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## **Amniotic Fluid Embolism During Cesarean Section: An Objective Structured Clinical Exam**

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AMNIOTIC FLUID EMBOLISM DURING CESAREAN SECTION:  
AN OBJECTIVE STRUCTURED CLINICAL EXAM

by

Mackenzie Acosta and Morgan Self

A Doctoral Project  
Submitted to the Graduate School,  
the College of Nursing and Health Professions  
and the School of Leadership and Advanced Nursing Practice  
at The University of Southern Mississippi  
in Partial Fulfillment of the Requirements  
for the Degree of Doctor of Nursing Practice

Approved by:

Dr. Nina McLain, Committee Chair  
Dr. Mary Jane Collins

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## ABSTRACT

Amniotic Fluid Embolism is a rare obstetric event that has a high morbidity/mortality rate. It is imperative that the anesthesia provider be properly educated on how to recognize and treat an AFE. Prompt recognition and treatment, including the AOK regimen, increase the patient's chance of survival. The faculty for The University of Southern Mississippi's Nurse Anesthesia Program acknowledged the need for an objective-based exam on Amniotic Fluid Embolism during the Cesarean section. The need for an educational tool on AFE prompted the creation of this doctoral project and resulted in an AFE OSCE which has been added to the OSCE library at USM NAP. Simulation of this obstetric emergency will allow students repetitive practice on how to recognize and treat an AFE, so that if the student encounters the event in the clinical setting, they will be prepared. A simulated experience helps increase patient safety as well as the student's confidence.

The OSCE template was developed following evidence-based research. The OSCE trigger film was created to supplement the template. A survey was sent to anesthesia faculty, practicing CRNAs, and 2<sup>nd</sup> and 3<sup>rd</sup>-year SRNAs to review and complete. The survey contained the OSCE template and a questionnaire. There were 60 participants in the survey and the response was positive. The quantitative and qualitative data showed that participants agreed the OSCE would be beneficial for the students and would be a good addition to the NAP curriculum. The results gave no criticism regarding change for the OSCE, so therefore no changes were made. Based on the results of the survey, it can be concluded that the AFE OSCE should be a good resource for the

students to increase their knowledge base and clinical competency regarding amniotic fluid embolism during cesarean section.

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## DEDICATION

I would like to thank my husband for his constant support and reassurance not only during the completion of this doctoral project but also during the entirety of this program. Next, I would like to thank my parents for always supporting me and giving me every opportunity to reach my goals. – *Mackenzie Acosta*

I would like to dedicate the completion of this doctoral project to my mother, Susan Self, whose unwavering support, encouragement, sacrifice, and love have helped me to achieve my goals. I would not be here today without her! Secondly, I would also like to express immeasurable gratitude to my late grandfather, Dr. E.C. O’Neal, who taught me the importance of education and always inspired me to reach higher. - *Morgan Self*

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## LIST OF ABBREVIATIONS

<i>AFE</i>	Amniotic Fluid Embolism
<i>COA</i>	Council of Accreditation
<i>CPR</i>	Cardiopulmonary Resuscitation
<i>CRNA</i>	Certified Registered Nurse Anesthetist
<i>C-Section</i>	Cesarean Section
<i>DIC</i>	Disseminated Intravascular Coagulation
<i>DNP</i>	Doctor of Nursing Practice
<i>IRB</i>	Institutional Review Board
<i>NAP</i>	Nurse Anesthesia Program
<i>OR</i>	Operating Room
<i>OSCE</i>	Objective Structured Clinical Exam
<i>SRNA</i>	Student Registered Nurse Anesthetist
<i>TEG</i>	Thromboelastography
<i>TF</i>	Trigger Film
<i>USM</i>	The University of Southern Mississippi

## CHAPTER I – INTRODUCTION AND BACKGROUND

It is the job of the certified registered nurse anesthetist, or CRNA, to safely provide anesthesia. The anesthesia provider is responsible for the patient before, during, and after anesthesia and is with the patient throughout the entirety of the procedure. The CRNA is uniquely prepared to handle a wide variety of complications that could arise throughout the surgical experience. The CRNA's ability to make decisions quickly and confidently protects patients from adverse outcomes in the operating room (OR). It is, therefore, crucial for student registered nurse anesthetists, SRNAs, to develop these critical thinking skills while in training to apply foundational knowledge to real-life scenarios.

### Problem Description

When an emergency situation arises in the operating room, anesthesia providers must be able to jump into action with appropriate treatments. Emergent events, especially those that do not occur often, can cause panic to arise in all who are involved, hindering patient care. It is imperative for the CRNA to be able to recognize and initiate treatment plans or algorithms in order to save patient lives.

An amniotic fluid embolism (AFE) is a rare yet potentially fatal complication of labor and delivery. An amniotic fluid embolism can occur during labor, cesarean section, or following an abnormal vaginal delivery, or after trauma to the abdomen. These various incidents place the CRNA in a position to encounter lethal complications during a routine cesarean section (C-section). Despite its low incidence rate, maternal and fetal morbidity and mortality are high, with a reported mortality rate as high as 60% (Pachecco et al., 2020). Due to its rarity, most health care providers have very limited experience when it

comes to diagnosing and managing an AFE. In fact, most providers will never witness an episode of AFE during their careers. Further, an AFE can often mimic other obstetric conditions making a diagnosis that much more difficult. However, if an AFE does occur under the care of a CRNA, they will be expected to act assertively and appropriately.

Unfortunately, since AFE is so rare, there is no standard of care or convenient algorithm to follow or to teach. At this time, early recognition of maternal compromise and rapid treatment of the acute symptoms as they evolve seems to provide the best chance at a good outcome for the mother and her unborn child. In order to facilitate a quick and accurate diagnosis of AFE and the rapid initiation of treatment, the use of high-fidelity simulation during an Observed Structured Clinical Exam, OSCE, could be used. The OSCE can be a beneficial tool in the encouragement of diagnostic thinking and enhancement of problem-solving skills in the SRNA who is about to enter the clinical arena. In this way, students become increasingly familiar with a rare complication that might not be encountered until it occurs during actual patient care. Creating an OSCE in order to increase a student's awareness and management of AFE is the primary aim of this doctoral project.

### Purpose and Context

The University of Southern Mississippi's (USM) Nurse Anesthesia Program does not have an objective-based structured tool to evaluate student learning and clinical skill in a consistent manner for infrequently occurring yet high morbidity and mortality critical incidents in a simulated environment. This doctoral project will focus on the rarely occurring amniotic fluid embolism scenario and appropriate evidence-based treatment by the SRNA. The purpose of the doctoral project will be to create a learning tool to assist

SRNAs in the diagnosis and treatment of AFE while in a safe environment that is conducive to learning. By becoming familiar with this uncommon obstetric event, students will be more likely to intervene appropriately if they encounter an AFE in clinical practice.

