Original Article

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Radiology Section

Current Utilisation and Challenges of Point-of-Care Ultrasound in Emergency Department Settings of Saudi Arabia: A Mixed Method Study

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ABSTRACT

Introduction: Point-of-care Ultrasound (POCUS) has transformed emergency medicine by providing immediate, non invasive diagnostic imaging directly at the patient's bedside. In Saudi Arabia, the adoption of POCUS has been gradual, with emergency physicians and trainees facing unique challenges in its implementation.

Aim: To assess the current practices of POCUS utilisation in Saudi Arabia, identify the key challenges encountered by emergency physicians and trainees, and suggest effective strategies to address these obstacles.

Materials and Methods: A mixed-methods approach was conducted from May to July 2025 among emergency physicians and trainees across multiple government and private hospitals in Saudi Arabia. A total of 387 participants were included. Data were collected using a self-developed questionnaire designed to capture participant demographics, POCUS training, usage patterns, and perceived barriers. The questionnaire was distributed through professional networks and hospital administrations. Staff members and other healthcare professionals were excluded from participation. Chi-square tests followed by multivariable regression analysis were used to perform the statistical analysis, and a p-value<0.05 was considered statistically significant. Thematic analysis was performed for qualitative data to identify recurring themes and patterns.

Results: Regarding POCUS training and competence, 356 participants (91.99%) reported having received formal POCUS training. Among them, 115 (32.30%) indicated participation in various POCUS workshops. Of those trained, 314 (81.14%) expressed satisfaction with their training in terms of clinical application. In terms of utilisation patterns, 176 participants (45.48%) stated that they use POCUS at least once a month. The majority, 307 (79.33%), reported using POCUS most frequently for evaluating abdominal pain, followed by cases of respiratory distress. Out of the total 387 participants, lack of training and the absence of standardised protocols were considered the main barriers to POCUS utilisation by 271 (70.03%) and 249 (64.34%) participants, respectively. To improve POCUS utilisation in Saudi Arabia, 386 participants (99.74%) believed that mentorship from experienced POCUS users would be beneficial, 381 (98.45%) highlighted the importance of structured training programs, and 370 (95.61%) believed that the implementation of standardised protocols and guidelines would enhance POCUS utilisation in clinical practice.

Conclusion: High training rates, strong clinician confidence, and recognised patient benefits indicate encouraging progress in the integration of POCUS into clinical practice, particularly within Saudi Arabia's emergency care system.

Keywords: Clinical competence, Diagnostic imaging, Emergency medicine, Patient care management

INTRODUCTION

POCUS has transformed emergency medicine by enabling rapid, non invasive diagnostic evaluations directly at the bedside. Its applications include trauma assessment and cardiac and abdominal evaluations, which significantly reduce diagnostic delays and have been shown to improve patient outcomes [1]. The American College of Emergency Physicians (ACEP) introduced guidelines outlining the core competencies for POCUS use in emergency departments in 2001 [2]. According to these guidelines, the seven core competencies include trauma, pregnancy, abdominal aorta, cardiac, biliary, urinary tract, and procedural applications. In 2009, ACEP expanded these guidelines to include additional competencies such as thoracic imaging, deep vein thrombosis evaluation, ocular assessments, and soft tissue/musculoskeletal examinations [3].

In Saudi Arabia, the adoption of POCUS has been gradual, with emergency physicians and trainees facing unique challenges in its implementation. The integration of POCUS into medical education and clinical practice remains uneven [4]. Studies conducted in Saudi Arabia highlight the growing recognition of POCUS utility while also revealing significant challenges, including limited access to equipment, a lack of trained faculty, and the absence of standardised curricula [5,6]. These findings emphasise the importance of addressing barriers to POCUS integration and underscore the need for context-specific training programs to promote its effective adoption within Saudi healthcare settings.

Globally, there is increasing recognition of the importance of incorporating POCUS training into undergraduate and postgraduate medical education to foster early competence and confidence among future clinicians [7]. Educational strategies such as simulation-based learning, structured workshops, and competency-based assessments have demonstrated effectiveness in enhancing physicians' diagnostic and procedural abilities. In Saudi Arabia, however, the integration of POCUS into medical curricula and residency programs remains inconsistent, resulting in substantial variation in practitioners' proficiency levels [8]. Bridging this gap is essential in achieving standardised competency, improving diagnostic accuracy, and ensuring the safe and effective use of POCUS in emergency settings.

