Virtual Simulation to Improve Self-Confidence in Clinical Decision-Making

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Abstract

Introduction: The didactic year in Marian University's Nurse Anesthesia program equips students with a comprehensive understanding of anesthesia's core concepts, including pathophysiology, pharmacology, and physics. The first year imparts essential knowledge and hones clinical skills through simulation-based training, covering fundamental procedures such as intubation, anesthesia machine checks, and bag-mask ventilation. The proficiency gained during this phase lays a robust foundation for the transition to clinical practice. However, the second-year challenges student nurse anesthetists face in the operating room, requiring autonomous decision-making and a swift shift from bedside nursing to anesthesia practice, highlight the need for continued enhancement of their preparedness.

Background: In anesthesia training, screen-based simulation stands out for its suitability in addressing knowledge-based learning objectives. While high-fidelity scenarios are generally preferred, the literature supports the idea that all levels of fidelity contribute to student learning when applied appropriately.

Purpose: This project aims to deliberately integrate screen-based simulation into the didactic year of the nurse anesthesia program and assess its impact on perceived self-confidence among first-year students.

Methods: This project used a quality improvement design. The modified Student Satisfaction and Self-Confidence in Learning tool was used as a pre and post-test survey to assess the implementation of screen-based simulation. Thirty first-year SRNAs participated in the survey during the spring semester of 2023.

Project Evaluation: The National League for Nursing Student Satisfaction and Self-Confidence in Learning tool was modified and used as both a pre-test and post-test. Utilizing Likert scale questions, the tool encompasses thirteen items, with five gauging student satisfaction and eight assessing confidence in learning. Participants completed identical surveys before and after the virtual simulation activity, and each question was analyzed independently. Student satisfaction and self-confidence scores were averaged to discern an overall trend.

Conclusion: This project successfully integrated screen-based simulation into the didactic year of the nurse anesthesia program, demonstrating its potential to enhance student learning and confidence. The positive outcomes, as evidenced by high agreement in both pre-test and post-test surveys, contribute to the evolving discourse on innovative approaches in anesthesia education. Despite limitations such as small sample size and time constraints, the project underscores the efficacy of screen-based simulation as a supplementary educational strategy. Future research endeavors with larger and more diverse samples can provide deeper insights into the effectiveness of screen-based simulation.

Introduction

Marian University's Nurse Anesthesia program is "front-loaded," meaning that the first year is entirely didactic education and simulation-based training. The didactic year introduces a breadth of knowledge and many clinical skills. Much of the curriculum is focused on core concepts of anesthesia: pathophysiology, pharmacology, and physics. Simulation-based training is also utilized to teach first-year students basic skills such as intubation, anesthesia machine check, and bag-mask ventilation. The knowledge and skill attained in the didactic year lay the foundation for clinical practice.

Still, student nurse anesthetists face many challenges as they enter the operating room in the program's second year. There is pressure to perform well in clinical, demonstrate proficiency in basic anesthesia skills, make plan of care decisions autonomously, and quickly transition from bedside nurse to anesthesia provider. Many individual factors complicate role strain and competence in the clinical realm, but basic knowledge of anesthetic variety need not be one of them. Anesthetic considerations, patient comorbidities, and case variety can be integrated into simulated scenarios. This project aims to utilize screen-based simulation more intentionally within the didactic year of the nurse anesthesia program and to measure how it affects perceived self-confidence.

Background

Simulation-based training has been utilized in educational programs for decades to expose students to clinical scenarios without risks to patient safety. Much literature boasts of the benefits of simulation training in various professions, from aviation to medicine. In anesthesia training, simulation is a tool that can help students gain knowledge of case variety, anesthetic

implications, and improve confidence in handling real patient scenarios in the operating room. The accrediting body for nurse anesthesia programs has also supported simulation-based training in anesthesia education (Council on Accreditation, 2020).

Several modalities of simulation-based training have proven to be effective in preparing students to enter the clinical realm (Fragapane et al., 2018). Modality in simulation refers to the methodology used. Standardized patients, smart mannequins, task trainers, and screen-based simulation are all separate modalities. Fidelity in simulation education refers to the extent of realism achieved (Kim et al., 2016). The equipment, scenario, and environment are all factors in achieving a realistic learning experience. For example, high-fidelity simulation (HFS) often involves a computerized mannequin that can demonstrate physiological responses to interventions (Kim et al., 2016). The setting may be a hospital or operating room complete with standard equipment and supplies, while an instructor typically controls the mannequin and bedside monitor from a neighboring room. The scenario's psychological, physical, and environmental aspects achieve a relatively high degree of realism.

In contrast, low-fidelity simulations (LFS) may lack the components that create a realistic scenario. For example, task simulators such as an airway trainer for intubation would be considered low-fidelity. Likewise, screen-based simulation is considered low-fidelity but may be more beneficial for knowledge-based learning objectives (Fragapane et al., 2018). While students and instructors reportedly prefer high-fidelity scenarios, the literature supports that all levels of fidelity benefit the student when applied appropriately (Fragapane et al., 2018). Screen-based simulation provides an excellent adjunct to HFS and comes with benefits such as ease of accessibility, low cost, and the ability to repeat case scenarios. While HFS may offer an

enhanced level of clinical realism, screen-based simulation (SBS) may be beneficial to increase knowledge and student confidence.

SBS are interactive, can simulate tasks, and still produce physiologic responses via scripts or mathematical models within the software (Swerdlow et al., 2020). The computerized mannequin may be superior for students to develop and practice psychomotor skills. However, SBS fosters cognitive skill development (Swerdlow et al., 2020). An application called Simpl was created with this in mind. The Simpl app is an adjustable patient monitor that is used for virtual simulation. This particular SBS program is inexpensive and can be used repeatedly by learners and educators. By utilizing a software program within the best-practice standards set by INACSL, first-year SRNAs have an opportunity to improve their cognitive skills, knowledge of case variety, and anesthetic considerations.

Problem Statement

Marian University's nurse anesthesia program provides access to HFS using a computerized mannequin in the setting of a simulation lab. The sim lab provides many high-fidelity learning opportunities but lacks other forms of simulation modality. Because of the range of clinical skills needed in anesthesia practice, all simulation modalities should be utilized as much as possible before entering the clinical environment. LFS is underutilized in the didactic year and is arguably more accessible and cost-effective than the existing simulation within the curriculum (Wiggins et al., 2018; Yunoki & Sakai, 2018). This project aims to employ SBS training in the nurse anesthesia program's didactic year and improve the knowledge and self-confidence of student nurse anesthetists.

Gap Analysis

Currently, SBS is not utilized in Marian University's curriculum. An organizational framework should be used to improve SBS experiences for first-year SRNAs. The Jeffries Simulation Theory provides a straightforward framework for modeling simulation training (Jeffries, 2005). The International Nursing Association for Clinical Simulation and Learning (INACSL) also provides an evidence-based framework on which to model simulation design and facilitation (INACSL, 2016). The opportunities for SBS could be enhanced by providing software such as Simpl. Students may have access to screen-based simulations in and out of the classroom. If the appropriate framework is applied and the opportunities for LFS are multiplied, the learning experience for first-year students may be improved. This led to the following PICO question: For first-year SRNAs at Marian University, does the implementation of virtual case studies improve self-confidence and knowledge compared to the current simulation curriculum?

