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Original Article

Faculty Development in Proficiency and Application of Point-Of-Care Ultrasound

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Abstract

Objective: To increase proficiency and comfort level with ultrasound skills, apply ultrasound skills to different clinical settings such as outpatient and inpatient, and address barriers to learning and improving ultrasound skills.

Design: We created a point-of-care ultrasound (POCUS) pilot program at a small academic center to assess faculty members' knowledge and perception of ultrasound in surgical settings**.** We conducted an observational cross-sectional study to test the hypothesis and hypothesized that members would have increased confidence in their proficiency. Participants attended a 2-hour session with expert faculty. During this session, participants took a pre-test assessment survey, attended a one-hour didactic lecture and a hands-on workshop with an ultrasound simulation machine and live standardized patient, and then took a post-test assessment survey. If desired, faculty were allowed to return for further self-directed learning with an ultrasound simulation machine after the pilot program.

Results: There was a statistically significant difference in pre- and post-survey questions that addressed comfort using ultrasound in a clinical setting and critical care setting, comfort in using ultrasound at bedside rounds, comfort in teaching medical students and residents, comfort performing FAST (Focused Abdominal Sonogram for Trauma) exam and comfort in doing basic bedside echocardiography. Faculty indicated time, availability of ultrasound equipment to faculty and house staff, and cost of equipment as important barriers to utilization of ultrasound in the clinical set.

Conclusions: Our pilot POCUS course showed improved confidence in ultrasound skills among faculty members. It is important to address barriers such as limited equipment availability and adequate preparation time for future POCUS curriculums.

Keywords: Point-of-Care Ultrasound, Sonography, Faculty Development, Barriers to Education, Case-Based Learning

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Introduction

Point-of-care ultrasound (POCUS) has been integrated into medical school and residency programs more recently, yet there is rarely a formal curriculum teaching and evaluating proficiency in the use of ultrasound. In a survey of critical care fellowship directors, less than 50% of program directors reported having a designated curriculum for teaching fellows. Of those without a curriculum, 91% planned on creating one in the next 5 years.[1] In a survey of Canada Internal Medicine (IM) program directors and division directors, half of the directors (9/17, 53%) reported POCUS use by their trainees. Still, only a quarter (4/16, 25%) reported having a formal ultrasound curriculum.[2] Medical house staff with limited training in POC echocardiography were able to assess LV function and pericardial effusion with a 3-hour training session but with lower accuracy than standard echocardiography.[3]

A longitudinal ultrasound curriculum may benefit more than a single session to preclinical medical students and residents.[4,5] A study of PGY-1 IM residents showed an increase in the correct identification of ultrasound images of ascites, kidney, and pleural effusions after 6 months with the introduction of a longitudinal curriculum involving teaching during morning report and ultrasound rounds.[5] POCUS has even been studied in pediatric residency through a structured pediatric intensive care unit rotation curriculum that showed increased comfort level with performing POCUS, improvement in self-test scores, and identifying appropriate indications.[6] There is potential for faculty and residents to benefit from a structured curriculum. In a 1-day POCUS training course in Japan, trainees and novice attending physicians showed similar improvement in pre-and post-test scores (65.5 to 83.9% for trainees, 66.7 to 81.5% for physicians).[7] Given the importance of POCUS in critical care, Lim et al. designed a two-day workshop for faculty intensivists and different subspecialists to further develop a standard curriculum for future critical care fellows.[8] The objective of our 1-day single session pilot program is to assess faculty members' proficiency and increased overall confidence in further ultrasound application.

Methods

We conducted an observational cross-sectional study to test the hypothesis that a POCUS pilot training program with didactics and hands-on training would improve faculty perceptions and knowledge about ultrasound in surgical settings. In our study, participants served as their own controls. The Quality Improvement (QI) study was approved by the Texas Tech University Health Sciences Center's Quality Improvement Review Board.

The study was conducted at a small academic medical center, using a sample of 15 faculty members from different areas of medicine. Self-selection bias was accounted for by informing faculty via email from a third party about the course. Participants reported they had limited or no previous exposure to ultrasound training. Didactic training was provided by faculty within the School of Medicine across various departments with expertise in POCUS. There were no exclusion criteria.

For statistical analysis, we used a non-parametric paired t-test, the Wilcoxon signed-rank test, to test for statistically significant differences between pre and post-test results. The sample size was small, so a non-parametric test was used. Analysis was conducted in GraphPad® prism.

Table 1: Faculty completed a 15-question pre-assessment survey before the course and an identical post-assessment survey immediately after. A combination of questions regarding prior and current experience in ultrasound with a scale of 1 (lowest) to 10 (highest) regarding comfort levels and beliefs about ultrasound education (Questions 4-13) were surveyed.

