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Improving Student Registered Nurse Anesthesiologists' Skills and Confidence Through High-fidelity Simulation

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Introduction of the Problem

Safe practice and optimal patient outcomes remain consistent goals in anesthesia care. Increasing patient and surgical complexity place a greater demand on the anesthetist's ability to respond to dynamic patient conditions. Acute stress reduces working memory and leads providers to revert to practiced skills (Harry & Sweller, 2016). High-fidelity simulation exposes providers to various clinical situations, builds foundational skill sets, and enhances provider proficiency while removing the risk of patient harm (Harry & Sweller, 2016; Lorello et al., 2014).

While high-fidelity simulation training is utilized in the Nurse Anesthesia program at a host university, the simulations focus on the recognition of and intervention for adverse events. Student Registered Nurse Anesthesiologists (SRNAs) may benefit from simulations involving foundational skills and frequently encountered clinical problems. The intended outcome for this project was to expose SRNAs to full scenarios of commonly encountered anesthesia situations to develop the participant's workflow, technical skills, troubleshooting, and critical thinking abilities.

Literature Review

The method with which nursing education is executed holds great importance. Recent literature demonstrates that problem-based learning improves student satisfaction and demonstrates greater gains in knowledge when compared to traditional techniques (Shin & Kim, 2013). However, no evidence within the literature review discussed the implementation of simulation training as a sole intervention. Indeed, current evidence by Gabbard & Steinert

(2021), Gisriel et al. (2021), and Staun et al. (2020) supports a combination of didactic training and high-fidelity simulation as education interventions.

Scenario-based simulation is frequently utilized in anesthesia training. High-fidelity simulation allows for variations in patient acuity and conditions. For example, Staun et al. (2020) utilized high-fidelity simulation for training routine scenarios within cardiothoracic anesthesia. Additionally, Bevil et al. (2020) simulated a local anesthetic toxicity event requiring advanced resuscitation efforts.

The debriefing piece of a high-fidelity simulation holds great value in a student's educational experience. Debriefing allows for self-reflection and reinforces the experience and knowledge gained from the hands-on portion of a simulation (Lavoie et al., 2013). Indeed, the effectiveness of a high-fidelity simulation increases by 25% when a debriefing is implemented (Tannenbaum & Cerasoli, 2012). Current evidence demonstrates that the debriefing should occur immediately following the completion of the simulation and should be two to three times longer than the duration of the simulation experience (Lavoie et al., 2013). Furthermore, debriefings should discuss the participant's positive and negative responses to the simulation and illuminate further areas for improvement (Lavoie et al., 2013).

Project Methodology

The project aimed to improve SRNA competence and confidence with the standard anesthesia induction sequence and commonly encountered complications, specifically esophageal or right mainstem bronchus intubations. Furthermore, the project intended to obtain SRNA perceptions of their simulation experience and to utilize the project's findings to guide improvements of the simulation program at the university's School of Nurse Anesthesiology.

The details of this quality improvement project were submitted to the IRB at Southern Illinois University Edwardsville (SIUE) as Protocol #1595. No participant names or identifying information were obtained for the simulation. Additionally, survey results were confidential and absent of identifying information. There were no conflicts of interest. The SIUE IRB deemed this project exempt from requiring approval based on the nature of the project.

All SRNAs in NURS 529 – Orientation to Nurse Anesthesia Practicum – participated in the simulation as part of their course laboratory experience. Students who volunteered to participate in this project completed a pre and post-test. In addition, the participants were provided an orientation to the SIUE simulation lab prior to the pre-test and simulation experience.

The class was divided into groups of four students. One group of two students completed the right mainstem intubation simulation, and the other completed the esophageal intubation simulation. Within each group, one participant managed the airway, and one administered medications. After being provided with pertinent patient information, the students collaborated to administer a standard induction of general anesthesia. After endotracheal intubation was completed, the simulation forced either a right-mainstem intubation or an esophageal intubation. Again, the students cooperated to diagnose and intervene for the given scenario. After both groups of two students had completed their simulation, the group of four underwent a debriefing and completed the post-test information.

Evaluation

An 11-question pre-test and 14-question post-test were utilized to evaluate the outcomes of the high-fidelity simulation experience. The pre-test consisted of two open-ended responses, one yes/no response, and eight 5-point Likert-type questions. The pre-test questions evaluated the participants' nursing background and their perceived confidence and competence regarding the anesthesia induction sequence, executing endotracheal intubation, confirming the placement of an endotracheal tube, and troubleshooting the potential complications of endotracheal intubation.

