

Feasibility of Incorporating the Focused Assessment with Sonography for Trauma (FAST) Scan as Part of Undergraduate Medical Education

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Abstract - Introduction: The utilisation of focused ultrasound, particularly the Focused Assessment with Sonography for Trauma (FAST) scan, has become increasingly significant in emergency departments (ED) worldwide. The FAST scan is a rapid bedside ultrasound examination performed by healthcare providers to identify internal bleeding or other traumatic injuries. Evaluating the feasibility of incorporating ultrasound training into undergraduate medical curricula is essential to understand its educational benefits and associated challenges. **Methods:** By utilising databases such as Ovid MEDLINE and PubMed, we searched for articles by using keywords that included "(Medical Undergraduates OR Medical Students) AND (Focused Assessment with Sonography for Trauma)". The advanced search tool was tweaked to only reveal results published between the years 2014 and 2024. **Results:** Through feedback evaluation via questionnaires, all 9 selected studies mentioned in this literature review have highlighted that the integration of FAST scan into the medical undergraduate program is indeed feasible. All the studies have consistently displayed positive feedback from both students and tutors in terms of satisfaction, interest and confidence levels. **Conclusion:** In conclusion, teaching undergraduates FAST scanning is a feasible goal that medical students value for its practical benefits. Feedback from various studies consistently shows high student satisfaction with these training sessions, emphasising their effectiveness in improving ultrasound skills and enriching the educational experience. Moving forward, addressing limited equipment access and clinical exposure variability is crucial for improving ultrasound training quality and consistency among medical students.

Keywords - FAST Scan, Intraabdominal Injury, Medical Undergraduate Curriculum, Ultrasound Education.

I. INTRODUCTION

The Focused Assessment with Sonography for Trauma (FAST) scan is one of the important diagnostic tools in the field of emergency medicine, where medical practitioners often encounter urgent or life-threatening cases which require swift and precise diagnosis and detection of internal injuries. It is a bedside ultrasound used in emergencies to quickly spot internal bleeding and other traumatic injuries without invasive procedures. While the ultrasound is not sensitive in detecting different types of bleeds, it is still highly effective in picking up bleeding within the intraperitoneal space, for example in a hypotensive patient who require emergency laparotomy or patients with penetrative trauma injuries. [1]. FAST scans are usually performed by formally trained clinicians to assist in rapid decision making during a trauma assessment. The extended FAST scan (EFAST) on the other hand, additionally includes examination of the chest to identify pneumothorax.

As ultrasound technology advances, many medical institutions have begun to emphasise on point-of-care ultrasound (POCUS) training for trainees, making it reasonable to suggest that this modality be included in undergraduate medical education globally [2]. While guidelines for POCUS have already been established in the post-graduate emergency medicine education, there is currently no uniform curriculum for teaching these skills to undergraduate medical students [3]. As a result, numerous medical schools do not yet consider ultrasound knowledge a compulsory requirement. Although some institutions have incorporated ultrasound into their undergraduate curricula, it is often limited and varies widely in training methods [4]. Several institutions have recently started adding ultrasound to its medical curricula, showing a growing recognition of its importance in

the undergraduate medical education. Over 30 years ago, a German anatomy class first incorporated ultrasound training into medical student education, as highlighted in a prior report [5]. This method greatly increased student motivation and enhanced anatomy teaching. In the early 2000s, portable ultrasound systems and their proven bedside usefulness made POCUS widely accepted. In 2010, the first cohort of students who completed a four-year "vertical ultrasound curriculum" graduated from medical schools in the USA [7]. The objective was for these graduates to acquire the knowledge and skills necessary to perform POCUS and apply it during their residency and future practice.

In Clinical School Johor Bahru (CSJB), Monash University Malaysia, final-year medical students recently received FAST scan training as part of their patient safety module sessions during their emergency medicine rotation. This 4-hour training includes a basic lecture on FAST scan and hands-on practice with simulated models. However, there is currently no required formal assessment on medical student's clinical competency on the FAST scan session at Monash as it is mainly designed to expose students to POCUS and enhance their learning experience. In Malaysia, it is mandatory for medical housemen to perform, observe or assist in at least five FAST scan procedure as part of their housemanship training logbook requirement. Hence, having such experience would better prepare them for housemanship and make them already familiar with one of the logbook requirements.