Literature Review

A literature review examined the evidence for virtual simulation in anesthesia education. This review was conducted from October 2022 to November 2022. The following electronic databases were searched: PubMed, CINAHL, MEDLINE, Google Scholar, and EBSCO. The search was conducted using the following phrases and keywords: *anesthesia training, anesthesia education, simulation-based education, simulation-based training, virtual simulation, computer simulation, screen-based simulation, low-fidelity simulation, and anesthesia simulator.* Only articles with full-text accessibility, peer-reviewed, and available in English were included. To fully grasp and understand how simulation-based training has evolved, the timeframe for these articles was not restricted to recent literature. Therefore, the dates of publishing range from 1994 to 2021.

Articles specific to virtual simulation in anesthesia education were very scarce. Due to the limited research on this topic, a broader selection of applicable papers was included. Very few randomized controlled trials have been published on SBS use in nurse anesthesia education; therefore, much of the literature included consists of other literature reviews and tangentially related simulation research. All articles were screened by title and abstract first. If the abstract discussed virtual simulation, fidelity in simulation, learner confidence, or a specific framework for simulation, the paper was tagged for full-text screening. Approximately 146 papers were considered, and 19 were utilized for this review. The major themes found in this literature are discussed below.

Effectiveness of Simulation

Decades of research have validated simulation as an effective tool in medical education. Simulation education allows the learner to hone clinical skills and knowledge without placing patients at risk, making it an integral part of modern educational programs (Hayden et al., 2014; Laschinger et al., 2008; Maran & Glavin, 2003; Massoth et al., 2019; Yunoki & Sakai, 2018). Several studies demonstrate that students participating in SBE have improved critical thinking, clinical competency, communication skills, and self-confidence (Al-Elq, 2010; Hayden et al., 2014; Okuda et al., 2009; Yunoki & Sakai, 2018). Five articles discuss the positive effect of simulation on student confidence and performance in the clinical setting compared to traditional education (Al-Elq, 2010; Chopra et al., 1994; Hayden et al., 2014; Nyssen et al., 2002; Wiggins et al., 2018). One longitudinal study found that for undergraduate nursing students, simulated experiences could replace actual clinical experiences with no adverse effects on clinical competency, critical thinking, or readiness for practice (Hayden et al., 2014). All articles discussing the benefits of SBE agree that the opportunity for students to practice skills repeatedly

improves knowledge and clinical performance (Al-Elq, 2010; Hayden et al., 2014; Laschinger et al., 2008; Massoth et al., 2019; Okuda et al., 2009; Yunoki & Sakai, 2018).

Simulation in anesthesia education has been proven effective in teaching airway management, regional anesthesia, ultrasound-guided techniques, intravascular line placement, developing crisis management skills, and non-technical skills (Chopra et al., 1994; Erlinger et al., 2019; Liaw et al., 2014; Nyssen et al., 2002; Swerdlow et al., 2020; Wiggins et al., 2018). In addition, mannequin-based simulation experience is quite effective in developing psychomotor skills (Chopra et al., 1994; Kim et al., 2016; Maran & Glavin, 2003). However, there is disagreement in some literature about whether SBE translates into clinical practice. Some studies agree that skills and confidence gained in a simulated setting transfer to actual clinical practice (Al-Elq, 2010; Hayden et al., 2014; Wiggins et al., 2018). However, other studies remain skeptical that SBE effectively translates to clinical preparedness or improves patient outcomes (Laschinger et al., 2008; Massoth et al., 2019).

Framework

Several studies discuss the importance of using a framework for effective SBE (Cannon-Bowers, 2008; Gordon et al., 2004; Pecka et al., 2014; Wiggins et al., 2018). Four articles discuss the importance of defining learning objectives prior to a simulated experience, stating that students will glean more from the scenario when clear objectives are provided (Cannon-Bowers, 2008; Chopra et al., 1994; Gordon et al., 2004; Pecka et al., 2014). Prompt feedback and debriefing also aid the learner in achieving the learning objectives or identifying growth opportunities. Nine articles discuss feedback and debriefing as imperatives in SBE (Al-Elq, 2010; Cannon-Bowers, 2008; Chopra et al., 1994; Gordon et al., 2004; Liaw et al., 2014; Massoth et al., 2019; Pecka et al., 2014; Swerdlow et al., 2020; Wiggins et al., 2018). While

many different frameworks exist to design and implement SBE, the literature supports a few commonalities within these frameworks.

First, a framework should be used when designing simulation scenarios or curricula (Cannon-Bowers, 2008; Chopra et al., 1994; Gordon et al., 2004; Pecka et al., 2014; Wiggins et al., 2018). The International Nursing Association for Clinical Simulation and Learning outlines the standards of best practice in SBE based on all available evidence in the current literature (Persico et al., 2021). As SBE grows, its facilitators must stay current with best practices to continue providing high-quality simulation that meets the needs of the learner. Finally, the simulation experiences must be evaluated regularly by both students and faculty to ensure that they continue to satisfy the overall learning objective effectively. This body of literature agrees that successful simulations have fundamental components such as clear learning objectives, a qualified facilitator, timely feedback, and debriefing (Cannon-Bowers, 2008; Gordon et al., 2004; Pecka et al., 2014; Persico et al., 2021; Wiggins et al., 2018).

Fidelity

Several articles discuss fidelity in simulation training, but the significance of fidelity in achieving specific learning objectives is unclear. Fidelity in SBE refers to the degree of realism achieved by the scenario. Specifically, fidelity is the extent to which the simulated scenario matches the system it simulates (Maran & Glavin, 2003). There is a distinction between psychological fidelity and physical fidelity that should be noted. Computerized mannequins or physical models such as an airway trainer offer a higher level of physical fidelity when compared to virtual simulation (Fragapane et al., 2018; Kim et al., 2016; Maran & Glavin, 2003). Students can develop psychomotor skills and gain a tactile understanding of specific tasks using these simulators. Psychological fidelity is the degree to which the learner feels in the simulation as

they would in the actual working environment (Maran & Glavin, 2003). Psychological fidelity may be achieved in any simulation modality if the scenario is appropriately designed.

While there is pressure for education programs to provide high-fidelity SBE, much of the literature agrees that fidelity does not always equate to improved learning outcomes (Fragapane et al., 2018; Kim et al., 2016; Massoth et al., 2019; Maran & Glavin, 2003; Schwid et al., 2001; Swerdlow et al., 2020). When planning a simulation scenario, the type of task or learning objective should inform the level of fidelity required. Several articles discuss the effectiveness of LFS when the learning objective is a cognitive task (Fragapane et al., 2018; Kim et al., 2016; Massoth et al., 2019; Maran & Glavin, 2003; Schwid et al., 2001; Swerdlow et al., 2020). However, high-fidelity simulation has been proven more effective in developing psychomotor skills (Fragapane et al., 2018; Kim et al., 2016; Liaw et al., 2014). There are pros and cons to SBE deemed low-fidelity and high-fidelity, which are discussed repeatedly in the literature. Cost, maintenance of equipment, faculty resources, and accessibility are the most common factors that are considered when choosing the level of fidelity.

