Anesthesia Providers' Perceptions of a Cognitive Aid for the Management of Amniotic Fluid Embolism: A Doctor of Nursing Practice Project

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Abstract

Amniotic fluid embolisms (AFE) are a rare but life-threatening obstetrical emergency associated with high maternal mortality. The purpose of this quality improvement project was to assess anesthesia providers' perceptions of a cognitive aid to aid in identifying and managing AFE. The cognitive aid was developed following a synthesis of literature and distributed during an informational session to Certified Registered Nurse Anesthetists (CRNAs) at a partnering facility. The CRNAs responded to pre- and post-implementation surveys regarding their perceptions of the usefulness of the cognitive aid. Results indicated that the anesthesia providers felt that the CA was well-designed and easy to use. CRNAs reported increased confidence in AFE identification and management following the presentation and CA dissemination. Finally, the CA also increased the speed of locating information regarding the identification and management of a suspected AFE. By enhancing CRNA confidence and reducing the time required to access critical information, the cognitive aid may contribute to earlier intervention, more coordinated team responses, and ultimately, improved patient outcomes during one of the most time-sensitive emergencies in obstetric anesthesia. Recommendations for future versions of this project include the development of a multidisciplinary simulation program incorporating the cognitive aid into AFE emergency management scenarios.

Keywords: anesthesia, CRNA, cognitive aid, amniotic fluid embolism

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Section I. Introduction

Background

Amniotic fluid embolism (AFE) is a life-threatening obstetric complication that occurs when amniotic fluid or fetal cells enter maternal pulmonary circulation and cause acute maternal cardiovascular compromise. While the incidence of AFE is rare, with a reported incidence varying from 1 to 7.7 cases per 100,000 births, rates of maternal mortality are staggering, reaching as high as 61% (Trieu et al., 2023). Furthermore, there is an associated neurologic injury rate of 30 to 40% (Arnolds, 2022). Despite the associated mortality and advances in medicine, little is known about the pathophysiology, risk factors, diagnosis, and treatment of AFE. Notably, a gold standard diagnostic tool has yet to be created, and treatment guidelines vary, but management is entirely supportive. The presence of an anesthesia provider or obstetrician at the time of AFE onset is associated with higher survival rates, indicating the importance of early recognition (Arnolds, 2022). Prompt identification and treatment of AFE is necessary because clinical manifestations are profound and progress rapidly toward circulatory collapse (Trieu et al., 2023).

Without a gold standard diagnostic tool, the identification of AFE is primarily made through clinical assessment and excluding other differential diagnoses (Trieu et al., 2023). The clinical presentation consists of severe maternal hypotension with or without respiratory distress and coagulopathy that often rapidly progresses to maternal cardiac arrest (Wiseman et al., 2023). Diagnosis relies upon identifying these non-specific clinical signs and excluding other potential causes (Bouvet et al., 2021). Further complicating the clinical diagnosis process are the various clinical diagnostic criteria in different countries (Trieu et al., 2023). The United Kingdom Obstetrical Surveillance System Criteria (UKOSS), Japan, and USA criteria slightly differ in

their definitions of required clinical manifestations (Wiseman et al., 2023). The varying diagnostic criteria further complicate an already difficult diagnosis, leaving identification and management mostly up to clinical judgment by the anesthesia provider.

The Anesthesia Patient Safety Foundation (APSF) emphasized the need for facility-specific cognitive aids (CA) to support the initial management of AFE. Additionally, they support using common diagnostic criteria and key distinguishing features from other common causes for maternal hypotension. The APSF management recommendations are primarily supportive and caution against several proposed interventions such as hydrocortisone, lipid emulsion, C1 esterase inhibitors, and a combination of atropine, ondansetron, and ketorolac, often referred to with the mnemonic "A-OK." These interventions have been described in the literature, but the APSF states that until further research supports their use, they should not be used in lieu of supportive care by the anesthesia provider (Arnolds, 2022). This project aims to identify the most pertinent recommendations and compile them into a cognitive aid for anesthesia providers to reference in the event of a suspected AFE event.

Organizational Needs Statement

The partnering organization for this quality improvement project cares for a vast number of obstetrical patients each year; however, given the rarity of this life-threatening obstetrical complication, many anesthesia providers have never experienced an AFE (T. Chabo, personal communication, September 24, 2024). Additionally, there are no protocols employed at this center to standardize and guide anesthesia providers in AFE identification and management. This leaves anesthesia providers to use their clinical judgment in diagnosis and personal preferences when providing treatment of a suspected AFE.

The Anesthesia Patient Safety Foundation (APSF) emphasized the need for facility-specific cognitive aids to assist in the identification and initial management of AFE (Arnolds, 2022). Additionally, Arnolds (2022) reported that patient outcomes are improved by the presence of an anesthesia provider at the time of AFE onset; an organizational-specific cognitive aid in the identification and management of AFE tailored to anesthesia providers could further improve provider readiness in an AFE emergency. This organizational need intersects with the goals of the Institute for Healthcare Improvement (IHI) Triple AIM concerning improving patient experience of care and reducing the per capita cost of health care (Berwick et al., 2008).

Problem Statement

Despite being recognized as a syndrome for nearly 100 years, AFE remains difficult to diagnose and lacks a widely accepted treatment protocol, leaving anesthesia providers at this institution to use clinical judgment and personal preferences in the identification and management of this life-threatening obstetrical complication. AFE often leads to rapid cardiovascular and coagulation collapse and is associated with high mortality; thus delays in diagnosis and lack of consensus on interventions further complicate this life-threatening situation.

Purpose Statement

The purpose of this Doctor of Nursing Practice (DNP) quality improvement project is to assess the usefulness of a newly developed cognitive aid for anesthesia providers on the identification and management of AFE. Additionally, this project will assess if the reference guide impacted CRNA confidence in diagnosing and treating AFE. It is anticipated that knowledge gained from this project could help inform future quality improvement initiatives aimed at diagnosing and treating an AFE.

Section II. Evidence

Description of Search Strategies

The purpose of this literature search was to examine current evidence and recommendations for the identification and management of AFE in the perioperative setting. The literature search was centered around a specific population, intervention, comparison, outcome, and time (PICOT) question regarding the current practice problem. The PICOT question used to guide the initial search strategy was: How can a cognitive aid improve anesthesia providers' readiness to rapidly and accurately identify and manage amniotic fluid embolisms? Utilizing the PICOT question to direct the literature search, five main concepts were used: AFE, management, diagnosis, protocol, and cognitive aid. See Appendix A for a complete list of keywords, MeSH terms, and subject headings utilized in the literature search.

The initial literature search was conducted using the databases PubMed and Cumulative Index to Nursing and Allied Health Literature (CINAHL), as well as the search engine Google Scholar. The Boolean operators AND and OR were used to combine keywords and concepts for the literature search. The first search strategy used for PubMed was ("embolism, amniotic fluid"[MeSH Terms] AND "diagnosis"[MeSH Terms]). Limits applied to the search strategy in PubMed included publication within five years (2019-2024). This search resulted in 28 articles that were reviewed by title and abstract. After this review, 11 articles were kept for full-text review. The second search strategy used for PubMed was ("nurse anesthetists"[MeSH Terms]) AND simulation AND education. Limits applied to the search strategy included publication within 5 years (2019-2024). This search resulted in 23 articles, which were reviewed by title and abstract. After this review, five were kept for full-text review. The second PubMed search

strategy and limits were used in Google Scholar, with two out of 41 articles kept for full-text review after review of the title and abstract.

The first search strategy used for CINAHL was (MH "Embolism, Amniotic Fluid") AND (MH "Protocols"). Limits applied to this search were publication within five years and English language. One article resulted and was kept for full-text review. The second CINAHL search strategy was (MH "Certified Registered Nurse Anesthetists") OR (MH "Anesthetists") AND MH "Patient Simulation") OR (MH "Simulations") OR "simulation" AND "skill decay." Limits applied to this search were publication within five years and English language. One article was obtained and kept for full-text review. After full text review of all selected articles from PubMed, CINAHL, and google scholar, 10 articles were utilized to inform the project tool and were used in the literature synthesis.

Given the limited search results in both databases using PubMed MeSH terms and CINAHL subject headings, additional search strategies using keywords identified in the literature search concept table (Appendix A) were used to broaden and increase search results. Additional evidence was identified by reviewing the reference lists of articles kept for full-text review. After reviewing articles identified via reference lists of articles for full-text review, an additional two articles were added to the literature synthesis. See Appendix B for a detailed literature search log, including the search strategies for PubMed, CINAHL, and Google Scholar, limits applied, and the number of articles identified and kept for full-text review.

Articles kept for review met the inclusion criteria of diagnosis, treatment tools, management, and protocols. Additionally, articles kept for evidence of cognitive aids met the inclusion criteria of cognitive aid and emergency situations. Exclusion criteria applied were testing modalities not currently available at the partnering organization, extracorporeal

membrane oxygenation (ECMO) as the only treatment modality analyzed, and case reports. Upon full-text review, using the level of evidence categories of Melnyk and Fineout-Overholt (2019), two randomized control studies (Level II), three cohort studies (Level IV), three systematic reviews of qualitative or descriptive studies (Level V), and four expert opinion (Level VII) articles were identified as pertinent and informative to this project. The hierarchy of evidence is a ranking system used to classify the strength and reliability of research findings. It typically follows a seven-level structure, with Level I being the highest quality evidence and Level VII being the lowest. See Appendix C for a detailed literature matrix including these 12 articles.

Selected Literature Synthesis

In this literature synthesis, 12 articles were selected as evidence for understanding the identification and management of AFE in the perioperative setting as well as the use of cognitive aids in emergencies. Throughout the literature review process, it was evident that there was a lack of consensus on the identification and management of AFE. However, the following common themes emerged: rapid identification, early supportive care, point-of-care ultrasound, correcting coagulopathies, multidisciplinary team approach, and the recommended use of cognitive aids.

