ORIGINAL RESEARCH

# Assessing the Competence of Junior Doctors in performing Point-of-Care Ultrasound Scan and identifying the barriers in training

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## Abstract

### Introduction

Point-of-care ultrasound (POCUS) has lately become an integral tool in healthcare due to its enhanced turnaround time and outstanding accuracy. Through development of improved quality handheld ultrasound devices, numerous countries have progressed to using POCUS as an adjunct to clinical examination. Effective use depends on the user's abilities, and junior doctors often portray inadequate ultrasound scan competence. We investigated the status quo to further understand the deficiencies in contrast to gold standard radiological care in emergency settings across LMICs.

### Methods

A validated questionnaire was distributed to junior doctors working in clinical roles in 28 countries to determine the self-reported competence, perceptions regarding POCUS, and its applicability to their practice of medicine.

### Results

A total of 407 junior doctors participated (males: 198, females: 209, aged 22-38 years). 63% participants had never heard of POCUS and less than 15% participants received ultrasound training in medical school or internship. The greatest self-reported competence was in positioning the patient (65%) in contrast to visualizing the target area being the least competent (16%). Knowledge and competence of use of POCUS remained generally low in the participants. The greatest applicability-competence gap was for the assessment of abscess/cellulitis (41% see it regularly, but only 30% are competent in diagnosing using POCUS). 97% of the 407 participants believed that POCUS is an essential skill for their medical practice.

### Conclusion

Despite the strong applicability and demand for POCUS, significant challenges in competence exist. Respondents to our study strongly believed that medical students and junior doctors should undergo formal training. The greatest barrier to POCUS training however, remains the lack of resources (equipment, infrastructure).

**Keywords:** Radiology, LMICs, POCUS, Healthcare Technology, Global Health.



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## Introduction

Point-of-care ultrasound (POCUS) in the current age has become an integral diagnostic and interventional tool within the scope of healthcare[1]. It enhances the turnaround time for physicians to quickly answer specific clinical questions at the bedside with an outstanding diagnostic accuracy[2].

Over the last decade there has been increased usage of POCUS as an adjunct to clinical examinations in a number of countries[3]. An increasing base of evidence has also demonstrated its utility in improving outcomes of emergency thoracic and abdominal procedures such as thoracentesis and paracentesis[4]. This supportive evidence coupled with the development of improved quality, portable handheld ultrasound devices have aided the increased use of POCUS. The lack of ionizing radiation and being non-invasive in nature have made ultrasound a first-line imaging modality for a broad range of indications[5].

While standard ultrasonography conducted by radiologists is a comprehensive examination designed to completely investigate the region of interest, POCUS performed at the bedside is designed to address and detect critical specific issues (e.g. pericardial effusion, ectopic pregnancies, pneumothorax, ascites, etc)[5]. In the United States, emergency doctors were the first to demonstrate that POCUS significantly enhanced the identification of life threatening conditions[6].

However, the effective use of POCUS is largely dependent on the user's abilities and is operator-dependent, which is one of the most significant barriers to doctors' widespread adoption of bedside ultrasonography[7]. POCUS involves a complex set of skills, including image acquisition, image interpretation, and integration of findings that require consideration of the patient's clinical context and pre-test probability[8]. To properly utilize POCUS, the trainee must have adequate medical and sonographic knowledge of probable differential diagnoses, as well as awareness and insight into the limitations of both POCUS use in general and one's own competence limitations[9]. An increasing amount of research suggests that specific training is required to achieve POCUS competency[10] and that training may reduce the risk of injury from typical POCUS blunders[11]. POCUS education must be promoted and thus focus on skills and knowledge deficiencies[8].

Health facilities, especially in the Low to Middle Income Countries (LMICs) are at the receiving end of socioeconomic inequalities and are known to experience significant resource limitations. Due to resource limitations in LMICs, procurement and use of medical equipment is a challenge. A number of LMICs acquire the majority of their medical equipment as donations[12]. The World Health Organization (WHO) postulates that due to factors such as space unavailability and lack of personnel training about 80% of acquired medical devices in LMICs are not in use[12].

