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Student Registered Nurse Anesthetists: Impact of Structured High-fidelity Simulation on Anesthesia Ready Time

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Abstract

Introduction: Student registered nurse anesthetists (SRNAs) at a large academic medical center are limited in clinical training experiences owing to the subjective perception by local anesthesia department administrators of decreased operating room efficiency with SRNA involvement. The purpose of this project was to utilize structured high-fidelity simulation (HFS) to increase basic skill proficiency in SRNAs and evaluate the impact of the simulation within the first month of clinical training.
Methods: Utilizing the Iowa Model of Evidence-Based Practice to Promote Quality Care, a 5-week structured HFS program was inserted into the nurse anesthesia curriculum before the SRNAs' first clinical rotation. The program promoted basic anesthesia skill proficiency through the assimilation of previously taught and tested technical skills. In-room times and anesthesia ready times of all SRNA cases involving general anesthesia with the placement of an endotracheal tube during September 2012 and 2013 were compiled by use of retrospective chart review. Using the calculation of elapsed time between in-room time and anesthesia ready time (IRTART), the clinical performance of 2 consecutive classes of SRNAs was compared, one with structured HFS training and one without.
Results: The mean IRTART for both groups was similar at 20 minutes with a standard deviation of 10 minutes. The IRTARTs from both groups were within the institution's operative norm.
Conclusion: Structured HFS did not impact the anesthesia ready time of new-to-practice SRNAs. However, the information collected during implementation of HFS and data analysis can be used to develop future avenues to improve current processes for structured HFS and clinical training opportunities.

INTRODUCTION

Nurse anesthesia educators are challenged to provide innovative training programs that prepare student registered nurse anesthetists (SRNAs) to care for a diverse patient population that is living longer with multiple comorbidities.[1] Use of simulation, including lifelike mannequins, interactive computer programs, and actors role-playing as patients, has gained increasing popularity in health care programs, especially nursing schools, around the world.[2] In 2012, 96% of nurse anesthesia programs reported the use of simulation within the curriculum.[3]

The nurse anesthesia program (NAP) at a large academic medical center strives continually to increase the quality of student experiences. In class sizes ranging from 26 to 30 students, SRNAs complete 12 months of classroom instruction followed by 16 months of clinical training. Within that time, each student must complete a certain number of surgical cases plus a required number of specific skills. These cases, required by the Council on Accreditation of Nurse Anesthesia Programs, involve skills as simple as preparing medications in syringes and as complex as managing a patient with multiple traumatic injuries.[4]

While the NAP program has partnered with many hospitals throughout both South Carolina and Georgia to provide students the necessary clinical experiences, often these institutions will not accept a student until after the student's third or fourth month of clinical training. Anesthesia department administrators contend that novice SRNAs slow the fast pace of the operating room (OR) because they require too much instruction. Unfortunately, this strictly subjective observation greatly limits early student experiences.

The anesthesia ready time (ART) is a timestamp noted in the electronic health record (EHR) that is used to determine anesthesia efficiency. It is defined as the "time when a surgical patient has a sufficient level of anesthesia established to begin surgical preparation."[5] Anesthesia efficiency can be estimated by the elapsed time between ART and the time the patient is brought into the surgical suite (in-room time). Because a surgery cannot begin until the patient is properly anesthetized, any setback the SRNA encounters in anesthetizing the patient delays the start of the procedure. Many basic anesthesia skills are utilized during the induction sequence of a general anesthetic. An increased proficiency in basic skills can ensure that SRNA performance does not hinder surgical start times.

Purpose of the Study

This project had a dual purpose. The first was to utilize structured high-fidelity simulation (HFS) to increase basic skill proficiency in SRNAs before the start of clinical training. The second was to evaluate the impact of structured HFS training on the time from in-room time to ART (IRTART) of SRNAs during their first month of clinical training. It was hypothesized that structured HFS would improve SRNA performance and decrease SRNA IRTART.