In a meta-analysis of research on simulation in nursing education, Kim et al. synthesized the results of 40 studies according to the level of fidelity (2016). The effect sizes for high, medium, and low-fidelity simulations were measured to determine if high-fidelity scenarios were superior. The results showed that high-fidelity simulation has a large effect on psychomotor skills, but the effect size was not proportional to the level of fidelity (Kim et al., 2016). The difference in student outcomes between levels of fidelity was not significant (Kim et al., 2016). The meta-analysis is a unique article, yet much of this literature agrees with the conclusion that high-fidelity simulation is most effective for the development of psychomotor skills (Kim et al., 2016; Liaw et al., 2014; Maran & Glavin, 2003; Swerdlow et al., 2020). However, the literature

also agrees that LFS influences cognitive skill development and is often underutilized in educational programs (Kim et al., 2016; Liaw et al., 2014; Swerdlow et al., 2020).

Modality

Three studies compare simulation modalities, specifically virtual vs. mannequin-based, and the effect on learner performance. Liaw et al. compared student performance in mannequin-based and virtual simulation scenarios and found that the difference in student outcomes was insignificant ($p = 0.17$) (2014). This study also noted that virtual simulation offers an equally effective learning strategy without the resource requirements of high-fidelity mannequin-based simulation (Liaw et al., 2014). In a randomized controlled trial, Erlinger et al. compared virtual and mannequin-based simulation effects on student recognition of intraoperative myocardial infarction (2019). Both modalities were equally effective, and the difference in time to recognition between them was insignificant ($p = 0.67$) (Erlinger et al., 2019). In a comparison study on mannequin-based and computer-based simulation, Nyssen et al. evaluated student performance in a case of an intraoperative anaphylactic reaction (2002). There was no significant difference in recognition times between the two modalities (Nyssen et al., 2002).

In a recent literature review, Swerdlow et al. examined the available evidence for SBS in anesthesia education (2020). This review considered 150 articles published between 1980 and 2020, and 33 were included for review (Swerdlow et al., 2020). SBS has advantages that include cost effectiveness, reduction of resource utilization, and less dependence on personnel (Swerdlow et al., 2020). SBS only requires a computer and allows the learner to practice at any time, in any location, and repeat simulations for maximum educational value (Swerdlow et al., 2020). Multiple studies have shown that SBS improves anesthesia students' cognitive and

teamwork skills (Swerdlow et al., 2020). According to much of the literature in this review, SBS is not an inferior modality to mannequin-based simulation if used correctly.

Discussion

Decades of literature demonstrate that simulation education can improve cognitive, psychomotor, teamwork, and communication skills across many disciplines. Substantial evidence supports the inclusion of SBE in health professions curricula. This group of literature defines fidelity as the degree of realism in a simulated scenario but reveals that it does not necessarily equate to improved learning outcomes. Many education programs have adopted HFS and spared no expense creating state-of-the-art simulation labs with high-fidelity computerized mannequins. Much of the existing research supports mannequin-based simulation, and evidence shows that it benefits students, especially in developing psychomotor skills. However, there are drawbacks to including and maintaining this simulation modality in university curricula, including the monetary expense and increased faculty workload.

While there is very little research on virtual simulation in anesthesia education, we can look to SBS research in other disciplines. The existing literature supports SBS as an effective modality to develop cognitive skills specifically. Higher education programs likely underutilize it, and it is more cost-effective than the on-campus simulation labs. The virtual simulation also offers greater accessibility and opportunity for repetition that is unmatched by other modalities. Based on the findings in this review of literature, it is reasonable to hypothesize that students who utilize SBS software will improve their knowledge and confidence. Hopefully, implementing SBS in Marian University's curriculum will provide an additional tool for anesthesia students to help smooth the transition from didactic courses to the clinical environment. See Appendix A for a completed literature matrix.

Theoretical Framework

The Jeffries Simulation Theory was presented in 2005 as a framework for designing, implementing, and evaluating simulation-based education (SBE) in nursing (Jeffries et al., 2005). The concepts of this theory include context, background, design, educational practices, simulation experience, and outcomes and will be briefly described.

Context refers to the setting and purpose of the simulated experience (Jeffries et al., 2005). Simulation may take place in a lab, hospital setting, classroom, or virtually from any location. The intended purpose, whether for practice or evaluation, also affects the context of the experience. *Background* includes specific goals and expectations that may shape the simulation design (Jeffries et al., 2005). Time, resources, allocation of those resources, and how the simulation relates to the curriculum all influence the successful implementation of simulated learning experiences (Jeffries et al., 2005).

The *simulation design* includes specific learning objectives that guide the simulated activities, scenarios, and complexity (Jeffries et al., 2005). While certain design elements may be changed throughout the implementation of a scenario, the level of fidelity, concepts, and equipment should be well established (Jeffries et al., 2005). Roles, scenario progression, and debriefing are all established in the simulation design.

The *simulation experience* should be interactive, collaborative, and centered on the learner (Jeffries et al., 2005). A dynamic interaction between the facilitator and the participant makes the simulation experience successful. The facilitator and the learner must have established trust and buy-in to promote perceived fidelity and authenticity (Jeffries et al., 2005). The facilitator must possess the skill, knowledge, and preparation to guide the learners throughout the

scenario. Cues offered during the simulation and timely feedback or debriefing are essential to the success of the experience.

Finally, simulation *outcomes* may be participant, patient, or system-focused (Jeffries et al., 2005). Most of the existing literature is focused on participant outcomes such as self-confidence, improved knowledge, competency, and transfer of skills into the clinical environment. Some literature is geared toward patient outcomes after receiving treatment from clinicians trained in simulation modalities. System outcomes refer to organizational-level issues such as cost and quality improvement (Jeffries et al., 2005).

The Jeffries Simulation Model will be used as a framework to design, implement, and evaluate this project. Each listed component will be considered as the new virtual simulation is developed. To see a visual representation of the Jeffries Simulation Model, please refer to Appendix F.

Project Aims

This project aims to utilize SBS software to improve the knowledge and self-confidence of first-year anesthesia students. The objectives are to enhance student knowledge of case variety, pharmacology, and confidence in decision-making before entering a real clinical setting.

Project Design

This project's design is a quality improvement initiative in the setting of graduate-level education. A new educational strategy was implemented within Marian University's current curriculum. Patient monitor simulation software was utilized for first-year anesthesia students to supplement their existing didactic learning objectives. Quantitative data was collected throughout the implementation stage for analysis. Data included student responses from the

modified Student Satisfaction and Self-Confidence in Learning tool. This project used a convenience sample of first-year nurse anesthesia students at Marian University.

The SBS was implemented in the Spring 2023 semester before clinical rotations began. The expected outcome was that these students would have an enhanced learning experience and gain confidence prior to entering the clinical realm. In addition, INACSL best practices for simulation training were utilized.

