

## ABSTRACT

**Background:** Little evidence exists on the effectiveness of simulation based education within pharmacy education. The pharmacy curriculum at the University of Pittsburgh School of Pharmacy includes experiential learning rotations during the final year of training. The objective of this study is to assess impact of simulation based learning on clinical pharmacotherapy skills related to treatment of dysrhythmias of fourth-year pharmacy students on acute care clinical rotation.

**Methods:** Approval was obtained from the University of Pittsburgh Institutional Review Board to perform this single-center, prospective, case-control study of fourth-year University of Pittsburgh School of Pharmacy students on acute care experiential rotation. Student enrollment was voluntary and withdrawal from the study was permitted at any time. Participating students were assigned to usual experiential teaching (control group) or simulation based learning (intervention group). In order to determine and compare the level of clinical pharmacotherapy skills of pharmacy students, a face-validated survey and test were administered to the control and intervention groups at the beginning and end of their fourth-year experiential rotation. This test assessed students' ability to recognize, manage, and monitor patients with various dysrhythmias. Students were asked to complete a survey pre- and post-rotation to assess attitudes toward simulation based learning. Outcome measures included mean pre- and post-rotation test scores for each study group, individual student improvement in pre- and post-rotation test scores, and survey responses for intervention and control groups. The 1 control and intervention group pre- and post-test scores were compared using an independent t-test. Within group pre- and post-rotation test scores were compared using a paired t-test.

**Results:** A total of 22 fourth-year pharmacy students were enrolled in the intervention group and 20 students were enrolled in the control group. The mean pre-rotation test score in the intervention group was 42%, while the control group achieved 43%,  $p=790$ . The mean post-rotation scores were 70% in the intervention group and 46% in the control group,  $p<0.05$ . Within group comparison of test scores in the intervention group indicated a statistically significant improvement ( $p<0.05$ ), however, no statistically significant improvement was noted in control group test scores ( $p=478$ ). Survey results show improvement in confidence, skills, and knowledge in the simulation based learning group, while controls showed minimal improvement. The intervention group survey responses about confidence in patient care ability improved from 77% to 91%, with more students reporting that they were confident during the post-rotation survey. Initially, 90% of the intervention group and 75% of the control group felt that simulation would improve pharmacotherapy skills and knowledge; this increased to 100% in the intervention group and 85% in the control group during the post-rotation survey.

**Conclusion:** Fourth-year student pharmacists on an acute care experiential rotation were able to apply pharmacotherapeutic concepts in a controlled patient simulation environment. Student post-rotation test scores improved after simulation based learning when compared to usual experiential training. Students undergoing simulation based learning expressed increased confidence toward working in a clinical setting. Simulation based learning shows great potential to increase pharmacotherapeutic knowledge and enhance clinical pharmacy performance in a safe practice environment.

## INTRODUCTION

Simulation-based learning (SBL) has become a part of training for physicians, nurses, and other healthcare professionals in recent years. SBL was found to be superior to problem-based learning (PBL) in teaching medical students acute care assessment and management skills.<sup>1</sup> In nursing students, a study revealed that a human patient simulator improved learning outcomes, increased knowledge, ability, and confidence in medication administration.<sup>2</sup> One important benefit of simulated learning is without being compromised by training needs.<sup>3</sup>

Simulation research at the University of Pittsburgh Department of Anesthesiology began in 1995, examining simulation modalities.<sup>4</sup> The Peter M. Winter Institute for Simulation, Education, and Research (WISER), located on the University of Pittsburgh Medical Center (UPMC) campus, was opened in 2003, and has trained more than 10,000 doctors, nurses, paramedics, medical students, and other health care professionals. The WISER Center features advanced instructional technology to develop innovative medical education programs that are ultimately targeted towards improving the public medical welfare and safety. The various technologies include interactive human simulation, computer-based simulation, Internet, and video learning systems.

## INTRODUCTION

Based upon results of studies in medical students and nurses, the expansion of SBL into pharmacy education has great potential. Clinical and educational literature was reviewed using MEDLINE with the following search terms: simulation, SBL, pharmacy, and pharmacy students. No studies examining SBL in pharmacy students have been published until recently, a study utilizing a human simulation mannequin was published.<sup>5</sup> Further evaluation of this novel approach, including an assessment of knowledge retention would aid in determining if this type of teaching modality is effective. The purpose of this study was to determine and compare the level of clinical pharmacotherapy skills of fourth-year pharmacy students on experiential rotation before and after a SBL session. In addition, the retention of learned clinical pharmacotherapy skills will be assessed six months after exposure to SBL.

