

Utility and challenges of ultrasound education for medical and allied health students in Asia

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Introduction

Nearly all medical specialties use ultrasound for diagnosis and intervention.^{1,2} Point-of-care ultrasound (POCUS) enables clinicians to perform ultrasonographic examinations at the bedside to assess urgent cases.³ The advantages of ultrasound examination include portability, lower cost, and the ability to perform multiplanar and repeated scanning without ionising radiation. Because ultrasound is the most operator-dependent imaging modality, formal education that covers appropriate and optimal use, specific imaging techniques, and its limitations is required.⁴

Ultrasound education is usually targeted towards postgraduate radiologists, with some piecemeal training in other specialties. However, the provision of undergraduate ultrasound education (UUE) is increasing.^{1,5} In a recent survey, 72.6% of medical schools in the United States who responded reported having an ultrasound curriculum.⁵ In another survey, the theoretical background of ultrasound was taught in 87% of the universities in Europe who responded, although only a minority had incorporated ultrasound into the preclinical curriculum.¹ Undergraduate ultrasound education can enhance understanding of basic medical sciences, such as anatomy and physiology, provide a bridge from basic science to clinical science, and improve the physical examination skills of students.⁴ However, two reviews of this topic found conflicting results regarding the value of ultrasound use among medical students.^{6,7}

Despite being recommended by the World Federation for Ultrasound in Medicine and Biology

(WFUMB),⁸ UUE is not popular in Asia according to our understanding. We recently ran a WFUMB-AFSUMB (Asian Federation of Societies for Ultrasound in Medicine and Biology) programme to provide UUE in Asia. In this commentary, we report the utility of UUE in Asia and the challenges around its implementation.

Utility and challenges of undergraduate ultrasound education in Asia

Between April and June in 2022, a pilot survey consisting of four open questions about UUE was sent by the AFSUMB to the presidents or representatives of 16 affiliated societies.⁹ The main outcome measure was the response to the question 'In addition to students of medical schools or clinical departments, is there ultrasound education provided to other students in medical college?' Qualitative analysis was performed on the data collected. Detailed survey results can be found in the online supplementary Appendix.

Of the 16 AFSUMB-affiliated societies, 10 (62.5%) responded. Training for undergraduates (medical students or allied health professionals) was provided in three places (30%), namely, mainland China, Hong Kong, and Taiwan. Limited ultrasound education was provided in five places (50%), namely, Japan, South Korea, Singapore, Thailand, and Vietnam. The societies in Bangladesh and India reported that there was no systematic UUE (Table 1).

Except India, nine of the ten societies (90%) reported that the determining factor in deciding the provision of UUE was whether graduates would

TABLE 1. Ultrasound education for medical students and allied health students, and ultrasound practice in Asia

Country/ region	No. of medical schools or colleges	Ultrasound education for medical students?	Ultrasound education for allied health students?	Professions that can perform USG independently	Professions that can issue USG reports	Legal considerations	Real-world clinical practice
Bangladesh	135	No	No	Doctors	Doctors	Nil	Performed by doctors in different specialties including radiology, O&G, and internal medicine
Mainland China	>280	Yes*	Yes [†]	Doctors Radiographers	Doctors	Prohibition of prenatal sex determination	Performed by doctors who specialise in ultrasound diagnostics
Hong Kong	2	Yes*	Yes [†]	Doctors Sonographers Midwives	Doctors	Nil	Performed by doctors in different specialties including radiology, O&G, cardiology, emergency medicine, anaesthesiology, and intensive care medicine Sonographers and midwives are supervised by doctors
India	604	No*	No	Doctors	Doctors	Prohibition of prenatal sex determination	Performed by doctors in different specialties including radiology, O&G, and cardiology in internal medicine
Japan	81	Limited*	No	Doctors	Doctors	Nil	Performed by doctors
Singapore	3	Limited*	Yes [†]	Doctors Radiographers	Doctors	Nil	Performed by doctors and by radiographers with supervision
South Korea	39	Limited*	No [†]	Doctors	Doctors	Nil	Performed mainly by doctors, with some USG performed by technologists with endorsement by doctors No sonographer system
Taiwan	13	Yes*	Yes [†]	Doctors Radiographers USG technologists	Doctors	Nil	Performed by doctors; for USG performed by radiographers and technologists, their reports are endorsed by doctors
Thailand	23	Limited*	No	Doctors	Doctors	Nil	Performed by doctors
Vietnam	16	Limited*	No/little [†]	Doctors	Doctors	Nil	Performed by doctors

Abbreviations: O&G = obstetrics and gynaecology; USG = ultrasonography

* Refer to the online supplementary Appendix for details of ultrasound training for medical students

