Original Article

Point-of-Care Ultrasound Training Among Intensivists in Singapore: A Multicentre Survey

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Abstract

Introduction: Point of care ultrasound (POCUS) has become essential in the management of critically ill patients. Multiple POCUS training courses exist, but are not widely adopted in Singapore. Given the discordance between training supply and demand, we aimed to uncover the learning needs and barriers among intensive care medicine (ICM) doctors locally. Materials and Methods: An anonymous online survey was carried out from January to April 2019 among ICM doctors from 6 major teaching hospitals in Singapore. Results: 66 out of 160 ICM specialists and trainees responded (41.3%). Although only 6% of respondents had current formal POCUS accreditation, the majority were already using critical care echocardiography (CCE) and pleural/lung ultrasound. 93% supported having a local training programme. More than 50% of trainees wanted training in CCE, diaphragm/muscle ultrasound, airway ultrasound and ultrasound for neurological disease. More than 50% of specialists wanted training in diaphragm/muscle ultrasound, with mixed interests in other topics. The top 2 obstacles hindering POCUS training were lack of supervisors and locally based programmes. Conclusions: ICM doctors who responded were supportive of a local POCUS training programme. The programme's curriculum should address the learning needs of the majority of learners, with diaphragm/muscle ultrasound being the top unmet need. The programme would need to develop supervisors and be as affordable as possible.

Ann Acad Med Singap. 2020;49:630–42

Key words: Continuing medical education, Cross-sectional survey, Intensive Care, Ultrasound

Introduction

Point-of-care ultrasound (POCUS) has become an essential tool for managing critically ill patients. Systematic application of POCUS techniques such as critical care echocardiography (CCE) and lung ultrasound may change or confirm a diagnosis in more than 80% of cases, decrease utilisation of chest X-ray and computed tomography scans, reduce mechanical ventilation duration and assist with haemodynamic optimisation and intravenous fluid titration.[1,2] In cardiac arrest situations, protocolised focused ultrasound provided diagnostic information and altered management in 78% of patients.[3]

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Transthoracic echocardiography (TTE) and general ultrasound have traditionally been done, respectively, by cardiologists and diagnostic radiologists. Several drawbacks of the traditional arrangement exist. Firstly, ultrasound scans are often not contemporaneous and cannot help answer urgent clinical questions or directly influence the immediate treatment. Secondly, ultrasound image acquisition and reporting are separated, which hinders clinical correlation. Thirdly, it is not easily repeatable and is not suitable for tracking therapeutic responses or rapid clinical changes. Given the drawbacks of the traditional arrangement, managing intensivists should learn and apply POCUS at the bedside. International experts agree that general POCUS and basic CCE should be mandatory in the ICM training curriculum.[4] Worldwide, assessment tools for CCE, [5] and guidelines for training and competency in POCUS[6,7] have been developed. However, no standardised curriculum has been universally adopted.[8] For instance, a comparison of POCUS training programmes in Europe showed that there was a lack of agreement among five accreditation programmes.[9]

Multiple courses and postgraduate programmes for POCUS training exist, such as the World Interactive Network Focused On Critical UltraSound (WINFOCUS), Rapid Assessment by Cardiac Echo (RACEplus) or Certificate in Clinician Performed Ultrasound (CCPU) by the Australasian Society for Ultrasound in Medicine (ASUM), but none has been widely adopted in Singapore. Given the discordance between POCUS training supply and demand, perhaps, the learning needs or barriers have not been fully addressed. National surveys on POCUS in intensive care units (ICU) have been conducted in Australia,[10] Brazil[11] and in the United States.[12] However, it is uncertain if results from the preceding 3 national surveys can be generalised globally, and there has been no survey done in Asia. As part of the Society of Intensive Care Medicine (Singapore)'s effort to develop a national curriculum for POCUS, we embarked on a survey among practising intensivists and trainees. In this survey, we aimed to study the current practice of POCUS, availability of training and resources, and the perceived needs for future training and competency assessment.

Materials and Methods

Data Collection

Ethics approval was exempted by the National Healthcare Group-Domain Specific Review Board (2018/01134). Thereafter, we conducted an anonymous online survey of intensive care medicine (ICM) specialists and trainees in all 6 major teaching hospitals of Singapore. "Specialists" were defined as practising intensive care physicians who were accredited by the Singapore Specialist Accreditation Board and registered as such by the Singapore Medical Council. "Trainees" were defined as doctors who were undergoing specialist training in intensive care and had yet to complete the local exit examination. Data was collected between January and April 2019. A web-based online survey platform (SurveyMonkey™) was used. This platform was accessible only by the principal investigator, and the data were anonymised and encrypted. No financial support was received from any source. Participants were emailed the invitation to the survey via members of the study team, who were representatives of the ICUs in their respective hospitals. Reminders were sent via email and phone about 1 and 3 months after the initial invitation. Participants did not receive any renumeration for their participation.

