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ORIGINAL RESEARCH

# The Impact of a Student-Taught Point-of-Care Ultrasound Workshop on Confidence in Medical and Pre-Medical Students

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## ABSTRACT

### BACKGROUND

The vast utilization of Point-of-Care Ultrasound (POCUS) across medical specialties has increased the need for enhanced undergraduate medical education in image acquisition and interpretation among medical students. However, challenges such as the need for a standardized medical school curriculum and limited trained faculty preceptors restrict its implementation. The literature highlights the potential of student-taught POCUS workshops in expanding access and enhancing learning. This study seeks to evaluate the efficacy of a student-run POCUS workshop for medical and pre-medical students.

### METHODS

A prospective, cross-sectional study assessed the efficacy of first and second-year medical students teaching a POCUS workshop on the Focused Assessment with Sonography for Trauma (FAST) exam. Student workshop participants were asked to complete pre- and post-workshop surveys to assess their confidence in utilizing POCUS and identifying relevant organs and landmarks. Surveys employed a standardized five-point Likert Scale.

### RESULTS

Of the 43 initial participants, 29 completed both surveys. Results showed a significant increase in self-reported ultrasound experience (1.7 to 3.2, $p < 0.001$) and confidence in performing the FAST exam and organ identification (2.2-fold increase, $p < 0.001$). Both medical and pre-medical student cohorts exhibited similar confidence improvements in confidence.

### CONCLUSIONS

This study supports the literature that student-taught POCUS programs may be a viable adjunct to an institution's ultrasound curriculum. Implementing medical student-led workshops could help address current training gaps, enhance students' teaching and leadership skills, and improve confidence in utilizing and interpreting ultrasound images.

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Ultrasonography has been an ever-growing field since its implementation into medicine in 1956. Its popularity is accounted to its diverse applications, ranging from assessing free fluid in the setting of trauma to guiding minimally invasive procedures and monitoring fetal development during pregnancy.[1–3] Point-of-care ultrasound (POCUS) brings this robust technology to small

yet powerful portable devices without the need for larger ultrasound machines, circumventing issues of portability and accessibility, profoundly increasing its utility .[4] Despite efforts from some medical institutions to embrace this technology, formal educational curricula are not yet widespread. A 2020 survey of 154 clinical ultrasound directors and curricular deans found that over 40% of institutions lacked an approved POCUS curriculum. Few students receive extensive training in this discipline, with only 8% of schools reporting a longitudinal four-year curriculum.[5] Commonly cited barriers to the integration of ultrasound and POCUS education into curricula include lack of financial support, time within curricula, faculty-trained instructors, and equipment.[4–7]

One way to increase ultrasound educational offerings is to allow trained and passionate medical students the opportunity to teach their classmates who may be less experienced. While the positive effects of faculty-taught curricula are clear, there is less support for student-based teaching. Ultrasound curricula taught by faculty have proven helpful in teaching residents and students alike.[8–11] As access to POCUS increases, we expect horizontal and vertical education opportunities to expand. However, to adapt to this growing need, consideration for the utility of student-taught ultrasound workshops is imperative. *Oberoi et al.* showed improved ultrasound assessment scores in 64 first-year students after the implementation of instructional videos, lectures, and hands-on teaching workshops from ultrasound-trained second-year medical student instructors at a single institution. Additionally, an after-study survey showed increased interest, comfort, and confidence.[12] *Ahn et al.* found that perceptions of junior medical students on ultrasound/physical exam sessions taught by senior medical student instructors were equivalent to training from faculty instructors for the majority of sessions.[13]

Further, there is promise for the teaching methodology to reach pre-medical students, although few studies have examined POCUS training in this capacity. *Smalley et al.* found self-reported confidence was 4 out of 5 or greater ("agree") across twelve Likert-scale questions assessing the ability to obtain ultrasound exam views and interpret basic anatomy in a group of 15 pre-medical students following a three-day hands-on training course.[14]

The primary objective of our study was to evaluate the effect of a student-taught POCUS workshop on student confidence scores in sonographic image acquisition, interpretation, and organ identification. Our secondary objective was to evaluate confidence changes in medical and pre-medical student-only cohorts.