Methods

Before this project was implemented, an exemption was obtained from Marian University's Institutional Review Board. Ten clinical scenarios were developed using the Jeffries Simulation Theory and INASCL standards for simulation with corresponding patient monitor adjustments. The project chair reviewed these scenarios and approved them for use in the virtual simulation. All students completed the same simulation scenarios and were not divided into control and experimental groups. Students first completed the Student Satisfaction and Self-Confidence in Learning tool that was modified for the purposes of this project. All questions were answered anonymously via a Qualtrics survey. Then, the virtual case scenarios were presented using the Simpl app. Students answered scenario questions in the Qualtrics survey while watching the patient monitor on their phones. The instructor adjusted the patient monitor to reflect each unique clinical scenario. Each question was multiple choice and focused on pharmacological interventions to be made according to the changes on the Simpl monitor. After completing the virtual scenarios, the students again completed the modified Student Satisfaction and Self-Confidence in Learning tool.

All data were collected via Qualtrics and analyzed for significance using SPSS statistical software. Thirty students completed the survey. No demographic information was collected as it was not relevant to the aim of this project. All participating students were first-year SRNAs, and this survey was administered in the spring semester of 2023.

Project Evaluation

An instrument developed by the National League for Nursing will be used to evaluate student confidence. This project administered the Student Satisfaction and Self-Confidence in Learning tool as a pre-test and post-test. This tool uses Likert scale questions to gauge student responses (NLN, n.d.). This instrument consists of thirteen questions with options ranging from "strongly disagree" to "strongly agree." Five questions measure student satisfaction with a learning activity, while the remaining eight measure students' confidence in learning (NLN, n.d.).

Quantitative data was evaluated based on student responses to the SSCL tool and not on correctness within the simulated scenarios. The goal was not to test for correctness but to determine whether the learning strategy was effective. Student satisfaction and self-confidence scores range from 5 to 25 and 8 to 40, respectively. The average of these scores was used to determine an overall trend. To see the original tool, see Appendix B. To see the modified tool, see Appendix C.

Data Collection

All data for this project was collected in a singular Qualtrics survey. The link for the Qualtrics survey was given to the students via Webex chat. The ten virtual case scenario questions immediately followed the pre-test. Then, the post-test followed the virtual case scenarios. Students were given roughly five minutes to complete the pre-test. The case scenarios

were allowed two minutes each, and another five minutes were allowed for the post-test. All responses remained anonymous and confidential within the Qualtrics application.

Ethical Considerations

Marian University IRB approval for this project was received on February 16, 2023. The project was deemed exempt. Please see Appendix D to review the approval letter. It should be noted that the project's title changed slightly from the original IRB proposal, but the project's design, methods, and objectives remained identical. Because no demographic data or personal identifiers were used, and all data remained anonymous, minimal risk of student harm was assumed.

Data Analysis

The data were analyzed using descriptive statistics, including central tendency, frequency, and variability measures. All categorical and numerical data were evaluated in frequency tables. Frequencies and percentages were calculated for questions in the survey that were categorical variables. Mean, median, mode, and standard deviation were calculated for questions with continuous variables. IBM SPSS Statistics was used to perform all statistical analyses. Because the goal was to determine if virtual case simulations using the Simpl app were well received by the students, the answers to the case study questions were not analyzed for correctness. To see the virtual case scenarios presented, please see Appendix E. Only the SSCL tool survey questions were explored for the overall effect of the learning activity.

Results

Thirty-one first-year Marian University students participated in the virtual simulation activity. Demographic data was not relevant to the aim of the study and, therefore, not collected.

When this data was collected, all students were enrolled in the Nurse Anesthesia DNP program. In the pre and post-test survey, questions one through five aim to measure student satisfaction with their current learning. Questions six through thirteen aim to measure student self-confidence in learning. Students completed the same survey twice. Each of these questions was analyzed separately.

In the pre-test survey, the distribution of the questions, or variables, is roughly symmetrical based on the closeness of their mean and median values. The median value for each question is 4. A rating of 4 in the survey correlates with an "agree" response on a scale of "strongly disagree to strongly agree." The mode is also consistently 4, indicating that it is the most common response to each question or statement in the survey. The pre-test survey's standard deviation and variance values are relatively low, indicating slight variation in the answers.

In the post-test survey, the distribution appears to be generally symmetrical based on the proximity of the mean, median, and mode values. The mode value 5 indicates that "strongly agree" is the most common response to each post-test survey question. This demonstrates widespread agreement among students regarding their experience with the virtual learning activity. The mean and median values also have close proximity to each other, indicating that most students gave high ratings to each of the post-test survey questions. The standard deviation and variance values are comparatively higher than the pre-test, meaning greater response dispersion. The contingency tables below display the number of respondents and response distributions for both pre-test and post-test surveys.

Table 1 *Pre-test Survey Measuring Satisfaction and Self-Confidence in Learning*

Item	N	Mean	Median	Mode	Std. Deviation	Variance	Min.	Maximum
Satisfaction								
1	29	4.14	4	4	0.58	0.34	3.00	5.00
2	29	4.14	4	4	0.69	0.48	2.00	5.00
3	29	4.24	4	4	0.58	0.33	3.00	5.00
4	29	4.07	4	4	0.59	0.35	3.00	5.00
5	29	4.21	4	4	0.62	0.38	3.00	5.00
Summed Satisfaction		20.8						
Self-Confidence								
1	29	3.59	4	4	0.87	0.75	2.00	5.00
2	29	3.97	4	4	0.63	0.39	3.00	5.00
3	29	4.07	4	4	0.65	0.42	2.00	5.00
4	29	4.17	4	4	0.66	0.43	2.00	5.00
5	29	4.24	4	4	0.64	0.40	3.00	5.00
6	29	3.93	4	4	0.80	0.64	2.00	5.00
7	29	4.21	4	4	0.56	0.31	3.00	5.00
Summed Confidence		28.18						

Table 2 *Post-test Survey Measuring Satisfaction and Self-Confidence in Learning*

Item	N	Mean	Median	Mode	Std. Deviation	Variance	Min.	Maximum
Satisfaction								
1	31	4.32	5	5	0.87	0.76	2.00	5.00
2	30	4.53	5	5	0.73	0.53	2.00	5.00
3	30	4.57	5	5	0.63	0.39	3.00	5.00
4	30	4.50	5	5	0.78	0.60	2.00	5.00
5	30	4.53	5	5	0.63	0.40	3.00	5.00
Summed Satisfaction		22.45						
Self-Confidence								
1	29	4.10	4	4	0.72	0.52	2.00	5.00
2	30	4.43	4	4	0.57	0.32	3.00	5.00
3	30	4.47	4.50	5	0.57	0.33	3.00	5.00
4	30	4.53	5	5	0.51	0.26	4.00	5.00
5	30	4.47	4	4	0.51	0.26	4.00	5.00
6	30	4.33	4.5	5	0.76	0.57	3.00	5.00
7	30	4.47	5	5	0.63	0.40	3.00	5.00
Summed Confidence		30.8						

The t-value for each response was calculated to determine the significance of the mean difference compared to zero. A larger absolute t-value indicates a more significant difference. Smaller numbers signify higher levels of significance for the degrees of freedom, which represent the number of observations in the sample. The following table demonstrates the pre-test and post-test questions' t-values and 95% confidence intervals.

