African Journal of Emergency Medicine 12 (2022) 333–338

Contents lists available at ScienceDirect

African Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/afjem

ORIGINAL ARTICLE

Current use and perceived barriers of emergency point-of-care ultrasound by African health care practitioners

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ARTICLE INFO

Keywords:
Ultrasound
Training
Accreditation
Credentialing
Africa

ABSTRACT

Introduction: The African Federation of Emergency Medicine (AFEM) recommends the use of emergency point-of-care ultrasound (ePOCUS) as a core skill for health care practitioners in Africa. The study explored the use of ePOCUS by health care practitioners among AFEM members who work across Africa.

Methods: An anonymous online survey was distributed to individual members of AFEM and affiliated organisations. The questionnaire was tested by the AFEM Scientific Committee for potential content modifications prior to distribution. Summary statistics are presented.

Results: Of the 220 participants that were analysed, 148 (67.3%) were using ePOCUS. The mean age was 36 years; 146 (66%) were male; and 198 (90%) obtained their primary medical qualification in Africa. In total, 168 (76%) were doctors, and most participants (n = 204, 93%) have worked in Africa during the last 5 years. Reasons for not using ePOCUS mainly related to lack of training and problems with ultrasound machines or consumables. Most ePOCUS users (116/148, 78%) attended courses with hands-on training, but only 65 (44%) participants were credentialed (by 18 different organizations). The median score for self-perceived level of ePOCUS skills was 75 in credentialed users versus 50 in those that were not credentialed. Ultrasound in trauma was the most frequently used module (n = 141, 99%), followed by focused cardiac assessment (n = 128, 90%) and thoracic (including lung) assessment (n = 128, 90.1%). The FASH-module (Focused Assessment with Sonography for HIV/TB) was the least used (n = 69, 49%).

Conclusion: Access barriers to ePOCUS training, mentorship, equipment and consumables are still relevant in Africa. The low credentialing rate and the potential discordance between local burden of disease and ePOCUS training requires further investigation.

Introduction

Emergency point-of-care ultrasound (ePOCUS) use by doctors, nurses and pre-hospital practitioners has become mainstream worldwide to expedite patient management at the patient's bedside [1–5]. The numerous benefits of its use is well described internationally. Not only does the use of ePOCUS reduce time to diagnosis in severely ill patients managed in the emergency centre, it also can lead to a decrease in diagnostic errors [6]. This have the potential to decrease morbidity and mortality of patients [6], although ePOCUS are yet to be shown to improve patient-centred outcomes [7–9].

The potential benefit of ePOCUS use in Africa is tremendous as it is a fast and relative low-cost imaging modality that can be used for the diagnosis and management of diseases prevalent in African countries. [10] The assessment of patients presenting with trauma and obstetric-related complaints immediately come to mind, but it is also valuable for highly prevalent infectious diseases. The use of ePOCUS in the diagnosis of HIV-associated tuberculosis has the potential to diagnose patients quicker, especially if it forms part of an extensive point-of-care orientated clinical algorithm. [11] These potential benefits of ePOCUS therefore led to the recommendation by the African Federation of Emergency Medicine (AFEM) that ePOCUS should be incorporated in all African training programs for all health practitioners [12].

The uptake of ePOCUS into lower resourced settings had been sluggish. Potential barriers include the high purchase cost of portable ultrasound machines, lack of access to training, ultrasound machine malfunction, and lack of ultrasound maintenance capability [13,14]. Cheaper portable hand-held ultrasound systems have become available that should alleviate some of the financial barriers. Skilled physicians affiliated with international universities provided ePOCUS training to some African countries over the past decade [15–17]. However, the di-

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https://doi.org/10.1016/j.afjem.2022.07.009
Received 22 March 2022; Received in revised form 6 July 2022; Accepted 24 July 2022

rect transferal of high resourced settings' ePOCUS curricula and delivery methods sometimes ignored the unique local disease burden, disease prevalence and training challenges of the recipient system with the potential of less desirable outcomes [17–19]. A paucity of data exist that evaluate the design, training and implementation of ePOCUS curricula in emergency care in Africa, particularly in respect of identifying aspects that may require revisions or improvement in ePOCUS usage.

