Increasing Confidence of Certified Registered Nurse Anesthetists in Managing an Amniotic Fluid Embolism – A Quality Improvement Project

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Submitted in partial fulfillment of the

requirements for the degree of Doctor of Nursing Practice

Finalized November 30, 2025

Notes from the Author

I want to thank the numerous faculty and staff who assisted me throughout my journey to become a CRNA. Thank you for the countless hours you have spent teaching me and helping me learn the art of anesthesia. I also want to thank all my preceptors and clinical coordinators for assisting me in completing my site work for this project. I sincerely thank Dr. Nikki Roebuck for her countless hours answering all my questions and critiquing my project. This project would not be possible without your patience, guidance, and leadership. Thank you to Dr. Chabo and the admissions committee for taking a chance and admitting me into the CRNA program in 2022. You all have changed my life forever. Thank you!

Lastly, I want to dedicate this DNP Project to my husband, Hunter, my parents, my Mommom, and my friends, both in the program and out. I truly could not have completed this without you all. To my church family and Sisters in Christ, thank you all for spending countless hours praying for me before every test or big event. Thank you! Class of 2026 fellow Pirate Student Anesthetists, and future DNP Nurse Anesthesia students, keep your head up and strive to be the best version of yourselves. Completing CRNA school is not easy, nor is it a short endeavor; however, you will succeed. I hope future cohorts will be motivated to continuously learn about anesthesia practice as they carry on the Pirate Anesthesia legacy. Take it one day at a time - you can do it!

Abstract

Amniotic fluid embolisms (AFE) are a rare obstetrical emergency with high mortality in the gravid patient and fetus, increasing both healthcare costs and stress for the patient, their family, and the provider. Data regarding AFE events are inconclusive, leaving CRNAs to rely on clinical judgment during this obstetrical emergency. The purpose of this quality improvement project is to assess whether the creation of a newly developed cognitive aid increased the confidence of CRNAs in identifying and managing an AFE event. A literature review was conducted to gather current recommendations on AFE events and the use of cognitive aids in anesthetic practice. A cognitive aid was then developed to illustrate the recommended steps for identifying and managing AFE events. The cognitive aid and current literature were presented to the CRNAs before their shift at a critical access hospital in Northeastern North Carolina. The participants (n = 3) completed both a pre- and post-presentation survey to gauge their thoughts on the tool and determine whether they perceived an increase in confidence. During data comparison, the use of a cognitive aid increased CRNA confidence in identifying and managing AFE events. An increase in CRNA confidence when using the tool will help reduce the likelihood of missing critical steps during an AFE event. However, due to the small sample size, further research is needed on the topic. Future research on AFE events can increase CRNA confidence while decreasing mortality for the fetus and parturient.

Keywords: AFE event, cognitive aid, CRNA confidence, critical access hospital

Table of Contents

Section I. Introduction

Background

Amniotic Fluid Embolism (AFE), also termed Anaphylactoid Syndrome of Pregnancy, is a rare and life-threatening maternal condition. AFE is in the top three leading causes of maternal mortality in the United States, the United Kingdom, China, France, and Poland. The incidence of Amniotic Fluid Embolism varies across countries due to differences in reporting criteria, making an AFE event difficult to identify. The incidence of AFE in North America and Europe is reported to be 1 in 15,200 to 53,800 deliveries, making it a rare event (Lao, 2022). Additionally, standardization of care for AFE events has not been identified. AFE is also a complex medical phenomenon, leading to a high mortality rate among parturients. Depending on the country, the mortality rate ranges from 13-27%, with seven percent of surviving mothers having permanent neurological injuries.

AFE is a complex disease to diagnose and treat because it lacks a distinguished medical definition, and there is no precise mechanism of action regarding its etiology. According to Clark (2014), some obstetricians note that AFE is the result of remnants of amniotic fluid and parts of the placenta entering the mother's bloodstream to create an occlusion in the lungs and heart, resulting in cardiovascular collapse. However, other obstetricians state that the term Anaphylactoid Syndrome of Pregnancy is a more appropriate term for AFE because remnants of amniotic fluid or placental fragments cause a systemic inflammatory response in the mother, leading to cardiovascular collapse (Clark, 2014). There is also a lack of consensus regarding treatment recommendations for a suspected AFE event. Certified Registered Nurse Anesthetists (CRNAs) must understand the differential diagnoses and clinical presentation of AFE to identify

patients at risk for an AFE event and provide treatment recommendations during a suspected obstetrical emergency.

Two authors in the literature explained that AFE presents as a Systemic Inflammatory Response Syndrome (SIRS), which evolves from mast cell degranulation and a histamine release (Clark, 2014; Moore, 2023). Mast cell degranulation and histamine release trigger a coagulation cascade, ultimately leading to Disseminated Intravascular Coagulation (DIC) in a patient with AFE. The coagulation crisis and histamine release from DIC can make a diagnosis of an AFE event difficult to distinguish from both medical conditions and other obstetric emergencies. Fardelmann and Alian (2020), Lao (2022), and Pacheco et al. (2020) combined the above hypothesis and stated that an AFE is due to activation of the coagulation cascade from mast cell degranulation, along with a SIRS response after fetal contents are introduced into the maternal bloodstream. The AANA (2022), Chiao and Sheeran (2020), and Combs et al. (2021) all had similar stances on the pathophysiology of AFE. They explain that an AFE event results from a reaction to the release of fetal material into the parturients circulation. Chiao and Sheeran (2020) further reported that the pathophysiological events of an AFE result in a physical obstruction of the pulmonary vessels from fetal components in the maternal bloodstream. However, Clark (2014) discussed that the researchers previously tested the hypothesis in various animals and terminally ill ovarian cancer patients. However, there was no replication of obstruction of the maternal pulmonary capillary system from fetal debris. One experiment noted by Clark (2014) infused 80% of the uterine volume into a primate's bloodstream to measure the effects of an obstruction, but the researchers did not elicit an AFE event. Hence, to successfully manage an AFE event, a provider must understand its pathophysiology. Without consensus on the

pathophysiology, a parturient's AFE event may not be evident, leading to conflicting diagnostic and reporting criteria.

The incidence of AFE is also controversial. Most authors in the published literature report an incidence of AFE between 1.9 and 6.1 per 100,000 deliveries (Clark, 2014; Combs et al., 2021; Lao, 2022; Pacheco et al., 2020). Fardelmann & Alian (2020) and Lao (2022) reported that the incidence rate is 1.7 to 6.6 per 100,000 deliveries. Conversely, the incidence of AFE reported by Moore (2023) ranged from 2 to 8 per 100,000 deliveries. The Moore (2023) numbers did not align with any of the reviewed literature. Clark (2014) and Chiao and Sheeran (2020) stated that the incidence was more accurately estimated to be 1 in 40,000 births. Likewise, 30-60% of patients diagnosed with AFE did not meet the current diagnostic criteria (Clark, 2014; Lao, 2022). Regarding the mortality rate of an AFE event, both Pacheco et al. (2020) and Clark (2014) estimated it at 60%. Chiao and Sheeran (2020) also reported a similar estimate for the mortality rate of AFE, ranging from 40% to 80%. This further exemplifies the high mortality rate of this obstetrical emergency and the need for quick identification and management to optimize patient outcomes.

All the authors who discussed the risks of AFE identified an increased incidence in patients undergoing mechanical induction and patients of advanced maternal age. One study specified an increased risk of an AFE event if the mother is greater than 35 years old, delivery of the fetus via cesarean section, and/or a diagnosis of placenta previa (Chiao & Sheeran, 2020; Clark, 2014; Fardelmann & Alian, 2020). However, Clark (2014) and Fardelmann and Alian (2020) included risks such as multiple gestation pregnancy and the use of instruments to assist with the delivery of the fetus. Placental abruption was also listed as a risk factor for AFE (Chiao & Sheeran, 2020; Clark, 2014). Clark (2014) explained that the most prominent risks for an AFE

event included cervical trauma, uterine tachysystole or tetany, a mother belonging to a minority ethnic group, and a male fetus. Chiao and Sheeran (2020) included operative vaginal delivery, uterine rupture, and coexisting eclampsia as risk factors for an AFE event. Fardelmann and Alian (2020) also examined the factors that increase mortality risk. Those factors included advanced maternal age, obesity, hypertension, coexisting heart disease, non-Hispanic black mothers, or foreign-born mothers. Non-Hispanic black mothers and foreign-born mothers can be at increased risk of mortality due to their socioeconomic status. The goal of the Triple Aim is to improve the health of the population, including ethnic minorities (Institute for Healthcare Improvement, n.d.-a).

Furthermore, AFE events are more prevalent among ethnic minorities (Clark, 2014). In 2018, the North Carolina Department of Health and Human Services, Division of Public Health (NCDHHSDPH) found that 55.7% of births within the health system where this QI project was performed had birthing mothers who identified as Hispanic or African American (2024a). Furthermore, the NCDHHSDPH (2022) included strategies in its Perinatal Health Strategic Plan to reduce severe maternal morbidity and pregnancy-related mortality. This included identifying racial disparities and reducing severe maternal mortality of non-Hispanic Black women by ten percent. Developing a cognitive aid to present recommended practice guidelines for identifying and treating a suspected AFE may provide a clearer understanding of the steps for managing an AFE during an obstetrical emergency, thereby increasing CRNA confidence in effectively identifying and managing a suspected AFE event. Due to the overlapping signs and symptoms and high patient morbidity and mortality of AFE, CRNAs must be able to quickly recognize and manage AFE early to decrease maternal mortality rates.

Organizational Needs Statement

No current policies and procedures were identified on the electronic policy database at the project site. A contributing factor may be the limited consensus in the literature, which may increase organizational challenges in establishing comprehensive policies. This quality improvement project was undertaken to address opportunities to develop standardized, evidence-based policies within the organization for this obstetrical emergency. To accomplish the Triple Aim and the NC Perinatal Health Strategic Plan, the project site may benefit from developing a reference guide for CRNAs regarding identifying and managing an AFE event. Although AFE events are infrequent, CRNAs must be prepared due to the significant morbidity and high mortality rates.

Problem Statement

The current practice recommendations for identifying and managing an Amniotic Fluid Embolism (AFE) lack consensus. The lack of agreement leaves anesthesia providers to use various methods to identify and manage an AFE event, based on their clinical experience and personal preferences. A lack of congruence and/or agreement on best-practice treatment recommendations may decrease CRNAs' confidence in identifying and managing an AFE. Currently, there are no policies at the project sites regarding AFE diagnosis or treatment. Therefore, a cognitive aid based on current best-practice recommendations for identifying and managing an AFE event may assist CRNAs in faster identification and more effective management. Referencing current treatment recommendations may increase CRNAs’ confidence in managing an AFE, potentially improving patient outcomes.

Purpose Statement

This Doctor of Nursing Practice (DNP) quality improvement project aimed to assess the usefulness of a newly developed reference guide for anesthesia providers in identifying and managing AFE events. Additionally, the author assessed whether the reference guide impacted CRNA confidence in identifying and managing AFEs. Knowledge gained from this project could inform future quality improvement initiatives to diagnose and treat AFEs.

Section II. Evidence

Description of Search Strategies

The Problem, Intervention, Comparison, Outcome, Time, and Setting (PICOTS) question used to conduct the initial literature search was: How will a video-simulated scenario of an amniotic fluid embolism event improve confidence among Certified Registered Nurse Anesthetists (CRNAs) and Labor and Delivery staff in identifying and managing an AFE? The literature search based on the original PICOTS question yielded few results. This author attempted to modify the search, based on the original PICOTS question, to elicit more results. Nevertheless, the results remained sparse. This author reviewed and discussed the literature findings on a simulated AFE event with the project chair, and a proposed project tool was developed. However, it was evident that the proposed project would not be feasible to complete within the determined timeline. Upon further discussion, the project team discovered that an AFE-specific reference tool was needed within the organization.

The initial search strategy was conducted in ProQuest and PubMed, including the following concepts: "(AFE or Amniotic Fluid Embolism) AND (CRNA or Nurse anesthetists or Anesthesia) AND (recognition or diagnosis)." This search provided 25 results. Articles on the first two pages of PubMed and the first three pages of ProQuest were examined to see if they matched the limitations that were set. To be kept for full-text review, all articles were required to be in English, published within the past five years (2019-2024), address AFE or Anaphylactoid Syndrome of Pregnancy as the subject, and have implications for anesthesia providers. Sixteen results were selected for further examination through a full-text review, and eight articles were retained to inform the project.

Based on the above discussion, another literature search on the use of a cognitive aid to improve CRNAs' confidence in identifying and managing an amniotic fluid embolism was conducted using ProQuest and PubMed. The following search strategy was used in ProQuest and PubMed: “((CRNA OR "Nurse Anesthesia" OR "Anesthesiology") AND ("cognitive aid" OR "handout")).” This search yielded 49 results in PubMed and 4 in ProQuest. PubMed and ProQuest were limited to publications within the past five years (2019-2024), literature written in English, and peer-reviewed studies. The ProQuest search also included the limitation criteria of DNP Projects and QI projects that created a cognitive aid or handout for their implementation. The PubMed search results were also filtered to include only literature written in English, published within the past five years (2019-2024), focused on anesthesia, and implemented in an operative setting (i.e., Perioperative, Intraoperative, or Postoperative). After reading the titles and abstracts of all the ProQuest articles and all the articles on the first two search pages of PubMed, six PubMed articles were kept for full-text review, and one of the ProQuest articles was kept for full-text review. All articles kept for full-text review were conducted in an operative setting, included anesthesia providers, were a DNP Project, or created a cognitive aid for their project implementation. Four articles were retained to inform the project. See Appendix A for the literature concept chart. See Appendix B for the Literature Search Log. Following the literature search, four articles on the project tool and eight on AFE were retained. A total of 12 publications informed the project. See Appendix C for the complete Literature Matrix.

The retained literature was evaluated using the MeInyk and Fineout-Overholt Levels of Evidence classification system (Brown, 2018), with Level I being the highest & Level VII being the lowest. There was one systematic review (Level I), one randomized controlled study (Level

II), and one quality improvement project (Level V). Nine studies were classified as Level VII, comprising six expert opinions, one qualitative study, one case study, and one seminal study.

Selected Literature Synthesis

Signs and Symptoms of AFE

The literature on AFE can be divided into three categories: signs and symptoms, diagnosis, and treatment and management. Although the literature shows similarities, it also shows differences. The AANA (2022) provides an extensive list of signs and symptoms of AFE. Some of the signs and symptoms include maternal anxiety and a sense of doom, change in mental status, dyspnea, cough, headache, chest pain, tachycardia, bronchospasm, uterine atony, seizures, and loss of end-tidal carbon dioxide readings. Cardiovascular collapse and cardiac arrest are among the most prominent and severe side effects and outcomes (AANA, 2022; Clark, 2014; Pacheco et al., 2020).

An AFE event occurrence accompanies an onset of distinguishable symptoms either during labor or within 30 minutes after delivery of the fetus (Clark, 2014). A provider may observe hypotension, coagulopathy, sudden desaturation, and hypoxia of the parturient (AANA, 2022; Clark, 2014). There is an increased risk of lung injury, acute respiratory distress syndrome (ARDS), multi-organ dysfunction syndrome (MODS), and hypoxic brain injury if the mother survives the initial cardiovascular collapse of the AFE event (Clark, 2014). Fetal distress is commonly observed due to the parturient's hemodynamic instability, hypoxia, and coagulopathy (AANA, 2022; Clark, 2014). Chaio and Sheeran (2020) published a suspected AFE event within the context of a case study. The parturient in the case had blood-tinged cerebrospinal fluid (CSF) after an epidural was placed. The authors believed this was likely the first sign of an AFE event. According to the authors, the providers missed this initial sign. The parturient had pink, frothy

secretions and a prolonged, undetectable fibrinogen thromboelastometry (FIBTEM) clotting time, decreased maximum clot firmness, and reduced amplitude on her blood work - further demonstrating the occurrence of a coagulation crisis.

The signs and symptoms of an AFE event can occur in various stages (Lao, 2022; Moore, 2023). It is inconclusive whether there are two or four stages. Although the authors differ in their views on the number of stages, they agree on the key components of the described phases. Lao (2022) explained that an AFE event begins when small amounts of amniotic fluid enter the maternal bloodstream via the maternal-fetal interface. The mother develops an "aura," a sense of impending doom. Other signs and symptoms may include breathlessness, chest pain, chills, nausea, vomiting, numbness, tingling, lightheadedness, restlessness, agitation, distress, panic, altered mental status, and fetal distress. The amniotic fluid materials arrive in bulk at the pulmonary vasculature. The amniotic fluid remnants cause vasoconstriction and a vasospasm of the pulmonary arteries, leading to pulmonary hypertension and elevated right ventricular pressures (Lao, 2022; Moore, 2023). These initial events may cause right ventricular infarction, displacement of the interventricular septum to the left side of the heart, and decreased cardiac output. Ultimately leading to left ventricular failure, ischemic injury, myocardial depression, and hypoxia. The signs and symptoms cause cardiogenic pulmonary edema and fetal demise from the global hypoxia (Lao, 2022). However, other authors in the literature refute the theory that AFE events occur from amniotic fluid remnants. Clark (2014) reported that amniotic fluid was injected into animals, and no cardiovascular collapse was observed.

Despite the disagreement of the initial causative agent, if the parturient survives the initial cardiovascular collapse, intravascular coagulopathy, also known as Disseminated Intravascular Coagulation (DIC), is often observed next (Lao, 2022; Moore, 2023). A Systemic Inflammatory

Response Syndrome (SIRS) response leads to DIC, postpartum hemorrhage, hemodynamic instability, and MODS. The SIRS response activates inflammatory mediators to attempt to combat a detected pathogen. In an AFE event, the pathogen is the amniotic fluid.