Clinical Diagnosis

Without a gold standard diagnostic tool, the identification of an AFE event is primarily made through clinical assessment and excluding other differential diagnoses (Trieu et al., 2023). The clinical presentation consists of severe maternal hypotension with or without respiratory distress and coagulopathy that often rapidly progresses to maternal cardiac arrest (Wiseman et al., 2023). Managing an AFE event relies upon identifying the non-specific clinical signs and

excluding other symptoms that may distract the anesthetist from managing this emergency. (Bouvet et al., 2021). Further complicating the standardization of the identification of AFE events are the various clinical diagnostic criteria in different countries (Trieu et al., 2023). The United Kingdom Obstetrical Surveillance System Criteria (UKOSS), Japan, and USA criteria slightly differ in their definitions of required clinical manifestations (Wiseman et al., 2023). In 2016, to improve data collection, research processes, and identification of clinical risk factors, the Society for Maternal-Fetal Medicine and the AFE Foundation promoted a uniform clinical case definition (Stafford et al., 2020; Trieu et al., 2023).

Despite the uniform criteria defined in 2016, diagnosis based on clinical presentation and previous various diagnostic criteria creates discrepancies and improper management. In a retrospective chart review of the largest amniotic fluid embolism registry, Stafford et al. (2020) reviewed 129 reported cases between 2013 and 2017. The new diagnostic criteria exhibited a sensitivity of 79.4% and a specificity of 100%. Additionally, the review confirmed past misdiagnosis of AFE, as 43% of cases believed to be AFE were found not to have been AFE. The researchers found these suspected cases of AFE represented a different diagnosis (hypovolemic shock, anesthetic complication, or sepsis) or an uncertain diagnosis, 21% and 22%, respectively (Stafford et al., 2020). The results of this retrospective chart review confirmed the validity of the diagnostic criteria and the non-specific nature of relying on clinician analysis of clinical manifestations to diagnose AFE accurately.

Given the variation and lack of consensus on diagnostic criteria, AFE should be suspected and included in the list of differential diagnoses whenever inclusionary symptoms present (Arnolds, 2022). The Society for Maternal-Fetal Medicine (SMFM) describes a triad of typical presentation: sudden hypoxia and hypotension, frequently followed by coagulopathy

(Pacheco et al., 2021). In their narrative review, Trieu et al. (2023) found that 100% of cases exhibited hypotension, 93% reported respiratory distress, coagulopathy was present 83% of the time, and 87% suffered a cardiac arrest. Given the ambiguity in identification, AFE should be considered in any case with these symptoms (sudden cardiovascular collapse or cardiac arrest, seizures, severe respiratory difficulty, or hypoxia), and if otherwise unexplainable coagulopathy presents, management should not be delayed (Pacheco et al., 2021). Furthermore, given the frequent rapid progression to cardiac arrest, prompt identification of pertinent symptoms by the anesthesia provider is necessary to improve outcomes (Fitzpatrick et al., 2019).

Management Recommendations

Given the discrepancies in case reporting due to varying diagnostic criteria, there is inconsistent evidence regarding the management of suspected AFE. Despite these variations, several common management recommendations were identified. Most management recommendations focus on emergency management, especially in the setting of cardiac arrest as a presenting symptom (Pacheco et al., 2021). In the event of cardiac arrest, prompt initiation of high-quality cardiopulmonary resuscitation (CPR) is recommended (Arnolds, 2022; Pacheco et al., 2021; Trieu et al., 2023). In addition, left uterine displacement was recommended in conjunction with CPR in the undelivered parturient to prevent aortocaval compression (American Association of Nurse Anesthesiology, 2023; Arnolds, 2022; Pacheco et al., 2021; Trieu et al., 2023). If the fetus has not been delivered at the onset of the arrest, recommendations are to proceed with immediate delivery. Guidelines regarding immediate delivery vary based on gestation between 20-23 weeks. However, all authors recommend immediate delivery if greater than 23 weeks gestation (Arnolds, 2022; Pacheco et al., 2021; Trieu et al., 2023).

Other early supportive measures recommended were related to supporting cardiac contractility and function. Inotropic support and/or pulmonary vasodilators are frequently recommended to support right ventricular (RV) function (Arnolds, 2022; Pacheco et al., 2021; Trieu et al., 2023). Trieu et al. (2023) and Pacheco et al. (2021) also recommend judicious administration of fluid to avoid volume overload causing further RV dysfunction and dilutional coagulopathy.

While routine use of Extracorporeal Membrane Oxygenation (ECMO) is not currently recommended, there is promising evidence to support the potential benefits of its use in AFE events. Arnolds et al. (2022), Pacheco et al. (2021) Trieu et al. (2023) as well as the AANA listed ECMO as a consideration in many management recommendations. Trieu et al. (2023) described a potential 88% recovery of ventricular function when ECMO was initiated to provide right ventricular decompression and sufficient perfusion to the coronaries. The AANA and SMFM recommend including the contact information for the organization's ECMO team on educational materials for the management of AFE (American Association of Nurse Anesthesiology, 2023; Pacheco et al., 2021).

Another common recommendation related to cardiovascular support is the use of echocardiography, especially point of care ultrasound (POCUS), for the identification and treatment guidance of RV failure associated with AFE (Arnolds, 2022; Pacheco et al., 2021; Trieu et al., 2023). Given the emerging use of point-of-care echocardiography in identifying and managing AFE, Wiseman et al. (2023) performed a systematic review of the literature to identify echocardiographic findings in this patient population. The review of 84 case reports describing AFE and echocardiograms found that POCUS is a tool that can rapidly identify hemodynamic abnormalities and help narrow the differential diagnosis. Right ventricular dysfunction was

present in 67% of patients and was associated with an increased risk of cardiac arrest and/or severe maternal complications (Wiseman et al., 2023). Limitations of this case review included extracting data from case reports with intermediate or high risk of bias, varied timing of echocardiograms, and potential for bias related to performing echocardiograms only on patients ill enough to require rapid diagnostic testing (Wiseman et al., 2023). Despite potential limitations, POCUS presents a potential tool for the rapid identification and management of AFE and is commonly recommended in AFE management (Arnolds, 2022; Pacheco et al., 2021; Trieu et al., 2023).

Given that a majority of AFE cases will present with coagulopathy or disseminated intravascular coagulopathy (DIC), many recommendations center around identifying and correcting coagulopathies as well as anticipating uterine atony/hemorrhage. The SMFM recommends early evaluation of clotting status and early and aggressive management of bleeding with standard massive transfusion protocol (MTP) at a ratio of 1:1:1 (Pacheco et al., 2021; Trieu et al., 2023). Correcting coagulopathy is a mainstay of AFE management (Arnolds, 2022; Fitzpatrick et al., 2019; Trieu et al., 2023). Arnold et al. (2022) and Trieu et al. (2023) suggest using viscoelastic studies to further guide coagulopathy management.

Evidence for the effectiveness of a hysterectomy is inconsistent. Fitzpatrick et al. (2019) described an increase in severe outcomes with a shorter interval between AFE and when the hysterectomy was performed. However, when corrected for those experiencing cardiac arrest at onset, this finding was not statistically significant (Fitzpatrick et al., 2019). Despite this lack of evidence, Trieu et al. 2023 recommended considering a hysterectomy in the setting of uncontrolled uterine hemorrhage.

Specific recommendations for blood product and clotting factor concentrates included tranexamic acid (TXA) administration and fibrinogen concentrate/cryoprecipitate. Consideration of the administration of TXA (1 gram intravenous over 10 minutes) was frequently reported in management protocols (Arnolds, 2022; Pacheco et al., 2021; Trieu et al., 2023). In their multi-country analysis of AFE cases (n=98-218 depending on case definition), Fitzpatrick et al. (2019) found that women who died received a lower dose of TXA compared to women who survived. Similarly, administration of a concentrated fibrinogen source such as fibrinogen concentrate or cryoprecipitate has also been correlated to improved outcomes (Arnolds, 2022; Fitzpatrick et al., 2019).

Finally, the involvement of a multidisciplinary team and the use of a cognitive aid were frequent non-clinical recommendations for the management of AFE events. In their best practice advisory, the SMFM stated the importance of involving all key players in a multidisciplinary team to best manage the parturient experiencing a suspected AFE (Pacheco et al., 2021; Trieu et al., 2023). Potential multidisciplinary team members "include anesthesia, respiratory therapy, critical care, and maternal-fetal medicine" (Pacheco et al., 2021, p. B19). Finally, the use of a cognitive aid was a common recommendation among professional organizations (Arnolds, 2022; Pacheco et al., 2021; The American College of Obstetricians and Gynecologists, 2016).

Cognitive Aid in Emergency Management

No specific studies were identified in the literature search regarding improved outcomes in the management of AFE with the use of a cognitive aid (CA), despite several AFE management recommendations advocating for the use of a CA (The American College of Obstetricians and Gynecologists, 2016; Arnolds, 2022; Pacheco et al., 2021). Notwithstanding

the lack of AFE-specific improvements with CA use, there is abundant evidence that supports the development and use of a CA in the management of emergencies.

The use of CA's has been shown to reduce errors in critical management steps in medical emergencies (Sellman et al., 2022; van Haperen et al., 2024). In their randomized control trial, Sellman et al. (2022) had 520 physicians participate in 240 medical emergencies (including cardiac arrest, bradycardia, difficult airway, hypoxia, bleeding, pulmonary embolism, and anaphylaxis). After randomization to a control or experimental group, they completed a high-fidelity simulation to evaluate the use of a CA in the management of a medical emergency. Findings suggested a significant reduction in risk with checklist use (17% absolute and 28% relative risk reduction). As a secondary outcome, 94% of participants reported ease of use, improved preparedness, and endorsement of future use of a CA in a medical emergency (Sellman et al., 2022).

