PATIENT SIMULATION

Transitioning Knowledge Gained From Simulation to Pharmacy Practice

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Using simulation to teach pharmacy practice skills may result in knowledge that is transferable to patient care. Key areas in which simulation is being used in pharmacy education include therapeutics, communication, physical assessment, patient safety, and populations to which students may have infrequent exposure. Enhancing interprofessional healthcare team dynamics and the skills of practicing healthcare professionals are other practical applications for simulation education. Educators should continue to be creative in the incorporation of simulation into pharmacy education and conduct more studies on the impact of simulation education on patient care to demonstrate the efficacy of this teaching modality.

Keywords: assessment, interprofessional education, simulation

INTRODUCTION

The use of simulation for training in areas such as space travel, aviation, and warfare has been widely accepted.[1-5] In the healthcare setting, however, the acceptance and adoption of simulation has been embraced only recently.[6,7] Increased emphasis on quality of care and patient safety has encouraged the use of simulated medical education experiences in health professions training.[8] The use of simulation-based learning has expanded beyond physician education and training to other healthcare disciplines including nursing, physical therapy, and pharmacy.[9-12]

The Accreditation Council for Pharmacy Education (ACPE) defines simulation as an activity or event that replicates pharmacy practice.[13] Simulation-based learning provides students an opportunity to apply previously acquired knowledge and skills in a realistic clinical setting that is a safe and controlled educational environment.[14] Simulation-based learning uses a range of mediums from standardized patients to high-fidelity human patient simulation.[12,13,15,16]

In their 2006 standards and guidelines for pharmacy education programs leading to the doctorate of pharmacy (PharmD) degree, ACPE recommends that faculty members use educational technologies and techniques that encompass a variety of methods of educational delivery and assessment. These standards support the use of simulation to aid in the development of students' critical-thinking and problem-solving skills.[17,18] The use of simulation-based learning in pharmacy education provides students with clinical experiences that they otherwise would not likely acquire in training, such as caring for patients in high-risk and less frequently encountered medical scenarios.[13,19-22]

In June 2010, ACPE acknowledged simulation-based education as a valuable resource and approved its use in introductory pharmacy practice experiences (IPPEs) to fulfill a portion of a college or school's IPPE program goals and objectives. ACPE recognizes numerous types of simulation as acceptable for use in IPPEs as long as they meet specific criteria that ensure the provision of a learning experience that is comparable to a real patient encounter.[13] ACPE deemed the use of simulation to be appropriate for scenarios that are difficult for students to experience in an actual patient care setting, and that are structured around specific learning objectives, include assessment activities, and are supervised by pharmacy educators, practitioners, or appropriately trained facilitators. Contact hours obtained through simulated experiences are perceived as providing similar knowledge as that gained from interacting with live patients in a "real world" setting. However, actual patient contact hours is still to remain a large portion of IPPEs, with simulation allowed to count for up to 20% of required contact hours.[13] Although the use of simulation in the pharmacy curriculum has increased, the best applications of this learning method are still being investigated. The purpose of this paper is to describe the benefits of using simulation to teach pharmacy practice skills that are likely to translate into patient care.

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SIMULATION IMPROVES STUDENT KNOWLEDGE

A possible rationale contributing to the ACPE's decision to approve simulation for IPPE contact hours is that improvement in knowledge through active learning can translate into clinical practice. Simulation education is provided in various manners through standardized patients, virtual patients, computer-based simulations, objective structured clinical examinations, and human patient simulation. An extensive review of the literature from 1948 to March 2011 in MEDLINE using the search terms "patient simulation," "computer simulation" and/or "knowledge or clinical competence" and "pharmacy" or "pharmacist" identified only 69 research articles, the majority of which were not applicable, a second search of only pharmacy education journals available in MEDLINE and the terms "patient simulation" and "computer simulation" was conducted. Twenty articles, all published in the *Journal*, were identified, and the 13 that involved studies designed to provide simulation learning and assessment of knowledge were included in this review (Table 1).[12, 15, 16, 23-33]

Based on the articles found in the literature review, the areas in which simulation is most often used to teach pharmacy students are: therapeutics, communication, physical assessment, patient safety, and care for patient populations to which students may have infrequent exposure (eg, patients with low vision, underserved patients). Pharmacy educators should continue to be creative in their teaching methods and use of simulation in hopes of enhancing students' retention of knowledge and their ability to translate the knowledge to clinical practice.