Diagnostic Criteria for AFE

To have a diagnosis of AFE, a patient must meet four criteria (Chiao & Sheeran, 2020; Clark, 2014). The patient must have a triad of signs, and the fourth criterion is symptoms that begin either during delivery or within 30 minutes thereafter. The triad consists of sudden hypoxia, hypotension, and coagulopathy (Chiao & Sheeran, 2020; Clark, 2014). Various authors in the literature have discussed the importance of identifying other obstetrical emergencies that may have overlapping signs and symptoms with an AFE event. Eclampsia, abruptio placentae, anaphylaxis, aortic dissection, aspiration pneumonitis, fat embolism, myocardial infarction, pulmonary embolism, and septic shock are all conditions that may have signs and symptoms that will also occur in a parturient with an AFE event (Clark, 2014; Long et al., 2022; Moore, 2023). Combs et al. (2021) explained that a high spinal block may also exhibit signs and symptoms like those of an AFE event.

Some authors discussed using various devices such as an echocardiogram (ECHO), transesophageal echocardiogram (TEE), pulmonary-arterial (PA) catheter, or Rotational Thromboelastometry (ROTEM) to aid in the identification of an AFE (Clark, 2014; Combs et al., 2021; Fardelmann & Alian, 2020; Lao, 2022). Providers have reported visualization of fetal remnants within the cardiovascular system after using a TEE or ECHO. Understanding how an AFE event is diagnosed and knowing the tools available for diagnosis can help an anesthesia provider recognize the crisis earlier.

Treatment Options for AFE

Treatment of an AFE event varies within the selected literature. The American Association of Nurse Anesthesiology (2022), Chiao and Sheeran (2022), Clark (2014), and Pacheco et al. (2020) recommend Cardiopulmonary Resuscitation (CPR), management of the coagulopathy associated with DIC, and correction of hemodynamic instability as treatments for a suspected AFE event. The American Association of Nurse Anesthesiology (AANA, 2022) also recommended administering medications during an AFE event, as outlined in the mnemonic "AOK." This treatment includes 0.2-1 mg of Atropine, 8 mg of Ondansetron, and 15-30 mg of Ketorolac. Authors within the literature recommend using vasopressors such as Norepinephrine, Epinephrine, and Vasopressin, along with fluid resuscitation to combat hemodynamic instability (Clark, 2014; Combs et al., 2021; Fardelmann & Alian, 2020; Pacheco et al., 2020). The authors also recommend managing DIC via massive transfusion of blood products and cryoprecipitate (Clark, 2014; Combs et al., 2021; Fardelmann & Alian, 2020; Pacheco et al., 2020). Some authors recommend novel treatments for AFE, including prostacyclin, inhaled nitric oxide, C1 esterase inhibitors, and high-dose corticosteroids (Clark, 2014; Combs et al., 2021; Fardelmann & Alian, 2020; Lao, 2022).

All authors of the articles within the literature search recommended using a variation of supportive therapy for the treatment of an AFE event (AANA, 2022; Chaio & Sheeran, 2020; Combs et al., 2021; Fardelmann & Alian, 2020; Lao, 2022; Moore, 2023; Pacheco et al., 2020). Supportive treatment includes providing the patient with oxygenation, mechanical ventilation, and medications to decrease hemodynamic instability. Clark (2014), Combs et al. (2021), Fardelmann and Alian (2020), Lao (2022), and Pacheco et al. (2020) all recommend using selective pulmonary vasodilators, which include inhaled nitrous oxide, an aerosolized

prostacyclin analog, and enteric sildenafil. Selective pulmonary vasodilators minimize the right heart strain with an AFE event.

Supportive treatment also consists of effective CPR, intravenous fluids, extracorporeal membrane oxygenation (ECMO), use of vasopressors and positive inotropes, and left uterine displacement for additional hemodynamic support (AANA, 2022; Chiao & Sheeran, 2020; Combs et al., 2021; Lao, 2022; Pacheco et al., 2020). Although intravenous fluid is recommended, anesthesia providers must aim to maintain euvolemia or slight hypervolemia, as excessive fluid administration can increase right heart strain (Combs et al., 2021; Moore, 2023; Pacheco et al., 2020). The preferred vasopressor for hypotension is norepinephrine, and inotropic medications are also recommended to increase cardiac output and blood pressure (AANA, 2022; Combs et al., 2021; Lao, 2022; Pacheco et al., 2020). Left uterine displacement helps to alleviate the pressure the fetus places on the inferior vena cava, increasing cardiac return and cardiac output (AANA, 2022; Combs et al., 2021; Pacheco et al., 2020). If all supportive measures to re-establish hemodynamic stability have been exasperated, use of ECMO, a balloon pump, a ventricular assist device, or cardiopulmonary bypass is recommended to provide hemodynamic support for the parturient (AANA, 2022; Chiao & Sheeran, 2020; Clark, 2014; Combs et al., 2021; Fardelmann & Alian, 2020; Lao, 2022; Moore, 2023; Pacheco et al., 2020). A preferred hemodynamic support regimen was not specified.

Coagulopathy is often the final phase of an AFE event; however, it is the leading contributor to parturient mortality (Lao, 2022; Moore, 2023). Chiao and Sheeran (2020), Combs et al. (2021), Fardelmann and Alian (2020), and Pacheco et al. (2020) all recommend monitoring the parturient's coagulation using a Thromboelastography (TEG) or Rotational Thromboelastometry (ROTEM). The gold standard of treatment for coagulopathy in patients

experiencing an AFE event is with a massive transfusion protocol (MTP; AANA, 2022; Chiao & Sheeran, 2020; Combs et al., 2021; Fardelmann & Alian, 2020; Pacheco et al., 2020). The Massive Transfusion Protocol (MTP) involves using blood products, including packed red blood cells (PRBCs) and fresh frozen plasma (FFP), to correct prolonged aPTT and low hemoglobin, fibrinogen, and platelet levels. Cryoprecipitate can be included in the MTP to replace fibrinogen, von Willebrand Factor (vWF), and factors VIII and XIII. (Combs et al., 2021; Lao, 2022; Moore, 2023; Pacheco et al., 2020). The products are administered as one unit each of PRBCs, platelets, and FFP, in sequence. However, authors recommend that MTP should be administered based on the parturient's labwork to minimize volume overload and excess strain on the right side of the heart (Clark, 2014; Combs et al., 2021). During the coagulation crisis of the parturient, cryoprecipitate may be preferred over FFP to help minimize excessive volume administration (Combs et al., 2021).

If the patient remains in a coagulation crisis, administration of adjuncts including tranexamic acid (TXA), factor VIIa, prothrombin complex concentrate (PCC), or plasmapheresis via intermittent hemodialysis may help reverse the crisis in the parturient (AANA, 2022; Chiao & Sheeran, 2020; Combs et al., 2021; Fardelmann & Alian, 2020; Lao, 2022; Moore, 2023; Pacheco et al., 2020). These adjuncts target various steps in the coagulation cascade to help reverse the crisis, and plasmapheresis removes the immune factors that initiate it. Although some authors recommend using Factor VIIa, others reported that its use results in MODS and death due to the clotting that occurs during administration (Clark, 2014; Moore, 2023). Additionally, treatment of the coagulation crisis also includes maintaining normothermia, treating electrolyte imbalances, and being cognizant of using an epidural in a coagulopathic patient (AANA, 2022;

Lao, 2022). Early recognition of coagulopathy in a patient who has received an epidural can help diminish the incidence of an epidural hematoma and decrease bleeding.

An additional treatment during an AFE event may necessitate a perimortem cesarean section (Chiao & Sheeran, 2020; Clark, 2014; Combs et al., 2021; Fardelmann & Alian, 2020; Moore, 2023). A perimortem cesarean may reduce the amount of blood shunted from the maternal circulation, thereby improving cardiac output. To further reduce uteroplacental bleeding, prophylactic oxytocin or early laparotomy with accompanying hysterectomy may be used (Chiao & Sheeran, 2020; Combs et al., 2021; Fardelmann & Alian, 2020). Novel treatments, such as high-dose corticosteroids or a C1 esterase inhibitor, are also recommended for managing an AFE event (Fardelmann & Alian, 2020).

Use of Cognitive Aid

This literature synthesis included four articles in which the authors reported the use of cognitive aids to improve nursing practice (Hardy, 2024; Saxena et al., 2020; vanHaperen et al., 2024; Yoong et al., 2021). In each article, the authors discussed providers' views on the use of cognitive aids. Most providers preferred using cognitive aids (Saxena et al., 2020). However, their willingness to use the aid was related to experience level, with both experienced and new providers showing greater appreciation for the tool. The authors discussed how a cognitive aid should be tailored to a provider's workflow and clinical environment (Hardy, 2024). Without tailoring the cognitive aid to healthcare providers or providing specialized training in its use, a cognitive aid can increase providers' workload (Saxena et al., 2020). Subsequently, it can be difficult to find time to complete all the steps, and excessive use of a cognitive aid can lead to checklist fatigue (Saxena et al., 2020; Yoong et al., 2021). Saxena et al. (2020) stated that no benefit in perioperative morbidity has been reported with a cognitive aid, and that using an

equipment checklist produced the same results as not using one. However, the above statements are true only when the cognitive aid is used incorrectly, providers do not receive appropriate training, or if a cognitive aid is redundant (Yoong et al., 2021). When a cognitive aid is not created for the appropriate audience or is ineffective in its implementation, one may see fixation errors, premature diagnosis, communication biases, and fatigue with the checklist (Hardy, 2024; Saxena et al., 2020; Yoong et al., 2021).

Alternatively, cognitive aids are beneficial in a variety of clinical settings. Despite highlighting the disadvantages, each of the authors of the above articles also discussed the benefits of cognitive aids in the healthcare setting. Using a cognitive aid helps decrease blood loss, wound infections, surgical complications, handoff time, and surgical failure rates (Hardy, 2024; Saxena et al., 2020; Yoong et al., 2021). Although cognitive aids have been thought to increase handoff time, the opposite was noted (Saxena et al., 2020; Yoong et al., 2021). Lastly, cognitive aids can enhance teamwork and communication, improve provider performance, decrease errors, and improve the effectiveness of accomplishing critical tasks in the operating room (Hardy, 2024; Saxena et al., 2020; vanHarpen et al., 2024; Yoong et al., 2021).

As previously stated, for a cognitive aid to be effective, it must be tailored to its audience. Hardy (2024) and Saxena et al. (2020) discussed key considerations for creating a cognitive aid. When creating a cognitive aid, one must consider team dynamics and its clinical application (Hardy, 2024). Both of which will improve the tool's effectiveness. If a cognitive aid is going to be effective, it must be consistently updated (Saxena et al., 2020). If a cognitive aid is not updated regularly, outdated practice recommendations may lead to errors in practice.

As noted previously, there is no consensus on how to synthesize best-practice methods for identifying and managing an AFE event, which may lead to inconsistent practices. After

reviewing the literature, identifying relevant symptoms, and listing management strategies, CRNAs can be guided in an emergent situation when an AFE is suspected. Although there are variations in the recommendations, these details may or may not help manage an AFE event. A succinct, evidence-based strategy for identifying and managing an AFE event can be compiled into an updated cognitive aid. Although there are barriers to providers' perceptions regarding cognitive aids, researchers have reported that using a cognitive aid reduces errors and decreases missed critical steps during an anesthesia-related emergency. Combining current literature on amniotic fluid embolisms and research on effective cognitive aid use may assist in earlier identification of suspected AFE events and more efficient management.

Project Framework

The framework used to guide this project was based on the Institute for Healthcare Improvement - Model for Improvement (IHI, n.d.-b; Langley et al., 2009). The IHI Model for Improvement is a framework that helps distinguish clear goals for the quality improvement project. The Plan-Do-Study-Act (PDSA) cycle is intended to be used throughout the project to create a test to change. A plan is first created to test the change; the change is carried out, observed, data is collected, and the data is analyzed to determine whether modifications are needed before implementing the next cycle. Each of these actions makes up a part of the PDSA cycle. The PDSA cycle for this quality improvement project consisted of conducting a literature review and designing the project in tandem with three other DNP anesthesia students, under the guidance of the project chair and course director. The cycle also included an in-service for CRNAs, with updates on perioperative management of AFE events and the use of an AFE checklist to guide management during subsequent AFEs.

A pre-survey was administered before providers attended the in-service presentation. After the presentation, a post-survey was also administered to participants. The pre-and post-survey results were used in the study phase of the PDSA cycle. Lastly, the effectiveness of the quality improvement project was analyzed, and a plan for future cycles was reported.

Ethical Considerations and Protection of Human Subjects

To ensure the protection of human subjects - research and project ethics training was completed through the Collaborative Institutional Training Initiative (CITI) Program (https://www.citiprogram.org/index.cfm?pageID=14). These modules were completed before the start of the project and covered ethical considerations in research. The project then completed a screening process through the East Carolina College of Nursing, which found it suitable for categorization as a quality improvement project (see Appendix D). Following approval from the College of Nursing, a second approval was obtained from the East Carolina University (ECU) University Medical Center IRB (ECUCIRB) to determine whether the project could be designated as a Quality Improvement project and to grant permission to implement and collect data within the partnering medical system. This project was categorized as a quality improvement (QI) project, which granted permission for implementation (see Appendix E). Any project determined to fall within QI categorization is exempt from the full IRB approval process.

The target population for this quality improvement project was CRNAs who work with obstetrical patients. The developed project tool was applied equitably to participants by being presented to and accessible to all CRNAs at the project sites. CRNA participation was voluntary, and no personally identifiable information outside of email addresses was collected. No more than minimal risk has been identified for this quality improvement project. Additionally, the CRNAs participating in this project have no greater risk than they experience during a typical

shift. This quality improvement project is based on current evidence-based practice recommendations. Data obtained during the project was kept confidential. No patient information or patient identifiers were included in the project population.

Section III. Project Design

Project Setting

This quality improvement project was completed at a critical access hospital in the eastern United States. The site performed over 1,200 surgeries and had 400 births in 2024 ([redacted], 2025). The project was implemented in the partnering organizations' obstetrics and main operating room settings. The setting for this QI project was important because the CRNAs at the project sites routinely care for minority ethnicities and some of the most impoverished parturients in North Carolina (Cataudella, 2023). As previously stated, the incidence of AFE is higher amongst both ethnic minorities and mothers who are of low socioeconomic status.

Throughout this QI project, this author identified several facilitators and barriers. Although the project site experienced numerous births throughout the year, it had no apparent policies or procedures for identifying or treating suspected AFEs. The site relied on the CRNAs' discretion and experience in treating suspected AFE patients, which facilitated the development of the project tool used for this quality improvement project. Another factor facilitating the project is the infrequency of actual AFE events. Because of its rarity, anesthesia providers may not be familiar with current practice recommendations for identifying and managing an AFE. Therefore, the need for current evidence-based practice updates and the AFE Emergency Management cognitive aid serve as facilitators for this QI project, providing current literature for anesthesia providers.

A barrier noted within the project site is the timing of the implementation. CRNAs at the site do not convene in one location at a specific time, unlike some units that hold daily huddles or monthly staff meetings. Due to various schedules, there is no standard time when all staff members are available to attend an educational presentation on the importance of an AFE

cognitive aid. Barriers noted at the outlying hospital include a small sample size due to fewer CRNAs on staff. The outlying hospital consists mostly of locum CRNAs, which may reduce staff buy-in. Lastly, since there are fewer CRNAs, fewer staff will be available to cover shifts, for CRNAs to participate in this QI project.

Project Population

The project population includes CRNAs working with the local private anesthesia practice that services the medical center and the outlying hospital. The practice consists of 29 anesthesiologists and over 70 anesthetists handling approximately 32,000 anesthetics annually for various surgical procedures for neonatal, pediatric, adult, and gerontological patients (ECAA Anesthesia Specialists, n.d.). The community hospital, also included in this group, provides anesthesia services for obstetrics, adults, and the gerontological population.

During the project's implementation, several barriers emerged. It was noted that CRNAs did not have a designated cognitive aid for use in the obstetrical areas. This is not unique to this health system, as the literature includes findings that CRNAs routinely do not have, or deem it unnecessary to use, a cognitive aid for managing an AFE event. Three authors within the literature discussed negative beliefs surrounding the implementation of a cognitive aid (Hardy, 2024; Saxena et al., 2020; Yoong et al., 2021). Hardy (2024) noted that anesthesia providers do not deem a cognitive aid necessary during emergencies because they have the experience to manage the situation appropriately. Hardy (2023) discovered that some anesthesia providers also believe cognitive aids make them seem incompetent.

Facilitators for this quality improvement project included fostering team involvement through an in-person meeting with the anesthesia providers. CRNA engagement was elicited before the start of their daily schedule or during their breaks to maximize participation at both

sites. This author asked various preceptors about their prior experiences with an AFE and discussed this quality improvement project with them. The anesthesia group also has supportive leadership that advocates for evidence-based practice changes to ensure safe anesthesia care for its patients. Lastly, the group fosters a positive organizational culture that values continuous improvement, learning from errors, and open feedback. All these facilitators help the CRNA staff constantly seek innovative, evidence-based data to support the anesthesia care they provide.

Project Team

This quality improvement project was started with a group of Doctor of Nursing Practice (DNP) Nurse Anesthesia students, the project chair, and the course director. The group consisted of three Student Registered Nurse Anesthetists (SRNAs) and this author as project lead. Each SRNA implemented their own quality improvement project in separate community hospitals. The project chair served as a resource for the QI team, overseeing the project and identifying CRNA participants within the medical system. The site contact person approved data collection within the perioperative area at the community hospital. The course director guided the team through the implementation process and ensured the QI project stayed on schedule. She also ensured each team member followed the appropriate steps for the College of Nursing IRB process.

