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Enhancing SRNA Confidence: Integrating Simulation-Based CRM Training with Didactic Education to Improve Intraoperative Recognition, Communication, and Management of Intraoperative Cardiac Arrest

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Final Scholarly Project

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Abstract

Within the operating room (OR), the ability to identify deteriorating patient conditions and effectively communicate, is essential to delivering safe and efficient care. Although rare, the critical nature of emergent events necessitates early recognition and prompt intervention by an experienced anesthesia provider. The complexity of emergency management is often related to diagnostic ambiguity, individual provider experience, and disruptions of the fast-paced OR environment, requiring appropriate training methods for proficient execution. However, student registered nurse anesthetists (SRNAs) often lack sufficient exposure to emergent clinical scenarios, leading to delayed intervention and diminished confidence during crisis management. An evidence-based simulation education guideline for intraoperative emergency management was developed following a comprehensive literature review. The goal of this project is to implement evidence-based practice guidelines for crisis resource management education using simulation for nurse anesthesia students in central, Ohio. The evidence suggests that simulation learning is effective in improving recognition of deteriorating patient conditions, critical decision making, interdisciplinary teamwork, and student confidence.

Keywords: simulation-based education, crisis resource management, intraoperative cardiac arrest, nurse anesthesia

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Introduction

A significant source of stress for novice SRNAs is due to uncertainties inherent to the transition period from didactic education into clinical practice. While a moderate level of stress may contribute to a positive learning experience for some trainees, stress beyond a motivational level is correlated with negative consequences for other graduate students (Chipas et al., 2012). Acute stress adversely affects overall learning performance, and thus undermines student self-confidence, and hinders the ability to complete complex tasks. Therefore, the culminant stress of emergent perioperative events may further exacerbate these negative effects, impairing the SRNAs confidence in the ability to recall information essential for intraoperative crisis management.

Despite mandates set by the Council on Accreditation of Nurse Anesthesia Programs (COA) for the inclusion of education related to perioperative anesthesia complications within traditional didactic curricula, a significant deficiency exists in the prioritization of crisis management training and stress reduction strategies. Notably, less than 50% of nurse anesthesia programs address the non-technical aspects of crisis management, such as leadership, interdisciplinary communication, enhancement of dynamic decision-making, and resource utilization (Lei & Palm, 2022). Recognizing the imperative to bridge the current gap between theoretical education and clinical practice, the COA (2020) advocate for the incorporation of simulated clinical experiences as a mandatory component in the curriculum standards for practice doctorate programs.

Traditional educational training within anesthesiology follows an apprenticeship model, which requires students to practice skills on real patients in a clinical setting (Zigmont, Kappus, & Sudikoff, 2011). While nurse anesthesia students are closely supervised during training, the potential for inadvertent patient harm during hands on education remains a substantial source of stress for SRNAs. SBE complements experimental learning by exposing trainees to deliberate and relevant clinical scenarios in a setting that is functional and familiar (Ambardekar et al., 2019). SBE permits the SRNA to experience real-life intraoperative emergencies in a controlled learning environment, removing the potential for patient harm, and mitigating stressors inherent to the fast-paced dynamic of the OR.

Recent research indicates that the integration of SBE in the context of intraoperative crisis management yields substantial improvement in both technical and non-technical clinical skills (Wunder, 2016). As the majority of adverse intraoperative incidents are the collaborative result of human factors and hospital system failures, crisis resource management (CRM) techniques have emerged as an invaluable component of SBE within the field of anesthesia. The inclusion of CRM principals plays a pivotal role in the development of behavioral competencies essential for optimal team-based performance (Lei & Palm, 2022). The goal of this project is to evaluate the effect of SBE for intraoperative emergency management and measure changes corresponding to SRNA self-reported confidence in identifying deteriorating patient conditions, and crisis management skills.

Background

Stress and Student Confidence

The specialty of anesthesia places high demand on students both academically, and professionally. The expectation that students perform at the highest academic caliber fosters high levels of psychological distress, which may lead to inadvertent consequences and diminished confidence in clinical performance overall (Mesisca & Mainwaring, 2021). The transition of nurse anesthesia education to a practice doctorate has expanded the academic and clinical expectations of SRNAs (Mesisca & Mainwaring, 2021). In comparison to a master's-level education, a practice doctorate in nurse anesthesia amplifies student stress by including a longer duration of education, increased clinical hours, and scholarly projects (Mesisca & Mainwaring, 2021). As nurse anesthetists are gaining higher levels of autonomy, SRNAs are exposed to complex patients and challenged with more diverse clinical decision making, ultimately increasing the performance demand on these novice learners.

Long-term stress for anesthesia providers, even at the student level, has been shown to adversely impact self-confidence and influence patient care delivery. Although stress among the graduate student population is inevitable, understanding the impact stress has on clinical confidence is essential for optimal professional development.

Perioperative Cardiac Arrest

An estimated 250 million surgical procedures are performed annually, providing numerous opportunities for challenges to arise in current anesthetic practice (Han et al., 2017). Within the rapidly growing surgical population, many patients are presenting with increasingly complex medical conditions often confounded by several comorbidities, adding additional risk for adverse perioperative events (Gabbard & Smith-Steinert, 2021). The reported incidence of intraoperative

cardiac arrest (ICA) is 4.3 per 10,000 anesthetics, with an anesthesia-related perioperative mortality rate of approximately 1 per 13,000 anesthetics (Gabbard & Smith-Steinert, 2021). Common causes of ICA, such as hypoxia, hypovolemia, severe hypotension, and electrolyte disturbances, are often considered reversible with prompt intervention (Han et al., 2017). In light of these challenges, continuous advancements in anesthesia education and perioperative care are imperative to enhance patient safety and improve outcomes.

Risk Factors for Intraoperative Cardiac Arrest (ICA) Events

Ellis et al. (2014) conducted a systematic review evaluating anesthesia-related cardiac arrest. The study identified that 64% of anesthesia-attributable perioperative cardiac arrest cases are directly related to airway management, with a mortality rate of 29%. The domains of airway management recognized as contributing factors to perioperative arrest include difficult placement or ventilation through an endotracheal tube and loss of airway during emergence. Age, sex, American Society of Anesthesiology (ASA) physical status, and emergency surgery status were evaluated for differences in the incidence of perioperative cardiac arrest. The cardiac arrest group was noted to have a greater percentage of patients with higher ASA status (ASA III and ASA IV), a higher proportion of males, and those of older age (Ellis et al., 2014). The findings from Ellis et al (2014) systematic review underscore the importance of addressing risk factors for adverse patient outcomes, such as difficult airway management, emphasizing the need for continued education in specific domains to further enhance patient safety.

Advanced Life Support Training

The emergency resuscitation algorithm is a principal component of training for SRNAs (Gabbard & Smith-Steinert, 2021). All nurse anesthesia education programs require that students maintain an Advanced Cardiac Life Support (ACLS) certification (Gabbard & Smith-Steinert,

2021). As a fundamental component of the nurse anesthesia education process, clinical requirements permit SRNAs to confidently apply the knowledge obtained from didactic work and develop individual methods of anesthesia practice (Labrague et al., 2019). However, the inconsistent occurrence of perioperative cardiac arrest creates a significant gap in training for novice anesthesia providers. It potentiates a decrease in ACLS knowledge, ultimately affecting student confidence in management skills.

Relevance to Anesthesia

Within the OR, ICA is a constant concern and demands anesthesia providers' immediate and precise intervention. Statistics from the National Anesthesia Clinical Outcomes Registry indicate that ICA affects approximately 5.6 out of every 10,000 patients resulting in a staggering mortality rate of 58.4% (Shang et al., 2022). While the statistical likelihood of facing ICA during clinical practice is relatively low, it is considered the most catastrophic event compromising postoperative recovery (Piccione, 2016). Dissimilar to cardiac arrest (CA) encountered within inpatient settings where patients are not continuously monitored, CA that occurs during anesthesia is typically witnessed and anticipated (Piccione, 2016). Therefore, anesthesia providers must be trained to anticipate emergent events and deliver prompt, effective crisis management to ensure optimal outcomes and patient safety.

The successful management of ICA depends on several factors, including provider experience, clinical knowledge, and the ability to recognize patient deterioration. However, preparing SRNAs adequately for ICA poses a significant challenge due to a lack of formal crisis management education and the rarity of ICA occurrences within clinical settings. Although nurse anesthesia programs mandate that students maintain current ACLS certifications, the training provided in traditional ACLS courses may not explicitly address the patient-specific or

perioperative factors commonly associated with ICA (Houseman et al., 2020). The absence of specific educational guidelines for SRNA crisis management education represents a significant gap in current educational practice, and potential threat to patient safety.

To enhance patient outcomes and mitigate the risk of mortality associated with ICA, SRNAs must recognize patient comorbidities and understand the subsequent underlying pathophysiology involved (Houseman et al., 2020). Concurrent with the increasing acuity of patients' healthcare needs across the nation, it is evident from research that singular-use didactic methods in healthcare education are insufficient, prompting the need for alternative educational modalities. While didactic-only education exposes SRNAs to critical events through lecture-based education and clinically based spontaneous exposure, SBE has gained acceptance in anesthesia education by providing true-to-life clinical scenarios using animation (Warren et al. 2016). SBE permits SRNAs to have exposure to the clinical setting on- demand, practice applicable skills in a non-threatening environment, and receive immediate feedback from educators, which can significantly enhance the learning process.

While nurse anesthesia didactic education often focuses on the technical skills of safe anesthetic practice, it places less emphasis on non-technical skills, such as effective communication, teamwork, and situational awareness which are equally imperative to effective crisis management (Lorello et al., 2014). The novice SRNA often struggles with developing proficient communication skills due to the rapidly changing dynamic of the OR environment. The SBE curriculum can incorporate CRM programs to address this issue by providing education to SRNAs on cognitive and interpersonal behaviors invaluable to team performance during crisis events (Lei & Palm, 2022). Since adverse events in healthcare often result from a combination of

human factors and system failures, using a SBE CRM training program aims to enhance teamwork among providers with varying levels of experience.

Problem Statement

Although evidence-based research finds integrating stimulation-based learning into nurse anesthesia didactic curriculum vital to ensure optimal outcomes for patients experiencing an intraoperative crisis, few nurse anesthesia programs utilize this approach. This project seeks to evaluate the efficacy of utilizing simulation-based CRM in conjunction with didactic education with an objective to establish comprehensive simulation education guidelines, reduce self-reported stress among SRNAs, enhance clinical confidence during uncommon critical clinical encounters, and promote enhanced intraoperative recognition of deteriorating patient conditions, such as cardiac arrest.

PICO Question

(P) For a student registered nurse anesthetist (SRNA) in a doctoral prepared nurse anesthesia (NA) program (I) is simulation-based anesthesia crisis resource management (CRM) training in addition to didactic education, (C) when compared to didactic only education, (O) beneficial in improving student self-reported confidence in intraoperative recognition of deteriorating patient conditions, interdisciplinary communication, and crisis management during uncommonly encountered clinical scenarios?