Table 3 *Pre-test Survey T-values and Confidence Intervals*

Item	**T-value**	**95% Confidence Interval**
Satisfaction 1	38.361	3.917 – 4.3589
Satisfaction 2	32.153	3.8743 – 4.4015
Satisfaction 3	39.61	4.022 – 4.4607
Satisfaction 4	36.921	3.8432 – 4.2947
Satisfaction 5	36.548	3.9711 - 4.4427
Self-Confidence 1	22.282	3.2565 - 3.9159
Self-Confidence 2	34.124	3.7275 - 4.2036
Self-Confidence 3	33.665	3.8214 - 4.3165
Self-Confidence 4	34.127	3.9220 - 4.4229
Self-Confidence 5	35.937	3.9996 - 4.4831
Self-Confidence 6	26.504	3.6272 - 4.2348
Self-Confidence 7	40.506	3.9942 - 4.4196

Table 4 *Post-test Survey T-values and Confidence Intervals*

Item	t-value	95% Confidence Interval
Satisfaction 1	27.623	4.003 - 4.6422
Satisfaction 2	34	4.2606 - 4.806
Satisfaction 3	34.952	4.3329 - 4.8004
Satisfaction 4	31.729	4.2099 - 4.7901
Satisfaction 5	39.487	4.2985 - 4.7681
Self-Confidence 1	30.509	3.8279 - 4.379
Self-Confidence 2	42.727	4.2211 - 4.6455
Self-Confidence 3	42.82	4.2533 - 4.68
Self-Confidence 4	48.934	4.3439 - 4.7228
Self-Confidence 5	48.215	4.2772 - 4.6561
Self-Confidence 6	31.308	4.0503 - 4.6164
Self-Confidence 7	38.907	4.2319 - 4.7015

A paired t-test was performed comparing values from the pre-test and post-test surveys to determine if the learning activity significantly improved student satisfaction and self-confidence in learning. Students reported their satisfaction with current learning on a 5-point scale ranging from 1 to 5. In the pre-test survey, students indicated they were satisfied with their current learning (Mean = 4.15, Median = 4, range = 2-5). In the post-test survey, students indicated increased satisfaction with current learning (Mean = 4.49, Median = 5, range = 2-5). The mean

results from both categories were compared between the pre-test and post-test. These results were statistically significant (p = 0.00042).

Students reported their self-confidence in learning on a 5-point scale ranging from 1 to 5. In the pre-test survey, students indicated they felt confident in their current learning (Mean = 4.03, Median = 4, range = 2-5). In the post-test survey, students indicated that their self-confidence in learning was increased (Mean = 4.4, Median 4.5, range = 2-5). The mean results from both categories were compared between the pre-test and post-test. These results were also statistically significant (p = 0.0004).

Summary

A total of 31 SRNAs participated in the virtual simulation learning activity. However, 29 students completed all questions in the pre-test and post-test survey, providing a completion rate of 94%. Overall, students reported being satisfied and self-confident in their current simulation learning. The pre-test results show a summed mean of 20.8 for satisfaction and 28.18 for self-confidence in learning. However, after the virtual simulation activity, students reported even higher levels of satisfaction (Mean difference = +1.65) and self-confidence (Mean difference = +2.62). The post-test survey yields a summed mean of 22.45 for satisfaction and 30.8 for self-confidence in learning. The increase in mean was statistically significant for satisfaction (p = 0.00042) and self-confidence (p=0.0004).

Discussion

While Marian University provides access to high-fidelity simulation in the sim lab and students are overall satisfied with their learning experience, screen-based simulation may offer improved opportunity and satisfaction among first-year SRNAs. As students prepare to enter the

clinical environment, a vast range of skills and critical thinking is required. All available simulation experiences and modalities should be utilized to maximize student self-confidence and clinical reasoning. This project aimed to employ SBS training in the nurse anesthesia program's didactic year and improve the knowledge and self-confidence of student nurse anesthetists. By utilizing the Simpl patient monitor app within the best-practice standards set by INACSL, first-year SRNAs had the opportunity to improve their cognitive skills, knowledge of case variety, and anesthetic considerations.

The students participating in the virtual simulation learning activity reported improved satisfaction and self-confidence compared to the existing simulation curriculum. Overall, SRNAs were already widely satisfied with their simulation education. While the increase in means was significant after the virtual simulation, it is possible that students were unaware of LFS or SBS options available to them, and providing such an opportunity increased their satisfaction in learning. Virtual simulation activities offer additional value to the existing curriculum and are a cost-effective way to improve student engagement and satisfaction.

Strengths and Limitations

The strengths of this project are ease of participation, marginal costs, applicable technology, and faculty buy-in. The Simpl app is free and designed explicitly for healthcare professional students. Compared to other simulation modalities, the Simpl app is more cost-effective and can be accessed anytime from the student's personal computer or smartphone. Faculty may incorporate the software into regular class time and facilitate virtual simulations, as was done in this project. Students may also promote their own learning by utilizing the app in group study settings. The opportunities for extension of this project are many. There is potential to enhance simulation education within Marian University's nurse anesthesia program. Virtual

simulation is not currently utilized regularly; therefore, no opposing factors exist. The ability to repeat case studies or scenarios may help to improve cognitive function and knowledge retention.

The limitations of this project stem from using a convenience sample of first-year SRNAs at Marian. Due to the sampling method, the results cannot be generalized to all SRNAs. The small sample size for this project also limited the ability to run parametric statistics. Time was an additional limitation for the project. The virtual simulation was implemented in March 2023, and the students were scheduled to begin clinical in May 2023. In retrospect, implementing SBS throughout the entire first year of the program may yield superior outcomes for students. Finally, whoever facilitates the simulation must create the simulations and case scenarios. Creation, presentation, and evaluation of the simulations can be time-consuming. Therefore, successful utilization depends on faculty buy-in.

Conclusion

In conclusion, this project aimed to enhance the knowledge and self-confidence of first-year anesthesia students using screen-based simulation. The project design incorporated a quality improvement initiative within a graduate-level education context, focusing on integrating patient monitor simulation software to augment existing learning objectives. The implementation of the SBS took place during the Spring 2023 semester, involving first-year SRNAs at Marian University.

The methodology employed a well-structured approach, which involved developing and approving simulation scenarios, utilizing the Simpl app for case presentations, and administering a modified Student Satisfaction and Self-Confidence in Learning tool for data collection. The study measured student satisfaction and self-confidence before and after the virtual simulation

activities, using Likert scale questions and descriptive statistical analysis. Ethical considerations were appropriately addressed through Institutional Review Board approval, ensuring the privacy and anonymity of student data. The study's limitations included a relatively small sample size, time limitations, and lack of generalizability to all SRNAs.

The results of the project indicated that the virtual simulation activity using the Simpl app was positively received by the participating students. Both pre-test and post-test surveys demonstrated a high level of agreement among students, with the post-test survey revealing increased satisfaction and confidence in their learning experience. The narrow proximity between mean, median, and mode values in the post-test survey demonstrates the consistent positive response from the students. While the standard deviation and variance values were somewhat higher in the post-test, indicating slightly greater response dispersion, the overall trend of enhanced satisfaction and confidence remained clear.

