





# Implementing Prehospital Ultrasound at the Saudi Red Crescent Authority: Perceived Barriers and Training Needs

Maher Alsulami <sup>1-3</sup>, Yasir Almukhlifi <sup>1,2</sup>, Adnan Alsulami <sup>1,2</sup>, Ziyad F Al Nufaei <sup>1,2</sup>,  
Abdullah Alruwaili <sup>4,5</sup>, Ahmed Alanazy <sup>4,5</sup>

<sup>1</sup>College of Applied Medical Sciences, King Saud Bin Abdulaziz University for Health Sciences, Jeddah, Saudi Arabia; <sup>2</sup>King Abdullah International Medical Research Center, Jeddah, Saudi Arabia; <sup>3</sup>Educational Leadership Program, School of Education, Duquesne University, Pittsburgh, PA, USA; <sup>4</sup>College of Applied Medical Sciences, King Saud bin Abdulaziz University for Health Sciences, Al-Ahsa, Saudi Arabia; <sup>5</sup>King Abdullah International Medical Research Center, Al-Ahsa, Saudi Arabia

Correspondence: Maher Alsulami, Department of Emergency Medical Services, College of Applied Medical Sciences- Jeddah King Saud bin Abdulaziz University for Health Sciences, Mail Code 6610 P.O.Box.9515, Jeddah, 21423, Kingdom of Saudi Arabia, Tel +966,566,244,421 Ext 46,087, Email alsulamim@ksau-hs.edu.sa

**Objective:** This study examines the inherent barriers to implementing prehospital ultrasound within the Saudi Red Crescent Authority (SRCA) in Saudi Arabia.

**Methods:** A qualitative study was conducted to explore the perceived barriers, mode of transportation, ultrasound familiarity, and self-efficacy level of relevant stakeholders in implementing the prehospital ultrasound in SRCA. Data was collected via surveys and interviews with 24 SRCA paramedics/EMTs, 4 SRCA station administrators, and two hospital physicians to further examine the inherent barriers of implementing the prehospital ultrasound.

**Results:** Thematic analysis revealed the main barriers were costs of ultrasound equipment, environmental factors affecting image capture, and lack of training in ultrasound skills and interpretation. Administrators and physicians also noted concerns about machine portability and technical maintenance. Stakeholders agreed ultrasound could improve trauma diagnosis if barriers were addressed through extensive training and protocols. In prehospital care setting, the two main modes of transportation are “stay and play”, involving on-scene interventions before transport, and “load and go”, prioritizing rapid transport to the hospital, with the choice depending on various factors. An overwhelming 96% of paramedics/EMTs preferred a ‘stay and play’ approach to stabilize patients before transport, while 75% of administrators preferred ‘load and go’ for rapid transport to hospitals. 62.5% of paramedics were familiar with ultrasound, but only 20.8% had previously used it.

**Conclusion:** This study provides important insights into stakeholder perspectives on the implementation of prehospital ultrasound within the Saudi Red Crescent Authority. The findings can guide efforts to implement appropriate ultrasound use through tailored training programs and enhanced coordination across groups, aimed at improving trauma outcomes.

**Keywords:** prehospital ultrasound, out of hospital ultrasound, Saudi Arabia, paramedics

## Introduction

The Kingdom of Saudi Arabia faces major public health issues related to trauma and traffic accidents.<sup>1</sup> It has one of the highest rates of traffic fatalities in the world, with over 7000 killed annually.<sup>2,3</sup> Prolonged ambulance response times are also a major concern, with average response times over 13 minutes versus an international standard of 8 minutes.<sup>4</sup> This contributes to high mortality rates from crashes and other trauma. As a result, many victims are transported by private vehicles, which further delays proper emergency care.

Many emergency medical services internationally have started using portable ultrasound devices in the field to improve the diagnosis and management of trauma patients.<sup>5-7</sup> Prehospital ultrasound can quickly detect internal bleeding and other injuries not evident on physical exam, leading to more appropriate care.<sup>8,9</sup>

The SRCA is the government agency responsible for providing emergency medical services and prehospital care across Saudi Arabia.<sup>4,10</sup> It operates over 1000 ambulances staffed by emergency medical technicians (EMTs) and paramedics.<sup>11</sup> However, SRCA faces a complex mix of cultural, political, religious, and geographical barriers that can affect emergency response capabilities and adoption of new technologies or Procedures.<sup>12</sup>