As part of their standards for accreditation, the Council on Accreditation of Nurse Anesthesia Educational Programs (COA) requires simulation to be incorporated into the curriculum. The COA define a simulated clinical experience as "...learning experiences involving the imitation or representation of clinical activities that are designed for competency attainment, competency assessment, or competency maintenance" (Council of Accreditation of Nurse Anesthesia Educational Programs [COA], 2014, p. 41). These experiences include web-based or computer-based simulation, standardized patients, and manikin-based technology and are designed to make connections between didactic and clinical knowledge. An OSCE using high-fidelity simulation falls in the simulation experience category as defined by the COA and is an educational method the nurse anesthesia program at USM could use to comply with these standards.

By using an amniotic fluid embolism OSCE, SRNAs will be able to bridge their didactic obstetric coursework with clinical knowledge. The aim is to prepare anesthesia students for entry into anesthesia practice with the tools to provide safe and competent anesthesia care to their patients. This includes preparation to manage and control intense and complex emergencies that arise in the operating room.



## Available Knowledge

### *Amniotic Fluid Embolism*

An amniotic fluid embolism involves a complex sequence of events triggered by the entrance of fetal material into the maternal pulmonary circulation causing cardiovascular collapse. Amniotic fluid embolism is further defined as the introduction of foreign antigenic material of fetal or infectious origin to the maternal central circulation and appears to involve the release of endogenous inflammatory mediators with secondary effects on cardiovascular and pulmonary function and activation of the clotting cascade (Pachecco et al., 2020). Amniotic fluid contains vasoactive and procoagulant properties which contribute to respiratory and cardiovascular collapse as well as to the prevalence of disseminated intravascular clotting (DIC) (Kaur et al., 2016).

While its etiology is still not completely understood, several risk factors have been identified. These include advanced maternal age, multiple pregnancies, gestational diabetes, polyhydramnios, placenta previa, and placental abruption (Lisonkova & Kramer, 2019). Despite the identification of these risk factors, no prophylactic intervention exists at this time.

AFE is unpredictable and its symptom onset is usually sudden. The typical presentation includes a triad of hypoxia, hypotension, and coagulopathy occurring in relation to labor and delivery (Society for Maternal-Fetal Medicine [SMFM] et al., 2016). Hypotension has been touted as the most common presenting symptom with pressures dropping significantly to the point of loss of a diastolic measurement. A period of dyspnea, anxiety, agitation, and mental status changes may precede the triad mentioned previously. However, patients usually progress rapidly to cardiac arrest. Treatment

measures are supportive in nature and begin with high-quality cardiopulmonary resuscitation (CPR). If the patient is undelivered at the time of cardiac arrest, immediate delivery of the fetus is indicated. Immediate delivery is not only lifesaving to the fetus, but it may also relieve venacaval compression in the mother and assist in resuscitation.

Table 1

*CPR in Pregnancy*

- Rapid Chest Compressions
  - At a rate of 100 x minute
  - Perform hard compressions that reach a depth of at least 2 inches
  - Ensure adequate chest recoil between compressions
- Minimize Interruptions of Chest Compressions
- Avoid Prolonged Pulse Checks
  - No more than 5-10 seconds
- Resume Chest Compressions Immediately After Defibrillation
- Switch Providers After 2 Minutes of Chest Compressions
- Lateral Displacement of Uterus During Resuscitation

Adapted from the American Journal of Obstetrics and Gynecology (SMFM et al., 2016).

If resuscitation is successful, hemodynamic instability is common. It is recommended to use a combination of fluids, vasoactive agents, and inotropes to maintain a mean arterial blood pressure above 65 mmHg (SMFM et al., 2016). Fluid must be carefully administered, however, because fluid overload could worsen right ventricular dilation caused by pulmonary hypertension. There must be a delicate balance between increasing the patient's preload and avoiding overload. Use of transthoracic or transesophageal echocardiography can be used to guide fluid therapy with an evaluation of left ventricular filling (Pachecco et al., 2020). An echo can also be used to assess right ventricular failure. In fact, it has been suggested that early use of transesophageal echocardiography can provide imperative diagnostic information and spur targeted hemodynamic support. Improvement in right ventricular output can be achieved by using

inotropes such as dobutamine and milrinone, and pulmonary vascular resistance can be reduced by using agents such as inhaled nitric oxide or oral sildenafil (SMFM et al., 2016).

Disseminated intravascular clotting is present in 83% of cases of AFE (Kaur et al., 2016). Therefore, early assessment of clotting status is recommended. The use of massive transfusion protocols should be used to aggressively treat coagulopathy with packed red blood cells, fresh frozen plasma, and platelets given in a 1:1:1 ratio (SMFM et al., 2016). It has also been suggested to use viscoelastic tests such as thromboelastography, or TEG, to guide transfusion therapy and decrease the number of blood products that are used (SMFM et al., 2016). Decreasing the number of blood products is a critical point because over administration can lead to fluid overload and further distention of the right ventricle.

Uterine atony is a common finding with AFE, and the use of agents such as oxytocin and prostaglandins should be used when indicated. Severe cases may require uterine tamponade, bilateral uterine artery ligation, and even hysterectomy. If surgical control is not an option for persistent bleeding during a c-section, then the pelvis should be packed, and the patient should be transferred to the intensive care unit for further resuscitation and management (SMFM et al., 2016).

There is no one specific treatment plan that has been proven to increase the survival rates of AFE. It remains a diagnosis of exclusion, however, an exact diagnosis is not needed to begin supportive treatment. It is essential for AFE to be included in the differential diagnosis of sudden cardiovascular and pulmonary instability occurring

during labor and delivery in order to initiate rapid interventions and improve maternal and fetal outcomes (SMFM et al., 2016).