Project Objectives

The critical nature of emergent events in the OR necessitates early recognition and prompt intervention by an experienced anesthesia provider. However, a significant proportion of nurse anesthesia programs do not include formal CRM within traditional didactic curriculum, leaving SRNAs to rely on spontaneous clinical exposure to develop essential management skills. By

providing adequate exposure to critical clinical scenarios through SBE, SRNAs demonstrate timely intervention and enhanced confidence during crisis management (Houseman et al., 2020). This EBP project aims to bridge the educational gap seen with didactic-only education by evaluating the effectiveness of integrating simulation-based CRM training into the traditional didactic curriculum. The objectives for this evidence-based project are as follows:

1. Review literature to formulate EBP SBE guidelines for ICA using CRM training for SRNAs.
2. Develop evidence-based guidelines to be implemented in Nurse Anesthesia programs to enhance SRNAs' confidence during critical clinical encounters and promote the improvement of intraoperative recognition of deteriorating patient conditions utilizing SBE.
3. Develop a comprehensive plan to implement the previously mentioned guidelines in a simulation-based curriculum.
4. Develop a comprehensive plan to monitor and measure the impact of simulation-based crisis management training in reducing self-reported stress among SRNAs during the transition period from didactic education into clinical practice.
5. Develop a comprehensive plan to adjust guidelines to achieve the desired outcomes by continuously evaluating the efficacy of simulation-based crisis management training in improving the strength of SRNA crisis management skills and outcomes for patients experiencing intraoperative crises.

To enhance patient safety and improve SRNAs' self-reported confidence in crisis management, a comprehensive literature review of recent research will guide the development of best-practice recommendations, implementation, and evaluation of the identified outcomes, including;

improved SRNA self-reported confidence in intraoperative recognition of deteriorating patient conditions, interdisciplinary communication skills, and strength of crisis management during uncommonly encountered clinical scenarios, such as cardiac arrest.

Literature Search

In the rapidly evolving healthcare environment, patient safety within the perioperative arena relies on the nurse anesthetist's ability to respond to complex clinical scenarios. Therefore, nurse anesthesia programs must employ educational modalities to bridge the gap between didactic based theory and clinical practice to prepare SRNAs appropriately for managing intraoperative emergencies, such as CA. SBE has emerged as a powerful and innovated approach to enhance novice anesthesia providers' training and skill development.

Literature Review

A systematic literature search to synthesize and critically evaluate relevant studies on the use of SBE within nurse anesthesia, focusing on analyzing its effectiveness, advantages, and impact on the competence and confidence of emerging nurse anesthetists. Otterbein University's OneSearch through the Courtright Memorial Library, PubMed, Cochran Database of Systematic Reviews, CINAHL, and EBSCOHost served as the primary databases for the literature search. The database search strategy incorporated a combination of the following terms, searching all fields or titles: "simulation-based education", "nurse anesthesia", "anesthesia training," "clinical simulation," "critical management," and "perioperative cardiac arrest." A secondary filter was applied to include only peer-reviewed scholarly articles available in full text online, yielding 5,485 results. Boolean operators "AND" and "OR" were incorporated into the search, in addition to a publication date restriction (2011-now), further limiting results to the most concise and relevant information, resulting in 625 scholarly articles.

Inclusion criteria for this literature review include the following: meta-analyses, systematic reviews, literature reviews, studies including healthcare professional training, studies including anesthesia education, studies involving simulation-based education, intraoperative critical resource management, and studies including student competency and skill development. Additionally, the author employed exclusion criteria, excluding studies published before 2011, those published in languages other than English, studies with limited or incomplete data, and nonpeer-reviewed sources. By maintaining strict exclusion criteria, the author ensured this study includes only valid, up-to-date, and relevant developments in simulation-based education and a comprehensive literature analysis not hindered by language barriers. After appraising all available results, eight articles were isolated for inclusion and rapid critical appraisal.

Literature Analysis

This literature analysis aims to provide evidence-based practice recommendations for the use of SBE for ICA within nurse anesthesia education compared to didactic-only education methods. Articles included in this literature search provide evidence of the clinical problem, methods to improve novice anesthesia provider management skills and confidence during intraoperative emergencies. A literature review table of the accepted articles and associated level of evidence scores can be found in Appendix A. The sections below discuss the literature search findings and analysis of the management of perioperative cardiac arrest, SBE, CRM, impact on student confidence, and stress.

Management of Perioperative Cardiac Arrest

Anesthesia providers are critical in managing patients throughout the perioperative period (Gabbard & Smith-Steinert, 2021). Safe and successful delivery of anesthesia relies on individual providers' aptitude for clinical knowledge and proficiency in clinical judgment (Nair et al., 2016).

These vital attributes are pivotal in effectively minimizing errors and events that compromise patient safety. The complexity of emergency management is often related to diagnostic ambiguity, individual provider experience, and disruptions of the fast-paced OR environment, requiring appropriate training methods for proficient execution (Lei & Palm, 2022). CA that occurs during the perioperative period is defined as a potentially reversible event (Han et al., 2017). Hypoxia, hypovolemia, severe hypotension, and electrolyte disturbances and are common causes of ICA and often reversible with prompt intervention (Han et al., 2017). Patient outcomes rely heavily on the availability of monitoring, equipment for resuscitation, and adequately trained personnel (Nair et al., 2016).

Simulation-Based Education

In anesthesia training, SBE is an emerging teaching modality that permits students to learn cognitive and clinical skills in a non-threatening environment (Labrague et al., 2019; Cook et al., 2011; Fung et al., 2015). High-fidelity simulation (HFS) provides a complementary teaching method to translate theoretical didactic education into clinical practice by exposing students to manikins that simulate real-life conditions or scenarios (Labrague et al., 2019). HFS simulator's parallel realistic, responsive physiologic function and monitoring allow participants to react to situations with similar stress and distractions found in real operating room crises (Lucisano et al., 2012; Labrague et al., 2019).

In a systematic review by Warren et al. (2016), an experimental randomized control trial revealed that simulation learning generates more critical thinking, increased knowledge, competence, and overall satisfaction of students. Additionally, following simulation participation, students had improved confidence in decision-making skills and the ability to recognize patient status changes (Warren et al., 2016). While didactic-only education exposes SRNAs to critical

events through lectures and spontaneous clinical exposure, SBE has gained acceptance in anesthesia by providing real-life clinical scenarios using animation (Warren et al. 2016).

Crisis Resource Management

In a study by Gros et al. (2021), the authors identified crisis resource management (CRM) as a practical addition to simulation-based learning for crisis preparation. Students with limited clinical experience are more likely to exhibit weak clinical logic and diagnostic abilities during critical situations (Gros et al., 2021). Proper crisis management education for anesthesia providers, incorporates aspects of technical and behavioral performance designed to improve task management, vigilance, reaction time, and communication (Gros et al., 2021). Intraoperative communication is a behavior that is highly valued during emergent events, an area where SRNAs often need more assurance due to minimal exposure to these scenarios (Gros et al., 2021; Fung et al.,2015). During emergent perioperative events, such as ICA, CRM is vital for closed-loop communication, anticipation, and planning (Gros et al., 2021). Including CRM within simulation-based training facilitates an opportunity to reframe and reinforce communication skills while practicing effective team management and delegation in a controlled environment (Gros et al., 2021). After simulation events, students found the degree of difficulty of non-technical skills to be significantly less, allowing for improved situational awareness and role clarity (Gros et al., 2021).

In a systematic review conducted by Fung et al. (2015), 12 studies compared the use of SBE to traditional didactic-only CRM training, finding improved teamwork behaviors in the post-test simulation group ($P < .01$). All studies indicated significant improvements in at least one clinical knowledge outcome when using simulation-based CRM training compared to didactic-only training (Fung et al., 2015). Participants exposed to repeated CRM simulation-based training showed improved workload management and completed resuscitations 2.5 minutes faster than

teams who did not receive simulated training (Fung et al., 2015). The retention of CRM skills in clinical practice was seen up to 24 months after simulated education modalities (Fung et al., 2015).

The role of team dynamics, a critical component of CRM training, is paramount to carrying out a successful resuscitation (Nair et al., 2016). Elements of effective resuscitation team dynamics include closed-loop communication, clear roles and responsibilities, knowledge of individual limitations, and constructive intervention (Nair et al., 2016). Unique to the field of anesthesia, anesthetists focus on intraoperative prevention strategies, including early recognition of patient deterioration and steps to avoid or interfere with the progression of critical events (Gros et al., 2021).

Impact on Student Confidence

Students who are provided high-fidelity simulation activities to teach physical skills demonstrate higher confidence levels in comparison to students to are provided with traditional didactic teaching methods (Labrague et al., 2019). A systematic review led by Warren et al. (2016) found that student confidence increased from 80.65% noted on pre-test data collection to 100% on post-test data collection following simulation-based training activities. Increased student confidence is related to an increased ability to function in the fast-paced clinical setting, high teamwork exposure, and an increased knowledge base (Warren et al., 2016). Two studies identified that crisis management simulation education significantly improved student confidence in technical skills, identification of patient deterioration, and knowledge of crisis resource management principles (Warren et al., 2016). Simulation medical training allows student learners to receive feedback and identify weak clinical knowledge areas that need continued practice (Warren et al., 2016; Gao et al., 2021).

The repetitive nature of simulated clinical scenarios significantly improves student confidence in managing critical events by enhancing technical, non-technical, leadership, and communication skills (Lucisano et al., 2012; Warren et al., 2016); Khalafi et al., 2023). A systematic review by Labrague et al. (2019) examined 35 studies to evaluate the effect of HFS on students' self-confidence and anxiety. Three RCT identified that students gained significantly higher levels of self-confidence in handling patients with cardiac conditions, enhanced critical thinking, and confidence in electrocardiogram (ECG) rhythm interpretation compared to students who had no simulation exposure (Labrague et al., 2019).

Summary of Literature Review

The COA (2020) encourages the addition of simulated clinical experiences as a required curriculum component of practice doctorate standards. Currently, less than 50% of nurse anesthesia programs address the nontechnical aspects of crisis management: leadership, interdisciplinary communication, improvement of dynamic decision-making, and resource utilization (Lei & Palm, 2022). The literature supports implementing SBE within traditional didactic-based nurse anesthesia education to address student-reported reductions in confidence when critical events are encountered intraoperatively.

Studies indicate that simulation-based CRM training leads to improved non-technical skills including teamwork behaviors, and clinical knowledge when compared to traditional didactic-only training (Cook et al., 2011; Fung et al., 2015; Gros et al., 2021; Labrague et al., 2019). Implementing simulation-based education curricula into current nurse anesthesia programs requires appropriate training and curriculum format, emphasizing the importance of incorporating guidelines and recommendations.