Methods and Measurement

This quality improvement project aimed to assess the usefulness of a newly developed reference guide for Certified Registered Nurse Anesthetists (CRNAs) in identifying and treating AFE events. The secondary aim was also to assess whether the newly developed reference tool would impact CRNA confidence in identifying and managing an AFE event. The knowledge

gained from this project was intended to inform future quality improvement initiatives aimed at identifying and managing an AFE event.

The project lead derived a plan to conduct one PDSA cycle to assess the perceived usefulness of the project tool in identifying and managing AFE events. All team members performed a literature search and compared the literature findings. Based on current literature, a cognitive aid was developed with the project chair and the course director. The cognitive aid (see Appendix F) was designed as a tool to assist anesthesia providers with a stepwise approach to identifying and managing an AFE event.

The team then collaborated on pre- and post-implementation survey questions, developed the PICOT question, and developed the presentation for the individual and group implementation days. Qualtrics software was used to facilitate the electronic delivery of the pre- and post-implementation surveys. The results from the Qualtrics surveys were used to evaluate whether the newly developed project tool improved CRNA confidence in diagnosing and treating AFE events, and to gather their feedback on the developed cognitive aid. These steps concluded the Plan phase of the PDSA cycle.

Implementation of the Do phase of the PDSA cycle is as follows. Although the project began as a group effort, individual data was collected through a specific community site within the healthcare system. CRNAs providing anesthesia at the project sites were emailed about a continuing education session that would discuss the current evidence-based practice recommendations for identifying and treating an AFE. The dates and times of the sessions were provided in the email (see Appendix G: Email to Participants). A laminated version of the project tool was also presented to participants during the educational session, with an extra copy available for the presentation.

Each session was planned to accommodate CRNA participation before their scheduled workday or during scheduled breaks. The presentation was held at a central location on the project site. Before the session, participants were asked to scan a QR code to access the Qualtrics pre-presentation survey (see Appendix I: Copy of Qualtrics Pre-Presentation Questions). After the pre-survey was completed, a short in-person presentation (see Appendix H: Amniotic Fluid Embolism Presentation) was delivered. This included updates on the recognition and management of an AFE event, as well as on the use of the cognitive aid. During the presentation, a question-and-answer session was held, and participants were encouraged to ask questions and clarify any information as needed. At the end of the session, participants were asked to scan a QR code to access and complete the Qualtrics post-presentation survey (see Appendix J: Copy of Qualtrics Post-Presentation Questions). The pre- and post-surveys were designed to gather nominal, ordinal, and free-form data. The response options included Likert, open-ended, and dichotomous responses.

Following the sessions at the community hospital, data from the Qualtrics pre- and post-presentation surveys were collected electronically, combined, and analyzed to evaluate the aims of this quality improvement project. All survey data was collected confidentially, as no participant identifiers were obtained. Analyzing the survey data satisfied the Study portion of the PDSA cycle. The survey data was stored in Qualtrics. Once the implementation period was completed, the data was downloaded from Qualtrics and placed in an Excel worksheet for analysis. Once the data was analyzed during the Study phase of the PDSA cycle, the Act phase was completed to identify changes needed for future project implementation and, if needed, to adjust the cognitive aid.

Section IV. Results and Findings

Results

This DNP project evaluated whether using a cognitive aid would increase CRNAs' confidence in identifying and managing AFE events. A cognitive aid and a PowerPoint presentation were created and presented to project participants. CRNAs' confidence in identifying and managing an AFE event was measured before and after the presentation. When this QI project was implemented at the community hospital, three participants were present. Three participants responded to the pre-implementation survey, and three participants responded to the post-implementation survey. Data from the surveys were collected with Qualtrics and analyzed with Microsoft Excel.

Data Presentation

The pre-presentation survey consisted of nine questions and was offered at the small regional hospital on implementation day. Three CRNAs attended the presentation, and all completed the pre-presentation survey. The first question measured the participants' experience level. Two of the CRNAs have been practicing between "5 and 9 years", and one CRNA has been practicing for "over 20 years".

Three questions asked the CRNAs about their experience identifying and managing an AFE event. One question was used to determine whether the identification and management of an AFE event wase commonly taught during continuing education. Many respondents had not received continuing education on an AFE event. Another question provided insight into the prevalence of an AFE event in their anesthesia practice. Two participants had never been involved in an AFE event. However, one participant had been involved in a suspected AFE event "more than four times". Lastly, CRNAs' self-perceived confidence in identifying and managing

an AFE event was addressed in another question. Since the results from this question are compared in the pre- and post-presentation surveys, they will be discussed in a subsequent section of this paper.

Two survey questions were developed to determine whether the regional hospital had guidelines for identifying and managing an AFE event, and one question assessed whether the facility's CRNAs were aware of a cognitive aid specifically developed for an AFE event. Two participants answered “no”; the facility did not have a cognitive aid, and one participant answered “yes” that it did. An additional question was established to gauge the effectiveness of the current guidelines. Two participants did not respond to this question, but the participant who did reported that the current guidelines were “very ineffective.”

One of the questions was used to discuss the guidelines at the regional facility. This question coincided with three others that queried the CRNAs about their use of cognitive aids. One question was used to examine how long CRNAs believed it would take to find information on practice recommendations for managing a parturient during an AFE event. The cognitive aid's accessibility was examined in both the pre- and post-presentation data; therefore, these results will be discussed in a subsequent paragraph. Another question was used to assess participants' likelihood of using the developed cognitive aid during an emergency by asking whether they had ever used such an aid. Most of the CRNAs had used a cognitive aid during an emergency. The last question in the survey judged whether the respondents would consider using a cognitive aid during an AFE event. One CRNA responded that they would “probably use” the cognitive aid, and two CRNAs stated that they would “very likely” use it.

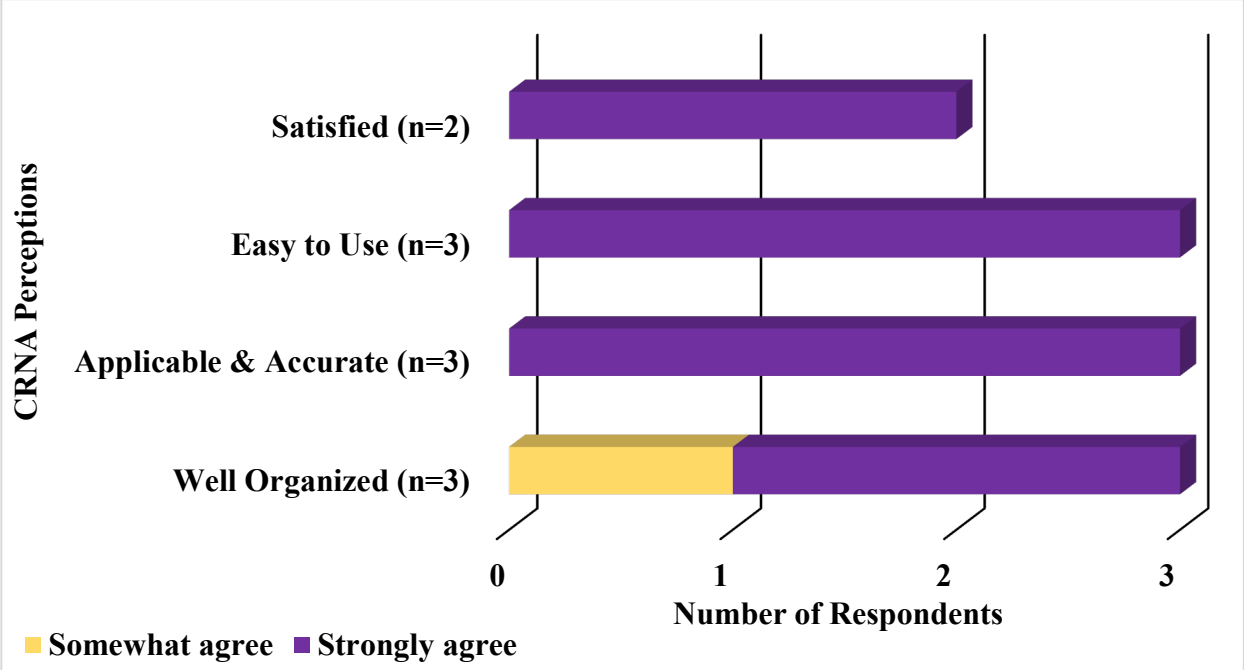
Post-Presentation Data

The post-presentation survey, consisting of nine questions, was distributed to the CRNAs after the presentation. All three CRNAs who attended completed it. Three of the questions were Likert scales, one was multiple-choice, and two were select-all-that-apply with an open-ended text box. All the questions pertained to the usefulness of the cognitive aid developed during this quality improvement project.

The first two questions examined the participants' perceptions of the cognitive aid. The first question asked participants about their perceptions of the AFE cognitive aid design. This question consisted of four parts: organization of the cognitive aid, pertinence of the information, ease of use, and satisfaction with the tool. Two CRNAs "strongly agreed" that the cognitive aid was well organized, and one CRNA "somewhat agreed". All three participants "strongly agreed" that the cognitive aid information was applicable, accurate, and easy to read and understand (see Figure 1). When asked if the respondents were pleased with the cognitive aid, two "strongly agreed", and one of the participants did not respond. Another question in the post-presentation survey was designed to examine whether the newly developed *AFE Emergency Management* cognitive aid would be used. All three participants said they were "very likely" to use the aid.

Figure 1

CRNA Perceptions of AFE Emergency Management Cognitive Aid



Two of the questions helped identify the best location for the cognitive aid by asking participants to select all locations they felt would provide easy access to the newly developed tool. The answer choices included a "QR code," a "laminated handout in the anesthesia machine in the Labor, Delivery, Recovery, Postpartum (LDRP) rooms", or a "practice advisory pop-up accompanied by a link to the tool in the electronic health record". Two CRNAs answered that all locations would increase accessibility to the cognitive aid, and one participant selected only the "Labor, Delivery, Recovery, Postpartum (LDRP) rooms" option. The second part of the question asked respondents to suggest other locations to help ease accessibility to the cognitive aid. No additional suggestions were provided. To determine the usefulness of the AFE cognitive aid, participants were asked whether the tool would allow quicker access to practice recommendations for managing a parturient during an AFE event. All three respondents said it

would take “less than one minute” to access the cognitive aid if placed in one of the reported locations.

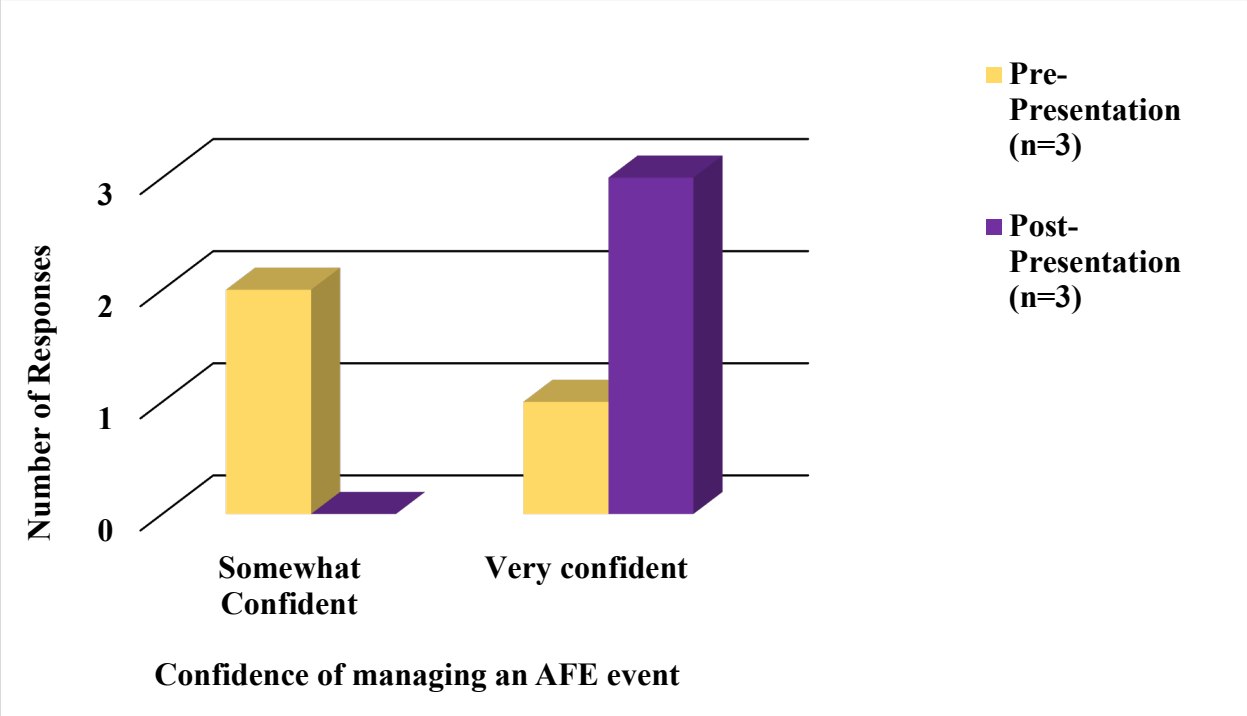
This author designed two questions to ascertain future project recommendations. One explored the participants’ recommendations for what groups should be considered as future research participants. The choices included “obstetric residents”, “fellows”, and “attendings”, “obstetric nurses”, “critical care nurses”, “critical care residents”, and “critical care fellows”. All CRNAs selected that all the above personnel should be participants in future presentations. The last question in the post-presentation survey asked the CRNAs to write in any proposals for improving the cognitive aid's efficacy. No suggestions were provided.

Comparisons in Pre- and Post-Surveys

The pre-presentation and post-presentation surveys used similar questions to compare participants’ perceptions of the presentation and the usefulness of the cognitive aid. One pre-presentation survey question was developed to assess CRNAs' perceived confidence in identifying and managing an AFE event. Two respondents reported being “somewhat confident”, while one CRNA reported being “very confident” in their ability to identify and manage a parturient during an AFE event. As in another question in the pre-presentation survey, a question in the post-presentation survey assessed whether the cognitive aid increased CRNAs’ confidence in managing an AFE event. After reviewing the cognitive aid, all three respondents reported being “very confident” in managing an AFE event (see Figure 2).

Figure 2

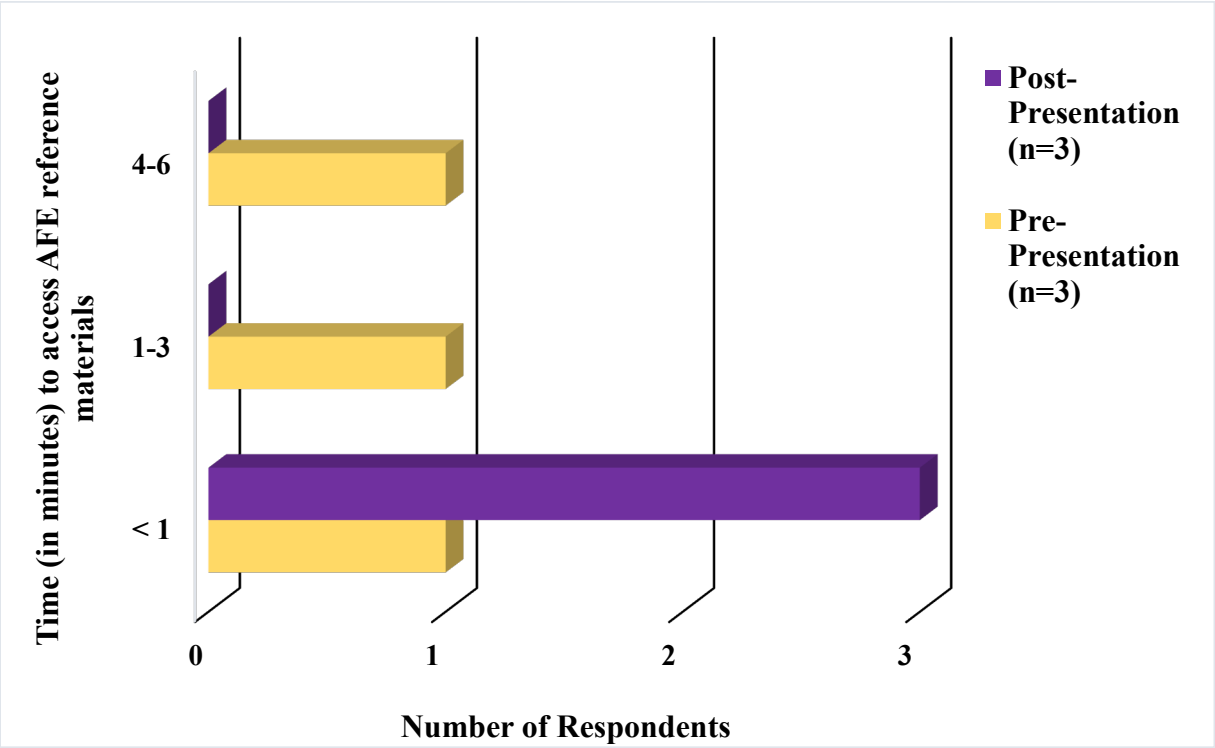
Self-reported confidence of managing an AFE event Pre- and Post-Presentation



Likewise, one survey from each of the questionnaires was developed to measure time estimates for CRNAs to gain access to reference material when attempting to identify and manage an AFE. One CRNA reported it would take approximately "1-3 minutes" to find the information. One answered that it would take them "4-6 minutes", and one reported they could find the information in "less than one minute". In the post-presentation, this author asked the respondents to estimate how long it would take them to access the cognitive aid if it were placed in a specified location. Every CRNA answered this question differently (see Figure 3). The following question assessed whether the above location would provide quicker access to current reference material than the previously estimated times for CRNAs caring for a parturient with an AFE. All participants answered that it would take them "less than one minute" to access the cognitive aid if placed in one of the locations mentioned above (see Figure 3).

