High-Fidelity Simulation for Continuing Education in Nurse Anesthesia

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Simulation represents a true paradigm shift in teaching and learning that has revolutionized healthcare education. However, few continuing education opportunities for anesthesia providers exist using simulation of any type. This article explores the usefulness of high-fidelity simulation (HFS) as a valuable tool for continuing education and reports the results of a needs assessment conducted among 22 practicing nurse anesthetists. The questions related to their exposure to HFS and asked them to rank their experience with 11 anesthesia events. Next, respondents were asked to rank a similar list of anesthesia events that would be useful for continuing education using simulation.

Of participants, 71% ranked advanced cardiac life support scenarios, anesthesia machine mishaps, and malignant hyperthermia as highly effective choices for using HFS. Eighty-one percent of participants identified that they envision simulation as a valuable tool to assess competency, but respondents had mixed written responses when asked if simulation should be used for recertification. This needs assessment represents a beginning, grassroots attempt to establish nurse anesthetists' perceptions related to using HFS as a tool for continuing education.

Keywords: Continuing education, high-fidelity simulation, nurse anesthetists, simulation.

A revolution in continuing education is occurring, and simulation is a key component. The most recent Institute of Medicine (IOM) initiative on *The Future of Nursing*[1] endorses simulation as an innovative educational technique to be used to expand the workforce, assess competency, and promote team training. Simulation as a teaching and learning method has been advocated as a viable tool to decrease human error in healthcare and anesthesia and is described as an ethical imperative.[2-4]

Simulation has now achieved enough status that it will be formally incorporated into the recertification process for anesthesiologists.[5,6] However, few continuing education opportunities for anesthesia providers exist using simulation of any type. Virtually no research has explored experienced Certified Registered Nurse Anesthetists' (CRNAs') thoughts, attitudes, and knowledge regarding participation in continuing education activities using high-fidelity simulation (HFS).[7-9] This article endeavors to explore the usefulness of HFS as a valuable tool for continuing education, and it reports the results of a needs assessment conducted among a small group of nurse anesthetists to glean future directions for continuing education curricula incorporating HFS. High-fidelity simulation immerses the participant using a variety of physiologic and pharmacologic real-time parameters to suspend disbelief.[10-13]

Simulation appears to be the idyllic teaching and learning method in many educational settings, but there are substantial barriers, limiting its diffusion into continuing education curricula. First, simulation is complex and requires extensive faculty involvement.[14] High-fidelity simulation is expensive, and many healthcare professional associations cannot afford the equipment and workforce needed to manage an effective simulation center. Therefore, access to this technology is currently unavailable to most practitioners.[10] Healthcare practitioners often avoid involving themselves in simulated activities because the simulated environment is unfamiliar and daunting. Other authors cite lack of exposure to simulation and an aversion to being videotaped as a barrier to using simulation for continuing education.[15,16]

Simulator technology related to fidelity may be new, but the technique of using simulation as a teaching and learning method has been used in nursing and nurse anesthesia for more than 30 years.[9,17] Simulation is used routinely throughout the education and training of student registered nurse anesthetists in approximately 96% of nurse anesthesia programs, although only approximately half of all nurse anesthesia programs use HFS.[18] Credentialing bodies are evaluating the use of simulation technologies to assess the competency and safety of its practitioners.[19]

Review of Literature

The review of the literature included evidence from nursing and nursing students because most information pertaining to perceptions of simulation in healthcare

education curricula currently resides in these areas. Evidence from other industries, such as aviation and the nuclear industry, was excluded from this review in order to focus and analyze existing evidence from a more homogeneous professional vantage point. This focus can become broader and more heterogeneous as more evidence is gathered regarding professional attitudes and perceptions in nurse anesthesia related to using simulation for continuing education.

Research related to nursing students and student registered nurse anesthetists using simulation tends to focus on qualitative aspects of the learning experience.[20-23] Consistently, students enjoy and appreciate simulation and value HFS as a meaningful teaching and learning experience.

