INSTRUCTIONAL DESIGN AND ASSESSMENT

Pharmacy Student Response to Patient-Simulation Mannequins to Teach Performance-based Pharmacotherapeutics

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Objective. To design and implement a simulated patient-case assessment using a mannequin for critical care pharmacotherapeutic education of doctor of pharmacy students and to evaluate student satisfaction with the simulation.

Design. During the second year of the doctor of pharmacy program, all students were required to complete Introduction to Critical Care. This course consisted of didactic education, written patient-case sessions, and an interactive patient simulation session. Information on the patient case was distributed to students after completing the didactic portion of the course. Patient information was programmed into a simulation mannequin, which demonstrated characteristics of a critically ill human. Students were surveyed post-simulation to determine the effectiveness of the learning experience.

Assessment. The majority of students (88%) were extremely satisfied with the experience. The facilitator was considered to be extremely useful in 75% of responses.

Conclusion. By simulating a patient case, the facilitator was able to control students’ learning environment, adapt the simulation to the level of the students’ performance, and debrief students immediately. Ultimately, by involving students in actual patient cases early in the pharmacy curriculum, this type of education could produce pharmacists with a high level of expertise and confidence.

Keywords: pharmacy education, patient simulation, critical care, therapeutics, curriculum

INTRODUCTION

For decades, simulation training has been a major component of military and aeronautics training. Also, the federal government has expanded bioterrorism training to include the use of patient simulations. The overwhelming evidence of successful training and competency assessment has led to recent advances in medical education.

In 1991, simulation-based training began with anesthesiology physicians in Denmark. Within the next decade, this training was introduced to physicians and nurses throughout Denmark. The first human mannequin simulation course was offered to medical students in 1994, and 1 year later the Department of Anesthesiology at the University of Pittsburgh began simulation research. Over the past 10 years, the Peter M. Winter Institute for Simulation, Education, and Research (WISER) has developed human simulators and task trainers for medical education.

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This simulation education has been used in the training of medical and nursing students.

The recommendations from the panel on General Professional Education of the Physician of the Association of American Medical Colleges and the subsequent Edinburgh Declaration supported a shift in medical education from large classroom instruction to interactive, competency-based learning. Simulation-based training represents one way of accomplishing these recommendations. It offers a facilitative type of teaching in a non-threatening environment for students. Another advantage is that simulators allow for a safe environment that can be repeated as necessary to achieve competence without involving patients in the early learning phase. Also, unique, critical clinical situations can be simulated.

Patient simulation is being used by medical and nursing schools, but has yet to be introduced into the pharmacy curriculum. The pharmacodynamics of medications can be demonstrated in a realistic situation, and at the same time, in a controlled environment. The simulation of patient cases allows facilitators the luxury of controlling the learning environment for each student, adapting
the simulation to the level of student performance, and finally, conducting immediate debriefing and assessment. Performance-based simulation examinations are better than written examinations for evaluating the cognitive skills of students.\textsuperscript{13} The Introduction to Critical Care course was initiated at the University of Pittsburgh School of Pharmacy curriculum in the year 2000 as a required course. It is designed to introduce the students to acute care concepts including the operative and intensive care-unit patients. Over the past 4 years, the student’s application of the knowledge presented in a didactic format has been applied directly to patient care by discussing written cases in both large and small groups. We believe that students’ interest levels and retention of knowledge may be further increased by interacting in a simulated environment during introduction of new pharmacology and therapeutics. Therefore, this patient simulation was introduced at the end of the semester to review the knowledge gained throughout the semester and provide the students with a unique learning experience.

The objective of this study was to design and implement a mannequin simulation-based patient case assessment for critical care pharmacotherapeutic education of doctor of pharmacy students and to evaluate student satisfaction after the simulation.