## METHODS

### STUDY DESIGN

This was a single-center, prospective, cross-sectional study. All data acquisition and analysis occurred at one institution. Investigators received no funding. This study was deemed exempt from formal institutional review. All participants gave informed consent, and enrollment in the study was not mandatory for participation in the workshop.

### TRAINING FOR STUDENT TEACHERS

First and second-year medical students served as teachers for two POCUS training sessions at the 50th Annual Latino Medical Student Association Northeast Regional Conference in Baltimore, Maryland. By the time of the workshop, student teachers were equipped with an understanding of the principles and clinical applications of

ultrasound. Student teachers were trained via both an integrated ultrasound curriculum provided by their home institution as well as separate training sessions with a professor of ultrasound medicine. Additionally, several of the student teachers operate the POCUS Student Body Interest Group, holding adjunct ultrasound review sessions for club members to receive further hands-on training throughout the academic year.

**SURVEY DESIGN**

Prior to participation in the workshop, student learners completed a web-based pre-workshop survey. This survey assessed past ultrasound experience, the presence of a dedicated ultrasound curriculum at their institution, confidence levels in acquiring and interpreting images of the Focused Assessment with Sonography for Trauma (FAST) exam, as well as relevant anatomical structures such as the heart, liver, kidney, and spleen. Confidence level responses for investigating prior experience using ultrasound were recorded in a Likert Scale format with 1 anchored at "I have no prior ultrasound experience" and 5 at "I feel comfortable using the ultrasound clinically." Confidence level responses for investigating competency in the FAST exam and relevant organ identification were recorded in a Likert Scale format with 1 anchored at "No Confidence" and 5 at "Very Confident". A post-workshop survey was administered to assess changes in self-reported ultrasound experience levels and confidence scores in acquiring and interpreting images of the FAST exam and related organs.

**WORKSHOP LEARNING OBJECTIVES**

Each student participated in one workshop. Workshop sessions were 50 minutes long. The training began with a presentation of sonographic principles and the widespread clinical utility and effectiveness of POCUS. Students were educated on echogenicity terminology and introduced to the identification of the relevant anatomy using sonography. The application of FAST in identifying free peritoneal and pericardial fluid in the acute care setting was explained, and all four spaces of the exam were demonstrated, with special attention given to the sentient locations of each exam window. For the right upper quadrant (RUQ) window, the liver, spleen, hepato-diaphragmatic area, splenorenal recess, pericardium, and caudal edge of the left lobe of the liver were emphasized. For the subcostal window, the pericardium and heart chambers were emphasized. For the left upper quadrant (LUQ), the spleen, kidney, splenorenal recess, and left paracolic gutter were emphasized. For the suprapubic window, the bladder was identified as well as the prostate and rectovesical pouch in natal sex males and the uterus, rectouterine, and vesicouterine pouches in natal sex females. Although the suprapubic view was taught via slideshow presentation, students were not required to participate in scanning this space. For this reason, no data was collected on confidence in acquiring and interpreting images of the suprapubic window. Following the presentation and initial demonstrations, student teachers broke into teaching groups of two, with one acting as an instructor and one as a scanning model. Each teaching group was paired with a group of 4-6 students. All teachers who assumed the role of the scanning model did so voluntarily and verbally consented to their role. Following hands-on learning, all participants regrouped to study examples of pathologic free pericardial and peritoneal fluid. At this time, emphasis was placed on the identification of free fluid in each of the four windows in relation to the "normal" structures covered previously. Teaching images

were obtained from the Department of Emergency Medicine at Temple University.

### STATISTICAL ANALYSIS

Likert Scales for pre- versus post-workshop analysis were compared using independent samples t-test. Categorical variables were compared using a Chi-Square test. A p-value of less than 0.05 was considered significant. Analysis was performed using IBM SPSS Statistics Version 29.