Evidence-Based Practice Model

Model Identification

As the acuity of patients' healthcare needs continues to increase nationwide, traditional didactic-only teaching methods within nurse anesthesia education are no longer considered an acceptable singular methodology to represent up-to-date, evidence-based education practice. Evidence-based practice within healthcare is best defined as a cumulation of scientific evidence used to amend current clinical practice guidelines to improve healthcare outcomes (Pellegrini, 2006). However, incorporating evidence-based recommendations into practice guidelines requires using an evidence-based practice model to support the necessary practice changes (Cullen et al., 2018). For this final scholarly project, the author uses the Iowa Model to provide a comprehensive framework for implementing evidence-based practice interventions, appraise applicable evidence, and guide the sustainable integration of practice change. The author received permission to use the Iowa Model for this project; see Appendix B.

Description of Iowa Model

Step 1: Identified Trigger and Opportunity for Improvement

The Iowa model's first step is identifying a trigger for clinical practice change and applicable opportunities for improvement. For this project, the author determined that the trigger for the evidence-based practice process is the student SRNAs lack of exposure to emergent clinical scenarios during traditional, didactic-based clinical training, leading to delayed intervention and diminished confidence during crisis management. Despite current literature indicating that successful ICA management depends on provider experience, clinical knowledge, and the ability to recognize patient deterioration, less than half of nurse anesthesia programs have implemented educational initiatives to adequately prepare students for this rare but critical event (Lorello et al.,

2014). This gap in education represents an opportunity for practice improvement, making the evaluation of simulation-based CRM education on nurse anesthesia student competency and confidence a priority topic for this project.

Additionally, this phase of the Iowa Model involves defining the desired clinical practice change as an organizational, state, or national initiative. New evidence, data, and accrediting agency requirements and recommendations are examined to determine the target for improvement initiatives (Cullen et al., 2022). Following the analysis of evidence found in recent literature, it was determined the desired clinical practice change to be an organizational initiative, including all three active cohort students in one nurse anesthesia program in central, Ohio.

Step 2: State the Question or Purpose

The second step of the Iowa model involves the development of a research question pertinent to the identified clinical trigger. The PICO question guides evidence-based research, aids in developing appropriate project implementation and evaluation plans, and focuses project objectives on identified practice change needs. For this scholarly project, the following PICO question is used to evaluate the efficacy of simulation-based crisis management for ICA within nurse anesthesia training: (P) For a student registered nurse anesthetist (SRNA) in a doctoral-prepared nurse anesthesia program (NAP) (I) is simulation-based anesthesia crisis resource management (ACRM) training in addition to didactic education, (C) when compared to didactic only education, (O) beneficial in improving student self-reported confidence in intraoperative recognition of deteriorating patient conditions, interdisciplinary communication, and crisis management skills during uncommonly encountered clinical scenarios such as intraoperative cardiac arrest (ICA).

As described by the Iowa Model, after the development of the PICO question, the comprehensive plan for project implementation begins with forming a team (Cullen et al., 2018). The project leadership-appointed primary investigator (PI) will establish team recruitment and stakeholder selection criteria to facilitate this process. The PI for this project, identified the primary stakeholders and interdisciplinary team members as first, second, and third-year SRNA's; nurse anesthesia program educators; and nurse anesthesia program administration. Other project stakeholders in the interprofessional team include simulation staff, who are responsible for ordering simulation equipment, initiating and maintaining simulation technology, and determining costs of simulation supplies.

Step 3: Evidence Appraisal

The third step of the Iowa model involves gathering literature to support project outcomes. As previously described, an external systemic literature review and appraisal of relevant quantitative and qualitative research were conducted to establish the best educational guidelines for crisis management within nurse anesthesia training (Appendix C). The evaluated evidence selected for inclusion in this scholarly project based on relevance to the primary clinical question, appropriate research designs, absence of bias, and outcome measures consistent with stated conclusions. Additionally, accrediting agencies were included in the clinical inquiry to provide the best available scientific evidence, as improvement strategies often derive from new evidence, research, and accrediting agency recommendations (Cullen et al., 2018). The information obtained from the literature review provides evidence to translate data into an evidence-based practice guideline for recommended practice change and nurse anesthesia educator reference.

Step 4: Design and Pilot the Practice Change

After the appraisal of sufficient evidence, the fourth step of the Iowa model involves the design of implementation strategies to pilot the applicable practice change. Designed to evaluate the effectiveness of contemporary models of practice change, this step is crucial for modifying implementation plans (Cullen et al., 2018). An essential aspect of this step is the collection of baseline data and plan for evaluation. Questionnaires are commonly used for pre-and post-evaluation of project implementation strategies, permitting the collection, and reporting of post-pilot data (Cullen et al., 2018). Qualitative and quantitative data are used to measure outcomes at pre-defined intervals to assess the need for additional components within implementation strategies to ensure effectiveness.

For this project, the questionnaire used to collect baseline data from nurse anesthesia students includes self-reported clinical competency, and preparedness for emergent OR events, such as ICA. Following the implementation phase, the questionnaire administered for baseline measurements is reused as a post-test questionnaire for participating students. Implementation plans are then molded to the objectives defined by student scores. The integration of interactive implementation strategies assists in promoting and adopting practice changes for nurse anesthesia students (Cullen et al., 2018). An example of the questionnaire is found in Appendix D.

Qualitative Data

Qualitative research gathers data based on participants' experiences, behavior, and perceptions (Tenny et al., 2022). Unique to qualitative research, the data collected with this process may assist in explaining patterns of human behavior that are traditionally difficult to quantify. As attitudes and experiences are difficult to accurately quantify, the author determined a qualitative

approach to questionnaire development would permit participants to explain individual thoughts and feelings experienced during the event of interest such as student confidence level.

Quantitative Data

Quantitative data is used to infer differences by using measured and numerical information. Basic descriptive statistics are commonly used to explain the main characteristics of data by noting frequencies, percentages, ratios, and mean values (Centers for Disease Control (CDC), 2018). The main characteristics of data permit the communication of data findings with stakeholders and larger audiences for broadened implementation plans (CDC, 2018). A significant advantage of using quantitative data includes assurance of concrete findings, minimizing the possibility of reviewer bias.

Following the implementation phase, the questionnaire administered for baseline measurement is reused as a post-test questionnaire completed by student participants. The quantitative and qualitative data collected is essential for successful evidence-based practice change implementation and provides evaluation for educational-based improvements within the nurse anesthesia curriculum.

Step 5: Implementation for Sustainability Framework

The Iowa model recognizes the implementation process of an EBP strategy to be a series of phases: creating awareness and interest, building knowledge and commitment, promoting action and adoption, and pursuing integration and sustained use (Cullen et al., 2018). The author received permission to use the supplementary Implementation for Sustainability Framework for this project, as detailed in Appendix B figure 1B.

The Iowa Implementation for Sustainability Framework, designed to promote excellence in healthcare, serves as a guide to implement evidence-based practice change and continuously

monitor for improvement. The steps of this model are designed as multidirectional, ultimately representing the non-linear nature of implementation within healthcare systems (Cullen et al., 2022). Each phase encompasses clusters of related strategies, defined as domains, and organized by their individual intention and potential function of their mechanism of action (Cullen et al., 2022). Domains supported by empirical evidence within healthcare are bold and are intended to be bundled across phases.

Phase one of the Iowa Implementation for Sustainability Framework is to create awareness and interest. The domains included within this project include marketing, information, and commitment. Through student participation in self-evaluation, the author aims to create awareness of the importance of adequate preparation for emergent operating room events. The implementation initiatives can be tailored to the needs of students, promoting increased clinical competency and improved patient outcomes by allowing students to continuously self-evaluate individual progress after simulation-based crisis management education.

The adoption of evidence-based practice models is crucial to meet the evolving healthcare needs of patients and ensure the delivery of safe and effective care. By using the Iowa Model, this project contributes to bridging the gap between evidence-based research and clinical practice, fostering a culture of continuous learning and improvement in nurse anesthesia education. As healthcare continues to advance, the adoption of evidence-based practice models will remain essential to ensure healthcare professionals are equipped with the most current knowledge and skills to provide optimal patient care.

Method and Design

To comprehensively evaluate the impact of simulation-based CRM for ICA training on the clinical competence and confidence of SRNAs when compared to didactic-only emergency management education, a multifaceted approach was developed. This approach includes the utilization of pre-and-post intervention tests, along with a clinical observation audit checklist provided in Appendices D, E, and F.

The DNP project utilizes the Iowa Model as the primary framework for quality improvement (QI) of the nurse anesthesia program curriculum. The QI initiative for this project aims to standardize crisis management education curricula for SNRAs to reduce variation in training methods, achieve predictable results, and improve outcomes for patients in the surgical setting and student confidence levels.

Using a pretest/post-test interventional design with a convenience sample of 66 SNRAs in a single nurse anesthesia program, the author assembled a pre-simulation and post-simulation survey, clinical observation checklist, and simulation education guideline. A sample of the simulation education guideline is found in Appendix C. The pre-and post-simulation surveys will be used to measure the impact of simulation learning on student confidence.

Clinical Setting and Population of Interest

The setting for this project is a level one trauma hospital in central, Ohio. The clinical simulation laboratory found within the medical center provides year-round access to simulation-based training for hospital-affiliated healthcare providers and nurse anesthesia program students. The target population for this project includes 66 bachelors' in science nursing (BSN) to Doctor of Nursing Practice (DNP) nurse anesthesia graduate students at a private university in central Ohio.

Participants selected for inclusion include adult graduate students who are of varying ages, experience levels and enrolled full-time.

Instruments

Pre-and post-intervention confidence and competency performance data are collected using the assessment forms found in Appendix D and E. The observational clinical checklist is essential for the continuous quality improvement project process as it provides the project leader with access to valid, reliable data for simulation guideline improvement.

Pre and Post Simulation Survey

The pre-simulation survey is designed to comprehensively assesses participants' confidence levels when handling critical intraoperative emergencies, such as ICA. In addition, the survey examines the participants' prior experiences with intraoperative emergencies and their perceptions of the efficacy of simulation-based teaching as a valuable component of clinical education. Beyond these critical aspects, the pre-simulation survey captures additional insights, such as participants' years of experience in the operating room and foundation of clinical knowledge.

Upon completing the simulation activities, the post-simulation survey is deployed to elicit participants' confidence scores, reflecting on improved skills and self-assurance. The comprehensive post-simulation survey provides valuable data to investigators for evaluation of the direct impact simulation intervention has on participant's confidence levels and recognition of the value of simulation-based education.