The novelty of the present study lies in its focused and in-depth exploration of physicians' and trainees' perspectives on POCUS utilisation within the unique educational and operational context of Saudi Arabian emergency departments. Unlike previous studies that primarily addressed general barriers, this research provides a detailed understanding of prevailing practices, perceived competencies, and the day-to-day challenges encountered by practitioners. By capturing direct, context-specific feedback, the study offers critical insights for developing targeted interventions, including customised curricula and optimised resource allocation, to promote sustainable and effective POCUS adoption across the Kingdom.

Ultimately, this comprehensive, user-centred assessment aims to ensure that POCUS integration within Saudi emergency care is both practical and enduring, thereby contributing to improved patient outcomes nationwide. Therefore, this study seeks to evaluate prevailing practices in POCUS utilisation, identify challenges faced by emergency physicians and trainees in Saudi Arabia, and propose strategies to overcome these barriers.

MATERIALS AND METHODS

A mixed-methods approach was conducted from May to July 2025 among emergency physicians and trainees across multiple government and private hospitals in Saudi Arabia. Ethical approval was obtained from the Bioethics Committee of Northern Border University, Arar, under protocol number 47/25/H, and informed consent was obtained from all participants.

Inclusion criteria: Consultants and postgraduate trainees from emergency medicine departments across various hospitals in Saudi Arabia.

Exclusion criteria: Individuals without experience in emergency medicine, staff members and other healthcare professionals were excluded from the study.

Sample size: The sample size (N=384) was calculated using the OpenEpi sample size calculator at a 95% confidence interval with 50% population proportion [9].

Sample size n={DEFF*Np(1-p)}/ {(d^2/z^2 1-a/2*(N-1)+p*(1-p)}

Population size (for finite population correction factor): 1,000,000.

Study Procedure

Initially, a cross-sectional survey was conducted among emergency physicians and trainees across multiple hospitals in Saudi Arabia. Data were collected using a self-developed questionnaire designed to assess participant demographics (age, gender, nationality, job location, region, and educational status), POCUS training, utilisation patterns, and perceived barriers.

The questionnaire was originally developed in English by two Associate Professors from the Department of Surgery, each with over 20 years of academic and clinical experience in medical education and emergency medicine. It was subsequently reviewed and validated by the Director of the Emergency Department at North Tower Hospital, Arar, Saudi Arabia. The questionnaire design was guided by a review of relevant literature on ultrasound education and training needs among medical professionals to ensure content validity.

The questionnaire consisted of several sections: demographic details; current practices and competencies (four questions); POCUS utilisation patterns (three questions); barriers to POCUS adoption (four questions); and suggestions for improvement (two questions). The final section included three open-ended questions exploring participants' perspectives on enhancing POCUS training, addressing workflow challenges, and integrating POCUS into the medical curriculum.

The questionnaire was disseminated through professional networks and hospital administrations. For the qualitative component, reflexive thematic analysis [10] was conducted to explore participants' perspectives on POCUS integration into emergency care. Three open-ended questions guided the qualitative inquiry:

1. What suggestions do you have to improve POCUS integration into emergency care in Saudi Arabia?
2. What challenges do you face when trying to incorporate POCUS into your daily workflow in the emergency department?
3. How do you think POCUS can be better integrated into the emergency medicine curriculum for trainees in Saudi Arabia?

All authors independently reviewed and coded the responses. Coding was performed manually and supported by NVivo version 12 software to organise and visualise the data. An inductive approach was employed, beginning with open coding to identify initial concepts, followed by axial coding to link related patterns, and concluding with selective coding to refine the main themes. Through collaborative consensus, three overarching themes were developed: enhancing POCUS training, overcoming workflow challenges, and curriculum integration.

Trustworthiness was ensured through data triangulation, member checking, and the maintenance of an audit trail. Eighteen participants contributed qualitative data, with sample adequacy justified by information power and data saturation.

STATISTICAL ANALYSIS

Data were entered into Statistical Package for the Social Sciences (SPSS) version 24.0. Chi-square tests followed by multivariable regression analysis were performed. A p-value <0.05 was considered statistically significant. Thematic analysis was used for qualitative data to identify recurring themes and patterns in participant responses.