### *A-OK Protocol*

Historically, studies have suggested mechanical obstruction as the main mechanism for pulmonary hypertension that occurs during an AFE (Rezai et al., 2017). In more recent studies, however, it has been suggested that serotonin and thromboxane act together to cause platelet dysfunction, platelet degranulation, and pulmonary hypertension (Rezai et al., 2017). Serotonin stimulates 5-HT receptors which cause pulmonary vasoconstriction, leading to pulmonary hypertension (Rezai et al., 2017). Thromboxane causes platelet recruitment and aggregation, adding to the platelets already entrapped due to pulmonary vasoconstriction. Even more serotonin mediators are released, leading to a self-perpetuating cycle of pulmonary hypertension (Rezai et al., 2017). The same mediators that cause pulmonary vasoconstriction, also cause systemic vagal stimulation and contribute to the fall in vasomotor tone. (Rezai et al., 2017)

The protocol coined *A-OK* was introduced to combat vagal stimulation, serotonin mediators, and platelet aggregation. The acronym stands for three medications that are commonly found in the anesthesia provider's cart or medication drawer atropine, ondansetron, and ketorolac. Atropine blocks the vagal stimulation which improves vagal motor tone, and ondansetron blocks serotonin receptors which inhibit the release of further mediators (Rezai et al., 2017). Ketorolac blocks thromboxane, stopping the cascade of inappropriate clotting. (Rezai et al., 2017) Case studies have shown that when these three medications are combined with traditional therapies used to treat an AFE, the patient's circulation is quickly restored leading to successful resuscitation.

### *OSCE Defined*

Objective structured clinical exams were first introduced to assess the basic clinical skills of medical students in the 1970s. These exams have since evolved into a versatile, multipurpose tool that is used to evaluate health care professionals on topics such as data interpretation, problem-solving skills, and the ability to handle unpredictable patient events. Traditional clinical examinations are limited in their scope and are only able to test a narrow range of technical skills (Zayyan, 2011). Objective structured clinical exams have paved the way to overcome the drawbacks of pen-and-paper testing when it comes to assessing the competencies that are most critical to the performance of health care professionals.

Objective structured clinical exams can be in the form of summative or formative evaluations. Summative OSCEs are usually more labor-intensive and result in a pass or fail grade for the participant. The potential of failure puts an added strain on the student. If an OSCE is used as a means to determine progression through curriculum, then policies regarding remediation and retesting must also be in place. Formative OSCEs on the other hand, enhance learning and work to improve future clinical performance. The formative OSCE is used to identify the participants' strengths and weaknesses and work to build a stronger student. Formative OSCEs can usually be accomplished with one instructor and a small group of students, unlike the summative OSCE which requires a stricter format. Feedback in a formative OSCE is used to improve performance without the threat of failure, therefore enhancing the students learning experience (Ballister, 2018).

The development of an OSCE should begin with a needs assessment. As mentioned, OSCEs can be formatted in many ways in an attempt to overcome gaps in the didactic curriculum, so topics should be based on the individual needs of the program. Once a topic is chosen, concepts needed for successful performance should be identified and defined. It is only then that the objectives of the OSCE can be finalized. The Society for Simulation in Healthcare suggests that each scenario has three to five objectives (Ballister, 2018). Each objective should specify the student expectations related to cognitive and psychomotor skills and behaviors. A realistic environment should also be encouraged, however successful scenarios depend on the student's ability to engage and also to accept the limitations of the simulation.

A review of the SRNAs' performance is crucial in an effort to ensure learning during the educational experience. It is important to the OSCEs success to incorporate 20-30 minutes for debriefing to occur. Feedback can be given to groups or individually through bidirectional debriefing. Bidirectional debriefing is a reflective discussion between the evaluator and all the learners who participated in the scenario allowing the SRNAs to play an active role in the feedback process (Ballister, 2018). An evaluation or survey of the OSCE should also be completed as part of the debriefing process so that recommendations can be collected for future OSCE development.

The adaptability of the OSCE makes it invaluable to nurse anesthesia programs because it can be adjusted in many different ways in order to enhance the didactic curriculum. There are numerous advantages to using OSCEs such as uniform scenarios, availability, safety, no risk of litigation, allows for recall, and allows for demonstration of emergency skills (Zayyan, 2011). By participating in an AFE OSCE, students should be

able to critically think through a simulated scenario applying the knowledge obtained from the classroom while developing diagnostic and treatment skills usually only learned at the bedside. However, this scenario will take place in a safe environment where there is no threat of patient harm, making OSCEs an ideal teaching strategy for this unpredictable patient event.

### *High-Fidelity Simulation*

A high-fidelity simulation is an educational tool that uses a life-like manikin in a simulated clinical environment that mimics realistic patient scenarios. High-fidelity patient simulators are computerized, contain hydraulics and compressors, and have external monitors that can display various vital signs such as electrocardiograph rhythms, blood pressures, and pulse oximetry (Healthy Simulation, n.d.). Manikins are usually operated by a technician or instructor in an adjacent room to the simulation experience. However, persons operating the manikin are still able to visualize the participants in the next room and can hear as the students work through clinical problems with their simulated patients.

Simulation has become an educational strategy to work around ethical issues regarding practicing medicine on human patients. It can provide an effective way to increase patient safety, decrease the incidence of error, and improve clinical judgment (Lewis et al., 2012). Students can rehearse rare, complex, and critical events before practicing on patients. Simulations give students the opportunity to run through emergency situations where mistakes will not result in a compromise in health or even the death of a patient. Alternatively, mistakes can be made safely, allowing for correction of those mistakes in real time providing a key learning experience for students that they

are less likely to forget. Simulation has been shown to improve students' critical thinking and clinical reasoning skills during complex situations and aids in the development of confidence in their own clinical abilities (Lewis et al., 2012).

Simulation provides the opportunity for engaged learning while keeping patients, learners, and educators safe. Including high-fidelity simulation in the AFE OSCE will give participating SRNAs the feel of a real-life patient scenario. The realism of this type of simulation will be more likely to result in transference of knowledge to the clinical setting, which will result in safer providers and better patient care.

### *Trigger Films*

Traditional teaching methods such as a lecture format encompass passive learning techniques that do not necessarily encourage students to critically think. For those training to become nurse anesthetists, however, critical thinking is an essential component of becoming a safe anesthesia provider. Recall of classroom knowledge can often become clouded in the face of dire patient circumstances, therefore it is of the utmost importance to incorporate learning strategies directed towards fostering students' problem-solving skills. Over the years, the use of trigger films (TF) have been used by many in the education of medical professionals to promote students to participate in a more active learning role.

Trigger films were created in the 1960s and involve a short, 2–4-minute video simulating a real-life situation that ends abruptly and without committing to a particular course of action (Hartland et al., 2003). Trigger films used by medical professionals will generally display an error occurring or a catastrophic patient scenario. The student is pulled into a virtual setting that enhances realism, introspection, active participation, and



objective evaluation (Hartland et al, 2003). Ideally, these films will elicit discussion of preventative treatments and corrective measures (McLain et al, 2012). Displaying a catastrophic patient scenario may also bring about an emotional response in the student which will promote a stronger recall when faced with the same problem in a real-life clinical situation. In fact, the Dual Coding Theory created by Allan Paivio reveals that visual imagery has a greater impact on long-term memory and is more readily retrievable than information coded from verbal cues (McLain et al, 2012).