Figure 3

Estimated time it takes to locate reference material when identifying and managing an AFE event.



Analysis

Upon reviewing the data, several conclusions can be gathered. The confidence in identifying and managing an AFE event at a regional critical access hospital may be related to experience with this obstetrical emergency. The newly developed cognitive aid was deemed beneficial because it can be readily made available, providing quick access to current treatment recommendations and potentially increasing CRNA confidence, as CRNAs at this regional facility are often the sole providers. Two of the three participants believed the data was well organized, whereas one participant only slightly agreed on the organization.

Subsequently, information gathered from the post-presentation question-and-answer session provided insight into practice within the facility and recommendations for future

implementations and versions of the cognitive aid. The participants' descriptions of the anesthesia workflow at the regional facility, along with their descriptions of the call schedule, led this author to associate the participants' satisfaction with the cognitive aid with the participants' experiences as the sole provider. After comparing the pre- and post-presentation data, the participants indicated both a likelihood of using the newly developed cognitive aid and an increase in confidence in identifying and managing an AFE event. Comparatively, in the pre-presentation survey, only one participant was "overtly confident" in identifying and managing an AFE event. This author believes that the increase in participants' confidence stems from their access to the cognitive aid when they are the only provider in the facility and entrusted with making critical decisions during an AFE emergency.

Lastly, when reviewing how participants felt about access to current practice recommendations for an AFE event, participants reported in the post-presentation survey that it would take them less time to access current literature than in the pre-presentation survey. In the weeks following the presentation, this author noted the cognitive aid in the OR at the regional facility. The presence of the cognitive aid indicates that the staff found it reliable and are committed to displaying the information to guide future management of AFE events.

The data indicated that the facility's location and size had the greatest influence on participants' responses. Participants had positive perceptions of the cognitive aid's usefulness in their everyday practice. Given the small size of the regional facility, participants considered this cognitive aid suitable for sharing with obstetric providers, obstetric nurses, critical care nurses, and critical care providers. Future progressions of the PDSA cycle should include presenting the cognitive aid to other healthcare providers at this facility and at other facilities in the health system. This may lead to improved identification and management of AFE events by the

perioperative team, including the CRNA. However, further research is needed to confirm or refute this hypothesis.

Section V. Implications

Financial and Nonfinancial Analysis

According to Heise (2020), operating rooms (ORs) are the main source of revenue for hospitals. It is estimated that one block of time in an OR — approximately 500 minutes — can generate between 50,000 and 100,000 dollars per day. Since AFE events are so rare, it is challenging for a hospital to determine a definitive monetary cost. However, it is estimated that DIC costs approximately $230,000, and cardiac arrest or ventricular fibrillation among parturients costs approximately $87,000 (Abbasi et al., 2017; Black et al., 2021). The estimated costs of DIC, cardiac arrest, or ventricular fibrillation may be used to determine the cost of an AFE event, since these conditions are often present in its late stages. Lastly, the occurrence of an AFE event can significantly increase a parturient's length of stay because it often results in an admission to the intensive care unit (Lao, 2022).

Contrarily, to develop and implement this QI project, this author spent $57 to print 18 copies of the cognitive aid. Doughnuts and coffee were also purchased for the participants, at a cost of approximately $60. Since this author conducted the PDSA cycle and the QI project, approximately $117 has been spent. To distribute the cognitive aid at the regional medical center, approximately thirty copies would need to be printed, resulting in a $95 expense. If a large medical center consulted a nurse educator to help with future development of this QI project, it would cost roughly $47 per hour to compensate the nurse educator (ZipRecruiter.com, 2025). The planning, design, and implementation of this project took about 150 hours; therefore, expanding its implementation would increase the cost from $117 to around $7,500. Since the cognitive aid has already been developed, the nurse educator will only need to present the information, place hard copies of the AFE cognitive aid in the appropriate settings, and increase

buy-in from future participants; as a result, no additional supplies will be needed. Moreover, the cost of future renditions of this QI project will be significantly less than an AFE event and will subsequently save the hospitals money.

AFE events have several nonfinancial implications for the project site, including decreased CRNA confidence in identifying and managing the event due to inexperience. In conjunction with the high maternal-fetal mortality rate, these events cause increased stress for anesthesia providers, parturients, and their families. Low confidence among CRNAs in identifying and managing an AFE event can affect the safety of the parturient and fetus. Delays in AFE management have been directly related to fetal and maternal mortality (Clark, 2014; Lao, 2022). Subsequently, the increased stress of an AFE event harms staff morale and the patient and family's experience. Safety results from communication, teamwork, and self-checking to ensure a safer environment (Yoong et al., 2021). Implementing the cognitive aid developed during this QI project may help to ensure a safer environment and increased teamwork within the health system. Increased safety and teamwork may also reduce provider stress, thereby boosting staff morale.

Implications of the Project

Throughout this quality improvement project, no apparent guidelines outlining recommendations for the identification and management of an Amniotic Fluid Embolism event were found at the regional critical access hospital. Upon reviewing the current literature, this author found that ethnic and foreign-born minorities, mothers of advanced maternal age, obese parturients, and parturients who have coexisting disease processes have a higher risk of developing an Amniotic Fluid Embolism (Clark, 2014; Fardelmann and Alian, 2020). As previously stated, the goal of the Triple Aim and the NCDHHSDPH is to improve the

population's health, including the health of ethnic minorities, and reduce severe maternal morbidity and pregnancy-related mortality rates (Institute for Healthcare Improvement, n.d.-a; NCDHHSDPH, 2022).

In 2018, the North Carolina Department of Health and Human Services, Division of Public Health (NCDHHSDPH) found that 55.7% of births within the health system where this QI project was performed had birthing mothers who identified as Hispanic or African American (2024a). Using a cognitive aid, such as the one developed for this project, could significantly improve the use of evidence-based practice when caring for patients experiencing this rare medical emergency, especially high-risk parturients such as those cared for at the project site. In rare emergencies, the use of a cognitive aid helps eliminate fixation errors, improves provider performance by allowing them to follow step-by-step instructions, and enhances the completion of critical tasks.

The most impactful aspect of the project has been the dissemination of the cognitive aid, "*AFE Emergency Management".* The cognitive aid can be used to develop the necessary standardization of practice and create policies around the practice recommendations for an AFE event. Following the fulfillment of the previously mentioned recommendations, this QI project can also have subsequent implementation opportunities, including video simulations of staff using the newly developed cognitive aid to identify and manage an AFE event. This simulation can be disseminated annually, accompanied by a quiz to ensure that CRNAs and the obstetrical team are aware of current practice recommendations and reminders on the most effective way to manage this obstetrical emergency. Future projects and further development of this QI project may reduce maternal mortality due to more effective AFE management. Likewise, further development may increase CRNA confidence at this regional facility.

Sustainability

Hypothetically, the health system in which this QI project was implemented could afford to sustain and expand this project. However, there would need to be interdisciplinary buy-in. As previously stated in the financial and non-financial analysis section of this paper, obstetricians, nurses, critical care providers, intensivists, and anesthesia providers should all be included in this quality improvement project. All the previously mentioned disciplines are responsible for managing patients with suspected AFE; therefore, they should be informed of this newly developed cognitive aid. Expanding the project's population may provide more information on whether the utility of the cognitive aid increases provider confidence across healthcare specialties. As previously explained, the financial cost of this project is negligible compared to that of large research studies. Therefore, the project should be sustainable for a large medical center to fund further development strategies for managing an AFE event. However, if studies stem from this quality improvement project at the local level, they may need additional support from the health system to continue the research study.

Dissemination Plan

This quality improvement paper was written and submitted in partial fulfillment of the requirements for the degree of Doctor of Nursing Practice. A poster was presented to members of the nurse anesthesia department and project participants on November 17th, 2025. The poster presentation covered the project's design, implementation, and results from pre- and post-implementation surveys conducted on Qualtrics. The project participants and this author's family members were also invited to attend the presentation. Subsequently, the final version of this paper, along with the poster, was posted in The Scholarship, the East Carolina University digital repository.

Section VI. Conclusion

Limitations

Several limitations were found during the development and implementation of this quality improvement project. While planning the project, the lack of literature regarding AFE events made it difficult for this author to compare the current research. Accordingly, a lack of consensus on the best practices for this obstetrical emergency posed challenges in distinguishing recommendations for the cognitive aid. The largest inconsistency was with the "AOK" treatment recommendation. CRNAs at the project site sought clarification regarding the use of "AOK", a regimen they had utilized during a suspected AFE event; however, available literature offers inconsistent evidence on its effectiveness.

During the implementation phase, it was difficult to organize the implementation dates for the proposed project sites with this author's clinical schedule. As a result, this author was unable to implement the project at one of the proposed sites. The presentation did not occur during an "ideal" time for the staff, resulting in a small sample size. The Chief CRNA reported to this author that the staff consisted mostly of temporary staff CRNAs who had to drive in for their shifts. Although the presentation took place on a Wednesday, participants reported having to get up earlier than usual to attend. However, the Chief CRNA stated that the staff requested that the presentation not occur after their shifts. Therefore, it appears that lunch or during a mid-day break would have been an optimal time for the presentation.

Recommendations for Future Implementation and/or Additional Study

In future project implementations, it is recommended that the team lead examine optimal times and locations for presentations to increase participation. Given CRNAs' varying schedules and time constraints, an online meeting may also be a viable option. This author also identified,

from discussions with the CRNAs and their survey responses, that the project should be further implemented with nurses in the labor and delivery unit, obstetricians, and intensive care unit (ICU) providers. This clinical tool and updated information on managing AFE events may be beneficial for all providers involved in this emergency. Likewise, participants expressed in the post-survey questionnaire that this project would be beneficial with buy-in from the interdisciplinary team (e.g., obstetricians, labor and delivery nurses, and operating room nurses). Another QI project should be implemented to evaluate these suggestions and increase awareness of AFE emergencies.

As previously stated, the question-and-answer portion of the presentation allowed participants not only to ask questions but also to offer suggestions for improving the cognitive aid. Future research can investigate how the suggested adjustments affect CRNA confidence in identifying and managing AFE events. Since AFE events are rare, a wide range of research can be conducted on this obstetrical emergency. This research can yield a more accurate estimate of AFE incidence and inform future expansions of this QI project.

Future research should also aim to develop a consensus among obstetricians and anesthesia providers on diagnostic and reporting criteria, as well as management options, given the conflicting information in the literature. Focused research could help gain a consensus, potentially leading to recommendations on treatment options. However, because AFE events are so rare, this research could be costly and time-consuming. It would have to include numerous hospitals throughout the country to obtain sufficient data. This research could be as simple as obtaining an ECHO and coagulation bloodwork from parturients who are categorized as “high-risk”. This can occur once during each of the first two trimesters and weekly during the last trimester. Although time-consuming and potentially costly, this research would not only increase

understanding of AFE events but also provide standardized diagnostic and treatment criteria, thereby reducing maternal and fetal mortality.

Furthermore, as recommended by participants during the presentation's question-and-answer session, future research may include studies on the novel “AOK” therapy. One CRNA at the facility where this QI project was conducted suggested the “AOK” treatment for an AFE event because the CRNA reportedly successfully treated such events. One CRNA mentioned creating an “AOK” kit with either three vials of atropine, ondansetron, and ketorolac or three syringes with the appropriate dosages of atropine, ondansetron, and ketorolac already drawn up and ready for use. If the vial method is used, the kit must include syringes with needleless tips to accompany the vials. While prefilled syringes would be less time-consuming, they would also be more costly, as atropine has a short shelf life once removed from the vial. After evaluating different pharmaceutical distributors, it is estimated that a kit with prefilled syringes may cost about $120, whereas a kit with vials may cost about $32.

Lastly, a videotaped or live simulation session can be used to demonstrate operating room staff using the cognitive aid during an AFE event. A videotaped simulation could also be constructed to show this obstetrical emergency in the labor and delivery unit. The simulation sequence can be further expanded to show the coagulopathy and ECHO findings that may be present in parturients. AFE events are a rarity that should be further examined to possibly decrease or eliminate maternal and fetal mortality.

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Appendix A

Concept Chart

	Concept 1 Population	Concept 2 Problem	Concept 3 Intervention	Concept 3 Intervention	Concept 4 Outcome
Keywords	CRNA's or Anesthesiologists or L&D Nurses or Labor and Delivery Nurses	Amniotic Fluid Embolism or AFE	Simulation Lab AND CRNA's	Cognitive Aid AND CRNA's or Anesthesia or Anesthesiologists	Early Recognition or Early Diagnosis
PubMed MeSH	"nurse anesthetists"[MeSH Terms] "anesthesiologists"[MeSH Terms] "labor, obstetric"[MeSH Terms] "nurses"[MeSH Terms]	"embolism, amniotic fluid"[MeSH Terms]	"computer simulation"[MeSH Terms]	"cognition"[MeSH Terms]	"recognition, psychology"[MeSH Terms] "early diagnosis"[MeSH Terms]
CINAHL Subject Headings	(MH "Certified Registered Nurse Anesthetists") OR (MH "Anesthesiologists") OR (MH "Labor and Delivery Nurses")	(MH "Embolism, Amniotic Fluid")	(MH "Patient Simulation") OR (MH "Certified Registered Nurse Anesthetists")	(MH "Reference Tool" AND "Cognition/ED")	(MH "Early Intervention") OR (MH "Early Diagnosis")

Appendix B

Literature Search Log

Search date	Database or search engine	Search strategy	Limits applied	Number of citations found/kept	Rationale for inclusion/exclusion of items
09.28.23	PubMed	(“Amniotic Fluid Embolism” OR “anaphylactoid syndrome of pregnancy”) AND (nurses OR nursing) "embolism, amniotic fluid"[MeSH Terms] "syndrome"[MeSH Terms] "pregnancy"[MeSH Terms] "nurses"[MeSH Terms] "nursing"[MeSH Subheading]	5 years (actual years 2018-2023) English Language	10/9 One page to review, and I reviewed the entries on that page.	I wanted the most current research on my topic, and I wanted to be able to read the article to glean information from it.
08.22.24	PubMed	(AFE or Amniotic Fluid Embolism) AND (CRNA or Nurse anesthetists or Anesthesia) "embolism, amniotic fluid"[MeSH Terms] "nurse anesthetists"[MeSH Terms] "anesthesiologists"[MeSH Terms] "labor, obstetric"[MeSH Terms] "nurses"[MeSH Terms]	5 years (actual years 2019-2024) English Language	73/4 Eight pages to review. I only reviewed the first page.	I wanted the most current research on my topic, and I wanted to be able to read the article to glean information from it.
09.04.24	PubMed	(AFE or Amniotic Fluid Embolism) AND (CRNA or Nurse anesthetists or Anesthesia) AND (recognition or diagnosis) "embolism, amniotic fluid"[MeSH Terms] "nurse anesthetists"[MeSH Terms] "anesthesiologists"[MeSH Terms]	5 years (actual years 2019-2024) English Language	25/3 Three pages to review. I reviewed two of them.	I wanted the most current research on my topic, and I wanted to be able to read the article to glean information from it.

		"labor, obstetric"[MeSH Terms] "nurses"[MeSH Terms] "recognition, psychology"[MeSH Terms] "early diagnosis"[MeSH Terms]			
09.04.24	PubMed	(CRNA or Nurse anesthetists) AND (simulation lab or simulation) "computer simulation"[MeSH Terms] "nurse anesthetists"[MeSH Terms]	5 years (actual years 2019-2024) English Language	79/9 8 pages to review. I reviewed 2 pages.	I wanted the most current research on my topic, and I wanted to be able to read the article to glean information from it.
09.04.24	CINAHL	((CRNA OR "Certified Registered Nurse Anesthetist" OR "Anesthesia") AND ("Amniotic Fluid Embolism" OR AFE) AND ("Early Recognition" OR "Early diagnosis")) (MH "Certified Registered Nurse Anesthetists") OR (MH "Anesthesiologists") OR (MH "Labor and Delivery Nurses") (MH "Embolism, Amniotic Fluid") (MH "Early Intervention") OR (MH "Early Diagnosis")	5 years (actual years 2019-2024) English Language	10/1 One page to review and one page reviewed	I wanted the most current research on my topic, and I wanted to be able to read the article to glean information from it.
09.11.24	ProQuest	(CRNA OR Anesthesiologist OR "Nurse Anesthetist") AND ("Amniotic Fluid Embolism" OR AFE) AND (treatment) MAINSUBJECT.EXACT("Advanced practice nurses") AND MAINSUBJECT.EXACT("Amniotic fluid") AND MAINSUBJECT.EXACT("Embolisms") AND MAINSUBJECT.EXACT("Simulators")	5 years (actual years 2019-2024) English Language	179/6 I reviewed 50 results on the first page of the search.	I wanted the most current research on my topic, and I wanted to be able to read the article to glean information from it.