RESULTS

Data were initially collected from 400 participants, including emergency physicians and trainees. After excluding incomplete or improperly completed responses, the final analysis included 387 participants. The mean age of the study population was 51.46±6.12 years. Among the respondents, 211 (54.52%) were male, 271 (70.02%) were Saudi nationals, and 109 (28.16%) had 4-6 years of professional experience [Table/Fig-1].

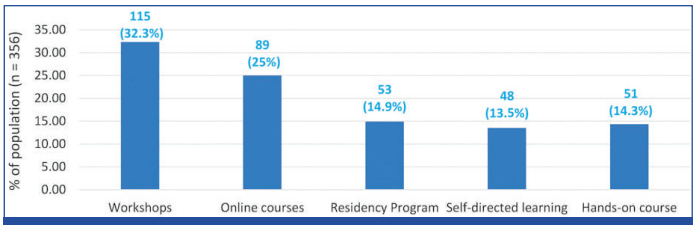
Regarding POCUS training and competence, 356 participants (91.99%) out of the total 387 reported having received formal training, while 31 participants (8.01%) had not received any formal training.

Variable	Characteristics	n (%)
Age (years)	18-29	69 (17.83)
	30-39	91 (23.51)
	40-49	102 (26.36)
	50-59	82 (21.19)
	>60	43 (11.11)
Gender	Male	211 (54.52)
	Female	176 (45.48)
Nationality	Saudi	271 (70.02)
	Non Saudi	116 (29.98)
Location	Central	261 (67.44)
	Periphery	126 (32.56)
Region	Riyadh province	191 (49.35)
	Northern province	95 (24.55)
	Eastern province	101 (26.10)
Job status	Government	219 (56.59)
	Private	168 (43.41)

Educational status	Bachelor	138 (35.66)
	Master	188 (48.58)
	Ph.D.	61 (15.76)
Current position	Emergency consultant	158 (40.83)
	Emergency specialist	91 (23.51)
	Emergency resident/ trainee	138 (35.66)
Experience (years)	<1	61 (15.76)
	1-3	79 (20.41)
	4-6	109 (28.16)
	7-9	91 (23.51)
	>10	47 (12.14)

[Table/Fig-1]: Demographic characteristics of study participants (n=387).

Among the 356 participants who had received formal training, 115 (32.30%) reported attending various POCUS-related workshops during their prior exposure [Table/Fig-2]. Furthermore, 314 trained participants (81.14%) expressed satisfaction with their training in terms of clinical application. When asked to rate their confidence in performing various POCUS applications on a scale of 1 (not confident) to 5 (very confident), the mean confidence score was 4.3±0.46 [Table/Fig-3].



[Table/Fig-2]: Method of training received for POCUS (p-value=0.012).

Application	1 F (%)	2 F (%)	3 F (%)	4 F (%)	5 F (%)
Trauma (e.g., FAST exam)	38 (9.82)	21 (5.43)	88 (22.74)	189 (48.84)	51 (13.18)
Cardiac (e.g., LV function)	41 (10.59)	63 (16.28)	85 (21.96)	151 (39.02)	47 (12.14)
Abdominal (e.g., free fluid)	19 (4.91)	23 (5.94)	41 (10.59)	192 (49.61)	112 (28.94)
Vascular (e.g., DVT)	53 (13.70)	42 (10.85)	81 (20.93)	169 (43.67)	42 (10.85)
Lung (e.g., pneumothorax)	12 (3.10)	28 (7.24)	62 (16.02)	191 (49.35)	94 (24.29)

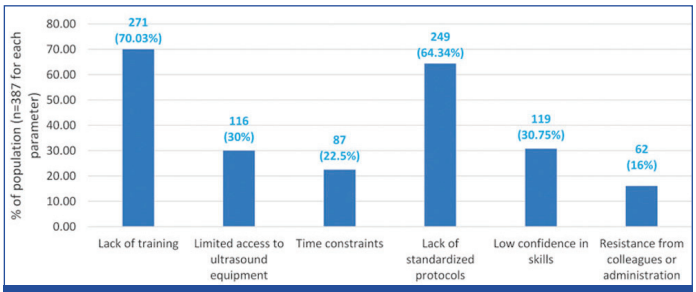
[Table/Fig-3]: The utilisation pattern of POCUS applications for various procedures. F=frequency; 1=rarely used; 2=less frequently used; 3=frequently used; 4=most frequently used; 5=always used