**DESIGN**

*Introduction to Critical Care* is a required course in the second year of the University of Pittsburgh School of Pharmacy’s curriculum. The students have completed 3 therapeutic modules, *Pharmacotherapy of Cardiovascular Disease*, *Pharmacotherapy of Infectious Disease*, and *Nephrology*, prior to this course. Also, all students have completed the first-professional year, including the following courses: *Anatomy and Physiology*, *Drug Development*, *Principles of Drug Action*, *Service Learning*, and *Biochemistry*. The intent of this course is to allow students to become familiar with basic critical care concepts including postoperative complications, advanced cardiovascular and infectious disease complications, and general prophylactic requirements for preoperative patients. This course incorporates didactic lecturing with practical application utilizing written patient cases for classroom discussion and patient simulation. The final case session of the semester was performed at the WISER Center where students were required to arrive as if they were attending patient care rounds in the hospital. All students dressed professionally with laboratory coats and brought drug information resources if needed.

A case was designed in which a patient was undergoing an acute myocardial infarction. The case included all subjective and objective information, paralleling what would happen in clinical practice. All laboratory, procedural, and other clinical data were available for students. The students were given this written case 1 week prior to the scheduled patient simulation experience. Each student group, compromised of an average of 6 students, was scheduled for a 30-minute simulation session. One facilitator was scheduled to control the simulation for each group. The group was guided to the patient room and oriented to the equipment in the room as well as the capabilities of the mannequin. The mannequin was controlled by a computer program, *Sim-Man* (Laerdal Corporation, Stavanger, Norway), and had a palpable pulse, audible heart, lung, and abdominal sounds, and visible hemodynamic parameters (including continuous electrocardiogram) on a monitor, and could also speak. The *Sim-Man* software was programmed with appropriate clinical responses for a patient with a myocardial infarction, including EKG and vital sign changes.

The students were asked to assess the patient and determine a primary diagnosis and pharmacotherapeutic management, as well as provide an appropriate monitoring plan for each recommendation. As the student asked for further objective information, such as the patient’s cardiac profile, the data were provided via a PowerPoint viewer within the patients’ room. After the additional information was assessed, the students were then asked to determine the next problem that the patient developed and to present their recommendation for therapy and monitoring. Each time the students suggested a medication for the patient, the facilitator prompted the *Sim-Man* software to change the mannequin’s physiologic parameters accordingly. These pharmacodynamic and pharmacokinetic changes that would result from administering various medications were programmed as trends into the software and were easily accessible to the facilitator during each session. The automated scenarios assured consistency in the feedback provided to and the experience received by all 16 groups of students. The facilitator was also able to speak to the students via the patient simulator and hear the students within the patient room while the facilitator was behind a one-way glass window in a control room. Leaving the students alone with the patient was done to enhance their sense of independence and responsibility. A debriefing tool was developed by the course director to grade the students’ performance and to time the entire simulation. This tool acted as a framework for minimal competency throughout the simulation. It was designed to record each decision made by the students and determine whether it was the appropriate decision at the appropriate time based on the preprogrammed scenario. This debriefing tool was able to assess performance consistently among students. At the end of the simulation,
the facilitator was able to display the log generated by the debriefing tool in the patient’s room. This provided immediate feedback to the students and created an open environment for asking questions.

After the simulation session was complete, each group was responsible for completing a subjective, objective, assessment, and plan (SOAP) note for the patient simulation. Also, each student was asked to complete an online, anonymous survey instrument regarding the simulation learning experience. The post-simulation survey instrument consisted of 6 statements (Table 1), with responses ranked on a 5-point Likert scale on which 1 = poor or strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = excellent or strongly agree. The students were also asked to provide a written reply on what they liked most about this experience, what they liked least, and any general comments.

Students were given a group grade for the simulation session, which was a part of the overall final grade for the course. This patient simulation session was 10% of the students’ overall grade and counted 25 points. A maximum of 15 points were given for the patient simulation session, 5 points for participation, and 10 points for the groups’ critical thinking skills in the simulation session. These critical thinking skills were assessed using the debriefing tool for each group. The remaining 10 points were based on the SOAP note prepared by each group.