The purpose of our study was to assess self-reported competence of junior doctors to perform POCUS examination in their routine medical practice for detection of disease conditions and identify the barriers to enhanced training in POCUS. Broadly, we wanted to evaluate self-reported competence of junior doctors to perform POCUS. Specifically, we wanted to assess the knowledge of POCUS in junior doctors; to assess the competence in use of POCUS by junior doctors; and to identify the barriers in training for POCUS skills.

## Methodology

### *Design*

This was a descriptive cross sectional survey that was performed amongst junior medical doctors in active clinical roles from 28 countries. Convenience sampling technique was employed. These countries were also listed as LMICs as defined by the World Bank.17 These countries included Burkina Faso, Cameroon, Ivory Coast, Ethiopia, The Gambia, Georgia, Ghana, Guinea, India, Indonesia, Iraq, Kenya, Malawi, Mali, Morocco, Nepal, Niger, Nigeria, Pakistan, Rwanda, Sierra Leone, South Africa, Sri Lanka, Sudan, Tanzania, Uganda, Zambia, and Zimbabwe.By definition, a junior doctor was one who had completed their undergraduate medical training but not yet started residency (specialist) training. These included those currently doing internships or working in primary health care roles. Junior doctors were chosen because in most settings they are responsible as first contact physicians for patients including during emergencies. [A junior doctor is considered to be any medical graduate who is practicing medicine but has not yet taken any speciality qualifications. This may include interns, medical officers and registrars]. The study was conducted between January to March 2022. Our sample size was calculated using $n=Z2\ P(1-P)/d2$ where $Z=1.96$; P assumed at 50%; d=5% at 95% confidence interval. Since this was an online study, we assumed a non-response rate of 20% and had a target sample size of 460.

### *Data collection tool development*

A review of studies detailing the uses of POCUS and the skills necessary for its safe use was conducted. The investigators used this information to create a questionnaire to assess junior doctors' perspectives of POCUS. After development, the tool was conveniently pilot tested amongst 30 junior doctors and their responses (to the questions) as well as their recommendations (on how the questions were framed) were used to improve the tool.

The survey instrument contained five sections. The first section requested demographic data (i.e., age, gender, etc.). The second section included questions on training, accreditation, and the use of POCUS. The third section asked participants to self-report their knowledge of the principles of ultrasound relevant to POCUS. This section was designed in contrast to the ultrasound competency assessment tool. The fourth section investigated the applicability of 13 diagnostic indications for POCUS. For each diagnostic application, participants were asked about their ability to perform POCUS (i.e., self-reported proficiency in each of the 13 indications for POCUS). The fifth section asked junior doctors to reflect on their attitudes towards training in POCUS and the barriers to training. After development of the tool it was piloted and amended as suggested before use.

### *Data collection*

The self administered questionnaire was sent to junior doctors via a link to an online form (Google Forms; Google, LLC, Mountain View, CA) in February 2022. The data collection tool requested written informed consent before a participant starts filling in their responses. No incentives were provided to the participants. To ensure high data quality only those junior doctors who at the time of data collection worked in clinical roles were allowed to participate. Unique identification number was automatically assigned to each recorded response.