Studies show emergency medical providers can effectively use ultrasound after relatively brief training to identify time-sensitive, life-threatening conditions.<sup>13,14</sup> This has the potential to reduce mortality when integrated with existing trauma protocols.<sup>15</sup> The two main modes of prehospital transportation are “stay and play” and “load and go”. “Stay and play” involves performing more interventions like ultrasound on the scene before transporting the patient.<sup>16</sup> This allows for faster diagnosis and treatment initiation. “Load and go” prioritizes quick transport to definitive hospital care, performing interventions en route. The choice depends on patient acuity, resource availability, and contextual factors. Both enable prehospital ultrasound – “stay and play” in a more interventions-focused model and “load and go” integrating it into rapid transport.<sup>17</sup> Ultimately, the evidence shows feasibility and benefit regardless of mode.

As emergency medical services personnel master the use of these devices in training and simulations, experience successes in detecting conditions, and receive positive feedback from patient’s supervisors, and their peers which will lead to the increase of self- and collective efficacy beliefs per Bandura’s theory.<sup>18</sup>

However, lack of training and protocols are major barriers preventing widespread prehospital ultrasound use.<sup>8,19,20</sup> There are also concerns about costs, technical challenges, and potential delays on scene versus quick transport to hospital centers.<sup>21–23</sup> Evaluating stakeholder perceptions and needs provides important insights into whether implementing prehospital ultrasound will provide sufficient benefits versus risks within a given emergency medical system. The research is exploratory research that helps to further examine the inherent barriers among stakeholders (SRCA and National Guard hospital) to implement the prehospital ultrasound at the SRCA.

This study investigates potential barriers to incorporating prehospital ultrasound use within SRCA emergency services, including training gaps, mode of transportation,<sup>1</sup> ultrasound familiarity, and self-efficacy level. With proper training, prehospital care providers can use ultrasound at the scene of trauma and during ambulance transport to help evaluate and diagnose patients. However, introducing ultrasound technology into a new healthcare context requires addressing various barriers and training needs to ensure successful and effective implementation.

## Methods

This qualitative study was conducted to explore the perceived barriers, mode of transportation, ultrasound familiarity, self, and collective efficacy of relevant stakeholders regarding implementing prehospital ultrasound within SRCA emergency services. The protocol was submitted to the Institutional Review Board at Duquesne University and was approved as an exempt on 07/15/2019 with no expire date. The protocol number is #2019/07/6.

## Participants

Participants included emergency medical technicians (EMTs), paramedics, SRCA Station administrators, and physicians associated with the National Guard Hospital in Riyadh, Saudi Arabia. A purposive sampling method was used to recruit 24 EMTs and paramedics from four Saudi Red Crescent stations in proximity to the National Guard Hospital. The researcher visited each station and invited all EMTs and paramedics on the day shift to participate. Additionally, the administrator on duty at each of the four stations was invited to participate in an interview (n=4 administrators). Finally, two emergency physicians from the National Guard Hospital with expertise in emergency medical services were recruited for interviews based on their experience working with the SRCA.

## Data Collection

Two instruments were utilized in this study. Semi-structured interviews were conducted with SRCA administrators and physicians using an interview protocol focused on perceived barriers to implementing prehospital ultrasound [Appendix 1](#). Parallel questions were adapted into an online survey that was administered to EMTs and paramedics [Appendix 2](#). The survey was hosted on the Survey Monkey platform. Interview questions examined emergency physicians’ and SRCA administrators’ perceptions of barriers to prehospital ultrasound implementation. The online survey gathered parallel

insights from SRCA paramedics and EMTs based at four Riyadh stations near the National Guard Hospital. The Arabic translations of both instruments were created by the researcher and verified for accuracy by a fluent bilingual academic familiar with the research methodology.

## Procedures

The researcher visited each of the four Saudi Red Crescent stations on 4 consecutive days. At each visit, all EMTs and paramedics on duty were invited to participate and provided the link to the online survey. The survey remained open for completion for 15 days following the final station visit. Reminder emails were sent every five days during this period. At each station visit, the SRCA station administrator was also invited to participate in a face-to-face recorded interview after providing informed consent. Interviews were conducted privately, and recordings were destroyed after transcription with all identifiers removed. Finally, the two emergency physicians were invited to participate in face-to-face interviews based on their expertise. These two emergency physicians were identified by the researcher and had worked with the National Guard Hospital and had frequent contact with the Saudi Red Crescent Authority in the past. Emergency Physician One had experience working in the hospital and had clinical and administrative duties. Emergency Physician Two had performed administrative duties in addition to his clinical work in the Emergency Department.