**ASSESSMENT**

Descriptive statistics of the class are included in Table 1. Overall, 98 students completed the patient simulation sessions and SOAP note assignment, and 94 of 98 (96%) completed the postsimulation survey instrument. The average grade for the simulation session was 22 of 25 total points or 88%. Seventy-three of 94 students felt that this experience strongly stimulated their interest in critical care pharmacotherapy. Eighty-seven students (93%) felt that this simulation session allowed them to utilize knowledge learned in the course. Seventy-one students stated this experience strongly helped develop their ability to solve problems. The majority of the students (66 of 94) felt “very strongly” that simulation training should be further incorporated into the pharmacy curriculum. The students were given the option of adding positive and negative comments on the survey instrument and all 94 students provided at least one comment. Ninety of 94 students (96%) made positive comments about the experience. Sixty-four students (68%) stated what they liked least about the session. Table 2 summarizes the students’ response to each question on the survey instrument. Many students provided additional comments, such as “being able to directly assess the outcomes of the chosen therapy greatly improved my understanding of the experience,” “The experience was good because it was life-like and allowed us to view what actually happened to the patient. It was a good practice of bedside manner.” Another student commented, “I liked how we had to actually think. It was a hands on experience that involves pressure and drawing knowledge from previous topics.”

Some students were uncomfortable in the lifelike situation, stating “it was frustrating to some extent to agree as a group what to do quickly, however, this is something I’m sure occurs in practice.” Another student commented, “I thought it was a little stressful to think on my feet like that.” A third student admitted, “It really made me nervous and actually made me afraid of doing this for real.”

**DISCUSSION**

We are not aware of any large studies comparing outcomes of patient simulation assessment with conventional teaching methods in pharmacy students. However, the findings from our survey are consistent with that of other studies found in the nursing and medical education literature. Our survey findings led us to hypothesize that pharmacy students’ experience with the simulation-based patient cases was more enjoyable and that this approach to teaching is preferred over traditional didactic lecturing in the *Introduction to Critical Care* course.

Based on the students’ positive response, this simulation training will be continued at our institution. The next learning experience will occur in our *Pharmacotherapy of Cardiovascular Disease* course in which students will learn basic physical assessment skills, blood pressure monitoring, management of hypertension, pharmacotherapy of dysrhythmias, and pharmacotherapy of myocardial infarction and heart failure. The next sessions will assess the students’ ability to apply knowledge as well as to
retain knowledge of basic concepts. Each student will complete and be graded for a physical assessment and blood pressure monitoring session. Continual assessment of students’ knowledge of and satisfaction with this learning experience will occur so that we only incorporate this into appropriate areas of the pharmacy curriculum. Other potential uses for this simulation tool are in assessing students’ communication skills, either with the patient or with other health care professionals. Also, this tool may provide excellent continuing education opportunities for pharmacists responding to codes in institutional settings.

A significant limitation to incorporating this simulation training in our pharmacy curriculum on a wide-scale basis is the large time commitment involved in the design process. In order to provide multiple simulations, it will be necessary to program numerous pharmacotherapeutic options into each simulation. Additional limitations include the amount of documented pharmacodynamic studies for each medication, as well as the many unknowns that exist in medicine today.

A challenge that arose during this simulation session was students’ comfort level with an actual patient care environment. At this stage of the curriculum most pharmacy students have little to no experience in an actual critical care setting. Some students expressed high levels of anxiety due to the “lifelike” mannequin simulation.

In order to utilize simulation education via patient mannequin training, technically advanced skills will be needed within the curriculum. Faculty members will need to partner with existing simulation training centers, medical schools, nursing schools, or other training facilities to learn this educational technique. To assure that the feedback students receive from the simulation software is consistent and the therapeutic principles are conveyed accurately, advanced training in patient-case design, case simulation development, debriefing tool preparation, and objective-assessments techniques are vital.

**CONCLUSIONS**

The utilization of a patient-simulation mannequin to teach performance-based pharmacotherapeutics was found to be highly beneficial in furthering pharmacy students’ comprehension of the therapeutic principles taught in conventional didactic lectures. University of Pittsburgh School of Pharmacy students who participated in the simulation exercise reported significant enhancement of their knowledge of critical care pharmacotherapy following the assignment. However, further study is needed to document the benefits of patient simulation training using a mannequin compared to traditional approaches to pharmacy education. By involving the student in actual patient cases very early in the pharmacy curriculum, this type of education may ultimately produce pharmacists with a higher level of expertise and confidence when entering the workforce.

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**REFERENCES**