Faculty staff-guided versus self-guided ultrasound training for internal medicine residents

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OBJECTIVES Ultrasonography is of growing importance within internal medicine (IM), but the optimal method of training doctors to use it is uncertain. In this study, the authors provide the first objective comparison of two approaches to training IM residents in ultrasonography.

METHODS In this randomised trial, a simulation-based ultrasound training curriculum was implemented during IM intern orientation at a tertiary care teaching hospital. All 72 incoming interns attended a lecture and were given access to online modules. Interns were then randomly assigned to a 4-hour faculty-guided (FG) or self-guided (SG) ultrasound training session in a simulation laboratory with both human and manikin models. Interns were asked to self-assess their competence in ultrasonography and underwent an objective structured clinical examination (OSCE) to assess their competence in basic and procedurally oriented ultrasound tasks. The primary outcome was the score on the OSCE.

RESULTS Faculty-guided training was superior to self-guided training based on the OSCE scores. Subjects in the FG training group achieved significantly higher OSCE scores on the two subsets of task completion (0.9-point difference, 95% confidence interval [CI] 0.27–1.54; $p = 0.008$) and ultrasound image quality (2.43-point difference, 95% CI 1.5–3.36; $p < 0.001$). Both training groups demonstrated an increase in self-assessed competence after their respective training sessions and there was little difference between the groups. Subjects rated the FG training group much more favourably than the SG training group.

CONCLUSIONS Both FG and SG ultrasound training curricula can improve the self-reported competence of IM interns in ultrasonography. However, FG training was superior to SG training in both skills acquisition and intern preference. Incorporating mandatory ultrasound training into IM residencies can address the perceived need for ultrasound training, improve confidence and procedural skills, and may enhance patient safety. However, the optimal training method may require significant faculty input.

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INTRODUCTION

Since its introduction in the 1960s and subsequent reimbursement by Medicare in the United States in the 1970s, ultrasonography has become an important extension of the physical examination in many medical specialties and now comprises nearly 25% of all imaging studies performed globally.[1] Its safety, relative low cost, ease of use and increasing portability have made it a rapidly growing imaging modality in both industrialised and developing countries.[2] The field of emergency medicine (EM) has utilised bedside ultrasound for over two decades and now includes mandated training during residency. The American College of Emergency Physicians (ACEP) recommends initial training should include 16 hours of didactic content and a minimum of 150 proctored scans.[3] By contrast, the field of internal medicine (IM) has been slower to integrate ultrasound into its training, although hospitalists and IM residents perform invasive bedside procedures that can benefit from the use of ultrasound.

The reason for the lack of standardised training in ultrasonography in IM is multi-factorial. To start with, there are no clear national guidelines at either the undergraduate or graduate medical education level. The American Medical Association (AMA), American Association of Medical Colleges (AAMC) and Accreditation Council for Graduate Medical Education (ACGME) all recommend ultrasound training but make no mention of a formal training requirement.[4–6] Furthermore, there are numerous barriers to universal ultrasound training within IM programmes. These include but are not limited to insufficient funding, limited time on the part of faculty staff and trainees, as well as a paucity of faculty staff trained in ultrasound use.[4]

Despite these barriers, the use of ultrasound has become the standard of care at many institutions. Studies have demonstrated that the use of ultrasound guidance during invasive procedures can reduce complications and improve patient safety.[5–10] Further, studies have shown that training residents and hospitalists in ultrasound is feasible and effective in supplementing clinical skills.[11–15]

In the last few years, there has been a growing literature advocating for the integration of formal ultrasound training within IM residency programmes. This literature highlights the finding that perceived confidence in the use of ultrasound is low among IM residents and is correlated with poor objective competency.[16] The first study to describe a pilot programme to standardise ultrasound training among incoming IM residents was published in 2011.[17] The authors demonstrated that residents improved their self-reported confidence in their ability to identify structures important in performing invasive ultrasound-guided procedures through a simulation-based module with faculty staff guidance. However, data to support a specific training strategy are limited.