Survey Construction

All members of the study team were certified intensive care specialists who perform and teach POCUS. The survey was primarily designed by 2 authors with every member of the study team providing feedback. Using a consensus approach, there were 3 rounds of email discussions and one in-person meeting to select the final 50 questions (see Supplement 1). The survey was then divided into 7 sections:

(1) Demographics and characteristics of respondents
(2) Current resources and usage
(3) Individual practice
(4) Individual training in POCUS
(5) Perceived obstacles
(6) Willingness to pay
(7) Future practice and formal competency assessment needs

Sections of the survey pertaining to individual practice were designed with a 4-point Likert scale to assess frequency of performing POCUS or the level of agreement to statements, such as "daily", "several times a week", "hardly ever or never", "strongly disagree", "disagree", "agree and "strongly agree".

Abdominal ultrasound included FAST (Focused Abdominal Sonography in Trauma). Ultrasound for neurological disease included ultrasound to assess optic nerve sheath diameter (ONSD) or cerebral circulation. Ultrasound for vascular diagnostics included screening for abdominal aortic aneurysm or deep vein thrombosis.

Statistical Analysis

Categorical variables were presented as absolute numbers and percentages. Where statistical analysis to compare percentages was done, Fisher's exact test was used. Thematic analysis was done by the first and last authors using the free text comments for the following question: "Any other ideas on how to implement critical care ultrasound training". Missing data were not imputed.

Results

Demographics and Characteristics of Study Respondents

One hundred and sixty ICM specialists and trainees received the survey invitation, and 66 responded (response rate 41.3%) (Table 1). 57.6% of respondents were male, and the mean age was 38.8 years (standard deviation 7.3 years). Of the respondents, 13 (19.7%) were trainees and 53 (80.3%) were specialists. 11 (18%) respondents were participating in POCUS training programmes as faculty.

Current Resources and Usage

All 66 respondents had access to an ultrasound machine dedicated for use in the ICU (Table 2). 57 (89%) were familiar with the machines available in their department. For the majority of POCUS scans, the respondents did not record static, cine clips or reports in the electronic health records. Specifically, if recorded, 28 (42.4%) would only store POCUS reports, 36 (54.5%) static clips and 36 (54.5%) cine images in the ultrasound machine and not in picture archiving and communication systems (PACS), paper or electronic medical records. Thirteen (19.7%) reported that they would also save POCUS reports in electronic health records.

Individual Practice

All 66 respondents used real-time ultrasound to guide central venous catheter (CVC) insertion. Ultrasound for vascular access, CCE, and pleural/lung ultrasound were the most common types of POCUS scans done (Figure 1). For new admissions, the commonest

Table 1. Characteristics of Respondents

	All respondents n=66 (%)
Years after graduation from basic medical degree	
1 to 5	3 (4.5)
6 to 10	21(31.8)
11 to 15	15 (22.7)
16 to 20	11 (16.7)
21 to 25	12 (18.2)
26 to 30	3 (4.5)
31 to 35	1 (1.5)
Years since obtaining Intensive Care qualifications	
1 to 5	23 (34.8)
6 to 10	10 (15.2)
11 to 15	10(15.2)
16 to 20	4(6.1)
Not applicable (currently still training)	19(28.8)
Primary (base) specialty	
Anaesthesiology	31 (47.0)
Respiratory Medicine	28 (42.4)
General Medicine	6 (9.1)
Emergency Medicine	1 (1.5)
Completed an official ICM fellowship, local or overseas	
Yes	40 (60.6)
No	7 (10.6)
Not applicable (currently training)	19 (28.8)
Types of ICUs	
Mixed medical and Surgical	13 (20.3)
Medical	27 (42.2)
Surgical (general surgical, burns, neurosurgical)	24 (37.5)

ICM: Intensive Care Medicine, ICU: Intensive Care Unit

Table 2. Current POCUS Resources

Resources	n = 6 4 (%)*
Ultrasound machine dedicated for use in the ICU	
No	0 (0)
Yes, but unsure about specifications	1 (1.5)
Yes, without continuous and pulse-wave doppler imaging	8 (12.5)
Yes, with continuous, pulse-wave, but not tissue doppler	27 (42.2)
Yes, with continuous, pulse-wave and tissue- doppler	29 (45.3)
Not answered	2(3.1)
Payoffs for POCUS scans	
None	28 (42.4)
Only for institution or unit	13 (19.7)
Only for physician	0 (0)
For both institution or unit and physician	5 (7.6)
Unknown	18 (27.3)