The prospect of integrating FAST scan at an undergraduate level appears to be promising as it would enhance students' learning on both anatomy and physiology, improve diagnostic capability, and safer procedural guidance [8]. Despite this, there is still an ongoing debate on whether or not to incorporate FAST scan training to medical students early in their medical training. Some of these concerns include potential pitfalls in diagnostic accuracy, leading to both overdiagnosis and underdiagnosis of conditions [9]. Considering these issues alongside the potential benefits, we conducted a literature review to explore the outcomes associated with introducing FAST scan training to medical undergraduates. The review aimed to provide a comprehensive analysis of the topic. The review question was "Is FAST scan feasible as part of the standard medical undergraduate education?"

II. MATERIALS AND METHODS

By utilising databases such as Ovid MEDLINE and PubMed, we searched for articles by using keywords that included "(Medical Undergraduates OR Medical Students) AND (Focused Assessment with Sonography for Trauma)". The advanced search tool was tweaked to only reveal results published between the years 2014 and 2024. These results were evaluated regardless of the country of origin. Search results were then exported to Microsoft Excel for synthesis. The initial screening of article abstracts was performed using specific selection criteria to decide which articles to include or exclude.

The inclusion criteria were as follows: original research (educational interventional studies, cohort studies, and cross-sectional studies); studies published in English; studies involving medical undergraduates or undergraduate medical curricula; and studies discussing the implementation, efficacy, or outcomes of ultrasound training, specifically FAST scan training. We excluded studies that focuses on post-graduate students or did not discuss undergraduate medical students or curricula. Brief mention of ultrasound training without detailed discussion and studies which did not focus on feasibility were excluded as well. The literature synthesis matrix will include details such as author of study, program structure, participants, country in which study was conducted, potential challenges/barriers or limitations, outcome measures and key findings of the study.

III. RESULTS AND DISCUSSION

A. Results

From this initial search, a total of 469 articles were yielded, and 292 articles were left upon removing duplicates. 43 articles were selected based on the relevance of its abstract. These studies were then screened based on both the inclusion and exclusion criteria mentioned above. Based on this, 22 studies fulfilled the criteria. Of these articles, 11 were excluded as our focus were on studies that gauged feasibility based on student satisfaction, confidence levels and perceptions of the program rather than clinical competencies. After thorough

evaluation, only 9 studies that were closest to CSJB, Monash University's FAST scan teaching session were accepted for this review.