Informed consent was obtained emphasizing the voluntary nature of participation. Identifying details for these participants were removed and they are described in the study based on their general experience.

Survey data was gathered securely and anonymously using an encrypted platform protecting respondent identities. Across the two instruments, questions aligned to elicit different stakeholder groups' views on challenges and obstacles that could impede the effective adoption of prehospital ultrasound and integration of this technology between SRCA teams and the National Guard Hospital.

## Data Analysis

The qualitative data was analyzed using thematic analysis to identify key patterns and themes related to the research objectives. Transcripts were coded through an iterative process and categorized to develop higher-level themes. Quantitative statistics were used to summarize demographic data and mode of transportation.

## Results

### Participant Demographics

#### Paramedics and EMTs

Figure 1 shows the participants certificates ranging from basic EMT through paramedic levels, with 58% certified paramedics. The administrators had 2 to 8 years of experience in SRCA. In addition, Figure 2 shows that 24 paramedics and EMTs had varying years of experience, with most (50%) having 3–5 years of experience in SRCA. The physicians had over 17 years of emergency medicine expertise.

### Key Identified Barriers

The most cited barriers to implementing prehospital ultrasound were costs of ultrasound equipment, environmental factors (eg heat, sunlight, vehicle movement) affecting image capture, lack of training in ultrasound skills and interpretation. Administrators and physicians also noted concerns about machine portability and technical maintenance. Physicians highlighted how differences in organizational policies could pose challenges to data sharing and effective use. Figure 3 shows the participants stated barriers in implementing the prehospital ultrasound in SRCA.

### Mode of Transportation

An overwhelming 96% of paramedics/EMTs preferred a “stay and play” approach where they provide medical interventions on the scene before transporting trauma patients. They felt this allowed them to better stabilize patients by stopping bleeding or starting IVs before loading them into the ambulance.