## METHODS

This single-center, prospective, case-control study included fourth-year University of Pittsburgh School of Pharmacy students on experiential rotations. Student enrollment was voluntary and withdrawal from the study was permitted at any time. Participating students were assigned to standard experiential rotation (control group) or experiential rotation and SBL (intervention group). In order to determine and compare the level of clinical pharmacotherapy skills of pharmacy students, a survey and test were administered to the control and intervention groups at the beginning and end of their rotation. Retention of skills and knowledge will be assessed by administering the survey and test to both groups six months after the end of the experiential rotation. Outcome measures included pre- and post-rotation survey responses for each study group, measured using percent correct, and six-month follow-up test and survey scores for the intervention and control groups reported accordingly. Within group pre- and post-rotation test scores were compared using a paired t-test.

### Survey and Test

A pre-rotation survey and test was given to each student during the first week of rotation and an identical post-rotation survey and test was administered during the last week of experiential rotation. Results were collected by investigators with student identification in order to assess changes in survey and test scores. Scores were then reported anonymously in order to ensure confidentiality. The voluntary, face-validated 10-question survey was administered to both intervention and control groups. The survey assessed the students' opinions of their clinical skills, clinical responsibility, and SBL. Students responded to the statements or close-ended questions with opinions using the survey scale or yes/no responses. The survey scale allowed three categories for response, ranging from no improvement/none, 2 = mild improvement/somewhat, 3 = greatly improved/extremely. Students were asked to provide open-ended comments as well. The test was composed of eight fill-in-the-blank questions, four multiple-choice questions, and one true/false question.

### Simulation Session

Intervention group students received a brief pre-simulation instruction in a classroom at the University of Pittsburgh Medical Center three weeks prior to the SBL session at the WISER Center. The instruction consisted of a one-hour explanation of student participation in the study and an overview of the simulation education. The simulation session at the WISER Center occurred during the last week of the experiential rotation and it lasted two hours. The session included a review of basic cardiac dysrhythmias on an electrocardiogram (ECG) in addition to pharmacotherapy recommendations, and two simulation dysrhythmia cases. The first dysrhythmia case was an introductory case, while the second was a test. Debriefing regarding the experience and the simulation scoring was conducted immediately after the simulation concluded. Upon completion of the patient simulation scenario, the simulation facilitator displayed the performance log generated by the debriefing tool, providing immediate feedback and consistent performance assessment to the students. After the simulation session debriefing, the post-rotation survey and test were administered.

## METHODS

Figure 1. Facilitator Debriefing



## RESULTS

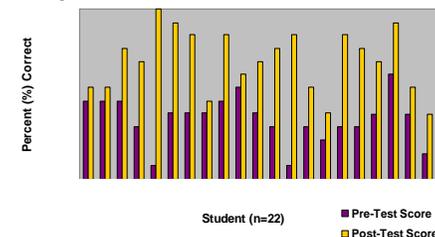
Table 1. Pre-Rotation and Post-Rotation Test Results

Study Group	Average Pre-rotation Score (% correct)	Average Post-rotation Score (% correct)	p Value
Control (n=18)	5.6/13 (43%)	6.0/13 (46%)	0.478
Intervention (n=22)	5.5/13 (42%)	9.1/13 (70%)	<0.05

## RESULTS

A total of 22 fourth-year pharmacy students were enrolled in the intervention group: 12 females (55%) and 10 males (45%). The control group was composed of 18 students: 15 females and 3 males. The mean pre-rotation test score in the intervention group was 42%, while the control group achieved 43%. No difference in pre-rotation scores was noted between groups ( $p=0.790$ ). The mean post-rotation scores were 70% and 46% in the intervention group and the control group, respectively. A significant difference favoring the intervention group was noted when comparing post-rotation scores ( $p<0.05$ ). Within group comparison of test scores in the intervention group indicated a statistically significant improvement ( $p<0.05$ ), however, no statistically significant improvement was noted when assessing control group test scores ( $p=0.478$ ).

Figure 2. Intervention Test Scores



Overall, 100% of the students in the SBL group showed improvement in objective test scores and only 28% of students in traditional rotations showed improvement,  $p<0.05$ . The intervention group survey responses about confidence in caring for patients improved from 77% to 91%, with more students reporting that they are somewhat confident during the post-survey. The control group's confidence in caring for patients did not change during their experiential rotation. When asked about nervousness in caring for a patient, 27% of the intervention group initially reported being extremely nervous; this improved by 5% on the post-rotation survey. Twenty percent of the control group initially reported being extremely nervous in caring for a patient; this improved by 10% on the post-rotation survey.

We are continuing to evaluate the retention of students following this simulation experience.

## REFERENCES

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