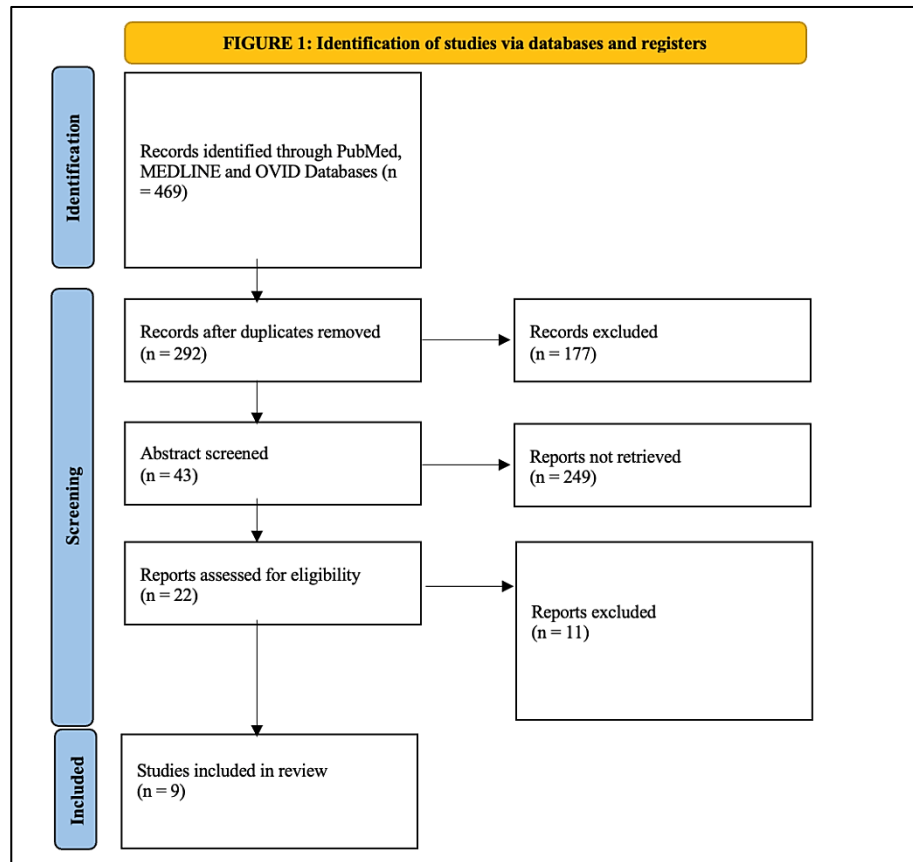


Figure 1. PRISMA Diagram for the Selection Process of Articles Reviewed

Celebi et al. (2019) introduced ultrasound teaching sessions for fifth-year medical students in Germany via peer-teaching approach whereby student tutors had to undergo a one-week intensive ultrasound course and rotations in seven laboratories alongside with lectures [10]. Kern's six-step model was used as a guide in the development of this curriculum. Feedback from students and tutors indicated high satisfaction, with an average Likert scale ratings of 1.4 and 1.3, respectively (1 = excellent to 6 = very poor). The team reported a factor that may hinder consistency and effectiveness of ultrasound training. It was challenging to predict and control the various pathologies encountered by each student during the training. Despite this, using the Kern's framework, they were able to effectively incorporate FAST scan education among medical undergraduates.

One other study conducted by Limchareon et al. (2016) involved 14 sixth-year Thai medical students at the Burapha University Hospital [11]. These students underwent 5 hours of hands-on practical classes during their elective radiology placement by directly interacting with real patients while being supervised by their radiologists. The study reported barriers including lack of ultrasound equipment and clinical staffs to facilitate this. Despite this, the feedback received from participants were positive. The feasibility of the session was gauged through a 5-point Likert scale questionnaire which included student satisfaction, efficacy and interest.

Chilstrom et al. (2019) structured their study around a curriculum that included 4 hours of didactic lectures by emergency medicine faculty and a 90-minute hands-on session for 94 final-year medical students in the USA [12]. Based on a questionnaire, the team was able to gather data regarding medical student's ultrasound experience, future career goals and current baseline knowledge of ultrasound. Other aspects that were assessed includes attitude and comfort levels too. Upon completion of the course, there were significant improvements in positive attitude and comfort levels ($P < 0.05$). Coiffier et al. (2020) introduced the ultrasound teaching session to 221 sixth-semester medical undergraduates in Hong Kong [13]. This program structure included a 1-hour lecture on ultrasound followed by a hands-on course. Upon completion of this program, these medical students

had the option to participate in a FAST scan module. Through the study, they were concerned that by integrating ultrasound teaching sessions formally into the undergraduate program, this may potentially overwhelm students who were still adjusting to the heavy workload of medical school. A low tutor-to-student ratio may also contribute to the lack of feasibility during practical classes, especially when large number of students were involved. Despite this, 90% of the students still responded positively towards the module.

Vanichkulbodee et al. (2021) gathered data through a questionnaire from 230 interns who have completed the ultrasound course during final years of medical school [14]. This program structure included 1.5 hours of lecture on POCUS and 1.5-2 hour of hands-on practical classes with human volunteers involved. 96% of respondents reported meaningful improvements in ultrasound abilities and over 50% felt more confident upon completion of the course. Overall, 81.8% responded positively in the questionnaire. The study reported that there were only a few ultrasound machines available at any given time which limits the efficiency of this program, especially when high number of participants were involved. Furthermore, the lack of predictability in patient numbers also contribute to inconsistent student experiences throughout the program. Dickerson et al. (2016) implemented a peer-assisted ultrasound course for 105 penultimate year medical students in the UK, facilitated during emergency medicine placements [15]. 98% of the medical students agreed that the course was well delivered and all of them reported improved ultrasound knowledge and would recommend the course to others.