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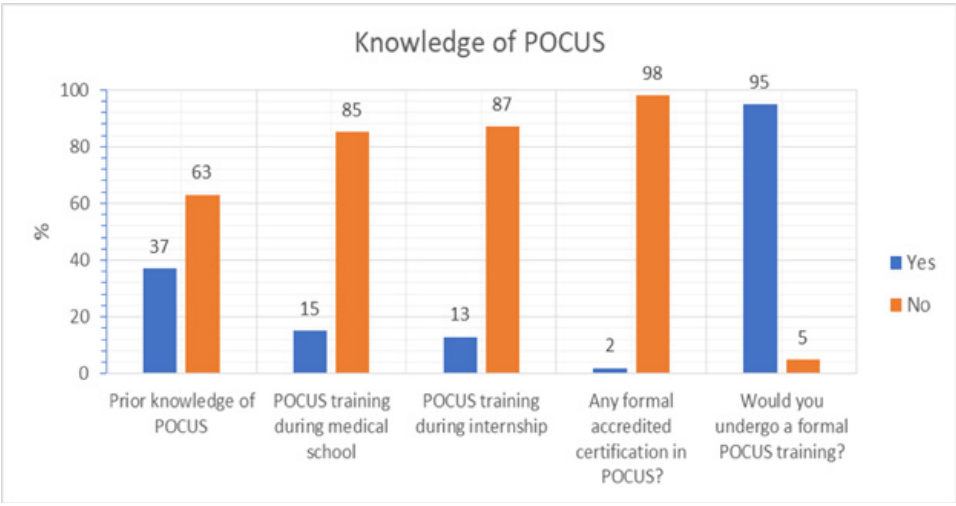


