

Original Article

Point of care ultrasound in acutely breathless patients-A qualitative study of the enablers and challenges in a teaching hospital in Kenya

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ABSTRACT

Objectives: Acute breathlessness is a common and distressing symptom experienced by patients presenting to the emergency department (ED). Adoption of clinician-performed bedside ultrasound could promote accurate, early diagnosis and treatment to acutely breathless patients. This may be particularly pertinent in low resource settings with limited human resources and lack of access to advanced (gold standard) diagnostic testing. The aim of the study was to explore the experience of point-of-care ultrasound (PoCUS) users in the emergency department, and to understand the facilitators and constraints of PoCUS incorporation into patient investigation pathways.

Materials and Methods: This was an exploratory qualitative study. Data collection entailed key informant interviews using a semi-structured interview guide between September 2019 and February 2020. Participants were purposively sampled according to role and responsibility in the acute care system at Kenyatta National Hospital, including front-line health practitioners and mid-level clinical hospital managers. Data collection proceeded until no new concepts emerged (thematic saturation). The analytical framework method was used for the thematic analysis of interview transcripts.

Results: At individual level, the lack of training on the use of PoCUS, as well as fears and beliefs impacted on capability and motivation of the clinicians to perform PoCUS for clinical diagnosis. Hospital level influencers such as hospital norms, workloads, and staffing influenced the use of PoCUS by impacting on the clinician's capability, motivation, and opportunity. General health system influencers such as relationships and power dynamics between clinical specialties and key stakeholders, and the lack of policy and practice guidelines challenged the uptake of the bedside ultrasound by the clinicians.

Conclusion: Lack of PoCUS training for clinicians, limited resources and a fragmented health system structure impacted the clinician's capability, motivation, and opportunity in performing PoCUS in diagnostics. PoCUS for diagnosis of acute breathlessness requires: (1) Well-maintained and accessible equipment; (2) highly trained individuals with time to perform the examination with access to ongoing support for the operators; and (3) finally, researchers must more accurately identify the optimal scope of ultrasound examination, the diagnostic benefits, and the opportunity costs. All three will be required to ensure patient's benefit.

Keywords: Point of care ultrasound, Dyspnea, Clinician performed sonography, Sub Saharan Africa

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INTRODUCTION

Breathlessness is a common and distressing symptom experienced by patients presenting to the emergency department (ED) and can be the primary manifestation of many disparate pathologies, posing a diagnostic challenge.^[1] Acute breathlessness may be a manifestation of a life threatening condition.^[1] Co-existing non-communicable cardiovascular disease is a frequent risk factor for respiratory diseases, this multimorbid pathology may complicate the diagnostic process.^[2] The epidemiology of dyspnea reveals geographical variation in population-based samples worldwide.^[3] Epidemiologic studies on the prevalence of dyspnea for the most of Africa is scanty. A recent study in Kenya^[4] reported cardiac abnormalities being most prevalent at 23.1% in patients with non-pulmonary causes of breathlessness. It is estimated that the burden of COPD varies from 4% to 25 % in SSA.^[5] Adopting the use of clinician-performed bedside ultrasound could impact the patient management positively by boosting the clinician's diagnostic capacity, therefore promoting early diagnosis and more accurate treatment to acutely breathless patients.^[6] This may be particularly pertinent in the lower resourced settings which lack adequate human resources and limited access to specialist diagnostic imaging such as computer tomography (CT) scanning.^[7]