Experienced nurse anesthetists express similar positive perceptions. Ten CRNAs who participated in an HFS scenario plus a debriefing session related to malignant hyperthermia reported that this type of deliberate practice was a valuable, positive experience.[7] Experienced nurse anesthetists agree that the rare occurrence of critical events would be a strong rationale for the use of simulator technology. In other words, it is difficult to maintain competency and schedule continuing education events for critical events rarely occurring in practice.[8] High-fidelity simulation would be perfectly matched to curricula focusing on high-risk, low-exposure events. More research with CRNAs is needed to delineate specific curricula using simulation that would be meaningful.

Surveys in nursing education and nursing practice that assess usage patterns and other experiences involving HFS appear in the literature. An international survey of 66 nursing programs and 150 simulation centers revealed that HFS was used most commonly in associate degree curricula for medical-surgical courses, whereas in bachelor degree programs HFS was used mostly for basic skills assessment.[22] High-fidelity simulation was used the least in graduate nursing programs; however, when it was used, it was most beneficial for advanced physical assessment and in the nurse anesthesia specialty.[22] A survey among 523 practicing registered nurses in a tertiary hospital identified barriers of HFS-based education and training.[16] These barriers included stress while in the simulated environment, unfamiliarity with the equipment, and anxiety about being videotaped. Nurses with prior simulation experience identified fewer barriers to simulation training than those with little or no prior exposure to HFS. Managing rare events was commonly suggested as a priority for simulation-based education, particularly among nurses with fewer than 5 years of experience.[16]

Fallacaro and Crosby[8] asked 120 practicing nurse anesthetists to identify and rank adverse events that occur in their daily anesthesia practice for the purpose of expanding and using these events in future simulation curricula. Seven events, in order of frequency, were identified as having occurred most frequently: hypertension, hypotension, bradycardia, acute hemorrhage, hypothermia, coronary constriction, and oliguria.

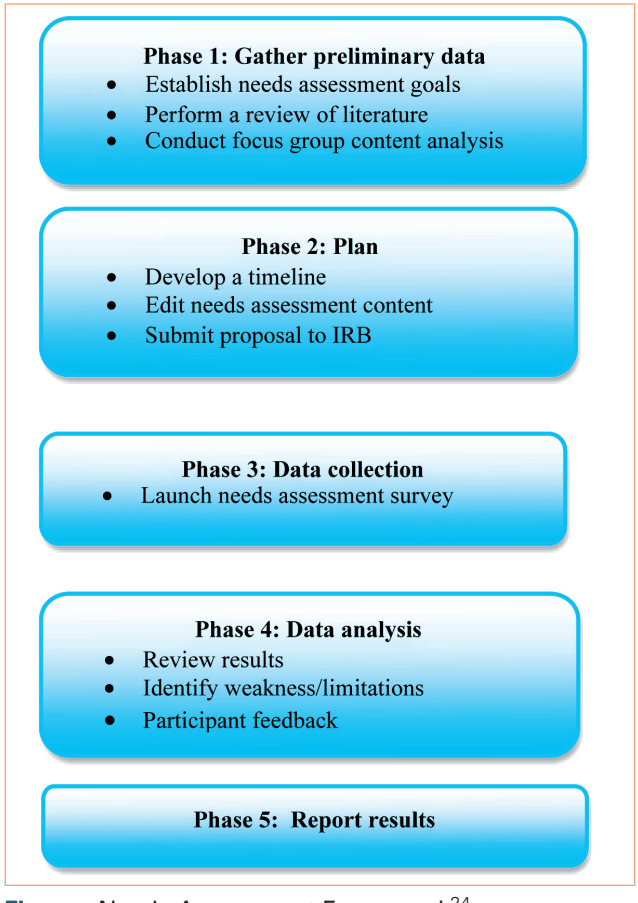

Figure. Needs Assessment Framework[24]
Abbreviation: IRB, institutional review board.

Traditional methods of continuing education among nurse anesthetists must be reevaluated to incorporate simulation activities in places where it might be beneficial to maintain competence in technical skills and complex clinical decision-making. Therefore, exploring how nurse anesthetists would use simulation as a teaching and learning method and how they perceive HFS technology would be valuable. One step toward a more organized approach to using simulation as a teaching and learning method among experienced nurse anesthetists is to conduct a needs assessment of these adult learners.