Experiential learning has long been the standard for procedural skills acquisition in medicine. With compressed duty hours and an increased focus on quality and safety, faculty-guided simulation training has taken a more prominent role.[18] Studies have shown that simulation-based education can improve ultrasound skills.[19,20] There is also evidence that direct faculty training of residents can be an effective means of teaching ultrasound skills.[21–23] However, in a large IM training programme, obtaining sufficient faculty staff to provide direct hands-on training of housestaff can present a significant challenge. Therefore, we sought to determine if self-guided, hands-on ultrasound training could be as effective as faculty staff-guided training.

Study objectives

In this study, we sought to: (i) provide the first subjective *and* objective assessment of incoming IM residents participating in an ultrasound training programme, and (ii) compare two distinct didactic modalities for ultrasound training. In the absence of data assessing self-guided training in ultrasound, we sought to examine if this training modality would preserve the educational experience while reducing demands on faculty staff time. We hypothesised that self-guided (SG) training would be equivalent to faculty-guided (FG) training in terms of both subjective and objective measures of competence in the use of ultrasound.

METHODS

Subject characteristics

We contacted potential subjects by e-mail, mail and in person during intern orientation in the summer of 2012. All 72 incoming interns in the Massachusetts General Hospital (MGH) IM programme scheduled to begin their intern year in June 2012 were eligible for inclusion in the study. This included interns in the categorical, primary care, preliminary and combined medicine/paediatrics tracks. All subjects provided informed consent and the local institutional review board approved the study.

Study design and protocol

This was a randomised, controlled and non-blinded trial. An administrator unaffiliated with the study and blinded to the intervention randomly assigned the subjects to either of two study groups using a computer random number generator. Because of the design of the study, it was impossible to blind the subjects to the nature of the intervention. All subjects were randomly assigned to receive either FG or SG training in hands-on ultrasonography skills. The FG group served as a control for the SG group as the FG group was designed to approximate the didactic style employed in the existing central venous catheter insertion training required for intermediate residents at our institution. The subjects were unaware of their group assignment until the hands-on session. After randomisation, all subjects attended a 2-hour lecture on ultrasonography delivered by the chief of the Division of Emergency Ultrasound, an attending physician in the Department of Emergency Medicine. All subjects were then given access to an online resource for learning ultrasonography (www.emsono.com) prior to the hands-on training session. EMSono is a comprehensive, web-based ultrasound education tool geared to EM providers at varying levels that features interactive, multimedia learning modules on subjects such as the basic principles of ultrasonography ('practical scanning') and performance of ultrasound-guided venous access, among others. Study subjects were strongly encouraged but not mandated to access the relevant training modules, watch the videos, and complete the multiple-choice assessments. Finally, as part of the process of gaining their consent to participation in the study, subjects were made aware of the possibility of an incidental finding during the hands-on session, and a protocol was adopted in accordance with previously published guidelines[24] and approved by the local institutional review board.

Subjects in the FG group underwent a 4-hour ultrasound training session in the MGH Learning Lab, a dedicated simulation centre at the study institution. Subjects were divided into two groups based on available space. The session included 2 hours of hands-on instruction in the basics of ultrasonography, as well as training in paracentesis, thoracentesis and internal jugular central venous line placement. Fellow interns were used as normal models and specialised procedure manikins were used for needle insertion and visualisation of ascites, pleural effusions and the internal jugular vein. The subjects went from station to station. At each station, the study subjects watched an instructor demonstrate a procedural technique using ultrasound, and then had the opportunity to try the technique before moving to another station. Subjects received real-time feedback from the faculty instructors on technique and image quality. This training was led by attending doctors and fellows in the Department of Emergency Medicine, all trained as per the ACEP guidelines (16 hours of continuing medical education and 150–200 proctored ultrasound examinations[3]).