The post-test included thirteen 5-point Likert-type questions and one select all that apply response. The post-test assessed participants' perceived confidence and competence regarding the anesthesia induction sequence, executing endotracheal intubation, confirming the placement of an endotracheal tube, and troubleshooting the potential complications of endotracheal intubation. In addition, the post-test evaluated the perceived quality and utility of the simulation design and whether the participants perceived an improvement in critical thinking, technical, collaborative, or troubleshooting skills.

All thirty-one students participated in the DNP project by answering the pre and post-tests. However, one student's responses were not included in the statistical analysis due to omitting a response to greater than fifty percent of the questions. The participants reported general nursing experience and intensive care unit nursing experience averages of 4.8 and 4.2 years, respectively. Of the included responses, 89.7% had previous simulation experience.

Overall, the participants reported improved confidence with induction, intubation, confirming placement, and troubleshooting complications of intubation. The participants also reported improved competence with induction, intubation, confirming placement, and troubleshooting complications of intubation. Participants ranked the greatest improvement in confidence with intubation and the lowest improvement in confirming endotracheal tube placement. Additionally, 60% percent of participants reported improving critical thinking skills, 66.7% technical skills, 46.7% collaboration skills, and 60% troubleshooting skills.

Overall, the simulation design was reported as beneficial. Participants reported a positive response to the value of the debriefing session and the relevance of the content to the NURS 529 course. Additionally, the participants indicated that the simulation environment was free of judgement and conducive to learning.

Time was identified as the greatest limitation of this DNP project. The variability of the induction sequence and a lack of first-year students' clinical experience produced hesitation and a lack of efficiency. Due to time constraints, each participant was allowed to complete the airway management role or medication administration. Limiting the participants' role in the simulation may subtract from the experience they would have gained in the respective role.

The mannequin's capability to provide realistic lung sounds was an additional limitation of this DNP project. Students who were provided a right-mainstem bronchus intubation utilized the auscultation of lung sounds to assist in formulating a diagnosis. However, the mannequins reduced ability to isolate right and left-sided lung sounds, in conjunction with the sounds from the moving internal components, presented the participants with confounding data and hindered a diagnosis.

The difficult airway algorithm is interwoven into the induction sequence. The plastic material of the mannequin proved difficult to achieve an adequate mask seal which led some uncertain participants to proceed to the difficult airway algorithm due to the inability to ventilate. While this is the appropriate action, it further compounded the limitation on time and subtracted from the realism of the simulation.

Impact on Practice

This DNP project held significant implications for the participants' clinical practice. Well-executed induction skills and rapid identification and intervention for associated complications are vital to the safety of perioperative patients. In contrast to a student first attempting these skills with a live patient, high-fidelity simulation eliminates the risk of patient harm. Indeed, the results of this DNP project suggest that the simulation led to an increased perception of confidence and competence in managing potential complications of an anesthetic induction. The experience gained by participating in this high-fidelity simulation will likely translate to increased competence and confidence in the clinical setting, thus, improving patient safety and outcomes.

Following the implementation of this DNP project, it has been decided that this simulation will be continued as a portion of the curriculum for future cohorts. While this simulation has been deemed beneficial, additional simulations in the SRNA's first year of study may hold great value. For example, a high-fidelity simulation for a rapid-sequence induction may hold equal value to first-year students. Furthermore, given the recurrent difficulty of mask ventilating the mannequin, a difficult mask scenario provides a logical addition for a future scenario. Allowing students to practice utilizing the difficult airway algorithm while removing the risk of patient harm may translate to improved patient outcomes in the clinical setting.

Conclusions

In the perioperative area, complications demand a rapid diagnosis and treatment to minimize patient harm. In crucial moments, a provider's clinical knowledge and prior experiences influence the speed and efficacy of their response. High-fidelity simulation allows

SRNAs to gain anesthesia experience while removing the risk of patient harm. Additionally, high-fidelity simulation promotes the opportunity for experimental learning, which may be discouraged in the operative setting. The improvements in confidence and competence that SRNAs report after the high-fidelity simulation, in conjunction with the added anesthesia experiences, will better prepare SRNAs to provide safe anesthesia care and mitigate complications, should they arise.

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