
3) Survey questions were developed to assess clinical experience and understanding.
4) Application to the Internal Review Board (IRB) of The University of Southern Mississippi was sent.
5) An online anonymous survey using Qualtrics© was created using the IRB-approved survey questions.

6) Once IRB approval was obtained (Protocol # 22-944), the Qualtrics© survey was sent to participants by email, using the email announcement, along with the informed consent and OSCE document.
    a. Email addresses were obtained voluntarily from participants.
    b. The survey was sent to the nurse anesthesia faculty (four full-time professors and one part-time professor that all currently practice anesthesia). Nurse anesthesia faculty with experience in education and OSCE design can provide valuable feedback that may significantly improve the project and impact SRNA learning. The survey was also sent to 39 SRNAs and thirty more CRNAs for additional evaluation from experienced providers.
7) All electronic data was kept on a password-protected laptop. Any physical data was stored in a locked file cabinet.
8) The qualitative and quantitative data retrieved from the survey were analyzed and organized based on common themes.
9) Recommendations supported by evidence-based peer-reviewed literature were implemented to improve the OSCE.
10) Any changes would have been discussed and approved by the DNP chair.
11) An adjunct demonstration video was created according to the steps of the approved OSCE for arterial line placement.
12) The OSCE for arterial line placement and results was disseminated at The School of Leadership and Advanced Nursing Practice DNP Scholarship Day on September 30, 2022.

13) The OSCE and video will be presented to the USM NAP administration to be considered for use in the program.

14) Any electronic data obtained for this research was destroyed by deleting files and emptying the trash folder on the laptop; physical data was shredded.

Measures and Instruments Used to Study the Intervention

The survey was delivered as a Qualtrics® (CC) questionnaire to the panel of SRNAs, CRNAs, and professors at USM. The questionnaire included both qualitative and quantitative questions to identify strengths and weaknesses within the OSCE.

1) Do you consent to participate in the evaluation of this OSCE pertaining to arterial line placement?
    a. Participation in this survey will be voluntary. No monetary or gift compensation was awarded for this project.
2) Are you a CRNA or an SRNA?
    a. The two groups were divided, and the results were organized and analyzed to obtain both perspectives.
3) How frequently do you perform arterial line placement?
    a. Frequency and experience in placing arterial lines may provide valuable feedback on the practicality of the OSCE.
4) Do you believe the information and objectives of this OSCE are clearly presented and will be beneficial for SRNAs in the clinical setting?
    a. The OSCE is aimed at providing the SRNA with clear background information and procedural instruction to perform arterial line

placement in the clinical setting after practicing in the simulation setting.

5) Is this project representative of doctoral work based on evidence and peer-reviewed literature?
    a. The OSCE should have evidence-based and peer-reviewed literature to provide the most up-to-date and accurate information to the learning SRNAs.
6) Do you have any comments or recommendations that may help improve this OSCE for future learning of SRNAs?
    a. Suggestions for improvement on the OSCE will also be requested at the end of the survey to provide qualitative data.

Analysis

Both the quantitative and qualitative data received from Qualtrics® (CC) were analyzed and organized for an easily interpreted summary. Common themes obtained from data provided by NAP faculty, SRNAs, and CRNAs were analyzed to revise and improve the OSCE if deemed beneficial and evidence-based. Revisions were discussed with committee members and implemented as seen as beneficial in improving the OSCE.

Ethical Considerations

Even if the USM NAP administration chooses to implement this OSCE into the curriculum, there remains a possibility of professors providing varying levels of evaluation. Professors may opt to not use the OSCE or alter it leading to nonuniform evaluations of SRNAs. The OSCE is intended to benefit SRNAs and faculty within USM's DNP program by providing a structured evaluation tool with the goals of

increasing patient safety (AANA, 2019), student self-confidence (Braier-Lorimer & Warren-Miell., 2021), and patient satisfaction (Mourad et al., 2011). Upon receiving approval from the IRB, the project met federal and institutional standards and guidelines. Informed consent and anonymity were provided to the participants within the survey. The development of this OSCE did not include direct patient contact as it is based on the simulation setting. There are no conflicts of interest within this project.