* n = 2 missing data
ICU: Intensive care unit
POCUS: Point-of-Care ultrasound

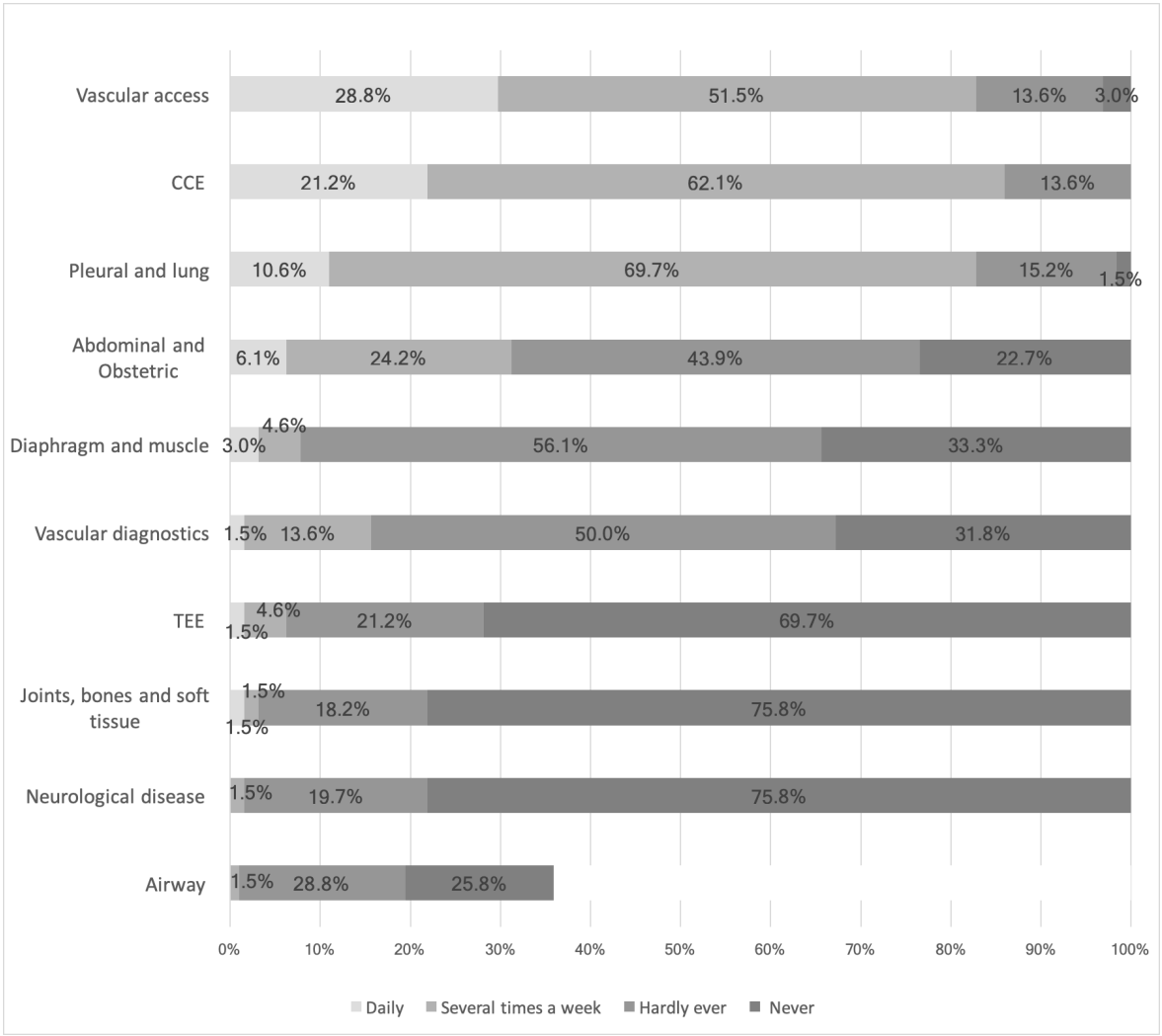

Fig 1. Most Common Types of POCUS Scans

POCUS performed was CCE (60/66, 90.9%) and pleural/lung ultrasound (52/66, 78.8%). Three (4.5%) responded that they did not routinely perform POCUS of any form for new admissions. Sixty-one (92.4%) agreed that the application of POCUS frequently changed the real-time management of ICU cases under their care; the 5 (7.6%) respondents who disagreed were all specialists. Prior to performing a percutaneous tracheostomy, among 31 respondents, 19 (61.3%) reported doing airway ultrasound routinely.

Individual Point-of-Care Ultrasound Training

POCUS or CCE courses attended by respondents included World Interactive Network Focused On Critical UltraSound (WINFOCUS) course (n=24), RACE*plus* course (n=23), Basic Assessment and Support in Intensive Care (BASIC) Transthoracic echocardiography course (n=18), the National Heart Centre Coronary Care Unit Symposium (n=5), and pre-conference workshops of international ICM congresses (n=27).

