

# An Experiential Learning Model Facilitates Learning of Bedside Ultrasound by Preclinical Medical Students

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**OBJECTIVE:** To examine the effects of an experiential learning model of ultrasound training on preclinical medical students' knowledge and practice of Focused Assessment with Sonography for Trauma (FAST) examination.

**METHODS:** The study was conducted in 2 phases. In phase 1, first- and second-year medical students participated in a 45-minute didactic presentation and subsequent 1-hour hands-on practice followed by 3-5 precepted FAST examinations in the emergency department. A pretest or posttest design was used to examine the participants' knowledge interpreting ultrasound images of the FAST examination.

In phase 2, students performed FAST scans on patients with abdominal complaints under the supervision of emergency ultrasound faculty over a 1-year period. The participants were scored based on window acquisition, quality of images, accuracy of FAST scan interpretation, confidence level rated by participant, and supervising attending physician.

**RESULTS:** In phase 1, 68 novice medical students participated in 11 training sessions offered over a 1-year period. Students showed significant improvement in basic ultrasound and abdominal anatomy knowledge. The mean score improved from a pretest score of 5.8 of 10 (95% CI: 5.3-6.2) to a posttest score of 7.3 of 10 (95% CI: 7-7.6). The students also demonstrated a significant improvement in FAST image interpretation (pretest of 6.2 [95% CI: 5.9-6.6] and posttest of 7.6 [95% CI: 7.1-7.9]).

In phase 2, 22 students performed 304 FAST examinations on patients. At the beginning of their training when they performed less than 10 FAST scans, students were able to

complete the right upper quadrant view in 88.9%, left upper quadrant view in 69.7%, subxiphoid in 64.7%, and pelvic view in 70% of scans. Across all views of the FAST examination, increasing level of practice was associated with improvement in successfully completing the examination. The absolute increase in the proportion experiencing success in the right upper quadrant view was 1.6%, 3.6%, and 6.2% for the 10-19, 20-29, and > 30 groups, respectively, of which none were statistically significant. However, the improvements in the left upper quadrant view was 12.7%, 11.6%, 15.7% for the 10-19, 20-29, and > 30 groups, respectively. In all views, performing > 30 examinations more than doubled the odds of successfully completing the examination.

**CONCLUSION:** An experiential learning model of ultrasound training consisting of brief didactic presentation, practice FAST examinations on normal models, and proctored examinations on patients is an effective way to teach preclinical medical students basic ultrasound skills. (J Surg Ed 73:208-214. © 2015 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

**KEY WORDS:** experiential learning, medical students, ultrasound, focused assessment with sonography for trauma

**COMPETENCIES:** Medical Knowledge, Patient Care, Practice-Based Learning and Improvement

## INTRODUCTION

As ultrasound technology advances, medical institutions have begun to focus on the education of trainees in point-of-care ultrasound.<sup>1,2</sup> Although guidelines exist for emergency medicine graduate medical education in point-of-care ultrasound,<sup>3-5</sup> a uniform curriculum for undergraduate medical students to learn appropriate use and the skills required to perform point-of-care ultrasound has not yet

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been adopted. In fact, ultrasound knowledge is not yet viewed as a requirement in many medical schools. Although ultrasound teaching has been incorporated into undergraduate medical student curricula at some institutions, it occurs on a very limited basis and with a wide range of variability in training methods.<sup>6-9</sup> As a sign of promise, recently several institutes have described efforts to integrate ultrasound into medical curriculum marking an increasing awareness of its relevance to undergraduate medical education.<sup>10-14</sup>

Proficiency with ultrasound has become a coveted skill for residents entering training. Trainees in a wide range of specialties are using ultrasound more frequently to make clinical diagnoses and to guide procedures. Despite acknowledgment of the need for this skill set before residency training, there is no standardized training in ultrasound for many medical students.

Yet, as point-of-care ultrasound becomes an increasingly common diagnostic modality across all specialties, the need for earlier training becomes even more essential. Early exposure to ultrasound provides medical students with a foundation upon which they can build as they receive more comprehensive specialty specific training. Medical students at varying stages in their education demonstrate proficiency with ultrasound and rapid skill acquisition after as little as a week of training.<sup>14,15</sup> First-year medical students show increase in both competence and confidence in their diagnostic skills after minimal abdominal ultrasound education.<sup>16</sup>

For students to develop competency in ultrasound, they need to achieve technical expertise, obtain medical knowledge and diagnostic acumen, and integrate everything. The goal being to use these findings is to enhance medical decision making. To achieve this, we used an Experiential Learning Model for ultrasound education of volunteer medical students.<sup>17,18</sup> This integrated method has the essential components of an experiential learning model, including an "intention to learn," an "active phase of learning," and a "reflective learning phase." In this educational course, interested medical students are volunteered to participate in experience-based practical scanning session. During the practice scanning sessions, students also received real-time feedback from clinical instructors. This bedside training provided an active learning format that emphasized skill building through participation in patient care, observation, and analysis of ultrasound examinations.

Overall, the study examines the extent to which practice using bedside training in ultrasound affects preclinical medical students' knowledge and subsequent performance on patients' Focused Assessment with Sonography for Trauma (FAST) examinations in the Emergency Department. We aimed to see whether an experiential learning model of training in bedside ultrasound increased preclinical medical students' ability to acquire and interpret the requisite views of the FAST examination in emergency department patients.

## MATERIALS AND METHODS

### Study Design

The design is a prospective observational study evaluating medical students' ultrasound skills and ability to perform a modeled ultrasound scan after participating in a series of didactic presentation and practical sessions. This is a part of a larger study that was conducted to evaluate the accuracy of a proposed external landmark for probe placement during FAST examination.<sup>19</sup> The FAST examination was chosen as the point-of-care ultrasound scan based upon its utility in further training across multiple disciplines. All didactic presentations, practical sessions, and subsequent execution of ultrasound scans occurred in a single urban Level 1 Trauma Center and teaching hospital with an emergency ultrasound fellowship. The clinical training sessions were conducted in 2 phases. During the phase 1, first- and second-year medical students volunteered to participate in a 45-minute didactic presentation and one hour of hands-on practice using a normal model. The students completed a pretest questionnaire to assess their baseline ultrasound knowledge, familiarity with anatomy in ultrasound images, and ability to interpret findings related to normal and abnormal physiology. The didactic presentation modules included features such as video clips and interactive exercises and reviewed ultrasound anatomy and pathological findings related to the FAST examination. In this phase 1, students performed 3-5 precepted FAST examinations on hospital patients. Following completion of the phase 1, students took a posttest questionnaire that was identical to the pretest survey.

During the phase 2, students who had completed their training performed FAST examinations under the supervision of the emergency medicine attending physicians credentialed in point-of-care ultrasound and with extensive experience in training clinicians in the use of ultrasound. Participants at this phase of bedside scanning received guidance and feedback on window acquisition and accuracy of diagnosis from an instructor after completing their scan and documenting their results.

The institutional review board approved the study before initiation, and students gave their written informed consent before beginning the scanning sessions. Patients also provided informed consent. No participants received financial compensation.

### Study Setting and Population

Student participants had no previous ultrasound training. Participation was voluntary, and students were informed that their decision to enroll would not affect their academic standing. Upon completion of the didactic training, students were asked to sign up for scanning shifts (previously scheduled blocks of time when emergency ultrasound faculty were to be present in the emergency department

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