Ang et al. (2017) introduced a focused curriculum on the E-FAST examination for fourth and fifth-year medical students in Australia, comprising of two online lectures and a practical session with a 1:4 instructor-to-student ratio [16]. Through this program, student's confidence in utilising the e-FAST scan was reported to improve after the session ($p < 0.001$). Similar to Limchareon et al. (2016), the study also identified limited equipment and clinician availability. Krause II et al. (2017) conducted a prospective cohort study to evaluate the feasibility of integrating a one-hour ultrasound training session on the eFAST scan among 148 third-year surgical clerkship students in the USA. The intervention included instruction in eFAST and three required observed examinations [17]. Pre- and post-intervention assessments using Likert scale questionnaires demonstrated significant improvements across all metrics: participants' comfort levels in recognizing eFAST pathology and performing and interpreting the examination improved notably.

Goodcoff et al. (2019) evaluated the feasibility of introducing FAST scan training through a peer-assisted learning style particularly for pre-clinical medical students [18]. The program structure revolved four monthly peer-assisted learning sessions covering various POCUS topics, including eFAST scan and ultrasound-guided procedures. At the end of the study, 86.2% of the medical students expressed interest in attending more sessions in the future. They also displayed an increase in confidence when identifying anatomical structures.

Table 1. Summary Table of Selected Articles Displaying Feasibility of Incorporating FAST Scan into Medical Undergraduate Program

No.	Author	Program Structure	Population	Country	Challenges, limitations and barriers	Outcome Measures	Key Findings
1	Celebi et al. (2019) [10]	1.5 hours lecture on ultrasound fundamentals and 12.5 hours practical hands-on session.	All fifth-year medical students	Germany	The student tutors have limited influence over the types of pathologies they encounter during their training	6-point Likert scale for student and tutor satisfaction from 1 = excellent to 6 = very poor	High student and tutor satisfaction with Likert point of 1.4

					period.		
2	Limchareon et al. (2016) [11]	A two-week radiology elective course includes five hours of practical ultrasound training on live patients in clinical environments, supervised by radiologists.	14 6th-year medical students	Thailand	Inadequate equipment and insufficient staffing	5-point Likert scale on interest, satisfaction, efficacy etc	Highly positive questionnaire results
3	Chilstrom et al. (2019) [12]	Four hours of lectures hosted by emergency medicine team and 90 minutes hands-on session.	94 final year medical students	USA	Not mentioned	This study gathered data on ultrasound exposure, career aspirations, procedural ultrasound knowledge, attitudes, and comfort levels, each evaluated using three questions employing a Likert scale	Improvement in positive attitudes and an increased comfort level with procedural ultrasound
4	Coiffier et al (2020) [13]	One-hour lecture, followed by a three-hour practical session, and the option to enrol in a four-week Special Study Module that covers FAST scan training.	221 Sem 6 students (Year 3)	Hong Kong	Concerns that the course might be too demanding for students who are still adjusting to the rigorous workload of medical school. Low tutor to student ratio	Task-based performance, quizzes, feedback, and round-table discussion to assess the learning experiences	Highly rated by over 90% of students, 16% increment of knowledge
5	Vanichkulbo dee et al (2021) [14]	A 1.5-hour lecture introduces the	230 interns who completed	Thailand	There is a shortage of ultrasound	Practice and perceptions of the	61.7% expressed satisfaction