This project's successful implementation of SBS as a supplemental educational strategy highlights its potential to effectively enhance student learning and confidence in anesthesia education. The positive outcomes observed in this study contribute to the broader discourse on innovative approaches to medical education and hold promise for the continued evolution of pedagogical methods in healthcare disciplines. Further research with larger and more diverse samples could provide deeper insights into the efficacy of SBS in various educational settings, ultimately advancing the quality of healthcare education and training.

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Appendix A

Literature Review Matrix

Citation	Research Design	Purpose / Aim	Population / Sample size n=x	Major Variables	Instruments / Data collection	Results
(Al-Elq, 2010)	Review of literature Level I	To demonstrate the value of simulation in undergraduate and postgraduate medical education programs.	40 articles	Literature review: Variables were clinical skills gained from simulation training	A search of literature between 1990 and 2009 was conducted. PubMed and MEDLINE databases were used.	Simulation training provides opportunities to improve students' confidence, competence, and patient safety.
(Cannon-Bowers, 2008)	Expert opinion Level VI	To explore simulation design and its influence on simulation-based education and training.	N/A	Learning objectives, instructional strategies, and feedback within simulation design.	No data collected	A framework is required for maximum benefit from simulation-based training. These frameworks should include learning objectives, performance measurement, and feedback or remediation.
(Chopra et al., 1994)	Cohort study Level IV	To determine if anesthesia simulation improves performance in recognizing anesthesia emergencies.	28 anesthesia students	Choice of treatment and response time for anesthetic crises	A scoring scheme was created to evaluate student performance within the simulation.	High-fidelity anesthesia simulators do improve performance if used appropriately.
(Erlinger et al., 2019)	RCT	To compare mannequin-	39 students	Mannequin-based	Time to recognition of	Students participating in the high-fidelity mannequin group

	Level I	based simulation and virtual simulation on students' ability to recognize intraoperative myocardial infarction		simulation vs. virtual simulation, recognition time	critical event was recorded and analyzed between the two groups.	had faster recognition times than the virtual simulation group. Third-year students were faster than second-year students, but this is attributed to more clinical experience.
(Fragapane et al., 2018)	Controlled clinical study Level III	To compare learning outcomes for students participating in high-fidelity simulation or read-only materials.	135 undergraduate students	High-fidelity simulation scenario compared to read-only material	A series of quizzes to assess mastery of learning objectives were given to each group. Statistical analysis was performed.	Student performance was equal between intervention and control groups. High-fidelity simulation may not be superior to other methods.
(Gordon et al., 2004)	Case report Level V	To explore the process of integrating simulation education into existing medical curriculum.	N/A Article was written about the simulation program at Havard Medical School.	N/A	No data was collected	The article reports how Harvard Medical School implemented a simulation-based education program into their curriculum. The authors pose it as an example for how to approach simulation in healthcare education.
(Hayden et al., 2014)	RCT Level I	To determine if simulation experience could replace clinical hours for undergraduate nursing students	666 students	Students who had traditional clinical experience vs. students who had clinical hours replaced by simulation	The Creighton Competency Evaluation Instrument (CCEI), the New Graduate Nurse Performance Survey (NGNPS), and the Global Assessment of Clinical Competency	There were no statistically significant differences in parameters of clinical competency, nursing knowledge, critical thinking, or readiness for practice between groups.

				-based education	and Readiness for Practice were the instruments used to assess student success.	
(Kim et al., 2016)	Meta analysis Level I	To determine the effectiveness of simulation-based education in nursing, and to compare the effect sizes between low and high-fidelity simulators.	40 studies included	High-fidelity vs. low fidelity simulators	Fidelity level was coded and analyzed using Comprehensive Meta-Analysis software. Effect sizes on psychomotor, cognitive, and affective ability were calculated.	High-fidelity simulation has a large effect size for psychomotor skills. However, the effect of simulation-based education was not proportional to fidelity level.
(Laschinger et al., 2008)	Meta-analysis Level I	To review best evidence on simulation-based training in health professions education.	23 studies included	Anatomical models either whole-body or part-body, with or without computer support.	Two independent reviewers extracted information from each paper. The Joanna Briggs Extraction tool was used for consistency.	Simulation training is a useful adjunct for clinical practice, but cannot replace clinical experience. Simulation experience may not translate into real-world skills.
(Liaw et al., 2014)	RCT Level I	To compare mannequin-based simulation with virtual simulation effects on students' ability to recognize clinical deterioration	57 students	Mannequin-based simulation vs. virtual simulation	Post-tests immediately following each simulation and again 2.5 months after the simulation were completed	Virtual simulation and mannequin-based simulation were rated positively. There was no statistically significant difference in post-test scores. Both styles of simulation were effective in achieving the set learning outcomes.

(Maran & Glavin, 2003)	Expert opinion Level VI	To discuss the use of different levels of simulation fidelity and modality in education..	N/A	N/A	No data was collected	Many different types of simulators exist, and each has benefits and drawbacks. Levels of fidelity may serve to enhance cognitive ability or psychomotor skills. All levels of fidelity have value in education.
(Massoth et al., 2019)	RCT Level I	To evaluate the response to low fidelity vs high fidelity simulation and effect on confidence	135 medical students	High-fidelity vs. low-fidelity simulations	A 20-item multiple choice assessment and an 8-item Likert scale assessment were given pre and post participation in the simulation.	High-fidelity simulation provided no advantage in learning compared to low-fidelity simulation. High-fidelity simulation overinflated self-confidence in the students' ability and knowledge.
(Nyssen et al., 2002)	Comparison Study Level IV	To compare computer-based and mannequin-based simulators and the effect on learning outcomes for anesthesia residents	40 students	Computer-based vs. mannequin simulators, treatment scores and diagnosis times	A scoring tool was used to assess student performance and time to diagnosis.	Screen-based simulators are useful in acquiring technical skills of patient management. The decision to use screen-based simulation or mannequin-based simulation should depend on cost and learning objectives.
(Okuda et al., 2009)	Review of literature Level I	To determine what evidence exists in favor of simulation training in medical education.	113 articles	Simulation training vs. standard training	No data was collected	Simulation improves knowledge, communication, teamwork, and performance compared to standard education.
(Pecka et al., 2014)	Expert Opinion Level IV	To propose the use of the Community of Inquiry Model to	N/A	N/A	No data was collected	The COI model serves as a framework to guide, evaluate, and research distance

		evaluate distance learning strategies in nurse anesthesia education.				learning techniques in nurse anesthesia programs.
(Schwid et al., 2001)	RCT Level I	To measure the effect of screen-based simulation on student response to critical events.	31 anesthesia residents	Screen-based simulation vs. traditional education	A quantitative scoring system was created to evaluate student responses	Simulation training proved to be more effective than written material. Students scored higher on evaluation in the screen-based simulation group.
(Swerdlow et al., 2020)	Review of literature Level I	To explore the evidence on screen-based simulation and how it may be utilized in anesthesia programs	150 articles	Screen-based simulation vs. mannequin-based simulators	No data was collected	SBS is a viable and effective modality for anesthesia training programs. SBS offers unique advantages in comparison to mannequin-based simulation that may be especially useful for distance learning.
(Wiggins et al., 2018)	Quality Improvement Project Level IV	To determine the effectiveness of a regional anesthesia training course on improving knowledge, skill, and confidence in regional anesthesia administration	49 CRNAs	Screen-based training and hands on experience	Pre-test and post-test surveys were used to collect data on confidence levels	Confidence levels and comfort with regional anesthesia improved after participation in the course
(Yunoki & Sakai, 2018)	Review of literature Level I	To summarize the status of simulation education in anesthesia training, encourage more providers to get involved with	95 articles	N/A	No data was collected	Simulation has been effective in many aspects of anesthesia practice including airway management, regional, obstetric, and cardiac. Still, the optimal use of simulation in anesthesia education is unclear.