The aim of the study was to explore the use of ePOCUS by health care practitioners among AFEM members who work across Africa. The objectives of the study were to determine the demographics, level of qualification and level of ePOCUS training, to determine the barriers to ePOCUS usage; to determine the ePOCUS modules used and their frequency; and based on the usage to provide recommendations on ePOCUS curriculum development and implementation.

Methods

An anonymous online survey was conducted and the study was approved by the Stellenbosch University Health Research Ethics committee (N21/10/112) and the AFEM executive committee.

An online platform was used due to convenience and the various restrictions imposed by the COVID-19 pandemic. The survey was distributed to members of AFEM, including individual members and members of affiliated organisations - contact persons at affiliated organisations were asked to distribute the survey to their members [20]. At the time of the study, the AFEM network represented more than 2000 members from 25 different countries (see table in supplementary material).

All eligible participants were contacted via e-mail with an explanation and invitation to participate in the survey. The invitational e-mail was sent on 17 November 2021 by the AFEM intern as the AFEM membership database is held on a password protected AFEM server with access limited to the AFEM executive committee. The invitation included the link to the online questionnaire and participants had four weeks to complete the survey; a general reminder was sent after two weeks. The questionnaire was based on a previously used questionnaire with the additional incorporation of modules described by the International Federation of Emergency Medicine [21,22]. The questionnaire is available at Zenodo [23]. The questionnaire was tested by the AFEM Scientific Committee for potential content modifications prior to distribution to the study participants.

Study data were collected and managed using REDCap electronic data capture tools hosted at Stellenbosch University [24,25]. REDCap (Research Electronic Data Capture) is a secure, web-based software platform designed for building and managing online surveys and research databases. Participation in the study was entirely voluntary and there were no monetary benefits for participation. The consent form was available as the landing page of the electronic questionnaire and participants were able to suspend involvement freely and at any time. Participants that indicated that they are not using ePOCUS were precluded from completing the section on ultrasound modules. Self-perceived level of ePOCUS skills were determined with a slider between 0 (no skill) and 100 (world-class master). Similarly, using ePOCUS to make clinical decisions without receiving hands-on training for the specific module application were also determined with a slider between 0 (never) and 100 (all the time).

Data were imported onto a password-protected electronic spreadsheet (Microsoft Excel®, Microsoft Corporation, Redmond, WA) and transferred to SPSS Statistics for Windows, Version 27.0 (IBM Corp. Released 2020. Armonk, NY: IBM Corp.) for analysis. Summary statistics were used to describe all variables. Categorical data were summarised using frequency counts or percentages, and distributions of variables were presented as bar charts. Medians or means were used as the measures of central tendency for ordinal and continuous responses and standard deviations (SDs) or quartiles as indicators of spread.

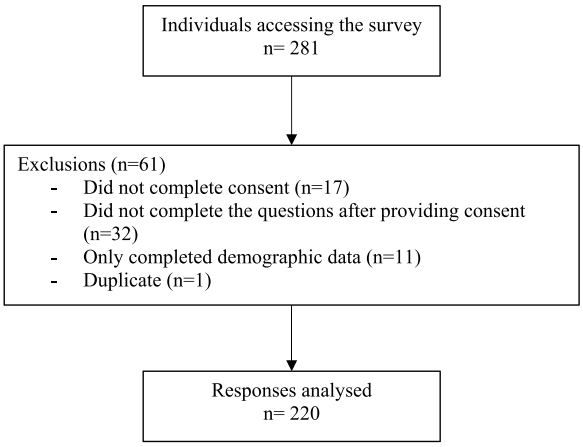

Fig. 1. Flow diagram study population.

Results

A total of 281 individuals accessed the survey of which 61 were excluded (Fig. 1). Of the 220 participants that were analysed, 148 (67.3%) were using ePOCUS.