CHAPTER III - RESULTS

Introduction

The University of Southern Mississippi's Nurse Anesthesia Program is lacking a uniform guideline and evaluation of arterial line placement. A nurse anesthesia program can assist its pupils by providing a structured, uniform evidence-based tool and evaluation set instead of the student being evaluated in a nonuniform format. Ultimately, having a uniform clinical evaluation will improve overall patient safety and satisfaction (Mourad et al. 2011), increase student confidence (Braier-Lorimer & Warren-Miell., 2021), and create an available guideline for practicing clinicians at any level to include students, nurse anesthetists, surgeons, and other physicians.

Steps of the Intervention

The Institutional Review Board (IRB) of University of Southern Mississippi approved proposal of the project and its entirety (Appendix D) to ensure that the proposed research met relevant standards. An evidence-based OSCE for arterial line placement (Appendix A) was developed and sent to five nurse anesthesia faculty members, 39 SRNAs, and 30 CRNAs. Emails were obtained voluntarily from participants. The email included the invitation to the survey, the link to Qualtrics®, the OSCE (Appendix A), and informed consent (Appendix B). The survey (Appendix C) discussed the following topics: consent to participate, the experience of the provider, frequency of the procedure, the clarity and whether the OSCE is beneficial to future SRNAs, whether or not the project is representative doctoral work, and an open-ended section for comments to improve the OSCE. The survey remained open for two weeks.

Of the 74 emails, 32 (43%) participants responded to the survey: sixteen CRNAs and sixteen SRNAs.

The frequency of arterial line placement was asked of the participants to assess clinical practice. Out of 32 respondents, there were no participants that perform arterial lines daily or never. Eight (25%) providers rarely perform this procedure. Eleven (34.4%) providers may only perform arterial line placement once or twice a month, while 13 (40.6%) providers stated they perform once or twice a week.

Twenty (62.5%) of the 32 participants were selected using the ultrasound technique only when the landmark was unsuccessful. Six (18.75%) providers typically just use ultrasound, while the other six (18.75%) just use landmarks. Experience level is unknown.

All 32 participants answered "yes" when asked if this OSCE would be beneficial to SRNAs in the clinical setting. All participants also answered "yes" that the project is representative of doctoral work and based on evidence and peer-reviewed literature. Two comments provided by SRNAs were in the open-ended question asking for comments or suggestions:

- "This would have been great to have while I was learning in school."
- "Excellent job!"

Details of Process Measures and Outcomes

The outcome objective of this OSCE is for future SRNAs to gain confidence in their performance, increase patient safety and satisfaction, and be able to identify risks and potential complications of this procedure. Sufficient data from the survey indicates the implementation of this OSCE into the NAP curriculum will be a valuable learning

tool for future SRNAs in gaining clinical competence and confidence. Overall, the responses provided were supportive of this OSCE.

CHAPTER IV - DISCUSSION

Summary

An OSCE is a valuable tool to assist learners to gain clinical knowledge, as well as understanding the learner's own personal strengths and weaknesses in the skill (Gupta et al., 2010). The aim of creating this OSCE was to provide a structured, uniform evidence-based tool and evaluation set to assist SRNAs. Incorporating the OSCE for arterial line placement has the potential to allow SRNAs to practice and build confidence in a controlled setting. SRNAs will be able to learn and receive feedback without risking harm to or safety of a patient.

Of the 74 individuals who emailed, 43% responded to the survey. All thirty-two participants agreed the OSCE is representative of doctoral work and will be beneficial for future SRNAs. Approximately 41% of the participants place arterial lines at least once or twice a week. Having participants that actively perform this procedure routinely in clinical practice strengthens the evaluation of the OSCE. The variety in the experience level of participants that assessed the OSCE may indicate that it provides clear and competent guidelines for all providers.