Twenty-one out of 66 (32%) respondents had previous formal full TTE training, defined as having direct supervision for a stipulated minimum number of full TTE scans, by an accredited supervisor/ sonographer. The commonest type of POCUS respondents received formal training in was CCE 42/64 (63.6%), followed by pleural/lung ultrasound 27/64 (40.9%), ultrasound for vascular access 21/64 (31.8%) and FAST 15/64 (22.7%). Less than 10% of respondents said they received training in each of the other types of POCUS (transoesophageal echocardiography (TEE), airway, abdominal/ obstetric, diaphragm/muscle, ultrasound for neurological diseases). None received training in joint/bone ultrasound.

Only 7 (6%) out of 62 respondents had current POCUS accreditation, such as Diploma in Clinical Ultrasound, European Association of Echocardiography/ European Association of Cardiovascular Imaging (EAE/ EACVI) TEE, Focused Intensive Care Echocardiography (FICE), or Postgraduate Certificate in Clinical Ultrasound. Two out of 66 (3%) answered that formal renewal of credentialing in POCUS was required by their institution. The median number of full TTE scans done by the respondents was 0 (range 0 to >100). In contrast, the median number of CCE scans done was 40 (range 0 to >100). Within the scope of CCE, 80.6% and 74.2% of respondents were comfortable with image acquisition and image interpretation, respectively. With regard to POCUS (including other types of scans, not just limited to CCE), 85.5% of respondents were confident with POCUS with clinical management. Fifteen (22.7%) stated that there was no need for competency assessment for management at the bedside.

Perceived Obstacles

The survey included a section on what respondents perceived as obstacles to advancing their own training in POCUS, and to explore the challenges that may arise in a future training programme. Of the 66 responses, the commonest obstacles reported were "lack of supervisors" (n=59, 89.4%), "programmes are only available overseas" (N=39, 59.1%), "lack of storage for clips and images" (n=20, 30.3%)," lack of time to scan" (n=20, 30.3%)," medico-legal implications" (20/66, 30.3%) and "inadequate knowledge" (n=18, 27.3%). Free text comments given were: "lack of time away from clinical and administrative work", "lack of dedicated framework to allow to work towards an external accreditation" and "to be certified, need for adequate supervisor framework to log scans and more importantly to teach and improve technique".

Willingness to Pay

For initial training and competency assessment, assuming it takes one year, respondents were willing to commit a median of 50 Singapore dollars (SGD) (range SGD0–200). The median number of hours per month a learner can commit to training was 12 hours (range 1 to 60 hours). For re-accreditation, assuming it is needed every 5 years, the median sum respondents were willing to commit was SGD32 (range SGD0–478).

Future Training and Competency Assessment Needs

Fifty-three respondents (93%) agreed that there was a need for a local POCUS training programme. Fifty-seven (72%) respondents agreed that there was a need for formal competency assessment in POCUS, while 4 (7%) disagreed.

Regarding what respondents would like to receive formal *training* for, the top 2 choices overall were CCE (n=38), and diaphragm/muscle ultrasound (n=28). There were differences in what trainees and specialists wanted to receive for training (Table 3). Regarding which areas of POCUS respondents would like to receive formal *competency assessment* for, the top 3 choices were CCE (n=46), pleural/lung ultrasound (n=29) and vascular diagnostics (n=20).

Thematic Analysis on How to Implement POCUS Training

When surveyed on the preferred platforms for acquiring content knowledge, the majority indicated

Table 3. Requests for formal training

	All n=66 (%)	Trainee n=19 (%)	Specialist n=47 (%)	P-value
CCE	38 (57.6)	17 (89.5)	21 (44.7)	0.001
Diaphragm and muscle ultrasound	38 (57.6)	14 (73.7)	24 (51.1)	0.108
Airway ultrasound	27 (40.9)	12 (63.2)	15 (31.9)	0.028
Ultrasound for Vascular diagnostics	27 (40.9)	9 (47.4)	18 (38.3)	0.584
Ultrasound for Neurological disease	27 (40.9)	12 (63.2)	15 (31.9)	0.028
TEE	25 (38.9)	5 (26.3)	20 (42.6)	0.270
Abdominal or obstetric ultrasound	24 (36.4)	9 (47.4)	15 (31.9)	0.268
Pleural and lung ultrasound	24 (36.4)	11 (57.9)	13 (27.7)	0.027
Ultrasound for Joints, bones, soft tissue	18 (27.3)	6 (31.6)	12 (25.5)	0.761
Ultrasound for vascular access	12 (18.2)	5 (26.3)	7 (14.9)	0.304

CCE: Critical care echocardiography
TEE: Transesophageal echocardiography

that they preferred in-person lectures (40/66, 60.6%), web-based lectures (35/66, 53.0%), internet-based applications (26/66, 39.4%) and YouTube™ (17/66, 25.8%). Only 1 respondent opted for social media such as Facebook™ or Twitter™. Other respondents (7/66, 12.2%) suggested learning from books and on-the-job training. Thematic analysis was done for the qualitative free text comments on how to implement POCUS training, revealing themes associated with accessibility, curriculum and credibility (Table 4).

