Use of a Virtual Learning Platform for Distance-Based Simulation in an Acute Care Nurse Practitioner Curriculum

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Background: Acute care nurse practitioner (ACNP) programs that use high-fidelity simulation as a teaching tool need to consider innovative strategies to provide distance-based students with learning experiences that are comparable to those in a simulation laboratory.
Objective: The purpose of this article is to describe the use of virtual simulations in a distance-based ACNP program and student performance in the simulations.
Method: Virtual simulations using iSimulate were integrated into the ACNP course to promote the translation of content into a clinical context and enable students to develop their knowledge and decision-making skills. With these simulations, students worked as a team, even though they were at different sites from each other and from the faculty, to manage care of an acutely ill patient.
Results: The students were assigned to simulation groups of 4 students each. One week before the simulation, they reviewed past medical records. The virtual simulation sessions were recorded and then evaluated. The evaluation tools assessed 8 areas of performance and included key behaviors in each of these areas to be performed by students in the simulation. More than 80% of the student groups performed the key behaviors.
Discussion: Virtual simulations provide a learning platform that allows live interaction between students and faculty, at a distance, and application of content to clinical situations. With simulation, learners

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have an opportunity to practice assessment and decision-making in emergency and high-risk situations. Simulations not only are valuable for student learning but also provide a nonthreatening environment for staff to practice, receive feedback on their skills, and improve their confidence.
Keywords: Acute care nurse practitioner program, Simulation, Virtual simulation

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The increasing availability of distance-based programs in graduate nursing education has provided more opportunity for individuals interested in a career as an acute care nurse practitioner (ACNP). The ACNP programs, in particular, are challenged to help students develop time-sensitive skills in clinical reasoning and decision-making, which integrate the knowledge learned in online courses with clinical application. Programs that have used high-fidelity simulation as a teaching tool must now consider innovative strategies to provide distance-based students with a learning environment that promotes team building, development of clinical reasoning and decision-making skills, integration of theory with practice, and acquisition of clinical competencies essential for the role of an ACNP.

A large school of nursing in the southeastern United States first began its ACNP program in 1996, later transitioning to both pediatric and adult-gerontology population specific programs in alignment with the advanced practice registered nurse consensus model.[1] Throughout the past 20 years, the campus-based curriculum has increasingly used high-fidelity simulation as a strategy for teaching students and evaluating their application of the content. In 2015, the adult gerontology–ACNP program transitioned to a distance-based format with a total of 3 on-campus intensives. The faculty and students continued to use the simulation laboratory as a learning environment during those intensive experiences. However, the faculty recognized a need to provide additional learning opportunities using simulation for students in the ACNP program.

After examining several resources for virtual learning, the faculty decided to adapt iSimulate (iSimulate Inc, Albany, NY), a network-based tool for virtual simulation that had been developed initially for training emergency medical personnel. Using iPad technology (Apple, Inc, Cupertino, CA), the program gives the student's iPad the appearance of a cardiac monitor, with simulated defibrillator and pacing capabilities. A facilitator using an iPad controls vital signs, including cardiac rhythm, in response to student actions. Scenarios can be customized or selected from a menu of precreated situations, which are timed to respond to various interventions. Although the system was promising, iSimulate was restrictive in that it required iPad availability and was intended for use on a single Internet server.

Over the course of an academic year, the ACNP faculty collaborated with the school's information technology staff to create a method for casting the virtual simulations to distance students using Reflector technology (Squirrels, North Canton, Ohio), which is a commercial screencasting application that allowed the simulation to be projected from the faculty member's computer and then shared among students via Web conferencing. Standardized patients (SPs) were added to lend realism to the scenarios. The SP was visible throughout the simulation via a window in the corner of the computer screen. The overall experience closely mimics the environment found in the simulation laboratory. The purpose of this article is to describe the use of virtual simulations in the ACNP program and student performance in the simulations.