09.24.24	ProQuest	“((CRNA OR "Nurse Anesthesia" OR "Anesthesiology") AND ("cognitive aid" OR "handout"))." MAINSUBJECT.EXACT("Advanced practice nurses") AND MAINSUBJECT.EXACT("Amniotic fluid") AND MAINSUBJECT.EXACT("Embolisms") AND MAINSUBJECT.EXACT("Visual Aid" OR MAINSUBJECT.EXACT("Education Material")	5 years (actual years 2019-2024) English Language DNP Projects	4/1 I reviewed all of the titles and abstracts.	I wanted the most current research on my topic, and I wanted to be able to read the article to glean information from it. I also wanted to know what projects had already been completed on my topic.
09.24.24	PubMed	“((CRNA OR "Nurse Anesthesia" OR "Anesthesiology") AND ("cognitive aid" OR "handout"))." (MH “Certified Registered Nurse Anesthetists”) OR (MH “Anesthesiologists”) OR (MH “cognition”) OR (“handout” [All Fields])	5 years (actual years 2019-2024) English Language	49/6 I reviewed the first two search pages.	I wanted the most current research on my topic, and I wanted to be able to read the article to glean information from it.

Appendix C

Literature Matrix

Year	Author, Title, Journal	Purpose & Conceptual Framework or Model	Design and Level of Evidence	Setting	Sample	Tool(s) and/or Intervention(s)	Results
2024	Hardy, J. L. (2024). *Increasing anesthesia provider knowledge in using emergency manuals for crisis management* [Doctoral dissertation, The University of Arizona]. https://www.proquest.com/dissertations-theses/increasing-anesthesia-provider-knowledge-using/docview/3053859975/se-2	Purpose: Increase the knowledge and confidence of anesthesia providers in using emergency manuals for crisis management Conceptual Framework/ Model: Lewin's change theory	Quality Improvement Level V	Community hospital and simulation lab	16 Anesthesia providers at Arizona Anesthesia Solutions (AzAS)	Used a simulation lab with and without the use of an emergency manual. Recordings of the simulations and pre-post surveys were sent to the participants. The participants then reviewed the training video and completed a post-pre survey.	Providers had increased the perceived importance of emergency manuals following review of the training video. Emergency manuals improve anesthesia provider performance during emergencies. Use of training improved provider confidence and knowledge of use of emergency manuals.
2024	van Haperen, M., Kemper, T. C. P. M., Koers, L., van	Purpose: Compare the use of two different cognitive	Randomized Controlled Study	Three different Hospital	81 participants divided into 27 teams – each	Four different scenarios were used to evaluate	108 perioperative emergency

	Wandelen, S. B. E., Waller, E., de Klerk, E. S., Eberl, S., Hollomann, M.W., & Preckel, B. (2024). A comparative analysis of the impact of two different cognitive aid bundle designs on adherence to best clinical practice in simulated perioperative emergencies. *Journal of Clinical Medicine, 13*(17), 5253. https://doi.org/10.3390/jcm13175253	aid bundles to adhere to best clinical practice during an emergency in the operating room. Conceptual Framework/ Model: None noted	Level II	Operating Rooms	team consisting of three members- an anesthesiologist, a Certified Registered Nurse Anesthetist (CRNA), and either an extra CRNA, or a scrub nurse, or anesthesia resident	the effectiveness of using a cognitive aid bundle, or different types of cognitive aid bundles to minimize critical misses during emergencies in the Operating Room	simulations were completed. Using a cognitive aid bundle reduced the number of missed steps during the emergency. The type of cognitive aid bundle that is used – branched, or cluster design – did not show significant difference in reducing misses. Study participants preferred the clustered design compared to the branched design.
2023	American Association of Nurse Anesthesiology. (2022). *Analgesia and anesthesia for the obstetric patient*. AANA Practice Manual. https://issuu.com/aan	Purpose: Guidelines for treatment of AFE from the American Association of Nurse Anesthesiology Conceptual Framework/ Model: None noted	Expert Opinion Level VII	Hospital	N/A	Guidelines for managing AFE	Treatment of AFE: Airway stabilization & maintain SpO2 greater than 96% Circulatory/

	apublishing/docs/analgesia_and_anesthesia_for_the_obstetric_patient?fr=sN2ZlNTU2NDAxMjU						hemodynamic support with pressors and Intravenous fluid Left uterine displacement Cardiopulmonary resuscitation Deliver fetus if the mother is greater than 22-23 weeks Massive transfusion protocol, maintain normothermia Assess for Disseminated Intravascular Coagulation via labs Consider Tranexamic acid (TXA), Prothrombin complex concentrates (PCC), and fibrin

							concentrate for coagulation labs Ventricular Assist Device, Cardiopulmonary bypass, or Extracorporeal Membrane Oxygenation
2023	Moore, L. E. (2023). *Amniotic fluid embolism*. Medscape. https://emedicine.medscape.com/article/253068overview?_gl=1*10px9wu*_gcl_aw*R0NMLjE3MjcyMDEwMzguQ2owS0NRand4c20zQmhEckFSSXNBTXRWejZQVWMwRkpraDRwcmFKTGdIOHJ2LThwakRNbVpQbk01WXFlaDRwbHIzVmlxY3JDUVpHcmJxVWFBdGR0RUFMd193Y0I.*_gcl_au*MTAyNzY0MTMzOC4xNzI3MjAwNz	Purpose: Define AFE; List diagnostic recommendations and differential diagnosis for AFE Conceptual Framework/ Model: None noted	Expert Opinion Level VII	Hospital; Labor and Delivery unit	N/A	Guidelines for diagnosing AFE	List of differential diagnosis for AFE Definition of AFE. Diagnostic recommendations listed – can be used to establish diagnostic criteria for AFE.
2022	Lao, T. T. (2022). Acute respiratory distress and amniotic fluid embolism in pregnancy. *Best Practice & Research.*	Purpose: Guidelines for treatment and diagnosis of AFE Conceptual Framework/	Expert Opinion Level VII	Hospital; Labor and Delivery Unit	N/A	Guidelines for managing AFE	Gave statistics of AFE incidence, mortality & talked about treatment and diagnosis

	Clinical Obstetrics & Gynaecology, 85(Pt A), 83–95. https://doi.org/10.1016/j.bpobgyn.2022.06.004	Model: None noted					Steps of signs and symptoms of AFE. Used in the first section and referenced in the list of best practice recommendations by the AANA.
2021	Combs, C. A., Montgomery, D. M., Toner, L. E., Dildy, G. A., & Society for Maternal-Fetal Medicine. (2021). Society for Maternal-Fetal Medicine Special Statement: Checklist for initial management of amniotic fluid embolism. *American Journal of Obstetrics and Gynecology*, *224*(4), B29–B32. https://doi.org/10.1016/j.ajog.2021.01.001	Purpose: Provide a checklist for ease of management of a patient with suspected AFE Conceptual Framework/ Model: None noted	Expert Opinion Level VII	Hospital; Labor and Delivery Unit	N/A	Guidelines for managing AFE	Need to have a protocol saying what to do if you suspect your patient has an AFE. Provided a checklist for management of AFE To be used to establish an AFE checklist for the project tool.
2020	Chiao, S. S., & Sheeran, J. S. (2020). Extracorporeal membrane oxygenation therapy after amniotic fluid	Purpose: Describe the diagnosis and treatment of a patient with AFE	Case Report Level VI	Hospital; Operating Room; Intensive Care Unit	One patient in the labor and delivery unit with suspected AFE	Used Trans-esophageal Echo-cardiography for early diagnosis of a patient with	Patients had sudden hypoxia and pulmonary edema, coagulopathy and intracranial debris

	embolism with undetectable ROTEM FIBTEM activity: A case report. *A&A Practice, 14*(13), e01349-e01349. https://doi.org/10.1213/XAA.0000000000001349	Conceptual Framework/ Model: None noted				suspected AFEE. Described treatment with use of Cardio-pulmonary Resuscitation measures, Extracorporeal Membrane Oxygenation Therapy, TXA, and anticoagulants.	on Trans-esophageal Echocardiography (TEE) Recommended delivery of fetus, support of the mother to improve oxygenation and ventilation, control hemorrhage, correct coagulopathy, and start cardio-pulmonary support. Study recommends early initiation of Extracorporeal Membrane Oxygenation (ECMO) in AFE Start with no anticoagulant and transition to anticoagulants due to risk of

							bleeding in this population Can be used in recommendations section.
2020	Fardelmann, K. L., & Alian, A. A. (2020). Anesthesia for Obstetric Disasters. *Advances in anesthesia*, *38*, 229–250. https://doi.org/10.1016/j.aan.2020.09.001	Purpose: Provide guidelines for the diagnosis and treatment of patients with suspected AFE Conceptual Framework/ Model: None noted	Expert Opinion; Qualitative Study Level VII	Hospital; Labor and Delivery Unit	N/A	Used the Rotational thromboelastometry to help with early diagnosis and management for patients with AFE.	Standards and recommendations for treatment of AFE Specific diagnostic criteria for recognizing AFE. Statistics about AFE
2020	Pacheco, L. D., Clark, S. L., Klassen, M., & Hankins, G. D. V. (2020). Amniotic fluid embolism: principles of early clinical management. *American Journal of Obstetrics and Gynecology, 222*(1), 48–52. https://doi.org/10.1016/j.ajog.2019.07.036	Purpose: Develop a set of guidelines for the treatment of AFE Conceptual Framework/ Model: None noted	Expert Opinion Level VII	Hospital; Labor and Delivery Unit	N/A	Guidelines for managing AFE.	Created a set of guidelines based on expert opinion for treatment of AFE. Listed as a reference for AANA's best practice recommendations
2020	Saxena, S., Krombach, J. W., Nahrwold, D. A., & Pirracchio, R. (2020). Anaesthesia-	Purpose: Assess the literature on perioperative	Systematic Review Level I	Perioperat-ive suite in the hospital	N/A	Review of the literature on the use of perioperative	Anesthesia-specific checklists reduce error, provide more

	specific checklists: A systematic review of impact. *Anaesthesia Critical Care & Pain Medicine, 39*(1), 65-73. https://doi.org/10.1016/j.accpm.2019.07.011	routine and crisis checklists Conceptual Framework/ Model: None noted				routine and crisis checklists.	effective communication and a higher quality of care. These checklists are effective in providing efficient handoff, help with emergency management, and they assist with routine anesthesia procedures. There needs to be more research to identify the components of an ideal anesthesia checklist and how this checklist will be best implemented.
2020	Yoong, W., Sekar, H., Nauta, M., Yoong, H., & Lopes, T. (2021). Developing the 'checking' discipline. *Postgraduate Medical Journal, 97*(1154), 825-830. https://doi.org/1	Purpose: Explore how to create and implement effective checklists and how to create a culture that maintains a vigilance and discipline to 'checking'	Expert Opinion Level VII	Hospital	Healthcare Professionals who are tasked with ensuring a culture of safety within the hospital	Review of current literature to state an opinion on how to effectively develop and use a checklist to establish a safer environment	The use of a checklist can help ensure a culture of safety within the healthcare environment. Safety is a result of communication,

	0.1136/postgradmedj-2020-139609	Conceptual Framework/ Model: None noted				within the healthcare setting.	teamwork, and checking behind oneself to ensure a safer environment (i.e. correct surgery on the correct patient) If checklists are not followed or are overlooked due to increasing workload or not enough time, the wrong surgery can be performed on the wrong site or the wrong patient.
2016	Clark, S. L. (2014). Amniotic Fluid Embolism. *Obstetrics and Gynecology, 123*(2, PART 1), 337–348. https://doi.org/10.1097/AOG.0000000000000107	Purpose: Proposed Diagnostic criteria and a uniform definition for AFE Conceptual Framework/ Model: None noted	Seminal Study Level VI	Hospital	N/A	Guidelines for defining and diagnosing AFE.	Need a Uniform definition of this diagnosis Created diagnostic criteria for AFE Stated inadequacies of AFE diagnosis and treatment, and current literature regarding the topic.

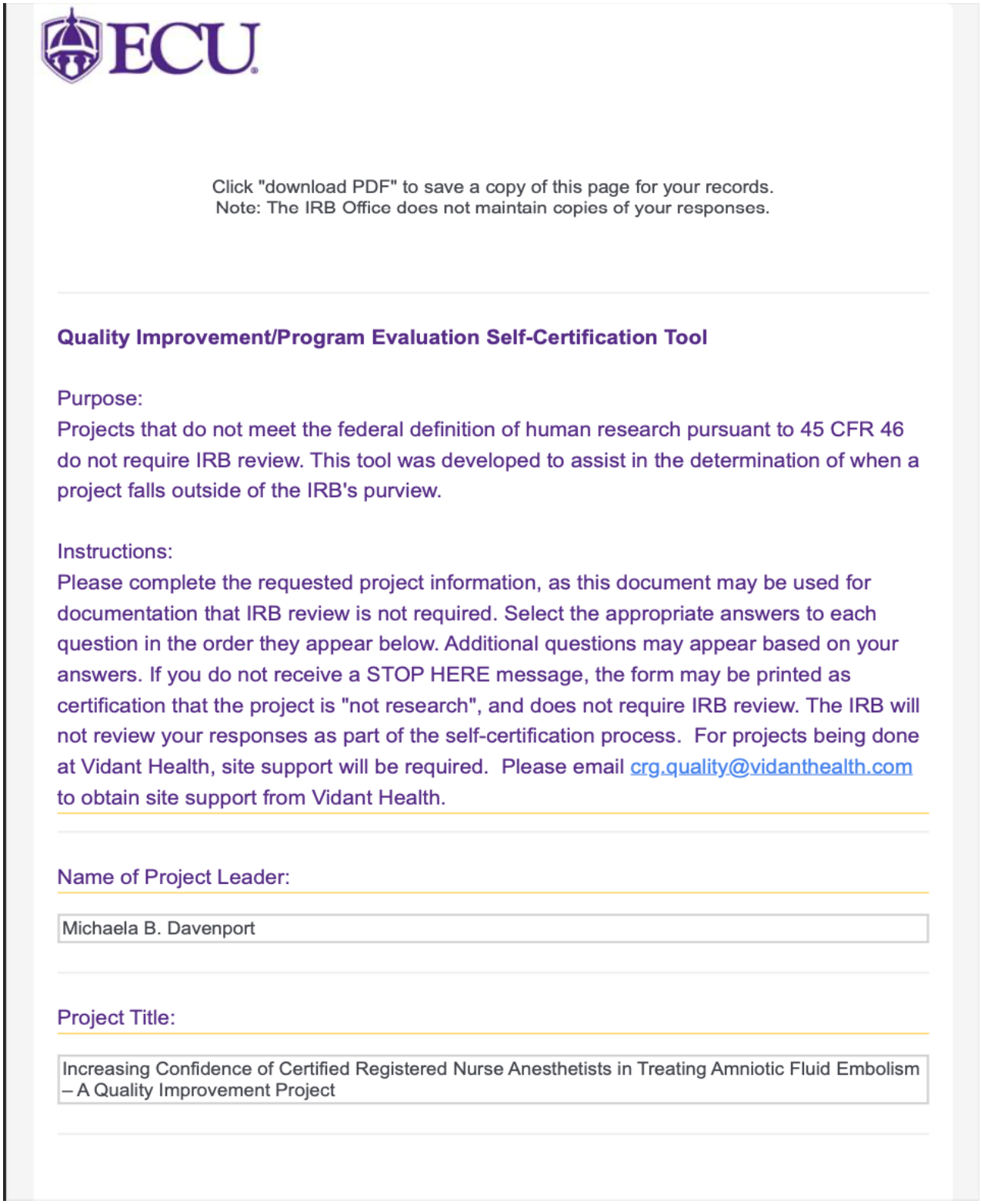
Notes

Note: Key to Levels of Evidence: I: Systematic review/meta-analysis of randomized controlled trials (RCTs); II: RCTs; III: Nonrandomized controlled trials; IV: Controlled cohort studies; V: Uncontrolled cohort studies; VI: Descriptive or qualitative study, case studies, EBP implementation, and QI; VII: Expert opinion from individuals or groups. Adapted from *Evidence-based practice in nursing and healthcare: A guide to best practice* (4th ed.), by B. M. Melnyk and E. Fineout-Overholt, 2019, p. 131. Copyright 2019 by Wolters Kluwer.

(Adapted from Brown, S. J. (2018) Evidence-based nursing: The research-practice connection. (3rd ed.). Jones & Bartlett Learning.)

Appendix D

IRB Approval Process



ECU

Click "download PDF" to save a copy of this page for your records.
Note: The IRB Office does not maintain copies of your responses.

Quality Improvement/Program Evaluation Self-Certification Tool

Purpose:
Projects that do not meet the federal definition of human research pursuant to 45 CFR 46 do not require IRB review. This tool was developed to assist in the determination of when a project falls outside of the IRB's purview.

Instructions:
Please complete the requested project information, as this document may be used for documentation that IRB review is not required. Select the appropriate answers to each question in the order they appear below. Additional questions may appear based on your answers. If you do not receive a STOP HERE message, the form may be printed as certification that the project is "not research", and does not require IRB review. The IRB will not review your responses as part of the self-certification process. For projects being done at Vidant Health, site support will be required. Please email crg.quality@vidanthealth.com to obtain site support from Vidant Health.

Name of Project Leader:

Michaela B. Davenport

Project Title:

Increasing Confidence of Certified Registered Nurse Anesthetists in Treating Amniotic Fluid Embolism – A Quality Improvement Project

Brief description of Project/Goals:

This quality improvement project aims to assess anesthesia providers' perceptions of the adequacy of a newly developed cognitive aid for identifying and treating amniotic fluid embolism (AFE) and determine whether it impacts Certified Registered Nurse Anesthetist (CRNA) confidence in managing this condition. Process: A quick-reference intraoperative AFE cognitive aid, based upon accepted national guidelines, will be developed. Anesthesia providers within the ECU Health system will be asked several questions (through Qualtrics) about their perceptions of the adequacy of their currently used treatment plan for patients with AFE. An in-service about using a newly developed cognitive aid will be presented to them, and they will be asked about its perceived usefulness and applicability to practice. After the in-service, they will be asked to complete a questionnaire about their perceptions of the adequacy of the cognitive aid, including its applicability to their current practice. Qualtrics survey software will be used to gather participant perceptions before and after the implementation of the project. No patient information will be recorded or maintained during this project. Participation in this quality improvement project is voluntary for project participants.