Point-of-care ultrasound (PoCUS) is a rapid, portable, focused imaging test performed at the bedside as opposed to medical imaging tests performed in a radiology department. The technique is noninvasive, repeatable, has no risk of ionizing radiation^[8] and is increasingly being used as a diagnostic tool in resource-limited settings.^[9] In addition, the use of ultrasound has been shown to promote patient safety.^[10] In acutely breathless patients, the areas of interest for PoCUS are the heart, the lungs, and the major blood vessels.^[6,11-14] Review of the literature reveals feasibility and clinical utility of PoCUS by non-radiologists and non-cardiologists.^[15-18] Focused cardiopulmonary ultrasound was demonstrated to improve diagnostic accuracy in emergency care in Ghana, particularly in patients with cardiac disease such as cardiogenic shock, congestive heart failure, or acute valvular disease.^[19] The use of a clinical-PoCUS integrated approach in low- and middle-income (LMICs) may obviate current limitations of human resource and other resource scarcity. Limitations include capital costs, and high training and experience requirements required for accurate usage.^[20] The majority of PoCUS protocols have been developed and implemented in high-resource settings where more advanced imaging technology is usually available to help the clinician confirm their ultrasound diagnosis.^[9] There is a need for context-specific ultrasound protocols suited to the needs and available resources in low resource settings.

There is need for evidence on how PoCUS can best be incorporated into care pathways to inform care for breathless

patients, and what services and structures must be in place to ensure optimal delivery in LMIC health-care settings. The most significant barriers to POCUS in high income countries are time constraints with suggested improvements targeting improving the workflow and incorporation of the PoCUS documentation into the electronic medical records.^[21] The aim of the study was to explore the perception of clinicians regarding performing PoCUS in the acute care department, and to understand the facilitators and constraints of incorporating PoCUS into patient investigation pathways at a teaching and referral hospital in a low resource setting.

MATERIALS AND METHODS

This exploratory qualitative study is nested within a quantitative study (breathlessness early detection with ultrasound study) under the International Multidisciplinary Program to Address Lung Health and TB in Africa "IMPALA" (<https://www.lstmed.ac.uk/impala>). IMPALA is a 4-year collaborative program involving 22 institutions across 14 countries to improve the health of children and adults in Africa through multi-disciplinary applied health research on lung health and TB.

Study setting

The study was conducted in Nairobi, Kenya at the Kenyatta National Hospital (KNH). KNH is a 1800-bed teaching and referral hospital with a busy ED which saw 54,207 patients in 2018.^[22] The ED has a workforce of 56 medical doctors (with only 2 permanent faculty), 116 registered nurses, and other support staff including patient porters and laboratory personnel.

The South African Triage system is employed to assess patients according to their severity/acuity based on the chief complaints, and brief physical examination.^[23] The department has 12 "resuscitation" beds to enable the assessment and stabilization of critically ill patients, which have piped oxygen and dedicated supportive equipment. Frequently, investigation is initiated in the ED, including venipuncture for laboratory investigation, and portable or departmental chest radiograph depending on the patient's clinical stability. The results of these investigations inform ED clinician's decisions regarding the management of the patient and the admission department.

Study design

This qualitative study was conducted between September 2019 and February 2020. Together with a team of research assistants (SM, CM, and AM), JK conducted 12 key informant interviews of purposively sampled respondents. We selected experienced clinicians of different cadres working at key points in the clinical pathway for acutely breathless patients at KNH. Participants

were also selected based on their exposure to the use of PoCUS to ensure familiarity with the proposed intervention. Eligible participants were provided written study information and allowed 2 weeks to consider their participation. Written consent was obtained for all participants.

Interviews were conducted face-to-face using semi-structured interview guide which indicated broad areas of discussion, and specific probing questions. The main focus of questions was to assess clinician experiences and perceptions regarding the use of PoCUS. Questions on the clinical pathway considered the key elements of in-hospital health-care services: accessibility to services, continuity of care, comprehensiveness, and coordination of care. Interviews were completed in English, by SM, CM, AM (research assistants), and JK (principal investigator). Interviews took on average between 30 and 45 min, were audio-recorded using encrypted digital recorders and transcribed verbatim by an external qualitative researcher (PA). JK, SM, and CM reviewed the transcripts for accuracy. Data collection proceeded until no new concepts emerged (thematic saturation).^[24] Thematic saturations were determined when additional data failed to identify participants sentiments which were unique to those previously expressed. Additional data were collected as part of a desk review of protocols, regulations, and guidelines.