Limitations

Limitations of this project include the number and type of participants. Thirty-two SRNAs and CRNAs participated in the assessment of this OSCE voluntarily. Having more feedback or contribution from first and second-year SRNAs would have been beneficial to assess the ease of understanding the material presented. Differentiation among student levels could help bridge any gaps in clarity that may be present in the OSCE. Though a smaller population size limits the statistical significance, participants

have clinical experience with the procedure and the development of an OSCE. A short number of survey questions may leave gaps in a proper assessment of the OSCE, but the number of questions was kept to a necessary minimum to decrease the inconvenience of time and increase the response rate.

Conclusions

This DNP project was developed using a synthesis of evidence-based practice guidelines and literature. The OSCE is being presented for consideration of adoption into the Nurse Anesthesia Education Program curriculum where it may be shared on the iUSM application for all future students in the program to access and use as a learning tool. Sufficient data from the survey indicates the implementation of this OSCE into the NAP curriculum will be a valuable learning tool for future SRNAs. The OSCE will benefit SRNAs by gaining clinical competence and confidence, but its impact may also expand into each healthcare facility the SRNA practices. Patients will be met with more skilled practitioners leading to increased safety in the clinical setting. Other practitioners who rarely perform this procedure or SRNAs in other nurse anesthesia programs may also benefit by using the OSCE as a guideline. As more experienced clinicians evaluate the OSCE, improvements may be made.

Further research that may improve the OSCE could include best practices for choosing ultrasound versus landmark. A practitioner may be unsuccessful with the first or second cannulation using the landmark technique. A patient with a bleeding disorder or diagnosed with peripheral vascular disease may be an indicator to go straight to using the ultrasound technique. Including this within the OSCE may help steer students toward

placing patient safety over ego. Though there is importance in landmark technique practice, patient safety is a priority.

ANESTHESIA OBJECTIVE STRUCTURED CLINICAL EXAM

Arterial Line Placement

LEARNER OUTCOMES: Students will be able to:

1. Identify the need for an arterial line.
2. Properly place arterial line in the radial artery.
3. Be able to identify signs and symptoms of complications and discuss treatment.

DOMAINS:

Clinical Skill
Critical Thinking
Formative Evaluation-Feedback

PURPOSE:

The purpose of this OSCE is to assess the necessity and clinical competence of placing an arterial line.

LEARNER OBJECTIVES:

1. Assemble proper equipment necessary to place an arterial line
2. Demonstrate understanding of how to place the arterial line by landmark and/or ultrasound.
3. Demonstrate and discuss the purpose of testing for collateral circulation prior to arterial cannulation.

INDIVIDUAL OR GROUP OSCE: Group

REQUIRED READING and ASSOCIATED LECTURES:

1. Barash, P. G., Cullen, B. F., Stoelting, R. K., Cahalan, M. K., Stock, M. C., Ortega, R., Sharar, S. R., & Holt, N. F. (2017). Chapter 26 Commonly Used Monitoring Techniques (8th ed., pp. 1776–1782). Wolters Kluwer.
2. Lecture PowerPoint

REQUIRED VIDEO: Arterial Line Placement video

REQUIRED PARTICIPANTS: Student examinees (No more than group of 3), Examiner

VENUE: **USM Lab**

STUDENT LEVEL OF OSCE: **Semester 3-5**

TIME ALLOTED: **30 minutes**

SEQUENTIAL PRACTICE & TESTING: **Assessment graded on demonstration of knowledge. No further testing required.**

RECOMMENDED PRACTICE PRIOR TO EXAMINATION: **Two attempts to become proficient at this OSCE. Three attempts to master this OSCE. 30 minutes for one attempt of arterial line placement. Three attempts recommended, 30 minutes each.**

CONTENT OUTLINE

CONTEXT:

You are assigned to Mrs. Dearman, a 59-year-old female. She is scheduled for an open nephrectomy. She is 85 kg with no known allergies. Mrs. Dearman has had a hysterectomy and cholecystectomy in the past with no anesthetic complications. She has a medical history of HTN, smoking, and a renal mass. Her labs are as follows: Hgb 11.3, Hct 35.3, Plt 233, K 4.5, Crt 1.3, Preoperatively, her vital signs are: BP 112/76 mmHg, HR 69, RR 14, oxygen saturation 98% on room air. Mallampati II, no removable items in mouth, teeth are intact. How will you manage this scenario?