The Observational Checklist Audit Form

The observational checklist is designed to highlight the importance of non-technical skills during intraoperative crisis management. The Anesthetists' Non-Technical Skills (ANTS)

framework provides a reliable, valid, and accurate evaluation of student performance during simulated crisis management (ANTS, 2012). The authors of the ANTS system have permitted the reproduction of this observational structure for organizational or not-for-profit use without further permission. The ANTS checklist is divided into four main categories: decision-making, task management, teamwork, and situational awareness. Each category is divided into fifteen skill elements. Skill elements are identified as critical components of CRM including planning and preparing, identifying, and utilizing resources, using authority and assertiveness, assessing capabilities, anticipating, and balancing risks, and selecting options (ANTS, 2012). Each category contains four possible points, one being the lowest total score, and sixteen being the highest if the participant scored four points in each category. A score of one indicates poor participant performance, two is marginal with room for improvement, three is acceptable, and four is good performance (ANTS, 2012). To ensure the success of the ANTS observational audit, student participants in this project will receive pre-implementation education on error management and non-technical skills.

Implementation of Simulation-Based Crisis Resource Management Education

Phase 1

Phase one of project implementation begins with the pre-intervention survey distributed to the participating students by the primary investigator. The students will complete the survey in the simulation laboratory classroom before the scheduled CRM education session. To ensure the anonymity and confidentiality of the participants information, the survey did not include personal identifiers, such as student names. The confidentiality precaution intends to create a comfortable and secure environment for participants, encouraging open and honest responses. The pre-

intervention survey tool permits the collection of essential information to evaluate the impact of SBE CRM on SRNA clinical competency and confidence when managing ICA.

After completing the pre-intervention survey, each SRNA cohort collectively attends an educational session on CRM and simulation exercise expectations. The primary lecture topics include defining technical and non-technical skills of CRM and providing students with real-life examples demonstrating appropriate and inappropriate behavior of each skill. Lecture materials are provided to students using information provided by Anesthesia Key: Principles of Anesthesia Crisis Resource Management (2019). The education session is led by the appointed nurse anesthesia program CRNA faculty, who are clinical experts in nurse anesthesia, making them qualified to train novice SRNAs in CRM of the intraoperative environment.

Phase 2

Phase two begins the simulation portion of the DNP project implementation. With approval from the Clinical Simulation Laboratory supervisor, mannequins and applicable emergency supplies are provided in accordance with the project budget. Using a randomized technique, students are placed in teams and provided with a report of the simulated patient. The patient report includes a perioperative assessment, past medical history, and an explanation of the surgical procedure. Each simulation experience involves an event to elicit patient deterioration into CA. The SNRA cohorts will participate in three simulation activities, each clinical scenario increasing in difficulty. The students will assume different roles during each activity, including the anesthesia provider code leader, circulating nurse, scrub tech, and surgeon. Participation in simulated activities in different roles allows students to experience crisis management techniques from the perspective of each part of the interdisciplinary intraoperative team. Throughout the simulated

scenarios, the primary investigator and faculty will assess individual student performance of CRM and emergency management skills and complete the ANTS observational audit.

Phase 3

After the simulation-based exercises, students will debrief with the CRNA leaders to discuss the positive and negative aspects of personal and team-based performance. According to Edwards (2021), debriefing is essential to CRM and simulation-based learning as it promotes an intentional conversation among team members that can be used for knowledge or skill attainment. The debriefing session is designed to support student learning and provide a further understanding of actions and decisions without reinforcing blame. The topics selected for the project debriefing sessions include identifying high-risk patients, intraoperative monitoring decisions, recognizing deteriorating patient conditions, knowledge sharing, and ACLS management.

At the conclusion of the didactic education, simulation exercise, and debriefing sessions, students are provided with the post-intervention survey. The post-intervention survey, found in Appendix E, includes questions similar to the pre-intervention survey to evaluate the improvement of student confidence and the benefit of simulation-based education. However, the post-test includes sections for students to make suggestions to improve SBE strategies.

Timeline

The timeline for implementing the FSP proposed education guidelines is estimated to span twelve months, as depicted in Table 1 in Appendix G. The implementation of SBE guidelines is estimated to occur for over a year. The development phase will ensue during the first two months and includes completing a comprehensive literature review to establish project objectives to improve the quality of SRNA training for intraoperative emergencies. The next three months involve creating an education team, training education faculty on simulation methods, developing

simulation scenarios, and retrieving applicable simulation equipment. However, this phase may take an additional three to four months due to the complexity of simulation training for faculty educators. Therefore, the sixth month will be used to finish the development of simulation training curricula, and ensure educational materials are ready for distribution to the participating SRNAs.

The integration of SBE guidelines into SRNA training will begin during month seven, following approval from the International Review Board (IRB). At this time, students will receive a CRM lecture, complete the pre-intervention survey, and participate in the simulated scenarios designed by the project leader. Each simulation exercise used will be the same for each student group. The SRNA participants will complete the simulation training from months seven through twelve. During this time, data collection from the pre-and post-intervention surveys and observation audit forms will permit the project investigator to monitor outcomes and adjust the FSP project recommendations accordingly. After the twelve-month implementation period, a re-evaluation of project outcomes by the project team will identify areas for improvement and strategies for enhancing future SBE ICA initiatives.

Budget

The projected budget for implementing SBE for ICA for SRNAs is $500.94. The primary cost of the SBE project includes paper and printing services for six months of material and binders to store the student observational audit forms. A comprehensive breakdown of expenses is outlined in Appendix H.

During the first four months of project development, the time requirement is four hours per week. To reduce the overall cost of implementation strategies, the project investigators and education team members will work on a volunteer basis. The volunteered time requirement during the following six-month implementation phase is eight hours per week, with an estimated 32 hours

per month. However, limited voluntary participation from education team members would be a notable financial barrier to implementing the FSP project.

Additional cost reduction strategies include using the NA program clinical simulation laboratory equipped with the high-fidelity SimMan simulation technology necessary for the FSP proposed education guidelines. The CRM educational materials are available online and do not require additional costs for the project team. However, for the purpose of project replication, if this curriculum occurred where a clinical simulation laboratory was unavailable, financial burden would be significant. Cost depends on infrastructure development costs including simulation equipment, anesthesia machines, ventilators, beds, OR tables and if applicable, infusion pumps. The estimated cost of high-fidelity human patient simulators range in cost from $50,000 to $210,000 (Mai & Cooper, 2019). Additional simulation cost includes the maintenance of simulators which ranges from $10,000 to $18,000 (Mai & Cooper, 2019).

Outcome and Analysis

The primary outcome of interest in this study is the improvement in self-reported confidence among SRNA's regarding their ability to recognize deteriorating patient conditions and manage CA within the intraoperative setting. The expected result of this doctoral project states that the use of simulation-based CRM training in conjunction with didactic education increases SRNA confidence in intraoperative cardiac arrest management more than didactic education alone. To assess the anticipated success of the project outcome, pre-simulation and post-simulation self-assessment surveys will serve as the primary data for statistical analysis.

Statistical Analysis

Following the completion of the pre-and-post simulation surveys, results will be placed in an organized format based on responses and entered into a Microsoft Excel spreadsheet for

comparison. The statistical test utilized for the analysis of data is a quantitative analysis paired samples t-test. Commonly used as a statistical test to demonstrate a difference between a set of paired samples, paired samples t-test will provide an estimate of the significant difference between the means of two samples from the same subjects. A p-value < .05 is used to delineate statistical significance between differences in test scores that are not caused by chance.

Project Results

The ultimate success of the scholarly project is contingent upon the demonstration of improved SRNA confidence in ICA management through simulated events. Project investigators will continuously monitor the success of the QI project throughout the 12-month implementation phase to ensure outcomes are met. If proposed outcomes are met within the twelve-month implementation phase, the project team will promote the simulation guidelines as future recommendations for public use.

Alternatively, after the completion of simulation activities and statistical analysis of student data, if it is determined that there is minimal improvement in student confidence levels, the project author will make applicable changes to the simulation guidelines. These changes include additional CRM classroom education and increased frequency of simulation exercises.

Limitations and Barriers

The primary limitations associated with this project are due to the reliance on the self-reported surveys. Evaluation of the survey results may be considered a weak assessment method for evaluating the SBE training program. Rather, assessment of patient outcomes may be more reliable for monitoring training method success. However, the addition of the ATNS observation checklist serves as a useful proxy indicator of training method success.

Potential barriers for this project include cost, availability of resources, and education volunteer support and compliance. Without the immediate availability of a high-fidelity simulation lab, the cost of simulation equipment would be prohibitive for the implementation of this project at other academic institutions. To address the concern for volunteer support and compliance, project leaders will hold educational meetings prior to the implementation of the project to discuss the gap in current nurse anesthesia education. This educational in-service will serve to mitigate volunteer attrition by stressing the importance of adequate preparation for novice SRNAs as they are integrated into the clinical setting.

Future Implications

The successful implementation of the SBE guideline outlined in this scholarly project at other institutions holds significant implications for the future of NA education. To further extend the benefit of CRM and SBE in ICA training for SRNAs, the creation of a formal education curriculum becomes imperative. As other education institutions embrace this emerging SBE approach, a structured curriculum tailored to the specific needs of SRNAs must be developed. Development of the curriculum involves the careful integration of theoretical knowledge, practical skills, and hands-on simulation experiences to ensure comprehensive and effective training. Additionally, the development of the curriculum must not only foster consistency in educational standards set forth by the COA, but also contributes to enhancing the preparedness of SRNAs in managing critical situations, ultimately advancing the quality of patient care across all hospital systems.

Conclusion

The recognition of the absence of EBP guidelines for ICA SBE prompted a through exploration of the issue and the background behind this significant clinical problem. Employing a PICOT question facilitated a focused literature search, aiding in the establishment of objectives and the development of the EBP guidelines. Leveraging the Iowa Model, a strategic implementation plan was created, encompassing method identification, target population specification, project team assembly, stakeholder engagement, logistical considerations, and budget allocation for implementation.

In summary, the integration of SBE for NA doctoral students represents a pivotal stride towards enhancing confidence in the management of intraoperative cardiac arrest. While the implementation of EBP guidelines demands meticulous planning, its enduring effects are undeniable. Specifically, by formulating anesthesia guidelines and a comprehensive implementation plan for SBE curricula in NA studies, there exists the potential to revolutionize the education for novice anesthesia providers, leading to improved outcomes and clinical competency.