Subjects in the SG group also underwent a 4-hour ultrasound training session in the MGH Learning Lab. Subjects were divided into two groups based on available space. During the first 2 hours, the subjects received an ultrasound-training handout as a teaching tool (Appendix S1). The handout was created by IM residents and modified after focus group testing with other residents, fellows and attending doctors from the Departments of Internal and Emergency Medicine. By working through the steps of the handout, the subjects first learned the basics of ultrasonography, including instruction on both curved and linear probes and how to adjust depth and gain. Subsequently, the handout provided station-specific instructions that guided the subjects through the basic steps of performing paracentesis, thoracentesis and internal jugular vein identification for central venous line placement with the use of ultrasound. Fellow interns were again used as normal models and specialised procedure manikins were used for needle insertion and visualisation of ascites, pleural effusions and the internal jugular vein. The subjects went from station to station, working with the handout at each station to learn how to perform the procedural technique at that station. There were no faculty members, fellows or senior residents present during this portion of the training and therefore the subjects did not receive a hands-on demonstration or real-time feedback on technique or image quality. However, the subjects could discuss performance of the techniques amongst themselves. Following this session, the subjects participated in an objective structured clinical examination (OSCE) and completed a survey in a similar manner to the FG group.

In the OSCE, a fellow intern was again used as a normal model to assess the subject's ability to use an ultrasound machine to identify normal anatomical structures (Appendix S2). The OSCE employed a modified version of a form used by the Department of Emergency Medicine for assessment of its residents. The grading form was modified based on input by residents, fellows and attending doctors from the Departments of Internal and Emergency Medicine. The OSCE grading form involved two sections. The first section tested the subject's ability to complete a series of tasks, graded as either completed or not completed (i.e. yes or no); 1 point was awarded per completed task. The second section of the OSCE was more subjective and asked the grader to rate the quality of the subject's ultrasound images obtained during the task completion section; 1–5 points were awarded for each of three images. Following the OSCE, each subject completed a survey gathering baseline demographic data, history of ultrasound use, self-assessed competence, and feedback on the training session (Appendix S3).

Subjects in both the FG and SG groups had access to Sonosite ultrasound machines (approximately one machine per four subjects) during the simulation centre hands-on training sessions. The procedural topics and techniques for the instructional sessions were determined prior to the sessions and were the same for both groups, but were taught by faculty members in the FG group and by self-directed handout in the SG group. In both groups, fellows and attending doctors from the Departments of Internal and Emergency Medicine graded the OSCE. Although the graders were not blinded to the subject's randomisation, the OSCE was standardised and designed to assess specific achievable milestones to minimise opportunities for bias. The subjects were unaware of the content of the OSCE until they actually underwent the assessment.

Study measures

We collected data on each subject's age, sex, experience with ultrasound and training in ultrasound prior to residency, opinion on the necessity and appeal of ultrasound training, self-assessed competence in using ultrasound, and ratings of the hands-on training sessions. This was accomplished through the survey administered after participants had completed the OSCE. We also compiled the subjects' scores on the OSCE in the two major categories of task completion (adjusting depth, identifying the internal jugular vein, etc.) and ultrasound image quality.

Study outcomes

The co-primary outcomes were the OSCE scores for task completion and ultrasound image quality. Secondary outcomes were change in self-assessed ultrasound competence after the hands-on training session and ratings of the hands-on training session.

Data analysis

The co-primary authors retained full control of the de-identified study database. The primary analysis was designed to determine if SG training was equivalent to FG training with respect to OSCE scores on task completion and ultrasound image quality. A total of 72 incoming interns entered the MGH IM programme in 2012, and we aimed to enrol all of them in the study. With 36 subjects in each group, we would have 99% power to detect a 1-point difference between SG and FG training with respect to task completion and 83% power to detect a 1-point difference with respect to ultrasound image quality at a two-sided significance level (p-value) of 0.05.