The mean (± SD) age of participants was 36 (±7) years and 146 (66.4%) were male. Most participants were doctors (n = 168, 76,4%), worked mostly in a clinical setting (n = 181, 82.3%), and obtained their primary medical qualification in Africa (n = 198, 90.0%). Hundred-and four (47.8%) of the participants held a master's degree or higher and 92 (55.1%) of the doctors obtained a specialist qualification (71 (77.2%) related to emergency medicine). Most of the participants (n = 204, 92.7%) worked in Africa during the last 5 years, with most working in South Africa (n = 72, 36.5%) (Table 1). A complete breakdown of African countries where participants worked is available as supplementary material.

One hundred and eighteen different reasons were given by the 72 participants for not using ePOCUS (Fig. 2), mainly relating to lack of training (n = 61, 84.7%) and problems with ultrasound machines or consumables (n = 20, 27.8%). Twelve of the 15 specialised doctors (80%) not using ePOCUS attributed this to lack of training. Two participants indicated that the role of ePOCUS in the pre-hospital setting still needs to be clarified and one participant felt that ePOCUS is not needed in his/her setting: "Unnecessary and potentially time wasting. It would add little to no value in patient assessment. Clinical findings are sufficient".

Hundred and sixteen of the 148 participants (78.4%) using ePOCUS attended courses with hands-on training, while 85 (57.4%) received supervised hands-on training. Forty-one (27.7%) taught themselves and 20 (13.5%) only attended on-line courses.

Only 65 (43.9%) participants using ePOCUS were credentialed (i.e., tested and evaluated by an outside person, committee, or organization to ensure that required standards of quality are met). A list of accreditors is available in the supplementary material.

The median score for overall self-perceived level of ePOCUS skills was 70.0 and was substantially higher in those that were credentialed (75.0 versus 50.0) (Fig. 3). Sixty percent (median) of ePOCUS users make clinical decisions without receiving hands-on training for a specific module application; this was also higher in the credentialed group (69% versus 50%).

Ultrasound in trauma (e.g., extended Focused Assessment with Sonography for Trauma (eFAST)) was the most frequently used ePOCUS module (n = 141, 99.3%), followed by focused cardiac assessment (n = 128, 90.1%) and thoracic (including lung) assessment (n = 128, 90.1%) (Table 2). The FASH-module (Focused Assessment with Sonography for HIV/TB), ocular and gastro-intestinal modules were the least used (Table 2).

Table 1
Demographics of study participants.

All *n* (%), unless otherwise indicated	All (*n* = 220)	Using ePOCUS[a] (*n* = 148)	Not using ePOCUS[a] (*n* = 72)
Age (years)[b]			
Mean ± SD[c]	36 ± 7	37 ± 7	35 ± 8
Gender			
Male	146 (66.4)	97 (65.5)	49 (68.1)
Female	74 (33.6)	51 (34.5)	23 (31.9)
Healthcare group			
Pre-hospital	22 (10)	9 (6.1)	13 (18.1)
Nursing	28 (12.7)	6 (4.1)	22 (30.6)
Doctors	168 (76.4)	132 (89.2)	36 (50)
Other	2 (0.9)	1 (0.7)	1 (1.4)
Biggest proportion of work			
Mostly clinical	181 (82.3)	128 (86.5)	53 (73.6)
Mostly educational	26 (11.8)	15 (10.1)	11 (15.3)
Mostly research or administration	12 (5.5)	5 (3.4)	7 (9.7)
Other	1 (0.5)	0 (0)	1 (1.4)
Highest qualification			
Diploma	16 (7.3)	7 (4.7)	9 (12.5)
Bachelor's or Honour's	96 (43.6)	55 (37.2)	41 (56.9)
Master's	76 (34.5)	58 (39.2)	18 (25)
Doctoral	31 (14.1)	27 (18.2)	4 (5.6)
Other	1 (0.5)	1 (0.7)	0 (0)
Continent where primary medical qualification was obtained			
Africa	198 (90.0)	129 (87.2)	69 (95.8)
Other	22 (10.0)	19 (12.8)	3 (4.2)
Doctors specializing after primary medical degree			
Specialised	92/167 (55.1)	77/132 (58.3)	15/35 (42.9)
Field of specialization			
Emergency Medicine	62/92 (67.4)	58/77 (75.3)	4/15 (26.7)
Other	21/92 (22.8)	11/77 (14.3)	10/15 (66.7)
Combination (Emergency Medicine and other)	9/92 (9.8)	8/77 (10.4)	1/15 (6.7)
Continent where specialist medical qualification was obtained			
Africa	76/92 (82.6)	64/77 (83.1)	12/15 (80.0)
Other	16/92 (17.4)	13/77 (16.9)	3/15 (20.0)
Continent where mostly worked over past 5 years			
Africa	204 (92.7)	137 (92.6)	67 (93.1)
Other	16 (7.3)	11 (7.4)	5 (6.9)
African country where mostly worked over past 5 years (*n* = 197)			
South Africa	72 (36.5)	62 (46.6)	10 (15.6)
Kenya	19 (9.6)	11 (8.3)	8 (12.5)
Ghana	18 (9.1)	10 (7.5)	8 (12.5)
Uganda	18 (9.1)	10 (7.5)	8 (12.5)
Other	70 (35.5)	40 (30.1)	30 (46.9)