Review of the Literature

An abundance of the literature focuses on simulation in health care education. Spanning both quantitative and qualitative designs, examples of the use of simulation include teaching specific tasks, increasing practical knowledge, developing critical thinking skills, increasing student confidence, and decreasing participant anxiety. For this study, evidence of HFS as a teaching tool for foundational skills was examined to include which elements to include as well as examples of implementation of simulation.

Noted by the Institute of Medicine as a learning enhancement tool,[6] HFS is a training method that exposes SRNAs to a variety of situations they will face as providers in the OR both as trainees and later as CRNAs. With the use of a computerized mannequin (human patient simulator), a variety of scenarios can be created that offer the SRNA an opportunity to interact with different patient conditions and to experience surgical situations and complications in real time.[7] An ideal environment for experiential learning, HFS offers SRNAs the opportunity for intervention and reflection to determine what actions are most relevant to clinical practice.[8] Most importantly, HFS allows for uninhibited student learning without threats to patient safety, threats to quality of care, or fear of blame.[9]

A 2005 review highlighted 10 essential elements of simulation: feedback, repetitive practice, integration of simulation in curricula, a range of levels of difficulty, multiple learning strategies, a controlled environment, individualized learning, clinical variation, defined outcomes, and simulator validity.[10] Additional recommendations include a faculty demonstration to visually define the outcomes for participants.[11] Use of these elements within nursing education varies. A 2010 survey of International Nursing Association of Clinical Simulation members noted structural differences in theory utilization, videotaping of sessions, debriefing practices, substitution for clinical time, and equipment.[2] The literature does not support a standard theory or framework for integration of simulation within a curriculum nor does it recommend a specific evaluation tool.[2]

In 2011, Meyer et al utilized many of the recommended essentials when implementing simulation into an undergraduate nursing curriculum.[12] With scenarios of progressing difficulty, nursing students repeatedly experienced situations and performed skills common in pediatrics.[12] Simulation-trained students earned higher and more consistent scores on a Likert-style tool, leading Meyer et al to conclude that student clinical performance was increased as a direct result of simulation.[12] This finding suggested positive skill transfer from the simulator to the clinical environment through the use of recommended elements.

With the purpose of this study being to improve basic skill proficiency, all the essential elements were incorporated into the simulation program except for varied levels of difficulty. Repetition of skills was patterned after Meyer's study and the skills most common within a general anesthetic induction were incorporated. For this study, *feedback* was defined as immediate debriefing following the completion of a simulation.[11]

Theoretical Framework

The Iowa Model of Evidence-Based Practice to Promote Quality Care (Iowa Model)[13] served as the theoretical framework for this study. Beginning with the identification of a clinical problem, the model provides a step-by-step guide for implementing change. The model starts with critical questions focused on how the clinical problem impacts the institution and what, if any, foundational research is available. If sufficient evidence exists, the model promotes implementation of change and then evaluation to determine if change is appropriate for adoption into practice. If not, the framework redirects improvement efforts toward soliciting more information or narrowing the initial focus of the clinical problem. The unique questions built into the framework require repeated reflection and review at different stages of the process, thereby keeping the project on target with goals and ensuring orderly completion of necessary steps. Answering the questions, in sequence, keeps the project narrowly focused.

METHODS

Participants

After institutional review board approval, this process improvement plan utilized a comparative study design. The intervention group consisted of 10 SRNA volunteers who had just completed the didactic portion of a front-loaded nurse anesthesia curriculum. The comparison group was the SRNAs of the prior year who did not receive structured HFS training.

The intervention group participants committed to a HFS program that began with orientation to the simulator and viewing a faculty demonstration video. Orientation included informed consent, explanation of the purpose of the project, and participant expectations. The video provided a standard of performance and demonstrated the skills that participants would use to successfully negotiate the scenarios.

Scenarios

SRNAs trained once a week for 5 weeks with the Laerdal SimMan 3G (SimMan), a high-fidelity computerized interactive mannequin, to assimilate the information taught in prior skill labs to include: anesthesia machine check, medication preparation, airway equipment preparation, and anesthesia induction.