Ethical approval for the study was obtained from the KNH-UoN Ethics and research committee (P295/04/2018) and the Research Ethics Committee of Liverpool School of Tropical Medicine (18-042). The Consolidated criteria for Reporting Qualitative Research checklist^[25] (COREQ) were used for reporting (Supplementary material).

Analysis process

Data analysis was performed by reading through all the transcripts using a framework approach with concurrent thematic analysis.^[26] JK, SM, CM, and AM deductively developed a preliminary coding framework from the theoretical framework and inductively coded subsequent transcripts. Following coding, data in each transcript were indexed, charted, and summarized systemically into themed matrices. For quality assurance and consistency checks, PA also independently coded the transcripts. The whole team met severally over the study period to review the analytical framework and the appropriateness of the indexing codes and themes. The team discussions and reflections allowed the opportunity to return to the data to clarify and resolve any inconsistencies or differences in understanding between the researchers. The data were analyzed using NVIVO software.^[27]

Theoretical framework

Our study followed the constructivism paradigm,^[28] we were interested in the views and perception of the participants

regarding PoCUS. We examined factors that interact with and influence PoCUS practices at the hospital within the framework of organizational capacity adapted from Aragon and Giles.^[29] Health-care organizations are conceptualized as hardware and software components at the individual and hospital levels and the systems context [Figure 1]. Hardware encompasses the infrastructure, technology, and physical resources. Software includes the *tangible aspects* such as management, knowledge, and skills and organizational systems and procedures and *intangible* components such as values and norms, relationships, and power dynamics. These hardware and software within a health-care organization affected the behavior clinicians. We used the Capability, Opportunity, Motivation-Behavioral model to report the physician's behavior toward the PoCUS influencers.^[30] Capability is defined as the individual's psychological and physical capacity to engage in the activity concerned. Motivation is defined as all those brain processes that energize and direct behavior. Opportunity is defined as all the factors that lie outside the individual that make the behavior possible or prompt it.

Positionality

All researchers involved in data collection and analysis were Kenyans with training and experience in clinical or nursing care in Kenya. The Principal Investigator (JK) is a physician in critical care practice with a master's degree in global health research and has in-depth knowledge of PoCUS activities in the hospital. SM and CM are research assistants with formal nursing training and had prior experience in health research. The research assistants underwent a 7-day training prior with a focus on qualitative research for 2 days.

RESULTS

We interviewed 12 front line health workers, five females and seven males, among whom; four were mid-level managers in

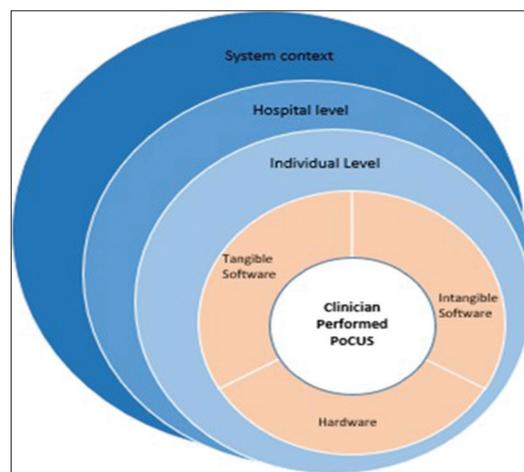


Figure 1: Theoretical framework.

clinical practice. Their clinical experience ranged between 1 year and 21 years with a median age of 33 years. Eight interviewees worked at the ED, two worked at the critical care unit, one worked in the respiratory unit and one worked at the obstetrics and gynecology department. Two of the interviewees also held significant top positions in their relevant professional societies. We identified 11 themes as shown in Figure 2, illustrating how the emerging themes had potential to impact the hardware and/or software in the delivery of health-care services, and whether the influences were at individual, hospital, or health system level.