Similarly, van Haperen et al. (2024) simulated a perioperative emergency and evaluated the effectiveness of two different CA bundles among 81 participants (anesthesiologists, anesthesia nurses, scrub nurses, PACU nurses, and junior anesthesia nurses). In their simulated emergencies, there was a reduction in the number of missed critical management steps during simulated perioperative emergencies by up to 75% (Van Haperen et al., 2024, p.1). Both studies found a significant reduction in risk and/or missed critical management steps with the use of a CA (Sellman et al., 2022; van Haperen et al., 2024).

The design of a cognitive aid is crucial to its perceived effectiveness as well as its outcome in risk reduction. Clebone et al. (2020) and van Haperen et al. (2024) evaluated CA designs concerning provider preference. In both studies, the format of a cognitive aid using a branched or clustered design was preferred over a traditional linear layout. Additionally, Clebone

et al. (2020) identified color coding, grouping of related information, and duplication of drug dosages into the summary section as key design features regarding reported provider ease of use.

Project Framework

The model used for this DNP project was based on the Institute for Health Improvement (IHI) model for improvement by implementing a single plan-do-study-act (PDSA) cycle of quality improvement (Langley et al., 2009). The literature review conducted in the *planning* phase examined the diagnosis and management recommendations of AFE as well as the use of a CA as an evidence-based technique.

Additionally, during the *plan* phase, the cognitive aid as well as pre- and post-implementation survey questionnaires were developed. During the *do* phase, emails were sent out to participants with a pre-implementation survey questionnaire. Next, in the *do* phase, an educational training session was presented to participants along with the cognitive aid dissemination, followed immediately by the post-implementation survey questionnaire.

During the *study* phase, data analysis of the pre-and post-implementation survey questions determined participants' perceptions of the educational intervention and perceived usefulness of the cognitive aid. During the *act* phase, results obtained during this DNP project were presented to organization members with future recommendations.

Ethical Considerations and Protection of Human Subjects

This quality improvement project involved the implementation of an educational tool and the dissemination of a cognitive aid focused on improving provider confidence in the management of AFE. Nurse anesthesia providers at the partnering organization were invited to participate at their discretion. No personal information was collected, and all results were kept confidential. This quality improvement project posed no additional risks to participants beyond

what they would typically encounter in their regular workday. No patients were involved, and no patient data was collected. Surveys and informational sessions were conducted away from scheduled time in the operating room.

The project lead obtained research ethics training through the Collaborative Institutional Training Initiative (CITI: https://about.citiprogram.org/) program by completing the Group 2: Social / Behavioral Research Investigators and Key Personnel modules before the execution of this project. The project screening process was initially completed through the East Carolina University College of Nursing in collaboration with the East Carolina University and Medical Center Institutional Review Board (UMCIRB), which determined that the project was within the framework of quality improvement and full IRB review was not required. Additional approval was obtained from the research office of the partnering institution in coordination with the East Carolina UMCIRB (Appendix D).

Section III. Project Design

Project Setting

The setting of this QI project was a smaller affiliated campus of a large academic medical center located in Eastern North Carolina. This site serves a diverse patient population and provides comprehensive obstetric care. A key feature of this setting is its high volume of cesarean deliveries, which created a robust environment for project implementation and CRNA perceptions of a newly developed cognitive aid.

Project Population

The project population for this QI project included CRNAs working in the main operating room area and labor and delivery suites of the participating organization. All involved CRNAs held active state licenses, national certifications, and hospital credentialing. Their engagement in the project was voluntary, with their voluntary participation serving as a key factor in project implementation. Given the smaller size of the affiliated campus, CRNAs at this organization are more frequently assigned to the labor and delivery OR, but smaller numbers of cesarean deliveries occur.

Project Team

The project team was led by the primary student registered nurse anesthetist (SRNA), who collaborated with three partnering SRNAs throughout the project's development. The primary SRNA was responsible for implementation and data analysis at the assigned location, while each partnering SRNA conducted data collection and analysis within a distinct population/site. The project chair, serving as clinical contact, provided oversight in project development, implementation, and participant recruitment. Additionally, the course director guided the project's progression by establishing a structured approach and timeline for

development, implementation, and analysis. The site contact person signed the letter of acknowledgment that data was collected from the partnering organization.

Methods and Measurement

The purpose of this Doctor of Nursing Practice quality improvement project was to develop, implement, and evaluate the perceived adequacy of a cognitive aid specifically designed for anesthesia providers for the identification and management of AFE. The project goal was to understand anesthesia providers' perceived adequacy of the cognitive aid. The model used for executing this DNP project was the Institute for Healthcare Improvement's (IHI) model for improvement by implementation of a single plan-do-study-act (PDSA) cycle of quality improvement (Langley et al., 2009). This quality improvement project utilized pre- and post-implementation survey questions to complete a single PDSA quality improvement cycle to assess anesthesia providers' perceptions of the adequacy of the cognitive aid.

During the *plan* phase of this project, an individual literature review and synthesis was conducted by the project lead in the fall of 2024. This examined the literature for management guidelines and recommendations. The literature review and synthesis informed the development of a cognitive aid describing the recommendations for the management of AFE (Appendix E). A brief PowerPoint presentation was developed to explain the purpose of the project and solidify key concepts from the cognitive aid (Appendix F). The cognitive aid was laminated and placed on all anesthesia machines in the labor and delivery suite. The educational tool was also emailed to project participants as a personal reference.

In the fall of 2024, the pre-and post-implementation survey questions were created using Qualtrics survey software (Appendix G). The survey questions included Likert-type scales, drag-down responses, and one open-response question to assess participants' perceptions of the

cognitive aid and determine the adequacy of the resource. The pre-implementation survey questions were designed to identify participants' anesthetic experience, experience regarding AFE management, and participants' perceptions of their current management practices of AFE. The post-implementation survey questions reflected the participants' perceptions of the cognitive aid.

In the spring of 2024, the project design was finalized and approved for implementation by the project chair and clinical contact. The project chair assigned individual project locations to each SRNA and facilitated participant recruitment. Formal approval was obtained through both the unit representative and the organization following the established organizational approval process.

This project was classified as quality improvement (QI) and was therefore exempt from full IRB approval. Institutional approval was granted through the UMCIRB in collaboration with the research office of the partnering organization. Additionally, local facility approval for data collection was secured through a designated site contact person, whose signature was obtained for the partnering organization's approval form.

During the *Do* phase, the participants were invited to the presentation via email (Appendix H). Then, a PowerPoint presentation was presented by all group members, including a QR code for pre- and post-implementation survey links, and the cognitive aid was handed out as well as emailed to participants for future reference (Appendix E, F). Immediately following the presentation and cognitive aid distribution, participants were asked to complete the post-implementation survey via a second QR code and email.

During the *Study* phase, data analysis of the completed pre- and post-implementation survey questions was used to determine the participants' perceptions of the cognitive aid. After

data analysis, results were displayed on a project poster and presented in November of 2025 to organization members with recommendations for future PDSA cycles. The project paper and poster were placed in The Scholarship of ECU for public display.

Section IV. Results and Findings

Results

The purpose of this Doctor of Nursing Practice (DNP) quality improvement project was to evaluate the perceived usefulness of a newly developed cognitive aid for anesthesia providers in the recognition and management of amniotic fluid embolism (AFE). To achieve this, pre- and post-implementation survey data were collected to measure participants' perceptions of the cognitive aid and the accompanying educational presentation.

Data collection occurred over a single session at the clinical site in Eastern North Carolina. A total of four CRNA participants attended the session. Before the presentation, participants completed a pre-survey via a QR code. Immediately following the presentation, which included an overview of the cognitive aid, a post-survey was administered using the same method. The response rate was 100%, with full completion of both pre- and post-surveys by all participants. All survey responses were collected using Qualtrics and analyzed using Microsoft Excel.

Data Presentation

The pre-implementation survey assessed the number of years of CRNA practice, any additional training/in-services participants had received regarding AFE management, the number of times they had encountered a suspected AFE as well as their perceptions of AFE management and cognitive aids. One CRNA practiced for 10-14 years, two CRNAs have been in practice 15-20 years, and once CRNA had been in practice for greater than 20 years. All participants responded "yes" to having received in-service or other education on the identification or management of AFE since graduation or recertification. All participants who responded (3 out of 4) indicated that they have not been involved in managing or caring for a patient with a

suspected Amniotic Fluid Embolism (AFE). Responses to the question assessing confidence in identifying and managing AFE were measured using a Likert scale with the options: not confident, not very confident, neutral, somewhat confident, and very confident. Two participants selected "somewhat confident," one selected "neutral," and one selected "not confident."

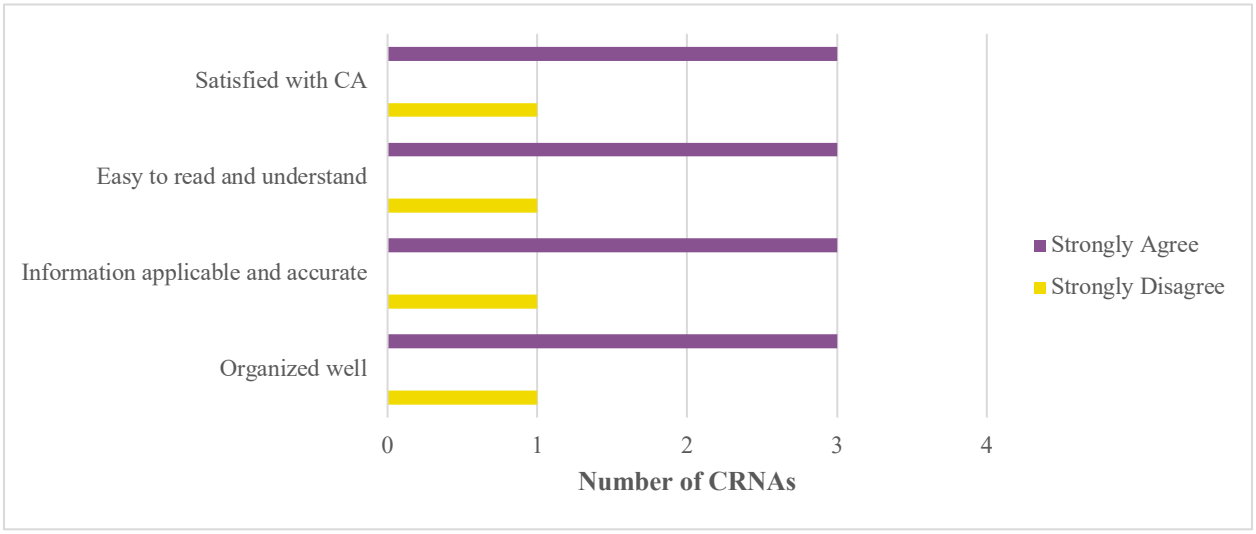
In response to the question regarding awareness of a cognitive aid outlining current treatment guidelines for AFE identification and management at their facility, three participants responded "yes," while one responded "no." Responses to the question rating the effectiveness of current treatment guidelines for AFE management were measured on a Likert scale with the options: very ineffective, ineffective, neutral, effective, and very effective. Two participants rated the guidelines as neutral, and one rated them as effective. All respondents indicated that it would take them 1–3 minutes to find reference material regarding AFE identification and management. Responses to the likelihood of using a cognitive aid to manage AFE were measured on a Likert scale with the options: “I am never going to use it”, “I will probably not use it”, “I have no preference”, “I will probably use it”, and “I am very likely going to use it”. Two participants responded, "I am very likely going to use it," and two responded, "I will probably use it."