Trigger films are particularly useful in the analysis of clinical scenarios that one may encounter during practice but may be difficult or dangerous to reproduce in a real clinical situation (Hartland et al., 2003). An amniotic fluid embolism is one such situation. By incorporating a trigger film into the required material to be reviewed by the SRNA before completing the AFE OSCE, the SRNA will be more likely to recall information during the patient scenario.

#### Rationale

The prevalence of an AFE is rare, but the morbidity and mortality associated with it are high and students and providers should be thoroughly educated on prompt recognition of symptoms and supportive management. Because it is a rare occurrence, the risk of a provider not understanding the warning signs and how to treat them is a high possibility. Using the OSCE to create a high-fidelity simulation of an AFE scenario, will allow students to gain and, hopefully, retain the knowledge required to recognize and treat an AFE. This OSCE should help to increase patient safety, as well as competence in the student.

Miller's Pyramid of Clinical Competence is a framework that demonstrates clinical competencies that students should meet through their education. The framework is illustrated in a pyramid that has four levels (Table 2). The levels are *knows*, *knows how*, *shows how*, and *Does*. The first level, or the base of the pyramid, is the *Knows* level which shows that the student has the knowledge base regarding the task (Miller, 1990). The second level of the pyramid, and competency, is *Knows How* where students know how to take their knowledge and use it in a clinical scenario. Having the knowledge base is essential, but it is useless if the student does not know how to put it into practice (Miller, 1990). These first competencies can be measured by classroom testing. The third level is *Shows How* which is a performance competency that allows the student to demonstrate their use of their knowledge in a clinical simulation, such as an OSCE. Miller (1990) discovered that it was not enough to only use classroom exams to test students' knowledge, but that they should have clinical simulation to see how they would put that knowledge into practice when in a clinical situation. The OSCE falls into this level of the pyramid and allows the student to take the information they have learned in the classroom setting and apply it in a real-time patient scenario. This level of the pyramid allows the student's knowledge, skill, and performance to be tested and their competence to be assessed. The final level of the pyramid is *Does* which regards the student's action in the real-world clinical setting (Miller, 1990). By using the OSCE to facilitate level three of the pyramid, students can be more prepared and competent when entering into the actual clinical setting and carrying out the final level of the pyramid.

Table 2

*Miller's Pyramid of Clinical Competence*

Does	Performance in clinical practice
Shows	Demonstration of learned skills (this is the level we are targeting with the creation of the OSCE)
Knows How	Proving the ability to apply the knowledge
Knows	Traditional testing/ Fact Gathering

Adapted from, Mehay and Burns (2009). Miller's Pyramid of Competency evaluation through performance. The table mimics the pyramid in the sense that the bottom row in the table is the bottom row of the original pyramid and this theme continues throughout the table.

DNP Essentials

The Doctor of Nursing Practice (DNP) Essentials helps to shape the foundation that is indispensable to the doctoral project. Meeting the DNP essentials while creating a doctoral project is necessary to show the competency of the provider practicing at the doctoral level. The following essentials were used for this study.

*Essential I: Scientific Underpinning for Practice*

Essential I describes the clinical and academic preparedness that DNP students require to practice at the doctoral level (American Association of Colleges of Nursing [AACN], 2006). As previously discussed, AFE is a rare occurrence for which the OSCE was created to help USM's nurse anesthesia program be clinically prepared for prompt recognition and treatment of AFE. This OSCE was developed using evidence-based literature and data.

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

DNP students use organizational and systems leadership to help promote safer patient care and improved outcomes as well as work towards reducing health care inequalities (AACN, 2006). The intent of the creation of the OSCE is for quality

improvement and advancement of patient safety regarding the treatment of AFE. This doctoral project was evaluated by an expert panel and feedback was given to improve the quality of the tool.

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

Using evidence-based practice is a key component of doctoral-level nurses and Essential III includes reviewing and incorporating new research into practice (AACN, 2006). The field is ever-changing and new evidence-based research helps to improve our current practice. In-depth research led to finding the most current evidence-based research and best practice guidelines for creating the OSCE.

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

Essential IV describes how DNPs use health care information systems and technology to provide and improve patient care (AACN, 2006). As technology evolves, health care technology needs to be continuously updated for the continuous betterment of patient care. This doctoral project was created with the intent of constructing a tool, the OSCE, using evidence-based practice to educate students and, in turn, improve patient care.

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

Interprofessional collaboration creates a safe and effective health care environment and is an important essential for DNP graduates to implement into their practice. To adequately meet this essential, multiple experienced and skilled individuals were chosen for an expert panel to contribute to the doctoral project by giving feedback

and criticism to make the OSCE as efficient as possible. The panel was selected based on their education and experience levels regarding their knowledge of anesthetic management of AFE.

### *Essential VIII: Advanced Practice Nursing*

The specific aim of creating the OSCE was for adequate preparation of DNP students. Essential VIII discusses the importance of Advanced Practice Registered Nurses being knowledgeable and prepared in their specialty so that they can practice to the fullest extent of their ability (AACN, 2006). The OSCE was formed using evidence-based practice and best practice recommendations to help educate and improve the AFE curriculum of the USM NAP students.

### Specific Aims

The purpose of this doctoral project is to create and provide a clinical teaching tool, OSCE, to help educate SRNAs and evaluate their ability and competence regarding AFE. The specific aim is to use an OSCE created to improve prompt recognition and treatment of AFE to improve SRNAs' education and clinical ability in a safe, conducive environment and to have an objective method to constructively assess student performance. When the SRNAs complete the OSCE, they will be better educated on what an AFE is and how to recognize it and more equipped to offer treatment in a clinical situation. This OSCE serves to create a safer patient environment and quality improvement in the long term.

### Summary

USM NAP students can use this AFE OSCE to improve their knowledge and clinical ability. It is also a tool to use to assess the student's knowledge and competency

as evidenced by the *Show* level of Miller's pyramid. By creating this OSCE, students should be able to use their knowledge to react to and treat a high-fidelity simulation patient without the high stress of treating such a complex patient in a real-world situation. The student will have the ability to repeatedly practice and improve their skills without threat to patient harm so that if they are ever faced with an AFE situation in a clinical scenario they are adequately educated and prepared to recognize and treat the patient safely. Utilization of the OSCE can lead to increased knowledge, competence, and confidence in the student which ensures a properly educated provider and a safer patient experience.