Although the tasks may be considered noncomplex, completing them in succession and in the proper order can be a challenge for novice SRNAs. The simulation exercises focused on these skills and enhanced performance through repetition. A section of the SRNA skills laboratory was arranged similarly to an OR and included a functional anesthesia machine with ventilator, the mannequin, an operating table, a stocked anesthesia cart, and distilled water for medication simulation.

The scenario began with the SRNA bringing the mannequin to the OR and transferring the mannequin to the surgical table and ended when the participant secured the breathing tube. The performance of the SRNA was immediately analyzed by using both the scenario script and the video recording as references. Time was allotted for facilitator-student feedback and questions. All SRNAs completed the same scenarios, were video recorded, received feedback, and deleted their videos before exiting the simulator. SRNA performance was not graded as part of the NAP curriculum.

Data Collection and Analysis

Participants completed the simulation experience in July 2013. Beginning the week of September 1, 2013, participants reported to the OR of a level I trauma center for their first month of clinical training. The OR had 22 operating suites and offered students experiences in neurosurgery, orthopedics, urology, gynecology, organ transplantation, reconstructive plastic surgery, head and neck surgery, and pediatrics. During 1:1 clinical training with a CRNA, students completed all the skills reviewed in the simulator course on every general-anesthetic case they participated in.

Documentation of all OR cases, regardless of SRNA participation, included recording of the in-room time and ART. The elapsed time between these 2 points indicated the amount of time it took the anesthesia providers to prepare the patient for surgery and was called the IRTART. Because these times exist in all OR records, we could compare the times for the September 2013 SRNAs (intervention group) with the September 2012 SRNAs (control group).

The retrospective analysis used information routinely recorded during all surgical cases within the institution's EHR. The study team utilized the filter and report feature of the EHR to identify SRNA cases in September 2012 and September 2013. Records were filtered for date, SRNA name, general anesthesia procedures with an endotracheal tube, the in-room time, and the ART. The report function of the EHR produced a de-identified spreadsheet that listed the in-room time, ART, and the year the procedure was performed. IRTART in minutes was calculated from the recorded times. Data analysis consisted of a *t*-test with calculation of the mean and SD of the IRTART in minutes by a statistician.

RESULTS

All 10 participants in the intervention group completed the entire simulation program. Because of space limitations at the clinical site, 9 students reported to the OR at the level I trauma center and completed their first clinical rotation in September 2013. The average age in the intervention group was 28 years (range, 25-31 years), and 7 participants (78%) were female. All of the participants in the intervention group had between 2.5 and 7 years of nursing experience, predominantly in critical care environments. Demographic information for the control group was not reported because those SRNAs were not consented for the project.

Influential factors outside of the intervention were minimized by comparing the 2 SRNA classes at the onset of clinical training and in the same clinical site. All raw data points were obtained directly from the EHR. To maintain consistency in comparison, only general anesthesia cases with placement of an endotracheal tube were included in the retrospective chart review.

Data collection yielded 127 records from September 2012 (control group) and 116 records from September 2013 (intervention group). There was no statistically significant difference in SRNA performance between the 2 groups. The mean IRTART for both groups was 20 minutes with an SD of 10 minutes (p=0.482). Therefore, the IRTARTs of 68% of general anesthesia cases requiring an endotracheal tube involving SRNAs on their first clinical rotation were between 10 and 30 minutes (Table 1).

Table 1. Mean ART in Minutes by Group

Group	No. of Records	Mean ART, min	SD	SEM
SRNAs in 2012	127	20.04	10.09	0.90
SRNAs in 2013[a]	116	20.10	10.02	0.93
Abbreviations: ART, anesthesia ready time; HFS, high-fidelity simulation; SRNA, student registered nurse anesthetist.				
[a]SRNAs in 2013 participated in the structured HFS program.				