1.	How many years have you been in practice? (a) Still in training (b) 0-3 years (c) 4-7 years (d) 8-12 years (e) more than 12 years
2.	I have training in ultrasound. Yes/No
3.	How often do you use ultrasound in the clinic setting? (a) None (b) few times annually (c) few times monthly (d) few times weekly (e) daily
4.	There is an educational benefit of learning ultrasound in a clinical setting
5.	How comfortable are you in using ultrasound in clinical setting?
6.	How comfortable do you feel about using ultrasound at the bedside on rounds?
7.	All medical schools should incorporate ultrasound education into their clinical curriculum.
8.	How comfortable are you in teaching ultrasound to medical students/staff?
9.	I plan to incorporate ultrasound into my clinical practice.
10.	How comfortable do you feel about using ultrasound for the FAST exam (Focused Assessment with sonography for trauma)?
11.	How comfortable are you in using ultrasound in procedures like central line placement?
12.	How comfortable are you in doing bedside basic echocardiography?
13.	How comfortable do you feel about using ultrasound in the Critical care setting?
14.	List two or more important barriers to using ultrasound in the clinical setting.
15.	How many hours do you need to learn about basic ultrasound applications in the health care field? (a) < 5 hrs, (b) 5-10 hrs, (c) 100-15 hrs, (d) 15 to 20 hrs, (e) > 20 hrs

Participants attended a 2-hour session with trained faculty. The session consisted of a pre-test assessment survey, one-hour of didactic lecture, a hands-on workshop with an ultrasound simulation machine and live standardized patient, and a post-test assessment survey. Faculty were given the option to return for self-directed learning with an ultrasound simulation machine after the pilot program if desired. Course topics covered during the didactic session included the FAST/eFAST exam with respective standard views, echocardiography (i.e., parasternal long and short axis views, apical 4 and 2 chamber views, and abdominal views.

Each faculty assessment was paired, and de-identified before analysis. Twenty-five faculty members completed pre-test surveys, and 15 faculty members completed post-test surveys, so 10 assessment surveys were not included in the post-test analysis (Table 1). Pre and post-test assessment differences for questions 4-13 were evaluated by paired t-tests.

Results

Twenty-five faculty members at Texas Tech University Health Sciences Center Amarillo registered for and participated in the POCUS workshop, with 15 completing pre- and post-test surveys. Eight out of fifteen faculty members (53%) admitted to not using any ultrasound in the clinic setting. Of the 15 faculty members, 47% (7/15) reported more than 12 years in practice (Figure 1). When asked how many hours were needed to learn about basic ultrasound applications in the healthcare field, faculty indicated pre (6/15) and post (8/15) survey that >20 hours were needed, with no difference between pre- and post-test survey (p=0.5) (Figure 2). There was a

statistically significant difference between pre-and post-survey questions 5, 6, 7, 10, 12, & 13 (Table 2). These questions addressed comfort using ultrasound in clinical and critical care settings, bedside rounds, teaching medical students and residents, performing a FAST exam, and bedside echocardiography. Questions 4, 9, and 11 did not show a statistically significant response between pre- and post-assessment (Table 2). These questions involved the educational benefit of learning ultrasound, plans to incorporate ultrasound into clinical practice, and comfort level using ultrasound for central line placement. As assessed by question 14, faculty indicated time, availability of ultrasound equipment to faculty and house staff, and cost of equipment as important barriers to the utilization of ultrasound in the clinical setting.

Question	Pre-Test (Median)	Post-Test (Median)	p-value
Question 4	10	10	0.5
Question 5	4	7	0.03
Question 6	4	7	0.01
Question 7	10	10	0.055
Question 8	4	7	0.002
Question 9	9	9	0.55
Question 10	2.5	7	0.002
Question 11	9	9	0.24
Question 12	2	7	0.005
Question 13	3	7	0.02

Table 2: Survey question 4-13 responses

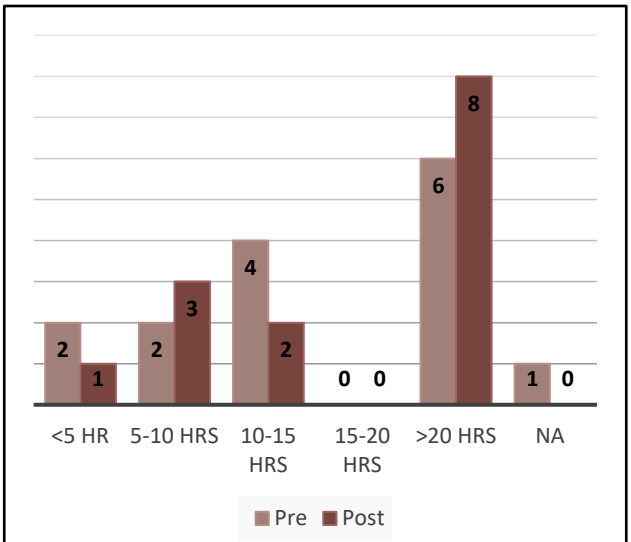

Figure 1: Question 15 - Number of hours to meet competency in basic ultrasound application based on faculty perception in re-and post- assessments.