The post-implementation survey assessed their perceptions of a newly developed cognitive aid and their tendency to use it. On the post-implementation survey, participants were asked to rate their agreement with four statements regarding different aspects of the provided cognitive aid, using a Likert scale with the options: strongly disagree, disagree, neither agree nor disagree, somewhat agree, and strongly agree. For the statement on whether the cognitive aid was organized well, three participants responded "strongly agree," and one responded "strongly disagree." For the second statement, “The information included was applicable and accurate,”

three participants responded "strongly agree," and one responded "strongly disagree." For the third statement, “This handout was easy to read and understand,” three participants responded "strongly agree," and one responded "strongly disagree." For the final statement, “Overall, I was satisfied with this cognitive aid,” three participants responded "strongly agree," and one responded "strongly disagree." Figure 1 summarizes user perceptions of the newly developed cognitive aid.

Figure 1

User Perceptions of the Cognitive Aid: Satisfaction, Readability, Accuracy, and Organization

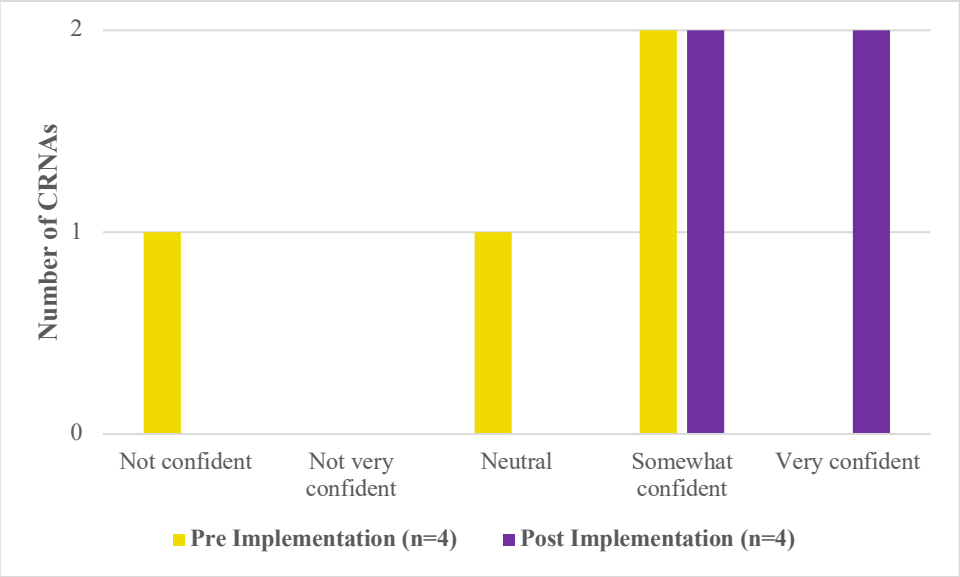


Participants were asked how likely they are to use the cognitive visual aid to manage AFE, using a Likert scale with the options: very unlikely, somewhat unlikely, neutral, somewhat likely, and very likely. Three participants responded "very likely," while one responded "very unlikely." Confidence in managing AFE after reviewing the cognitive aid and listening to the presentation was rated using a Likert scale with the options: not confident, not very confident, neutral, somewhat confident, and very confident. Two responses indicated "very confident,"

while two indicated "somewhat confident." Figure 2 compares CRNA confidence from pre-implementation to post-implementation.

Figure 2

CRNA Confidence Regarding AFE Identification and Management

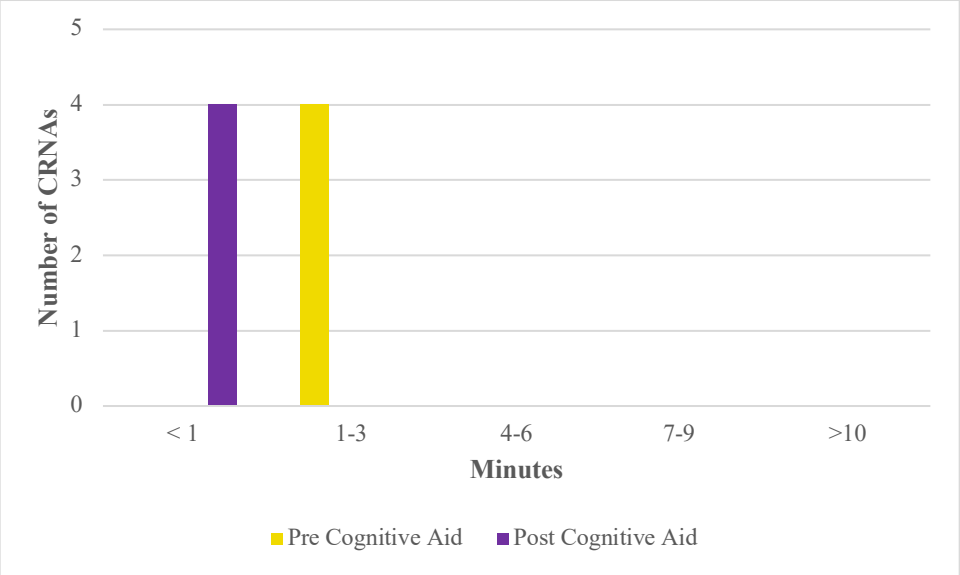


When asked which location would provide the easiest, quickest, and best accessibility to the cognitive aid, the options were: QR code on the anesthesia machine in Labor, Delivery, Recovery, and Postpartum (LDRP); laminated handout in the anesthesia machine in LDRP rooms; Practice Advisory popup with a link within the Electronic Health Record (EHR); all of the above; or other. Two responses favored the laminated handout in LDRP rooms, and two selected "all of the above."

All responses indicated it would take less than one minute to access the cognitive aid to manage AFE when provided in one of the mentioned locations. Figure 3 compares the pre- and post-implementation responses for time to access.

Figure 3

Time to Access AFE information



When asked which other healthcare personnel would benefit from the cognitive aid and presentation, the options included Obstetrical (OB) Residents/Fellows, OB Nurses, OB Attendings, Critical Care Nurses, Critical Care Fellows/Residents, all of the above, or other. Three responses selected "all of the above," while one selected OB Nurses, OB Attendings, and Critical Care Nurses.

Analysis

Analysis of pre- and post-survey responses indicated that the cognitive aid was positively received and contributed to increased CRNA confidence in identifying and managing amniotic fluid embolism (AFE). The majority of participants (3/4) indicated that the cognitive aid was well organized, had applicable and accurate information, was easy to read and were overall satisfied with the CA. One of the participants answered strongly disagree to all of the previous statements regarding the CA, but then commented in the open text box at the end of the survey that the CA and presentation were “well done and helpful.” This suggests that perhaps because strongly disagree was the first answer choice listed, they erroneously selected strongly disagree

instead of strongly agree. Regardless, the majority of participants found the CA to be well-made and easy to use.

This CA also increased the speed of locating information regarding the identification and management of a suspected AFE. All participants indicated on the post-implementation survey that it would take them less than one minute to locate information as compared to 1-3 minutes on the pre-implementation survey. While not a significant reduction in time, in a scenario where seconds count as with a suspected AFE, this indicates that the CA may reduce time to find information. Finally, confidence in AFE identification and management increased from pre- to post-implementation indicating that the presentation and cognitive aid aided CRNA perceptions of their ability to identify and manage a suspected AFE.

Section V. Implications

Financial and Nonfinancial Analysis

Implementation of an AFE presentation and cognitive aid dissemination to obstetric operating room suites is vastly less expensive as compared to the associated costs of AFE events. Hospitalizations for uncomplicated deliveries incur a cost of around $4,450 to $12,212. General estimates for deliveries complicated by severe maternal morbidity, including AFE:
have median costs around $11,500. That reflects a 7% cost premium compared to uncomplicated deliveries (Lin et al., 2020). Conversely, the cost of implementing a cognitive aid in all OB ORs only carries the cost of printing and laminating enough reference guides for all ORs. The minimal cost would likely recur every 1-3 years as new evidence is published and updates required to the cognitive aid arise. Additionally, the cognitive aid could be made available in a digital format, which would eliminate the recurring costs of printing and distribution associated with revisions. By using a QR code posted in all obstetric operating rooms, providers could have immediate access to the most current version of the aid. This approach ensures real-time updates, promotes standardization, and enhances accessibility without the logistical burden of physical replacements. The only limitation to this would be if WIFI was not available to open the site.