		application of emergency ultrasound, followed by a 1.5 to 2-hour hands-on introductory session on POCUS, specifically eFAST scanning, conducted individually with a human volunteer.	the course during final year		machines available for learning. There is no dedicated simulation centre for ultrasound training, necessitating learning and practice in the emergency room using simulated patients. Additional practice time lacks dedicated machines. The number of patients available for scanning is insufficient. Medical student volunteers are required to simulate patients. Availability of ultrasound machines in the resuscitation room requires waiting.	course through Likert scale	with the extent of the course.
6	Dickerson et al (2016) [15]	Peer tutors instructing medical students in ultrasonography techniques during emergency	105 penultimate year medical students	UK	Not mentioned	Questionnaire to assess their views on the course, tutors, and ultrasound confidence	98% believed the teaching was effectively delivered, 100% reported

		medicine rotations.					improved ultrasound knowledge, and all participants would recommend the course
7	Ang et al (2017) [16]	Two online lectures lasting 20 minutes each, covering fundamental ultrasound concepts and the E-FAST examination, followed by a 2-hour practical session with an instructor-to student ratio of 1:4.	27 fourth- and fifth-year medical students	Australia	Difficulty accessing equipment and aligning clinician availability with student needs	An online questionnaire was employed to assess knowledge, image interpretation skills, and confidence levels before and after the intervention	Notable increase in confidence levels for performing the E-FAST after the intervention [p < 0.001]
8	Krause II et al (2017) [17]	One hour of instruction in the eFAST examination, coupled with three mandatory observed examinations during the surgery clerkship	148 third year medical students	USA	Lack of required resources and scheduling difficulty of faculty owing to clinical duties	Pre and post intervention questionnaire utilising Likert scale on comfort levels	Improvement in comfort, knowledge, skill, and speed of conducting the eFAST examination
9	Goodcoff et al (2019) [18]	4 monthly peer assisted learning extracurricular ultrasound sessions including eFAST scan	58 first- and second-year medical students	USA	Interest in integrating POCUS into the formal curriculum was not gauged	Liert-style questions on complexity, comfort with US, informativeness and confidence level	Response rate of 86.2% which were overwhelmingly positive

B. Discussion

Although there is a lack of literature in Malaysia pertaining to ultrasound learning among medical undergraduates, there is vast international experience to suggest that POCUS, particularly FAST scan, is a significant skill in the hospital setting. These studies have suggested that learning FAST scan is valuable as part of

the curriculum and an important clinical skill. The ultrasound learning program can also be designed in a flexible manner depending on its scale. As interest in using ultrasound in medical education continues to grow worldwide, more Universities have been incorporating it into their teaching.

Currently, there is no agreed-upon curriculum for ultrasound education. Hence, two organizations are currently working together to create an international agreement on this topic. One of which is The Society of Ultrasound in Medical Education (SUSME) which promotes ultrasound education globally by holding conferences on Anatomy and Physiology Ultrasound Education [7]. The other organization known as the World Interactive Network Focused on Critical Ultrasound (WINFOCUS) is known for advocating point-of-care ultrasound and hosting International Consensus Conferences to set standards in critical medical areas [19]. Together, both SUSME and WINFOCUS aim to unify leaders in ultrasound education and practice to define essential elements of ultrasound training worldwide [20].

Despite this, it is important to address some notable challenges before the integration of such novel programs. For example, one of the key challenges include limited access to ultrasound equipment in hospitals. In busy settings, especially in emergency departments, students are only able to use these equipment opportunistically during less crucial moments. The low number of formally trained clinical instructors also posed a small challenge in which it may hinder the efficiency of the program.

To address this issue, some universities have resorted to peer-to-peer learning. There were mixed responses to this, as some students found the sessions with peers to be "odd" or "strange" as mentioned in Dickerson et al (2016) and would prefer to be guided by trained physicians or radiologists. Furthermore, it is also worth anticipating the lack of predictability when it comes to encountering certain pathologies in the hospital. Each student groups will have variable learning experience as a result. Some studies also have concerns about potentially overwhelming students with this additional FAST scan program should this be made formal in undergraduate programs. Hence, it is important to balance the timing and intensity of the program while tailoring it with the existing curriculum. Future challenges related to training delivery, accreditation, and competency assessment were not addressed in this study.