All analysis was based on the intention-to-treat principle. Likert-type questions were used to obtain self-assessments of ultrasound competence and ratings of the hands-on training sessions. We used two-tailed *t*-tests (paired or unpaired depending on data type) for normally distributed continuous variables, the Wilcoxon rank sum test for non-normally distributed continuous variables, and Fisher's exact test for categorical variables. A p-value of < 0.05 was considered to indicate statistical significance. Cohen's effect size ([mean 1−mean 2])/pooled standard deviation) was used to examine the change in ultrasound competence after the training sessions as well as the ratings of the respective training sessions. Data were expressed as the mean ± standard deviation (SD), mean with 95% confidence interval (CI), or median with interquartile range (IQR) depending on the statistical test used.

RESULTS

Study population

In June 2012, 72 incoming interns were recruited to participate in the trial. All 72 interns participated; there were no dropouts or crossovers (Table 1). The two groups were well balanced with respect to baseline characteristics; there were no significant differences between the groups. Approximately three-quarters of the subjects had used an ultrasound machine prior to entering residency, but only a small minority had previously participated in a formal ultrasound training course. Nearly all of the subjects felt that formal ultrasound training was necessary during IM residency, and a majority of the subjects felt that formal ultrasound training would make an IM programme more appealing. There was no statistically significant difference between the groups in the numbers of subjects who accessed the EMSono online modules prior to the intervention.

Table 1 Baseline characteristics of the subjects

Characteristic	Self-guided training	Faculty-guided training	p-value*
Age, years, mean ± SD	27.5 ± 2.27	27.8 ± 2.82	0.57
Male sex, n/*total* n *(%)*	20/36 (55.6)	20/36 (55.6)	1
Used an ultrasound machine prior to residency, n/*total* n *(%)*	26/36 (72.2)	27/36 (75.0)	1
Number of uses of an ultrasound machine prior to residency, median (IQR)	2.5 (0–5)	2.25 (0.75–5)	0.72
Participated in formal ultrasound training course prior to residency, n/*total* n *(%)*	2/36 (5.6)	6/36 (16.7)	0.26
Do you think formal ultrasound training is necessary during IM residency? Yes, n/*total* n *(%)*	34/36 (94.4)	36/36 (100)	0.49
Would having a formal ultrasound training programme make an IM programme more appealing to you? Yes, n/*total* n *(%)*	25/36 (69.4)	31/36 (86.1)	0.16
Did you use any of the EMSono online modules prior to this session? Yes, n/*total* n *(%)*	17/36 (47.2)	13/36 (36.1)	0.47

* p-values were calculated using the t-*test for age, the Wilcoxon rank sum test for number of uses of an ultrasound machine prior to residency, and Fisher's exact test for sex, whether the respondent had used an ultrasound machine prior to residency, whether he or she had participated in formal ultrasound training prior to residency, whether he or she thought formal ultrasound training was necessary during internal medicine residency, whether he or she thought having a formal ultrasound training programme would make an IM programme more appealing, and whether he or she had used any of the EMSono online modules prior to the session.*
SD = standard deviation; IQR = interquartile range; IM = internal medicine.

OSCE scores

The FG group performed significantly better than the SG group on both the task completion (0.9-point difference, 95% CI 0.27–1.54; p = 0.008) and ultrasound image quality (2.43-point difference, 95% CI 1.5–3.36; p < 0.001) sections of the OSCE (Table 2).

Self-assessed ultrasound competence

Both the SG and FG training groups felt more competent in the use of ultrasound after their respective training sessions; there was almost a doubling of self-assessed competence scores in each group (Table 3). There was little difference between the two groups in the change in self-assessed competence, with an effect size of 0.33 (small compared with the SDs of the groups).

Training preferences of subjects

Subjects significantly preferred the FG training session. The SG session was rated as close to 'satisfactory', whereas the FG session was considered to be 'excellent' (Table 3). The effect size of 2.79 was quite large compared with the SDs of the groups.

DISCUSSION

In this randomised, controlled trial conducted within an IM residency programme, we compared two didactic methods for training interns in the use of ultrasound, and found that FG training was superior to SG training based on significantly higher OSCE scores on the two subsets of task completion and ultrasound image quality. Furthermore, although both training groups demonstrated similarly large improvements in self-assessed competence after their respective training sessions, subjects still rated the FG training group much more favourably than the SG training group. The results of this study suggest that faculty guidance is an integral component of ultrasound training and provides a novel comparison of different types of feedback.