Will the project involve testing an experimental drug, device (including medical software or assays), or biologic?

- ○ Yes
- ● No

Has the project received funding (e.g. federal, industry) to be conducted as a human subject research study?

- ○ Yes
- ● No

Is this a multi-site project (e.g. there is a coordinating or lead center, more than one site participating, and/or a study-wide protocol)?

- ○ Yes
- ● No

Is this a systematic investigation designed with the intent to contribute to generalizable knowledge (e.g. testing a hypothesis; randomization of subjects; comparison of case vs. control; observational research; comparative effectiveness research; or comparable criteria in alternative research paradigms)?

- ○ Yes
- ● No

Will the results of the project be published, presented or disseminated outside of the institution or program conducting it?

- ● Yes
- ○ No

Would the project occur regardless of whether individuals conducting it may benefit professionally from it?

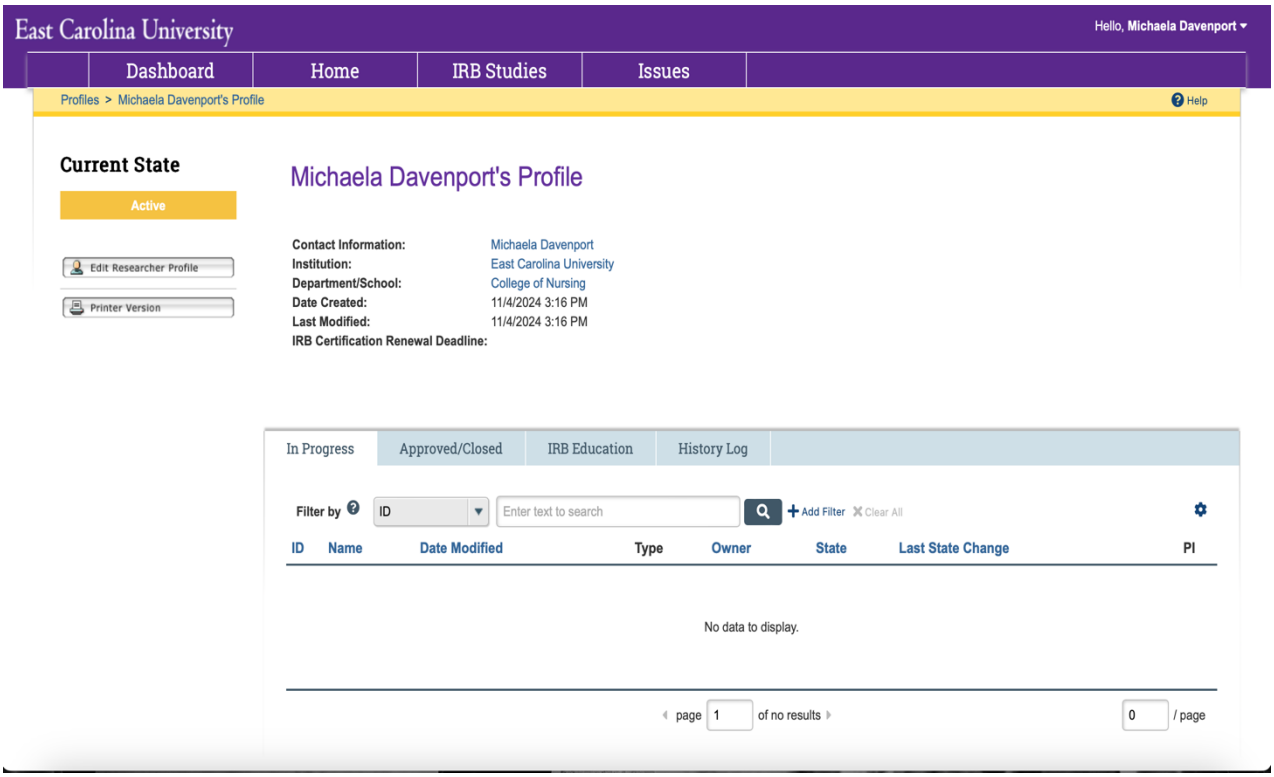
- ● Yes
- ○ No

Does the project involve "no more than minimal risk" procedures (meaning the probability and magnitude of harm or discomfort anticipated are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests)?

- ● Yes
- ○ No

Is the project intended to improve or evaluate the practice or process within a particular institution or a specific program, and falls under well-accepted care practices/guidelines?

- ● Yes
- ○ No


East Carolina University
Hello, Michaela Davenport
Dashboard
Home
IRB Studies
Issues
Profiles > Michaela Davenport's Profile
Help
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Edit Researcher Profile
Printer Version
Michaela Davenport's Profile
Contact Information: Michaela Davenport
Institution: East Carolina University
Department/School: College of Nursing
Date Created: 11/4/2024 3:16 PM
Last Modified: 11/4/2024 3:16 PM
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page 1 of no results
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Appendix E: QI vs Research

Human Subject Research Determination Form

This form should be completed and submitted for review by the service lines impacted by the work prior to project initiation (including, but not limited to, collection or analysis of baseline data). Projects that are "Not Human Subjects Research" are not required to submit an IRB application in ePirate. To help make that determination, you may utilize the Decision Chart provided by the Office for Human Research Protections along with this worksheet. For any project where there is a question as to whether it qualifies as Quality Improvement or Research, or if certification of "Not Human Subjects Research" is needed for publication, please route to the UMCIRB office via email: umcirb@ecu.edu.

Please check the Office of Clinical Research Website or UMCIRB website to make sure that you have the most recent version of this form.

Project Title	Increasing Confidence of Certified Registered Nurse Anesthetists in Treating Amniotic Fluid Embolism – A Quality Improvement Project
Project Leader	Michaela B. Davenport
Project Leader Contact E-mail	Davenportm23@students.ecu.edu
Department or Unit Affiliation	Anesthesia
Project Advisor (if applicable)[1]	Dr. Travis Chabo

Additional Faculty, Staff, and Trainees Involved (add more rows if needed):

Name	Department or Unit	Role	Check this box if this team member will access PHI or PII for the purposes of this project.
Dr. Nikki Roebuck	East Carolina University – College of Nursing	Clinical Assistant Professor – Course director	☐
Blake Compliment	East Carolina University	Student Registered Nurse Anesthetist	☐
Ashley Perry	East Carolina University	Student Registered Nurse Anesthetist	☐
Selina Villamor	East Carolina University	Student Registered Nurse Anesthetist	☐
			☐
			☐
			☐
			☐

[1] All student, resident, and fellow projects must have a faculty or unit leader designated as the advisor for the project.

			☐
			☐
			☐
			☐
			☐
			☐

Please answer the following questions to the best of your ability. If the answers to these questions change during the course of the project, please resubmit this form for review:

End Goal / Desired Outcome:

[The purpose of this quality improvement project is to assess anesthesia providers' perceptions of adequacy of a newly developed cognitive aid addressing the identification and treatment of amniotic fluid embolism (AFE) and any impact it has on anesthesia provider confidence in managing this emergent condition. The cognitive aid addressing the identification and treatment of AFE, will be developed based upon accepted national guidelines. Anesthesia providers practicing within the [redacted] will be administered a pre-survey asking their current practice with AFE identification and management. Then, a presentation regarding use of a cognitive aid addressing the diagnosis and treatment of AFE will be made available to them, and they will be asked to evaluate the cognitive aid. The post-survey will assess their perceptions of the cognitive aid's applicability to their practice. Qualtrics survey software will be used to gather data. No patient information will be recorded or maintained during this project. This project will be deemed successful if the newly developed cognitive aid is well-received and there is an increase in CRNA confidence in identifying and treating an AFE. Knowledge gained from this project could be used in future quality improvement and policy efforts aimed at standardizing anesthesia care and increasing CRNA confidence in managing an AFE.]

Methodology / Intervention:

[The project will consist of a single Plan, Do, Study, Act cycle using a pre- and post-implementation survey design. The implementation for this project will be a newly created project tool/cognitive aid focused on the diagnosis and treatment of AFE which is based on current evidence and falls within current accepted practice standards within the facility. CRNA participants will voluntarily participate in the project and will attend an in-person presentation and asked to complete a pre-implementation survey. They will receive training on use of the cognitive aid and be asked to utilize a quick reference guide based on current evidence that aligns with practices currently accepted within the facility to support their practice regarding the diagnosis and treatment of AFE. After the presentation the participants will be asked to evaluate the cognitive aid and any impact it may have on their current practice. The participants will then be asked to complete a post-implementation addressing their perceptions of the project tool. The project lead will be available to answer any questions in-person.]

Data to be collected:

[Data will be gathered directly from participants through completion of Qualtrics pre- and post-surveys delivered and completed electronically. Aside from participant emails, no identifiable data will be gathered. Data of interest is participant opinions and perceptions of practice and the newly developed informational tool.

All data will be gathered using Qualtrics survey software then transferred to Excel for analysis. The only identifying information will be email addresses. Qualtrics survey software is accessed through ECU and involves multifactorial password protection. Data in Excel will be on a password protected spreadsheet and laptop. Email addresses will be deleted from Excel files after both surveys are completed and analysis of results begins. No PHI will be collected for this project. Data will be stored in Qualtrics and in Excel files (de-identified) until student graduation, anticipated to be spring of 2026. The deidentified data will be analyzed with results shared via a poster presentation to the ECU Nurse Anesthesia Program students and faculty, with participants invited to view the presentation remotely. If requested, a presentation of results to the participating department will be provided. Additionally, analysis of results will be addressed in a DNP Project Paper, completion of which is required for program graduation. This paper will be posted in the ECU digital repository, The Scholarship.]

Complete the following questions to guide leadership's determination of this project's status:

	True	False
The PRIMARY purpose of the proposed activity or project is limited to: - implementing a standard practice to improve the quality of patient care and to collect data regarding that implementation for clinical, practical, or administrative purposes, and/or - delivering healthcare and measuring and reporting provider performance data for clinical, practical, or administrative uses.	☒	☐
The activity or project would be carried out even if there was no possibility of publication in a journal or presentation at an academic meeting.	☒	☐
The activity or project falls under well-accepted care practices/guidelines and are designed to bring about immediate improvements in health delivery or quality of care. If "true" and the project is related to clinical activity, please provide a citation below as evidence that project activities fall within standards of care. Projects not directly related to clinical activity, such as medical education, do not need to provide a citation. Saxena, S., Krombach, J. W., Nahrwold, D. A., & Pirracchio, R. (2020). Anaesthesia-specific checklists: A systematic review of impact. *Anaesthesia Critical Care & Pain Medicine, 39*(1), 65-73. https://doi.org/10.1016/j.accpm.2019.07.011	☒	☐
The activity or project involves "no more than minimal risk" procedures. (i.e., the probability and magnitude of harm or discomfort anticipated are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests).	☒	☐

Please submit this form to your supervisor (or designee) for review and approval. Signature on this form certifies that that the below individual is in support of this project taking place and agrees with the project leader's answers to the above questions:

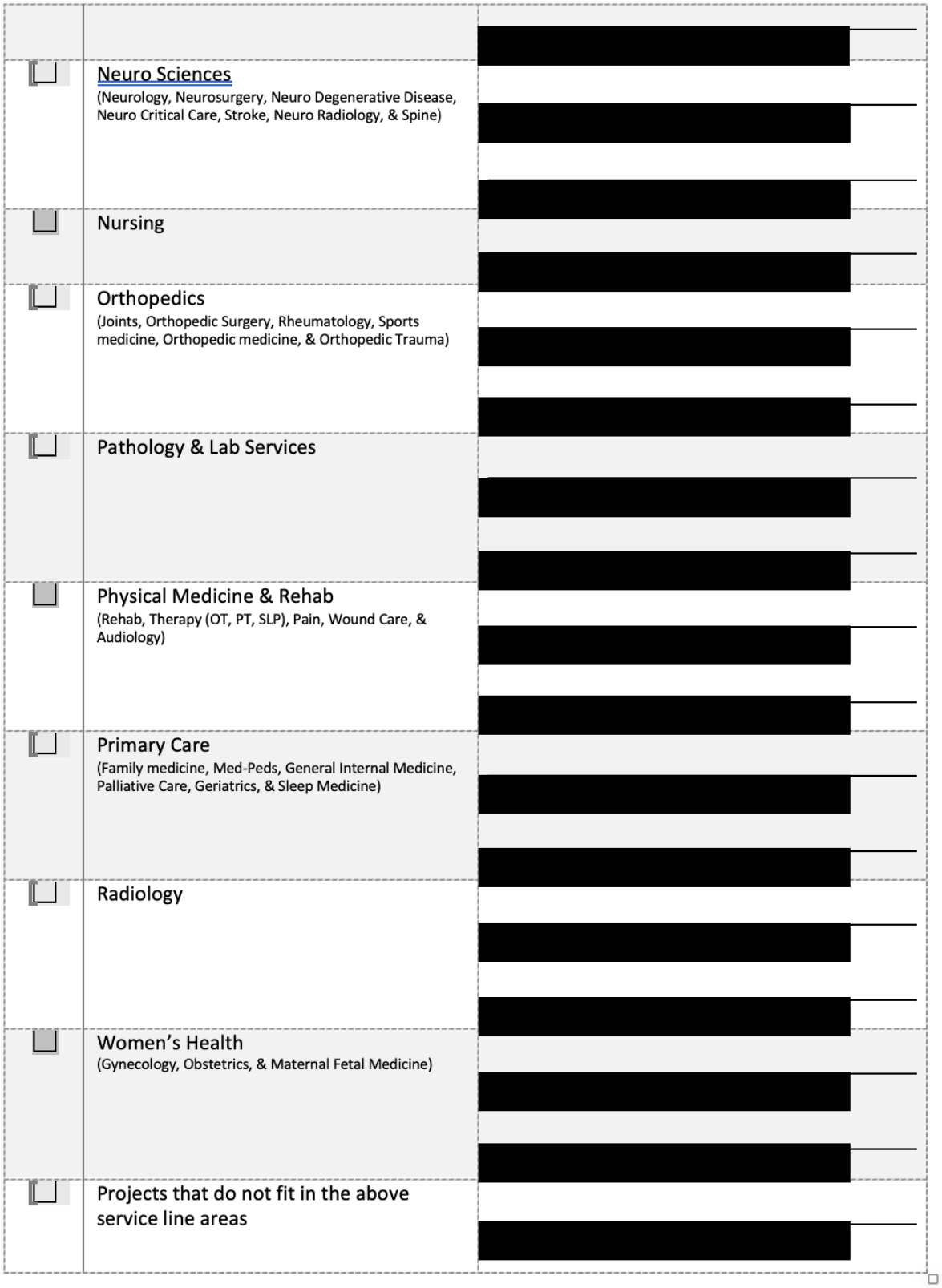
Supervisor's Name	
Signature	

Date	[

For Project Leaders: From the list below, please check the boxes for each service line where interventions may take place or where data may be collected. For each selected area, please route for signature for both the physician leader and administrator (preferably via DocuSign). Send a completed copy of the form to qualityimprovement@ecu.edu.

For Service Line Leaders: Signature on this form certifies that you are in support of this project taking place and agree with the answers to the above questions. If you are not in support of the proposed project, please discuss with the project leader, supervisor, and UMCIRB as needed.

	SERVICE LINE	SIGNATORY
☐	Adult Medicine (Medical Critical Care, Infectious Disease, Hospital Medicine, Pulmonology, Endocrinology, Allergy, Dermatology, & Nephrology)	[redacted]
☒	Adult Surgical Service (Anesthesiology, Trauma, ENT, Benign Urology, Plastics, Ophthalmology, Transplant Surgery, & Acute Care Surgery)	[redacted]
☐	Behavioral Health (Child / Adolescent Psychiatry, Behavioral medicine, & Adult Psychiatry)	[redacted]
☐	Cancer (Breast cancer, Lung cancer, Gynecologic cancer, hematology, GI cancer, Urologic cancer, and Head & Neck cancer)	[redacted]
☐	Children's Health (Pediatric Surgery, General Pediatrics, Well Newborn, Newborn & Pediatric Critical Care, Pediatric Hem-Onc, Neonatology, Pediatric medicine, Medicine subspecialities, surgical subspecialties)	[redacted]
☐	Emergency Services (Emergency Preparedness, Emergency Management, & Emergency Services)	[redacted]
☐	Heart & Vascular (Interventional Cardiology, Electrophysiology, Cardiac Surgery, Advanced Heart Failure, Cardiac Critical Care, Vascular Surgery, Cardio pulmonary rehab, Structural heart, & Thoracic Surgery)	[redacted]


Neuro Sciences
(Neurology, Neurosurgery, Neuro Degenerative Disease, Neuro Critical Care, Stroke, Neuro Radiology, & Spine)
Nursing
Orthopedics
(Joints, Orthopedic Surgery, Rheumatology, Sports medicine, Orthopedic medicine, & Orthopedic Trauma)
Pathology & Lab Services
Physical Medicine & Rehab
(Rehab, Therapy (OT, PT, SLP), Pain, Wound Care, & Audiology)
Primary Care
(Family medicine, Med-Peds, General Internal Medicine, Palliative Care, Geriatrics, & Sleep Medicine)
Radiology
Women's Health
(Gynecology, Obstetrics, & Maternal Fetal Medicine)
Projects that do not fit in the above service line areas

		[redacted]

Optional Determination:

For any project where there is a question as to whether it qualifies as Quality Improvement or Research, or if certification of "Not Human Subjects Research" is needed for publication, please route to the UMCIRB office via email: umcirb@ecu.edu.