The non-financial benefits of implementing an AFE presentation and disseminating cognitive aids extend beyond cost considerations. These initiatives contribute to improved patient safety by standardizing the response to a rare but life-threatening obstetric emergency, reducing variability in care, and facilitating timely interventions. Furthermore, they enhance CRNA confidence and preparedness by providing clear, evidence-based guidance during high-stress situations. This not only promotes clinical competence but also reduces cognitive overload,

supporting better decision-making under pressure. Collectively, these measures foster a culture of safety, teamwork, and continuous learning within the perioperative environment.

Implications of Project

As stated by Arnolds (2022), AANA (2023), and ACOG (2016), a cognitive aid for the identification and management of an AFE event is strongly recommended. The findings of the project supported the newly created cognitive aid and presentation in identifying and managing a suspected AFE as well as impacts on CRNA confidence in these emergencies. The project findings align with the strong recommendations from professional organizations and the use of cognitive aids in emergency situations.

As discussed in the literature review and synthesis, cognitive aids are well-established tools for reducing errors and improving efficiency during emergency management scenarios. This was supported by the findings of the pre- and post-implementation surveys conducted at the outlying medical center. Overall, the introduction of the cognitive aid positively influenced CRNA perceptions, specifically in enhancing confidence and decreasing the time required to access critical information related to AFE management. The findings of this project may have meaningful implications across multiple levels of clinical care. For patients, rapid identification and management of AFE can be life-saving. AFE is a rare but catastrophic obstetric emergency, and delays in diagnosis or treatment can result in significant morbidity or mortality. By enhancing CRNA confidence and reducing the time required to access critical information, the cognitive aid may contribute to earlier intervention, more coordinated team responses, and ultimately, improved patient outcomes during one of the most time-sensitive emergencies in obstetric anesthesia.

From a CRNA practice perspective, this project reinforces the value of equipping providers with targeted cognitive tools to support clinical decision-making under pressure. Despite years of professional experience, baseline confidence in AFE management was variable among participants, highlighting the importance of ongoing education and accessible clinical resources. The use of cognitive aids can help standardize care, minimize variation in emergency responses, and promote adherence to evidence-based clinical guidelines—an essential component of high-quality nursing and anesthesia practice.

At the level of the health system and organization, early recognition and guideline-based management of AFE has the potential to significantly reduce both clinical and financial burdens. Timely intervention may lead to decreased lengths of stay in intensive care units and general inpatient settings. Additionally, consistent use of cognitive aids can serve as a protective factor in malpractice cases, demonstrating that the provider followed current clinical practice standards. This could ultimately reduce the organization's risk exposure and associated legal costs. By investing in tools that enhance clinical preparedness, the system can improve patient safety, optimize resource utilization, and support professional accountability across interdisciplinary teams. In sum, the implementation of a cognitive aid for AFE not only empowers providers but also serves as a practical, cost-effective strategy to enhance patient care, mitigate legal risk, and support system-wide quality improvement efforts. Additionally, the CA serves as a checklist to help ensure needed equipment and medications are readily accessible in the event of an emergency.

Sustainability

For the continued implementation and sustainability of this cognitive aid as a standardized reference tool for AFE emergencies across the health system, organizational

support and departmental collaboration will be essential. Leadership from either the anesthesia department, the obstetric department, or ideally a joint partnership would be needed to champion the project and guide its integration into clinical practice. Formal approval from the organization would be required to ensure alignment with existing protocols and to authorize system-wide dissemination.

Once approved, the implementation process would require minimal financial investment. The primary resource needed is staff time for a brief in-service training, which could be efficiently delivered during existing department meetings, change-of-shift huddles, or brief sessions during routine clinical downtime. Following this orientation, cognitive aids could be distributed and placed in all obstetric care areas, including labor and delivery, operating rooms, and recovery units. With thoughtful planning and interdisciplinary collaboration, the integration of this cognitive aid could become a low-cost, high-impact addition to emergency preparedness efforts, supporting both clinical excellence and patient safety.

Looking ahead, a logical next step for advancing this initiative would be the development of a multidisciplinary simulation program incorporating the cognitive aid into AFE emergency management scenarios. Such simulations would allow for team-based practice in a controlled, high-fidelity environment, reinforcing the use of the cognitive aid while promoting interprofessional collaboration and role clarity during rare, high-acuity events. However, this level of implementation would require positive pilot project outcomes to justify the additional investment of time and resources. Unlike the initial rollout, simulation training would involve greater costs due to the need for paid staff participation, use of simulation equipment, software platforms, and dedicated facilitation time. Nonetheless, the long-term benefits—including improved team performance, reduced error rates, and enhanced clinical readiness—could

outweigh the initial expenses, especially in settings where high-risk obstetric events like AFE are a concern.

Dissemination Plan

The results of the quality improvement project were presented on an electronic poster and shared through a formal presentation with members of the nurse anesthesia department, project participants, and nurse anesthesia faculty and students. The final version of the DNP project paper and poster was published in *The Scholarship*, East Carolina University's digital repository.

Section VI. Conclusion

Limitations

The project faced several limitations that impacted data collection and analysis. A small sample size limited the data analysis. This could have been improved if the project was implemented over more than one day or at different times in order to gain more CRNA participants. Additionally, there could have been a lack of buy-in from participants, which may have stemmed from a perceived lack of relevance or value in the project. This challenge was amplified by the project taking place in an external facility unfamiliar with student-led initiatives and DNP projects, making it more difficult to secure full engagement. As participation was voluntary, there may have been an increased number of participants with improved student relationships or perceived value.

Recommendations for Future Implementation and/or Additional Study

For future students or organizations aiming to replicate or expand this project, there are several key recommendations regarding planning and implementation. First, securing CRNA buy-in early is essential. Engaging the CRNAs through targeted outreach, individual conversations, or department meetings before the education session can help build interest. Additionally, for future implementation, hosting multiple presentations across various shifts and days would allow more opportunities for CRNAs to attend, thereby increasing exposure and response rates. Additionally, for future and larger projects, offering continuing education credit may serve as an incentive for participation.

A natural next step for this project would be the development of a multidisciplinary simulation focused on the management of an AFE event, incorporating both cognitive aid and non-cognitive aid groups. This simulation-based extension would allow for a structured

evaluation of the cognitive aid's impact on time to decision-making, completion of critical management steps, and provider confidence in managing this high-acuity and rare obstetric emergency. By involving a full care team (anesthesia, obstetrics, nursing, and critical care) the simulation could better reflect real-world dynamic and communication challenges. Additionally, collecting both objective performance data and subjective feedback would help validate the utility of the cognitive aid and inform future iterations or broader system-wide adoption.

Finally, regarding additional areas to study, it is imperative to continue monitoring emerging research related to tachyphylaxis of pregnancy and/or AFE identification and management. Even during the timeframe of this project, the literature and terminology surrounding AFE began to shift, with growing discussion around renaming the condition to better reflect its multifactorial syndrome-like nature rather than a singular embolic event. Future studies should include a search for tachyphylaxis of pregnancy research.

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Appendix A
Literature Search Concept Table

	Concept 1 **Problem**	**Concept 2** **Rapid Identification and Treatment**	**Concept 3** **Population**	**Concept 4** **Education**
Keywords	Amniotic Fluid Embolism AFE	Identification Diagnosis Treatment Medication Protocol	Nurse Anesthetists CRNA	Simulation Education Readiness Training video
PubMed MeSH	"embolism, amniotic fluid"[MeSH Terms] "embolism, amniotic fluid"[MeSH Terms]	"diagnosis"[MeSH Terms] "treatment"[All Fields] OR "treatment s"[All Fields] "therapeutics"[MeSH Terms] "medications"[All Fields] "protocol"[All Fields] OR "protocol s"[All Fields] OR "protocolized"[All Fields]	"nurse anesthetists"[MeSH Terms] "crna"[Journal] OR "crna"[All Fields]	"computer simulation"[MeSH Terms] "healthcare simulation"[All Fields] "education"[MeSH Subheading] "readiness"[All Fields]

CINAHL Subject Headings (	(MH "Embolism, Amniotic Fluid")	(MH "Emergency Treatment") (MH "Protocols")	(MH "Certified Registered Nurse Anesthetists") OR (MH "Anesthetists")	(MH "Patient Simulation") OR (MH "Simulations") OR "simulation" "readiness"
Google Scholar	"embolism, amniotic fluid"[MeSH Terms] "embolism, amniotic fluid"[MeSH Terms]	"diagnosis"[MeSH Terms] "treatment"[All Fields] OR "treatment s"[All Fields] "therapeutics"[MeSH Terms] "medications"[All Fields] "protocol"[All Fields] OR "protocol s"[All Fields] OR "protocolized"[All Fields]	"nurse anesthetists"[MeSH Terms] "crna"[Journal] OR "crna"[All Fields]	"computer simulation"[MeSH Terms] "healthcare simulation"[All Fields] "education"[MeSH Subheading] "readiness"[All Fields]

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
09/12/2024	PubMed	("embolism, amniotic fluid"[MeSH Terms] AND "diagnosis"[MeSH Terms]) AND (y_5[Filter])	5 years (2019-2024) English Language	28/11	Inclusion Criteria: risk factors, diagnostic tools, management tools Exclusion Criteria: ECMO as only treatment, Autopsy identification, not AFE specific 3 articles with no abstract available
9/12/2024	PubMed	("embolism, amniotic fluid"[MeSH Terms]) AND protocol AND education	5 years (2019-2024) English Language	1/1	Inclusion Criteria: AFE related protocols and simulation/education
9/12/2024	PubMed	("embolism, amniotic fluid"[MeSH Terms]) AND ("nurse anesthetists"[MeSH Terms])	No filters	0/0	
9/12/2024	PubMed	("nurse anesthetists"[MeSH Terms]) AND simulation AND education	5 years (2019-2024) English Language	23/5	Inclusion criteria: simulation based educational tool/CRNAs Exclusion criteria: anesthesia program development/SRNAs only
9/12/2024	CINAHL	S1: (MH "Embolism, Amniotic Fluid") 71 results	5 years (2019-2024)	1/1	Inclusion criteria: AFE Protocols