Methods of Conducting a Needs Assessment

The purpose of this needs assessment was to create a pilot survey to investigate the knowledge, perceptions, and attitudes of nurse anesthetists regarding using HFS for continuing education.[24] A needs assessment could be considered a beginning toward applying evidence-based practice in the setting of education and includes not only finding and using the best evidence in providing quality

1. Please indicate your gender.
2. Please select a category that includes your age.

   20-30 51-60

   31-40 61-70

   41-50 > 70
3. Please select the number of years you have been practicing as a CRNA.

   0-5 years 16-20 years

   6-10 years 21-25 years

   11-15 years > 25 years
4. Which of the following best represents your type of anesthesia practice setting?

   Hospital

   Ambulatory/outpatient (surgical center/office-based)

   Academic (college/university)

   Administration

   Research
5. Please indicate your current employment status.

   Full-time Part-time
6. Have you ever been exposed to high-fidelity simulation (HFS)? (A high-fidelity simulation involves an immersive scenario experience where a mannequin automatically responds to user assessments and interventions. The simulator breathes, has heart sounds and breath sounds, and allows a variety of medications and other interventions to be administered.)

   Yes No
7. If you have been exposed to HFS, please indicate the type of first experience.

   Nursing undergraduate curricula

   Nurse anesthesia curricula

   Anesthesia continuing education conference

   Other, please specify *(open-ended response allowed)*
8. How many other educational experiences using simulation have you had since your first experience?

   None 1 2 3 > 3
9. Does your institution have a high-fidelity simulator?

   Yes No Unsure
10. Would you be interested in earning continuing education credits using high-fidelity simulation?

    Yes No Unsure
11. Would you pay additional money for a continuing educational event that was designed using high-fidelity simulation?

    Yes No Unsure
12. Would you be interested in being an active participant for a continuing educational event utilizing high-fidelity simulation? (An active participant would be at the head of the bed actively involved in the scenario, making decisions and interacting with the simulator and any other participants involved in the scenario.)

    Yes No Unsure
13. How important is simulation to teaching current and future issues/topics in nurse anesthesia continuing education?

    Highly unimportant

    Somewhat unimportant

    Neutral

    Somewhat important

    Highly important
14. Approximately how often do you encounter the following clinical issues? (Choices are daily, weekly, monthly, once per year, rarely [every few years], or never.)

    Anaphylaxis

    Anesthesia machine mishaps

    Bleeding

    Bronchospasm/laryngospasm

    Cardiopulmonary resuscitation

    Difficult airway

    Hypotension

    Hypertension

    Hypoxemia

    Respiratory failure

    Malignant hyperthermia

    Myocardial ischemia/infarction
15. How effective do you believe high-fidelity simulation could be for continuing education related to the clinical issues listed below? (Choices are highly effective, effective, neutral, ineffective, or highly ineffective.)

    Anaphylaxis

    Anesthesia machine mishaps

    Bronchospasm/laryngospasm

    Anesthesia crisis resource management

    Cardiopulmonary resuscitation

    Debriefing

    Difficult airway

    Hypotension/hypertension

    Hypoxemia/respiratory failure

    Malignant hyperthermia

    Myocardial ischemia/failure
16. Do you have any comments or suggestions related to continuing education using high-fidelity simulation? *(open-ended question)*
17. Do you envision simulation as a valuable tool to assess clinical competency?

    Highly not valuable

    Not valuable

    Neutral

    Valuable

    Highly valuable
18. What are your thoughts regarding using high-fidelity simulation for recertification? (*open-ended question*)

Table 1. Final Needs Assessment Survey Questions

education but also what best suits the individual participating in the educational event.[25]

A systematic approach was used to develop this needs assessment following Gupta's framework.[24] In phase 1, prior published surveys conducted in nursing and nurse anesthesia were translated to this assessment. Key phases of this approach are outlined in the Figure. Content validity was performed as part of phase 1, using a small focus group of 4 practicing CRNAs, 2 of whom were content experts, having experienced HFS both in nurse anesthesia education and continuing education. The other 2 CRNAs had no HFS experience. Each member of the focus group completed the survey privately, and then all 4 came together to discuss and decide if each question would remain in the survey, would be deleted from the survey, or would be modified. Gaps related to information contained in the survey, as well as future information needed to be ascertained, were discussed. The final version of the needs assessment appears in Table 1.