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Appendix A

Evidence Review Worksheet

Citation	Conceptual Framework	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Outcome Measurement	Data Analysis	Findings	Level of Evidence	Quality of Evidence: Critical Worth to Practice
Article 1									
Cook et al., (2011) Technology-Enhanced Simulation for Health Professions Education	NR	**Design:** SR and MA **Purpose:** summarize the outcomes of technology-enhanced simulation training for health professions learners in comparison with no intervention	**Data source:** MEDLINE, EMBASE, CINAHL, ERIC, PsychINFO, Key journals and previous review bibliographies through May 2011 Total Studies: n=609 - RCT: n = 137 - Non-randomized control trials: n = 67 - Single group pre-test, post-test design: n =405 Inclusion Criteria - Studies in any language if they investigated use of technology-enhanced simulation Exclusion Criteria - Studies that evaluated computer based virtual patients requiring only standard computer equipment - Studies that involved standardized, human patients	IV1: Technology-Enhanced Simulation Education DV1: Knowledge and Time skills DV2: Process and Product skills DV3: Time and process behaviors	**Outcomes:** Product skills: learners' performance, procedural success or quality of finished product Behavior: while caring for patients Effects on patient care	Mean and standard deviation or odds ratio was converted to a standardized mean difference – the Hedges g effect size. - If information unavailable: effect size was estimated using P values **Statistical significance:** Defined by a 2-sided alpha = .05 **Confidence intervals:** Cohen effect size classifications	**Time Skills:** 95% CI, 1.03-1.25, P < .001 **Process Skills:** 95% CI, 1.03-1.16, P < .001 **Product Skills:** 95% CI, 0.98 -1.37, P < .001 **Behavior:** 95% CI, 0.47-1.10, P < .001 **Effect on Patient Care:** 95% CI, 0.34-0.66, P < .001)	1	**Conclusion:** Technology-enhanced simulation training is associated with improved clinician behavior and patient care when compared to no intervention. **Strengths:** Comprehensive review across diverse simulation models and educational contexts **Limitations:** Many studies reported multiple measures of the same outcome. **Feasibility:** Recommendations could be implemented as the majority of nurse anesthesia programs have simulation-education facilities. Cost of additional training and programing was not disclosed in the research article **Risk/Benefit:** Technology enhanced education has no associate risk to student or patients. The benefits outweigh the risk of additional educational cost.

Annotated Bibliography Statement

Written by physicians associated with Mayo Medical School in Rochester, Minnesota this article contains a comprehensive synthesis of literature to evaluate the use of simulation within healthcare education. Using a systematic search of recent literature, authors identified relevant studies that investigated the effects of technology-enhanced simulation on educational outcomes within healthcare training. 609 studies were eligible for inclusion, permitting the evaluation of 35,226 healthcare trainees and the effect of simulation training on mastery learning, performance, and patient care behaviors. Authors reviewed a wide range of simulation modalities, including virtual reality, computer-based simulation, and mannequin-based simulation. In comparison to the group of students who received no simulation-based education intervention, technology-enhanced simulation training in health profession education has significant effects on outcome knowledge, skills, and clinical behavior.

Thematic Analysis

Key themes or FSP related significance

1. Technology-enhanced simulation has a positive and significant effect on educational outcomes across various health professions
2. Simulation-based education is associated with improved knowledge acquisition, enhanced skills performance, and increased learner satisfaction
3. Specific factors that influence the effectiveness of simulation-based education include the fidelity of the simulation, repetitive exposure to clinical scenarios, and deliberate practice
4. The article concludes that technology-enhanced simulation is a valuable educational tool in healthcare training
5. Simulation-based education serves as a realistic and immersive learning environment that can improve knowledge, skills and, learner satisfaction
6. The use of mannequin-based simulation promotes real-to-life clinical scenarios that enhances knowledge recall and overall student performance.
7. Findings support the integration of simulation-based training into healthcare training curriculum to enhance educational outcomes and improve patient care.

Citation	Conceptual Framework	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Outcome Measurement	Data Analysis	Findings	Level of Evidence	Quality of Evidence: Critical Worth to Practice
Article 2									
Fung et al., (2015) Impact of crisis resource management simulation-based training for interprofessional and interdisciplinary teams: A systematic review	NR	**Design:** SR **Purpose:** Review the effectiveness of simulation-based CRM training for interprofessional and interdisciplinary teams compared to traditional didactic education **Method:** The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement	**Data Sources:** Medline, EMBASE, CINAHL, ERIC **Search Terms:** crisis resource management, crisis management, crew resource, teamwork, and simulation **Studies included in SR:** n = 22 - 10 RCT - 2 ITS - 1099 participants **Inclusion criteria** - RCT, quasi-RCTs and quasi-experimental designs - Studies that compared simulation-based education vs. any other method of education **Exclusion criteria** - Studies with only Kirkpatrick level 1 outcomes - Studies with outcomes that rely solely on self-assessed data Participant characteristics - All healthcare providers - All levels of training: undergraduate, post-graduate, and staff.	**IV1:** simulation-based CRM training **IV2:** simulation-based training without CRM training **IV3:** didactic only procedural teaching **DV1:** modification of attitudes and perception **DV2:** CRM skills acquired **DV3:** Behavior change in the workplace **DV4:** Improved knowledge/skills	EPOC tool used to appraise bias among studies **Primary outcomes:** improvement in scores for overall teamwork (validated TBR), Simulation training decreased weighted adverse outcomes score, improved team behaviors (validated TDRF)	NR	**Improvements in teamwork, communication, and non-punitive responses to error:** ($p < .01$) - Participants retained what they learned more and made changes to patient management **Improved efficacy, team behavior, and vigilance** ($p < .01$) **Repeated CRM simulation-based training showed improved workload management** ($p < p < .01$) - Participants completed resuscitations an average of 2.5 minutes faster than teams who did not receive additional teamwork training	1	**Conclusion:** Significant improvements in at least one learning outcome when using simulation-based CRM team training compared to alternate forms of training such as didactic teaching - Enhanced clinical knowledge and skills - Improved communication - Benefit to increased patient safety **Strengths:** Evaluation of a large sample pool demonstrates promise for the use of simulation-based CRM to enhance communication and crisis management ability. EPOC tool was used to appraise bias **Limitations:** Incomplete descriptions of methods in some publications, searches did not specifically include skill-related team training. **Feasibility:** Teaching CRM using simulation learning vs. didactic case-based CRM shows increased knowledge. Though, repeated simulation is needed to see how education is transferred to impact on patient outcomes.

Annotated Bibliography Statement

The authors of this article are affiliated with the Department of Anesthesiology and Department of innovation in Medical Education at the University of Ottawa, Canada. A systematic review of literature identified relevant studies that evaluated the impact of Crisis Resource Management (CRM) simulation-based training on teamwork, performance during crisis situations, and communication within healthcare teams. The outcomes evaluated included teamwork behaviors, effective communication skills, situational awareness, and provider clinical performance. Findings of the systematic review indicate that CRM simulation-based training has a positive impact on teamwork behaviors, communication skills, and situational awareness of interprofessional and interdisciplinary healthcare teams.

Thematic Analysis

Key themes or FSP related significance

1. CRM simulation-based training is associated with improvements in team coordination, leadership, decision-making skills, and effective communication styles.
2. CRM simulation-based training is an effective approach to improving interprofessional and interdisciplinary teamwork during crisis situations in healthcare.
3. Simulation-based training assists with the development and enhancement of collaborative competencies that are necessary to provide efficient patient care.
4. Findings support the integration of CRM training into healthcare education and professional development programs
5. CRM training is associated with enhanced teamwork, communication style, and clinical performance within high-stress environments.
6. The article provides valuable insight for educators, and healthcare providers that are interested in promoting effective crisis management skills among interprofessional healthcare teams.

Citation	Conceptual Framework	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Outcome Measurement	Data Analysis	Findings	Level of Evidence	Quality of Evidence: Critical Worth to Practice
Article 3									
Gao et al., (2021) Simulation of operating room crisis management – hypotension training for pre-clinical students	NR	**Design:** RCT **Method:** Anesthesia students examined basic theory, participated in fundamental procedural techniques, and case studies. Following, students the participated in ORCM training and were evaluated on improvement. - Pre-test: 15-minute written examination related to scenario topic - Students randomly divided into groups for simulation training - Post-test: 15-minute final test with identical to pre-test **Purpose:** Establish or identify the problems that occur when students implement crisis management during the beginning of clinical practice. **Location:** Dalian Medical University **Time frame:** 7th semester of a anesthesia program.	N = 31 student participants **Inclusion criteria:** - Minimal experience or exposure to clinical anesthesia - Qualified skill examination - Ability to solve case problems **Exclusion Criteria:** - Previous experience with similar simulated scenarios - Advanced clinical experience	**Clinical scenarios – Hypotension** Bradycardia – gallbladder reflex Low PVR (anaphylactic shock) Hypovolemia (massive blood loss) Decreased cardiac contractility (arrhythmia) **Pre/post-test** 15-minute timed exam on clinical scenarios **Simulation scores** Assessed based on standardized guidelines for clinical knowledge and non-technical skills	Evaluation was performed according to standards based on the Emergency Manual by the Stanford Anesthesia Cognitive Aid group - Crisis management points - Non-technical skills **Non-technical skills** 1 point: perfect completion ½ point: partial success 0 point: student lacked in the area - Task management - Teamwork - Communication - Sustained vigilance - Reaction time - Crisis identification - Decision making - Self-confidence **Crisis management Points** 2 points: 100% completed 1 point: 50% completed 0 point: 0% completed - Medication administration/correct choice of medication - Discontinuing the operation - Blood transfusion preparation - BLS - ACLS	All tests blindly graded **Scores and time analysis** - Nonparametric Wil-coxon matched-pairs signed-rank test **Before and after study analysis** - Paired t-test - $P < 0.005$ considered statistically significant **All results analyzed by** - GraphPad Prism 5 software	**Improved examination scores from pre-test to post-test after simulation** - Less time to complete post-test **Nontechnical skills scores** - P = 0.00002 - Students found the degree of difficulty to be significantly less post-simulation **Crisis management points** - P = 0.0016 **Test-time** - P = < 0.0014	2	Students with limited clinical experience are weak in clinical logic and diagnosing critical situations **Strengths:** The study provided evidence that implementing simulation learning experience is beneficial to student education **Simulation benefits:** increase confidence, decrease anxiety communication and leadership. **Limitations:** small sample size and only 4 different scenarios used for simulation to evaluate training outcomes. - Crisis management and nontechnical skills cannot be evaluated independently

Annotated Bibliography Statement

Authors affiliated with the Department of Anesthesiology at the Hospital of Dalian Medical University; studied the effectiveness of simulation-based training to prepare pre-clinical students for managing hypotensive related crises in the operating room. Training modalities included in the study involved immersive simulation that simulated real-to-life operating room critical situations. Effectiveness of training modalities were measured by the outcomes; student ability to recognize and respond to hypotensive emergencies, decision-making, teamwork, and communication. Findings indicate that simulation-based training modalities significantly enhance the knowledge and understanding of hypotensive emergencies, as well as pre-clinical students' ability to effectively manage hypotensive events.

Thematic Analysis

Key themes or FSP related significance

1. Inclusion of pre-clinical students notes the importance of early exposure to realistic simulation scenarios to assist in the development of critical thinking and decision-making skills.
2. Findings suggest that simulation-based training contributes to the development of essential competencies needed for successful performance within high-stress situations.
3. Pre-clinical students demonstrated improved teamwork, communication, and decision-making skills prior to entering the clinical environment.
4. Simulation-based training is an effective method for preparing pre-clinical students to manage hypotensive crises in the operating room.
5. The use of early exposure to realistic crisis scenarios using simulation permits students to develop critical thinking skills, and improved decision-making skills in a low-stress environment.