INTERPROFESSIONAL USE OF SIMULATION

Collaborative interdisciplinary learning and training is a central component in the provision of safe, quality patient care.[8] The education of healthcare professionals focuses on the development of technical and clinical skills required in their specific discipline and commonly takes place within the profession, with limited exposure and contact with healthcare professionals from other disciplines. There is a lack of training and opportunities to enhance interdisciplinary and team performance in healthcare, even though health care professionals working in teams make less mistakes than health professionals acting independently.[34-37]

The ACPE has recognized the importance of team-based learning and communication in the education of future pharmacists and stresses the importance of interprofessional team work within the PharmD curriculum.[17] Simulation can be used to create scenarios that engage health professions students from multiple disciplines in a stressful environment that presents them with clinical challenges and necessitates communication and teamwork to successfully care for a patient. Simulated scenarios can be used to present health professions students with language barriers, patient-family social issues, lack of readily available clinical information, and other communication conflicts that may arise when working as part of a healthcare team.[38] A simulated environment provides a "safe harbor" where the timing in which a scenario normally occurs can be slowed down so that participants can focus on a specific educational aspect, such as the development and acquisition of communication skills.[39] During a simulated scenario, healthcare team members are able to identify issues that arise in their daily practice with their daily processes and discuss their professional role and how they can contribute to patient care with other members of the interdisciplinary team.[39,40] Common interprofessional simulation scenarios include trauma training, cardiac arrest training, operating room situations, and intensive care unit (ICU) care.[19-22]

Published studies of the effects of team-based training using simulation support its continued use in pharmacy education. In the setting of trauma training, both subjective and objective improvement in team performance was reported. The trauma teams performed with increased communication and efficiency after sequential simulation experience, and it is believed that simulation not only improved team performance, but was also useful to identify potential safety issues.[19] The incorporation of simulation into the training of interprofessional teams for emergency situations produced similar results. Participants reported increased knowledge and insight into the importance of communication in a crisis scenario involving an obstetric emergency.[20] A simulation training exercise exposed participants to the health care team's responsibilities in the operating room, promoted effective interaction among team members, and maximized the strengths of each member.[21] When simulation was applied to the operating room, significant improvements in role clarity ($p = 0.02$), cross monitoring ($p < 0.01$), anticipatory response ($p = 0.01$), and team cohesion and interaction ($p < 0.01$) took place.[30] Using simulation to teach interdisciplinary skills in a high-risk environment provides a safe situation for errors to occur and an effective means of teaching skills that can be transferred and applied in clinical practice.

TEACHING KNOWLEDGE AND SKILLS THAT TRANSLATE INTO PRACTICE

Skills taught using simulation scenarios translate into clinical practice improvements (Table 2).[41-45] Wayne and colleagues evaluated simulation education provided to second-year medical residents and the translation of this knowledge to clinical practice.[41] Second- and third-year medical residents were included in this analysis with third-year residents being the controls that did not receive simulation