[a] Emergency point-of-care ultrasound.
[b] All *n* = 219, Using ePOCUS *n* = 147.
[c] Standard deviation.

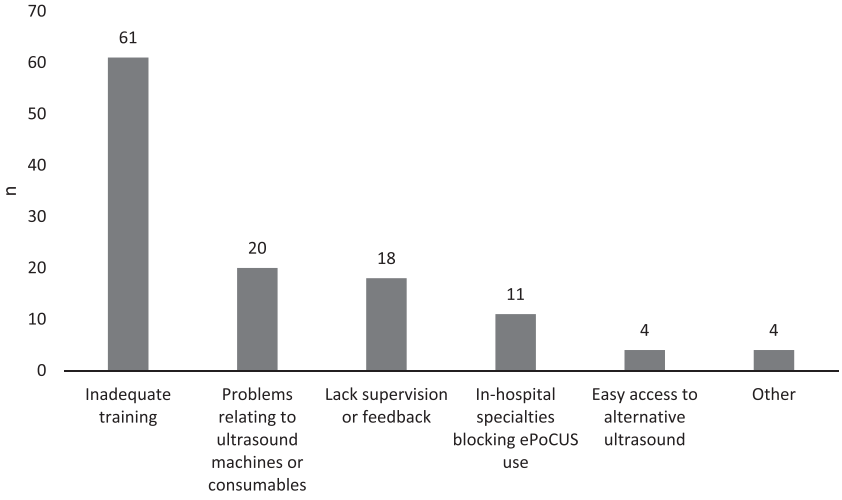

Fig. 2. Reasons for not using emergency point-of-care ultrasound (ePOCUS) ePOCUS: emergency point-of-care ultrasound.

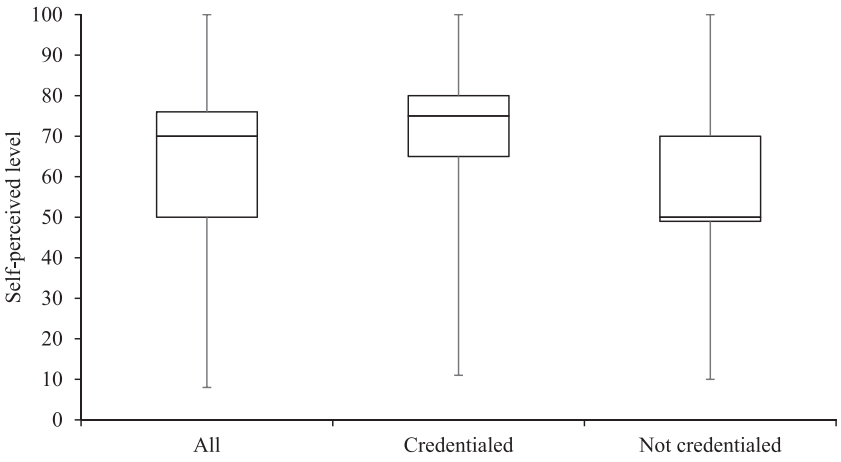

Fig. 3. Self-perceived level of emergency point-of-care ultrasound (ePOCUS) skills between 0 and 100, overall and divided according to being a credentialed ePOCUS provider or not (whiskers representative of maximum and minimum, box representative of 25th percentile, median and 75th percentile).