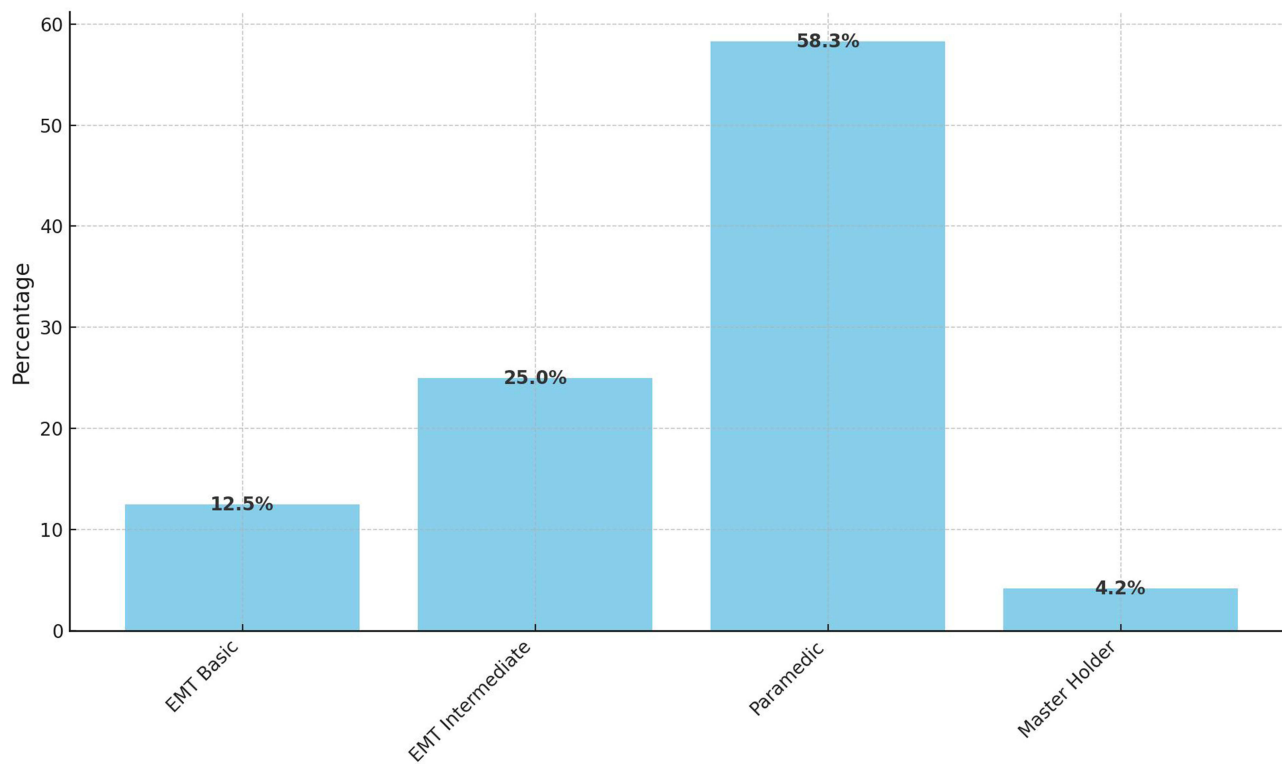


Figure 1 Type of certificate.