## RESULTS

Forty-three students completed the pre-workshop survey, and 29 students completed the post-workshop survey, conferring a retention rate of 67%, as demonstrated in **Table 1**. Of the 43 student respondents to the pre-survey, 58% self-identified as a medical student (n=25), and 42% as a pre-medical student (n=18). One-fifth (20%) of the medical students (n=5) and 6% of the pre-medical students (n=1) endorsed having a dedicated ultrasound educational curriculum at their home institution, accounting for 14% of the total study population (n=6).

Initially, respondents rated their ultrasound experience with a mean score of 1.7, which increased to 3.2 in the post-workshop survey ($p < 0.001$). In a subgroup analysis, both medical ($p < 0.001$) and pre-medical student ($p < 0.001$) cohorts showed improvement in self-reported experience.

Respondents displayed a 2.2-fold increase in confidence scores for both acquiring and interpreting ultrasound images related to the FAST exam ($p < 0.001$). A significant increase was seen in both medical student ($p < 0.001$) and pre-medical student ($p < 0.001$) cohorts, as shown in **Figure 2**.

Respondents experienced a 2.0-fold increase in confidence in identifying both the liver and kidney, a 2.1-fold increase in confidence in identifying the spleen, and a 1.8-fold increase in confidence in identifying the heart on sonography ($p < 0.001$ for all tests) seen in **Figure 3**. Subgroup analysis for both medical ($p < 0.001$) and pre-medical students ($p < 0.001$) showed similar confidence gains for all organs.

**Table 1**. Demographics of the pre-workshop study population.

| Characteristics | Medical Students | Pre-medical Students | Total |
|---|---|---|---|
| No. of students, (%) | 25 (58%) | 18 (42%) | 43 (100%) |
| Dedicated US curriculum, (%)* | 5 (20%) | 1 (6%) | 6 (14%) |

* Percentage related to total number of medical students or pre-medical students, respectively.

## DISCUSSION

In this study, we examine the effect of a student-taught POCUS workshop for medical and pre-medical students on confidence scores in image acquisition, interpretation, and organ identification. We found that students exhibited higher self-reported experience as well as confidence in performing the FAST exam and identifying relevant organs following the workshop. Our findings lend support to the efficacy of student instructors teaching student learners as described in the literature.[12]

The secondary objective of our study was to assess confidence changes in medical and pre-medical student-only cohorts. We found that both medical and pre-medical students showed confidence improvements in POCUS image acquisition, interpretation, and organ identification. While understudied in the literature, pre-medical students may also benefit from training in POCUS. Teaching POCUS to this group not only trains future medical students and physicians in an important diagnostic modality but also provides a valuable experience for applicants seeking medical school acceptance. POCUS training sessions offer unique medical

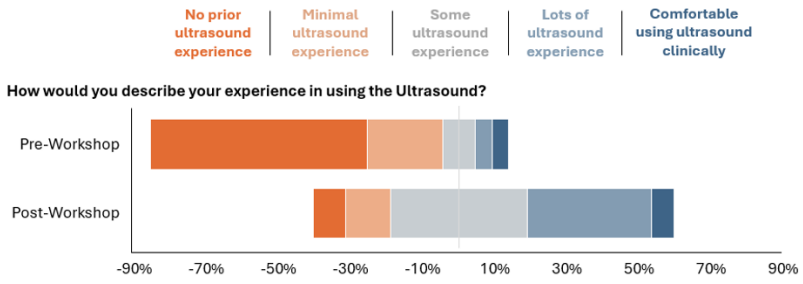


**Figure 1. Pre- and post-workshop survey responses assessing one's experience and comfortability using ultrasound.**

Overall change in experience and comfortability using ultrasound. Self-reported confidence levels were assessed via Likert Scale format with "1" anchored at "I have no prior ultrasound experience" and "5" at "I am comfortable using ultrasound clinically." The mean confidence levels pre- and post-workshop were 1.7 and 3.2, respectively. The differences between these means were compared using independent samples t-tests.