Discussion

The use of ePOCUS on the African continent is still being limited by access barriers to training, mentorship, equipment and ultrasound-related consumables. Only a third of ePOCUS users have validated their expertise in ePOCUS by means of credentialing. This is rather unfortunate as the self-perceived level of ePOCUS skills was substantially higher in those that were credentialed. The most frequently used ePOCUS modules are trauma ultrasound, focused cardiac assessment, and thoracic assessment.

Two-thirds of respondents indicated that they use ePOCUS in Africa. This is much lower than a recent study in Korea where 96% of physicians reported using ePOCUS in emergency centres [26]. In Canadian emergency centres, ePOCUS are reportedly used on an average of 68% of shifts and 23% of patients and was used in 2.1% of patients in Australian emergency centres [27,28]. The low adoption rate in the survey is of concern even though the availability of mobile ultrasound machines increased substantially over the last couple of years [3]. We do acknowledge that the usage of ePOCUS in Africa is likely much higher as reported here, but there are still room for improvement. Especially if considering that ePOCUS has the potential to increase access to quality health care in remote areas.

Access barriers to training were highest ranked in the group that reported they did not use ePOCUS (Fig. 2). These findings correspond with survey studies of emergency medicine specialist physician trainees in Cape Town and health care workers in 44 low-to-middle-income countries who also trained and worked in lower resourced settings [13,29]. However, valuable lessons can also be learnt from survey studies that were conducted in higher resourced settings that reported similar access barriers. Studies identified that training over long distances and at multiple sites overstretched their equipment logistical support, reduced the quality control of trainers and the feedback they provided to their trainees, and may have not planned their training to account for potential language barriers [30–32]. Eventually overcoming the identified access barriers (Fig. 2) will be essential to provide effective learning delivery to ePOCUS trainees that will result in learning enhancement and ultimately increase competent ePOCUS use [33–36].

Respondents that used ePOCUS had achieved overall low credentialing rates (44%). Although this is higher than the 20% reported by a 2015 Cape Town based study [13], it is still concerning low. Credentialing is worldwide a contentious issue despite it's clear benefits [37]. Russell et al reported that many training programs in the United States have less than 50% of their faculty credentialed to perform and teach ePOCUS [38]. A credentialing initiative in the United States managed to achieve a credentialing rate of 74% [39]. The initiative include standardization of credentialing and a stepwise process to ensure the attainment of manageable goals [39]. In our study 19 different accrediting organisations (14 international and 5 African based) were listed by the study participants, with each organization likely to have their own selection of ePOCUS modules and training methodologies that result in severe heterogeneity of curricula content and delivery methods across the African continent.

Trauma ultrasound was the most frequently used ePOCUS module (Table 2). This may appropriately match the well-known high trauma burden experienced in many African countries [40–42]. However, factors other than disease prevalence may influence which ePOCUS modules should be taught and subsequently used. For example, Africa has a very high burden of HIV-associated tuberculosis, yet the FASH module is infrequently used. Two landmark African based studies recommended unique methods to select functional ePOCUS modules (curriculum content) that should be grounded to the local epidemiology, health system capabilities and resources. Firstly, Van Hoving et al. suggested a weighing scoring system using local disease prevalence, disease impact and technical skill difficulty to select the ePOCUS modules that should be trained [19]. Secondly, Salmon et al recommended the training of certain core competencies (ePOCUS modules) based on local disease but within the local infrastructure and training limitations. Their study also proposed that ePOCUS should be used early in the patient's presentation; the presenting symptoms and signs should trigger the appropriate algorithm that are organ- or procedural-based ultrasound examinations [18]. A model that includes both these recommendations should be considered to select context specific ePOCUS training modules (curriculum content) for Africa.

