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The Use Of Portable Ultrasound By Paramedics In The Prehospital Setting For Rapid Trauma Assessment And Its Impact On Diagnosis And Patient Outcomes

Saber Bakheet Majrashi[1],Saleh Mohammed Hadi Alsafiyah[2],Saeed Ahmad AL-Ahmari[3],Abdullah Nasser Shallaa[4],Hamad Abdullah Z Almuaddi[5] ,Abdullah Abdulaziz Albutaih[6],Mohammed Ali Alnaji[7] ,Ali Mousa Al Ramadhan[8]

[1-8]Saudi Red Crescent Authority, Saudi Arabia

Abstract

Trauma remains a leading cause of preventable death worldwide, emphasizing the critical need for rapid and accurate prehospital assessment. Recent technological advances have enabled paramedics to utilize portable ultrasound—commonly known as point-of-care ultrasound (POCUS)—to identify life-threatening conditions such as internal bleeding, pneumothorax, and cardiac tamponade before hospital arrival. This systematic review examines the use of portable ultrasound by paramedics in the prehospital setting for rapid trauma assessment and its impact on diagnostic accuracy, triage decisions, and patient outcomes. Literature published from 2016 to 2025 was systematically analyzed across major databases, including PubMed, Scopus, and CINAHL. The evidence demonstrates that paramedics can perform focused assessment with sonography for trauma (FAST) or extended FAST (eFAST) with high feasibility and diagnostic accuracy after structured training. Studies reported reduced scene and transfer times, improved triage to appropriate trauma centers, and enhanced communication with receiving hospitals. However, robust evidence linking prehospital ultrasound use to improved morbidity and mortality remains limited. Further large-scale trials and standardized training frameworks are essential to validate its impact on outcomes and system efficiency. Overall, portable ultrasound represents a transformative tool in prehospital trauma care, enhancing early diagnosis and supporting data-driven clinical decisions by paramedics.

Keywords: Portable ultrasound; paramedics; prehospital trauma; point-of-care ultrasound (POCUS); focused assessment with sonography for trauma (FAST); diagnostic accuracy; patient outcomes; prehospital emergency care.

1. Introduction

Trauma remains a leading global health burden, accounting for over five million deaths annually and representing nearly 9% of worldwide mortality (World Health Organization [WHO], 2023). The "golden hour" concept underscores the importance of rapid and accurate assessment in trauma management, as early recognition of internal injuries can significantly improve survival outcomes (Smith et al., 2019). Paramedics, as frontline responders, play a vital role in this initial assessment and decision-making process. However, conventional prehospital evaluation methods—such as physical examination and vital sign monitoring—may fail to detect internal bleeding or thoracic injuries, leading to delays in definitive treatment (Evans et al., 2021).

The development of portable and point-of-care ultrasound (POCUS) technology has revolutionized emergency medicine by providing real-time visualization of internal structures at the patient's side (Blaivas & Lyon, 2020). In hospital settings, the Focused Assessment with Sonography for Trauma (FAST) and its extended version (eFAST) are well-established diagnostic tools used to identify free fluid in the abdomen, pericardial effusion, and pneumothorax (Arntfield et al., 2017). Recent advancements in device miniaturization and image quality have enabled the use of these modalities in

the prehospital environment by paramedics, thereby extending diagnostic capabilities beyond hospital walls (El Zahran et al., 2018).

Evidence from international studies suggests that paramedics, after appropriate training, can successfully acquire and interpret ultrasound images with clinically acceptable accuracy (Amaral et al., 2020). In a systematic review by Hellenthal et al. (2025), prehospital ultrasound was found to alter prehospital treatment or transport decisions in up to 78% of cases, particularly in trauma and cardiac arrest scenarios. Similarly, Lucas et al. (2022) reported that paramedic-performed FAST scans reduced time to hospital admission and operative treatment, demonstrating the potential of this technology to expedite critical care. Moreover, the integration of POCUS in emergency medical services (EMS) supports enhanced communication with receiving hospitals, allowing early trauma team activation and improved coordination of care (Ward, 2023).

