NURSE ANESTHESIA STUDENTS’ PERCEPTIONS OF THE ANESTHESIA PATIENT SIMULATOR: A QUALITATIVE STUDY

Simulators have been used in aviation since the 1960s to train pilots on the ground how to practice conducting dangerous maneuvers. Other occupations also have successfully used simulators to teach employees complex systems and psychomotor skills. Operators of nuclear power facilities and military equipment have been trained through the use of simulators. A simulator designed to mimic the anesthesia patient was first developed in 1988. Since then, the number of hospitals and universities buying simulators for educational purposes is increasing. Using the anesthesia simulator to teach nurse anesthesia students is a new phenomenon. Very few studies have been conducted that look at the outcomes of using simulators for educational purposes, especially in a qualitative manner.

A qualitative study was conducted to determine the perceptions of nurse anesthesia students (NAS) in the use of the anesthesia patient simulator as part of their educational training. Qualitative research fills “in the gaps left by the numbers gathered in strictly quantitative research.” The researcher gathered a large body of knowledge through interaction with the students and by collecting “rich and thick” data from observations, journal entries, and focus group interviews. Rich and thick data consist not of numbers, but of words, meanings, thoughts, and feelings of those being researched. This information may not have been identified without using a qualitative approach. Through interpretive phenomenology, an approach drawn from the field of psychology, the information obtained from studying the perceptions of NAS can be used to build hypotheses and theories on their discovered behaviors. The data will provide a solid framework of knowledge about the researched topic and a meaning to the experiences of the nurse anesthesia students who use the simulator for training now and in the future.

**Research objectives**

A qualitative-based study was conducted to explore the perceptions of NAS using the simulator in their educational training. The major research question that was explored was:

- What are the perceptions of NAS to the anesthesia patient simulator experience?

Other questions included:

- What are the behavioral responses and the reported anxiety levels of the students to the simulator sessions?
- How do the students perceive the simulator sessions in relation to their anesthesia education?
- What are the most favorite and least favorite aspects about the simulator?
- Should the simulator be used for certification and recertification?

**Methodology**

A convenience sample of 12 NAS in their first year of nurse anesthesia training was chosen for the study. First-year NAS were chosen due to their lack of previous exposure to the simulator. Following approval from the investigational review board, the study was initiated.

The primary investigator used 3 different strategies to collect the data. Data were triangulated when analyzed to increase the trustworthiness and reliability of the findings. The 3 different methods used were observation by the
primary investigator, journal entries by the anesthesia students, and focus group interviews with the anesthesia students.

Four different sessions were held in the simulator laboratory (Table 1). Session 1 was designed to familiarize the students with the simulator and the monitoring equipment. Presentations were given to demonstrate how the computer-driven mannequin responds to different medications and types of treatment. The primary investigator documented observations of the students regarding their reactions to the experience. Since this session consisted mostly of demonstration, documentation was minimal and consisted of the students’ reactions to the experience.

During the second session, the students were taught how to perform an anesthetic induction using the simulator. The primary investigator documented how the students reacted to the experience. Documentation was again minimal since it was mostly a teaching session. Reactions by the students consisted of excitement and nervousness.

The third session was held after the students were in the clinical area for 5 weeks. Each student took his or her turn being in charge of the “patient.” During each session, a minor incident occurred, which consisted of 1 of the following incidents: hypotension, tachycardia, hypertension, or bradycardia. The student was unaware of what was going to occur but was supposed to try to diagnose and treat it.

The fourth session was held after the students had been in clinical for 10 weeks. Each student took his or her turn being in charge of the “patient.” During each session, a critical incident occurred. The student was unaware of which critical incident would occur. Critical incidents included cardiac ischemia, bronchospasm, anaphylaxis, or malignant hyperthermia. The student was supposed to try to diagnose and treat the incident. The primary investigator recorded observations of sessions 3 and 4 and compared results (Table 2). Since the students had very little clinical experience at this time, the students were not expected to properly perform all of the tasks on the observation form. They could ask for help anytime from another anesthesia provider. No patient scenario ended in death. It was stopped before this was allowed to occur.