Phase 2 included a project proposal approved by the institutional review board of Texas Christian University Harris College of Nursing and Health Sciences. Phase 3 launched the data collection process using Zoomerang, a web-based survey site. Participants had a 2-month time frame to respond. A reminder was sent electronically to all participants 2 weeks before the needs assessment survey was closed. Informed consent was implied by voluntarily agreeing to complete the needs assessment survey. Individuals could respond only once, and all responses were anonymous.

A convenience sample of 50 practicing nurse anesthetists from Fargo, North Dakota, and Houston, Texas, were asked to complete the electronic needs assessment survey. Participants were chosen in specific geographical areas that were already known to the investigator, in order to simplify access to participants for this pilot project.

Results

Twenty-two of 50 individuals completed the needs assessment, yielding a response rate of 44%. Most respondents were not affiliated with Texas Christian University. Demographic analysis (Table 2) revealed that respondents were mostly female (59%) and between 31 and 50 years of age (64%). Of the respondents, 23% had up to 5 years practicing as a CRNA, 27% had 6 to 10 years of experience, 27% had 11 to 25 years of experience, and 23% possessed greater than 25 years of experience. Most of the nurse anesthetists practiced full-time (95%) and in a hospital setting (73%).

These respondents were nearly equally balanced between having prior exposure to HFS (48%) and having no prior exposure to HFS (52%), with 1 respondent not fully answering this question (Table 3). Ninety-one percent of nurse anesthetists exposed to HFS experienced it for the first time in their nurse anesthesia curricula, with only 1 nurse anesthetist experiencing HFS as part of a continuing education experience. Overall, 59% of the participants had never experienced subsequent exposure to any other educational experiences using HFS. Most nurse anesthetists participating in this needs assessment survey worked in an institution that does not have a HFS (57%), but most were interested in earning continuing education credits using HFS (77%).

	No. (%)[a]
Gender	
Male	9 (41)
Female	13 (59)
Age (y)	
20-30	1 (5)
31-40	7 (32)
41-50	6 (27)
51-60	6 (27)
61-70	1 (5)
> 70	1 (5)
Years of CRNA practice	
0-5	5 (23)
6-10	6 (27)
11-15	2 (9)
16-20	4 (18)
21-25	0 (0)
> 25	5 (23)
Practice setting	
Hospital	16 (73)
Ambulatory	0 (0)
Academic	5 (23)
Office	0 (0)
Administration	1 (5)
Research	0 (0)

Table 2. Demographic Characteristics (N = 22)
[a] Some totals do not add to 100% because of rounding.

The higher cost of simulation technology, as opposed to traditional teaching and learning methods, has been cited as a barrier to simulation.[16] Yet more than half of the nurse anesthetists polled would pay extra to experience HFS for continuing education (59%) and would be interested in being an active participant (68%). Participants also reported that simulation was of some to high importance (77%) to teaching current and future topics for continuing education in nurse anesthesia.

Eleven anesthesia intraoperative critical events were part of the needs assessment survey, and respondents were asked to indicate how frequently they experienced each event in their practice (daily, weekly, monthly, once per year, rarely, never). This list was adapted from the anesthesia pathophysiologic events used in the study by Fallacaro and Crosby.[8] The 3 most frequently

Any exposure to HFS[a]	No. (%)
Yes	10 (48)
Type of first exposure to HFS[b]	
Nursing undergraduate curricula	0 (0)
Nurse anesthesia curricula	10 (91)
Anesthesia-related CE conference	1 (9)
Other	0 (0)
No	11 (52)

Table 3. Reported Simulation Experiences (N = 22)
[a] One respondent did not check yes or no but replied to the subquestion on type of first exposure to HFS.
Abbreviations: HFS, high-fidelity simulation; CE, continuing education.

experienced anesthesia intraoperative critical events reported by participants in this survey to occur on a daily or weekly basis were hypotension (48%), hypertension (32%), and bleeding (14%). Cardiopulmonary resuscitation and anaphylaxis were ranked as experienced rarely to almost never. These rarely experienced high-risk, low-exposure critical anesthesia events create a compelling reason to use HFS for continuing education, as they pose no harm to patients but allow unlimited practice, especially in a team setting.