Individual level influences

Barriers

Knowledge and skills

Knowledge and skills of performing the PoCUS appeared as a major challenge. Most clinicians across the cadres reported difficulties in performing the PoCUS:

“I think the only thing I would say is point of care ultrasound is a useful tool and there is a big gap in terms of training and also sensitization” Medical Officer SSI_8

Some participants suggested that insufficient training for PoCUS operators could result in medical errors and increase mortality:

“When somebody is not trained on how to use the ultrasound properly, it can lead to medical errors and could be quite significant because you make decisions

based on an ultrasound that has not been done properly and you end up losing a patient.” Medical Officer_SSI_4

However, within defined competencies, there was confidence that ultrasound could be useful:

“I think the question is presence or absence or something life threatening? That question may not change between the radiologists and clinician, if a clinician is properly trained” Consultant_SSI_2

Fears and beliefs

Clinicians also held beliefs or fears that influenced their practices. Some expressed skepticism whether other clinicians would accept their ultrasound scans:

“I was talking about acceptability ... would they just go by my scan? And not do any further imaging? Probably no.” Medical Officer_SSI_5

Hospital level influencers

Barriers

Hospital norms

A lack of hospital practice guidelines or protocols to guide care of the acutely breathless patients made standard setting and quality assurance difficult, this would require explicit governance measures:

“We need to now get protocols that have to be shared and reinforced and we need to appraise ourselves, are we getting better, are we worsening?” Medical Officer_SSI_3

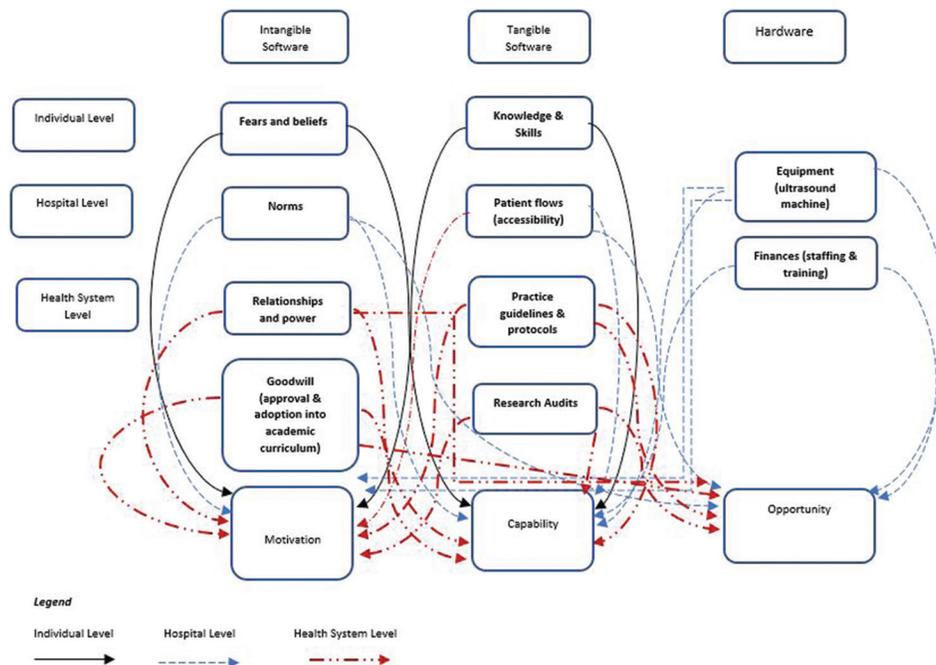


Figure 2: Emerging themes showing connections with each other and capability, opportunity, motivation-behavioral model elements.