Discussion

Key Findings

One hundred and sixty ICM specialists and trainees received the survey invitation, and 66 responded (41.3%). Although only 6% of respondents had current formal POCUS accreditation, the majority of ICM doctors were already using it frequently. Ninety three percent supported having a local training programme. Additional POCUS training requested but not frequently available now were TEE, airway and diaphragm/muscle ultrasound. More than 50% of trainees wanted training in CCE, diaphragm/muscle ultrasound, airway ultrasound, and ultrasound for neurological disease. More than 50% of specialists wanted training in diaphragm/muscle ultrasound, with mixed interests in other topics. Training in ultrasound for vascular access was not highly requested, likely because it is part of base-specialty training (such as in Anaesthesiology or Respiratory Medicine), prior to entering ICM training. The top 2 obstacles hindering formal POCUS training were lack of supervisors and locally based programs.

Relation to Previous Literature

All respondents had access to an ultrasound machine dedicated for use in the ICU, which is more than ICUs in Brazil, 64%[11] and 83–95% in USA.[12] All the respondents used real-time ultrasound for CVC insertion, which is in line with international guidelines.[13] 85% and 83% of respondents here reported using CCE and lung ultrasound, respectively, at least several times a week during their ICU practice, which is similar to ICUs in Australia (94% and 83% respectively).[10] The 3 most common POCUS modalities in ICUs locally (CCE, lung ultrasound and ultrasound for CVC insertion) were slightly different from USA (procedural guidance, vascular access, CCE),[12] or Brazil where lung ultrasound was only performed by 8.5%.[11]

The majority of respondents had exposure to 1 to 2-day training courses, but far fewer had exposure to formal training programmes, board examinations or o verseas diploma programmes with remote supervision. This is unlike respondents from Australian ICUs who predominantly had training through courses by ASUM or diploma courses,[10] or USA, who had training through national programmes.[12]

Table 4. Thematic analysis for comments on "any other ideas on how to implement POCUS training"

Theme	Sub-theme	Number of comments	Verbatim comments
Accessibility	Increase training opportunities	7	Regular training at CME Regular series of lectures Have more courses in Singapore
	Increase mentor availability	2	More mentors, especially those that implement POCUS in their daily practice "Grand-father" clause for those who are already doing and train the rest of the intensivists first
Accessibility	Increase equipment availability	2	More machines/more machines dedicated to training in echocardiography Use ultrasound probes that can connect to the handphone
	Protected time	2	Departmental support to release trainers/trainees for teaching/learning Dedicated bedside teaching by a dedicated supervisor in normal, ward and ICU patients once to twice a week
	Make training affordable	3	Has to be inexpensive Institution sponsored training
	Provide online learning resources	3	Educational videos on SICM website Online based learning with submission of cases Online e-learning module and training videos
Curriculum	Standardise teaching and assessment	13	Have a structured syllabus Make it part of ICM training/required competency. Integrate it into residency training for Anaesthesiology, Respiratory medicine or internal medicine A framework whereby time can be set aside for training and whereby scans can be recorded then assessed by a suitable person Create a competency checklist Standardised curriculum—too many different courses Standardised reporting. Move towards formal credentialing Initial teaching followed by regular bedside practice with supervision. Teaching in terms of attending course and workshop will not make one competent in doing so, it is regular practice at bedside that makes one competent
	Provide hands-on practice	1	Have competency maintenance
	Provide continuing education	1	Have refresher courses
Credibility	Ensure competency of teachers	3	Tap on cardiologists, echocardiographers for training; apprentice to sonographers Having appropriately trained mentors Determine who can assess competency for trainees
	Collaborate with external accreditation bodies	2	Credentialing first and collaboration with accredited body Conjoint accreditation of critical care ultrasound training with international training bodies would enhance buy-in for the training programme
	Avoid excessive regulation	1	Should not have reaccreditation. Waste of time

CME: Continuing Medical Education; ICU: Intensive Care Unit; ICM: Intensive Care Medicine; POCUS: Point-of-care Ultrasound; SICM: Society of Intensive Care Medicine (Singapore)

The majority of respondents stated "lack of standardised competencies", "lack of supervisors" and "training programmes are only available overseas" as the top barriers to embarking on formal training. This is similar to studies done in other regions.[9,10,15,16] Locally, among internal medicine physicians, lack and cost of an ultrasound machine were also significant barriers to learning.[14] Importantly, lack of equipment[14,16] or resistance from other ultrasound providers[10] did not appear as one of the barriers in this survey. Lengthy and costly overseas programmes may not be necessary for competency in specific areas of POCUS, [6] pleural and lung ultrasound[17] or CCE.[18,19] Local learners want to do things cheaply and quickly, not aligning with most international curricula.