The incorporation of formal ultrasound education into IM residency will depend on a variety of factors. These include cost, reimbursement, restrictions

Table 2 Objective structured clinical examination (OSCE) score (primary outcome)

OSCE score component	Self-guided training, mean (95% CI) [range]	Faculty-guided training, mean (95% CI) [range]	Faculty-guided score minus self-guided score, mean (95% CI)	p-value*
Task completion (range 0–19)	17.43 (16.82–18.04) [9–19]	18.33 (18.05–18.61) [16–19]	0.9 (0.27–1.54)	0.008
Ultrasound image quality (range 3–15)	9.49 (8.81–10.17) [4–12]	11.92 (11.21–12.63) [8–15]	2.43 (1.5–3.36)	< 0.001

* p-values were calculated using a t-*test*.
95% CI = 95% confidence interval.

Table 3 Competence in using ultrasound and training preferences

	Self-guided training	Faculty-guided training	Cohen's effect size*
Self-assessed competence† in use of ultrasound before training, mean ± SD (range)	1.83 ± 0.91 (1–4)	1.94 ± 1.09 (1–4)	–
Self-assessed competence† in use of ultrasound after training, mean ± SD (range)	3.31 ± 0.86 (1–5)	3.69 ± 0.67 (2–5)	–
Change in self-assessed competence after training, mean ± SD	1.47 ± 0.88	1.75 ± 0.81	0.33
Rating of training session,‡ mean ± SD (range)	2.69 ± 1.11 (1–5)	4.91 ± 0.29 (4–5)	2.79

* (Mean of faculty-guided group – mean of self-guided group) / (Pooled standard deviation from all 72 subjects).
† Self-assessed competence was assessed using a 5-point Likert scale, on which 1 = not at all competent, 3 = neutral, 5 = extremely competent.
‡ Rating of training session was assessed using a 5-point Likert scale on which 1 = poor, 3 = satisfactory, 5 = excellent.
SD = standard deviation.

on trainee work hours, availability of dedicated faculty staff with training in ultrasonography, and a lack of standardised national guidelines. Emergency medicine doctors have long seen the value in dedicated ultrasound education and it is now a mandated component of EM residency programmes across the United States.[25,26] A recent needs assessment by Kessler and Bhandarkar highlighted the growing desire among medical students and IM residents to obtain formal education in ultrasound during their training.[16] In our survey, interns were asked whether they believed ultrasound training to be necessary for IM residents and whether having formal ultrasound training during residency made an IM programme more appealing. Seventy of the 72 interns (97%) felt formal ultrasound training to be necessary during IM residency and 56 of the 72 interns (78%) felt it made an IM programme more appealing. It is clear the desire for ultrasound training is high among incoming IM interns, but the optimal strategy for delivering such training has yet to be established. Our study hopes to further illuminate the growing desire for ultrasound training within IM residency, as well as to stimulate discussion on how this training might be offered most effectively within the context of the existing medical education literature on learner self-assessment, feedback and self-regulated learning.

Self-assessment

Our data are consistent with those cited in the recent literature suggesting that ultrasound training of IM resident doctors results in improved self-assessed confidence in the use of ultrasound.[17] Keddis *et al.*[17] studied a simulation-based ultrasound learning module for incoming IM residents at the Mayo Clinic and demonstrated a significant increase in self-perceived confidence in the understanding of ultrasound principles and in identifying seven different anatomic structures. However, the present study importantly demonstrates that self-assessment does not necessarily correlate with actual objective performance. Both the FG and SG groups in this study showed similar increases in self-assessed competence as a result of training. Despite similar increases, however, subjects in the FG group performed better on the OSCE than subjects in the SG group. In the context of the existing literature on self-assessment, these results are not surprising. Prior studies have consistently demonstrated that doctors' self-assessments are unreliable in comparison with objective assessments of their competence. Our study further suggests that objective external assessment should be used preferentially over self-assessments in future trials of ultrasound training.[27,28]