		S2: (MH "Protocols") 5,772 results S1 and S2 – 1 result	English Language		
9/12/2024	CINAHL	S1: (MH "Embolism, Amniotic Fluid") 71 results S3: (MH "Emergency Treatment") 952 results S1 and S3 -No results	5 years (2019-2024) English Language		
9/12/2024	CINAHL	S1: (MH "Embolism, Amniotic Fluid") 71 results S4: (MH "Certified Registered Nurse Anesthetists") OR (MH "Anesthetists") -2884 results S1 AND S4 – 0 results	5 years (2019-2024) English Language		
9/12/2024	CINAHL	S4: (MH "Certified Registered Nurse Anesthetists") OR (MH "Anesthetists") -2884 results S5: MH "Patient Simulation") OR (MH "Simulations") OR "simulation" S4 and S5 – 78 results S6: "skill decay" – 56 results S4 AND S5 AND S6 – 1 result	No filters	1/1	Inclusion criteria: simulation based learning tool to decrease anesthesia provider skill decay
9/12/2024	Google Scholar	amniotic fluid embolism AND protocol AND CRNA	5 years (2019-2024)	41/2	Inclusion Criteria: AFE related educational tool used to improve CRNA readiness Exclusion Criteria: Doctoral projects, non-AFE etiology

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	VanHaperen, M., Kemper, T., Koers, L., van Wandelen, S. B., Waller, E., de Klerk, E., Eberl, S., Hollmann, M., & 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*(7), Article 5253. https://doi.org/10.3390/jcm13175253	Compared the effectiveness of two different CAB bundles regarding critical management steps in a simulated perioperative emergency No framework or model noted	Multicenter prospective randomized control study Level II	Dutch operating rooms	81 participants (27 anesthesiologist, 38 anesthesia nurses, 5 scrub nurses, 2 PACU nurses, 9 junior anesthesia nurses) Participants were randomly divided into groups of 3 (anesthesiologist, CRNA, and CRNA or other)	CAB1 branched, clustered CAB design with table of contents CAB2 linear, step-by-step design SimMan with certified operator running pre-programmed OR emergencies	No difference found in the percentage of missed critical management steps between CAB 1, CAB 2 design Significant reduction in amount of missed critical management steps using any CAB versus without a CAB "Employing CABs reduces the number of missed critical management steps during simulated perioperative emergencies by up to 75%" (Van Haperen et al., 2024, p.1).
2023	Trieu, N. H. K., Pham, H. M., & Mai, A. T. (2023). Initial management of acute	Evaluate the known body of evidence regarding diagnosis	Systematic reviews of qualitative	n/a narrative review	Broad narrative review of 90	n/a narrative review	Pathophysiology - unknown; Clinical diagnosis - development of

	circulatory failure in amniotic fluid embolism: A narrative review. *Trends in Anaesthesia and Critical Care*, *52*, Article 101288. https://doi.org/10.1016/j.tacc.2023.101288	and management of patients with amniotic fluid embolisms (AFE) No framework or model noted	or descriptive studies Level V		articles of what is known and unknown surrounding AFE pathophysiology, diagnosis, and initial management		biomarker lack sensitivity & specificity and appropriate turnaround time, clinical diagnoses vary based on criteria used, SMFM and AFE 4 criteria, diagnosis dependent on clinical judgement and exclusion, echocardiography useful in early diagnostic and management, management focused on maintaining perfusion & correcting coagulopathy NOTE: Great visual tool for management
2023	American Association of Nurse Anesthesiology. (2023). *Analgesia and Anesthesia for the Obstetric Patient*. https://issuu.com/aanapublishing/docs/analgesia_and_anesthesia_for_the_obstetric_patient	AANA treatment guidelines for AFE management No framework or model noted	authorities and/or reports of expert committees Level VII	n/a	n/a	n/a	Clinical diagnosis and signs/symptoms Supportive care, CV and hemostatic support "A-OK" protocol
2023	Wiseman, D., Simard, C., Yang, S. S., Koolian, M., Abenhaim, H. A., & Lipes, J. (2023). Echocardiography findings in amniotic fluid embolism: A systematic	Systematic review to identify echocardiographic findings in AFE patients	Systematic reviews of qualitative or descriptive studies	n/a	84 cases reporting AFE and echocardiography findings were	PRISMA guided selection of articles found from inception to Nov 2021 in	Most patients showed RV dysfunction and RV dysfunction was associated with cardiac arrest/severe maternal complications

	review of the literature. *Canadian Journal of Anaesthesia*, *70*(1), 151–160. https://doi.org/10.1007/s12630-022-02343-9	No framework or model noted	Level V		extracted from 2,636 publications for review	MEDLINE and Embase	POCUS is a rapid tool that can identify hemodynamic abnormalities and help narrow the differential diagnosis age, UKOSS/Japan/USA criteria, delivery, LOS, and outcomes were reported
2022	Arnolds, D. E. (2022). Recognition and management of amniotic fluid embolism: A critical role for anesthesia professionals on labor and delivery 1. *APSF Newsletter*, *37*, 83–84. https://www.apsf.org/wp-content/uploads/newsletters/2022/3703/APSF3703-2022-10-a03-AmnioticFluidEmbolism.pdf	Recommendation by APSF for recognition and management of AFE No framework or model noted	Opinion of authorities and/or reports of expert committees Level VII	n/a	n/a	n/a	Recommended diagnostic criteria (Clark criteria) Recommended cognitive aid Initial effective supportive care, support RV function and consider cardiac ultrasound, viscoelastic testing for management of blood product and clotting concentrate administration
2022	Sellman, T., Alchab, S., Wetzchewald, D., Meyer, J., Rassaf, T., Thal, S. C., Burisch, C., Marsch, S., & Breuckmann, F. (2022). Simulation-based randomized trial of medical emergency cognitive	Evaluated treatment efficacy and adherence to protocols with and without a CA in managing simulated medical emergencies	Randomized control trial Level II	Germany intensive care medicine	520 physicians – divided into teams of 3-6 physicians each	High fidelity simulation Primary outcome measure – error rate reduction	Checklist usage led to a 17% absolute and 28% relative risk reduction 94% of participants found the CA easy to use, improved their sense of preparation, and

	aids. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*, *30*(1), Article 45. https://doi.org/10.1186/s13049-022-01028-y	No framework or model noted			40 teams executed 120 scenarios with CA 40 teams executed 120 scenarios without CA	Secondary outcomes – subjective evaluation of using the CA	participants stated they would use the CA in future medical emergencies
2021	Pacheco, L. D., Saade, G., Hankins, G. D., & Clark, S. L. (2021). SMFM Clinical Guidelines No. 9 Amniotic fluid embolism: Diagnosis and management. *American journal of obstetrics and gynecology*, *215*(2), B16–24. https://doi.org/10.1016/j.ajog.2016.03.012	Recommendation by SMFM for checklist as cognitive aid for management of AFE No framework or model noted	Systematic reviews of qualitative or descriptive studies Level V	n/a	n/a	GRADE methodology utilized to define the strength of recommendations	Clinical diagnosis Provision of immediate high quality supportive care Multidisciplinary team involvement Supportive hemodynamic status Coagulopathy assessment and management Recommendation for a checklist, with a sample checklist provided. Recommended simulations to trial the checklist with users.
2021	Bouvet, L., Gariel, C., Boisson-Gaudin, C., & Chassard, D. (2021). Contribution of blood detection of insulin-like growth factor binding	Purpose: assess the ability of Insulin-like growth factor binding protein-1 (IGFBP-1) to	Retrospective cohort study Level IV	n/a	86 patients had IGFBP-1 blood detection test performed	Data from 2011-2019 France 3 tertiary obstetric care units blood sample to fetal-	Blood detection of IGFBP-1 was positive in <20% of UKOSS defined AFE patients

	protein-1 for the diagnosis of amniotic-fluid embolism: A retrospective multicentre cohort study. *BJOG: An International Journal of Obstetrics and Gynaecology*, *128*(12), 1966–1973.	diagnosis AFE in clinical practice				maternal biology lab	Blood detection of IGFBP-1 had high specificity but low sensitivity Likelihood ratios + 1.3 -0.9 suggesting blood detection of IGFBP would not likely change the probability of detection
2020	Clebone, A., Burian, B. K., & Tung, A. (2020). The effect of cognitive aid design on the perceived usability of critical event cognitive aids. *Acta Anaesthesiologica Scandinavica*, *64*(3), 378–384. https://doi.org/10.1111/aas.13503	Analyzed the perceived usability of CA depending on CA design No framework or model noted	Cohort study Level IV	University of Chicago/ National conference	23 anesthesia providers	Used CA designs ("step by step" control aid and two experimental CA designs – sampling and sampling & key features) in low fidelity emergency situations and analyzed provider preference	Experimental aid design was preferred in regard of ease of use Key design features – grouping of content into topic based section, color coding, grouping related information, duplication of drug and drug dosages in the summary section
2020	Stafford, I. A., Moaddab, A., Dildy, G. A., Klassen, M., Berra, A., Watters, C., Belfort, M. A., Romero, R., & Clark, S. L. (2020). Amniotic fluid embolism syndrome: Analysis of the United States international registry. *American Journal of Obstetrics & Gynecology*	Using the largest international amniotic fluid embolism registry to analyze clinical features and outcomes Investigate differences in demographics,	Retrospective descriptive study using chart review Systematic reviews of qualitative	n/a	129 charts of suspected AFE	n/a	Diagnostic criteria for the research reporting of AFE demonstrated a sensitivity of 79.4% and specificity of 100% upon review 46% (59/129) met the criteria for typical AFE 12% (15/129) cases were considered atypical AFE