Table 1. Use of Simulation to Teach Knowledge to Pharmacy Students

Reference	Simulation Used	Skill Taught[a]	Measurement of Knowledge Gained	Result
[15]Rickles NM, et al 2009	Standardized patient	Communication	Communication skills assessment form at baseline, midpoint and completion of course	Significant improvement in communication skills over time
[23] Raney EC, et al 2007	Standardized patient	Therapeutics-anticoagulation	Post-test examination and evaluation by the standardized patient	Mean examination scores were >90% and >90% of students met appropriate evaluation criteria
[16] Marken PA, et al 2010	High-fidelity mannequin and standardized patient	Communication of difficult conversations by inter-professional teams	Self-assessment completed before and after educational session	Demonstrated significant knowledge gain in the majority of items for the self-assessment
[25] Meiure KD, et al 2010	High-fidelity mannequin	Therapeutics- ACLS	Post-quiz scores	Students enjoyed the session but the knowledge gained was not evident quiz scores
[26] Seybert AL, et al 2007	high-fidelity mannequin	Physical assessment-blood pressure	Pre and post written examinations	Knowledge and ability to take a blood pressure improved significantly
[27] Vyas D, et al 2010	High-fidelity mannequin	Therapeutics-multiple topics	Post-quiz scores	A control group was used for comparison. Knowledge retention was significantly higher in students that used simulation to learn.
[12] Seybert AL, et al 2008	High-fidelity mannequin	Therapeutics-cardiovascular concepts	Pharmacotherapy plan rubric completed during high-fidelity mannequin simulation. An assessment of data collection, problem list, monitoring, communication was completed	Students scored >95% on six of the eight domains evaluated in the pharmacotherapy plan rubric
[28] Tofil NM, et al 2010	High-fidelity mannequin	Therapeutics-pediatrics	Pre- and posttest	95% of students' scores improved demonstrating a gain in knowledge.
[29] Bennedict N, 2010	Virtual patients	Therapeutics-sepsis	Examination and pharmaceutical care plan development	Virtual patients were combined with PBL. Students obtained scores of 90% on related exam questions and written pharmaceutical care plan

(Continued)

Table 1. (*Continued*)

Reference	Simulation Used	Skill Taught[a]	Measurement of Knowledge Gained	Result
[30] Orr KK, et al 2007	Virtual patients	Therapeutics-self-care	Student responses to self-care inquires assessed using a standardized form	Student knowledge, problem-solving and communication skills improved from baseline
[31] Kiersma ME, et al 2009	Medication error scenarios-dispensing and counseling simulations	Medication errors related to dispensing and communication	Pre- and posttest	Knowledge pertaining to recognition, prevention, communication and reporting of errors improved
[32] Zagar M, et al 2010	Simulation goggles	Medication management difficulties-low vision	Perception survey	Differentiate among various low-vision mediation management difficulties
[33] Chen JT, et al 2008	Role- paly: Student simulation of an actual patient	Patient empathy	Empathy scale and reflection papers	Empathy toward underserved population improved due to an increase in knowledge and insight

[a] The description of skill taught was summarized from the purpose and the method of each research study evaluated.

education and the second-year residents were the simulation trained group. An evaluation of cardiac arrest team responses for actual in-hospital patients was completed retrospectively. The treatment logs for these patients were evaluated for adherence to the American Heart Association ACLS guidelines and compared for second- and third-year resident led code teams. Simulation education improved the quality of ACLS care since the second-year residents had significantly higher adherence to the guidelines (68% vs. 44%; $p = 0.001$).

No studies evaluating the use of simulation education to train pharmacists in pharmacotherapy skills and the impact of such training on actual clinical practice were found in the literature. Increasing the use of simulation training in pharmacy education may first require the identification of areas that can be enhanced by simulation based education, such as treatment plan development.[46,47]

Simulation Training to Improve Clinical Skills

The improvement in clinical skills in actual practice as a result of simulation training has also been demonstrated. For example, the use of simulation-based education was effective at increasing the number of successful insertions of central venous catheters in actual patients by medical residents compared to the number successfully inserted by non-simulator trained residents (95% vs. 81%; p = 0.005).[42] Similarly, simulation-based training also could be used to hone the compounding and drug preparation skills of practicing pharmacists. Although simulation has been adopted by colleges and schools for use in many pharmacy practice experiences, simulation experiences could also be used to further refine the skills of practicing pharmacists during competency assessments and continuing education sessions. Simulation education also could be used to teach drug preparation and calculations to nurses and pharmacy technicians. Incorporating this active-learning strategy may help health professionals to create a system of zero tolerance for these types of errors.[44]

Standardized patients disguised as random shoppers/patients to evaluate clinical and communication skills of pharmacists in practice have also been used.[47-51] This is an interesting application of simulation as a tool for assessment; however, the primary goal of these studies was not simulation-based learning. Instead, the use of standardized patients could be used as a teaching tool for the enhancement of communication skills for practicing pharmacists as is being done in pharmacy student education. Again, while educators are using simulation to teach skills such as drug preparation and communication to pharmacy students, the value of this teaching modality has not been transmitted to hands-on continuing education of practicing pharmacists nor evaluated for clinical impact in actual patients.