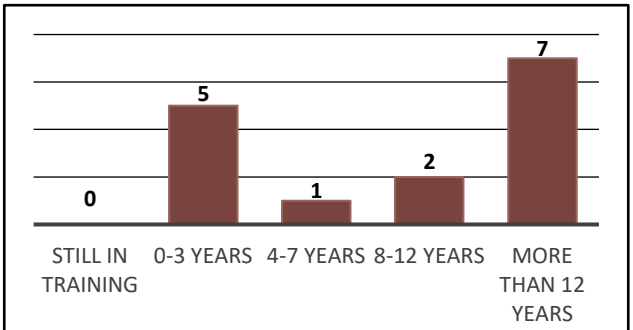

Figure 2: Question 1 - Number of years in practice among faculty participants.

Discussion

After a POCUS course designed for faculty members, participants had improved confidence levels in their ultrasound skills and a greater desire to adopt these skills into their future medical practice. Our educational course with faculty showed a statistically significant difference in pre-assessment and post-assessment survey questions regarding the following: comfort in using ultrasound in a clinical setting, critical care setting, and bedside rounds; belief that medical schools should incorporate ultrasound into their curriculum;

teaching ultrasound to medical students and other house staff; comfort in using ultrasound for FAST Exam; and comfort in doing bedside basic echocardiography. Questions 4, 9, and 11 did not show a statistically significant response between pre- and post-assessment. These questions involved the educational benefit of learning ultrasound, plan to incorporate ultrasound into clinical practice, and comfort level of using ultrasound for central line placement.

There is limited literature detailing faculty proficiency with ultrasound curriculum and the barriers that hinder faculty utilization of POCUS. Practicing anesthesiologists who underwent a 1-day standardized course and 3 video assessments had increased proficiency in ultrasound-guided perineural catheter insertion.[9] In a similar study, anesthesia faculty who completed a two-phase perioperative ultrasound training program had a statistically significant increase in quiz scores across six sessions and average mean and median scores on the three Objective Structured Clinical Examination (OSCE) stations of 95.63% and 98.33%.[10]

In a 10-week faculty development program in which 15 faculty members completed 2 hours of didactic training and 10 hours of hands-on training, statistically significant improvements in the ability to interpret images and make clinical decisions, perceptions of usefulness and limitations of POCUS, and perceptions of POCUS improving patient care.[11] Incorporating training by experienced faculty early in training, such as through orientation, can substantially improve proficiency. During internal medicine intern orientation at a tertiary academic medical center, interns had significantly higher OSCE scores in faculty-guided training vs. self-guided training.[12]

Several barriers can hinder faculty's consistent utilization of POCUS. In a survey of 44 participating academic emergency medicine faculty, barriers included lack of time (71%), consultants' request for comprehensive ultrasound (67%), and discomfort with operating machines such as patient information and saving clips (61%).[13] In our educational session, faculty indicated time, availability of ultrasound equipment to faculty and house staff, and equipment cost as important barriers to the utilization of ultrasound in the clinical setting. A combination of scheduled online and classroom ultrasound training may address some of these barriers in implementing an ultrasound curriculum.

We acknowledge some limitations of our study. Our study did involve a significant number of faculty members not completing post-assessment surveys, leaving a small sample size. Although there were faculty members across various fields of medicine, such as surgery, pediatrics, internal medicine, and obstetrics/gynecology, including more faculty members would be helpful. Also, the pre- and post-assessment surveys addressed the individual faculty member's perceptions of their improvements rather than objective quantitative results. Our results were limited to a single-day session rather than a longitudinal course. A future direction would be to assess and trend the progress of faculty members' proficiency in a longitudinal course at subsequent POCUS teaching sessions, such as in 3-month and 6-month intervals.

Conclusions

After a POCUS course designed for faculty members, participants had improved confidence levels in their ultrasound skills and a greater desire to adopt these skills

into their future medical practice. As highlighted in other studies regarding barriers to ultrasound curriculum implementation, addressing barriers such as limited availability of ultrasound equipment and adequate time for preparation can assist faculty members in formalizing a curriculum for other faculty and house staff.

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Conflict of Interest Disclosures

None of the authors have any relevant conflict of interest or other financial disclosures.

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