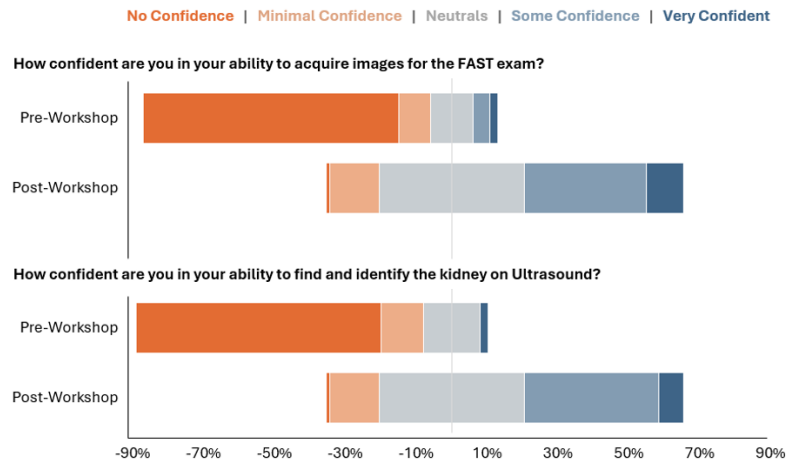


**Figure 2. Pre- and post-workshop survey responses assessing one's confidence in acquiring and interpreting images for the FAST exam.**

Overall change in confidence levels for acquiring and interpreting various images from the FAST exam. Self-reported confidence levels were assessed via Likert Scale format with "1" anchored at "no confidence" and "5" at "very confident." The mean confidence levels pre- and post-workshop were 1.6 and 3.4 for acquiring images and 1.5 and 3.4 for interpreting images, respectively. The differences between these means were compared using independent samples t-tests.

exposure, hands-on practice, and networking opportunities with instructors at prospective medical institutions.[14] Pre-medical students can likely grasp fundamental concepts of POCUS and leverage these educational opportunities for success in the medical school application process.

The integration of POCUS into undergraduate medical education is rapidly increasing. However, a significant challenge lies in the scarcity of qualified faculty instructors.[4–6] The use of ultrasound-trained medical students as instructors offers promise to circumvent this barrier while still providing needed training opportunities to their peers. Empowering students to take on the role of educators serves not only their classmates but the student teacher as well. This experience enhances communication, collaboration, and leadership skills, all of which are essential attributes for becoming a strong and competent resident physician. Furthermore, honing teaching skills during medical school sets the stage for a