Through feedback evaluation via questionnaires, the studies mentioned in this literature review have highlighted that the integration of FAST scan into the medical undergraduate program is indeed feasible. All the studies have consistently displayed highly positive feedback from both students and tutors in terms of satisfaction, interest and confidence levels. Generally, we can also observe that questionnaires from these studies include surveys via Likert-scale assessment.

In assessing the feasibility of the program, these questionnaire items collectively focused on student's satisfaction on the FAST scan sessions, interest in participating in additional sessions, confidence levels in performing these scans and whether students would advocate for these programs to be integrated into the medical undergraduate program [21]. While ultrasound teaching has progressed maturely in the past few decades, there is still room for new content and training deliveries. Some studies have suggested the implementation of an e-portfolios for medical students to track their learning progress with regards to POCUS. This can pave the way for competency-based models and future accreditation.

C. Questionnaire Development

A newly developed questionnaire was structured based on this literature review to align with the FAST scan curriculum at CSJB, Monash University (see Appendix 1). This questionnaire will be required to be validated soon. All questionnaire feedback will be collected anonymously, and no incentives were provided to participating students. The questionnaire will be divided into five sections. The first section will provide study information and seek participant consent. The second section will gather participant details, including age, gender, and past exposure to ultrasound. The third and fourth sections will collect feedback on student perceptions of the session and explore future directions and possibilities using a 5-point Likert scale (1=Strongly Agree, 5=Strongly Disagree). The final section will focus on identifying opportunities for improvement and addressing challenges or barriers.

IV. CONCLUSION

In conclusion, teaching undergraduates FAST scanning is a feasible goal that medical students value for its practical benefits. Feedback from various studies consistently shows high student satisfaction with these training sessions, emphasizing their effectiveness in improving ultrasound skills and enriching the educational experience. Moving forward, addressing limited equipment access and clinical exposure variability is crucial for improving ultrasound training quality and consistency among medical students.

Appendix 1 Questionnaire: Exploring the Feasibility of Focused Assessment with Sonography for Trauma (FAST) Scan Teaching as part of the Standard Medical Undergraduate Education

Section 2: Participant Details					
Age					
Gender					
Past exposure to ultrasound					
Section 3: Participant's perception of the session					
Rating (1=Strongly Agree, 5=Strongly Disagree). Please tick box that applies	1	2	3	4	5
The session met my expectations					
I enjoyed the ultrasound training session					
The training was practical and useful					
The training was innovative in supporting learning					
I feel more confident using ultrasound machine and probes					
Time allocation for the workshop was sufficient					
The complexity of the session was appropriate for my level of training					
I can image the liver, spleen, pelvis and heart at a basic level					
I have gained a basic understanding of ultrasound physics					
believe that ultrasound training is an important skill for my career and the technique is more and more widespread					
I believe that training in ultrasound will provide me with an advantage over other applicants for residency programs because few medical schools train their students in ultrasound so far					
I believe that ultrasound training will help me better communicate with my colleague					
Did the session help you during your exposure to ultrasound in the Emergency Department placement?					
Please rank your comfort level performing the following scan: FAST Scan					
Please rank your comfort level performing the following scan: Bedside Scanning					
I understand how to use the ultrasound device, what its functions are, adjust, and change scanning modes (e.g. colour doppler)					
I feel I better understand the nature of ultrasound artefacts such as acoustic shadowing, reflections, mirror images etc.					
Section 4: Future Direction					
If given the opportunity, I would like more ultrasound training sessions					
Ultrasound training should be integrated into the undergraduate medical education					

Ultrasound training applies to my future career as a physician					
I would consider formal accreditation in trauma ultrasound					
An e-portfolio should be implemented to gauge the progress of medical students with regards to ultrasound training					
Multiple Choice Questions (MCQs) and Observed Simulated Clinical Encounter (OSCE) should be conducted after the session to test on clinical competency					
Section 5: Further Improvements					
How can we improve on the curriculum?					
Were there any challenges/barriers/limitations faced during the ultrasound session?					

Conflicts of Interest

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests.

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