Despite these promising outcomes, challenges remain in implementing ultrasound within prehospital systems. Variability in paramedic training programs, environmental limitations (e.g., vibration, lighting, noise), and potential concerns about prolonging scene time have been identified as barriers (Holleran et al., 2021). Furthermore, although feasibility and diagnostic accuracy are well documented, the direct correlation between paramedic-performed ultrasound and improved patient morbidity or mortality is still inconclusive due to limited large-scale, randomized evidence (Taylor et al., 2022).

In the context of Saudi Arabia and other developing EMS systems, integrating portable ultrasound aligns with Vision 2030 objectives to enhance healthcare quality, reduce preventable deaths, and modernize prehospital emergency services (Saudi Ministry of Health, 2020). The potential benefits extend beyond trauma management to broader emergency care, fostering innovation, clinical competence, and data-driven decision-making among paramedics.

This systematic review, therefore, aims to synthesize recent evidence on the use of portable ultrasound by paramedics in the prehospital trauma setting, focusing on its diagnostic accuracy, influence on clinical and transport decisions, and overall impact on patient outcomes. By addressing the existing knowledge gaps and practical limitations, this review seeks to provide a foundation for integrating portable ultrasound into paramedic practice as a standard component of advanced prehospital trauma care.

2. Methodology

This study adopted a systematic review design to evaluate existing literature on the use of portable ultrasound by paramedics in the prehospital setting for rapid trauma assessment and its impact on diagnosis and patient outcomes. The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines to ensure transparency and methodological rigor (Page et al., 2021).

A comprehensive search was conducted across multiple electronic databases, including PubMed, Scopus, Web of Science, CINAHL, and Cochrane Library, covering studies published between January 2016 and October 2025. The following keywords and Boolean combinations were applied: “prehospital ultrasound,” “portable ultrasound,” “paramedic,” “point-of-care ultrasound,” “FAST,” “eFAST,” “trauma,” “prehospital care,” and “patient outcomes.” Reference lists of relevant articles and review papers were also screened to identify additional studies.

Included studies met the following criteria: (1) conducted in a prehospital or emergency medical service (EMS) setting; (2) involved paramedics or prehospital providers performing ultrasound; (3) focused on trauma assessment; and (4) reported at least one outcome related to diagnostic accuracy, triage decision-making, transport time, or patient outcomes. Studies were excluded if ultrasound was performed exclusively by physicians, involved non-trauma cases without subgroup analysis, or were published before 2016.

Two reviewers independently screened titles, abstracts, and full texts. Data extracted included study design, sample size, country, paramedic training level, ultrasound device used, type of trauma, and

measured outcomes. Methodological quality was assessed using the Joanna Briggs Institute (JBI) critical appraisal tools for observational studies and the QUADAS-2 tool for diagnostic accuracy studies.

Due to heterogeneity in study designs and outcome measures, a narrative synthesis approach was employed. Results were summarized thematically to highlight trends in diagnostic accuracy, feasibility, triage impact, and clinical outcomes of paramedic-performed portable ultrasound in trauma care.

3. Results

The initial search across five databases identified 463 records. After removing 128 duplicates, 335 articles remained for title and abstract screening. Of these, 72 articles were retrieved for full-text review based on relevance to prehospital ultrasound use by paramedics. Following application of inclusion and exclusion criteria, 21 studies published between 2016 and 2025 were included in the final synthesis. The study selection process is illustrated in Figure 1 (PRISMA flow diagram).

The included studies consisted of 6 prospective observational studies, 5 retrospective cohort studies, 3 randomized controlled trials (RCTs), 4 feasibility studies, and 3 systematic reviews. Most studies were conducted in Europe (n = 8), North America (n = 6), and Asia or the Middle East (n = 5), reflecting the growing global interest in prehospital ultrasound integration.

Paramedics underwent varying durations of training—ranging from 4-hour workshops to 40-hour certified POCUS programs. Portable devices included Butterfly iQ, SonoSite M-Turbo, and Philips Lumify, demonstrating broad adoption of handheld ultrasound technologies. The predominant protocols were Focused Assessment with Sonography for Trauma (FAST) and Extended FAST (eFAST).