		simulation education, and stimulate future research				

Appendix B

Student Satisfaction and Self-Confidence in Learning

Instructions: This questionnaire is a series of statements about your personal attitudes about the instruction you receive during your simulation activity. Each item represents a statement about your attitude toward your satisfaction with learning and self-confidence in obtaining the instruction you need. There are no right or wrong answers. You will probably agree with some of the statements and disagree with others. Please indicate your own personal feelings about each statement below by marking the numbers that best describe your attitude or beliefs. Please be truthful and describe your attitude as it really is, not what you would like for it to be. This is anonymous with the results being compiled as a group, not individually.

Mark:
1 = STRONGLY DISAGREE with the statement
2 = DISAGREE with the statement
3 = UNDECIDED - you neither agree or disagree with the statement
4 = AGREE with the statement
5 = STRONGLY AGREE with the statement

Satisfaction with Current Learning	**SD**	**D**	**UN**	**A**	**SA**
1. The teaching methods used in this simulation were helpful and effective.	○ 1	○ 2	○ 3	○ 4	○ 5
2. The simulation provided me with a variety of learning materials and activities to promote my learning the medical surgical curriculum.	○ 1	○ 2	○ 3	○ 4	○ 5
3. I enjoyed how my instructor taught the simulation.	○ 1	○ 2	○ 3	○ 4	○ 5
4. The teaching materials used in this simulation were motivating and helped me to learn.	○ 1	○ 2	○ 3	○ 4	○ 5
5. The way my instructor(s) taught the simulation was suitable to the way I learn.	○ 1	○ 2	○ 3	○ 4	○ 5
Self-confidence in Learning	**SD**	**D**	**UN**	**A**	**SA**
6. I am confident that I am mastering the content of the simulation activity that my instructors presented to me.	○ 1	○ 2	○ 3	○ 4	○ 5
7. I am confident that this simulation covered critical content necessary for the mastery of medical surgical curriculum.	○ 1	○ 2	○ 3	○ 4	○ 5
8. I am confident that I am developing the skills and obtaining the required knowledge from this simulation to perform necessary tasks in a clinical setting	○ 1	○ 2	○ 3	○ 4	○ 5
9. My instructors used helpful resources to teach the simulation.	○ 1	○ 2	○ 3	○ 4	○ 5
10. It is my responsibility as the student to learn what I need to know from this simulation activity.	○ 1	○ 2	○ 3	○ 4	○ 5
11. I know how to get help when I do not understand the concepts covered in the simulation.	○ 1	○ 2	○ 3	○ 4	○ 5
12. I know how to use simulation activities to learn critical aspects of these skills.	○ 1	○ 2	○ 3	○ 4	○ 5
13. It is the instructor's responsibility to tell me what I need to learn of the simulation activity content during class time..	○ 1	○ 2	○ 3	○ 4	○ 5

 Revised December 22, 2004

Appendix C

Modified NLN Tool

Instructions:
This questionnaire is a series of statements about your personal attitudes about the instruction you receive during your simulation activity. Each item represents a statement about your attitude toward your satisfaction with learning and self-confidence in obtaining the instruction you need. There are no right or wrong answers. You will probably agree with some statements and disagree with others. Please indicate your own personal feelings about each statement below by marking the numbers that best describe your attitude or beliefs. Please be truthful and describe your attitude as it really is, not what you would like for it to be. This is anonymous with the results being compiled as a group, not individually.

Mark:
1 = STRONGLY DISAGREE with the statement
2 = DISAGREE with the statement
3 = UNDECIDED - you neither agree or disagree with the statement
4 = AGREE with the statement
5 = STRONGLY AGREE with the statement

Satisfaction with current learning

	1 Strongly Disagree	2 Disagree	3 Undecided	4 Agree	5 Strongly agree
The teaching methods used in simulation are helpful and effective.	○	○	○	○	○
The simulations promote my learning in the anesthesia curriculum.	○	○	○	○	○
I enjoy how my instructor presents simulations.	○	○	○	○	○
The technology used in simulation help me to learn.	○	○	○	○	○
My instructor's method is suitable to the way I learn.	○	○	○	○	○

Self-confidence in learning

	1 Strongly disagree	2 Disagree	3 Undecided	4 Agree	5 Strongly agree
I am confident that I am mastering the material in the presented simulations.	○	○	○	○	○
I am confident that simulation covers necessary material in the anesthesia curriculum.	○	○	○	○	○
I am confident that simulation helps me obtain pertinent clinical knowledge.	○	○	○	○	○
My instructor uses helpful resources to teach the simulation.	○	○	○	○	○
It is my responsibility to learn what I need to know from simulation activities.	○	○	○	○	○
I feel confident asking for help when I do not understand concepts in simulation.	○	○	○	○	○
I am confident that simulation helps me learn important clinical skills.	○	○	○	○	○

National League for Nursing. (2005). Student Satisfaction and Self-confidence in Learning ©.

Modified for purposes of this DNP project.

Appendix D

MARIAN UNIVERSITY
Indianapolis ®

Institutional Review Board

DATE:	02-16-2023
TO:	Kristen Richey & Dr. Lee Ranalli
FROM:	Institutional Review Board
RE:	S23.118
TITLE:	Virtual Simulation to Improve Knowledge of Anesthetic Implications
SUBMISSION TYPE:	New Project
ACTION:	Determination of EXEMPT Status
DECISION DATE:	02-16-2023

The Institutional Review Board at Marian University has reviewed your protocol and has determined the procedures proposed are appropriate for exemption under the federal regulation. As such, there will be no further review of your protocol and you are cleared to proceed with your project. The protocol will remain on file with the Marian University IRB as a matter of record.

Although researchers for exempt studies are not required to complete online CITI training for research involving human subjects, the IRB **recommends** that they do so, particularly as a learning exercise in the case of student researchers. Information on CITI training can be found on the IRB's website: http://www.marian.edu/academics/institutional-review-board.

It is the responsibility of the PI (and, if applicable, the faculty supervisor) to inform the IRB if the procedures presented in this protocol are to be modified of if problems related to human research participants arise in connection with this project. Any procedural modifications must be evaluated by the IRB before being implemented, as some modifications may change the review status of this project. Please contact me if you are unsure whether your proposed modification requires review. Proposed modifications should be addressed in writing to the IRB. **Please reference the above IRB protocol number in any communication to the IRB regarding this project.**

Amanda C. Egan, Ph.D.
Chair, Marian University Institutional Review Board

Appendix E

Virtual Simulation Scenarios

Your patient was recently induced followed by successful intubation of the trachea with an endotracheal tube. Based on the vital signs, which of the following would be the most appropriate intervention?