Regarding POCUS utilisation patterns, 176 participants (45.48%) reported using POCUS at least once per month. The majority of respondents, 307 (79.33%), indicated that they most frequently use POCUS for evaluating abdominal pain, followed by cases of respiratory distress. When asked about perceived patient benefit from POCUS use, 206 participants (53.23%) estimated that more than half of their patients had benefited from its application [Table/Fig-4].

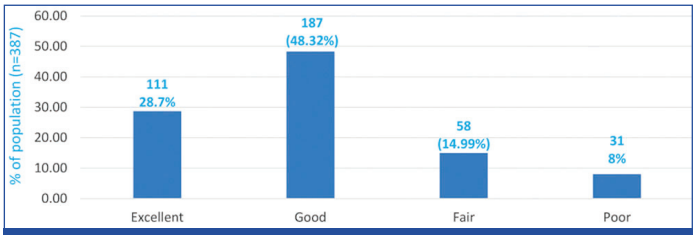
Among the total 387 participants, 271 (70.03%) identified a lack of training and 249 (64.34%) cited the absence of standardised protocols as the primary barriers to POCUS utilisation [Table/Fig-5]. When asked about the availability of POCUS equipment in their departments, 187 participants (48.32%) rated it as "good" [Table/Fig-6]. Regarding accessibility, 215 respondents (55.56%) indicated that POCUS equipment was "always available" [Table/Fig-7]. Notably, 371 participants (95.86%) reported that their hospital administration provides adequate support for POCUS use.

Question	Options	Yes F (%)	No F (%)	p-value
How often do you use POCUS in your clinical practice?	Daily	139 (35.92)	248 (64.08)	0.015
	Weekly	152 (39.28)	235 (60.72)	
	Monthly	176 (45.48)	211 (54.52)	
	Rarely	72 (18.60)	315 (81.40)	
	Never	63 (16.28)	324 (83.72)	
For which clinical scenario do you most frequently use POCUS?	Trauma	291 (75.19)	96 (24.81)	0.001
	Cardiac arrest	247 (63.82)	140 (36.18)	
	Undifferentiated hypotension	249 (64.34)	138 (35.66)	
	Respiratory distress	285 (73.64)	102 (26.36)	
	Abdominal pain	307 (79.33)	80 (20.67)	
	Procedural guidance (e.g., central lines)	283 (73.13)	104 (26.87)	
What percentage of your patients do you estimate benefit from POCUS?	10-20%	17 (4.39)	370 (95.61)	0.001
	21-30%	27 (6.98)	360 (93.02)	
	31-40%	31 (8.01)	356 (91.99)	
	41-50%	106 (27.39)	281 (72.61)	
	More than 50%	206 (53.23)	181 (46.77)	

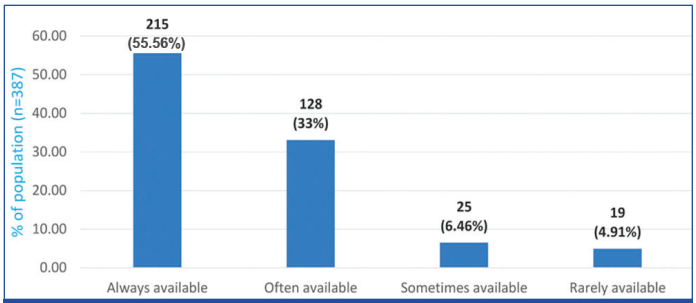
[Table/Fig-4]: Utilising patterns of POCUS among study participants.



[Table/Fig-5]: Barriers to the utilisation of POCUS in clinical practice.