Citation	Conceptual Framework	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Outcome Measurement	Data Analysis	Findings	Level of Evidence	Quality of Evidence: Critical Worth to Practice
Article 4									
Gros et al., 2021 In situ interprofessional operating room simulations: Empowering learners in crisis resource management principles **Funding:** Internal funding – Risk authority Stanford Health Care	Messick's Framework	**Design:** Quasi-experimental, pre-test, post-test, pilot study **Time:** Data collected over a 2-year time period. Simulations conducted monthly Crisis scenarios were designed to be no more than 20 minutes in length and concluded after crisis resolution - Hemorrhage - Airway emergency - Cardiac arrest **Debrief:** completed by an interdisciplinary team, trained in CRM. Key CRM themes were highlighted during discussion	**Inclusion:** Physicians, residents, and OR staff N=134 **Recruitment:** based daily staff schedules and clinical practice relevance **Setting:** Data was collected at a single academic medical center - Cath-Angio lab - Endoscopy - Ambulatory surgery sent - Main operating room	**DV:** self-reported confidence, utilization of resources, role clarity, effective situational awareness	**Survey internal structure** – Cronbach's alpha	Comparisons of individual confidence levels, pre- and post-simulation surveys were performed using the Wilcoxon signed-rank test **Statistical Analysis:** RStudio version 1.2.1335 software,	**Scale Data:** Greater self-reported confidence from presimulation to postsimulation for each of the confidence constructs - **Effective communication:** P = .0014, R=0.18 - **Role Clarity:** P < .0010, R = 0.22 - **Situational awareness:** P < .0010, R = 0.27	3	**Strengths:** Describes how simulated crisis management education is an effective way to increase the confidence and communication skills among interdisciplinary members of operating room teams during crisis. - Evaluate system competence and interdisciplinary dynamics - Identify latent conditions that predispose medical error **Feasibility:** Although measured outcomes show benefit to interprofessional simulation, the ability to schedule educational simulation training between two anesthesia learning domains would pose as a potential issue to the success of this modality. **Risk/Benefit:** There is no risk to patient safety. Benefit is significant.

Annotated Bibliography Statement

This article explores the use of interprofessional operating room simulations to empower learners of interdisciplinary teams to use crisis resource management (CRM) principles. With specific focus on the impact of simulation-based learning on knowledge, skills, and confidence in managing critical events within the operating room environment, researchers conducted simulation-based events within an actual operating room. Simulations aimed to replicate realistic crisis scenarios and facilitate team-based learning and communication. Following the evaluation of pre- and post- simulation evaluations, researchers found the use of CRM in conjunction with realistic simulation-education significantly enhanced interdisciplinary learning.

Thematic Analysis

Key themes or FSP related significance

1. Participant performance was assessed through pre-and post-simulation evaluations
2. Simulations improved participants' knowledge, skills, and confidence in crisis management, including the ability to recognize and respond to critical events, communicate effectively, and demonstrate leadership and teamwork.
3. The study emphasizes the importance of integrating simulation-based training as it helps to prepare learners for real-world challenges within the operating room environment.
4. Repetitive exposure to simulation-based education improves knowledge, clinical skill and overall confidence of healthcare providers.

Citation	Conceptual Framework	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Outcome Measurement	Data Analysis	Findings	Level of Evidence	Quality of Evidence: Critical Worth to Practice
Article 5									
Khalafi et al., (2022) Simulation-based interprofessional education for enhanced attitude and teamwork of anesthesiology residents and nurse anesthesia students in Iran	NR	**Design:** Quasi-experimental study **Purpose:** examine the effects of simulation-based educational approach on anesthesia students' attitude and teamwork	**Participants:** n = 72 (nurse anesthesia students) - Intervention group: n = 36 - Control group: n = 36 **Inclusion criteria** - Senior status - Willingness to participate in research - Active participation throughout the sessions of simulation **Exclusion criteria** - Previous participation in simulation-based education programs - Participation in a parallel workshop - Inadequate questionnaire completion	**IV1:** Simulation-based IPE experiences **DV:** anesthesia students' attitude and teamwork during emergency events	**Primary outcomes:** Changes in attitudes toward interprofessional learning **Secondary outcome:** Change in teamwork	**Normality of Data:** Kolmogorov-Smirnov Test **Analyze qualitative data**: Chi-square test and Fisher's exact test **Quantitative data:** ANCOVA Paired T-test **All statistical analyses:** SPPS software version 22	**Changes in attitudes toward interprofessional learning** - Significant difference between pre-test and post-test scores in the intervention group (P=0.011) **Change in teamwork** - In the intervention group the subscale (roles and responsibilities, communication, and patient centered care) had significant changes (P < 0.05)	3	**Conclusion:** It is imperative to create opportunities to change misconceptions in the OR - Improved attitudes toward teamwork and collaboration may help reduce individualism in the OR - Practiced responses to emergency situations significantly reduced patient's adverse outcomes - Interprofessional collaboration is important in modern medical care – although most training models focus on routine education and not interprofessional education. **Strengths:** Allowed anesthesiology residents and nurse anesthesia students to interact through joint simulation practice to learn communication skills in a safe environment **Limitations:** Due to difficulty scheduling multiple simulation settings, the study could only hold one session which prohibited additional accumulation of data. **Feasibility:** Simulation-based session requires 5 steps (pre-briefing, pre-scenario activities, task training, simulation, debriefing). Potential issues for full implementation.

Annotated Bibliography Statement

The purpose of this research article aims to examine the impact of simulation-based interprofessional education on the attitudes and teamwork skills of anesthesiology residents and nurse anesthesia students. Using a pre-test, post-test design involving a total of 60 participants, authors found simulation-based learning has a positive influence on the attitudes and teamwork skills of both anesthesiology and nurse anesthesia students. The intervention had a notable influence on the student perception of interprofessional collaboration and teamwork within the anesthesia setting. Authors concluded that simulation-based interprofessional education effectively enhances the attitudes and teamwork skills among anesthesiology students.

Thematic Analysis

Key themes or FSP related significance

1. Pre-test, post-test design is a valuable tool for measuring the effectiveness of simulation-based education within anesthesia.
2. The intervention positively influenced the perceptions of interprofessional collaboration and teamwork within the anesthesia setting.
3. Authors suggest incorporating simulation-based education into the training curriculum.
4. Findings suggest that enhanced attitudes and teamwork skills of anesthesiology students may ultimately lead to improved patient care outcomes within anesthesia practice.

Citation	Conceptual Framework	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Outcome Measurement	Data Analysis	Findings	Level of Evidence	Quality of Evidence: Critical Worth to Practice
Article 6									
Labrague et al., (2019) High-fidelity simulation and nursing students' anxiety and self-confidence: A systematic review	NR	**Design:** SR **Method:** Review of articles from 2007-2017 on using HFS on students' self-confidence and anxiety. **Purpose:** Appraise articles that examined the influence of using HFS on the effects of nursing students' anxiety and self-confidence during nursing education.	6 electronic databases used: Proquest, SCOPUS, MEDLINE, PubMed Central, CINAHL, and PsychINFO **Articles:** n = 35 - RCT: n = 7 - Non- RCT: n = 8 - Pre-test, Post-test design: n = 11 **Inclusion criteria:** - Articles considered for review if the primary objective of research evaluated the effects of using HFS on nursing students' levels of anxiety and self-confidence - Peer-reviewed - Published in English - Published between 2007-2017 **Exclusion Criteria:** - Articles that used simulation modalities other than HFS - Students in programs other than 4-year degree programs.	**Types of simulation modality:** Students exposed to clinical case scenarios using HFS - **Control group:** students exposed to LFS, MFS, or traditional lecture education **Impact of HFS on nursing students' confidence** **Impact of HFS on nursing students' anxiety**	**Impact of HFS on nursing student's confidence** - n = 29 - most studies were in RCT format - Students provided simulation-based activities demonstrated higher confidence levels in comparison to traditional methods. - Significantly higher levels of self-confidence and readiness in handling cardiac events. **Impact of HFS on nursing student's anxiety** - n = 7 - High reduction in anxiety levels for students who practiced with HFS vs. control group - Measured anxiety levels over 7-week experience with HFS in both cohorts notes anxiety scores were reduced significantly.	N/A	**Conclusion:** HFS is effective in improving nursing self-confidence and the reduction of anxiety when providing patient care and employing nursing skills.	1	**Strengths:** Provides updated evidence on the efficacy of HFS in enhancing student confidence and reducing anxiety. - Notes that alternate teaching methods are critical for the advancement of the nursing profession - Simulation-based activities may help connect nursing theory and actual nursing practice **Limitations:** All studies included in the review were published in English, potentially excluding relevant studies of other languages. Additionally, review only included articles from 2007-2017, articles published before 2007 might have been missed **Feasibility:** Recommendations need educator support for implementation. Adequate supplies and equipment need to create a realistic clinical environment **Risk/Benefit:** Cost of HFS is higher than other teaching modalities, though evidence supports the use of HFS as beneficial, justifying additional cost of education.

Annotated Bibliography Statement

Utilizing a systematic review, authors examined the impact of high-fidelity simulation on anxiety and self-confidence levels of nursing students. Following a comprehensive literature search, relevant studies that investigated the influence of high-fidelity simulation were included in the review. Studies from various clinical settings were included to encompass a range of simulation scenarios and outcome measures. The findings of the systematic review indicate that high-fidelity simulation has a positive impact on reducing anxiety levels among nursing students. The realistic nature of simulation experience familiarized students with clinical scenarios, decreasing the negative impact of anxiety when these situations were encountered within real clinical situations.

Thematic Analysis

Key themes or FSP related significance

1. High-fidelity simulation has a positive impact on reducing anxiety levels among nursing students
2. Simulation-based learning enhances nursing students' self-confidence, by providing opportunities to practice and refine clinical skills in a safe and controlled environment
3. The article emphasizes the need for well-designed simulation experiences that align with student-specific learning needs and clinical competencies.
4. Decreased anxiety levels and enhanced student self-confidence contributes to improved learning ability and overall clinical preparedness.