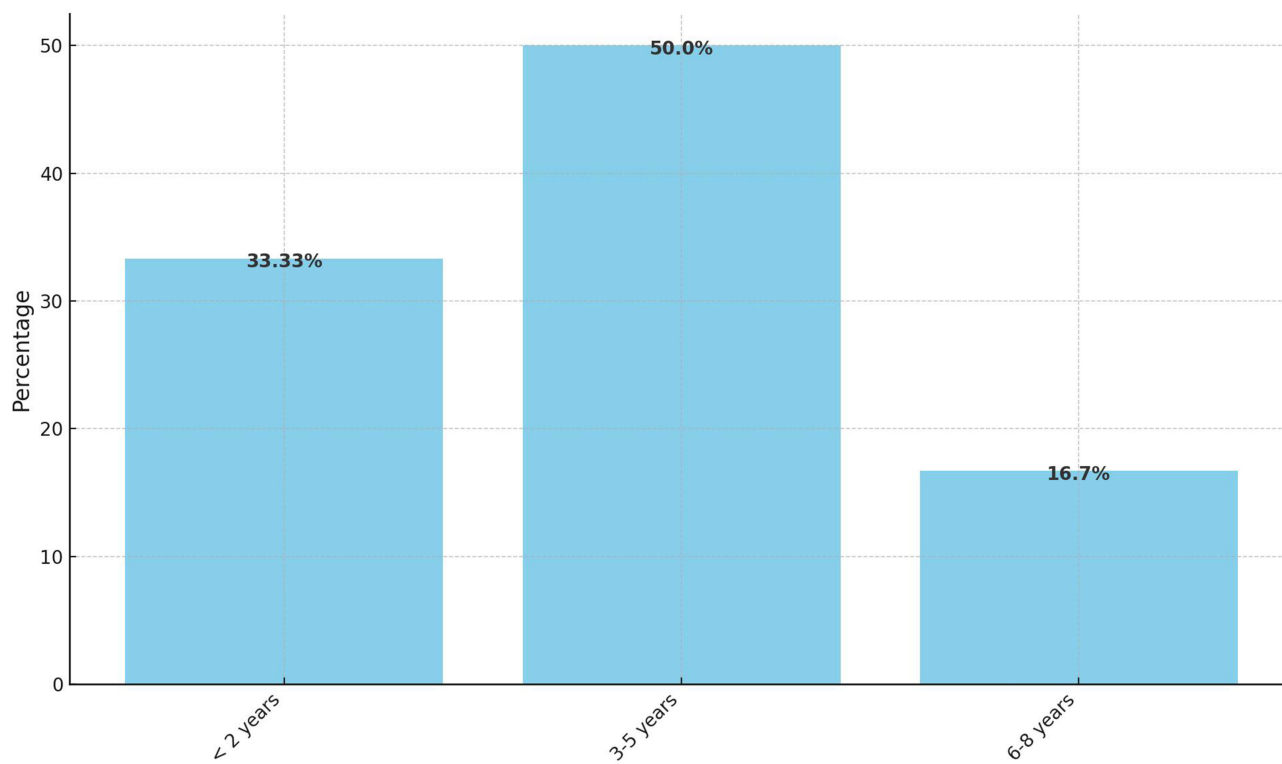
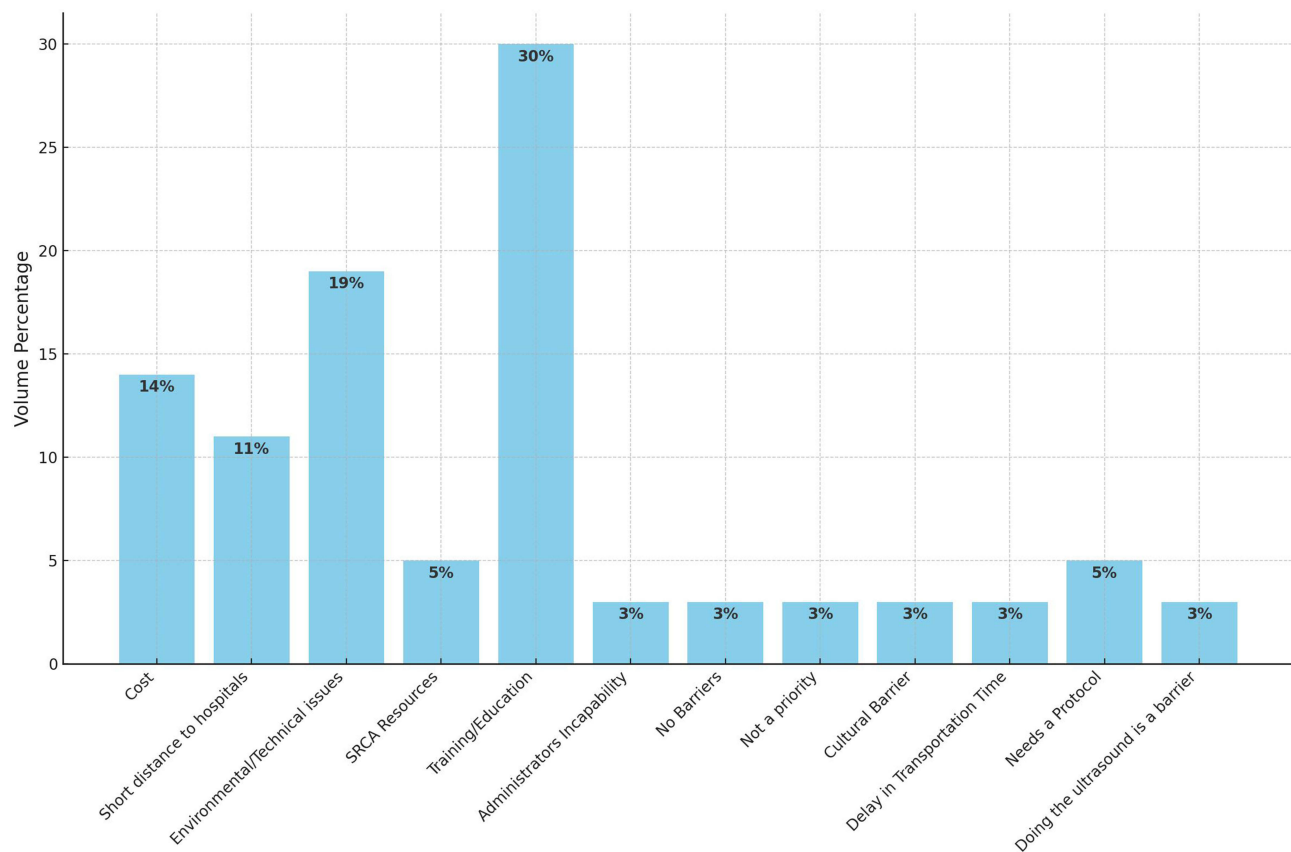