☐ **Not Human Subjects Research:** The UMCIRB office has determined that based on the description of the project, approval by the IRB is not necessary. Any changes or modifications to this project may be discussed with the UMCIRB office at that time to ensure those changes do not elevate the project to human research that would need IRB approval.

☐ **Human Subjects Research:** This project requires review by the IRB prior to initiation. An application in the electronic IRB submission system should be submitted.

UMCIRB Office Staff Signature: _____ **Date:** _____

The UMCIRB office will contact you if any further information is needed to make this determination. Please note that if the UMCIRB office determines the activity is not human subjects research, then any presentation, publication, etc. should not refer to the activity as such.

Human Subject Research Determination Form

This form should be completed and submitted for review by the service lines impacted by the work prior to project initiation (including, but not limited to, collection or analysis of baseline data). Projects that are "Not Human Subjects Research" are not required to submit an IRB application in ePirate. To help make that determination, you may utilize the Decision Chart provided by the Office for Human Research Protections along with this worksheet. For any project where there is a question as to whether it qualifies as Quality Improvement or Research, or if certification of "Not Human Subjects Research" is needed for publication, please route to the UMCIRB office via email: umcirb@ecu.edu.

Please check the Office of Clinical Research Website or UMCIRB website to make sure that you have the most recent version of this form.

Project Title	Increasing Confidence of Certified Registered Nurse Anesthetists in Treating Amniotic Fluid Embolism – A Quality Improvement Project
Project Leader	Michaela B. Davenport
Project Leader Contact E-mail	Davenportm23@students.ecu.edu
Department or Unit Affiliation	Anesthesia
Project Advisor (if applicable)[1]	Dr. Travis Chabo

Additional Faculty, Staff, and Trainees Involved (add more rows if needed):

Name	**Department or Unit**	**Role**	**Check this box if this team member will access PHI or PII for the purposes of this project.**
Dr. Nikki Roebuck	East Carolina University – College of Nursing	Clinical Assistant Professor – Course director	☐
Blake Compliment	East Carolina University	Student Registered Nurse Anesthetist	☐
Ashley Perry	East Carolina University	Student Registered Nurse Anesthetist	☐
Selina Villamor	East Carolina University	Student Registered Nurse Anesthetist	☐
			☐
			☐
			☐
			☐

[1] All student, resident, and fellow projects must have a faculty or unit leader designated as the advisor for the project.

			☐
			☐
			☐
			☐
			☐
			☐

Please answer the following questions to the best of your ability. If the answers to these questions change during the course of the project, please resubmit this form for review:

End Goal / Desired Outcome:

[The purpose of this quality improvement project is to assess anesthesia providers' perceptions of adequacy of a newly developed cognitive aid addressing the identification and treatment of amniotic fluid embolism (AFE) and any impact it has on anesthesia provider confidence in managing this emergent condition. The cognitive aid addressing the identification and treatment of AFE, will be developed based upon accepted national guidelines. Anesthesia providers practicing within the [redacted] will be administered a pre-survey asking their current practice with AFE identification and management. Then, a presentation regarding use of a cognitive aid addressing the diagnosis and treatment of AFE will be made available to them, and they will be asked to evaluate the cognitive aid. The post-survey will assess their perceptions of the cognitive aid's applicability to their practice. Qualtrics survey software will be used to gather data. No patient information will be recorded or maintained during this project. This project will be deemed successful if the newly developed cognitive aid is well-received and there is an increase in CRNA confidence in identifying and treating an AFE. Knowledge gained from this project could be used in future quality improvement and policy efforts aimed at standardizing anesthesia care and increasing CRNA confidence in managing an AFE.

Methodology / Intervention:

[The project will consist of a single Plan, Do, Study, Act cycle using a pre- and post-implementation survey design. The implementation for this project will be a newly created project tool/cognitive aid focused on the diagnosis and treatment of AFE which is based on current evidence and falls within current accepted practice standards within the facility. CRNA participants will voluntarily participate in the project and will attend an in-person presentation and asked to complete a pre-implementation survey. They will receive training on use of the cognitive aid and be asked to utilize a quick reference guide based on current evidence that aligns with practices currently accepted within the facility to support their practice regarding the diagnosis and treatment of AFE. After the presentation the participants will be asked to evaluate the cognitive aid and any impact it may have on their current practice. The participants will then be asked to complete a post-implementation addressing their perceptions of the project tool. The project lead will be available to answer any questions in-person.

Data to be collected:

[Data will be gathered directly from participants through completion of Qualtrics pre- and post-surveys delivered and completed electronically. Aside from participant emails, no identifiable data will be gathered. Data of interest is participant opinions and perceptions of practice and the newly developed informational tool.
All data will be gathered using Qualtrics survey software then transferred to Excel for analysis. The only identifying information will be email addresses. Qualtrics survey software is accessed through ECU and involves multifactorial password protection. Data in Excel will be on a password protected spreadsheet and laptop. Email addresses will be deleted from Excel files after both surveys are completed and analysis of results begins. No PHI will be collected for this project. Data will be stored in Qualtrics and in Excel files (de-identified) until student graduation, anticipated to be spring of 2026. The deidentified data will be analyzed with results shared via a poster presentation to the ECU Nurse Anesthesia Program students and faculty, with participants invited to view the presentation remotely. If requested, a presentation of results to the participating department will be provided. Additionally, analysis of results will be addressed in a DNP Project Paper, completion of which is required for program graduation. This paper will be posted in the ECU digital repository, The Scholarship.

Complete the following questions to guide leadership's determination of this project's status:

	True	False
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The activity or project would be carried out even if there was no possibility of publication in a journal or presentation at an academic meeting.	☐	☐
The activity or project falls under well-accepted care practices/guidelines and are designed to bring about immediate improvements in health delivery or quality of care. If "true" and the project is related to clinical activity, please provide a citation below as evidence that project activities fall within standards of care. Projects not directly related to clinical activity, such as medical education, do not need to provide a citation. Saxena, S., Krombach, J. W., Nahrwold, D. A., & Pirracchio, R. (2020). Anaesthesia-specific checklists: A systematic review of impact. *Anaesthesia Critical Care & Pain Medicine, 39*(1), 65-73. https://doi.org/10.1016/j.accpm.2019.07.011	☐	☐
The activity or project involves "no more than minimal risk" procedures. (i.e., the probability and magnitude of harm or discomfort anticipated are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests).	☐	☐

Please submit this form to your supervisor (or designee) for review and approval. Signature on this form certifies that that the below individual is in support of this project taking place and agrees with the project leader's answers to the above questions:

Supervisor's Name	[redacted]
Signature	[redacted] [redacted]

Date	2/13/2025 | 11:41 PM EST	2/10/2025 | 5:38 PM PST

For Project Leaders: From the list below, please check the boxes for each service line where interventions may take place or where data may be collected. For each selected area, please route for signature for both the physician leader and administrator (preferably via DocuSign). Send a completed copy of the form to qualityimprovement@ecu.edu.

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☐	Adult Surgical Service (Anesthesiology, Trauma, ENT, Benign Urology, Plastics, Ophthalmology, Transplant Surgery, & Acute Care Surgery)	[redacted]
☐	Behavioral Health (Child / Adolescent Psychiatry, Behavioral medicine, & Adult Psychiatry)	[redacted]
☐	Cancer (Breast cancer, Lung cancer, Gynecologic cancer, hematology, GI cancer, Urologic cancer, and Head & Neck cancer)	[redacted]
☐	Children's Health (Pediatric Surgery, General Pediatrics, Well Newborn, Newborn & Pediatric Critical Care, Pediatric Hem-Onc, Neonatology, Pediatric medicine, Medicine subspecialities, surgical subspecialties)	[redacted]
☐	Emergency Services (Emergency Preparedness, Emergency Management, & Emergency Services)	[redacted]
☐	Heart & Vascular (Interventional Cardiology, Electrophysiology, Cardiac Surgery, Advanced Heart Failure, Cardiac Critical Care, Vascular Surgery, Cardio pulmonary rehab, Structural heart, & Thoracic Surgery)	[redacted]

☐	Neuro Sciences (Neurology, Neurosurgery, Neuro Degenerative Disease, Neuro Critical Care, Stroke, Neuro Radiology, & Spine)	[redacted]
☐	Nursing	[redacted]
☐	Orthopedics (Joints, Orthopedic Surgery, Rheumatology, Sports medicine, Orthopedic medicine, & Orthopedic Trauma)	[redacted]
☐	Pathology & Lab Services	[redacted]
☐	Physical Medicine & Rehab (Rehab, Therapy (OT, PT, SLP), Pain, Wound Care, & Audiology)	[redacted]
☐	Primary Care (Family medicine, Med-Peds, General Internal Medicine, Palliative Care, Geriatrics, & Sleep Medicine)	[redacted]
☐	Radiology	[redacted]
☐	Women's Health (Gynecology, Obstetrics, & Maternal Fetal Medicine)	[redacted]
☐	Projects that do not fit in the above service line areas	[redacted]

[redacted]

Optional Determination:
For any project where there is a question as to whether it qualifies as Quality Improvement or Research, or if certification of "Not Human Subjects Research" is needed for publication, please route to the UMCIRB office via email: umcirb@ecu.edu.

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☐ **Human Subjects Research:** This project requires review by the IRB prior to initiation. An application in the electronic IRB submission system should be submitted.

UMCIRB Office Staff Signature: [redacted] _____ **Date:** 4/3/2025 | 8:03 PM EDT

The UMCIRB office will contact you if any further information is needed to make this determination. Please note that if the UMCIRB office determines the activity is not human subjects research, then any presentation, publication, etc. should not refer to the activity as such.

Appendix F: Cognitive Aid

AFE Emergency Management

Signs and Symptoms

Neuro:
- Altered mental status [3]
- Seizure [3]
- Loss of Consciousness [1]

Respiratory:
- Dyspnea [3]
- Hypoxia [5]
- Loss of EtCO2 [3]
- Respiratory failure [6]

Circulatory:
- Chest pain [3]
- Hypotension [5]
- Cardiac arrest [6]
- Heart failure [12]
- Arrhythmia [12]

Maternal/Fetal:
- Maternal hemorrhage [12]
- DIC [12]
- Fetal distress [3]

CALL FOR HELP

Consult anesthesiologists, intensivists, cardiologists, and obstetricians [1,3,6]

ABC's

Airway: secured? If not, **secure advanced airway** [1,3]

Breathing: SpO2 and RR, auscultate [1]
- Administer **100% FiO2**. Maintain SpO2 94-98% [12]
- Pulmonary HTN - consider **pulmonary vasodilator** [12]
- Consider **ECMO** [1,3]

Circulation:
- Establish 2 large bore IVs, arterial line, CVC [1,3]
- Vasopressors and inotropes to maintain **MAP > 65 mmHG** [1,3]
- Caution with fluid overload [11,12]
- Cardiac arrest → **high-quality CPR** [11,12]

Maternal Management

Manually **displace uterus** or place patient in **left lateral tilt** [3]

- Monitor FHR [1]
- Consider **emergency delivery if > 23 weeks** of gestation. [12]
- If no pulse at **4 mins**, start **postmortem cesarean delivery** [12]

- Anticipate uterine atony, DIC, hemorrhage [1]
  - **Oxytocin prophylaxis** and other uterotonics as needed
- Anticipate hysterectomy [12]
- Consider A-OK (Atropine 1 mg, Ondansetron 8 mg, Ketorolac 15 mg) [3,6]

Coagulopathy

- **Labs**: CBC, coags, fibrinogen, BMP, ABG, TEG/ROTEM

- Activate **MTP**
  - Transfuse blood products to keep normal INR, aPTT, and fibrinogen > 1.0 g/L [1]

- **1 g TXA over 10 minutes** [3]

Scan for Reference List

Appendix G: Email to Participant

Initial Pre-Survey Email to Participants

Dear [redacted] Hospital CRNAs,

Thank you so much for considering participating in a quality improvement project titled "Increasing Confidence of Certified Registered Nurse Anesthetists in Treating Amniotic Fluid Embolism." This project aims to assess the usefulness of a newly developed cognitive aid for anesthesia providers in identifying and treating AFE and whether the reference tool can impact CRNA confidence in diagnosing and treating AFE at [redacted] Hospital.

Participation is voluntary and involves completing a short pre-implementation survey, viewing a brief presentation on AFE, and, after the presentation, evaluating a newly designed cognitive aid for its usefulness in identifying and managing a suspected AFE. Please use the newly developed cognitive aid in each anesthesia workstation in the Labor and Delivery and the Operating Room (OR) suites.

Each survey and the presentation should take less than 10 minutes to complete. The surveys were created and are to be completed using Qualtrics Software. This cognitive aid aligns with the currently accepted practice in your work area. Your participation is both voluntary and confidential. The results of this QI study will be shared with you upon completion.

You will complete the pre-implementation survey before the presentation on the scheduled presentation day.

After completing the survey, I will present current evidence-based practice recommendations for diagnosing and treating an amniotic fluid embolism. The newly developed cognitive aid will be available in digital form, and laminated versions can be found in the second drawer of the anesthesia workstations in all the labor and delivery rooms and the anesthesia workstations in the OR suites. After learning about the newly developed cognitive aid discussed in the presentation, you will be asked to complete a brief post-implementation survey to evaluate its usefulness.

Again, thank you so much for participating in this quality improvement project. I will be at [redacted] Hospital starting on April 23, 2025, at 7:00 am. If you have any questions, please email Dr. Chabo or me.

Sincerely,

Michaela B. Davenport, SRNA
davenportm23@students.ecu.edu

Travis Chabo, PhD, CRNA
chabot14@ecu.edu

Final Thank You Email to Participants

Dear [redacted] CRNAs,

I want to extend my heartfelt thanks to everyone who supported me with my DNP Project! I have gathered all the data I need to proceed with the data analysis and finish my paper. Once it's complete, everyone will have the opportunity to read it if they're interested. If you found the cognitive aid helpful, please keep using the tool. If there are areas within your practice site that would benefit from this cognitive aid and you would like copies to be placed there, please let me know, and I will get copies to you.

Thank you again! I hope to work with you more in the future.

Take care,
Michaela B. Davenport, SRNA
ECU Nurse Anesthesia Program
Class of 2026

Appendix H: Amniotic Fluid Embolism Presentation

Pre-Implementation Survey

Please scan the following QR code to take our Pre-Implementation Survey:

ECU

1

ECU

Use of a Cognitive Aid in the Identification and Treatment of an Amniotic Fluid Embolism

Blake Compliment, SRNA
Michaela Davenport, SRNA
Ashley Perry, SRNA
Selina Villamor, SRNA

2

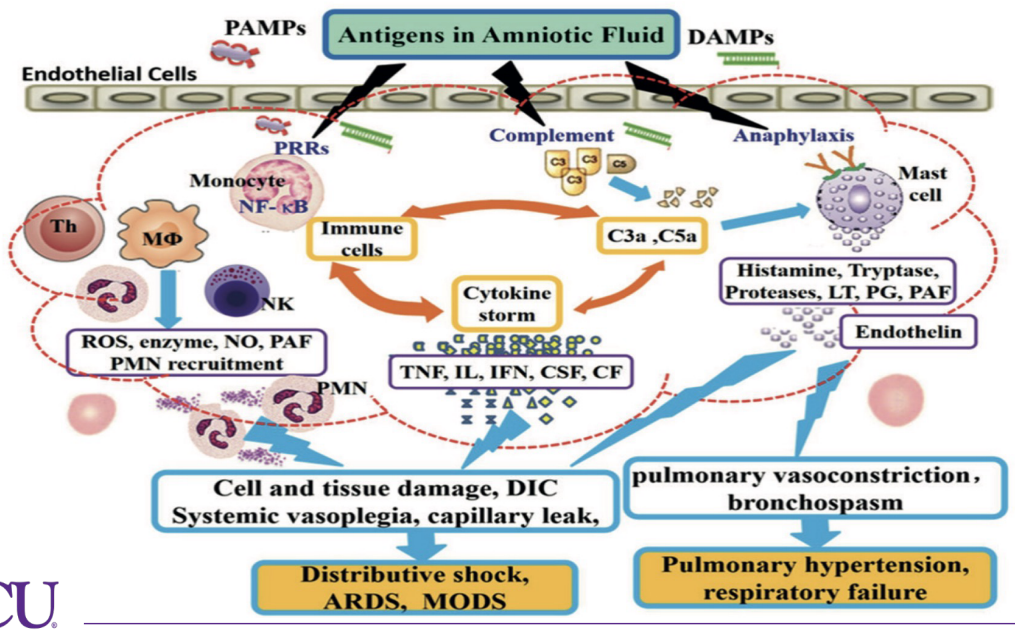
AFE Risk Factors

- Advanced Maternal Age (> 35 years of age)[7, 8, 9]
- Multiple-gestation pregnancy[8, 9]
- Cesarean Section[7, 8, 9]
- Mechanical induction[7, 8, 9]
- Operative-assisted delivery (e.g., forceps delivery or vacuum extraction)[8, 9]
- Uterine Tachysystole/Uterine Tetany[8]
- Placenta Previa[6,7,8] or Placental Abruption[7, 8]
- Eclampsia[7]
- Cervical trauma[8]