## CHAPTER II – METHODOLOGY

### Context

The use of an OSCE can help to facilitate learning in SRNAs and can help facilitate the learning curve between didactic learning and the implementation of learned skills. Scenario-based OSCEs can help create confidence in students who are about to enter a professional world and may encounter these scenarios as a provider. AFE, as stated before, is an extremely rare event that many may never experience during the extent of their career. The AFE OSCE is a high-fidelity scenario that allows the student participating to engage in a situation that should instill the knowledge of how to properly respond to an AFE so that they can be prepared in future clinical situations. The creation of the AFE OSCE was done with the purpose of educating USM's NAP students and allowing instructors a fair and consistent method to grade and gauge clinical preparedness.

The University of Southern Mississippi's NAP simulation laboratory is the location where OSCEs are utilized. The purpose of the creation of OSCEs for the USM NAP is to improve student education and provide a pathway for students to practice simulated skills using the OSCE. The nurse anesthesia program has the current infrastructure to support this doctoral project and help with the development of the OSCE to make it successful.

### Intervention

The process of creating this DNP project took multiple steps. After an intensive literature review and formulation of the methodology process, the doctoral project was proposed to the DNP committee. An online informed consent was completed to be

attached to the online survey. The OSCE document and a volunteer recruitment email were developed and sent to the DNP Chair for approval. Email addresses for the panel of expert anesthesia providers were publicly available or volunteered to the researchers. Using information from the literature, the OSCE template was developed and submitted to the DNP Chair for approval. The template includes learner outcomes and objectives, domains, purpose, assigned reading, assigned trigger film, time allotted and recommended practice before an exam, content outline, and rubric. Once the doctoral project was proposed, approval from the Institutional Review Board (IRB) was required.

An expert panel was created to help participate and input their comments on the doctoral project. The expert panel was formed by skilled volunteers with experience in obstetric anesthesia who agreed to participate in the doctoral project. Once the IRBs approval was received, protocol number 22-013, the next step involved sending out the survey by email. The expert panel's evaluation of the doctoral project via the survey was examined and implemented to improve the doctoral project's ability to safely and effectively teach SRNAs to assess for and treat an AFE in a clinical scenario. The approved OSCE, literature review, informed consent, and evaluation were submitted to the panel of experts via the USM anonymous online survey platform. The online platform was designed to maintain confidentiality and no identifying information will be asked in the survey. The doctoral project was submitted to the DNP project committee for approval. At the USM DNP Scholarship Day in March 2022, the doctoral project was disseminated.



## Study of Interventions and Measures

The doctoral project was evaluated by gathering data from a questionnaire through Qualtrics that is sent to a panel of anesthesia care providers. The evaluation of the doctoral project by the expert panel provided feedback that should improve the OSCE after alterations were made. The OSCE was made using the most current evidence-based research regarding AFE and to allow the user to evaluate their knowledge and ability to respond to AFE. The OSCE includes a list of objectives, steps, and goals for completing the OSCE so that the user will be able to understand what they should have accomplished at the end of the scenario. The feedback from the questionnaire and the committee chair was used to make improvements to the OSCE which helped improve the efficacy and usability of the OSCE for the SRNAs.

## Measures

The primary objective of this doctoral project was to create a learning tool for SRNAs at USM to enhance the awareness and management of the infrequently occurring but high mortality AFE and provide the faculty with a fair and consistent manner to grade and ensure student clinical readiness. The OSCE that was created will not only amplify the knowledge gained in the classroom but should also improve clinical outcomes. It also has the ability to build confidence in the SRNAs' ability to handle stressful situations that may arise in the OR. An evaluation tool was created to assess student perception of preparedness in knowledge and ability to care for an AFE. The evaluation tool provided feedback to improve and strengthen the OSCE experience for continued use in the USM Nurse Anesthesia Program curriculum.

## Data Collection and Analysis

Qualitative data was collected through the use of an evaluation tool that was sent to a group of volunteer current anesthesia providers and current student registered nurse anesthetists. The evaluation had the primary purpose of determining whether or not the OSCE provided the Anesthesia provider with the knowledge and confidence to correctly diagnose and treat an AFE during a c-section. Once collected, the data were reviewed and analyzed. Information gathered from the evaluations was then used to make revisions to improve the learning experience of the AFE during Cesarean Section OSCE.

## Ethical Considerations

Patient safety is a fundamental factor for all health care providers and is a key element in the education of these providers. Simulation is an alternative means of practicing patient care without the threat of harm. The potential risks to patients associated with learning at the bedside are becoming increasingly unacceptable, and the search for education and training methods that do not expose the patient to preventable errors from inexperienced practitioners is ongoing. (Lewis et al., 2012) By participating in this OSCE, SRNAs will be able to rehearse the steps needed to provide optimal care to a patient experiencing an AFE while undergoing a C-section in the OR without direct contact with an actual patient.

Ethics are the principles that guide human conduct as it relates to right and wrong. Health care ethics guide how choices are made in health care and include the principles of beneficence, nonmaleficence, respect for autonomy, and justice. The American Association of Nurse Anesthetists used these guiding principles to shape the Code of Ethics for Certified Registered Nurse Anesthetists. Nonmaleficence is the obligation of

the provider to “do no harm” to the patient, and it does not distinguish between intentional and unintentional harm. The use of simulation for the practice of patient care is a way to fulfill the provider's obligation of nonmaleficence. OSCEs using simulated scenarios are completely devoid of any potential threat to patients.