[†] Refer to the online supplementary Appendix for details of ultrasound training for allied health students

be required to perform ultrasound examinations in hospitals after graduation. The way in which ultrasound imaging was practised and which specialties routinely performed it differed between the societies and geographical locations surveyed (Table 1). For example, student radiographers in Taiwan and mainland China received training, as may be expected, but in Hong Kong, student midwives also received training and performed obstetric examinations once qualified. In Taiwan, qualified radiological technicians performed ultrasound examinations but their final reports must be approved by a physician. In Singapore, there was an initiative whereby medical students were regularly exposed to radiological practice from the start of their education in the hope of attracting more residents to the speciality.¹⁰ In Japan, UUE was provided to medical students who were designated to provide medical care, which would include ultrasound

examinations, in rural areas after their graduation.¹¹ Basic education was provided to student nurses in mainland China, despite them not being allowed to perform ultrasound examinations once qualified. In South Korea, there was no education for allied health students; however, there was no sonographer role as medical doctors conducted all ultrasound examinations. However, if the main aim of UUE is to improve anatomical knowledge and physical examination skills, it is questionable whether the time and money required to implement it would be justified.⁶

Unlike the usual issues that hamper the introduction of UUE, the major issue identified in India was the Preconception and Prenatal Diagnostics Techniques (Prohibition of Sex Determination) Act 2003, which bans the use of ultrasound machines by medical students, technicians, and nurses. Although similar laws regarding sex selection for non-medical

TABLE 2. Undergraduate ultrasound education and examples of collaboration between ultrasound societies and universities or medical schools in the world by region

Region	Undergraduate ultrasound education	Collaboration between ultrasound societies and universities, medical schools or student organisations*
Asia	<p>Limited and variable.</p> <p>Examples are a structured ultrasound course, e-learning modules, and an elective POCUS programme.</p> <p>Challenges include the usual obstacles such as a lack of resources and inadequate infrastructure and the prohibition of prenatal sex determination in India.</p>	<p>Medical students were invited to attend selected AFSUMB workshops with complimentary registration.</p> <p>The AFSUMB plans to provide UUE through collaboration with the WFUMB, local ultrasound societies, and medical schools.</p>
Australia and New Zealand	<p>Most medical schools or faculties have a dedicated radiology/medical imaging component where the theory of ultrasound is taught; however, the number and format of practical sessions is variable.</p> <p>Examples include the following: (1) the use of ultrasound during anatomy classes with cadavers; (2) four half-day hands-on sessions per year for scanning classmates, with local ultrasound practitioners acting as tutors; and (3) exposure to ultrasound imaging during rotations through obstetrics, cardiology, and radiology.</p>	<p>The Australasian Society for Ultrasound in Medicine will assist, if approached, in formulating POCUS education for medical students.</p>
Europe	<p>Although the theoretical background of ultrasound is taught in most universities, only a small proportion of universities integrate ultrasound education into anatomy or basic science courses. Practical sessions are available in more than half of universities, but testing in a practical examination is uncommon.</p> <p>The number of teaching hours varied from 1 to 58.</p> <p>Challenges identified are lack of time and funding.</p>	<p>The EFSUMB discussed with universities about their proposals and difficulties in implementing ultrasound teaching in orientation programmes for new medical doctors. The EFSUMB sent its proposal to those universities who responded and all the national universities of the student representative organisations.</p>
Latin America	<p>Variable approach.</p> <p>Many medical faculties incorporate ultrasound to a limited degree into the first year of the medical curriculum and offer an elective basic course on ultrasound during the second or third year.</p> <p>Some universities provide a more advanced and longitudinal approach. Examples include the following: (1) extra-curricular ultrasonography courses; (2) combining traditional semiology and POCUS in the medical curriculum; (3) elective, sequential courses on a variety of sonographic topics; and (4) emergency department-based courses, including an online platform and face-to-face, competency-based practices.</p>	<p>The Latin American Federation of Societies for Ultrasound in Medicine and Biology is working to develop pathways and a certificate for non-radiologists who perform ultrasound.</p>
Mediterranean and Africa	<p>Although there are many advantages of providing UUE in Africa, the challenges are the overall lack of a budget to purchase ultrasound machines, people with the technical skills to maintain these machines, skilled instructors, and support to provide formal training programmes.</p>	<p>Nil.</p>
United States	<p>Medical schools have continued to integrate ultrasound into the medical curriculum, mostly in basic science or clinical skills courses, and some in clinical rotations. Most of these schools have a designated ultrasound director, and emergency medicine physicians accounted for more than half of course directors.</p> <p>The challenges identified were as follows: (1) not compensating the ultrasound faculty for their time dedicated to education; (2) availability of ultrasound machines, although this is partially solved since the introduction of low-cost handheld devices; and (3) a shortage of faculty.</p>	<p>The AIUM provides connections with mentors in UUE and helps educators manage a UUE programme in a North American medical school.</p> <p>The AIUM also sponsored conventions to educate medical school deans about UUE and has conducted workshops on practical issues.</p> <p>The Society of Ultrasound in Medical Education partners with others, such as the Association of American Medical Colleges, to integrate UUE into medical schools and enhance communication and collaboration between educators.</p> <p>These societies develop a database of information about the use of UUE.</p>