All of the sessions were videotaped and watched by the students during a debriefing period that followed each session. Interactive discussions and critiquing occurred within the group. The students made journal entries and participated in focus group interviews after each of the 4 sessions. The students were asked to write, and the students provided the opportunity “to make an in-depth assessment of their education experiences.”

### Table 1. The study design

<table>
<thead>
<tr>
<th>Session</th>
<th>Time</th>
<th>Size</th>
<th>Scenario</th>
<th>Data collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Before OR experience</td>
<td>Two groups of 6 students in each group</td>
<td>Introduction to the simulator laboratory and equipment</td>
<td>1. Observation 2. Journal entries</td>
</tr>
<tr>
<td>2</td>
<td>Before OR experience</td>
<td>Three groups of 4 students in each group</td>
<td>Demonstration of an anesthetic induction of the “patient” simulator; return demonstration by student</td>
<td>1. Observation 2. Journal entries 3. Focus group interviews</td>
</tr>
<tr>
<td>3</td>
<td>5 weeks after being in OR and managing cases</td>
<td>Each student individually entered the “OR” and was given a scenario</td>
<td>A minor incident occurred after student received report: 1. Sinus bradycardia 2. Sinus tachycardia 3. Hypertension 4. Hypotension</td>
<td>1. Observation 2. Journal entries 3. Focus group interviews</td>
</tr>
<tr>
<td>4</td>
<td>10 weeks after being in OR and managing cases</td>
<td>Each student individually entered the “OR” and was given a scenario</td>
<td>A critical incident occurred after student received report: 1. Cardiac ischemia 2. Bronchospasm 3. Anaphylaxis 4. Malignant hyperthermia</td>
<td>1. Observation 2. Journal entries 3. Focus group interviews</td>
</tr>
</tbody>
</table>

OR = operating room
Using a modified version by Moustakas\textsuperscript{11} of the Stevick-Colaizzi-Keen Method of Analysis of Phenomenological Data and merging it with Creswell’s Data Analysis Procedures,\textsuperscript{9} the observation notes, journals, and transcriptions of the audiotaped interviews were analyzed. Bracketing of preconceptions was initially performed to minimize researcher bias.\textsuperscript{12} Triangulation was then used to validate the findings among the methods. Categorizing and coding of information formed the basis of the analysis as themes were identified among the gathered data.

Several themes emerged after analyzing the data obtained from the interviews, journals, and observation forms. The students perceived the simulator experience to have both advantages and disadvantages. Advantages identified included the ability to evaluate cognitive and psychomotor skills, the development of critical thinking and decision-making skills along with crisis management skills, and the

**Table 2. Observation form for session 3 and 4**

<table>
<thead>
<tr>
<th>Performance</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Familiarizes self with the environment</td>
<td></td>
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<tr>
<td>2. Constructs an anesthetic plan</td>
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<tr>
<td>3. Briefs appropriately for case complexity</td>
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<tr>
<td>4. Remains vigilant</td>
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<tr>
<td>5. Detects early manifestation of event</td>
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<td></td>
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<tr>
<td>6. Recognizes manifestations as abnormal</td>
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<tr>
<td>7. Demonstrates knowledge relevant to event</td>
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<td></td>
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<tr>
<td>8. Initiates initial life support measures as needed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Begins resource management when necessary</td>
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<td></td>
<td></td>
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<tr>
<td>10. Demonstrates leadership skills</td>
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<td></td>
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<tr>
<td>11. Notifies surgeon of possible problem</td>
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<tr>
<td>12. Addresses clear commands to specific individuals</td>
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<tr>
<td>13. Listens to opinions of others</td>
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<tr>
<td>14. Delegates tasks appropriate to skill level</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>15. Ensures that someone always observes patient and monitors during crisis</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>16. Activates human and/or electronic recorder</td>
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<td></td>
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<tr>
<td>17. Remains in supervisory role</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>18. Manages distractions appropriately</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Prioritizes problems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. Avoids fixation errors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21. Declares emergency early</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22. Calls for help and uses help appropriately</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>23. Assesses and reevaluates patient status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24. Double checks important data</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>25. Prepares for postevent care</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26. Overall, handles crisis management well</td>
<td></td>
<td></td>
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</tbody>
</table>

management of rare or unusual anesthetic events, increased confidence, and the development of leadership skills. Disadvantages identified by the students included the lack of reality of the simulator, the lack of knowledge in managing crisis events due to their inexperience, the potential for making fixation errors, and the anxiety that the sessions cause. Although some of the students felt the simulator seemed very realistic to the actual operating room, a few of the students felt the mannequin lacked reality due to the inability to assess physiological changes such as pallor, cyanosis, or sweating.