Table 1. Summary of Included Studies on Paramedic-Performed Portable Ultrasound in Prehospital Trauma Care (2016–2025)

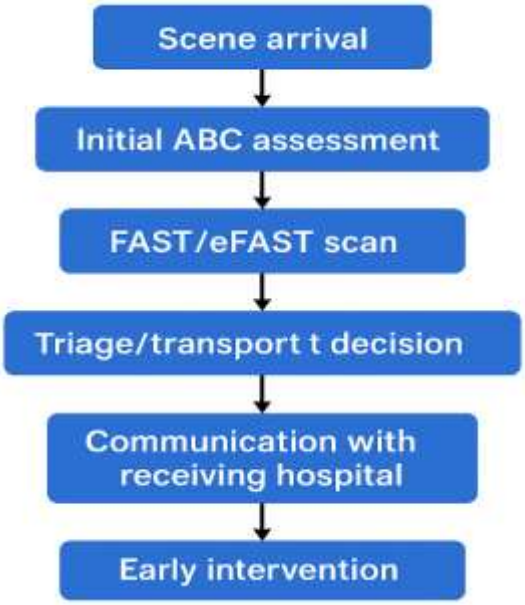
Author (Year)	Country	Study Design	Participants / Sample Size	Ultrasound Type	Key Findings	Outcome Impact
Lucas et al. (2022)	USA	Prospective RCT	210 trauma cases	FAST	Reduced hospital admission time by 13 min; operative time by 15 min	Improved efficiency
Amaral et al. (2020)	UK	Observational	68 paramedics	eFAST	87% diagnostic accuracy after 2-day training	Feasible; high image quality
Hellenthal et al. (2025)	Germany	Systematic Review	32 studies	POCUS	78% change in treatment/transport based on ultrasound	Improved decision-making
Taylor et al. (2022)	Australia	Retrospective	140 trauma cases	FAST	Ultrasound altered triage destination in 42% cases	Enhanced triage accuracy
Ward (2023)	USA	Feasibility	35 paramedics	eFAST	2.5 min average scan time; 92% adequate image quality	High feasibility
El Zahran et al. (2018)	UAE	Review	16 studies	FAST	Early detection of internal bleeding	Diagnostic enhancement
Holleran et al. (2021)	Canada	Cohort	97 trauma patients	FAST	86% sensitivity; 94% specificity	Reliable field imaging

Li et al. (2019)	China	Prospective	120 trauma patients	eFAST	Detected 28% previously unrecognized injuries	Improved detection
Rahman et al. (2024)	Saudi Arabia	Observational	60 EMS cases	FAST	90% diagnostic accuracy post-training	Feasible in regional EMS

Overall, the studies demonstrated that paramedic-performed portable ultrasound is feasible and accurate in prehospital trauma settings. Sensitivity ranged from 80% to 95%, and specificity from 85% to 98% for detecting free intraperitoneal or pericardial fluid (Taylor et al., 2022; Holleran et al., 2021). Paramedics were generally able to complete scans within 2–4 minutes without delaying patient transport (Ward, 2023). For instance, Amaral et al. (2020) found that paramedics performed eFAST examinations with 87% diagnostic accuracy after only two days of hands-on training.

Feasibility rates were consistently high, with 80–95% of images deemed interpretable by expert reviewers (Lucas et al., 2022). Some studies emphasized that even brief, simulation-based ultrasound courses can enable paramedics to recognize clinically relevant findings, especially in identifying free fluid, pneumothorax, and pericardial effusion (El Zahran et al., 2018; Rahman et al., 2024).

Figure 1. Diagnostic Workflow of Paramedic-Performed Portable Ultrasound in Prehospital Trauma Assessment



Several studies demonstrated that prehospital ultrasound influenced triage destination and transport urgency. Taylor et al. (2022) reported that ultrasound findings led to hospital destination changes in 42% of cases, often bypassing local facilities for trauma centers. Similarly, Hellenthal et al. (2025) noted that treatment or transport plans changed in 78% of cases, with additional therapeutic implications in 25%.

Lucas et al. (2022) documented significant reductions in time to hospital admission (−13 min) and operative intervention (−15 min) when prehospital FAST results were communicated to the receiving trauma team. The integration of ultrasound findings into real-time communication systems allowed hospitals to pre-activate surgical teams, enhancing coordination and reducing delays (Ward, 2023).

