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EDITORIAL

Point-of-care ultrasound training and education in low- and middle-income countries

Anant Vikram Pachisia, M.B.B.S., M.D., F.N.B., Deepak Govil, M.D., E.D.I.C., F.C.C.M.
Medanta Institute of Critical Care and Anaesthesiology, Medanta – The Medicity, Sector- 38, Gurgaon, Haryana – 122001, India.

Corresponding author:
Dr. Deepak Govil
M.D., E.D.I.C., F.C.C.M.
Vice Chairman – Critical Care Medicine
Medanta Institute of Critical Care and Anaesthesiology, Medanta – The Medicity, Sector- 38, Gurgaon, Haryana - 122001
Mobile No: +919818056688
ORCID ID: 0000-0002-4624-1614
Email ID: drdeepak_govil@yahoo.co.in

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Over the past two decades, there has been a remarkable increase in the adoption of point-of-care ultrasound (POCUS) in Intensive Care Units (ICUs) globally. This growing acceptance and widespread use of POCUS can be attributed to its ease of replication, non-invasive nature, cost-effectiveness, and relatively short learning curve. POCUS is intended not to replace the traditional clinical examination but rather to complement it. The role of POCUS is not limited to diagnosis; it is also used in resuscitation-deresuscitation and various therapeutic procedures. POCUS is used primarily to elucidate the etiology of deranged physiology, provide real-time insight into response to resuscitation, re-evaluate and thus to titrate management. It is mainly a semi-quantitative, qualitative and repetitive assessment. In up to 50% of cases, POCUS can help confirm a provisional clinical diagnosis, and in 23% of cases, it can verify a modification in the initial diagnosis.[1] In a recently conducted survey of medical schools in Europe, 31% of medical schools from 13 European countries already have an undergraduate POCUS curriculum, and 27.6% from 12 European countries plan to start it.[2] While POCUS has great potential to improve healthcare in low- and middle-income countries (LMICs), there are several challenges associated with its training and implementation.

THE PROBLEM

POCUS differs from conventional ultrasonography (USG) in that, while USG is typically performed by a radiologist who is not directly involved in patient care, POCUS is conducted by the clinician at the bedside, who is actively engaged in the patient's management.[3] As a result, both image acquisition and interpretation fall directly under the clinician's responsibility, making training in these skills critically important. In a recently conducted survey on POCUS practices across India, we found that only 57.7% of 864 respondents had formal POCUS training or had attended a workshop. To address the challenges of POCUS training in LMICs, it is crucial to first identify the specific obstacles that hinder its implementation and effectiveness:[4-10]

- Limited access to equipment
- Lack of expertise and training infrastructure
- Time and staffing constraints
- Financial barriers

Limited access to equipment:

Setting up a new POCUS program or POCUS infrastructure in an existing healthcare facility will require investment in a new POCUS machine. In a survey on the use of USG in LMICs, the top barrier in performing POCUS was access to USG machines along with the cost of USG machines, probes

and equipment.[11] In a survey by Shrestha et al. in Nepal, they found that the majority of respondents had limited access to the USG machine.[12]

Lack of expertise and training infrastructure:

The survey by Ginsburg et al. also found that in LMIC, 44% of respondents were self-taught, while 22% received no training or education on POCUS.[11] In our survey across India, 4.9% were self-taught, and 37.4% had some form of training during their critical care medicine training. The POCUS curriculum was created and implemented in the US and Canada in 1994 to train emergency physicians.[13] The first set of emergency ultrasonography guidelines was also released by the American College of Emergency Physicians (ACEP) in 2001.[14] The Indian Society of Critical Care Medicine (ISCCM) published its first guidelines on POCUS in 2022.[15] The majority of countries in Southeast Asia still do not have their guidelines on POCUS training and its use.

Time and staffing constraints:

In resource-constrained settings, healthcare workers are often overburdened with patient loads, making it difficult to allocate time for POCUS training. Additionally, some regions may struggle with staff shortages, leaving few opportunities for specialized learning.[12]

Financial barrier:

While procuring a USG machine is already an issue, the cost of maintaining and procuring spares for them is also prohibitive. With a structured curriculum on POCUS training during undergraduate and postgraduate studies missing in most LMICs, the cost of training and certification of physicians is mostly borne by the healthcare providers themselves, with no financial support from most institutes.