Cost implications to the patients in need of service, were noted to act as a deterrent or a limitation to access existing radiological services:

“CTs take quite a while.... because it’s quite expensive. The patient has to look for money to pay.” Medical Officer_SSI_5

Resource scarcity

The shortage of both equipment and consumables limited the current use of ultrasound in the ED:

“The challenges of ultrasound are one, availability of ultrasound” Consultant_SSI_2

“We already have a machine in the department, maybe not the probes” Medical Officer_SSI_2

“There are times you get the machine but then the gel is not available...., you might fail to do the ultrasound because of the missing gel.” Medical Officer_SSI_8

The hardware cost was specifically limiting due to limited hospital autonomy and decision space over budgetary allocations:

“Cost of buying the machine is in our budget. The hospital is not being given funds for capital items and an ultrasound is a capital item....” Medical Officer_SSI_2

Experience of maintenance and equipment safety in the hospital suggested that even capital outlay would not ensure viable equipment:

“Challenges...we are not able to maintain equipment properly; we don’t take care of them.” Medical Officer_SSI_1

Theft of the accessories, or their replacement, or inherent hardware limitations (often from donated equipment) were also problems which reinforced a reluctance to perform the POCUS, and potentially affected its adoption:

“We have a machine to use but then we are unable to use because of an accessory that is taken by someone.” Medical Officer_SSI_5

“What difficulties do we have? There was a time we had a missing cable, which was then replaced, but it took long before it was replaced.” Medical Officer_SSI_8

“Previously we have had donations, but they had linear probes only, so they were just for maybe vascular and nerve blocks. These were pre-owned machines and they overheat. Sometimes the mother board short circuits. Previously we have had intermittent availability of the machines, but even though they were available they would only do select tasks, not everything.” Consultant_SSI_3

Staffing shortages

Participants reported time pressures among clinicians as a challenge to the clinician performing PoCUS at the patient’s bedside:

“At times I don’t even want to do ultrasound in the ED because we have a queue to clear. To stop and do an ultrasound will take me forever. If we had more staff that would help., I know that I can scan, I want to scan but I have a queue, so, I rather send this patient to the radiology in the mean-time as I sort the next patient” Medical Officer_SSI_5

There were also staff shortages and attrition among the nurses and the patient porters who are responsible for transporting the patients to the radiology department for the chest radiograph and other radiological investigations:

“Those supposed to take the patients are the nurses and the porters and they are quite few. In one shift you could have two porters and they are doing everything....., when there are more patients, sometimes you have to wait for a porter to be available to take the patient.... And, the nurse’s numbers have really gone down, some nurses have left for studies outside the country and others have gone outside to look for work. They have not been replaced.” Medical Officer_SSI_5

The staff shortages and heavy clinical workload also affect the radiology department resulting in prolonged turnaround time for results:

“I can say the radiology unit covers the entire hospital... Every day they are multiple CT scans, X-rays and MRIs that need to be done, so there is usually that delay, because the doctors have to report each and every CT scan that is done. By the time your patient gets their CT scan reported, it has taken so much time.” Medical Officers_SSI_4

Lack of training

Staff training on POCUS was reported as paramount to ensure patient safety, as this modality is operator dependent, although competing budgetary demands limited this:

“The challenges are one, we need training especially for the ultrasound, most of the doctors are not trained in this.....” Medical Officer_SSI_8

“Yes, we have a budget for training, which we do every year... The challenge with that is that sometimes the funding comes from the government, and the government regulates some of these funding. Last year we had no training, yet we had projected. For the hospital to run, we have to cut down on some of these costs.” Medical Officer_SSI_2

Patient flows (accessibility)

Logistical barriers to radiographer-dependent departmental or portable radiological investigations presented a challenge and an opportunity for ultrasound-related advantages to improve diagnostic efficiency:

“The X-ray department is our next neighbor, it’s on the same floor, and it’s the same radiological department that serves the entire hospital, so all our patients have to go there and meet with other patients” Medical Officer_SSI_2

“It’s a bit difficult [to get chest X-ray and CT scans] because any patient who needs a chest X-ray or CT scan from the department, in most cases, they are very sick patients. A nurse and with a porter must accompany the patient. It’s a very busy unit.” Consultant_SSI_2