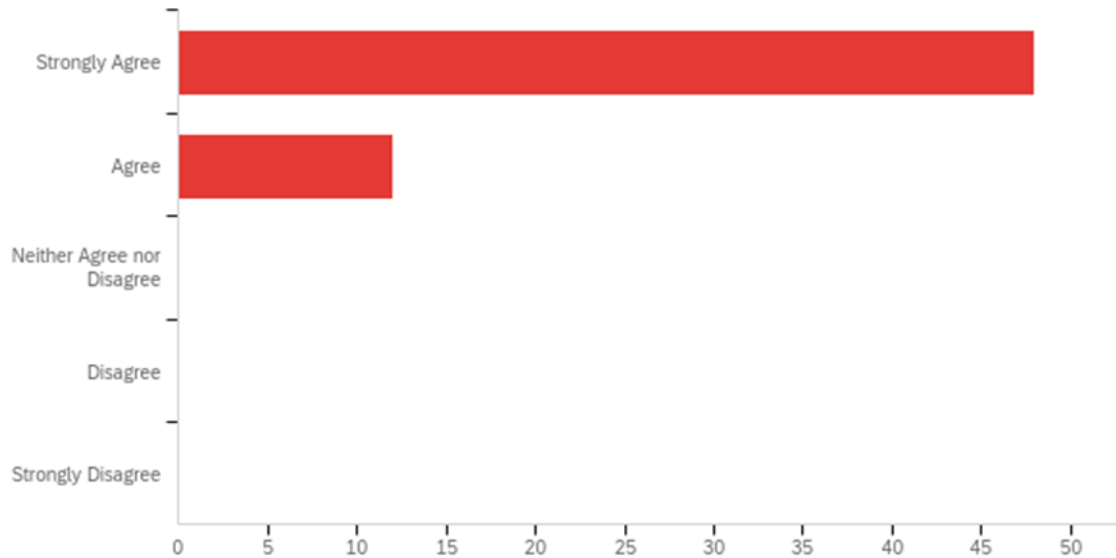
### Summary

The purpose of this doctoral project was to develop an OSCE to improve the connection between the didactic education and clinical experience in order to provide safe and effective patient care. It provides additional learning experiences to SRNAs enrolled in the NAP at USM and will lead to nurse anesthetists who are competent anesthesia providers. The most recent evidence-based practice data was collected and used for the creation of this OSCE as well as expert opinions on the management of an AFE.

### CHAPTER III – RESULTS

Participants completed an evaluation of the OSCE. The data collection process included a survey sent to second and third-year SRNAs and practicing CRNAs. There was a total of 60 participants. The survey's main focus was to ascertain the realism of the patient scenario provided in the OSCE and its influence on learning for those participating in it. The following six questions were examined in the survey: (1) consent to participation, (2) current level of practice, (3) determining if the model for managing an AFE during a cesarean section was realistic, (4) whether the OSCE portrays evidence of doctoral-level work, (5) verifying whether or not the OSCE would be beneficial to SRNAs who are learning the management of an AFE, (6) an open-ended question asking for feedback that would improve the OSCE.

The survey was sent to participants by email and included the AFE OSCE, a formal consent form, and the link to the survey. The link sent consenting participants to Qualtrics, a data collection website, where data was collected anonymously. The survey was open for a period of 14 days and there was a total of 54 SRNAs and 6 CRNAs who agreed to participate. Results for each question were analyzed individually. Forty-eight out of the 60 total participants answered that they “strongly agree” that the patient scenario reflected a realistic model of managing an AFE occurring during a c-section. The remaining 12 participants responded with “agree” as shown in Figure 1. Fifty-one participants responded with “strongly agree” when asked whether they believed this OSCE would be beneficial to SRNAs learning to manage an amniotic fluid embolism, while the remaining nine answered with “agree”.



*Figure 1. Patient Scenario Reflects a Realistic Model of Management of an AFE.*

The final question of the survey was open-ended for those participating to leave suggestions for improvement to the OSCE. There was not a comment left for revisions, however, there were multiple comments stating the OCSE was well done. For example, a third-year SRNA commented that they “appreciated the clear instructions”, and a second-year SRNA stated, “Fantastic job. A very well thought out OSCE that will be beneficial to any SRNA of any program.” One CRNA mentioned that this OSCE could even be incorporated into the curriculum for SRNAs completed their obstetric course.

#### Summary

The purpose of the AFE occurring during cesarean section OSCE was to create a learning tool that would provide SRNAs with the knowledge for diagnosis and treatment of an emergent obstetric event. The intention was to bridge SRNA’s didactic coursework with clinical knowledge in order to prepare them for entry into the clinical space. By participating in the OSCE, SRNAs will become increasingly familiar with a rare complication that may not be seen again until they are practicing anesthesia providers.

The amniotic fluid embolism OSCE will ensure that SRNAs are entering into practice with the tools needed to provide safe and competent care to their patients.

## CHAPTER IV – CONCLUSION

This OSCE was created with the purpose of educating SRNAs on prompt recognition and treatment of Amniotic Fluid Embolism. This doctoral project will serve as a supplementation to the USM NAP's obstetric anesthesia curriculum. The OSCE template and video that were created from the doctoral project will be available for the anesthesia students to use and can be found on the NAP application. Evidence-based data was used for research as well as best practice guidelines regarding the treatment of AFE to create the template and video. The DNP essentials were considered and met while developing this doctoral project.

The simulation presents a unique opportunity for SRNAs to practice skills in a closely monitored environment without the risk of harm to the patient. The sim lab environment allows students to participate in skills or processes repeatedly which allows them to hone their skills. There is usually a debriefing after the simulation which gives the student learner instant criticism on their performance and feedback on how to improve. This debriefing along with the open learning environment helps the SRNA practice to their fullest extent and hopefully encourages confidence in them. This repetition allows for better success in a clinical setting and therefore, creates a safer provider. AFE is a high-fidelity simulation so proper preparation didactically and in simulation can help the SRNA if they were to ever encounter AFE in clinical practice. Also, the simulation ensures patient safety because it is being performed on a simulation man. The AFE OSCE simulation will help prepare SRNAs for this high mortality rare event in a safe controlled environment.

The DNP project was surveyed by willing participants who ranged from SRNAs to CRNAs with OB experience. There were 60 total participants and the feedback was encouraging with positive qualitative and quantitative data. The response from the participants did not give any criticism for the change of the OSCE so no adjustments were made after the survey was reviewed.

In the future, the research for this doctoral project could be extended and more projects could even be created based on the success of the OSCE. More CRNAs and possibly SRNAs could be recruited to review the OSCE and put in criticism for improvements. Further research could be extended into how applicable the OSCE is for different levels of SRNAs by studying the response of 2<sup>nd</sup> years that had taken an OB anesthesia course and 3<sup>rd</sup> years close to the end of their training. The doctoral project could also be applied to the clinical setting and converted into a project on improving education for CRNAs or a project on the creation of an AFE tray with necessary drugs, equipment, and treatment protocol all in one place.

#### Summary

In conclusion, this doctoral project was created as a tool for the USM NAPs students as a tool to evaluate student learning and clinical skill consistently for infrequently occurring yet high morbidity and mortality events, Amniotic Fluid Embolism, in a simulated environment. This doctoral project focuses on early recognition and prompt treatment with early initiation of the AOK protocol. This learning tool will help to assist SRNAs in the diagnosis and treatment of AFE while in a safe environment that is conducive to learning. The use of the OSCE can help bridge the learning curve between didactic learning and the implementation of learned skills in clinical scenarios.