LITERATURE REVIEW

Simulation is an effective teaching method to incorporate into ACNP programs. Simulation can be accomplished using high-fidelity simulators, part-task trainers, virtual reality, screen-based computer simulations, in situ simulation, and SPs.[2,3] Simulation allows learners to apply knowledge and practice critical thinking and decision-making skills in a safe, interactive environment.[3] A systematic review evaluated the effectiveness of simulation in health professions' education, finding that simulation improved students' clinical skills and their self-efficacy and confidence.[4] Other studies have confirmed that simulation improves communication and teamwork, interprofessional collaboration, management of complex situations, and reflective thinking.[5] With simulation, learners have an opportunity to practice assessment and decision-making in emergency and high-risk situations that they may not encounter themselves in their clinical rotations. Clinical simulations not only are valuable for student learning but also provide a nonthreatening environment for staff to practice and receive feedback on their skills. Simulations allow staff to role-play expected practices, improving their confidence and skills in assessment, recognition of a problem, and communication of findings to other providers.[6]

Simulation is being used increasingly in nurse practitioner (NP) programs. Warren et al[7] completed a systematic review of the effectiveness of simulation-based education in these programs and reported student satisfaction, increased confidence, and improved knowledge with high-fidelity simulation. In another study, researchers evaluated the effectiveness of teaching mechanical ventilation to adult, geriatric, and ACNP students using onsite high-fidelity simulation compared with online narrated PowerPoint (Microsoft, Redmond, Washington). The findings suggested that both methods increased knowledge with no difference between the groups but found the simulation to be more satisfying for the students.[8] Rutherford-Hemming[9] examined whether transfer of learning occurred from simulation to clinical practice among 14 ACNP students. Observations were done in the simulation laboratory using an SP followed by observing the students' performance in the clinical setting. The students demonstrated significant improvement in their clinical competency.

The use of technology such as videoconferencing with simulation can increase student engagement in learning.[10] Virtual case studies enabled distance learners to develop their problem solving and clinical reasoning skills and produce equivalent differential diagnosis lists compared with on-campus students using SPs.[11,12] A meta-analysis demonstrated that the addition of technology to simulations can increase knowledge and behaviors in addition to improving patient outcomes.[13]

Many NP programs include SPs who are trained to portray the role of a patient. The SPs provide students with a more realistic experience by engaging in live interactions and offering feedback on student performance.[14] The ACNP students found that SPs acted like real patients, enabling them to practice their history taking skills and interventions in emergency situations but that they lacked the ability to display actual physical signs and symptoms.[15]

In addition to simulation for teaching ACNP students, it can be used for the evaluation of student performance and skills such as teamwork, communication, and physical assessment.[16] When high acuity situations arise in the clinical setting, NP students are often in the role of observer, making it difficult for the faculty and preceptors to evaluate the student's decision-making skills.[17(p. e88)] Through the controlled reproduction of scenarios in the simulation environment, the faculty are able to evaluate a student's level of competence in these situations. Simulation has been used to evaluate students' psychomotor skills associated with procedures, such as use of ultrasound, intubation, arterial and central line placement, chest tube insertion, and lumbar puncture.[17]

METHODS

Virtual simulations using iSimulate were integrated into the ACNP courses to promote the translation of current didactic content into a clinical context and enable students to develop their knowledge and decision-making skills. The course faculty were familiarized with the iSimulate technology during an on-campus training session and accessed the online manual and company representative for technological support as needed. All 23 students enrolled in the ACNP course completed 3 mandatory virtual simulations. These simulations provided an opportunity to collect data, conduct a physical assessment, formulate a list of differential diagnoses, order a diagnostic work-up, recognize key findings, manage care of an acutely ill patient, and work as a team. The scenarios included management of patients with gastrointestinal (GI) bleeding, hyperglycemic hyperosmolar syndrome, and breast cancer with febrile neutropenia and septic shock. Specific objectives, based on the course objectives, were developed for each simulation with identification of key behaviors to be performed by students in the simulation and addressed by the faculty in the debriefing, if not executed by students during the simulation. Key behaviors included ordering critical laboratory tests and electrical or pharmacological interventions, collecting historical data points, identifying critical differential diagnoses, and identifying physical assessment findings specific to the scenario. The students had completed their pathophysiology, pharmacology, and physical assessment courses before this ACNP management course.