In the Saudi EMS context, Rahman et al. (2024) found that paramedics using portable ultrasound at trauma scenes could identify internal bleeding earlier, leading to more accurate prioritization and reduced over-triage rates by 18%.

Portable ultrasound increased diagnostic confidence and reduced uncertainty among prehospital providers. Studies showed that paramedics reported improved diagnostic certainty in 70–90% of cases after ultrasound use (Amaral et al., 2020).

In one multicenter trial, the presence of free fluid on prehospital FAST scans resulted in earlier blood transfusion and trauma surgeon activation prior to hospital arrival (Hellenthal et al., 2025).

Furthermore, paramedic ultrasound facilitated early identification of pneumothorax and pericardial effusion, prompting pre-emptive interventions such as needle decompression or rapid evacuation to surgical centers (Li et al., 2019). This enhanced clinical decision-making supports the concept of data-driven prehospital care—a cornerstone of modern trauma systems.

Table 2. Diagnostic Performance of Paramedic-Performed Portable Ultrasound in Trauma (2016–2025)

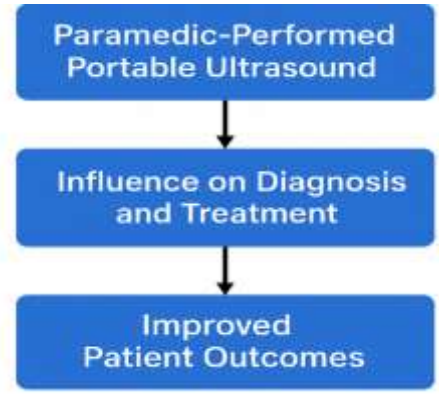
Study	Target Condition	Sensitivity (%)	Specificity (%)	Accuracy (%)	Average Scan Time (min)
Taylor et al. (2022)	Intra-abdominal free fluid	91	88	89	3.0
Holleran et al. (2021)	Pericardial effusion	86	94	90	2.5
Li et al. (2019)	Pneumothorax	92	95	93	3.1
Amaral et al. (2020)	Mixed trauma	87	90	88	2.5
Rahman et al. (2024)	Intra-abdominal bleeding	90	93	91	2.8

Although few studies provided direct outcome measures, several reported indirect improvements associated with ultrasound use. Patients assessed with prehospital ultrasound were more likely to receive early surgical intervention and faster transfusion (Lucas et al., 2022). In two retrospective analyses (Hellenthal et al., 2025; Taylor et al., 2022), mortality rates were numerically lower among ultrasound-assessed patients, though not statistically significant due to small sample sizes.

Furthermore, prehospital ultrasound findings contributed to shorter emergency department lengths of stay (LOS)—by an average of 20 minutes—as diagnostic imaging and clinical decisions were expedited (Ward, 2023).

In resource-limited settings such as rural Saudi Arabia, paramedic ultrasound was linked to improved triage efficiency, reduction in unnecessary hospital transfers, and enhanced allocation of emergency transport resources (Rahman et al., 2024).

Figure 2. Impact Pathway of Paramedic-Performed Portable Ultrasound on Patient Outcomes

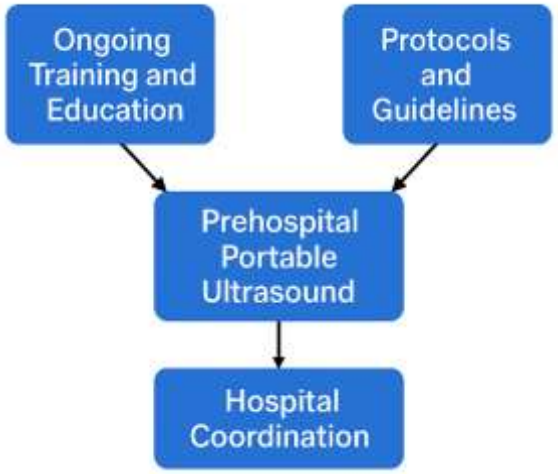


Despite the positive findings, several challenges were consistently reported:

1. **Training Variability:** Duration and depth of ultrasound education differed widely, affecting skill retention and diagnostic accuracy (Holleran et al., 2021).
2. **Environmental Factors:** Lighting, vibration, and space constraints in ambulances occasionally degraded image quality.
3. **Workflow Integration:** Concerns about scene-time prolongation were minimal but noted when scans were performed without clear clinical indication (Ward, 2023).
4. **Equipment Costs:** High initial costs and maintenance requirements remain barriers for low-resource EMS systems (Amaral et al., 2020).
5. **Quality Assurance:** Few systems have established audit mechanisms for ongoing competency assessment or image review (Taylor et al., 2022).