Feedback

To our knowledge, this study describes the first formal ultrasound training module for incoming IM residents to incorporate an objective assessment of skill. We demonstrated that FG training was superior to SG training based on OSCE performance in the subsets of both task completion and ultrasound image quality. However, in order to understand why FG training yielded superior OSCE scores over SG training, it is necessary to better understand the differences between the groups and to isolate the independent variables measured. As the study was constructed, there are two primary independent variables: faculty staff demonstration of skills, and real-time feedback. Ideally, we could have employed a video demonstration of faculty staff performing the various ultrasound techniques and procedures at the beginning of the SG session in order to isolate real-time feedback as the sole independent variable. Feedback has long been viewed as critical for learner guidance and as a necessary condition for learning.[29–31] Subjects in the FG session were provided with a clear goal-based scenario, as described by Schank *et al.*[30], and with real-time feedback on their technical skills and quality of image acquisition. Subjects in the SG session were also provided with a goal-based scenario, but lacked formal faculty-provided feedback. Instead, learners in the SG group presumably received informal peer feedback as they navigated the stations, although this can only be conjectured as these sessions were not directly observed or recorded. This study provides support for the principle that feedback is critical to learning. It also offers a comparison between types of feedback, specifically 'strong' and 'weak' feedback, as defined by van de Ridder *et al.*[31] Strong feedback is provided by an expert observer on easily observable tasks and competencies with the aim of improving performance (akin to the FG group), whereas weak feedback consists of feedback provided by an uninformed or non-expert observer, based on an implicit standard, on competencies that are not clearly observable (akin to the SG group).[31] Our study suggests that strong feedback is more effective than weak feedback for procedural tasks. We speculate that the authority of the observer providing the feedback (e.g. a faculty member trained in ultrasonography compared with a senior resident) may also yield differential efficacy.

Learners view feedback as an important component of their learning and are often dissatisfied with lack of feedback or with the quality of the feedback they receive.[32–34] This is suggested by the finding that subjects in the FG group rated the session more favourably than subjects in the SG group. Interns in the SG group, who were not blinded to the intervention, may have felt they were missing an opportunity to work with faculty staff and to obtain direct feedback on their skills prior to an objective assessment.

Self-regulated learning

Self-regulation in medicine has long been recognised as a critical requirement for medical professionals at all stages of training, particularly with respect to learning, as practitioners and trainees are expected to identify gaps in their knowledge in order to respond appropriately to a given clinical context.[35] Novel didactics in undergraduate medical education, such as problem-based learning, have emerged to help equip students early with the tools for successful self-directed learning.[36] A recent review by Brydges and Butler of medical education research on self-regulation highlighted a few concepts relevant to our study.[37] One is that medical educators should support environments for self-regulation. Medical simulation is one such fertile ground for developing novel tools for promoting self-directed learning. Another concept to which Brydges and Butler[37] refer is the notion of 'grain size', which is defined as the level of detail or analysis used for self-assessment.[38] Recent literature suggests that if the analysis is more finely focused such that learners are made to dynamically self-monitor (e.g. while performing a given task), they self-assess their competence more accurately than they do in a global self-assessment.[39] This is particularly relevant for future research on ultrasound training. Self-monitoring during given tasks may prove to be a more reliable outcome measure than more global self-assessment and thus may better correlate with the efficacy of a proposed didactic structure.

Strengths

Our study has several strengths. It demonstrates the feasibility of conducting ultrasound training within a large IM residency programme at an academic medical centre. All 72 interns participated in the study; there were no dropouts or crossovers. It also offers the first objective assessment of competence in ultrasound use post-intervention using an OSCE format administered by faculty members with training in ultrasonography.