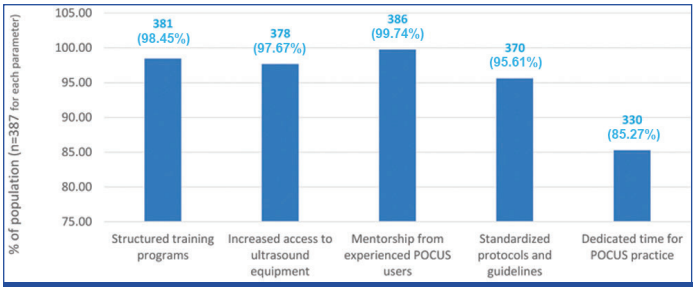


[Table/Fig-6]: Availability of POCUS equipment in emergency department.



[Table/Fig-7]: Accessibility of ultrasound equipment in emergency department.

Regarding strategies to enhance POCUS utilisation in Saudi Arabia, 386 participants (99.74%) emphasised the importance of mentorship from experienced POCUS users, while 381 (98.45%) highlighted the need for structured training programs. Additionally, 370 participants (95.61%) believed that implementing standardised protocols and guidelines would significantly improve POCUS practice [Table/Fig-8]. Moreover, 379 participants (97.93%) expressed willingness to participate in a POCUS training program if one were offered.



[Table/Fig-8]: Suggested strategies to enhance POCUS utilisation in clinical practice in Saudi Arabia.

The qualitative findings derived from the thematic analysis of participants' responses are summarised in [Table/Fig-9]. Overall, effective integration of POCUS into emergency care settings requires standardised training, adequate workflow support, and early integration into medical curricula. Addressing these areas is essential to ensure the effective and sustainable implementation of POCUS across Saudi Arabia.

Theme	Description	Representative focus areas
Enhancing POCUS training	Emphasised the need for standardised, competency-based training and institutional support	Residency programs, continuing education, equipment access, workflow optimisation
Overcoming workflow challenges	Identified barriers to daily POCUS use in emergency departments	Time constraints, patient load, equipment limitations, documentation, physician confidence
Curriculum integration	Advocated for early and structured inclusion of POCUS in medical education	Medical school training, simulation, mentorship, assessments, faculty development

[Table/Fig-9]: Key themes identified on qualitative analysis.

DISCUSSION

A substantial majority of participants (91.99%) reported having received formal POCUS training, with 32.30% attending various workshops and 81.14% expressing satisfaction with their clinical training. These findings align with a study evaluating a four-day POCUS course that demonstrated significant improvements in participants' skills, knowledge, and confidence, with median skill scores increasing from 25% to 50% following training [11]. Such findings confirm that short, focused training programs can effectively enhance technical skills, particularly in image optimisation and clinical assessment.

However, other studies highlight the long-term benefits of competency-based and longitudinal training formats, which incorporate repeated practice, continuous evaluation, and structured feedback to maintain proficiency. For example, a structured training program for general practitioners employed repeated training sessions and expert evaluations to support sustained learning and skill validation [12]. This underscores the value of ongoing practice and assessment beyond short-term educational interventions.

Additionally, educational models recommend integrating didactic instruction with hands-on experience and regular competency assessments to address knowledge gaps and promote clinical integration of POCUS [13]. These conclusions are further supported by comparative research advocating longitudinal, competency-driven training approaches to achieve durable competence in clinical POCUS application [14].

The high mean confidence score of 4.3±0.46 reported by participants across various POCUS applications indicates strong self-perceived competence, consistent with previous studies in which healthcare providers demonstrated high confidence in both performing and interpreting POCUS [15,16]. For instance, a study among residency trainees reported that 74% felt confident performing POCUS and 76% felt confident interpreting the findings [15]. Confidence is a well-established driver of increased utilisation and ongoing skill development.

The results of the multivariable analysis, which identified lung and abdominal POCUS applications as particularly significant, are consistent with current clinical trends prioritising these modalities for rapid bedside diagnosis. Additionally, Chi-square analysis revealed significant variation in confidence across different POCUS applications. Studies involving family medicine residents have shown that structured curricula incorporating practical instruction significantly improve confidence in abdominal and pulmonary ultrasound interpretation [17].

Furthermore, patient-centred research has demonstrated that POCUS use enhances not only diagnostic confidence but also patient satisfaction, trust, and understanding of their medical conditions. These positive patient–provider interactions may further reinforce clinician confidence and encourage more frequent and effective POCUS utilisation [18]. Overall, clinical applicability and provider confidence appear to form a mutually reinforcing relationship that supports the sustained integration of POCUS into emergency care practice.