Citation	Conceptual Framework	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Outcome Measurement	Data Analysis	Findings	Level of Evidence	Quality of Evidence: Critical Worth to Practice
Article 7									
Lucisano & Talbot, (2012) Simulation Training for Advanced Airway Management for Anesthesia and Other Healthcare Providers: A Systematic Review	NR	**Design:** SR - Conducted of articles published between 1990 and 2009 **Method:** 34 articles were analyzed, 15 included in the review. Articles were examined to answer the following questions 1. The effects of different types of simulation and techniques on learning 2. A comparison of the effects of simulation training over time 3. The effects of nonhuman interfaced simulation	4 electronic databases used: Cumulative Index to Nursing & Allied Health Literature, MEDLINE, PsycINFO, and Web of Science **Articles:** n = 34 - Experimental or Quasi Experimental: n = 15 - Descriptive studies: n = 8 - Analyses of equipment or technique evaluations using simulation: n = 11 **Inclusion criteria:** experimental or quasi-experimental design, inclusion of a simulated advanced airway management training process for anesthesia or other healthcare providers, clearly stated objectives with measured outcomes. **Exclusion Criteria:** Articles not written in English.	Time to completion of a specific task and number of attempts Subjective and/or self-perceived value of the simulated experience Measurement of efficient and nonefficient time Performance based on generally accepted guidelines using several different reporting modalities	**Outcome Measures** 1. Single and multiple measures of performance compared with a predetermined checklist	NR	**Conclusion:** Simulation offers anesthesia students and providers a standardized, structured experience that demonstrates the proper management of uncommon high-risk events with no danger of injury to a patient.	5	**Limitations:** Some relevant studies might have been missed. Standardized outcome criteria to measure the effects of training are notably dissimilar across multiple studies **Implications:** If the support of simulation as an adjunct to didactic training is successful, educators should develop a standardized curriculum and outcome criteria that are preprogrammed and learner-centered **Feasibility:** Measured outcomes show benefit to student performance. However, the study focused on airway emergencies. The ability to incorporate CA is not impossible, but a consideration

Article 7

Lucisano, K., & Talbot, L. (2012). Simulation training for advanced airway management for anesthesia and other healthcare providers: A systematic review. *AANA Journal*, 80(1), 25-31.

Annotated Bibliography Statement

The authors of this article are affiliated with the College of Health and Human services, University of North Carolina with a specific interest in improving student education. Using a systematic review of literature, authors evaluated the use of simulation training for advanced airway management among anesthesia and other healthcare providers. Articles selected for inclusion within the study investigated the effectiveness of simulation-based training in improving knowledge, skills, and confidence in airway management. Findings indicate that simulation-based training is effective in enhancing knowledge, skills, and confidence of healthcare workers.

Thematic Analysis

Key themes or FSP related significance

1. Simulation training provides a safe and controlled learning environment, facilitates repeated practice, and promotes that application of critical thinking skills
2. Simulation-based education offers anesthesia students and providers a standardized, structured experience that demonstrates the proper management of uncommon high-risk events with no danger or injury to a patient.
3. Measured outcomes show benefit to student performance when simulation curriculum is standardized, preprogramed, an learner-centered.

Citation	Conceptual Framework	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Outcome Measurement	Data Analysis	Findings	Level of Evidence	Quality of Evidence: Critical Worth to Practice
Article 8									
Warren et al., (2016) A systematic review on the effectiveness of simulation-based education on satisfaction and learning outcomes in nurse practitioner programs	NR	**Design:** SR **Method:** Joanna Briggs Institute systemic review methodology **Purpose:** To synthesize the best available evidence about the effectiveness of HFS within NP education. - What effect will HFS have on learner satisfaction, attitude, knowledge, and skill performance	4 electronic databases used: Cumulative Index to Nursing & Allied Health Literature, MEDLINE, PsycINFO, and Web of Science **Articles:** n = 34 - Experimental or Quasi Experimental: n = 15 - Descriptive studies: n = 8 - Analyses of equipment or technique evaluations using simulation: n = 11 **Inclusion criteria:** experimental or quasi-experimental design, inclusion of a simulated advanced airway management training process for anesthesia or other healthcare providers, clearly stated objectives with measured outcomes. **Exclusion Criteria:** Articles not written in English.	Time to completion of a specific task and number of attempts Subjective and/or self-perceived value of the simulated experience Measurement of efficient and nonefficient time Performance based on generally accepted guidelines using several different reporting modalities	**Outcome Measures** - Knowledge - Attitudes - Skills - Satisfaction	N/A	**Conclusion:** Simulation offers anesthesia students and providers a standardized, structured experience that demonstrates the proper management of uncommon high-risk events with no danger of injury to a patient.	5	**Limitations:** Some relevant studies might have been missed. Standardized outcome criteria to measure the effects of training are notably dissimilar across multiple studies **Implications:** If the support of simulation as an adjunct to didactic training is successful, educators should develop a standardized curriculum and outcome criteria that are preprogrammed and learner-centered **Feasibility:** HFS is associated with improved outcomes in comparison to traditional teaching methods although the cost of both interventions are rarely reported which presents a challenge to make a true comparison of the value of simulation training **Risk/Benefit**: The Benefit outweighs the risk.

Annotated Bibliography Statement

Using a systematic review method, the purpose of this article is to synthesize the best available evidence of the effectiveness of high-fidelity simulation within nurse practitioner education. Authors specifically evaluated the effect of simulation on learner satisfaction, attitude, knowledge, and skill performance. 34 experimental or quasi experimental studies were included within the review, each concluding that simulation-based learning is a successful adjunct for traditional didactic education within nurse practitioner preparation courses.

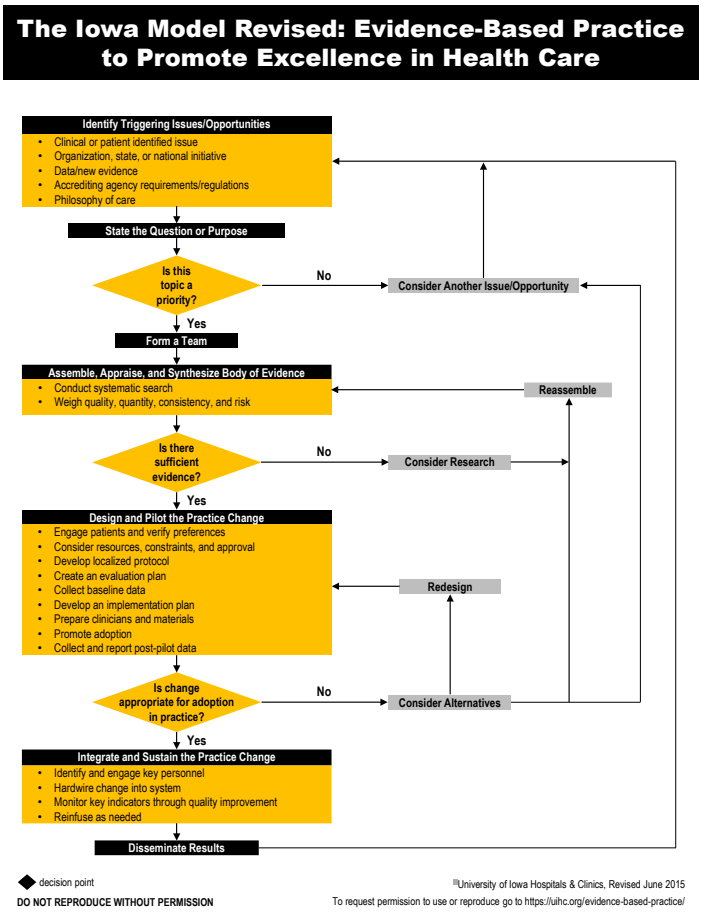
Thematic Analysis

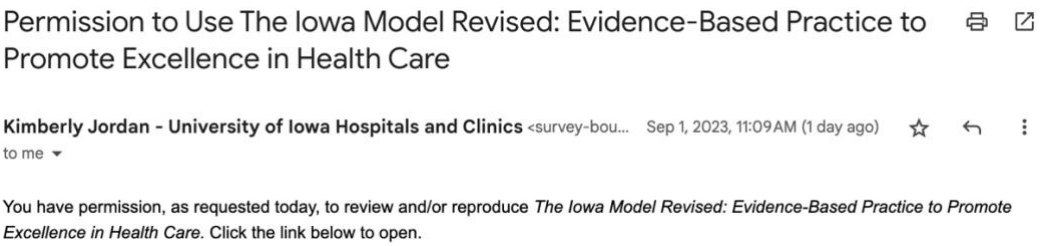
Key themes or FSP related significance

1. Simulation training provides a safe and controlled learning environment, facilitates repeated practice, and promotes that application of critical thinking skills
2. Simulation-based education allows for active participation, critical thinking, and the application of theoretical knowledge into practice.
3. The design and structure of simulation scenarios must align with nurse practitioner students' educational needs for success
4. Improved student attitudes towards constructive criticism during simulated learning translated into improved confidence in clinical abilities and increased desire to have repetitive simulation education exposure.

Appendix B

Figure 1A: The Iowa Model





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Kimberly Jordan - University of Iowa Hospitals and Clinics <survey-bou... Sep 1, 2023, 11:09 AM (1 day ago)

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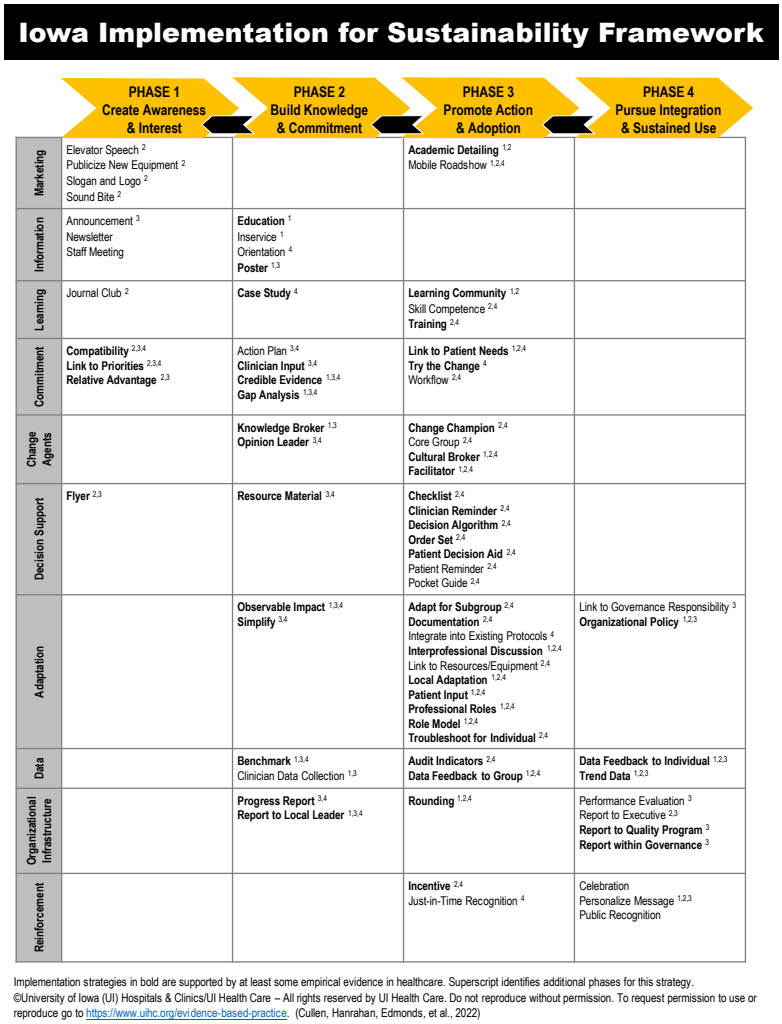
Appendix B