**Figure 1 shows proportions of respondents with prior knowledge and trainings on Point of Care Ultrasound**

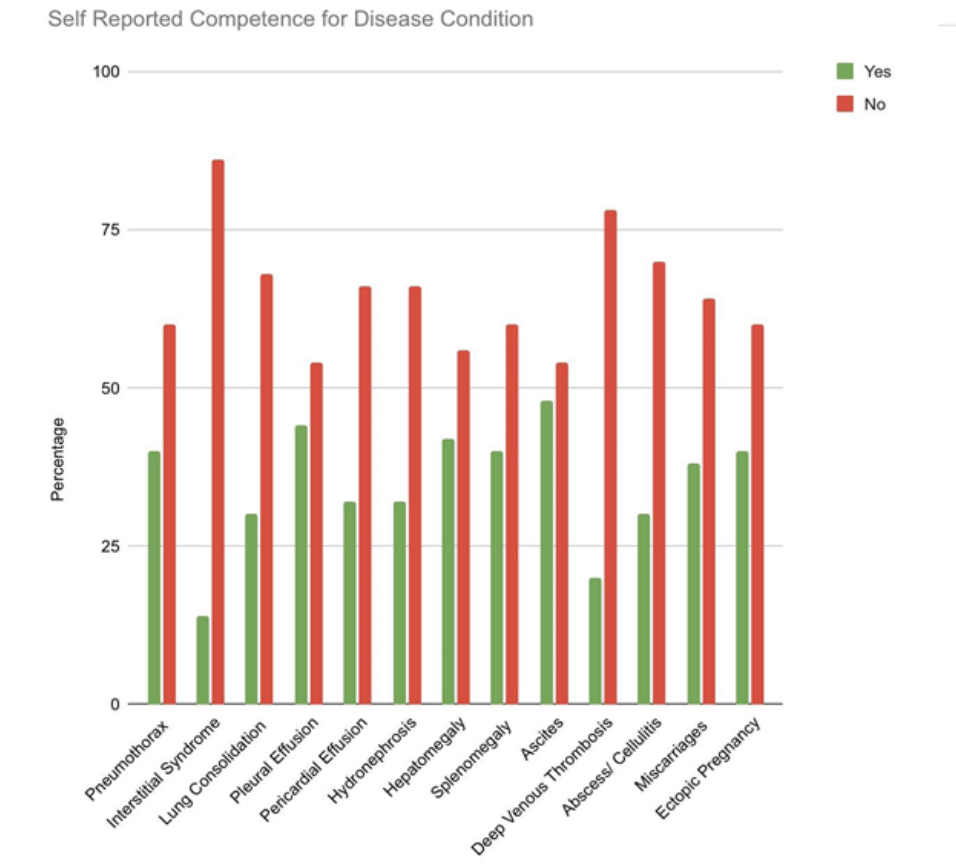


**Figure 2 shows self-reported competence on usage of Point-of-care Ultrasound scan for diagnosis**

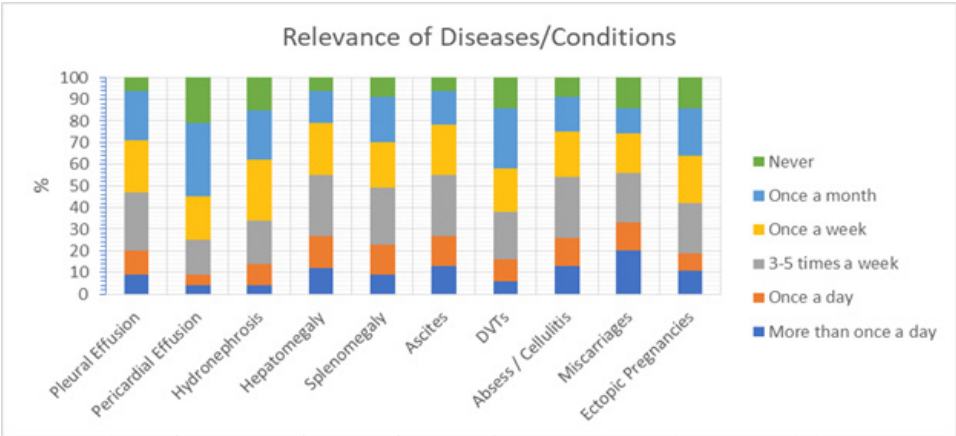


**Figure 3 shows frequency of usage of Point-of-care Ultrasound uses to aid diagnoses**

Data was stored securely online and offline with the investigator's personal work systems and accessible by only the investigators.

### *Data management and analyses*

Unique identification number was automatically assigned to each recorded response. Data was stored securely online and offline with the investigator's personal work systems and accessible by only the investigators. The data was analyzed using excel to calculate proportions and produce different graphs.

## Ethical considerations

A written informed consent was obtained from all participants prior to the response collection to the survey. No incentive was provided to the participants. This study posed no physical risk to participants. . The names and any identifier details of the participants were not asked to protect the privacy of the participant. The data collected was password-protected, and all documents were stored in a password-protected folder to which only the researchers had access.

## Results

### *Demographic characteristics of participants*

A total of 407 junior doctors responded to the online-questionnaire that was sent. Of the respondents, 208 were females, 196 were males, and 3 participants preferred not to state their gender. The mean age of the respondents was 29. The majority had just completed their medical training within the past year prior to when they responded to the questionnaire. There was skewed geographical representation with the majority of participants coming from Africa mainly southern and east Africa. A few respondents were from Asia and Latin America.

### *Knowledge on POCUS and need for training*

Only 37% of participants reported to have had prior knowledge of POCUS by the time they responded to the questionnaire. Above 85% of the respondents did not have training on POCUS in medical school, during internship or any formal certification. Above 95% reported that they would need to undergo a formal training in POCUS (see figure 1)

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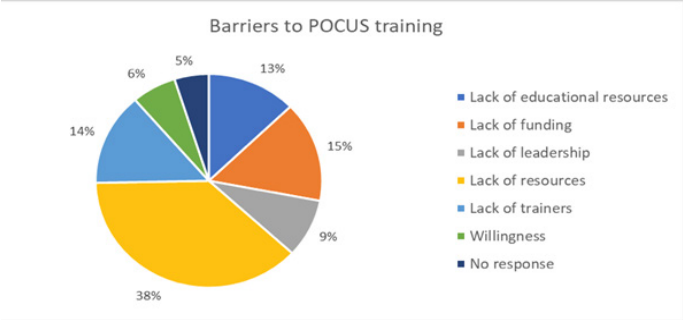


**Figure 4 shows barriers to POCUS training**

### *Reported self-competence in disease diagnosis using POCUS*

Amongst those that reported prior knowledge on POCUS less than 50% reported to have been able to use POCUS for making diagnoses for a listed number of conditions with interstitial syndrome and DVTs being the least (12% and 20%). The rest ranged between 30% to 45% (see figure 2).