Study Implications

Currently in Singapore, POCUS training is not mandatory for specialty accreditation in ICM. Nonetheless, almost all respondents agreed there is a need for a local POCUS training programme and formal competency assessment, which is in agreement with international statements on training standards for POCUS in ICU.[4]

More respondents were comfortable with image acquisition than with image interpretation for CCE, which confirmed that CCE needs special attention to training, as it has been shown that individual domains of CCE are picked up differentially.[18]

While overall learning needs may be similar across various populations, some local differences would exist.[14] Hence, training cannot depend entirely on a common global curriculum; local modifications and enhancements would be necessary.

Respondents' suggestions on ways to improve POCUS training locally included: having a structured curriculum; and, after having attended courses, having continued supervision by trained mentors in the hospital. Respondents still wanted in-person lectures and teaching. Given the above, web-based teaching will not fulfil learning needs. Teaching and faculty development need to be done locally. Respondents asking for protected time reflects the need for POCUS training at the bedside to be valid and to maximise benefits to learners, as outlined by Sewa and Anantham.[20] To increase validity, we will need to ensure that trainers and trainees both have some protected teaching time.

The survey also showed that most respondents were willing to pay for training and competency assessment, which can inform future financing models for ultrasound training.

In the ICU, POCUS is used to complement physical examination at the bedside, rather than as a standalone radiological tool. This is especially true for resource-limited settings with lower-end ultrasound systems, without storage capability or central archiving systems, which is not in alignment with most international curricula. Even in a resource-rich setting like Singapore, we found that the majority of POCUS clips were not reported or recorded in electronic health records. Although this has its drawbacks, such as the inability to compare images or clips, it reflects the reality of POCUS practice. As such, for training to succeed in an authentic clinical environment, supervision and learning needs to be like teaching bedside physical examination and storage needs to be point-of-care.

Strengths and Limitations

This is the first nation-wide survey in an Asian country on the practice of POCUS amongst ICM physicians. The limitations of this study include a low-moderate response rate of 41.3%, which may affect the representativeness of the results. However, this is comparable to email survey response rates in other medical publications.[21] Participation bias is possible as physicians who use POCUS regularly may be keener to participate in the survey. Based on this survey, ICM specialists appear to want a programme, but with only 19.7% of respondents being ICM trainees, the sample may be too small to confidently determine their interest.

Conclusions

Our survey showed that ICM physicians who responded were supportive of a local POCUS training programme. The programme's curriculum should include modules that address the learning needs for the majority of trainees and intensivists, diaphragm/muscle ultrasound being the top unmet need. Additionally, the programme would need to develop supervisors and be as affordable as possible.

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Supplement 1. Online Survey Form

SUPERB Practice based survey of Critical Care ultrasonography_v1 13Dec18

Dear esteemed colleague,

On behalf of Society of Intensive Care Medicine- National Investigators for Clinical Epidemiology and Research (SICM-NICER), we would like to invite you to spend 10 minutes to participate in this survey. The purpose of this survey is to study the current practice of Critical care ultrasonography (CCUS) by Intensive Care Specialists and Trainees in Singapore, to understand the resources available for training and the current learning needs. As a research study we aim to contribute to the growing literature on CCUS and aim to publish our findings in due course.

Participation in this survey is anonymous and voluntary. We deeply appreciate your time in completing this survey as it will give us valuable insights into developing Critical care ultrasonography training and research in Singapore. Proceeding to the next page of the survey implies consent to participate in this study. This survey is conducted solely for the purposes of research and is not part of competency assessment. Once again, we thank you sincerely for your time.

Warm regards,
The SICM Ultrasound for Practice Enhancement in Real-time at the Bedside Collaboration (SUPERB) study team

Drs Lau Yie Hui, See Kay Choong, Sean Loh, Shala Siddiqui, Tan Chee Keat, Chia Yew Woon, Claudia Tien, Jonathan Tan

* 1. Your age (in years)
- 26-30
- 31-35
- 36-40
- 41-45
- 46-50
- 51-55
- 56-60
- 61-65
- 66 or older

2. Your gender
- Female
- Male

* 3. Years after graduation from basic medical degree
- 1-5
- 6-10
- 11-15
- 16-20
- 21-25
- 26-30
- 31-35
- 36-40
- 41-45
- 46-50

* 4. Are you doing ICM Advanced speciality training currently?
- Yes
- No

* 5. Primary specialty
- Anaesthesiology
- Cardiology
- Emergency Medicine
- General /Internal Medicine
- Respiratory Medicine

Other Primary speciality

* 6. Completed ICM Fellowship (eg ICM AST, overseas HMDP or the equivalent)
- Yes
- No
- Not applicable (currently still in ICM AST)