Abbreviations: AFSUMB = Asian Federation of Societies for Ultrasound in Medicine and Biology; AIUM = American Institute of Ultrasound in Medicine; EFSUMB = European Federation of Societies for Ultrasound in Medicine and Biology; POCUS = point-of-care ultrasound; UUE = undergraduate ultrasound education; WFUMB = World Federation for Ultrasound in Medicine and Biology

* The WFUMB strengthens collaborations with universities and national student organisations. The International Federation of Medical Students' Associations expressed their interest in promoting the WFUMB students' educational activities and requested an ultrasound handbook from the WFUMB for students to complete on their electives

reasons are in place in other Asian countries with high child sex ratios, to what extent this prohibition has an effect on UUE in those countries is unknown.¹²

In Hong Kong, an ultrasound e-learning module was provided by The University of Hong Kong and The Chinese University of Hong Kong to enhance and facilitate students' learning by making the material more accessible, relevant, and effective (online supplementary Appendix).^{8,13,14} The use of such an e-learning platform is one of the solutions to the problems identified around the integration of ultrasound into medical education, namely, a lack of trained faculty, requisition of ultrasound machines for teaching, and limited space in an already full curriculum.^{4,13,14} The WFUMB is developing e-learning that focuses on the development and distribution of e-learning materials and web-based simulations to supplement theoretical knowledge.⁸ To improve practical skills, the use of healthy volunteers, mannequins or clinical skills laboratories is required.^{4,8,11} Finally, collaboration between ultrasound societies and medical schools is important for a successful UUE programme (Table 2).^{8,15}

Point-of-care ultrasound was introduced in the two medical schools in Hong Kong and in Taiwan. After following a transthoracic echo programme on a 2-week anaesthesia rotation, most students had learned the basic views and had generally favourable success rates in identifying obvious cardiac anomalies, although with some variability.¹⁶ These results were consistent with a previous critical review.⁶ With the development of portable or affordable handheld ultrasound devices and the growing body of evidence supporting its extensive utility, POCUS has been widely accepted since its introduction. It is therefore reasonable to suggest that POCUS training can be incorporated into undergraduate medical education.^{2,11}

This was the first survey conducted by the AFSUMB involving the presidents or representatives from affiliated societies in various places in Asia, although not all societies responded. Since responses were not directly collected from medical schools and/or colleges, it is possible that the information might not have been up to date. The responses were descriptive in nature, precluding statistical analysis. In-depth, repeated surveys of medical schools are required to gain a better appreciation of the situation regarding UUE.

As the use of ultrasound and POCUS by various medical specialties increases and the cost and size of ultrasound machines decreases, we envisage that medical students will be increasingly expected to use ultrasound, or at least understand its use after their graduation.² The motivation of students to learn ultrasound techniques is closely connected to their future career as doctors¹⁷ and their feedback to such

education is often positive.¹⁶ Medical schools may adopt different teaching methods due to variations in teaching methods between different universities (Table 2).^{1,5,8} Medical systems also vary significantly across Asia.^{8,18-21} The problems associated with ultrasound teaching can be partly solved by adding, for example, an e-learning platform for theoretical education and training in POCUS as an elective programme, as discussed above.^{4,11,13-15}

Conclusion

The current state of UUE in Asia is in its infancy, as well as being relatively varied because of the different educational and medical systems. We believe that the utility and challenges found in the present survey will be useful to educators, institutions, and societies for the development of UUE.

Author contributions

Concept or design: KY Leung, YL Wan.

Acquisition of data: All authors.

Analysis or interpretation of data: KY Leung, YL Wan.

Drafting of the manuscript: KY Leung, YL Wan.

Critical revision of the manuscript for important intellectual content: All authors.

All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Conflicts of interest

All authors have disclosed no conflicts of interest.

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Ethics approval

This study was reviewed and approved by the local institutional review board at Linkou Chang Gung Memorial Hospital, Chang Gung University, Taoyuan, Taiwan as an exempt study because it did not involve patients or human images. All representatives of the responded societies gave consent for their participation.

Supplementary material

The supplementary material was provided by the authors and some information may not have been peer reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by the Hong Kong Academy of Medicine and the Hong Kong Medical Association. The Hong Kong Academy of Medicine and the Hong Kong Medical Association disclaim all liability and responsibility arising from any reliance placed on the content. To view the file, please visit the journal online (<https://doi.org/10.12809/hkmj2210647>).

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