### *Frequency of which POCUS is used to aid in diagnosis*

It was reported that POCUS is used at least once a week, more than 60% of the time to aid different diagnoses. Only in pericardial effusion that it was reported to be used more frequently in about 40%. 30% of the time is used once a month and 20% never used. Important to note that miscarriages are the reasons for the most frequent usage of POCUS 20% reported usage more than once a day (see figure 3)

### *Barriers to POCUS training*

Lack of resources was the commonest reported reason as a barrier to attaining formal training in POCUS (30%). Other barriers reported include lack of funding, trainers, educational resources, and leadership (see figure 4).

## Discussion

POCUS remains a reliable addition to diagnostic services, especially for use in emergency bedside investigations[2]. However, there remains a huge shortfall in the training as well as implementation of POCUS services into daily clinical practice, especially in the LMICs[13]. Particularly in some parts of LMICs, POCUS remains an abstract and non-existent concept. We conducted a cross-sectional study amongst junior doctors to examine self-reported competence on usage of POCUS. Our findings show that most of the junior doctors have limited knowledge and skills on POCUS usage in clinical settings; have minimal diagnostic capacity (if any) where POCUS was used to aid diagnosis; and that lack of resources and funding remains one of the critical factors contributing to this scenario.

Our findings are similar to what other studies have found including in well resourced countries. One review that focussed on low and middle income countries reported limited knowledge and skills on usage of POCUS in most low-income settings (Tran, et al paper). Another study further highlighted a need to formally train family physicians for optimal usage of POCUS to aid diagnosis in a developed country meaning that even in such settings POCUS use remains suboptimal (Homar, et al paper). However, unlike our study where lack of resources was mentioned as the most common factor, the preceding study reported lack of continuous education as one key barrier to POCUS use (Tran, et al paper). This could be due to the difference in study population. Unlike the preceding study which was a review, our study focussed on junior doctors who most had just completed undergraduate education and limited experience. Since they were in active practice then, they might have been conditioned to think if they had the resources they would have gotten the training. Other reported barriers in other studies include supply constraints, and high cost of training (Matiang'i et al; Hoving, et al) which were not directly mentioned in our study.

Nonetheless, POCUS is a relatively new concept and has not gained much popularity due to the nature of practice in LMICs which emphasizes the importance of physical examination for adequate diagnosis. Our results, probably, speak to lack of pre-service training as one key contributing factor which is further worsened by limited on job training. Most junior doctors do not get POCUS training in school. Likely, such training is not included in their curriculum and hence the current situation. However, the health systems do not even utilize the internship period to provide on-job training on POCUS. This could indeed be an incredibly huge opportunity to build capacity on POCUS when these junior doctors no longer have examination pressures. Therefore, the first step to curb the lack of knowledge is to increase awareness, emphasizing the importance of POCUS in making fast, reliable and adequate diagnosis. Most importantly, training institutions would do well to introduce POCUS concepts in their pre-service curriculum with emphasis on practical and diagnostic skills. The training institutions are better positioned to impart these skills as they usually have access to training resources than health systems (Blans, et al paper). To supplement this, health systems should consider building on the pre-service training to cement skills in POCUS through continuous personal development sessions during medical internship for newly qualified doctors (Jawrwan, et al paper). Furthermore, health systems should continuously mobilize resources to make instruments and supplies available sustainably. Commitment from Ministries of Health and development partners would be critical to ensure this comes to fruition.

The key limitations for our study is that we did not capture opinions from pre-service training institutions or the hospitals where these junior doctors do clinical internships. These would be integral to understanding any efforts and areas requiring support.

Key strength of our study is that it targeted the "would be" primarily users of POCUS in LMICs who are junior doctors and usually first point of contact for patients including in emergencies whose feedback is critical.