	Maternal-Fetal Medicine, *2*(2), Article 100083. https://doi.org/https://doi.org/10.1016/j.ajogmf.2019.100083	clinical presentation, and outcomes between typical AFE and atypical AFE using previously published and validated research reporting criteria for reporting AFE (5 criterion) No framework or model noted	or descriptive studies Level V				21% (27/129) appeared to represent a different diagnosis (77.7% hypovolemic shock secondary to postpartum hemorrhage, 14.8% anesthetic complications, 7.4% sepsis related cardiovascular collapse) 22% (28/129) uncertain diagnosis Confirming frequent misdiagnosis of AFE - almost 1/2 of patients who diagnoses was believed to be sufficient to report to national registry did not have confirmed AFE
2019	Fitzpatrick, K. E., van der Akker, T., Bloemenkamp, K. W., Deneux-Tharaux, C., Kristufkova, A., Li, Z., Schaap, T. P., Sullivan, E. A., Tuffnell, D., & Knight, M. (2019). Risk factors, management, and outcomes of amniotic fluid embolism: A multicountry, population-based cohort and nested case-control study. *PLOS Medicine*, *16*(11), Article	Analysis of risk factors, treatment and outcomes of AFE No framework or model noted	population-based cohort and nested case-control study Level IV	Multicounty analysis of AFE	AFE group (n=99-218 depending on case definition) Control sample (n=4,938)	INOSS cases analyzed AFE onset, features at presentation, Platelet count, INR, Fibrinogen, Coagulation management, surgical intervention analyzed	Risk factors: older maternal age, multiple pregnancy, polyhydramnios, placenta previa, induction, cesarean section Poor maternal outcomes associated with not receiving FFP, lower dose of TXA, lack of obstetrician and/or anesthesia provider at the time of AFE

	e1002962. https://doi.org/10.1371/journal.pmed.1002962						
2016	The American College of Obstetricians and Gynecologists. (2016). *The use and development of checklists in obstetrics and gynecology* (Committee Opinion 680). https://www.acog.org/-/media/project/acog/acogorg/clinical/files/committee-opinion/articles/2016/11/the-use-and-development-of-checklists-in-obstetrics.pdf	ACOG committee opinion on the use and development of checklists as CA in obstetrics and gynecology No framework or model noted	Report of expert committee Level VII	n/a	n/a	n/a	ACOG recommends that checklists are ideal for promoting standardized care processes in situations that involve patient risk and risk of medical errors Checklists should be readily accessible, clear and concise Users should be consulted in checklist development Validation and revision of checklists required

Note: Key to abbreviations used in chart: AFE – amniotic fluid embolism, CAB – cognitive aid bundle, CA – cognitive aid, APSF - Anesthesia Patient Safety Foundation, SMFM – Society for Maternal-Fetal Medicine, INOSS – International Network of Obstetric Survey Systems, FFP – fresh frozen plasma, A-OK – Atropine, Ondansetron, Ketorolac, TXA – tranexamic acid, ACOG – American College of Obstetricians in Gynecologists, CRNA – Certified Registered Nurse Anesthetist, H/F ratio – hemoglobin/fibrinogen ratio, GRADE – Grading of Recommendations Assessment, Development, and Evaluation

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.

Melnyk, B. M. & Fineout-Overholt, E. (2019). *Evidence-based practice in nursing: A guide to best practice.* (4th ed., pp. 131). Philadelphia, Wolters Kluwer.

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

gcf2023

Appendix D:

CON QI Determination Form; UMICIRB/ECU Health Approval

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:

Ashley Perry

Project Title:

Anesthesia Providers' Perceptions of a Cognitive Aid for the Management of Amniotic Fluid Embolism: A Doctor of Nursing Practice Project

Brief description of Project/Goals:

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

Based on your responses, the project appears to constitute QI and/or Program Evaluation and IRB review is not required because, in accordance with federal regulations, your project does not constitute research as defined under 45 CFR 46.102(d). If the project results are disseminated, they should be characterized as QI and/or Program Evaluation findings. Finally, if the project changes in any way that might affect the intent or design, please complete this self-certification again to ensure that IRB review is still not required. Click the button below to view a printable version of this form to save with your files, as it serves as documentation that IRB review is not required for this project. 11/24/2024

Human Subject Research Determination Form

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	**Anesthesia Providers' Perceptions of a Cognitive Aid for the Management of Amniotic Fluid Embolism: A Doctor of Nursing Practice Project**
Project Leader	Ashley Perry
Project Leader Contact E-mail	Hodgesas18@students.ecu.edu
Department or Unit Affiliation	Anesthesia
Project Advisor (if applicable)[1]	Travis Chabo, PhD, CRNA

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.
			☐
			☐
			☐
			☐
			☐
			☐
			☐
			☐
			☐
			☐
			☐
			☐

[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:

[This Doctor of Nursing Practice (DNP) quality improvement project aims to assess Certified Registered Nurse Anesthetists' (CRNAs') perception of the adequacy of a newly developed cognitive aid regarding the identification and treatment of Amniotic fluid embolism (AFE). Additionally, any impact this cognitive aid may have on their confidence in managing AFEs. This project is relevant as it has been shown that cognitive aids are crucial in emergency management by decreasing errors and improving provider adherence to care recommendations. Furthermore, given the rarity of an AFE providers may lack experience in management of a patient with a suspected AFE and a cognitive aid can aid and speed provider decisions during an emergency. This project will be deemed successful if the newly developed cognitive aid is well received and increases CRNA confidence in managing 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 AFE.

Methodology / Intervention:

[This project framework is a single Plan, Do, Study, Act cycle using a pre-and post-implementation survey design. During the *plan* phase, a cognitive aid addressing the identification and management of AFE will be designed based on current national guidelines and accepted practice standards within the practice site and will address a project site need. CRNA participants will be recruited, and their participation will be voluntary. During the *do* phase, project participants will receive an email inviting them to participate in an informational session where a PowerPoint presentation will be presented discussing current recommendations for the management of AFE and the cognitive aid that was developed. A pre-survey will be completed before the presentation and shortly after the presentation participants will complete a post-survey evaluating the project tool based on the perceptions of its applicability to their clinical practice and any impact it may have on their confidence in managing a patient with a suspected AFE. During the *study* phase, the project lead will analyze the data obtained from the pre-and post-implementation surveys to determine CRNA perceptions of the cognitive aid and any impact on their confidence in managing 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 the management of AFE.]

Data to be collected:

[Data will be gathered confidentially directly from participants through the completion of Qualtrics pre-and post-implementation survey delivered and completed electronically. Qualtrics survey software is accessed through East Carolina University and involves multifactorial password protection. The surveys will contain nominal, ordinal, and free response data. No PHI will be collected for this project.
Aside from participants' emails, no identifiable data will be gathered. Data of interest are participant perceptions of the adequacy of the cognitive aid to their clinical practice and any impact it may have on their confidence in managing AFE.
Once collected, the data will be transferred to Excel for deidentification and analysis. Data in Excel will be stored on a password-protected spreadsheet and laptop. The deidentified data will be analyzed with results shared via a poster presentation to the ECU Nurse Anesthesia Program students and faculty, with project participants invited to view the presentation remotely. If requested, a presentation of results to the participating department will be provided. Data will be stored in Qualtrics and Excel files (de-identified) until student graduation, anticipated in Spring of 2026. Additionally, the analysis of results will be discussed in a DNP project paper, the 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. Society for Maternal-Fetal Medicine (SMFM), Pacheco, L. D., Saade, G., Hankins, G. D., & Clark, S. L. (2016). SMFM Clinical Guidelines No. 9 Amniotic fluid embolism: Diagnosis and management. *American journal of obstetrics and gynecology*, *215*(2), B16–24. https://doi.org/10.1016/j.ajog.2016.03.012	☒	☐
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	Dewayne Byrd Edward Cournoyer
Signature	[redacted] 0704FC6E5DCA423... 0AB90DB4D15E492...

Date	2/26/2025 | 8:16 PM EST	2/10/2025 | 6:15 AM EST

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)	Paul Bolin, MD
☒	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)	Michael Lang, MD Todd Hickey, MHA
☐	Cancer (Breast cancer, Lung cancer, Gynecologic cancer, hematology, GI cancer, Urologic cancer, and Head & Neck cancer)	Emmanuel Zervos, MD Todd Hickey, MHA
☐	Children's Health (Pediatric Surgery, General Pediatrics, Well Newborn, Newborn & Pediatric Critical Care, Pediatric Hem-Onc, Neonatology, Pediatric medicine, Medicine subspecialities, surgical subspecialties)	Matthew Ledoux, MD Tara Stroud, DNP
☐	Emergency Services (Emergency Preparedness, Emergency Management, & Emergency Services)	Leigh Patterson, MD

		Debra Hernandez, MHA
☐	Heart & Vascular (Interventional Cardiology, Electrophysiology, Cardiac Surgery, Advanced Heart Failure, Cardiac Critical Care, Vascular Surgery, Cardio pulmonary rehab, Structural heart, & Thoracic Surgery)	Mark D. Iannettoni, MD Jay Briley, MHA
☐	Neuro Sciences (Neurology, Neurosurgery, Neuro Degenerative Disease, Neuro Critical Care, Stroke, Neuro Radiology, & Spine)	Stuart Lee, MD Jay Briley, MHA
☐	Nursing	Trish Baise, DNP
☐	Orthopedics (Joints, Orthopedic Surgery, Rheumatology, Sports medicine, Orthopedic medicine, & Orthopedic Trauma)	Deanna Boyette, MD Van Smith, MBA/MHA
☐	Pathology & Lab Services	Craig Steffee, MD Dave Harlow, PharmD
☐	Physical Medicine & Rehab (Rehab, Therapy (OT, PT, SLP), Pain, Wound Care, & Audiology)	Clint Faulk, MD Dave Harlow, PharmD
☐	Primary Care (Family medicine, Med-Peds, General Internal Medicine, Palliative Care, Geriatrics, & Sleep Medicine)	Jonathon Firnhaber, MD Dan Drake, PhD
☐	Radiology	Eric Martin, MD, PhD

		Dave Harlow, PharmD
☐	Women's Health (Gynecology, Obstetrics, & Maternal Fetal Medicine)	James Whiteside, MD
		Tara Stroud, DNP
☐	Projects that do not fit in the above service line areas	Niti Armistead, MD
		Brian Floyd, MBA

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.