Limitations

There are a number of important limitations to this study. The chief component of our assessment, the OSCE, was not formally validated and instead represented consensus expert opinion on the part of the faculty-appointed authors. In reiterating this study, we would determine inter-rater reliability in OSCE scoring among graders. We would also test participants with a range of skill levels in order to validate the OSCE for future training sessions. The OSCE was graded by human proctors from two fields of medicine, interjecting subjectivity in the objective assessment of the study participants. However, the OSCE scoring system was designed to be simple and reliable. The faculty staff grading the OSCE were not blinded to the subject's randomised group, which may have resulted in ascertainment bias. The OSCE was administered only once, after the intervention, and thus we have no baseline for comparison. However, randomisation should have produced negligible differences between the two groups in baseline OSCE performance. Further, by assessing the learners immediately after the intervention, we cannot determine long-term knowledge and skill retention. Finally, there is no validated curriculum for SG ultrasound training, and the finding that FG training was superior to SG training may have reflected deficiencies in the prepared curriculum rather than an inherent superiority of the FG training.

Future research

Despite the limitations of our trial, this study demonstrates a successful ultrasound training format within an IM residency programme. Whether this success is durable cannot be determined by the given design. Thus, we plan to repeat modified versions of ultrasound training at future intern orientations and to re-assess subjects with OSCEs at varying time-points after the intervention.

This study explores a novel training method with the aim of addressing one of the main barriers to universal ultrasound training: demand for and utilisation of faculty staff time. Although the trial showed that FG training was significantly superior to SG training in objective measures as determined by OSCE performance, further study is required to optimise the SG curriculum and re-examine whether SG training or some combination of the two strategies would be equivalent to FG training. Perhaps self-guided curricula in combination with varying faculty or resident guidance can be developed and implemented so that trainees can learn the skills they need in order to be able to identify relevant anatomy during invasive procedures. The literature suggests that the results of peer teaching can be comparable with those achieved by more experienced health care professionals, and a recent study of peer-assisted ultrasound training demonstrated that complex technical skills could be adequately taught to students employing student-teachers.[40,41]

Finally, although faculty staff feedback may have been the intended independent variable, we realise that a number of factors may have contributed to the observed difference between groups in OSCE scores. As previously discussed, one possible way to isolate the (non-)provision of real-time feedback as representative of the difference between the two groups is to use a video demonstration of the various procedures at each station. Nonetheless, we know that feedback is a necessary condition for learning. Future trials could conduct more formal comparisons of 'strong' and 'weak' feedback, as well as of the levels of authority of feedback (e.g. faculty-compared with resident-derived feedback). Regardless of future findings, this study indicates that, in order to begin to effectively train IM residents in the use of ultrasound, institutions must support faculty staff in developing these instructional programmes.

CONCLUSIONS

Despite the burgeoning role of ultrasound as a valuable adjunct to improve the safety of bedside procedures within IM, the available training remains inconsistent and is hampered by a lack of uniform standards at the national level. The optimal training required for proficiency in bedside ultrasound is largely unknown but typically consists of combined didactic and proctored, simulation-based modules. This study demonstrates that formal ultrasound training can be effectively incorporated as a component of IM resident orientation for a large group of residents, and introduces a novel didactic structure of SG training to help reduce demands on faculty staff time in ultrasound training. Although the study demonstrated that both SG and FG training improve self-perceived ability to perform ultrasonography, FG training resulted in superior objective outcomes compared with SG training. Further study is needed to optimise such training for IM residents with well-validated objective measures of efficacy and to examine the correlation between ultrasound-trained resident doctors and improved procedural safety. In an era in which increasing focus is placed on the quality of care, efficiency and patient safety, the incorporation of formal ultrasound training into IM residency is an important, much-desired step in the right direction. This study underlines the importance of having faculty staff committed to training house staff in the use of ultrasound in order to accomplish this goal.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Appendix S1. Ultrasound Objective Structured Clinical Examination (OSCE) Grading Form.
Appendix S2. Ultrasound Training Survey.
Appendix S3. Ultrasound Training Handout for Self-Guided Session.

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