“The process of getting the X-Ray done usually takes time... For a patient who is acutely breathless, we don’t want to waste time when we get to the radiology department.” Medical Officer_SSI_4

“It is the same thing that applies to portable X-Rays. It is used in the entire hospital. We have to wait for it to come all the way from the 8th floor to the ED [ground floor]. That also is a challenge.” Medical Officer_SSI_4

Access to other specialist investigations was also time limited, suggesting an additional benefit from a, focused, less specialist, but more widely available immediate bedside assessment:

Interviewer: “Are there some imaging services that are unavailable during the night?”

Respondent: “Yes, you cannot get an echocardiography during the night.”

Interviewer: “Why is that?”

Respondent: “Because it is done in the clinic 27 [cardiology unit]... it’s only available during the day, weekdays actually.” Medical Officer_SSI_1

Health system level influencers

Barriers

Lack of national protocols and practice guidelines

The clinicians reported that there were no national practice guidelines or protocols to guide care of the acutely breathless patients. Consequently, as reported by some of the clinicians, this led to a lack of coordination and continuity of care:

“... there is no structured protocol that guides care in such a way that if you find a breathless patient, do step 1, step 2, step 3. The steps taken depend on the clinician seeing that patient” Consultant_SSI_1

Relationships and power dynamics

The relationships and power plays between the different medical specialties impacted the capability and motivation of clinicians performing PoCUS:

“... the guys who use the ultrasound are either the radiologists or cardiologists. So sometimes when they see us with the ultrasound machines and they are the ones who control the ultrasounds in the hospital, they

feel like maybe we are taking their jobs. But we always tell them that we are not making diagnosis, we are just making decisions regarding care.... I think the intended purpose here is not to replace them but to augment them.” Consultant_SSI_3

Incorporating PoCUS in the ED would require the involvement of these different specialties to foster collaboration instead of competition.

Lack of PoCUS within the training curriculum

Some clinicians felt that the lack of PoCUS within training curricula reduced adoption and made it difficult for them to teach the resident clinicians:

“From the few ultrasound workshops, I have attended; I don’t think I have seen a consultant from the university’s side, yet they are supposed to be the ones bringing change. We could try and convince the lecturers to attend the training workshops, then maybe they would see the utility of ultrasound.... Sometimes you know you are very right but just because you are not a lecturer or you are not affiliated to a teaching institution, the students actually dismiss you.” Consultant_SSI_3

Opportunities to improve the overall efficiency of the system (facilitators)

Adoption of clinician performed PoCUS

Most clinicians felt that PoCUS performed by the attending clinician at the patient’s bedside would improve diagnostic accuracy:

Interviewer: “Regarding the clinician performing point of care ultrasound in the clinical pathways of acutely breathless patients, what is your perception?”

Respondent: “It’s a game changer. I think it’s something that will really help in enhancing care in terms of coming up with proper diagnosis and the management of patients.” Medical Officer_SSI_3

Some clinicians also felt that PoCUS would allow rapid diagnosis and interventions as an initial diagnostic test in stabilizing an acutely ill patient, complementing other diagnostic modalities:

“... after we have stabilized our patients and the patient is better, then we can go for these other imaging modalities i.e., CT Scan and the rest. Point of care ultrasound from what I have seen, is something that can really help us.” Medical Officer_SSI_4

Many clinicians felt that PoCUS could improve patient safety, through quicker diagnosis and increased diagnostic confidence and efficiency:

“I think we would get improved care because there would be quicker diagnosis at the bedside and therefore, quicker

decisions made towards the patient's care, so I think outcomes of morbidity and mortality would be improved."