The use of ePOCUS in the pre-hospital and nursing groups were low (9/22 and 6/28 respectively). Both prehospital- and nurse-performed ePOCUS is feasible with the potential to change patient management [2,4,5]. Many African countries have a shortage of specialized healthcare workers creating massive healthcare challenges. One potential solution is task shifting for ePOCUS away from doctors, especially in the primary healthcare setting [43]. Many examples exist of ePOCUS being successfully performed by midwives, nurses, community health workers etc., in various different conditions. Challenges faced were high cost of hands-on training, poor internet connectivity affecting tele-ultrasound, and unstable electricity networks [43]. However, the low use of ePOCUS in non-physicians in acute care in Africa should be further explored.

The survey's results should be appraised against the study's limitations. The extensive AFEM membership email database provided the best viable option, although far from ideal, to explore the current ePOCUS use of health care practitioners in Africa. A formal response rate could not be calculated since organisations affiliated to AFEM were requested to forward the survey to their members; the denominator is thus unknown. While several reminders were sent, a low rate of response was likely and the introduction of nonresponse bias into the study's findings is possible. Similarly, the high exclusion rate (22%) could have intro-

Table 2
Emergency point-of-care ultrasound (ePOCUS) modules used in Africa (number per row exclude incomplete submissions).

ePOCUS[a] module	Never used n (%)	Used n (%)	Frequency of use			
			Daily n (%)	Weekly n (%)	Monthly n (%)	Less than monthly n (%)
Trauma Ultrasound (Extended Focused Assessment with Sonography for Trauma (eFAST)) (n = 142)	1 (0.7)	141 (99.3)	66 (46.8)	46 (32.6)	16 (11.3)	13 (9.2)
Focused Cardiac Assessment (n = 142)	14 (9.9)	128 (90.1)	52 (40.6)	36 (28.1)	23 (18.0)	17 (13.3)
Thoracic assessment (including lung ultrasound) (n = 142)	14 (9.9)	128 (90.1)	52 (40.6)	45 (35.2)	15 (11.7)	16 (12.5)
Obstetric ultrasound 1st semester (e.g. confirming intra-uterine pregnancy) (n = 142)	24 (16.9)	118 (83.1)	25 (21.2)	32 (27.1)	25 (21.2)	36 (30.5)
Deep venous thrombosis (DVT) assessment (n = 142)	24 (16.9)	118 (83.1)	23 (19.5)	39 (33.1)	29 (24.6)	27 (22.9)
Shock assessment (e.g. RUSH, EGLS etc.) (n = 141)	24 (17.0)	117 (83.0)	41 (35.0)	36 (30.8)	16 (13.7)	24 (20.5)
Procedural: Central vascular access (n = 142)	26 (18.3)	116 (81.7)	23 (19.8)	29 (25.0)	28 (24.1)	36 (31.0)
Procedural: Peripheral vascular access (n = 142)	30 (21.1)	112 (78.9)	27 (24.1)	29 (25.9)	24 (21.4)	32 (28.6)
Urinary tract assessment (including bladder) (n = 141)	30 (21.3)	111 (78.7)	21 (18.9)	31 (27.9)	34 (30.6)	25 (22.5)
Liver and biliary assessment (n = 142)	31 (21.8)	111 (78.2)	14 (12.6)	36 (32.4)	34 (30.6)	27 (24.3)
Procedural: Thoracentesis (n = 142)	43 (30.3)	99 (69.7)	13 (13.1)	23 (23.2)	37 (37.4)	26 (26.3)
Procedural: Paracentesis (n = 141)	44 (31.2)	97 (68.8)	13 (13.4)	24 (24.7)	28 (28.9)	32 (33.0)
Procedural: Pericardiocentesis (n = 142)	48 (33.8)	94 (66.2)	8 (8.5)	13 (13.8)	24 (25.5)	49 (52.1)
Soft tissue/musculoskeletal/fracture assessment (n = 142)	51 (35.9)	91 (64.1)	12 (13.2)	27 (29.7)	25 (27.5)	27 (29.7)
Obstetric ultrasound 2nd semester (e.g. assessing fetal viability, growth, multiple pregnancy, placenta location)) (n = 142)	52 (36.7)	90 (63.4)	14 (15.6)	19 (21.1)	19 (21.1)	38 (42.2)
Abdominal assessment for undifferentiated abdominal pain or distention (ABUE) (n = 142)	55 (38.7)	87 (61.3)	20 (23.0)	28 (32.2)	19 (21.8)	20 (23.0)
Procedural: Regional anaesthesia (n = 142)	57 (40.1)	85 (59.9)	11 (12.9)	15 (17.6)	18 (21.2)	41 (48.2)
Obstetric ultrasound 3rd semester (e.g., assessing fetal viability, growth, multiple pregnancy, placenta location) (n = 142)	60 (42.3)	82 (57.7)	10 (12.2)	10 (12.2)	14 (17.1)	48 (58.5)
Gastro-intestinal tract assessment (e.g., appendicitis) (n = 142)	66 (46.5)	76 (53.5)	8 (10.5)	20 (26.3)	20 (26.3)	28 (36.8)
Ocular assessment (n = 142)	70 (49.3)	72 (50.7)	3 (4.2)	9 (12.5)	22 (30.6)	38 (52.8)
Focused assessment with sonography for HIV-associated tuberculosis (FASH) (n = 142)	73 (51.4)	69 (48.6)	13 (18.8)	18 (26.1)	16 (23.2)	22 (31.9)
Other (n = 137)	111 (81.0)	26 (19.0)	6 (23.1)	5 (19.2)	6 (23.1)	9 (34.6)