Next, the participants were asked to review a list of anesthesia events and select those that would be useful for continuing education using simulation. The list of anesthesia events was compiled from simulated anesthesia events found in the literature and from the author's personal experience with simulation.[8,26,27] Cardiopulmonary resuscitation scenarios, anesthesia machine mishaps, and malignant hyperthermia were selected by 71% of the respondents as being highly effective choices for using HFS as part of continuing education curricula, whereas difficult airway, debriefing, and anesthesia crisis resource management were least frequently selected. Eighty-one percent of CRNA respondents identified that they envision simulation as a valuable tool to assess clinical competency, but respondents had mixed written responses when asked if simulation should be used for recertification.

Discussion

Many nurse anesthetists in this needs assessment survey saw the value of using HFS for recertification but did not feel comfortable with simulation in general. This is similar to findings in other surveys.[16,22] One possible explanation for this finding is the participants' limited exposure to simulation. Simulation in nurse anesthesia is a relatively new phenomenon; only 48% of the participants had prior HFS experience. In this group, 59% of respondents had no subsequent exposure to HFS, whereas 33% had greater than 3 exposures to HFS. These data likely reflect the limited nature of sampling conducted in this pilot study and cannot be generalized among all nurse anesthetists. A future needs assessment survey conducted nationally could glean more comprehensive knowledge related to CRNA exposure to HFS. Increased exposure of nurse anesthetists to HFS is needed in order to more thoroughly evaluate learning needs using this innovative technology.

This sample of nurse anesthetists ranked difficult airway, anesthesia crisis resource management, and debriefing the lowest among their choices for highly effective uses for HFS. Strong evidence exists supporting simulation for all of these clinical issues. Anesthesia crisis resource management and nontechnical skills are integral to simulation curricula. Debriefing is at the crux of effective simulation.[10,14,27] Increased exposure to HFS might change these existing perspectives regarding specific curricula using simulation. However, this needs to be studied on a larger scale in order to possess greater external validity and extrapolate this information to a larger population.

Using HFS for recertification resulted in mixed written responses when asked as an open-ended question in this needs assessment survey. Six responders indicated they were unsure, compared with another 6 responders who indicated HFS for recertification was a good idea. Only 2 survey responders wrote that recertification using simulation is "unfavorable and make-believe practice" and "absolutely unnecessary." It would be interesting to glean more information regarding recertification issues and HFS from nurse anesthetists.

It is clear that this needs assessment has limitations related to selection bias from accessing only participants known to the investigator and its small sample size. More questions must be explored related to anesthesia topics of interest using simulation as well as to perceptions related to using simulation for recertification. Nurse anesthetists are interested in using simulation for continuing education curricula, but more information is necessary at the national level in order for an organized approach to be effective.

Conclusion

Best evidence does not exist regarding a specific place for HFS among experienced nurse anesthetists. This pilot needs assessment survey was developed from the literature and was conducted to establish grassroots perceptions related to HFS and to explore the extent of interest in using HFS as a tool for continuing education among practicing nurse anesthetists. This needs assessment identified a strong interest, with 77% of CRNAs willing to participate in HFS for continuing education. It is evident that practicing nurse anesthetists value simulation as a teaching and learning method but do not fully understand its capabilities. High-risk, low frequency events such as cardiopulmonary resuscitation, anesthesia machine mishaps, and malignant hyperthermia were cited as highly effective events to be used in simulation

curricula. An overwhelming 81% of respondents valued HFS to assess competency, but only 59% favored using HFS for recertification. A knowledge gap persists related to exactly how and when to use HFS as an effective teaching and learning method for continuing education among practicing nurse anesthetists. Information from this needs assessment could be used as a foundation for further research and educational planning at the local, state, and national levels related to using HFS for continuing education.

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