Consultant_SSI_1

"I think its beneficial for the patient because it brings together the clinical aspect and the radiological,.... with the added advantage of the ultrasound, you can be sure of your diagnosis and confident about patient's treatment"

Medical Officer_SSI_6

"I think it will impact in a positive way. It will reduce a lot of time wastage. Sometimes you would realize you are waiting for an imaging which was done and you are not getting the report.... Instead of waiting for the radiologist to be reporting on an image, you would rather do them, get the findings immediately and action it."

Medical Officer_SSI_8

Adoption of dedicated radiology services with ready access to a referral chain

Reporting CT scan images takes time and some clinicians reported having difficulties interpreting the images. This resulted in a need to leave their clinical workstations to discuss images with radiological specialists:

"... most of the CT scans are never reported and some of them are hard to interpret. It depends with how proactive you are because then you can walk with the image to the radiology department and then talk to the doctor to give you a report immediately." Medical Officer_SSI_5

Some clinicians felt that having a dedicated radiology service at the ED would help with accessibility issues:

"Maybe having a radiology unit fully dedicated to the emergency department, will help us a lot, as in, completely separating the ED from the rest of the hospital in regard to radiology services" Medical Officer_SSI_4

Adoption of PoCUS by the academic faculty

Incorporation to the medical curriculum was suggested, although this would require careful negotiation of traditional specialisms and existing work patterns:

Interviewer: "Are Doctors usually trained in the use of these machines during their formal training?"

Respondent: "No, there is no ultrasound training in the undergraduate training, there is no ultrasound training in the post graduate training, it is only reserved to those doing radiology. [...] The point of care ultrasound once validated, is something that would be adopted in the medical school curriculum." Consultant_SSI_1

Approval and support of PoCUS by other stakeholders

The reluctance to perform the point of care scans by clinicians was also linked to lack of approval from key stakeholders, including governmental and professional organizations:

"It would need to be adopted by Ministry of Health"

Consultant_SSI_1

"Radiologists would have to approve of the use of ultrasound by other clinicians other than themselves."

Consultant_SSI_1

"We need to work with other professional societies; The Emergency Medicine Kenya, Critical Society of Kenya, Kenya Society of Anesthesia, Renal Physicians. If we approach it that way, maybe we can have a little more penetration and acceptance." Consultant_SSI_3

Research and audits

Validation studies would help in the uptake of new diagnostics like POCUS for breathless patients:

"It needs proper evidence, preferably randomized control studies or at least quality improvement audits to show that it makes a difference." Consultant_SSI_1

DISCUSSION

We set out to explore the experience of clinician performed PoCUS used in the ED of a Kenyan teaching hospital, and to understand the facilitators and constraints of incorporating PoCUS into patient investigation pathways. We found that the clinicians viewed the use of a clinician performed PoCUS integrated approach as beneficial, but at individual level, lack of training, as well as beliefs and fears impacted their capability as well as motivation to perform a bedside ultrasound. Hospital level influencers such as hospital norms, workloads, and staffing in limited resource settings affected how individual clinicians attempts to perform the bedside ultrasound in acutely breathless patients by impacting on their capability, motivation and opportunity. General health system weaknesses such as relationships and power dynamics between the various specialties and cadres of medicine and lack of practice guidelines challenged the uptake of the bedside ultrasound by the clinicians. Opportunities to improve the overall efficiency were suggested in the adoption of dedicated radiology services with easy access to a referral system. The referral chain could consist of health workers with radiology training or certified levels of competencies. In addition, integration of PoCUS into academia (residency programs) with support and approval from key stakeholders including governmental and professional organizations could provide essential skills that are required to be a proficient and competent POCUS user.