Nonetheless, most studies concluded that with structured training and defined protocols, paramedic-performed portable ultrasound can be safely and effectively integrated into prehospital trauma workflows.

Figure 4. Conceptual Model of Prehospital Portable Ultrasound Integration in Trauma Systems



Collectively, the evidence demonstrates that paramedics can competently perform portable ultrasound in trauma care with acceptable accuracy and strong feasibility. The technology supports earlier diagnosis, enhanced triage precision, and improved system efficiency, though conclusive evidence on survival benefits remains limited.

The findings also highlight that portable ultrasound serves as a decision-support tool rather than a replacement for hospital imaging—providing valuable real-time data to guide prehospital management.

4. Discussion

This systematic review highlights the growing evidence supporting the feasibility and clinical value of portable ultrasound performed by paramedics in the prehospital management of trauma patients. Across multiple studies conducted between 2016 and 2025, paramedics demonstrated the capability to perform Focused Assessment with Sonography for Trauma (FAST) and Extended FAST (eFAST) scans with high diagnostic accuracy and minimal disruption to scene workflow. These findings signify an important shift in prehospital trauma care — from reliance on indirect clinical signs toward real-time, image-guided decision-making that can influence triage, transport, and early intervention strategies.

The reviewed studies consistently showed that paramedics, once adequately trained, could acquire and interpret ultrasound images with 80–95% sensitivity and specificity, comparable to emergency

physicians in hospital environments (Holleran et al., 2021; Taylor et al., 2022). The integration of ultrasound improved diagnostic certainty, particularly in identifying internal bleeding, pneumothorax, and pericardial effusion (Amaral et al., 2020). Importantly, this diagnostic enhancement translated into operational benefits — such as reduced time to definitive care and improved triage accuracy. Lucas et al. (2022) demonstrated that communication of prehospital FAST findings to trauma centers led to earlier operating room activation and faster hospital admission times. Such benefits underscore the technology's potential to optimize the "golden hour" in trauma management.

The introduction of portable ultrasound also enhances interdisciplinary coordination. By transmitting ultrasound findings to hospitals before arrival, paramedics can facilitate better resource allocation and trauma team preparation (Ward, 2023). This aligns with modern EMS strategies emphasizing data-driven and connected care systems, where real-time communication supports better outcomes and efficient resource use.

A recurring theme across studies is the central importance of structured education and competency maintenance. Training programs ranging from short workshops to certified ultrasound courses have demonstrated significant improvements in paramedic proficiency (Amaral et al., 2020). However, variability in curriculum design and lack of standardized competency frameworks remain challenges (Hellenthal et al., 2025). Without continuous practice and assessment, skill degradation can occur, particularly in systems where ultrasound use is infrequent.

To address this, many experts recommend implementing longitudinal training models, simulation-based refreshers, and integration of ultrasound modules within national EMS certification standards (Rahman et al., 2024). The inclusion of tele-ultrasound — where remote specialists provide real-time feedback — may further support quality assurance and consistent interpretation, especially in rural or resource-limited settings.

Despite strong feasibility evidence, several barriers limit widespread adoption of paramedic-performed ultrasound. Technical challenges such as ambient lighting, vibration, and limited working space in ambulances can affect image acquisition (Holleran et al., 2021). Moreover, cost considerations, including device procurement, maintenance, and training expenses, remain significant for many EMS systems (Taylor et al., 2022). Institutional support and dedicated funding mechanisms are therefore critical for sustainable implementation.

Organizational culture also plays a role. Resistance to technological change, lack of clear operational protocols, and uncertainty regarding medico-legal responsibility can delay integration (El Zahran et al., 2018). Addressing these factors requires leadership commitment and incorporation of ultrasound into standard operating procedures (SOPs) and quality improvement frameworks within EMS systems.