ECU

3

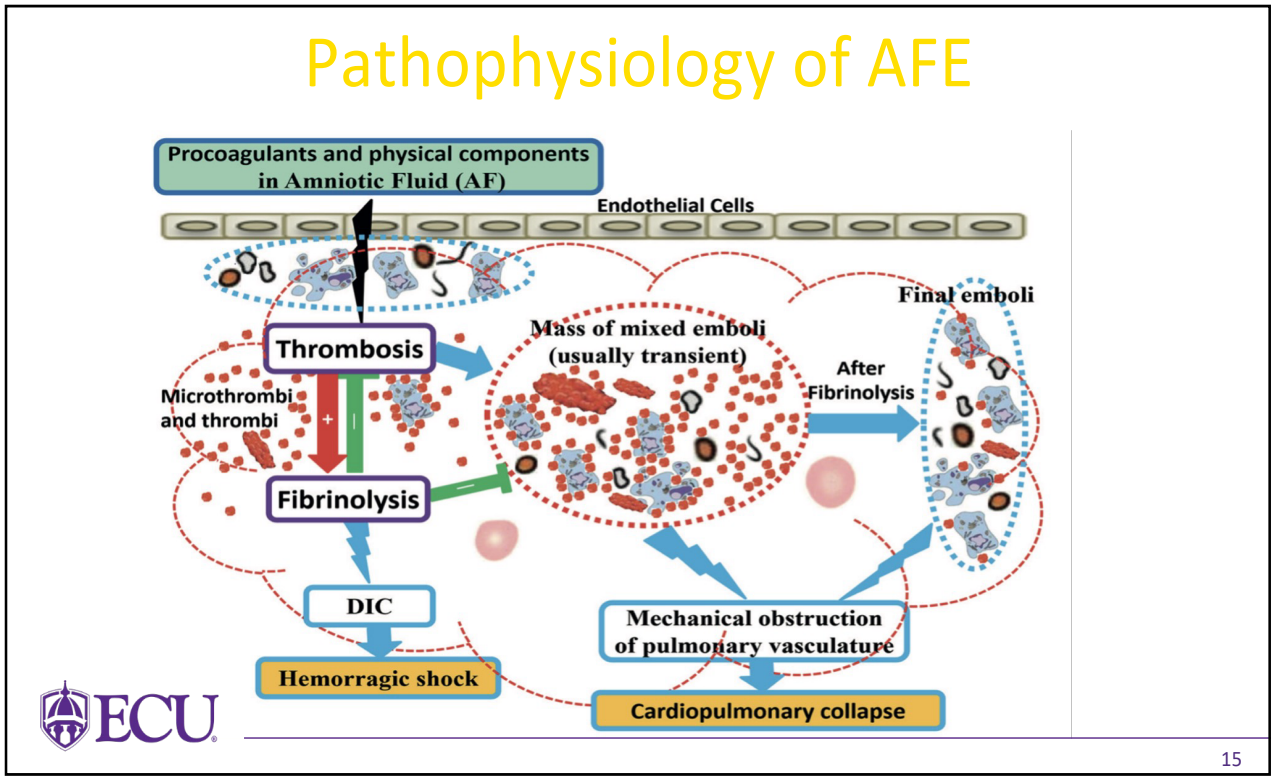
Pathophysiology of AFE



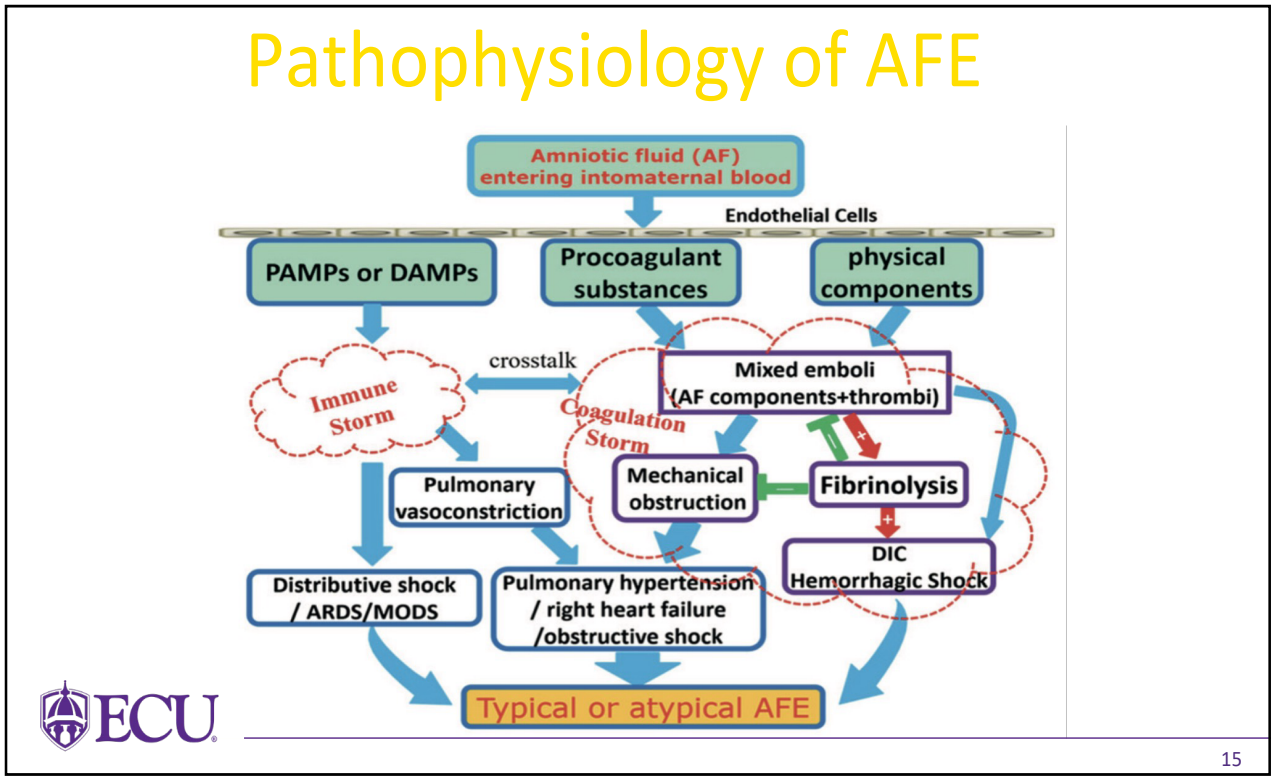
ECU

15

4


Pathophysiology of AFE
Procoagulants and physical components in Amniotic Fluid (AF)
Endothelial Cells
Thrombosis
Microthrombi and thrombi
Mass of mixed emboli (usually transient)
After Fibrinolysis
Final emboli
Fibrinolysis
DIC
Hemorragic shock
Mechanical obstruction of pulmonary vasculature
Cardiopulmonary collapse
ECU
15

5


Pathophysiology of AFE
Amniotic fluid (AF) entering intomaternal blood
Endothelial Cells
PAMPs or DAMPs
Procoagulant substances
physical components
crosstalk
Immune Storm
Coagulation Storm
Mixed emboli (AF components+thrombi)
Pulmonary vasoconstriction
Mechanical obstruction
Fibrinolysis
DIC Hemorrhagic Shock
Distributive shock / ARDS/MODS
Pulmonary hypertension / right heart failure /obstructive shock
Typical or atypical AFE
ECU
15

6

Pathophysiology of AFE

- Amniotic Fluid Embolism
  - Reaction to the release of fetal material into the maternal circulation[11]
  - Physical obstruction of the pulmonary vasculature from fetal components into the bloodstream[11]
- Anaphylactoid Syndrome of Pregnancy[11]
  - Introduction of fetal components into the maternal circulation
    - Activation of the coagulation cascade from mast cell degranulation + Systemic Inflammatory Response Syndrome (SIRS)[11]
  - Mast cell degranulation, histamine release, & activation of the coagulation cascade[15]

ECU

7

Signs and Symptoms

- Altered mental status[3]
- Seizure[3]
- Loss of consciousness[1]
- Dyspnea[3]
- Hypoxia[5]
- Pulmonary edema[3]
- Loss of $EtCO_2$[3]
- Respiratory failure[6]
- Chest pain[3]
- Hypotension[5]
- Arrhythmia[12]
- Heart failure[12]
- Cardiac arrest[6]
- Maternal hemorrhage[12]
- Disseminated intravascular coagulation (DIC)[12]
- Fetal distress[3]

ECU

8

AFE Treatment

- Call for help![1, 3, 6]
- Consult Intensivists, Anesthesiologists, Cardiologists, &/or Obstetricians[1, 3, 6]
- ABC
  - Airway: secure the airway[1, 3]
  - Breathing: SpO_2 + RR, auscultate breath sounds[1]
    - Administer 100% FiO_2. Maintain SpO_2 of 94-98%[12]
    - Pulmonary Hypertension – consider pulmonary vasodilators[12]
    - Consider Extracorporeal Membrane Oxygenation (ECMO)[1, 3]
  - Circulation: HR + BP, UOP[1]
    - Establish 2 large bore IV's, Arterial line, & CVC[1, 3]
    - Vasopressors & inotropes to maintain MAP > 65 mmHg[12]
    - Use caution to avoid fluid overload[11, 12]
    - Cardiac arrest high-quality CPR[1, 3, 6, 11, 12]
  - Consider "AOK" Protocol[3, 6]
    - Atropine: 0.2-1 mg
    - Ondansetron: 8 mg
    - Ketorolac: 15 mg

ECU

9

AFE Treatment Continued

- Manually displace uterus or place patient in 15° left lateral tilt[3]
  - Monitor Fetal Heart Rate[1]
  - Consider emergency delivery if ≥ 23 weeks gestation[12]
  - If no pulse at 4-minute interval, start postmortem cesarean delivery[12]
  - Anticipate uterine atony, DIC, or hemorrhage[1]
    - Oxytocin prophylaxis & other uterotonics as needed
  - Anticipate hysterectomy[12]
- Labs: CBC, coags, fibrinogen, BMP, ABG, TEG/ROTEM
  - Activate MTP - Transfuse blood products to keep fibrinogen > 1.0 g/L, and INR, & aPTT within normal limits[1]
  - Administer 1 g TXA over 10 minutes[3]

ECU

10

Cognitive Aid Benefits

- Error reduction in critical management steps during medical emergencies[2, 10, 13]
- Ensure compliance with essential life-saving protocols[2, 4]
- Bolster Memory[2, 4, 10]
- Aid in decision-making[2, 3, 10]
  - Diminish fixation errors[16]
  - Decrease premature diagnosis[16]
  - Decrease communication biases[16]
- Standardize actions[2, 4, 10]
- Enhance communication[2, 4, 10]

ECU

11

AFE Emergency Management

Signs and Symptoms

Neuro:
- Altered mental status [3]
- Seizure [3]
- Loss of Consciousness [1]

Respiratory:
- Dyspnea [3]
- Hypoxia [5]
- Loss of EtCO2 [3]
- Respiratory failure [6]

Circulatory:
- Chest pain [3]
- Hypotension [5]
- Cardiac arrest [6]
- Heart failure [12]
- Arrhythmia [12]

Maternal/Fetal:
- Maternal hemorrhage [12]
- DIC [12]
- Fetal distress [3]

CALL FOR HELP
Consult anesthesiologists, intensivists, cardiologists, and obstetricians [1,3,6]

ABC's

Airway: secured? If not, **secure advanced airway** [1,3]

Breathing: SpO2 and RR, auscultate [1]
- Administer **100% FiO2**. Maintain SpO2 94-98% [12]
- Pulmonary HTN - consider **pulmonary vasodilator** [12]
- Consider **ECMO** [1,3]

Circulation:
- Establish 2 large bore IVs, arterial line, CVC [1,3]
- Vasopressors and inotropes to maintain **MAP > 65 mmHG** [1,3]
- Caution with fluid overload [11,12]
- Cardiac arrest → **high-quality CPR** [11,12]

Maternal Management

Manually **displace uterus** or place patient in **left lateral tilt** [3]

- Monitor FHR [1]
- Consider **emergency delivery if > 23 weeks** of gestation. [12]
- If no pulse at **4 mins**, start **postmortem cesarean delivery** [12]

- Anticipate uterine atony, DIC, hemorrhage [1]
  - **Oxytocin prophylaxis** and other uterotonics as needed
- Anticipate hysterectomy [12]
- Consider A-OK (Atropine 1 mg, Ondansetron 8 mg, Ketorolac 15 mg) [3,6]

Coagulopathy

- **Labs**: CBC, coags, fibrinogen, BMP, ABG, TEG/ROTEM
- Activate **MTP**
  - Transfuse blood products to keep normal INR, aPTT, and fibrinogen > 1.0 g/L [1]
- **1 g TXA over 10 minutes** [3]

Scan for Reference List

AFE Cognitive Aid

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12

Locations of Cognitive Aid

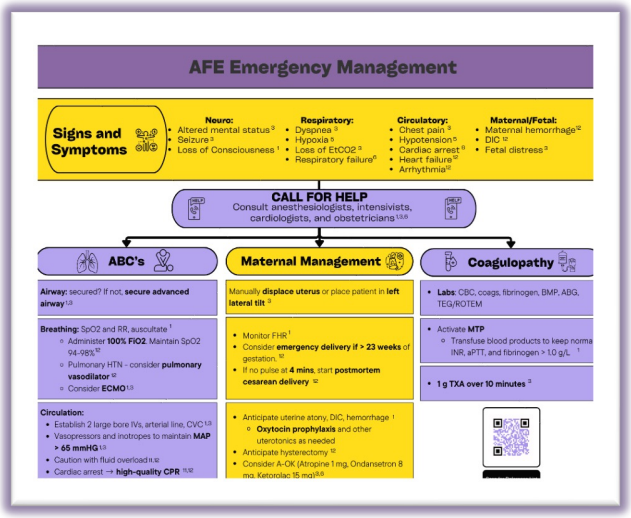
- Digital version:

SCAN ME

13

Locations of Cognitive Aid

- Laminated version:
  - Second drawer of the anesthesia workstation in all Labor & Delivery OR's
  - Trauma-ready rooms
    - OR 4, OR 15, OR 16, or OR 18



14

Post-Implementation Survey

Please scan the following QR code to take our Post-Implementation Survey:

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15

Thank you so much for your participation!

QUESTIONS?

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16

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17

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18

Appendix I: Copies of Qualtrics Pre-Presentation Questions

AFE Pre-Implementation Survey

How many years have you practiced as a Certified Registered Nurse Anesthetist (CRNA)?

- ○ Less than 5 years
- ○ 5-9 years
- ○ 10-14 years
- ○ 15-20 years
- ○ Greater than 20 years

Since graduation and/or recertification, have you received any in-service or other education regarding the identification or management of AFE?

- ○ Yes
- ○ No
- ○ Not Sure

How many times have you been involved in managing and caring for a patient with a suspected Amniotic Fluid Embolism (AFE)?

Rate your confidence regarding AFE identification and management.

Not confident	Not very confident	Neutral	Somewhat Confident	Very confident
○	○	○	○	○

Are you aware of a cognitive aid outlining current treatment guidelines regarding AFE identification and management at your facility?

- ○ Yes
- ○ No
- ○ Not sure

Rate the effectiveness of your current treatment guidelines regarding AFE management.

Very ineffective	Ineffective	Neutral	Effective	Very effective
○	○	○	○	○

If you had a question about the management of AFE, how long would it take you to find reference material regarding AFE identification and management?

- ○ < 1 minute
- ○ 1-3 minutes
- ○ 4-6 minutes
- ○ 7-9 minutes
- ○ 10 minutes or more

Have you used a cognitive aid (e.g., an ACLS card) to support your management of an emergency in the past?

- ○ Yes
- ○ No
- ○ Unsure

If a cognitive aid is provided, how likely are you to use it to manage AFE?

- I am never going to use it
- I will probably not use it
- I have no preference
- I will probably use it
- I am very likely going to use it

Appendix J: Copies of Qualtrics Pre-Presentation Questions

AFE Post-Implementation Survey

Please select the answer that best describes the extent to which you agree or disagree with the following four statements regarding the provided cognitive aid:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Cognitive aid was organized well	○	○	○	○	○
The information included was applicable and accurate	○	○	○	○	○
This handout was easy to read and understand	○	○	○	○	○
Overall, I was satisfied with this cognitive aid	○	○	○	○	○

After reviewing this cognitive visual aid, how likely are you to use this tool to manage AFE?

Very unlikely	Somewhat unlikely	Neutral	Somewhat likely	Very likely
○	○	○	○	○

Since reviewing the cognitive aid and listening to our presentation, how confident do you feel regarding the management of AFE?

Not confident	Not very confident	Neutral	Somewhat confident	Very confident
○	○	○	○	○

Which location would provide the easiest/quickest/best accessibility to the cognitive aid?

- ○ QR on anesthesia machine in Labor, Delivery, Recovery, and Postpartum (LDRP)
- ○ Laminated handout in the anesthesia machine in LDRP rooms
- ○ Practice Advisory Popup with a link within the Electronic Health Record (EHR)
- ○ All of the above
- ○ Other. Please write in your response below. _____

If provided in one of the locations mentioned above, how long would it take to access this cognitive aid to manage AFE?

- ○ Less than 1 minute
- ○ 1-3 minutes
- ○ 4-6 minutes
- ○ 7-9 minutes
- ○ 10 minutes

What other healthcare personnel would benefit from this cognitive aid and presentation? Select all that apply.

- ☐ Obstetrical (OB) Residents/Fellows
- ☐ OB Nurses
- ☐ OB Attendings
- ☐ Critical Care Nurses
- ☐ Critical Care Fellows/Residents
- ☐ All of the Above
- ☐ Other. Please write in your response below. _____

Do you have any suggestions for improving the effectiveness of this cognitive aid and presentation? Please write in your suggestions.