By becoming increasingly familiar with AFE and how to recognize and treat the event, students will be more likely to react promptly and appropriately if they were to encounter AFE in clinical practice.

## APPENDIX A – Objective Structured Clinical Exam

### Amniotic Fluid Embolism During Cesarean: OSCE Overview

**LEARNER OUTCOMES:** Students will be able to:

1. Recognize the early signs and symptoms of Amniotic Fluid Embolism (AFE).
2. Correctly utilize equipment and medications for the treatment of AFE.
3. Properly identify their role and show an ability to delegate tasks to other providers.
4. Demonstrate knowledge and importance of the AOK for the AFE algorithm.
5. Appropriate post AFE patient care and recovery.

**PURPOSE:** Exposure to infrequently occurring, high morbidity obstetric clinical situations to improve critical thinking and clinical performance.

**LEARNER OBJECTIVES:**

1. Demonstrate understanding of the pathophysiology of an AFE.
2. Identify risk factors of AFE.
3. Appropriately demonstrates proper treatment for an AFE, including all medications and equipment necessary.
4. Appropriately analyze clinical skills and self-evaluate the technique.

**DOMAINS:**

Assessment
Critical Thinking
Didactic Knowledge
Communication
Clinical Skill

**INDIVIDUAL OR GROUP OSCE:** Group

**REQUIRED READING and ASSOCIATED LECTURES:**

1. Hession, P. M., Millward, C. J., Gottesfeld, J. E., Rehring, T. F., Miller, K. B., Chetham, P. M., Muckleroy, K., Bates, C. A., & Hollis Jr., H. W., (2016). Amniotic fluid embolism: Using the medical staff process to facilitate streamlined care. *The Permanente Journal*, 20(4).  
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3. Chestnut, D. H., Wong, C. A., Tsen, L. C., Ngan Kee, W. D., Beilin, Y., & Mhyre, J. M. (2014). Embolic disorders. In *Obstetric anesthesia: Principles and practice* (5th ed., pp. 915–920). Elsevier Saunders.

**REQUIRED VIDEO:** [https://smтт-my.sharepoint.com/personal/w161864\\_usm\\_edu/Documents/Attachments/NAP\\_AFE\\_OSCE\\_VIDEO.mp4](https://smтт-my.sharepoint.com/personal/w161864_usm_edu/Documents/Attachments/NAP_AFE_OSCE_VIDEO.mp4)

**STUDENT LEVEL OF OSCE:** Semester 6-9

**TIME ALLOTTED:** 30 minutes for simulation

**RECOMMENDED PRACTICE BEFORE EVALUATION:** No practice is necessary prior to participation. Highly recommend reading and video aids. Along with reviewed AFE treatment guidelines.

<b>CONTEXT OUTLINE</b>
------------------------

**SCENARIO:** A 37-year-old female, Mrs. B., has presented for a scheduled, routine cesarean section for macrosomia. She is Gravida 3, Para 0. Her pregnancy has been complicated by gestational diabetes. She has hypertension that is well controlled with medication. She is otherwise healthy. She has a 20g PIV in her left hand and a nasal cannula already applied. Spinal anesthesia has already been administered, and Mrs. B. has been prepped and draped for surgery.

**VITAL SIGNS:** Initial vital signs for Mrs. B are as follows: BP 135/89, HR 87bpm, SpO2 99% on room air, RR 14bpm

**CONTEXT:** An amniotic fluid embolism is a rare yet fatal obstetric event. Due to its rarity, many anesthesia providers have limited experience with diagnosing and treating an AFE. However, if an AFE does occur under the care of a CRNA, they will be expected to act quickly and competently in order to save the patient’s life.

**EQUIPMENT & SUPPLIES:**

1. Anesthesia Machine with Circuit
2. LAERDAL SIM MAN
3. Monitors:
  - a. 5-lead electrocardiogram
  - b. pulse oximeter
  - c. blood pressure
  - d. end-tidal carbon dioxide
4. General Anesthesia setup

5. Drug cart, syringes, and needles
6. Code cart with drugs and defibrillator
7. A-OK: Atropine, Ondansetron, Ketorolac (should be on drug cart)
8. Blood Products Available: PRBCs, platelets, FFP, cryoprecipitate, Factor VII
9. Blood pressure support: Phenylephrine, Ephedrine, Vasopressin, Calcium Chloride (also should be available in drug cart)
10. Arterial Line setup
11. Central Line Setup
12. TEE - Available

**TASK STATEMENT:** Your task is to demonstrate an understanding of the amniotic fluid embolism treatment pathway for anesthesia by appropriately treating both early and late-stage symptoms of AFE and peripherally supporting surgical staff as able.

**PROCESS:**

1. The patient is prepped and draped. Vital Signs are stable. Lactated Ringer bolus is running through a peripheral IV. Spinal anesthesia is in effect. The patient is wearing a nasal cannula at 2L/min with ETCO<sub>2</sub> monitoring. She is alert and ready for the cesarean section to begin.
2. The surgeon makes the initial incision and begins a cesarean section.
3. The patient becomes hypotensive.
4. The patient begins complaining of feeling anxious and seems to be working harder to breathe.
5. Blood pressure drops further
6. The patient becomes unresponsive/Hemodynamic collapse
7. Notify the Surgeon/Immediate delivery of the baby
8. Initiate ACLS and Call for help
9. Intubate patient
10. A-OK Protocol
11. Support with vasopressors, inotropes, fluid, and blood products
12. Call blood bank for emergency blood product release
13. Anticipate mass hemorrhage:
  - a. Arterial line
14. Consider TEE
15. Once stabilized, transfer to ICU.

**DEBRIEFING FORM:**

1. Could you properly recognize an amniotic fluid embolism?
2. How would you describe your ability to navigate through the AFE treatment plan?
3. Is the suggested practice enough to make you feel capable of identifying and treating an AFE? If not, why not?
4. What did you like about this OSCE?
5. What would you change about the OSCE?

<b>RUBRIC FOR AMNIOTIC FLUID EMBOLISM IDENTIFICATION AND MANAGEMENT</b>			
<b>TASKS</b>	<b>PASS</b>	<b>FAIL</b>	<b>COMMENTS</b>
Recognizes the signs and symptoms of an amniotic fluid embolism			
Notifies the surgeon and calls for help			
Administer 100% Oxygen			
ACLS with high-quality CPR			
Administer vasopressors to maintain a MAP > 65			
Administer Atropine, Ondansetron, and Ketorolac  <ul style="list-style-type: none"> <li>- Atropine 1 mg IV</li> <li>- Ondansetron 8 mg IV</li> <li>- Ketorolac 30 mg IV</li> </ul>			
Notifies Blood Bank of possible massive transfusion protocol  <ul style="list-style-type: none"> <li>- Administer blood products in a 1:1:1 ratio</li> </ul>			
Prepare for massive blood transfusion: Large-bore IVs, Arterial Line, and consider central line placement.			