EQUIPMENT& SUPPLIES:

- Monitors and appropriate cable connecting the transducer
- Pressure bag with normal saline
- Single line tubing and transducer
- Appropriately sized needle/arterial catheter
- Chlorhexidine prep or equivalent cleanser
- Mask, gown, sterile gloves, drape
- Sterile dressing and tape (sutures if applicable)
- Gauze
- Optional: Lidocaine 1% with small TB syringe, wrist stabilizer, or towel roll

SITE SELECTION:
University of Southern Mississippi's School of Nursing Simulation Lab

TASK STATEMENT:

The purpose of this OSCE is to identify proper technique of placing an arterial line and to build competency in the simulation setting.

PROCESS:

1. Perform Allen test or use the ultrasound to assess collateral circulation.

2. Gather proper equipment based on patient needs.

3. Ensure monitors are appropriately set up.

4. Successfully catheterize the radial artery by palpation or ultrasound.

5. Connect catheter to transducer and ensure proper waveform.

6. Secure and dress the arterial line.

DEBRIEFING FORM:

1. What are the primary concerns in this scenario?
2. What could be done differently to ensure better outcomes for the patients?
3. Was the individual smooth in his or her execution?
4. What interventions were done and were they appropriate?

ASSESSMENT

RUBRIC FOR ARTERIAL LINE PLACEMENT

QUESTION & DEMONSTRATION STATION:

	TASKS	PASS	FAIL	COMMENTS
	1. Properly perform Allen test or use color doppler on ultrasound to assess circulation.			
	2. Set up pressure bag, transducer tubing, and monitors.			
	3. Extend patient's hand and secure with tape or a wrist stabilizer. Palpate the radial artery to assess for most conducive positioning.			

	4. Cleanse the site with antiseptic solution.			
	5. Apply mask, sterile gloves, drape, and probe cover if using ultrasound.			
	6. (Optional) If using lidocaine, place small skin wheal at site of catheterization.			
	7. Palpation Technique: Isolates radial artery by palpation with nondominant hand and inserts needle at 30-45 degree angle until blood flash is confirmed. Ultrasound Technique: Uses nondominant hand to steady probe in out-of-place position to locate radial artery. Directs needle into the artery and blood flash is confirmed.			
	8. After pulsatile flash of blood is noted, the guidewire should be advanced. If resistance is met, remove and reassess. Do not force. If the guidewire advances smoothly, the catheter may be advanced over the wire. (If no guidewire, the catheter will carefully be advanced over the needle)			
	9. Hold pressure to radial artery distal to tip of catheter to decrease arterial pressure when withdrawing the wire and needle. Pulsatile blood flow will confirm placement. (Placing gauze under catheter hub prior to removing needle and wire will mitigate blood spillage.)			
	10. Connect arterial catheter to pressurized transducer tubing and			

	observe for proper waveform on monitor.			
	11. Secure the catheter with tape or sutures. Apply sterile dressing.			
	12. Assess hand for perfusion, numbness, tingling, and coolness frequently.			
	13. Document procedure appropriately according to organization.			

The OSCE by the student demonstrates foundational knowledge and correct demonstration of an arterial line placement: (Circle one) PASS FAIL

Does the student need to repeat this OSCE at a later time to satisfy learning requirements? (Circle one) YES NO Date to return for evaluation: _____

EXAMINER: _____ DATE: _____

APPENDIX B - Informed Consent

ORI | Office of Research Integrity

INSTITUTIONAL REVIEW BOARD
STANDARD (ONLINE) INFORMED CONSENT

STANDARD (ONLINE) INFORMED CONSENT PROCEDURES

The Project Information and Research Description sections of this form should be completed by the Principal Investigator before submitting this form for IRB approval. Use what is given in the research description and consent sections below when constructing research instrument online.