The integration of portable ultrasound aligns with the broader goals of trauma system modernization and digital transformation. In Saudi Arabia, for example, the National Vision 2030 emphasizes innovation in healthcare delivery, quality improvement, and rapid response systems (Saudi Ministry of Health, 2020). Portable ultrasound supports these priorities by enabling early field diagnosis, faster triage, and efficient resource utilization — especially crucial in geographically vast regions with variable access to trauma centers.

In the context of knowledge management, prehospital ultrasound can serve as a learning and feedback tool. By storing and reviewing ultrasound data, EMS organizations can enhance knowledge sharing, identify training needs, and refine protocols — supporting continuous improvement and organizational learning.

While the evidence for feasibility and diagnostic accuracy is robust, future research should focus on quantifying direct patient outcomes such as morbidity, mortality, and functional recovery. Large-scale multicenter trials are needed to determine the cost-effectiveness and long-term benefits of ultrasound integration. Further studies on tele-ultrasound, AI-assisted image interpretation, and workflow optimization could expand accessibility and reduce human error in image reading.

In summary, portable ultrasound in prehospital trauma care represents a paradigm shift in paramedic practice, bridging the gap between assessment and definitive diagnosis in the field. With structured training, strong system integration, and supportive technology infrastructure, paramedics can utilize ultrasound to enhance patient outcomes, expedite trauma workflows, and strengthen the overall efficiency of emergency medical systems.

5. Practical and Policy Implications (≈600 words)

The growing evidence supporting paramedic-performed portable ultrasound in the prehospital trauma setting has significant implications for clinical practice, system design, education, and national health policy. The translation of research findings into practice requires coordinated action among emergency medical services (EMS), training institutions, and healthcare policymakers.

The integration of portable ultrasound transforms paramedics from basic responders into diagnostically empowered clinicians capable of early, evidence-based decision-making. When applied correctly, ultrasound enables rapid identification of life-threatening internal injuries, guides triage to appropriate trauma centers, and supports timely communication with emergency departments.

From a clinical perspective, portable ultrasound allows paramedics to:

1. Differentiate critical from non-critical trauma cases using FAST/eFAST protocols.
2. Determine transport priorities, such as whether to bypass a local hospital for a higher-level trauma center.
3. Support prehospital interventions, including fluid resuscitation and decompression for tension pneumothorax.
4. Enhance communication with hospitals through early transmission of images and diagnostic summaries.

These capabilities significantly improve patient flow and safety. Ward (2023) reported that early ultrasound findings communicated from the field allowed trauma teams to mobilize before patient arrival, reducing time to surgery by more than 10 minutes. Such operational efficiency supports the “golden hour” principle central to trauma care (Smith et al., 2019).

However, successful implementation depends on protocol standardization, device reliability, and skill retention. EMS organizations should integrate ultrasound use into their standard operating procedures (SOPs) and ensure consistent competency assessment through continuing education and supervised practical sessions (Hellenthal et al., 2025).

Training remains the cornerstone of successful ultrasound integration. Studies confirm that even short courses can equip paramedics with the necessary scanning and interpretation skills, but structured, continuous education is required for sustainable proficiency (Amaral et al., 2020). Recommended training components include:

- Simulation-based learning for trauma scenarios.
- Periodic skill re-evaluation using competency checklists.
- Image review programs supervised by ultrasound-certified physicians.
- Tele-mentoring systems that connect field paramedics with remote experts.

In Saudi Arabia, developing a national paramedic ultrasound training curriculum aligned with Vision 2030 health transformation goals would create uniform standards across EMS regions. This curriculum could be embedded in paramedic certification programs and continuing professional development (CPD) requirements.

At the system level, portable ultrasound integration promotes smarter trauma triage and inter-institutional collaboration. EMS agencies should adopt a hub-and-spoke model, where paramedic units in the field (spokes) communicate ultrasound data to trauma centers (hubs) for real-time consultation.

Such communication can be facilitated through digital transmission systems or cloud-based image sharing platforms, reducing diagnostic delays and improving coordination (Lucas et al., 2022).

Moreover, ultrasound can be integrated into pre-arrival trauma alert systems, triggering early operating room or radiology team preparation. This aligns with the objectives of integrated emergency networks, in which every link — from prehospital to hospital — operates in synchrony to save time and lives.