In terms of patient outcomes, 53.23% of participants believed that more than half of their patients benefited from the use of POCUS. This perception was consistent with existing literature demonstrating the technique's positive impact on morbidity, mortality, and diagnostic efficiency [19]. However, significant barriers remain, including a lack of training (70.03%) and the absence of standardised protocols (64.34%). These challenges are widely reported in the literature, where inadequate education and inconsistent clinical guidelines are recognised as major impediments to effective POCUS implementation [20].

Despite these challenges, 55.56% of participants reported that POCUS equipment was consistently available, and 48.32% rated equipment access as satisfactory, suggesting that hardware availability is not a primary limitation within this cohort. Furthermore, strong institutional support was reported by 95.86% of participants, reflecting organisational readiness to integrate POCUS into routine clinical practice. This finding aligns with previous studies identifying administrative support as a critical factor for successful POCUS adoption [18].

Evidence from comparative studies indicates that POCUS not only improves diagnostic accuracy but also enhances patient perceptions, making them feel more thoroughly evaluated and more confident in their physicians. These benefits contribute to improved therapeutic relationships and higher overall patient satisfaction. Additionally, POCUS use has been shown to improve communication of diagnostic information, increase patient awareness, and potentially enhance treatment adherence [21,22]. Accordingly, the literature emphasises the need for systematic, competency-based training and the development of clear clinical protocols to facilitate broader adoption. These recommendations are consistent with the training and standardisation challenges identified in the present study [20,22]. Collectively, these findings suggest that although institutional support is strong and patient-related benefits are well recognised, addressing educational gaps and implementing standardised clinical protocols are essential in maximising the clinical utility of POCUS.

Saudi physicians highlighted that effective integration of POCUS into emergency care requires a multifaceted approach encompassing enhanced training, streamlined workflows, and sustained institutional support. Although the diagnostic advantages of POCUS are well established, time constraints in high-volume emergency departments and uneven access to equipment continue to present challenges [23]. This observation was consistent with prior studies conducted in Riyadh, where time pressures and logistical constraints limited POCUS adoption among emergency medicine residents.

In addition to formal training, ongoing continuing medical education is essential to help practising physicians maintain and refine their POCUS skills, particularly given regional disparities in training exposure across Saudi Arabia. While institutional support appears robust, it must also facilitate effective integration through optimised workflows, equitable resource distribution, and reliable equipment availability [5].

Although several studies have examined POCUS utilisation patterns in Saudi Arabia [5,6,24], the present study offers a novel contribution by providing a detailed, multidimensional analysis of prevailing practices, perceived competencies, and daily challenges faced by emergency physicians and trainees. By including a broad range of government and private hospitals, this research offers a more comprehensive and generalisable perspective than earlier studies that primarily focused on general barriers. International evidence further underscores the importance of structured processes and active administrative engagement in overcoming systemic barriers and enabling widespread POCUS adoption. To fully realise the benefits of POCUS in Saudi emergency care, a comprehensive, multilayered framework incorporating education, operational reform, and organisational commitment is required.

Limitation(s)

As data were collected using a self-administered questionnaire, the findings may be subject to response bias. Participants may have overreported their POCUS utilisation or satisfaction with training due to social desirability bias or recall limitations. These factors may affect the accuracy of reported usage patterns and perceived barriers.

CONCLUSION(S)

High rates of formal training, strong clinician confidence, and recognised patient benefits indicate encouraging progress in the integration of POCUS into emergency care in Saudi Arabia. Nevertheless, key challenges persist, including inconsistent training, the absence of standardised protocols, and practical issues related to workflow and equipment access. Comparative evidence highlights the critical need for comprehensive, standardised education programmes, ongoing competency assessment, and sustained institutional support. To fully harness the potential of POCUS in enhancing diagnostic accuracy, clinical efficiency, and patient care, targeted efforts must address these multifaceted barriers through structured training, adequate resourcing, and administrative commitment.

AI use disclosure: AI tools were used exclusively for language refinement, grammar correction, and improvement of clarity in this manuscript. The authors confirm that all aspects of the research, including study design, scientific content, data collection, analysis, and interpretation of results, were conducted and validated solely by the authors, who retain full responsibility for the integrity and accuracy of the work.

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