Last Edited May 13th, 2019

Today's date:06-06-2022

PROJECT INFORMATION

Project Title: Objective Structured Clinical Examination for Arterial Line Placement

IRB Protocol #22-944

Principal Investigator: Delorean Calloway	Phone: 601-347-0242	Email: delorean.calloway@usm.edu
College: Nursing and Health Professions	School and Program: School of Leadership and Advanced Nursing Practice	

RESEARCH DESCRIPTION

1. Purpose:

The purpose of the survey is to evaluate the objective structured clinical examination (OSCE) of arterial line placement for adherence to evidence-based practice and practicality from practicing anesthesia professionals.

2. Description of Study:

An anonymous electronic survey will be utilized to evaluate an OSCE for placement of arterial lines. The survey can be completed in 30 minutes with minimal inconvenience to particpants. The data will be collected and analyzed for common themes. This data will be used to adjust the OSCE if needed. Results will be disseminated at USM SLANP DNP Scholarship Day in September 2022.

3. Benefits:

No benefits have been idenitified to the participant or to others as a result of participation in the study,

4. Risks:

The time required to complete this survey is the only expected inconvenience. The survey is brief and consists of 6 questons to minimize the inconvience to the particiapnt.

5. Confidentiality:

The electronic survey is anonymous with no particiant identifiers. Deidentified survey results will be kept confidential by storing on a password protected computer, and in a locked drawer. Following the dissemination of research results, electronic data will be destroyed by deleting from the password protected computer and trash bin will be deleted. Physical data will be destroyed by shredding.

6. Alternative Procedures:

The survey is voluntary with no repercussions for non-participation. Alternatives to participation will be the choice to not participate.

7. **Participant's Assurance:**

This project and this consent form have been reviewed by the Institutional Review Board, which ensures that research projects involving human subjects follow federal regulations. Any questions or concerns about rights as a research participant should be directed to the Chair of the Institutional Review Board, The University of Southern Mississippi, 118 College Drive #5125, Hattiesburg, MS 39406-0001, 601-266-5997.

Any questions about this research project should be directed to the Principal Investigator using the contact information provided above.

CONSENT TO PARTICIPATE IN RESEARCH

I understand that participation in this project is completely voluntary, and I may withdraw at any time without penalty, prejudice, or loss of benefits. Unless described above, all personal information will be kept strictly confidential, including my name and other identifying information. All procedures to be followed and their purposes were explained to me. Information was given about all benefits, risks, inconveniences, or discomforts that might be expected. Any new information that develops during the project will be provided to me if that information may affect my willingness to continue participation in the project.

Include the following information only if applicable. Otherwise delete this entire paragraph before submitting for IRB approval: The University of Southern Mississippi has no mechanism to provide compensation for participants who may incur injuries as a result of participation in research projects. However, efforts will be made to make available the facilities and professional skills at the University. Participants may incur charges as a result of treatment related to research injuries. Information regarding treatment or the absence of treatment has been given above.