* 7. Years since obtaining Intensive Care qualifications

- 1-5
- 6-10
- 11-15
- 16-20
- 21-25
- 26-30
- 31-35
- >35
- Not applicable (currently still in ICM AST)

* 8. Current participation in any other CCUS training programs or projects as faculty

- Yes
- No

* 5. CCUS recording of cine images (tick all that apply)

- [ ] None
- [ ] Stored in the ultrasound machine
- [ ] Stored in the paper-based medical record
- [ ] Stored in the electronic health record
- [ ] Stored in the picture archiving and communication system (PACS)

* 6. Payoffs

- None
- Only for institution/ unit
- Only for physician
- For both institution / unit and physician
- Unknown

* 7. Place of work

- Private
- Public

* 8. Number of Intensive care beds in the unit (excluding high dependency beds)

* 9. Number of High dependency beds in the unit (under the care of an intensivist)

* 10. What patient demographic does your ICU cater to?

- Paediatric
- Adults
- Mixed (adults and paediatrics)

Current resources and usage

* 1. Ultrasound Machine dedicated for use in the ICU available?

- No
- Yes, without continuous and pulse-wave Doppler imaging
- Yes, with continuous and pulse-wave Doppler, but not tissue Doppler
- Yes, with continuous, pulse-wave and tissue Doppler

Other (please specify)

* 2. I'm familiar with the use of ultrasound machines currently available in the department (for any type of scan)

- Strongly disagree
- Disagree
- Agree
- Strongly agree

* 3. Storage of CCUS report (tick all that apply)

- [ ] None
- [ ] Stored in the ultrasound machine
- [ ] Stored in the paper-based medical record
- [ ] Stored in the electronic health record
- [ ] Stored in the picture archiving and communication system (PACS)

* 4. CCUS recording of static clips (tick all that apply)

- [ ] None
- [ ] Stored in the ultrasound machine
- [ ] Stored in the paper-based medical record
- [ ] Stored in the electronic health record
- [ ] Stored in the picture archiving and communication system (PACS)

* 11. What type of ICU

- Mixed Medical and Surgical
- Medical
- Surgical (inclusive of general surgical, burns, neurosurgical)
- Cardiothoracic
- Cardiac

Individual practice

* 1. I routinely use real time Ultrasonography for CVP insertion
- Yes
- No

* 2. How often do you perform CCE(Critical care echocardiography) in your daily practice?
- Daily
- Several times a week
- Hardly ever
- Never

* 3. How often do you perform TEE (Transesophageal echocardiography) in your ICU practice?
- Daily
- Several times a week
- Hardly ever
- Never

* 4. How often do you perform Pleural and lung US in your ICU practice?
- Daily
- Several times a week
- Hardly ever
- Never

* 5. How often do you perform ultrasonography for Diaphragm and muscle in your ICU practice?
- Daily
- Several times a week
- Hardly ever
- Never

* 6. How often do you perform Abdominal ultrasound (including FAST) /obstetric in your ICU practice?
- Daily
- Several times a week
- Hardly ever
- Never

* 7. How often do you perform Ultrasonography for Vascular access in your ICU practice?
- Daily
- Several times a week
- Hardly ever
- Never

* 8. How often do you perform Vascular diagnostics (AAA, DVT) in your ICU practice?
- Daily
- Several times a week
- Hardly ever
- Never

* 9. How often do you perform Neurological Ultrasound (ONSD, cerebral circulation) in your ICU practice?
- Daily
- Several times a week
- Hardly ever
- Never

* 10. How often do you perform Ultrasonography for Joints, bones and soft tissue in your ICU practice?
- Daily
- Several times a week
- Hardly ever
- Never

* 11. How often do you perform Airway ultrasound in your ICU practice? (check those which apply, may have more than 1 answer)
- [ ] routinely pre- percutaneous tracheostomy
- [ ] sometimes pre-percutaneous tracheostomy
- [ ] Daily
- [ ] Several times a week
- [ ] Hardly ever
- [ ] Never

* 12. The application of CCUS has frequently changed the real time management of ICU cases under my care
- Strongly disagree
- Disagree
- Agree
- Strongly agree

* 13. If the indications exist, I routinely scan new ICU admissions with (check all that apply)
- [ ] Critical care echocardiography
- [ ] Pleural and lung ultrasound
- [ ] Abdominal ultrasound
- [ ] Diaphragm/ muscle ultrasound
- [ ] Optic nerve sheath diameter
- [ ] Airway ultrasound
- [ ] Others

Other (please specify)

Critical care ultrasound training

* 1. Previous CCUS courses attended (check all that apply)
- [ ] WINFOCUS
- [ ] BASIC TTE
- [ ] RACEPLUS
- [ ] NHC CCU SYMPOSIUM
- [ ] Others: eg Other preconference workshops