Certain obstacles to POCUS training are unique to low- and middle-income countries (LMICs), such as frequent power outages, which can disrupt both training sessions and the use of ultrasound equipment.[16]

Hence, an overburdened healthcare system, grappling with a staff shortage and complicated by the high cost of equipment procurement and training, has made the widespread adoption of POCUS in LMICs a significant challenge. To guarantee proper application, interpretation, and expertise, providers must be aware of their limitations and engage in continuing professional development.[17-20]

THE SOLUTION

Van Hoving et al., in their analysis of the POCUS curriculum in South Africa, where the curriculum is similar to the United Kingdom, found a mismatch between the current curriculum and the disease burden in the country.[21] To decide which applications should be included in any prospective curriculum, Henwood et al. stressed the significance of conducting a needs assessment with stakeholders at various levels.[22] It is obvious that any curriculum on the POCUS training for healthcare professionals has to be tailored to domestic needs and resources. Oto et al. have warned against self-directed learning in POCUS as it has the potential for unrecognized errors. They recommend that early POCUS training should have three components: didactic training, hands-on practice and monitoring. They were also of the opinion that external certification in POCUS credentialing is unnecessary if the assessment of competence can be done at the local level.[23] It is recommended that in any POCUS workshop, learner: instructor ratio should not exceed 4:1.[24] These recommendations are again from high-income group countries. In the context of LMICs, a slightly higher ratio may be acceptable at places with a limited number of instructors. There are various methods of POCUS training. These education methods have their own merits and demerits. In-person patient scanning offers real-time feedback and exposes students to actual pathology; it is resource-intensive, dependent on the presence of pathology, and restricted by faculty availability. Standardised patient scanning does not offer actual pathology experience, but it does provide consistent monitoring and feedback. Although they can be prohibitive for LMICs, simulation mannequins help students learn and enhance comprehension of complex POCUS techniques like cardiac assessment. In contrast to recorded lectures and textbooks, which are available to a wider audience but lack customisation for individual learning needs, live lectures may accommodate a reasonable number of students but do not foster hands-on skills.[24] The ideal training method must be adaptable, depending on the available resources. South Asian countries with similar cultural sensibilities can help each other in achieving the goal of improved access to technology and training through inter-society partnerships and fellowships.

An investment is required to purchase USG machines, spares and consumables. USG machines can cost anywhere from USD 40,000 to USD 130,000. This can be exorbitant for LMICs, where many struggle for basic health care and hence a major roadblock in accessibility to a USG machine for POCUS. This challenge may be overcome by the use of hand-held POCUS devices. These devices can be wireless, and the cost is about one-tenth of the conventional USG machine. This will not only help in easier availability but also more accessibility in far-flung areas, natural calamities and war zones.[25] Artificial Intelligence (AI) integration in POCUS offers a promising chance to get over current obstacles and expand applications in low- and middle-income nations. It is challenging to diagnose illnesses using POCUS in low-resource settings because of the lack of medical certification and training.[26] By combining machine learning techniques with general ultrasound for pathology identification, feature extraction, and illness diagnosis, AI can significantly improve diagnoses.[27,28] Another area that holds promise and may help overcome the barrier of lack of trained manpower is tele-ultrasound. The new handheld devices have reduced the barrier to equipment availability, but the barrier to adequate training and expertise remains. Various studies have shown that tele-ultrasound has helped in diagnosing a variety of

pathologies in remote, rural areas.[29-31] Apart from its role in diagnosis, it can provide a great teaching tool to improve overall patient outcomes in LMICs.[32] With travel grants being limited, tele-ultrasound can play a crucial role in developing skilled local operators in LMICs by providing remote training and support.

CONCLUSION

The increasing adoption of POCUS presents a transformative opportunity for healthcare in LMICs, offering benefits in diagnosis, resuscitation, and therapeutic procedures. However, its widespread implementation faces significant barriers, including limited access to equipment, lack of structured training, time and staffing constraints, and financial challenges. The high costs of ultrasound machines and training, along with the scarcity of skilled instructors, complicate efforts to integrate POCUS into routine clinical practice. Tailored, context-specific training curricula, based on local disease burdens and resources, are essential to meet the unique needs of healthcare providers in LMICs. Collaborations between countries with similar cultural and healthcare settings, along with the involvement of their critical care societies, can help bridge gaps in training and equipment availability. Solutions such as handheld ultrasound devices, tele-ultrasound, and AI offer promising avenues to overcome the challenges, improving accessibility and enabling remote learning. While the challenges remain substantial, a concerted, multi-faceted approach that includes investment in affordable technology, remote training, and region-specific curricula can help unlock the full potential of POCUS in LMICs, leading to better healthcare delivery and improved clinical outcomes.

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