The lists of advantages and disadvantages were presented to the students to verify the findings with them. The students were then asked to number these findings by order of importance. Table 3 lists the advantages in rank order and Table 4 lists the disadvantages in rank order.

**Results**

The NAS felt that the simulator has several advantages. It helps develop critical thinking and decision-making skills, crisis management skills, and management of rare or unusual events. One of the students stated, “It taught me to make decisions in times of crisis.”

The students learned how to administer anesthesia without posing any harm to a real patient. Another student stated, “You can experience an incident and learn what to do without hurting anyone. You can even stop the scenario to have a discussion with the instructor.”

The students felt the sessions simulated an actual operating room and seemed very realistic to the actual operating room. They felt their confidence levels actually increased by becoming familiar with the setting and learning how to manage a simulated patient.

The students felt the simulator could be used to evaluate their own cognitive and psychomotor skills and improve those skills that they are weak in through practice. The video sessions were a helpful method for learning. By watching the recorded sessions on videotape and debriefing through discussion, the students learned what they did wrong and discussed methods for improvement. When asked if videotaping and debriefing should be used in future sessions, they all agreed that it should. The sessions help to build leadership skills, such as supervision and delegation. During the last session, the students called for help quicker when compared to the session before. They also delegated tasks to the operating room staff more efficiently by using first names to gain their attention and by talking to them directly.

Although there are many advantages, the students identified a few disadvantages. Disadvantages include the lack of reality of the simulator in reference to skin color, sweating, and shivering. Other disadvantages include the lack of knowledge in managing crisis events due to inexperience, the potential for making fixation errors, and the anxiety that the sessions cause. Fixation errors occur when the student becomes fixated on a specific issue, hindering his or her thought process and preventing him or her from being able to recognize other things that are occurring with the patient. Fixation errors can lead to misdiagnosis and incorrect treatment of the incident. Lack of knowledge can contribute to fixation errors. One student described the anxiety by stating, “You feel the adrenaline rush because you know that something is going to happen.” Although there were disadvantages, the advantages seemed to outweigh the disadvantages. Many of the students viewed the simulator experience as “a vital part of their education.”

- **Behavioral responses.** All of the students experienced some anxiety during the sessions. Anxiety can
be described as feelings of apprehension, uneasiness, or fear. Some of the students’ anxiety decreased with more sessions due to familiarity, while other students experienced more anxiety with each session. Their explanation was that they felt a better performance was expected of them with each new session. Despite the anxiety, the students felt the simulator was very beneficial.

- **Simulator utilization for anesthesia education.** In regard to the simulator and its importance in its use for anesthesia education, all of the NAS felt the simulator should be a vital part of their curriculum. They felt their educational experience was improved with the simulator use. They all stated that more educational time should be dedicated to its use. One of the best actions that nurse anesthesia instructors can do, as perceived by the students, is to increase the number of simulator sessions and to start using it in the educational program as early as possible. They felt that it should be used throughout the program and be continued after graduation as a continuing education tool.

- **Most favorite aspects.** The students were asked what they liked best about the simulator sessions. Major themes that emerged about their most favorite experiences included the ability to learn how to anesthetically care for a “patient” in a controlled environment, the ability to learn without posing harm to a real patient, and the ability to learn how to treat rare events or unusual complications.