[a] Emergency point-of-care ultrasound.

duced bias. This was mainly a result of responders accessing the survey and then opting out by not giving consent or by not completing anything after consent was given. The exact reasons for this remain unknown and one can only speculate why this occurred. Although the effect and direction of the nonresponse bias on the study findings can't be quantified, we expect the impact to be limited given the exploratory aim of the study. We did not formally try to prevent multiple survey responses from individuals as the survey was anonymous. The sample was heavily skewed towards South African study participants, although the majority of respondents were professionally qualified emergency medicine specialist physicians, who also worked in Africa for the past five years. We do acknowledge that all African countries are not equivalent, making it difficult to draw conclusions from the data. It is also possible that the online survey was not accessible by all healthcare providers since internet connectivity is often problematic in certain areas. The reported frequency of ePOCUS modules used by health care workers were influenced by many local (equipment and health system restrictions) and external (modules trained, trainer feedback and mentorship access) factors that are complex and beyond the limit of the study's methodology. Therefore, we recommend more in-depth and context specific studies to improve the understanding of the difficulties health care workers face on the ground to firstly access ePOCUS training and secondly to use ePOCUS seamlessly in their daily practice.

Conclusion

Access barriers to training, mentorship, equipment and consumables still reduce ePOCUS use and expansion of its use among African based health care workers. The low credentialing rate, potential heterogeneity of ePOCUS training and the inconsistent use of different ePOCUS modules by African users requires further investigation. Detailed planning (by the African Federation of Emergency Medicine), meticulous coordination and local buy-in will be essential to overcome these challenges and improve the safe and competent use of ePOCUS in Africa.

Dissemination of results

Results from this study was shared with the executive committee of the African Federation of Emergency Medicine. The results are to be included in the federation's annual report.

Authors' contribution

Authors contributed as follow to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: DJvH. contributed 50%; HL 40%; and ANA and FK contributed 5% each. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Declaration of Competing Interest

Prof Lamprecht is an editor of the African Journal for Emergency Medicine. He did not participate in this manuscript's editorial process. The journal applies a double blinded process for all manuscript peer review. The authors declared no further conflicts of interest.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.afjem.2022.07.009.

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