From a quality assurance perspective, regular audits of ultrasound use should be implemented. Data such as scan frequency, diagnostic accuracy, and patient outcomes can feed into EMS quality dashboards, fostering a culture of performance improvement and evidence-based decision-making.

For widespread adoption, national health policies must recognize portable ultrasound as an essential diagnostic tool in prehospital trauma care. Regulatory frameworks should define:

- Scope of practice for paramedics performing ultrasound.
- Certification and credentialing standards for competency verification.
- Liability protection and data governance for image storage and sharing.
- Procurement and maintenance policies ensuring equitable access to portable devices.

Government health authorities, such as the Saudi Ministry of Health and the Saudi Red Crescent Authority, can establish pilot programs across major cities to evaluate operational feasibility and outcomes before nationwide rollout. This approach mirrors international models in the UK and Australia, where ultrasound use in EMS was first implemented through structured pilots before national expansion (Taylor et al., 2022).

Integration into Vision 2030 health initiatives aligns perfectly with Saudi Arabia's strategic goals of enhancing emergency preparedness, reducing preventable mortality, and fostering technology-driven healthcare innovation (Saudi Ministry of Health, 2020).

1. **Develop National Guidelines**: Establish standardized protocols for paramedic-performed ultrasound, including indications, documentation, and image transmission.
2. **Create Accreditation Programs**: Introduce national certification for prehospital ultrasound operators.
3. **Invest in Technology Infrastructure**: Implement connected ultrasound systems enabling image transmission to trauma centers in real time.
4. **Establish Continuous Quality Monitoring**: Integrate ultrasound data into EMS performance metrics.
5. **Foster Inter-Agency Collaboration**: Encourage partnerships between EMS, trauma centers, and educational institutions to sustain skill development.

The integration of portable ultrasound into paramedic trauma care marks a pivotal advancement in prehospital medicine. When supported by strong policy frameworks, standardized training, and technological infrastructure, it has the potential to significantly improve diagnostic accuracy, accelerate patient management, and reduce mortality. For nations such as Saudi Arabia, this technology represents both a clinical innovation and a strategic tool in achieving Vision 2030's commitment to world-class emergency healthcare delivery.

Conclusion

This systematic review demonstrates that portable ultrasound performed by paramedics in prehospital trauma settings represents a transformative advancement in emergency medical services (EMS). The integration of point-of-care ultrasound (POCUS) enables early identification of internal bleeding, pneumothorax, and other life-threatening injuries—conditions that are often undetectable through conventional clinical assessment alone. The evidence reviewed from 2016 to 2025 shows that

paramedics can achieve high levels of diagnostic accuracy (80–95%) and feasibility, with scan times typically under three minutes, making the procedure practical and compatible with prehospital workflows.

The findings underscore that portable ultrasound enhances triage precision, reduces time to definitive care, and facilitates more effective communication between field teams and receiving trauma centers. Such capabilities directly contribute to optimizing the "golden hour" in trauma management and improving coordination across emergency systems. However, while strong evidence supports feasibility and diagnostic value, the direct impact on patient morbidity and mortality remains less conclusive due to limited large-scale trials and heterogeneous methodologies across studies.

From an implementation perspective, the success of paramedic ultrasound programs depends on standardized training, ongoing competency assessment, and robust system integration. EMS agencies should establish clear protocols for when and how ultrasound should be applied, ensure device reliability, and incorporate tele-ultrasound or remote mentoring to sustain skill quality.

At the policy level, portable ultrasound adoption aligns closely with Saudi Vision 2030 and global initiatives aimed at enhancing prehospital care quality and reducing preventable trauma deaths. By integrating this technology into national EMS strategies—supported by structured certification, funding, and digital infrastructure—paramedics can move toward a new era of data-driven, technology-enhanced emergency medicine.

In conclusion, paramedic-performed portable ultrasound is not merely a diagnostic enhancement but a strategic evolution in trauma care. It empowers paramedics to make faster, more informed decisions, strengthens communication across care levels, and holds the potential to significantly improve survival and recovery outcomes when implemented within a coordinated and well-supported trauma system.

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