Describing the clinical care pathway of acutely breathless patients, deepened our understanding of the patient flow, including location of radiological services, timing, and manner of service delivery, and targets for improvement. Lack of available of resources and staffing issues are persistent challenges in low-resource settings, and these

hinder adoption of new policies and health interventions. If investment was made in training and equipment, participants were optimistic that this could be positive impacts on patient care. We observed challenges in getting basic images like CXRs promptly in breathless patients who were on oxygen and this ended up frustrating both clinicians and patients. Poor accessibility to the imaging services has been recognized elsewhere as an impediment to quality of care given to patients^[31] and simple care redesign strategies can improve patient flows using existing capacity efficiently, leading to improved physical opportunities to perform bedside POCUS. Conceptually, access to health care has been described using the pillars of availability, acceptability, and affordability. However, acute care of breathless patients requires acknowledgment of time dependent appropriate clinical care and thus PoCUS may have a role to play.

We described challenges to the adoption in PoCUS in clinical care within an ED. Our results are similar to those of Shah *et al.* and Shrestha *et al.* done in low resource settings which reported similar significant barriers in the use of ultrasound, including lack of training, machine malfunction, and inability to perform maintenance on existing machines.^[32,33] This highlights the need for context-specific ultrasound protocols suited to the needs and available resources in LMIC settings. As with all training courses, the curriculum should delineate the appropriate use of POCUS and help trainees to recognize device limitations with emphasis on the incorporation of the findings into the clinical context of the patient at hand.^[20] Trainings should also be embedded within an accreditation model to ensure consistency and upholding of the set standards. Overuse of ultrasound especially for commercial gains is a real threat to PoCUS adoption and this can lead to many unnecessary scans could be performed when not indicated, mainly for financial gain.^[34]

In high volume EDs in settings with limited human and financial resources, the clinician's time may have competing demands. Therefore, the adoption of clinician performed PoCUS may not be plausible due to clinician's time pressure. A study in Malawi demonstrated that clinical officers were able to improve their diagnosis of cardiac conditions using a simplified screening PoCUS protocol after 5 days training.^[17] Similarly, nurses in Rwanda were able to accurately diagnose different causes of heart failure and provide care for heart failure patients using a simplified echocardiography protocol.^[35] These studies demonstrate viable alternatives to clinician performed PoCUS in resource limited settings. In addition, bedside PoCUS is not a replacement of an expert performed ultrasound and difficult cases should be referred to the experts. Health systems in LMIC, including Kenya, need to support early diagnostics for any successful acute care strategy. This involves having standardized diagnostic and treatment protocols, stable drug supply, ready access to

referral chains and political commitment to ensure adequate budgetary allocation.^[35]

Our study had several strengths. We employed various strategies to ensure rigor, including purposive selection of participants to allow comparison between cadres and get a wide range of perspectives; triangulation of findings from interviews; regular meetings; and reflections of the research team to improve the quality of data collection and develop shared understanding during data collection and analysis. In addition, there were also limitations to our study. These include the use of a purposive sample which did not include other specialist clinicians who routinely use the traditional ultrasound for diagnostics: The radiologists and cardiologists. This means that our results may not fully reflect the range of views and experiences of these specialist clinicians. There was additional disruption caused by the COVID 19 pandemic during the last quarter of the study period^[36] which influenced who was available to interview.

CONCLUSION

Lack of PoCUS training for clinicians, limited resources and a fragmented health system structure impacted the clinician's capability, motivation, and opportunity in performing PoCUS in diagnostics. PoCUS for diagnosis of acute breathlessness requires: (1) Well-maintained and accessible equipment; (2) highly trained individuals with time to perform the examination; and (3) strong evidence of benefit. First, health planners should consider and provide for the resource and health systems impacts. Second, medical educators should design realistic training packages which provide ongoing support the operators. Finally, researchers must more accurately identify the optimal scope of ultrasound examination, the diagnostic benefits, and the opportunity costs. All three will be required to ensure patients benefit.

Acknowledgments

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Availability of data materials

The datasets (interview transcripts and observation notes) generated and analyzed in this study are not publicly available due to maintaining confidentiality of the study participants but are available from the corresponding author on reasonable request.

Declaration of patient consent

Institutional Review Board (IRB) permission obtained for the study.

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Conflicts of interest

There are no conflicts of interest.

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