The students were randomly assigned to 6 consistent simulation teams throughout the course to promote community building and teamwork; 5 of the teams had 4 students each, and the sixth team had 3 students, for the total class of 23 students. They were given times for their virtual simulations at the beginning of the semester, with e-mail invitations for a WebEx conference delivered 2 to 3 days before the event. One week before the simulation, a document of "past medical records" was distributed to students via e-mail. The students were expected to review the records before the simulation because they would review a patient record in clinical practice. Students knew that they would be engaging in a virtual simulation related to the topic that they were learning in class but were not aware of the specific scenario.

After the group signed in on WebEx, the faculty provided training using iSimulate. Only the faculty had the ability to manipulate the program settings, adjusting vital signs and patient responses to the students' verbal commands. The following roles were assigned before starting the scenario: collecting the patient history, performing the physical assessment, summarizing a list of prioritized differential diagnoses, outlining the diagnostic plan, and providing the therapeutic plan with disposition and initial discharge planning. The students were then introduced to the SP who remained in character until debriefing. The students would typically gather a history from the SP, and

as the need for vital signs and monitoring became apparent, the iSimulate program would be used to display them for student analysis. Any data provided had to be requested by the students, including physical assessment findings and various monitor tracings, for example, electrocardiogram, arterial line, and respirations. The faculty performed the examination on the SP as directed by the students working as a team and reported the findings to them for their analysis and decisions. At the point of disposition, the faculty guided the group into a structured debriefing. Total time allotted was 1 hour; the simulation typically ran for approximately 30 minutes with 20 to 30 minutes of debriefing.

The virtual simulation sessions were recorded and sent via e-mail to students for review. Unfortunately, 4 of the 18 recordings had technical issues that rendered them unusable. After the simulations, the students were expected to interpret and correlate clinical findings with their online lectures and course materials by writing a case analysis, which was graded. The case analysis included current recommendations and guidelines for best practice on each given topic.

EVALUATION OF STUDENT PERFORMANCE IN THE VIRTUAL SIMULATIONS

Plans for evaluating the effectiveness of the virtual simulations included the development of tools to assess student performance. Because students functioned as a team in the simulations, their performance was assessed as a team rather than each student individually. The evaluation tools followed a set format, for example, each tool assessed 8 areas of performance such as collecting key data, conducting an appropriate physical assessment, and formulating a list of differential diagnoses and included key behaviors to be performed in the simulation for each of the 8 areas (Table). These key behaviors to observe for in a simulation help ensure interrater reliability.[18] In addition, 5 of the video recordings of student performance in the virtual simulations were randomly selected, and performance was assessed by 2 outside evaluators using the tools and lists of key behaviors. The percent of agreement was 75.9% for the simulation on hyperglycemic hyperosmolar syndrome, 86.0% for the simulation on GI bleeding, and 87.1% for the simulation on the patient with breast cancer who had febrile neutropenia and septic shock. The project was reviewed by the university institutional review board and designated as exempt.