## Conclusion

There is limited knowledge and skill on usage of POCUS amongst junior doctors in LMICs. Resources are a critical challenge to accessing POCUS training. Pre-service training institutions and health systems need to invest in training medical students while in school and cementing on the same during clinical internship.

## Knowledge of POCUS

About only a quarter of the respondents reported having some knowledge about POCUS with minimal training from medical school and on job training during clinical internship. POCUS is a relatively new concept and has not gained much popularity due to the nature of practice in LMICs

which emphasizes the importance of physical examination for adequate diagnosis. Therefore, the first step to curb the lack of knowledge is to increase awareness, emphasizing the importance of POCUS in making fast, reliable and adequate diagnosis.

## Self reported confidence for disease conditions

Despite some knowledge reported by the participants, less than half were able to confidently make diagnosis of certain disease conditions with interstitial disease and DVT being the less likely. Confidence of the participants was reported most in other abdominal diseases: ascites and hepatomegaly, being the diagnosis participants were most confident about using POCUS to diagnose.

The knowledge of POCUS and self-reported confidence helps draw parallels that justify the need for formal training in POCUS in the study group and largely junior doctors in LMICs. While only 37% of the participants knew about POCUS, only 30-40% of those with knowledge were able to use it to diagnose diseases. Amongst those participants were most confident about ascites and hepatomegaly which can equally be diagnosed on physical examination.

## Relevance of Disease Conditions

The participants reported that 60% of the time POCUS was used once a week in the diagnosis of diseases. It was also reported that POCUS was most frequently used in diagnosing miscarriages while being used more than once a day and pericardial effusion being diagnosed using POCUS at least once a month.

With little knowledge and low self reported confidence, it is no surprise the low frequency in using POCUS to diagnose the diseases. Again this justifies the urgent need for formal training in POCUS which would increase awareness, increase confidence in and frequency for which POCUS is used.

## Barrier to Pocus

The commonest barrier stated was the general lack of resources to carry out POCUS.To tackle this there's the need for relevant stakeholders to invest where necessary to provide these resources including equipment and other facilities to facilitate the implementation of POCUS. It is important that the provision of these resources are extended to include funding of educational resources and general funding for individuals to attain formal training. These will go a long way to improve the number of trainers and the willingness of others which were also reported barriers of the study.

## Conclusion

This in depth study into the competence of junior doctors in LMIC to perform POCUS has highlighted little knowledge is relatively available to junior doctors and its effect on reduced competence in using POCUS to make diagnosis. It further sheds light on how POCUS is not an integral part of making daily diagnosis as well as the endless number of barriers to POCUS training.

In Spite of being an integral healthcare tool especially in emergency procedures like thoracentesis and paracentesis as well as its diagnosis ability for conditions like pneumothorax, pleural effusion, hepatomegaly etc along with being non invasive, it was found that POCUS training had a few barriers with lack of resources being the most common limitation.

In the process of collecting data on POCUS use and training where 443 junior doctors from 28 LMICs were targeted, 407 junior doctors responded to a questionnaire that collected demographic data , training, accreditation and use of POCUS, self reporting their knowledge on principle of POCUS, applicability of 13 diagnostic indications for POCUS and lastly the junior doctors were asked to reflect their attitude towards POCUS training and barriers to training. It was not at all surprising that 85% did not have any formal training on POCUS in medical schools; however 95% reported that they would need to undergo a POCUS training. The interesting thing was that POCUS was used at least once a week more than 60% of the time to aid for differential diagnosis.

It can be safely concluded that a tool as useful and interesting as POCUS is a great asset and a lot in demand in the medical world however it faces a bunch of barriers like lack of resources being the most common at 35-40% ,lack of funding, trainers, educational resources, leadership and of course lack of willingness. As obvious as it is that Training junior doctors in LMICs in POCUS is an important task yet to be achieved, it can also not be ignored that most of these countries lack resources and majority of their medical equipment are acquired through donations making this a challenging yet an important task.

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