DISCUSSION

The structured HFS scenarios were designed to increase SRNA basic anesthesia skills with the intent that students would require less step-by-step instruction during their first clinical rotation. The program aimed to provide participants with a systematic approach to induction of general anesthesia that could be augmented for specific procedures when necessary in the clinical environment. This was accomplished by using scenarios with 5 different surgical procedures commonly encountered by new SRNAs. All 5 cases were nonemergent procedures for healthy patients and required the same anesthesia induction plan.

The SRNA control group did not receive structured HFS training. HFS was available to them but it was not mandated nor was it highly structured. For example, an afternoon skills lab included multiple stations and students self-selected the amount of time spent with each skill. HFS experiences varied, the simulations lacked objectives, and scenarios were dependent on the instructors. There was no standard amount of time the students spent in HFS and participation required self-motivation. The project's orientation process provided the intervention group with a standard of performance for the basic skills of equipment preparation, medication preparation, and the steps of anesthesia induction. While provider skill level is an element, many other things influence the amount of time required to safely anesthetize a patient, such as the surgical procedure; the patient's size, age, and weight; and the need for an endotracheal tube and any additional intravenous, arterial, or central access or monitoring devices. All of these factors and tasks can impact the time anesthesia providers require to anesthetize a patient.[14]

No benchmarks exist within the literature or anesthesia professional organizations that state what an IRTART should be for a specific surgical procedure, diagnosis, or presenting patient condition.[14] This simulation program does not account for every situation or factor that may impact an IRTART but promotes repetition of the portions of an anesthetic that are within the provider's control, such as ensuring the presence and function of airway equipment. Therefore, the percentage of SRNAs with IRTART beyond 30 minutes may have experienced a delay related to something other than their basic skill level. This cannot be determined without additional data collection.

The medical center's OR surgical schedule begins at 0730 every weekday. For a procedure scheduled to start at 0730, the anesthesia provider is expected to bring the patient to the assigned OR suite by 0700, allowing approximately 30 minutes for the induction of anesthesia. The clinical performance of both groups of nurse anesthesia students, those with and without structured HFS before the onset of clinical training fell within the scheduled 30-minute time frame. While an impact of structured HFS was not seen with the comparison of IRTARTs, the data and statistical analysis highlight the positive performance of the majority of students within the institution's established acceptable time frame for the anesthetic preparation of a patient.

The results of this project support 3 main conclusions. First, the current NAP curriculum prepares students to perform within this OR's accepted time frame of efficiency at the start of their clinical training. This is highlighted by the very similar performance of both groups during the first month of their initial OR rotation. Second, the ART did not indicate an effect of structured HFS on the training of nurse anesthetists. It is possible that both groups performed equally because the HFS training did not have an impact or that ART is not sensitive to differences in individual performance. A larger sample size or a different measurement tool may better identify changes in student proficiency as a result of HFS. Third, the 2 years of consistent average ARTs between 10 and 30 minutes can be used to partially counter the argument that novice nurse anesthesia students decrease OR efficiency. The presence of basic skills on arrival to the clinical setting allows preceptors to tailor training to other factors that impact timely performance.

In summary, NAP students have limited clinical training opportunities as a result of unconfirmed observations of anesthesia department administrators that SRNAs decrease OR efficiency because they require too much instruction. Guided by the Iowa Model, we inserted a 5-week, structured HFS program into the NAP curriculum before the students' first clinical rotation. The program promoted basic anesthesia skill proficiency through the assimilation of previously taught and tested technical skills. Using the calculation of IRTART, we compared the clinical performance of SRNAs who underwent the structured HFS training with that of SRNAs with unstructured HFS training.

In conclusion, the structured HFS did not impact the ART of new-to-practice SRNAs, although the IRTARTs of both groups were similar and within the institution's operating norms. The information gained during the implementation of HFS and the data analysis period can be used to develop future avenues to improve current processes. Further studies identifying clinical indicators sensitive to HFS are necessary before cause and effect can be determined.

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