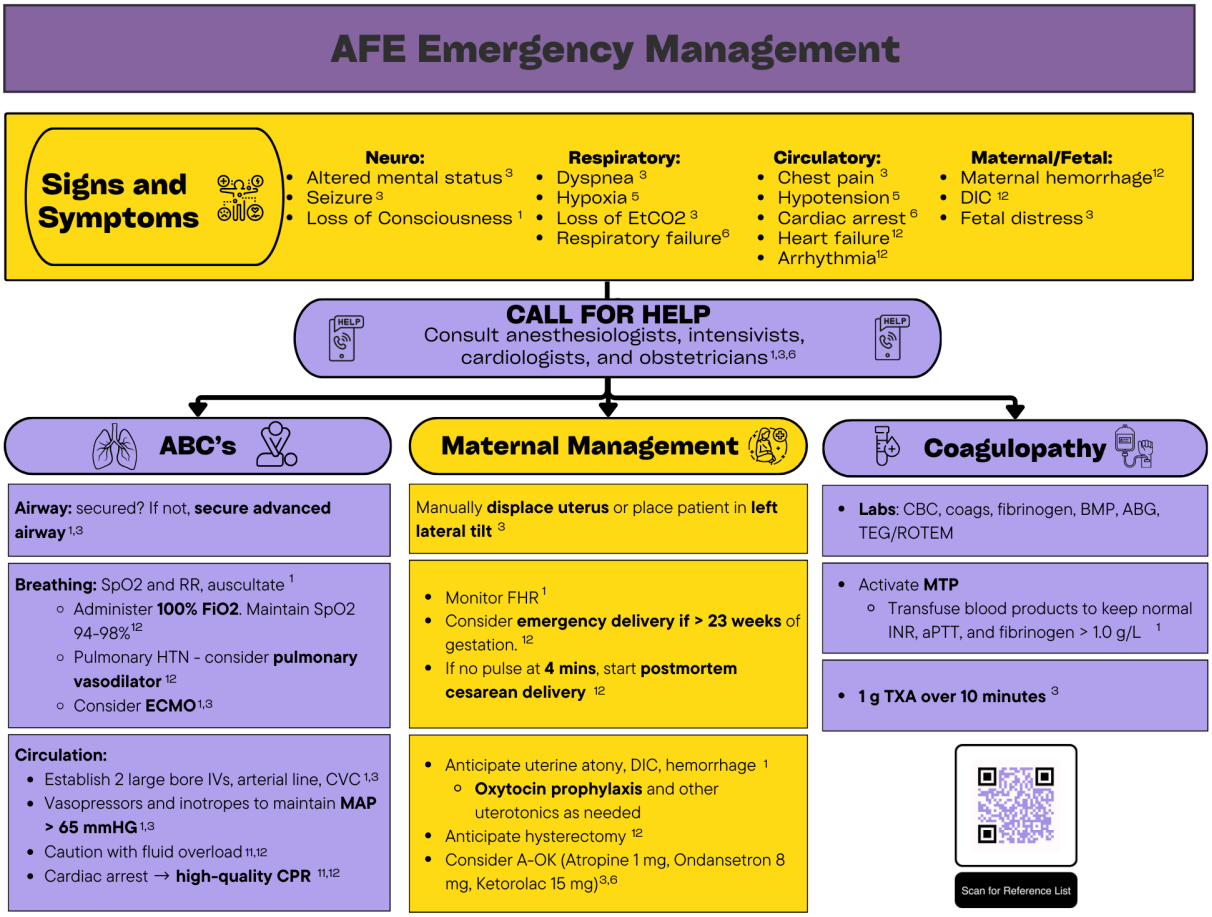
☐ **Human Subjects Research:** This project requires review by the IRB prior to initiation. An application in the electronic IRB submission system should be submitted.

UMCIRB Office Staff Signature [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 E

Cognitive Aid



Appendix F

PowerPoint Presentation Presented to Participants

Pre-Implementation Survey

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

ECU

ECU

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

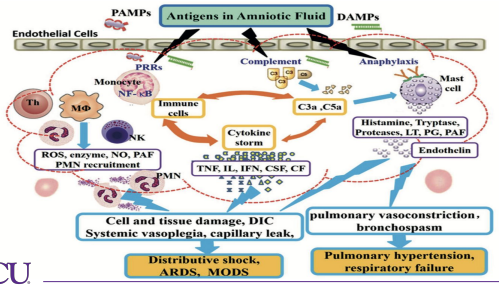
Blake Compliment, SRNA
Michaela Davenport, SRNA
Ashley Perry, SRNA
Selina Villamor, SRNA

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

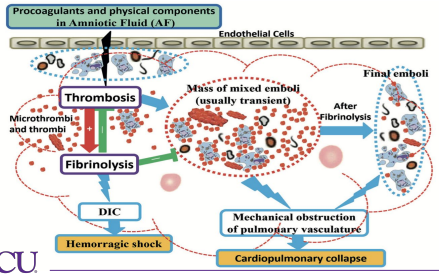
Pathophysiology of AFE



ECU

15

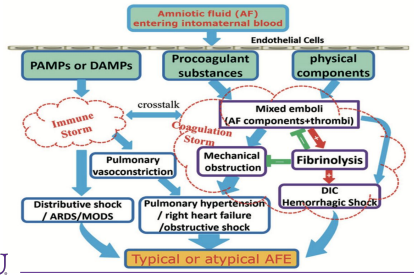
Pathophysiology of AFE



ECU

15

Pathophysiology of AFE



ECU

15

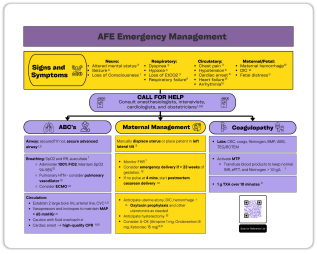
Locations of Cognitive Aid

- Digital version:

SCAN ME

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



Post-Implementation Survey

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

Thank you so much for your participation!

QUESTIONS?

References

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10. Gerets, J., Marynen, F., Atasever, A. G., & Van Gerven, E. (2023). Amniotic fluid embolism and the role of thromboelastometry. In Practical Guide to Simulation in Delivery Room Emergencies (pp. 653–670). Springer. https://doi.org/10.1007/978-3-031-10067-3_41

11. Haftel, A., Carlson, K., & Chowdhury, Y. (2024). *Amniotic fluid embolism*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK559107/

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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

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

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

AFE Treatment Continued

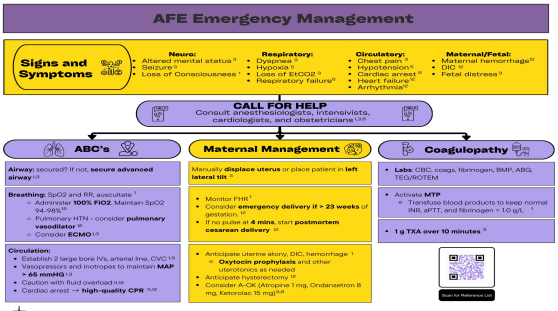
- Manually displace uterus or place patient in 15° left lateral tilt[3]
  - Monitor Fetal Heart Rate[1]
  - Consider emergency delivery if ≥ 23 weeks gestation[12]
  - If no pulse at 4-minute interval, start postmortem cesarean delivery[12]
  - Anticipate uterine atony, DIC, or hemorrhage[1]
    - Oxytocin 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

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



ECU

Appendix G

Qualtrics Survey 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 there current treatment guidelines or a cognitive aid at your facility regarding AFE management?

- Yes
- No
- Not sure

Rate the effectiveness of your current treatment guidelines regarding AFE identification and 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

AFE Post-Implementation Survey

Please select the answer that best describes the extent to which you agree or disagree with the following 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
○	○	○	○	○

Where would be the best location to improve the accessibility of this 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?

- ☐ 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 future suggestions for improving the effectiveness of this cognitive aid and presentation? Please write in your suggestions.

Appendix H

Emails to Participants

(1) Initial Pre-Survey and Video Email to Participants

Dear [redacted] CRNAs,
Thank you for considering participating in a quality improvement project titled "Anesthesia Providers' Perceptions of a Cognitive Aid for the Management of Amniotic Fluid Embolism: A Doctor of Nursing Practice Project."

The purpose of this project is to assess the usefulness of a newly developed cognitive aid for anesthesia providers for the management of AFE at [redacted]

Participation is voluntary and will involve completing a short pre-implementation survey, attending a brief PowerPoint presentation, reviewing the cognitive aid, and completing a short post-implementation survey when the presentation concludes.

Each survey should take less than 2-4 minutes to complete. The surveys were created and are completed using Qualtrics® survey software. The use of this cognitive aid falls within currently accepted practice in your work area. Your participation is voluntary and confidential. We will share the results of this QI study with you upon completion.

First, you will complete the pre-implementation survey on the day of the presentation before listening to our brief presentation. After all participants complete the pre-implementation survey, I will present a PowerPoint presentation on the identification and management of AFE, including a newly developed cognitive aid. The post-implementation survey will be available directly after the presentation for you to give feedback on the cognitive aid.

Again, thank you for your participation in my quality improvement project. I will be at [redacted] at 0700 on 4/23/2025 for the presentation and before/after if you have any questions. You may also reach out to me or Dr. Travis Chabo by email at any time.

Sincerely,

Ashley Perry, BSN, SRNA, CCRN, hodgesas18@students.ecu.edu

Travis Chabo, PhD, CRNA, Project Chair, chabot14@ecu.edu

(2) Final Thank You Email to Participants

Dear [redacted] CRNAs,

I just wanted to say thank you so much to everyone for helping me out with my DNP Project! I have collected all of the data I need to proceed with data analysis and will then be finishing my paper. Once it's complete you all will be able to read it if you'd like. And if you liked the cognitive aid and found it useful, you can continue to use it or find a newer published version as more AFE research evolves.

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

Take care,

Ashley Perry, SRNA

ECU Nurse Anesthesia Program

Class of 2026