Name of preconference workshop

* 2. Formal* Echocardiography attachments / electives/ training (eg with Cardiology/ during ICM fellowship) of at least one month duration (*Formal= direct supervision for minimum number of scans, with assigned supervisor)
- Yes
- No

* 3. Received Formal* ultrasound training in (check those which apply)
- [ ] TEE
- [ ] CCE (Critical care echocardiography)
- [ ] Airway
- [ ] Pleural and lung ultrasound
- [ ] Diaphragm and muscle
- [ ] Abdominal/obstetric
- [ ] FAST
- [ ] Vascular access
- [ ] Vascular diagnostics (AAA, DVT)
- [ ] Neurological (ONSD, cerebral circulation)
- [ ] Joints, bones and soft tissue
- [ ] Other (please specify)

* 4. Formal initial credentialing/ accreditation done? (if yes, name of CCUS accreditation)

- ○ Available
- ○ Not available

Formal CCUS accredition: eg DDU, FICE

* 5. Is your formal credentialing/ accreditation is current?

- ○ Yes
- ○ No
- ○ Not available

* 6. Is formal renewal of credentialing / accreditation of CCUS accreditation required by your institution?

- ○ Yes
- ○ No

* 7. Number of full TTE scans done (same views required when done by a professional sonographer)

- ○ 0
- ○ 1-5
- ○ >5-30
- ○ >30-50
- ○ 50-100
- ○ >100

* 8. Number of Critical care echocardiography (CCE) scans done

- ○ 0
- ○ 1-5
- ○ >5-30
- ○ >30-50
- ○ 50-100
- ○ >100

Barriers

* 1. What are the perceived obstacles when embarking on a formal training program for CCUS currently? (Check those which apply)

- ☐ Lack of supervisors
- ☐ Overseas (eg ASUM, BSE, EDEC) programs are costly
- ☐ Lack of ultrasound equipment
- ☐ Lack of storage for clips and images
- ☐ Lack of time to scan
- ☐ No need for competency assessment for management at the bedside
- ☐ Medico-legal implications
- ☐ Inadequate knowledge
- ☐ Inadequate practice opportunities
- ☐ Others

Other (please specify)

* 9. I'm comfortable with image acquisition for Critical care echocardiography (CCE)

- ○ Strongly disagree
- ○ Disagree
- ○ Agree
- ○ Strongly agree

* 10. I'm confident with ultrasound image interpretation of Critical care echocardiography (CCE) images

- ○ Strongly Disagree
- ○ Disagree
- ○ Agree
- ○ Strongly agree

* 11. I'm confident with integrating CCUS with clinical management

- ○ Strongly disagree
- ○ Disagree
- ○ Agree
- ○ Strongly agree

Future practice needs assessment

* 1. I would like to receive formal ultrasound training for…. (check those which apply)

- ☐ Critical care echocardiography
- ☐ Transesophageal echocardiography
- ☐ Airway ultrasound
- ☐ Pleural and lung ultrasound
- ☐ Diaphragm and muscle
- ☐ Abdominal / obstetric
- ☐ Vascular access
- ☐ Vascular diagnostics (AAA, DVT)
- ☐ Neurological disease (ONSD, cerebral circulation)
- ☐ Joints, bones and soft tissue

Other (please specify)

Resource availability

* 1. For initial training, assuming it takes one year, what is the number of **hours per month** a learner can commit to CCUS training and competency assessment

0 90 180

* 2. For initial training, assuming it takes one year, what is the amount of money (in Singapore Dollars) a learner can commit to CCUS training and competency assessment?

0 1500 3000

* 3. For reaccreditation, assuming reaccreditation is needed every 5 years, amount of money in Singapore Dollars) one can commit to reaccreditation?

0 1500 3000

* 4. Any other ideas on how to implement critical care ultrasound training?

* 4. What is your preferred platform for acquiring content knowledge?

- [ ] In -person lectures
- [ ] Website lectures
- [ ] Internet-based app eg Elearn
- [ ] YouTube
- [ ] Social media like Facebook, Twitter

Other (please specify)

Future formal competency assessment needs

* 1. I think there is a need for formal competency assessment in CCUS

- ( ) Yes
- ( ) No
- ( ) Unsure

Comments

* 2. I think there is a need for a local CCUS training program

- ( ) Strongly agree
- ( ) Agree
- ( ) Disagree
- ( ) Strongly disagree

* 3. I would like to receive formal competency assessment for (check those which apply)

- [ ] CCE Critical care echocardiography
- [ ] TEE Transesophageal echocardiography
- [ ] Pleural and lung ultrasound
- [ ] Diaphragm and muscle
- [ ] Abdominal/obstetric
- [ ] FAST
- [ ] Vascular access
- [ ] Vascular diagnostics (AAA, DVT)
- [ ] Neurological (ONSD, cerebral circulation)
- [ ] Joints, bones and soft tissue
- [ ] Airway