

# Simulation-based Procedural Training in a Preclinical Medical Student Curriculum: Brief Report

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## **ABSTRACT**

*In 2012, a family medicine department affiliated with a medical school in the United States piloted a clinical simulation course for second-year medical students to address limited exposure to basic medical procedures prior to clinical clerkships. The course's primary goal was to increase students' knowledge and skill in procedures encountered in family practice. The pilot course provided students with hands-on experience with central line placement, lumbar puncture, and either cardiac exam or thoracentesis. A formative evaluation was employed, including individualized student feedback on performance. Students' proficiency was assessed by an experienced clinician. After each session, students completed a brief questionnaire to rate their experience. Eighteen students participated in the course. Despite only a brief intervention, all students showed marked improvement in performance and demonstrated proficiency in each procedure. Students scored all aspects of the course favorably. The course generated positive feedback, and students showed a marked improvement in skill. Future goals include designing a more rigorous evaluation to assess students' knowledge and skill retention over time.*

**Keywords:** Family medicine, medical student, preclinical, simulation, training

## **I. INTRODUCTION**

The use of clinical simulators in medical education has become commonplace,[1-3] with a 2010 survey by the Association of American Medical Colleges showing nearly all students in the United States (US) practicing with the technology at some point during their undergraduate training.[4] Medical simulation can be an attractive and effective training tool due to its low cost, safety, and capacity for repetitive use. Given the wide variety of inpatient and outpatient procedures within the practice of family medicine, family physicians are uniquely positioned to provide targeted instruction to preclinical medical students on diagnostic and therapeutic procedures regularly encountered during medical and surgical clerkships; moreover, exposing preclinical students to procedures common to family medicine may work toward countering negative stereotypes about the profession.[5-8]

To these ends, physicians from a family medicine department affiliated with a US medical school developed a course for second-year medical students focusing on procedures practiced by family medicine physicians. Capitalizing on resources at the medical school's clinical simulation center, the

course used clinical simulation mannequins to train students in conducting a cardiac exam or thoracentesis, central line placement, and lumbar puncture. In this observational study we describe the pilot course, students' experience and perceptions, results from the formative evaluation, and next steps.

## II. METHODS

In the summer of 2012, the medical school solicited faculty proposals for new elective courses targeting second-year medical students. These courses were to be focused and brief, totaling 6 hours (three 2-hour sessions) during the fall semester. The proposed course—titled *Simulated Procedures in Family Medicine*—would utilize the clinical simulation center and provide students hands-on experience with central line placement, lumbar puncture, and either cardiac exam or thoracentesis. Upon approval, the pilot course was launched in October 2012. Evaluation of the pilot course was classified as exempt from review by the university's institutional review board.

The eighteen students who enrolled in the course were evenly divided into two groups: group one received training and practice in central line placement, group two received training and practice with performing a cardiac exam, and both groups received training in thoracentesis and lumbar puncture. These procedures were selected for their general relevance to the practice of medicine and to demonstrate a sample of procedures within the scope of primary care.

Each session consisted of a brief presentation (e.g., anatomic landmarks, indications, contraindications, etc.), followed by a demonstration from the instructor, hands-on practice with one-on-one coaching until individual competency could be demonstrated, and in-depth discussion of the procedure's finer details. Students were assessed using a real-time formative evaluation characterized by qualitative feedback on performance and technique. Given the skill-based and practice-oriented nature of the course, proficiency was defined as the student's ability to skillfully carry out the procedure without assistance or coaching from the instructor. After each session, students were asked to complete a short questionnaire to rate their experience and perspectives. To protect students' identities, demographic information was not collected. Summary scores and qualitative responses are presented.

## III. RESULTS

All students from both groups (n=18) completed the course. By the end of each session, all students demonstrated proficiency with the session's target procedure. While the majority of students were able to grasp the technique of each procedure with a modicum of one-on-one coaching, several students benefited from individualized, step-by-step guidance. The small group setting, low student-to-instructor ratio, and low-risk environment of the clinical simulation center made independent practice-to-competency possible.

A total of 53 post-session questionnaires were returned. As shown in Table 1, the course was well-received by students. When asked to "Rate the degree to which you believe you acquired knowledge and skills in this session"—where 1 was the least positive response and 6 the most positive—students' mean rating for the course was 5.21. Students' highest ratings were given to the questions "Opportunity to do hands-on learning" and "Opportunity to have hands-on practice," where mean scores were 5.53 and 5.51, respectively.

**Table 1. Post-session Questionnaire from Second-year Medical Students:  
Pooled Results Assessing Simulated Procedures in Family Medicine**

n=53 post-session questionnaires	Mean	Minimum	Maximum
Quality of demonstrations	5.25	3	6
Visual clarity of demonstrations	5.23	3	6
Clarity of verbal presentations	5.09	2	6
Opportunity to do hands-on learning	5.53	3	6
Opportunity to do hands-on practice	5.51	3	6
Guided step-by-step instructions	5.38	3	6
Instruction forced me to think through the concepts	5.15	3	6
Level of procedural knowledge applied to practice exercises and skills	5.21	2	6
Rate the degree to which you believe you acquired knowledge and skills in this session	5.21	3	6

Scores based on 6 point scale, where 1=very poor, 2=poor, 3=average, 4=good, 5=very good, and 6=outstanding

Beyond self-efficacy, all students were able to rapidly demonstrate objective procedural competency during each session. None of the students had prior experience with any of the needle procedures, so all were true novices. Following proctored practice, each student was able to successfully demonstrate very rapid acquisition of procedural familiarity, as judged by the preceptor, based on number of needle insertions/redirects, orderly execution of the procedure, and completion of the procedure in a timely fashion.

The post-session questionnaire also provided space for qualitative feedback (“What else would you like to tell us about this session in the Clinical Simulation Center?”). Of the 11 responses, 9 described the course positively and 2 negatively. Among positive responses were the following: “We love to come into the Sim Center its [sic] a great way to learn outside of class,” “Hands-on experience very helpful,” “The instruction was fantastic,” and “I had no idea what a central line was before starting and now feel comfortable practicing further.” The two negative comments related to the course’s pace (e.g., “Presentation was a bit slow”).

#### **IV. CONCLUSION**

This small pilot course was well-received by preclinical students at the medical school. While students had previous exposure to cardiac exam, none had practiced central line placement, thoracentesis, or lumbar puncture. At the end of the course all students demonstrated proficiency, and nearly all perceived the course as improving their knowledge and skill.

Given students’ favorable ratings, the course will be offered to second-year medical students in the future. Next steps for the course’s evaluation include a summative assessment of knowledge acquisition (i.e., a short exam before and after the course), and quantifiable benchmarks related to proficiency (e.g., number of needle insertions/redirects, time to complete procedure, etc.). To assess

students' perception of and interest in family medicine, a revised version of the *Physician Work Life Study* [9] questionnaire will be employed.

By offering a hands-on and procedure-oriented family medicine course early in medical students' training, it is hoped that interest in primary care medicine will be piqued and that more students will consider family medicine as a possible career option.

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