A. Ephedrine 10 mg IV

B. Epinephrine 10 mcg IV

C. Phenylephrine 100 mcg IV

D. Esmolol 50 mg IV

Instructor scenario: Tachycardia, hypotension, decreased EtCO2

You successfully placed a spinal anesthetic for a patient undergoing cesarean delivery. Based on the vital signs, which of the following would be the most appropriate intervention?

A. Ephedrine 10 mg IV

B. Epinephrine 10 mcg IV

C. Phenylephrine 100 mcg IV

D. Esmolol 50 mg IV

Instructor scenario: Bradycardia, hypotension, decreased EtCO2

The surgeon is conducting pneumoperitoneum for a laparoscopic cholecystectomy. Based on the vital signs, which of the following would be the most appropriate intervention?

A. Labetalol 5 mg IV

B. Nitroglycerin 50 mcg IV

C. Hydralazine 10 mg IV

D. Esmolol 50 mg IV

Instructor scenario: Tachycardia, hypertension

The surgeon is conducting pneumoperitoneum for a laparoscopic cholecystectomy. Based on the vital signs, which of the following would be the most appropriate initial intervention?

A. Atropine 1 mg IV

B. Epinephrine 10 mcg IV

C. Ephedrine 10 mg IV

D. Advise the surgeon to stop and deflate the abdomen

Instructor scenario: bradycardia, hypotension

Vitals remain similar after deflation of the pneumoperitoneum. Based on the vital signs, which of the following would be the most appropriate pharmacologic intervention?

E. Atropine 1 mg IV

F. Glycopyrrolate 0.4 mg IV

G. Epinephrine 10 mcg IV

H. Ephedrine 10 mg IV

Instructor scenario: bradycardia, hypotension

You've successfully induced your patient for a total shoulder arthroplasty. After the patient has been positioned, you notice these changes on the monitor. Which of the following is the most appropriate action?

A. Phenylephrine 100 mcg IV

B. Ephedrine 10 mg IV

C. Glycopyrrolate 0.2 mg IV

D. Epinephrine 10 mcg IV

Instructor scenario: bradycardia, hypotension

Which reflex is most likely responsible for the change in vital signs?

A. Vasovagal reflex

B. Bainbridge reflex

C. Bezold-Jarisch reflex

D. Baroreceptor reflex

Instructor scenario: bradycardia, hypotension

The surgeon is performing a craniotomy for tumor removal and has just tightened the Mayfield pins. Which of the following is the most appropriate action?

A. Rocuronium 30 mg

B. Propofol 50 mg

C. Hydromorphone 2 mg

D. Titrate the gas to 1.2 MAC

Instructor scenario: tachycardia, hypertension, increased respiratory rate

During a sitting craniotomy, you notice a sudden change vital signs. What is the first action that should be taken?

A. Increase FiO2 to 100%

B. Alert the surgeon to flood the field with irrigation

C. Call for help

D. Auscultate with a precordial doppler

Instructor scenario: low EtCO2, hypotension, tachycardia, ST depression

Your patient is undergoing a robotic assisted hernia repair. Your preoperative evaluation revealed they are taking methadone, furosemide, and metoprolol. Based on the vital signs, what is the most appropriate action?

A. Calcium chloride 1 g IV

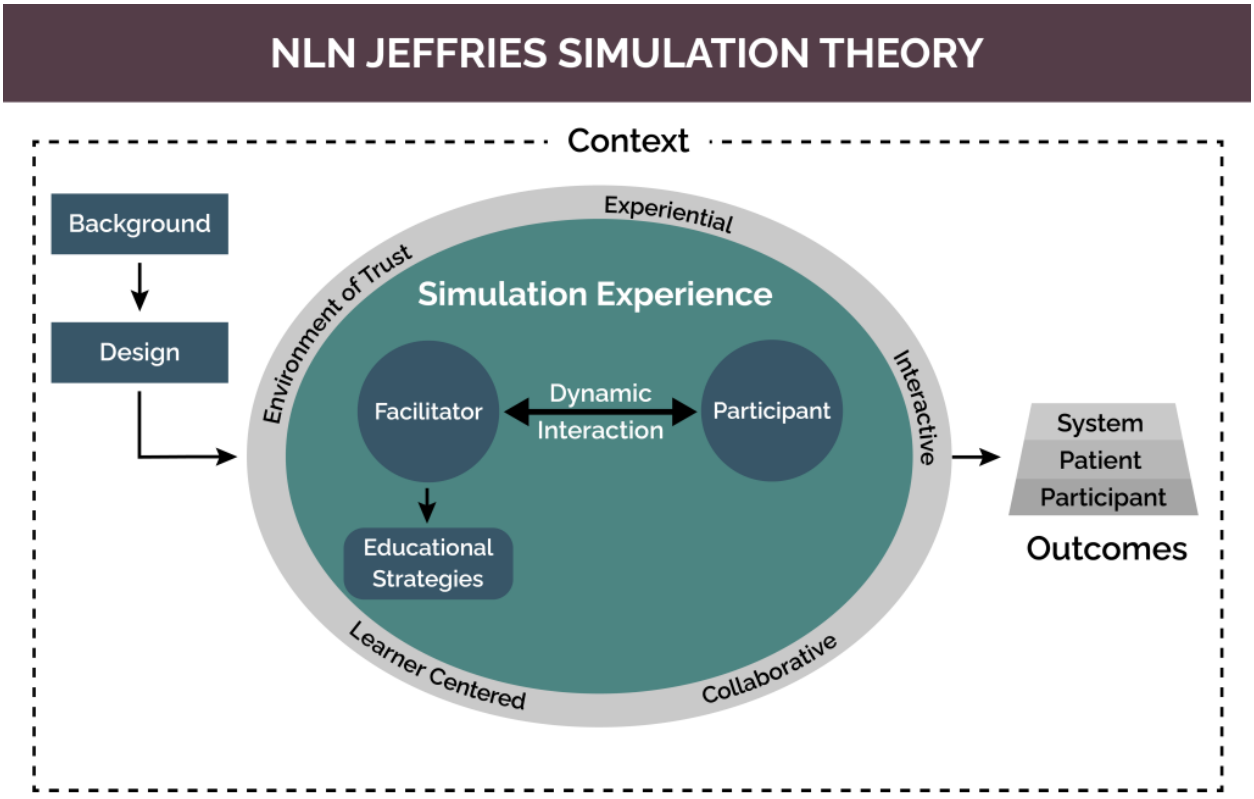
B. Epinephrine 1 mg IV

C. Atropine 0.5 mg IV

D. MgSO4 2 g IV

Instructor scenario: hypotension, Torsades de Pointes, low EtCO2

Appendix F



"Jeffries Simulation Model," by P. R. Jeffries, 2005, Nursing Education Perspectives, 26(2), 96±103.

(https://journals.lww.com/neponline/pages/articleviewer.aspx?year=2005&issue=03000&article=00009&type=abstract)