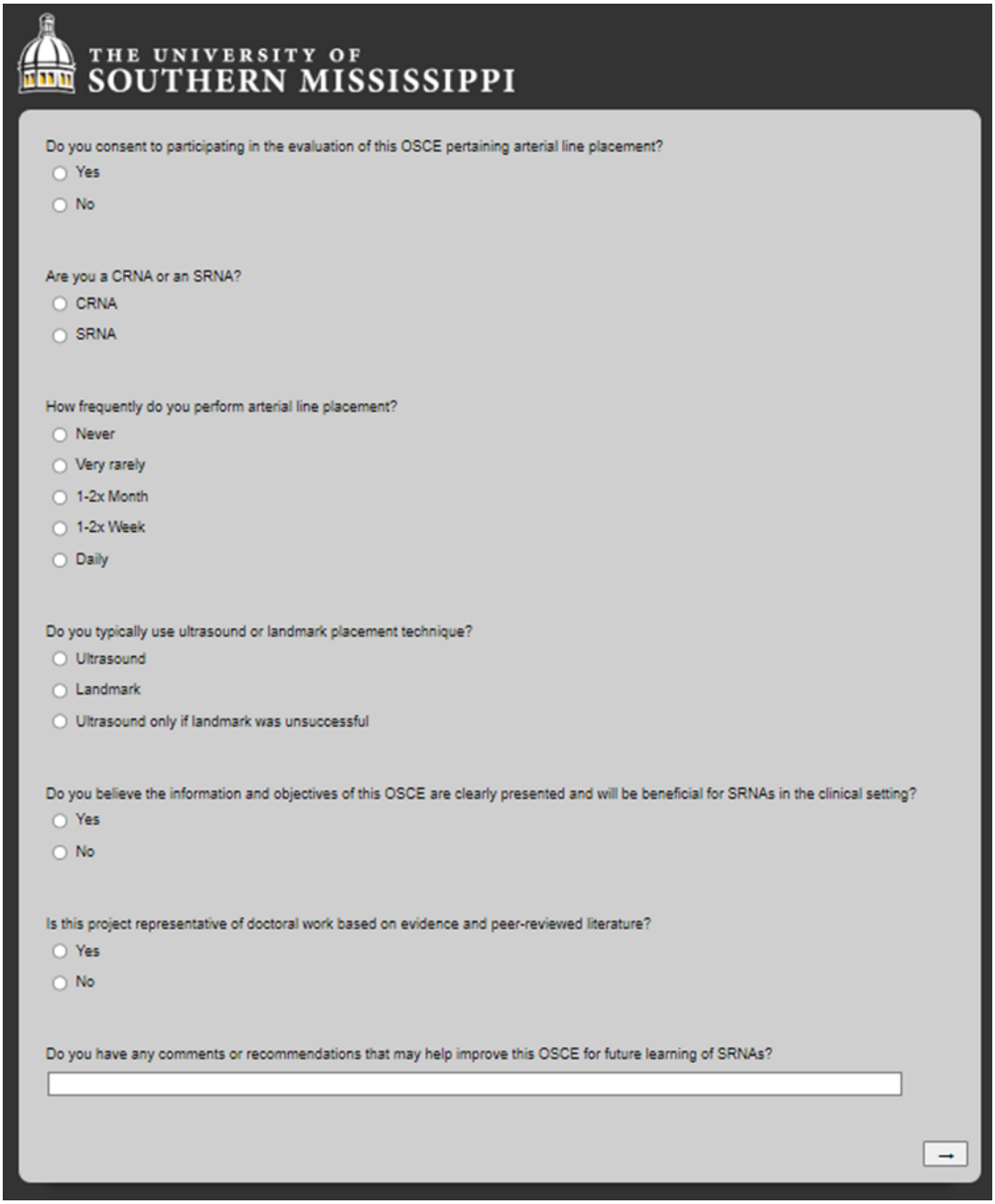
CONSENT TO PARTICIPATE IN RESEARCH

By clicking the box below, I give my consent to participate in this research project.

☐ Check this box if you consent to this study, and then click "Continue." (Clicking "Continue" will not allow you to advance to the study, unless you have checked the box indicating your consent.)

If you do not wish to consent to this study, please close your browser window at this time.

APPENDIX C - OSCE Evaluation


THE UNIVERSITY OF
SOUTHERN MISSISSIPPI

Do you consent to participating in the evaluation of this OSCE pertaining arterial line placement?
- Yes
- No

Are you a CRNA or an SRNA?
- CRNA
- SRNA

How frequently do you perform arterial line placement?
- Never
- Very rarely
- 1-2x Month
- 1-2x Week
- Daily

Do you typically use ultrasound or landmark placement technique?
- Ultrasound
- Landmark
- Ultrasound only if landmark was unsuccessful

Do you believe the information and objectives of this OSCE are clearly presented and will be beneficial for SRNAs in the clinical setting?
- Yes
- No

Is this project representative of doctoral work based on evidence and peer-reviewed literature?
- Yes
- No

Do you have any comments or recommendations that may help improve this OSCE for future learning of SRNAs?

→

APPENDIX D - IRB Approval Letter

Office *of*
Research Integrity

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

118 COLLEGE DRIVE #5116 • HATTIESBURG, MS | 601.266.6756 | WWW.USM.EDU/ORI

NOTICE OF INSTITUTIONAL REVIEW BOARD ACTION

The project below has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services regulations (45 CFR Part 46), and University Policy to ensure:

- The risks to subjects are minimized and reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered involving risks to subjects must be reported immediately. Problems should be reported to ORI via the Incident submission on InfoEd IRB.
- The period of approval is twelve months. An application for renewal must be submitted for projects exceeding twelve months.