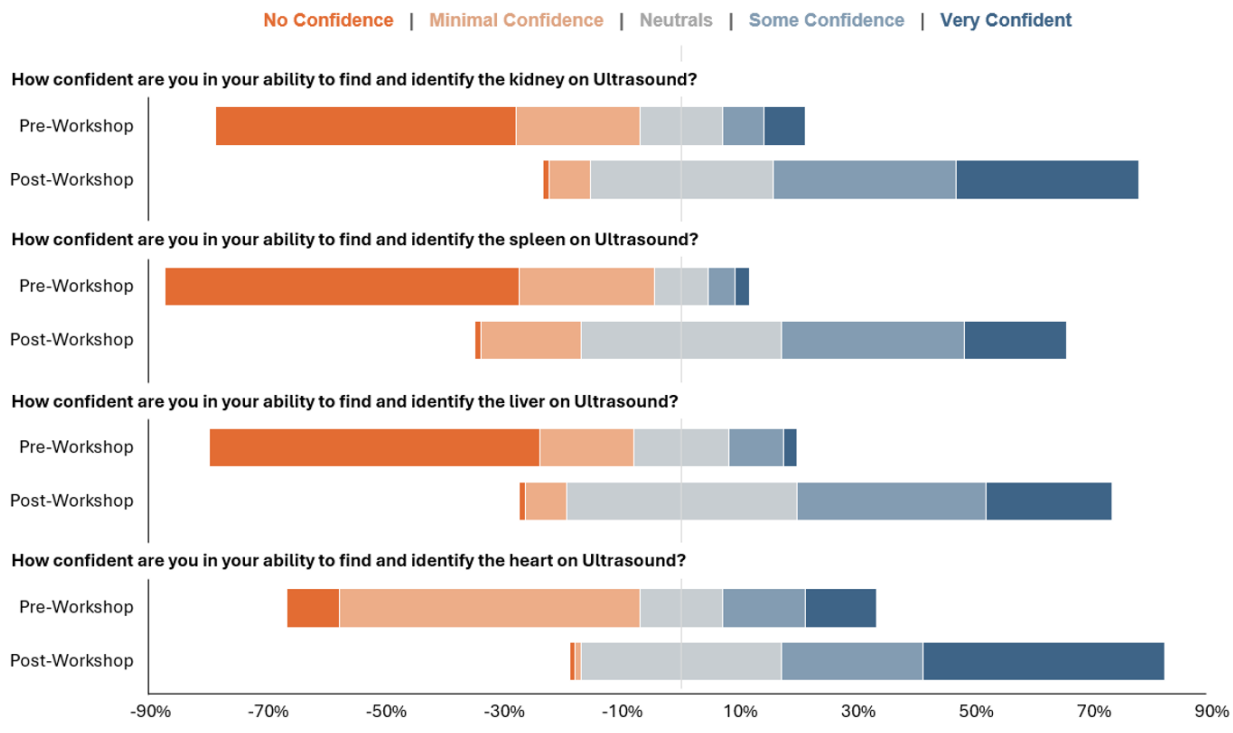


**Figure 3. Pre- and post-workshop survey responses assessing one's confidence identifying various organs.**

Overall change in confidence levels identifying basic organs comparing pre-workshop to post-workshop. Self-reported confidence levels were assessed via Likert Scale format with "1" anchored at "no confidence" and "5" at "very confident." The mean confidence levels pre- and post-workshop were 2.0 and 3.9 for the kidney, 1.7 and 3.5 for the spleen, 1.9 and 3.7 for the liver, and 2.3 and 4.1 for the heart, respectively. The differences between these means were compared using independent samples t-tests.

continued commitment to education throughout one's career. It must be stated that student-taught POCUS experiences should not be used to replace faculty-taught sessions. Instead, we propose this practice as a means to supplement faculty-driven education and clinical experience. Lastly, student-taught POCUS opportunities offer an important, effective, and accessible adjunct modality that bypass current obstacles for implementing POCUS training into undergraduate medical curricula.[4,5]

## LIMITATIONS

Although this study highlights the potential benefits of integrating POCUS into medical education, several limitations should be acknowledged. The study's limited sample size and response rate for the post-survey may hinder the generalizability of its findings. Additionally, this study lacks intermediate and long-term follow-up data to evaluate the retention of confidence scores. While student teachers underwent POCUS training prior to the workshop, experience level differed between instructors. To what effect this had on educational outcomes is uncertain. Furthermore, students who attended this workshop were likely interested in ultrasound at baseline. This heightened level of enthusiasm and attention may have contributed to their successful training outcomes and might not be representative of a randomized cohort of pre-medical and medical students. Lastly, we did not directly compare between student-taught and faculty-taught POCUS training. Further studies are

needed to address questions related to these areas of limitation.

## CONCLUSIONS

In conclusion, our study found that a student-taught POCUS workshop increased student confidence scores in image acquisition, interpretation, and organ identification. These findings were seen in both the medical and pre-medical student cohorts. As we navigate the present challenges to ultrasound education within medical school, the involvement of medical students as educators not only helps address this shortage but fortifies their diagnostic skills and cultivates essential teaching proficiencies.

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