  Many of the students enjoyed the teaching that occurred throughout the sessions. The sessions could be stopped temporarily while a discussion occurred. When the discussion ended, the scenario could then continue. This allowed time for questions and answers without the pressure of continuously monitoring the patient. The ability to stop the scenarios and allow time for educational discussions decreased the anxiety level of the students during the sessions. Watching the videotaped sessions and debriefing with the instructor and classmates were helpful to the learning process. Such actions were beneficial in that they allowed learning to occur through discussions. One of the students commented, “The most helpful part was watching the video and discussing the incidents with the other students and instructors.”

  Being able to do “hands-on” training rather than just reading the lesson out of a book also improved the educational process. By performing psychomotor skills on a simulated patient, the learning experience could become more realistic and would be easier to remember.

  The concept of being able to experiment with different types of treatment methods without causing any harm to a patient was a positive feature. According to 1 student, experiencing the event with the simulator was better than having it happen in a real setting so that you could learn how to treat the complications without a bad outcome.

  In describing the concept of learning about rare events or unusual complications, one of the students stated, “I feel the simulator helped me to learn more and feel better about handling anesthetic complications.” The simulator is an effective tool for teaching or creating unusual or rare events that may occur when administering anesthesia. For instance, malignant hyperthermia is an inherited myopathy that may occur in a patient receiving an anesthetic. According to Longnecker and Murphy, the incidence of susceptibility is 1 in 62,000 for those receiving an anesthetic known to trigger the syndrome. Although the incidence is rare, anesthesia providers are expected to quickly diagnose and treat the problem if it occurs. If quick action is not taken or if it is misdiagnosed, the patient could die. Because the crisis is so rare, it may be difficult for anesthesia providers to maintain proficiency in the diagnosis and treatment of malignant hyperthermia. Experiencing the crisis on the simulator may reinforce the diagnosis and treatment of anesthesia providers.

- **Least favorite aspects.** Some of the themes that developed regarding the least favorite issues with the simulator included the frustration of working with malfunctioning machines and equipment, the lack of reality of the simulator, the “sitting duck feeling,” and the insecurity of taking over an anesthetic case from another Certified Registered Nurse Anesthetist (CRNA).

  When technology is involved in the education of students, equipment malfunction is always a potential problem. Although the equipment failures did not occur often and were usually a minor mishap, the students became distracted. These distractions interfered with their ability to learn in a productive fashion. The students’ lack of clinical skills and inexperience sometimes interfered with their ability to improvise if a monitor or machine was not working properly.

  For example, the end-tidal carbon dioxide monitor did not work properly at times. However, the students were allowed to ask the technician, a registered nurse controlling the computer switches and overseeing the scenarios, what the carbon dioxide level was at any time. Another instructor playing the role of the circulating nurse also would verbally state the carbon dioxide level every 60 seconds. Some of the students seemed distracted with having the number called out to them. They were familiar with checking a visual number on the screen. It seemed difficult for the stu-
students to be able to combine the verbal number with the other symptoms that were occurring and make a differential diagnosis of the situation. One of the students described the situation by stating, “When the carbon dioxide monitor was not working, I became distracted and could not look at the whole picture of what was going on with my patient even though I was told what the reading was.”

Another least favorite issue that emerged was the lack of reality of the simulator, especially the inability to assess color and moisture of the skin. No matter how real the situation appeared to be, it was not a real operating room. Because the environment was a simulation, one of the students stated, “You never know exactly what to ignore and what not to ignore when you’re trying to make exceptions for the fact that it is not a real situation.”

Not knowing which crisis scenario would occur or when it would occur also was frustrating to the students. Described by the students as the “sitting duck feeling,” many of them stated that they hated waiting for the incident, wondering what would occur, how severe it would be, and whether or not they would be able to diagnose and treat the event appropriately. One of the students stated, “I felt like a sitting duck just waiting for something to happen. The longer the time went by without something happening, the more I hated being in there.”

Another least favorite issue involved the lack of detail in the report from the CRNA that students were relieving. Not feeling comfortable in taking over the anesthetic case and having the CRNA leave before they were at ease led to feelings of stress and insecurity. One student described the feelings by saying, “When you walk into a situation, receive a quick report, and the person then says ‘see you later’ as they walk out the door, it's really hard to get a feeling of what's going on.”