PROTOCOL NUMBER:	22-944
PROJECT TITLE:	Objective Structured Clinical Examination for Arterial Line Placement
SCHOOL/PROGRAM	Leadership & Advanced Nursing
RESEARCHERS:	PI: Delorean Calloway Investigators: Calloway, Delorean~Collins, Mary Jane~
IRB COMMITTEE ACTION:	Approved
CATEGORY:	Expedited Category
PERIOD OF APPROVAL:	26-Sep-2022 to 25-Sep-2023

Donald Sacco Jr.

Donald Sacco, Ph.D.
Institutional Review Board Chairperson

APPENDIX E - DNP Essentials

DNP Essentials	Clinical Implications
I: Scientific Underpinning for Practice	Evidence-based and peer-reviewed literature was synthesized and organized into guidelines and rationales to be used for the OSCE.
II: Organizational and Systems Leadership for Quality	This project was presented to a panel of experts in OSCE development and clinical performance to make any improvements and enhance the learning quality.
III: Clinical Scholarship and Analytical Methods for Evidence-Based Practice	Evidence-based and peer-reviewed literature was synthesized and organized into guidelines and rationales to be used for the OSCE.
IV: Information Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care	The OSCE was developed using best practice guidelines and evaluated via an anonymous survey to assess clarity for future use of SRNAs that will lead to increased patient care and safety.
V: Health Care Policy for Advocacy in Health Care	Best practices and guidelines were compiled into the OSCE to instill proper techniques in future SRNAs.
VI: Interprofessional Collaboration for Improving Patient and Population Health Outcomes	By consulting with practicing clinicians and faculty members, input was received from all levels to ensure the development of the OSCE would lead to the best possible patient outcomes.
VII: Clinical Prevention and Population Health for Improving the Nation's Health	The aim of this OSCE is to improve patient outcomes by giving the SRNA a tool to increase clinical competency.
VIII: Advanced Nursing Practice	The OSCE will aid in continuing education for advanced practice nurses in the NAP program.

(AANA, 2019)

APPENDIX F - Literature Matrix

Author/Title/Journal	Year of Publication	Type of Evidence/Level of Research	Summary
Braier-Lorimer, D. A., & Warren-Miell, H. (2021). A peer-led mock OSCE improves student confidence for summative OSCE assessments in a traditional medical course. *Medical teacher*, 1–6. https://doi.org/10.1080/0142159X.2021.2004306	2021	Journal Article	The article gives an overview of the level of stress medical students face and then evaluates the amount of confidence the students felt before and after use of an OSCE tool.
Dahan A, Engberts DP, Niesters M. (2016). Arterial line placement: safety first. *Anesthesiology, 124*(3):528-9. doi: 10.1097/ALN.0000000000000968. PMID: 26606174.	2016	Journal Article	This article summarizes the common reasons for arterial line placement, techniques, and complications that can arise from placement.
Gupta, P., Dewan, P., & Singh, T. (2010). Objective Structured Clinical Examination (OSCE) revisited. *Indian pediatrics, 47*(11), 911–920. https://doi.org/10.1007/s13312-010-0155-6	2010	Qualitative Review	Objective structured clinical examinations are used as tools for formative and summative evaluations. The use of this tool can provide the learner with feedback on personal strengths and weaknesses.
Mourad, M., Auerbach, A.D., Maselli, J., & Sliwka, D. (2011). Patient satisfaction with procedural care. *Journal of Hospital Medicine, 4(*219-224) doi:10.1002/jhm.856	2011	Quantitative Review	Measurement of patient satisfaction with procedures performed in the hospital setting was taken via survey. Patients stated higher satisfaction rates with physician communication throughout the procedure.
Nguyen, Y. & Bora, V. (2021). Arterial pressure monitoring. *StatPearls*. StatPearls Publishing.	2021	Journal Article	Provides an overview of the importance of frequent hemodynamic monitoring via arterial lines and the mechanism of how it works.

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