Figure 1B: Iowa Implementation for Sustainability Framework



Iowa Implementation for Sustainability Framework

	PHASE 1 Create Awareness & Interest	PHASE 2 Build Knowledge & Commitment	PHASE 3 Promote Action & Adoption	PHASE 4 Pursue Integration & Sustained Use
Marketing	Elevator Speech [2] Publicize New Equipment [2] Slogan and Logo [2] Sound Bite [2]		**Academic Detailing** [1,2] Mobile Roadshow [1,2,4]	
Information	Announcement [3] Newsletter Staff Meeting	**Education** [1] Inservice [1] Orientation [4] **Poster** [1,3]		
Learning	Journal Club [2]	**Case Study** [4]	**Learning Community** [1,2] Skill Competence [2,4] **Training** [2,4]	
Commitment	**Compatibility** [2,3,4] **Link to Priorities** [2,3,4] **Relative Advantage** [2,3]	Action Plan [3,4] **Clinician Input** [3,4] **Credible Evidence** [1,3,4] **Gap Analysis** [1,3,4]	**Link to Patient Needs** [1,2,4] **Try the Change** [4] Workflow [2,4]	
Change Agents		**Knowledge Broker** [1,3] **Opinion Leader** [3,4]	**Change Champion** [2,4] Core Group [2,4] **Cultural Broker** [1,2,4] **Facilitator** [1,2,4]	
Decision Support	**Flyer** [2,3]	**Resource Material** [3,4]	**Checklist** [2,4] **Clinician Reminder** [2,4] **Decision Algorithm** [2,4] **Order Set** [2,4] **Patient Decision Aid** [2,4] Patient Reminder [2,4] Pocket Guide [2,4]	
Adaptation		**Observable Impact** [1,3,4] **Simplify** [3,4]	**Adapt for Subgroup** [2,4] **Documentation** [2,4] Integrate into Existing Protocols [4] **Interprofessional Discussion** [1,2,4] Link to Resources/Equipment [2,4] **Local Adaptation** [1,2,4] **Patient Input** [1,2,4] **Professional Roles** [1,2,4] **Role Model** [1,2,4] **Troubleshoot for Individual** [2,4]	Link to Governance Responsibility [3] **Organizational Policy** [1,2,3]
Data		**Benchmark** [1,3,4] Clinician Data Collection [1,3]	**Audit Indicators** [2,4] **Data Feedback to Group** [1,2,4]	**Data Feedback to Individual** [1,2,3] **Trend Data** [1,2,3]
Organizational Infrastructure		**Progress Report** [3,4] **Report to Local Leader** [1,3,4]	**Rounding** [1,2,4]	Performance Evaluation [3] Report to Executive [2,3] **Report to Quality Program** [3] **Report within Governance** [3]
Reinforcement			**Incentive** [2,4] Just-in-Time Recognition [4]	Celebration Personalize Message [1,2,3] Public Recognition

Implementation strategies in bold are supported by at least some empirical evidence in healthcare. Superscript identifies additional phases for this strategy.
 (Cullen, Hanrahan, Edmonds, et al., 2022)

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Appendix C

Simulation Education Guideline

Otterbein University
Department of Nursing Graduate Nurse Anesthesia Program
Draft Teaching Plan Guideline

Title of Educational Activity: Nurse Anesthesia Crisis Resource Management Training Principles During High-Fidelity Simulation Targeting Intraoperative Cardiac Arrest

Goal: To increase student confidence and clinical competency of CRM principles as applied to intraoperative cardiac arrest simulation using team-based practice.

Learning Objectives

1. *Participants will apply CRM principles introduced during classroom education in practice simulation to enhance teamwork and communication.*
2. *Following the completion of the pre-simulation survey and classroom education, participants will be able to identify, diagnose, and manage a patient experiencing deterioration and/or intraoperative cardiac arrest.*
3. *Following the completion of repeated exposure to practice simulation scenarios, participants will partake in debriefing sessions to evaluate simulation self and team performance as it relates to CRM principles.*

Objectives	Content	Method of Instruction	Media	Time	Evaluation
Participants will demonstrate an understanding of the key points of anesthesia CRM management for intraoperative emergencies including: • Cognitive components of dynamic decision making • Team management components	1. Overview of CRM principles. 2. Non-technical skills in emergency management. 3. Provider roles in the OR environment. 4. Identification, diagnosis, and treatment of intraoperative cardiac arrest. 5. Review of ACLS	Classroom education	Anesthesia Key: Principles of Anesthesia Crisis Resource Management. • Printed Material • PowerPoint Presentation	4 Hours	Continuous throughout simulation activity cycle
Participants will apply didactic education principles to simulated intraoperative cardiac arrest scenarios.	1. Rules of Safe simulation 2. Simulation activity expectations 3. Explanation of the ANTS observation audit tool. 4. Case-scenarios with increasing complexity per simulation round 5. Each student will participate in each role of the emergency response team	Classroom pre-briefing	Rules and Expectations: PowerPoint Presentation. ANTS observation tool: Printed copy distributed to participants. Case-scenarios: Students are provided with a printed situation overview including the patient's pre-operative evaluation, past medical history, and surgical plan.	4 Hours	ANTS Observation Audit Tool Verbal feedback from clinical simulation leaders. Student self-evaluation.
Participants will participate in post-simulation debriefing to identify CRM principles and practice peer-to-peer feedback methods.	1. Review clinical events and discuss indicators of patient deterioration. 2. Discuss team performance and communication during simulation event. 3. Establish areas of team performance that were done well. 4. Establish areas of team performance that could be improved.	Classroom post-simulation	Face-to-Face discussion with team members and simulation faculty.	30 Minutes	Continuous by faculty members
Following the completion of the simulation exercises and debriefing session, students will participate in a reflection period.	1. Completion of post-simulation intervention survey 2. Meet with faculty and receive feedback from the ANTS observation audit findings.	Classroom post-simulation	Post-simulation intervention survey: Printed word document. Faculty meeting: Face-to-face ANTS observation audit: Printed word document	1 Hour	ANTS Observation Audit Tool Verbal feedback from clinical simulation leaders. Student self-evaluation.

Appendix D

Pre-Simulation Survey

The purpose of this questionnaire is to evaluate your current level of understanding related to **Crisis Resource Management** principles, and comfort in providing **intraoperative cardiac arrest management**. To ensure participant privacy, do not write any information on this form that may be used to identify you.

1. **What is your age range?**
   - **a.** < 25
   - **b.** 25-29
   - **c.** 20-39
   - **d.** 40-49
   - **e.** 50+
2. **How many years of OR experience do you have, including anesthesia school experience?**
   - **a.** < 1
   - **b.** 1-2
   - **c.** 3-4
   - **d.** >5
3. **Do you have any experience in managing intraoperative cardiac arrest?**
   - **a.** Yes
   - **b.** No
4. **Rate your confidence level in being able to properly detect intraoperative emergent deteriorating patient conditions.**

1----------2----------3----------4----------5

Not Confident | Somewhat Confident | Confident

5. **Rate your confidence level in being able to properly manage intraoperative cardiac arrest.**

   1----------2----------3----------4----------5

   Not Confident — Somewhat Confident — Confident

6. **Do you think that simulation-based education is beneficial for students to experience uncommon emergent events outside of the clinical environment?**

   a. Yes

   b. No

7. **Have you participated in simulation-based education exercises for other areas of practice?**

   a. Yes

   b. No

8. **Which of the following is <u>NOT</u> an example of a Crisis Resource Management Skill?**

   a. Team Leadership

   b. Decision Making

   c. Task-Related Assertiveness

   d. Mentorship

   e. Mutual Performance Monitoring

9. **Clinical Scenario: Steve is an 89-year-old-male with a past medical history positive for severe AS with an EF of 35%, CVA without deficits, HTN, and DM2 is undergoing a hip arthroscopy for a left hip fracture. Soon after medullary nail**

placement, you notice profound hypotension 45/20 and loss of ETCO2 waveform. What is the most likely cause for the loss of ETCO2.

a. Pulmonary Embolism

b. Acute Hemorrhage

c. Cement Implementation Syndrome

d. Acute Left Ventricular Dysfunction

Appendix E

Post-Simulation Survey

The purpose of this questionnaire is to evaluate your current level of understanding related to **Crisis Resource Management** principles, and comfort in providing **intraoperative cardiac arrest management**. To ensure participant privacy, do not write any information on this form that may be used to identify you.

1. **Rate your confidence level in being able to properly detect intraoperative emergent deteriorating patient conditions.**

   1----------2----------3----------4----------5

   Not Confident — Somewhat Confident — Confident

2. **Rate your confidence level in being able to properly manage intraoperative cardiac arrest.**

   1----------2----------3----------4----------5

   Not Confident — Somewhat Confident — Confident

3. **Do you think that simulation-based education is beneficial for students to experience uncommon emergent events outside of the clinical environment?**

   c. Yes

   d. No

4. **What was the most valuable CRM tool you plan to incorporate into your evolving practice as an anesthesia provider?**

5. **What aspect of the simulation activities did you find most challenging?**

6. **What would you change about the simulation training you participated in today?**

7. **Any other comments**

Appendix F

ANTS Observational Assessment Audit

Task Management	1 Poor	2 Marginal	3 Acceptable	4 Good	5 Not observed	Comments
Planning and Preparing						
Prioritizing						
Providing and Maintaining Standards						
Identifying and Utilizing Resources						

Team Working	1 Poor	2 Marginal	3 Acceptable	4 Good	5 Not observed	Comments
Coordinating Activities with Team Members						
Exchanging Information						
Using Authority and Assertiveness						
Assessing Capabilities and Supporting Others						

	1	2	3	4	5	
Situational Awareness	Poor	Marginal	Acceptable	Good	Not observed	Comments
Gathering Information						
Recognizing and Understanding						
Anticipating						

	1	2	3	4	5	
Decision Making	Poor	Marginal	Acceptable	Good	Not observed	Comments
Identifying Options						
Balancing Risks and Selecting Options						
Re-evaluating Providing and Maintaining Standards						
Identifying and Utilizing Resources						

Appendix G

Implementation Timeline

Table 1.

Project Tasks	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
• Synthesize best evidence. • Project Objectives												
• Education team Training • Simulation Scenario Development • Equipment Retrieval												
• Continued Simulation Education • Education Material Ready for Distribution												
• Integration of SBE into Nurse Anesthesia Training.												
• Re-evaluation and Adjustment of FSP Recommendations.												

Appendix H

Budget Breakdown

Implementation
May 2023 - May 2024

Simulation Education Budget

CATEGORY	Item	Cost	Total for 66 Students
Paper and Printing Services	Pre SBE Survey	0.20	13.20
Paper and Printing Services	Post SBE Survey	0.20	13.20
Paper and Printing Services	Observation Audit	0.20	13.20
Printing Total for 6 Months			237.60
Organization Supplies	3 Ring Binder	3.99	263.64
Total expenses			**500.94**

Note: Cost estimation found from Staples (2023)