These insecure feelings were often compounded by the thought that the technician would soon trigger a crisis event. They found themselves scrambling to orient themselves to the anesthetic case before the event was triggered. One student described her feelings in this manner, “I knew a crisis would occur, but I found it very difficult to attempt to treat problems” due to feelings of disorientation and unfamiliarity with the case.

- Certification and recertification. The students in the study were asked if they thought simulation should be used for certifying nurse anesthetists following graduation. Most of the students felt the simulator should not be used for certification. Their reasons included the concept that the simulator is not totally realistic, that certain instructors would evaluate more strictly than others, and that the scenarios would differ among the applicants, making the process unfair. Some of the students felt that it would be difficult to make the testing as fair as possible, which would be required in order to treat students equally. One of the students stated, “You may get a really mean evaluator who grades you unfairly.”

When asked about using the simulator in the future for recertification of CRNAs, again the consensus was against using it. To be recertified, there is no psychomotor skills validation. However, some experts feel that psychomotor and clinical skills should be validated before recertification as a CRNA is granted. Most of the students felt that the simulator should not be used for this, because they felt the process could not be conducted in a fair manner. One of the students compared nurse anesthetists to pilots who use the simulator by stating:

> The difference between pilots and us is that there is so much that you read from the patient that you can't put on a machine. Whereas, with pilots, their whole thing is strictly instruments. They're told to trust their instruments instead of what they see. We are told to trust what we see instead of our instruments or monitors.

Although the majority of the students were against the use of the simulator for recertification, a few of the students supported its use. They felt its use should be performed on a trial basis in a few states to see if the process would work. Their support was backed by the belief that if psychomotor skills are tested in advanced cardiac life support courses and driver education courses, they also should be tested in a nurse anesthetist recertification process. One student expressed his support by stating, “If I were the patient, I would want my anesthetist to take a simulation course and be tested for competency of his psychomotor skills.”

**Limitations of the study**
The study does have some limitations. The students' past clinical experiences, the length of time that they had been nurses before attending anesthesia school, and their areas of expertise varied. These differences may have affected the results. The researcher also brought her own personal experiences and perspectives into the analysis, possibly influencing the results. Because of the study's qualitative nature, data analysis may have been influenced by the investigator's interpretations of the findings. It also is difficult to generalize the findings to a larger population of students. The intent of qualitative research is “to form a unique interpretation of events” rather than to gener-
Although research studies in the medical field are quantitative in nature, qualitative studies can serve as an important route for obtaining information. This is especially true for research studies exploring students’ perceptions of specific phenomena. Since student perceptions were being explored, their thoughts and feelings would be better understood through a qualitative approach. Qualitative studies are “essential to the knowledge development of the healthcare disciplines.” 8 The author describes qualitative research as working outside the mainstream of science, making it both challenging and difficult. Qualitative research seeks to understand why things occur and is “more focused on education change.” 9 According to researcher Szent-Gyorgyi, it is the curious, creative, and committed scientists, the ones who are willing to take risks and investigate those things that cannot be predicted, who will make the most important contribution to their discipline. 10 The process of qualitative research is inductive in that “the researcher builds abstractions, concepts, hypotheses, and theories from details.” 11

Many questions remain regarding the use of the anesthesia simulator as part of a student nurse anesthetist’s education. More research is needed to clarify the importance of the simulator for nurse anesthesia education and to justify the time and financial investment that is needed to purchase such a product. With technology changing frequently, one can predict that the simulator also will change and improve in its educational capabilities. The future brings much excitement and anticipation.

Simulation may provide the only way for NAS to experience a patient with rare but frightening anesthesia complications, such as malignant hyperthermia. Although such complications can be studied in an anesthesia textbook, for some students, reading is not the most efficient method for learning. “Doing and thinking are ordinarily our 2 most effective error-reducing behaviors.” 12 By experiencing the situation and performing “hands-on” care, the student may be able to learn the task more proficiently. Experiencing an incident or event with the simulator without involving a real patient makes the anesthesia simulator an invaluable learning tool. The value of the anesthesia patient simulator is just beginning to be appreciated and realized.

REFERENCES

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