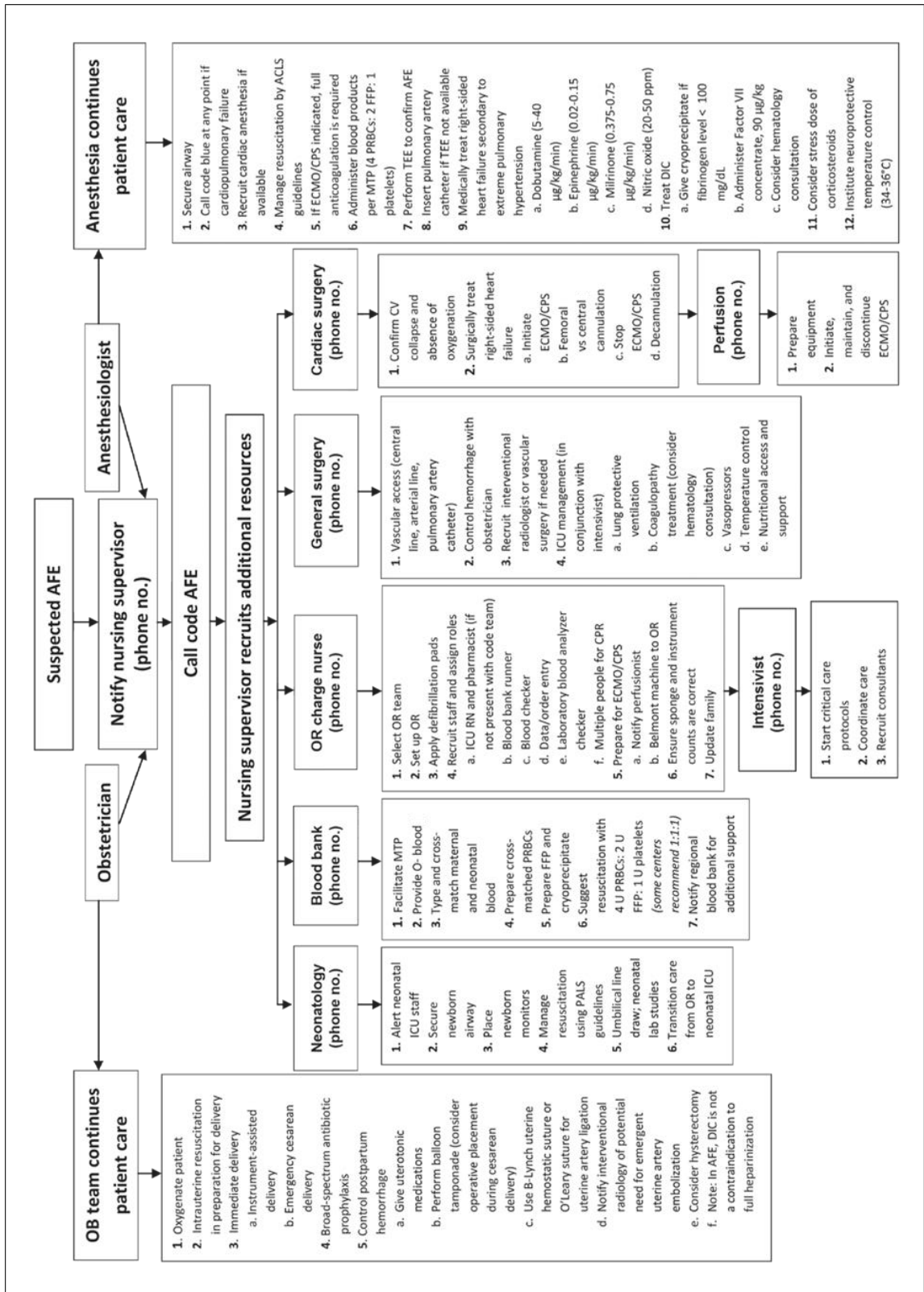
Consider bedside TTE			
Transfer to ICU once stabilized			

The OSCE by the student demonstrates the foundation of amniotic fluid embolism occurring during cesarean section: (Circle one) **PASS/FAIL**

Does the student need to repeat this OSCE at a later date to satisfy learning requirements? (Circle one) **YES/NO**

**If YES, Date to return for evaluation:** \_\_\_\_\_

**EXAMINER:** \_\_\_\_\_ **DATE:** \_\_\_\_\_



(Hession et al, 2016)



APPENDIX B – Evaluation Tool

Amniotic Fluid Embolism During Cesarean Section Objective Structured Clinical Exam

Morgan Self and Mackenzie Acosta

\*Participation is voluntary and there are no repercussions for not participating in the survey.

\*Responses to this survey will be anonymous

		<b>Comments</b>
Do you agree to participate and consent to the online voluntary survey?	Yes          No	
Are the learning objectives clear?	Strongly Agree Agree Neither Agree nor Disagree Disagree Strongly Disagree	
The patient scenario reflects a realistic model of managing an amniotic fluid embolism during c-section	Strongly Agree Agree Neither Agree nor Disagree Disagree Strongly Disagree	
The objective structured clinical exam shows evidence of doctoral-level work	Strongly Agree Agree Neither Agree nor Disagree Disagree Strongly Disagree	
Implementation of this OSCE will be beneficial to student registered nurse anesthetists learning how to manage amniotic fluid embolism	Strongly Agree Agree Neither Agree nor Disagree Disagree Strongly Disagree	
Please provide any feedback/suggestions to add to the OSCE.		

APPENDIX C – IRB Approval Letter

Office of  
Research Integrity



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**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: 22-013  
PROJECT TITLE: Amniotic Fluid Embolism Occurring During Cesarean Section Objective Structured Clinical Exam  
SCHOOL/PROGRAM: Leadership & Advanced Nursing  
RESEARCHERS: PI: Morgan Self  
Investigators: Self, Morgan-Mclain, Nina Elisabeth-  
IRB COMMITTEE ACTION: Approved  
CATEGORY: Expedited Category  
PERIOD OF APPROVAL: 18-Jan-2022 to 17-Jan-2023

Donald Sacco, Ph.D.  
Institutional Review Board Chairperson

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