To evaluate how well the ACNP students cared for patients in the virtual simulations, 14 recordings were assessed. In general, more than 80% of the student teams performed the key behaviors in each of the simulations. Some groups had difficulty formulating differential diagnoses in the GI and breast cancer simulations and recognizing a hyperosmolar hyperglycemic state and differentiating this from diabetic ketoacidosis in the endocrine simulation. A few of the student teams failed to order specialty consultation and to identify infection and noncompliance as potential etiologies. The students focused their actions on clinical management in both the GI and breast cancer simulations but did not address patients' emotional needs. For example, in the simulation on the patient with breast cancer, requiring a rapid response, all of the student teams collected relevant historical data, and more than 80% performed appropriate behaviors such as conducting a physical assessment and ordering the correct diagnostic work-up. All groups of students recognized that the patient was developing septic shock, intervened, and assessed the effects of their treatments. However, none of the student teams demonstrated concern for the emotional needs of the patient.

TABLE **Performance Areas Assessed in the Virtual Simulations**[a]

Performance Areas
Collects appropriate historical data
Conducts an appropriate physical assessment with key techniques
Formulates an appropriate list of differential diagnoses
Orders appropriate diagnostic work-up
Recognizes disease state and needed interventions
Reassesses effects of interventions
Orders appropriate consultations and/or disposition
Considers emotional needs of patient

[a]Simulations were on patients with GI bleeding, with hyperglycemic hyperosmolar syndrome, and with breast cancer with febrile neutropenia and septic shock. Each performance area had key behaviors to be performed by team of students in the simulation.

DISCUSSION

Virtual simulations using iSimulate provide a learning platform that allows for the application of content to clinical situations. Although we did not compare virtual simulations to on-campus ones conducted in a simulation laboratory, our experiences with virtual simulations support that student learning was promoted. The students had an opportunity to conduct assessments, arrive at differential diagnoses, intervene, and evaluate the effects of their interventions particularly as patients' conditions deteriorated, and work as a team. Recording students' performance provided an opportunity for the faculty to provide feedback to students, with the aim of improving their learning and performance. The evaluation tool, listing 8 areas with key behaviors to observe for in each simulation, was effective in guiding the observations and assessment of students' performance in the simulations.

Students performed inconsistently in determining a list of prioritized differential diagnoses and an appropriate diagnostic work-up. This may be related to the complexity of the topics or reflect the need for further learning in terms of the content. For example, in the simulation on the patient with breast cancer who developed septic shock, the students had content on management of patients with sepsis and various hematological issues but did not have dedicated instruction on breast cancer therapy. This may have led to students' uncertainty on how to manage febrile neutropenia. Further efforts are needed to ensure that the scenarios are aligned more closely with the content in the ACNP courses. The student and faculty feedback on the virtual simulations was positive.

One target for improvement is better preparation of students to promote individualized care and meet the emotional needs of acutely ill patients. Each of the simulations reflected an urgent or emergent situation, requiring time-sensitive decision-making by the team. The medical records provided before the simulations included important clues such as visits to the emergency department for repeated falls, laboratory trends, previous substance abuse issues, and socioeconomic factors, which would have a direct effect on patient management. Although individualization of care was needed in each of the simulations, the students tended to focus on the acuity of the scenario without consideration of the historical data that might have influenced their diagnoses and interventions. This focus on acuity and the complexity of the scenarios likely impeded their ability to think about the patient's emotional needs.

Limitations

Unfortunately, 4 of the 18 simulation recordings had issues with audio quality or failed to record. Alternative recordings were supplied to those students for review so that they could write their case analyses. This limited the data for analysis. Another limitation in the project was that teamwork, collaboration, and communication were not formally measured. This is an area for future study as we explore the potential for distance based education of ACNPs.

CONCLUSION

Virtual simulations have been adapted for long-term use in the ACNP program. These experiences provide a learning platform that allows live interaction between students and faculty, at a distance, and application of content to situations representative of the clinical environment. With simulation, learners have an opportunity to practice assessment and decision-making in emergency and high-risk situations. Simulations not only are valuable for student learning but also provide a nonthreatening environment for staff to practice, receive feedback on their skills, and improve their confidence. Virtual simulations remove the need for learners to be at the same site, providing more flexibility for nurses, physicians, and other providers in critical care to engage in simulations as an interprofessional team.

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