Simulation has been used to improve emergency department nurses' triaging skills. After completing an educational program that included lectures and scenarios with high-fidelity human patient simulation, the nurses' triage skills improved 30% to 60%.[43] Likewise, pharmacists' clinical skills in detection and reporting of adverse drug reactions may benefit from simulation training such as was used in a computer-based simulation program to improve pharmacists' ability to identify heparin-induced thrombocytopenia.[30,52]

Table 2. Studies Using Simulation for Education that Demonstrated Improvement in Clinical Practice

Reference	Simulation Used	Healthcare Professional Evaluated	Skill Evaluated	Measurement of Skill	Comment
[41] Wayne DB, et al 2008	High-fidelity mannequin used for education of concept	Medical residents	Application of knowledge gained from education (case = traditional education plus simulation; control = traditional education)	Compliance with American Heart Association guidelines for treatment of advanced cardiac life support	Medical residents trained with simulation demonstrated a higher compliance rate to American Heart Association guidelines in clinical practice compared to medical residents that did not experience ACLS simulation training (68% vs 44%; P = 0.001)
[42] Barsuk JH, et al 2009	High-fidelity mannequin	Medical residents	Central venous catheter insertion	Pre and post performance skill checklist and pre/post written test	Simulator trained residents reported significantly fewer needle passes, arterial punctures, catheter adjustments and higher success rates for catheter insertion compared to non-simulator trained residents
[43] Wolf L, et al 2008	Didactic lecture and high-fidelity mannequin	Nurses	Clinical assessment-triaging patients in an emergency department	Before and after chart review of triage documentation	Baseline data demonstrated that 40% of patients were under-triaged. Accurate triage was noted in 70-100% of patient cases in the post-course evaluation.
[44] Garnerin P, et al 2007	3 simulated scenarios for medication labels (Form A, B, C)	Nurses and physicians	Drug selection	Error rate	Form A and B had a higher rate of errors and the number of errors was high for nurses compared to anesthetists
[45] Ford D, et al 2010	High-fidelity mannequin	Nurses	Appropriate medication administration (case= simulation; control = traditional lecture)	Medication administration error rate	Nurses educated with simulation had a 25% reduction from baseline. The effects of simulation were sustained over a 3-month period. Nurses educated with traditional lectures did not demonstrate a significant reduction in medication errors.

An important component of pharmacists' daily function is to educate other healthcare professionals on the safe use of medications.[53] Pharmacists' use of human patient simulation to educate nurses resulted in a 25% reduction in medication administration errors.[45]

Because technology changes so rapidly, research studies on the impact of a pharmacy implementing new technology, such as an active medication monitoring system, may not be available.[54] Using simulation to test the new technology may prevent errors, or in the case of medication alert systems, prevent alert burden.

Simulation has been used by patient safety organizations such as The Leapfrog Group (Washington, DC) to test the efficacy of active medication monitoring systems at

detecting adverse drug events.[55-57] In one simulation, a set of physician orders that would result in an adverse drug event was entered in a fictitious electronic patient health record at 62 institutions to determine how well their clinical decision support systems could detect the adverse events.[56] The clinical decision support systems at the 62 hospitals detected 53% of medication orders that could have resulted in death and 10% to 82% that could have caused an adverse drug event. As this study illustrates, simulation can be used to test and improve clinical decision support systems.

SUMMARY

A variety of simulation modalities have been used in health care education and practice to teach knowledge and skills, encourage effective team communication, and improve patient care. There are opportunities to increase the use of simulation to train pharmacists' that could translate into improved pharmacy practice. Pharmacy educators should continue to be creative in the incorporation of simulation into the pharmacy curriculum. Additionally, the use of simulation in educational scenarios should be evaluated for the impact on actual patient care to demonstrate the efficacy of this teaching modality.

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