Figure 2 Years of experience.



**Figure 3** Key Identified Barriers.

In contrast, 75% of administrators preferred “load and go” where patients are transported as quickly as possible with minimal on-scene intervention. They saw rapid transport to hospital centers as the top priority. This divergence reveals possible issues related to administrators’ trust and confidence in the skills of ambulance personnel versus the staff’s confidence in their own abilities.

## Ultrasound Familiarity and Confidence

Fifteen participants (62.5%) indicated that they had seen the ultrasound used in various instances, five of the participants (20.8%) reported that they had previously used the ultrasound, three participants (12.5%) noted that they had only heard about the ultrasound machines as a diagnostic tool, and finally, one participant reported having no familiarity with the ultrasound machine.

## SRCA Station Administrators

Four administrators from the Saudi Red Crescent were interviewed to gather insights on implementing ultrasound and identify potential barriers from an administrative standpoint. The interviews encompassed preferred transportation modes, barriers to ultrasound implementation, and confidence in paramedics’ and EMTs’ ultrasound proficiency.

Diverse perspectives emerged regarding transportation preferences. Administrator One emphasized case-specific transportation, favoring urgency. Conversely, Administrator Two advocated for “Stay and Play”, citing resource sufficiency and capable paramedics. Administrator Three supported “Load and Go”, valuing promptness for trauma cases, while Administrator Four aligned with this preference for safety reasons and minimizing on-scene patient time.

Regarding barriers to ultrasound implementation, viewpoints varied. Administrators One and Two acknowledged several barriers, including portability, size, environmental factors, training, and cost. Administrator Three highlighted

maintenance needs and machine expenses. Administrator Four emphasized device sterilization requirements and the necessity of a unified usage protocol.

Regarding confidence in paramedics' and EMTs' ultrasound capabilities, administrators expressed conditional confidence, stressing the importance of comprehensive education and training for successful implementation.

## Emergency Physicians

Emergency Physician One highlighted multiple inherent barriers to ultrasound implementation, including cost, consistent maintenance, environmental challenges, and the need for comprehensive training. Conversely, Emergency Physician Two indicated no specific barriers within the hospital but identified hurdles related to the Saudi Red Crescent, emphasizing training, ambulance mobility, and the device's accuracy in diagnosing trauma patients.

Regarding hospital policy barriers, Physician One highlighted existing mistrust between emergency doctors and radiologists, emphasizing the importance of building trust among stakeholders to ensure successful implementation. In contrast, Physician Two noted the absence of a designated emergency door for ambulances as a procedural challenge.

Concerning the National Guard Hospital's role, Physician One emphasized the hospital's supervision of ultrasound scans, proposing the creation of protocols for paramedic training. Physician Two emphasized the advantage of pre-knowing patient conditions for resource preparation and discussed creating protocols for direct operation room access.

Confidence in paramedics' and EMTs' ultrasound proficiency varied. Physician one expressed partial confidence, questioning whether all personnel would prioritize mastering ultrasound. Physician Two refrained from assessing their capabilities due to lack of involvement with Saudi Red Crescent staff.

## Discussion

The findings reveal important insights into the perceived barriers and training needs critical to the successful adoption of prehospital ultrasound within the SRCA emergency medical system.

Costs, environmental factors, and lack of ultrasound training were the main inherent barriers identified by stakeholders. These are consistent with other studies on adoption challenges.<sup>24,25</sup> The concerns about equipment costs and technically appropriate devices would need to be addressed through careful selection and budgeting.<sup>6,19</sup> Environmental conditions posing issues for ultrasound use like high heat or bright sun may necessitate modified protocols and training for the Saudi context.<sup>26</sup>

However, the divergence in preferred transportation modes between administrators and ambulance personnel highlights equally important implicit barriers concerning trust, confidence, and coordination. The overwhelming preference for "stay and play" among paramedics likely reflects high self-efficacy - referring to one's belief in one's ability to succeed in specific situations, according to Bandura's social cognitive theory.<sup>18</sup> This indicates that paramedics have confidence in their skills and desire to be more involved in direct patient care. Yet administrator concerns about on-scene time potentially delaying transport suggest they lack full trust or collective efficacy - belief in the group's conjoint capabilities to organize and execute courses of action<sup>27</sup> - in the staff's capabilities to stabilize patients.

Establishing extensive ultrasound training for SRCA personnel is essential to developing their skills and self-efficacy in using the technology effectively.<sup>20,28,29</sup> A recent systematic review of evidence-based guidelines for prehospital care have shown that evidence-based training protocols that improve diagnostic accuracy and patient outcomes in prehospital settings are crucial.<sup>30</sup> Building mutual trust, understanding, and coordination between SRCA, hospitals, and other entities through collaborative training and protocols is equally critical. The necessity for an integrated approach that combines technical training with efforts to build trust and communication between different stakeholders is key, reflecting the transformative potential of prehospital ultrasound in emergency medical services.<sup>31,32</sup>

The study findings propose implementing a staged training program that prioritizes providing intensive ultrasound instruction initially to experienced paramedics.<sup>20</sup> With mentoring from medical experts, they can then provide initial onboarding and ongoing field training to expand staff capabilities. This train-the-trainer approach capitalizes on peer modeling and mastery experiences to enhance trainee self-efficacy.<sup>33</sup> It would require close coordination between SRCA, hospitals, and academic programs training future EMTs and paramedics.

Limitations include the small sample size concentrated in one city, which restricts the generalizability of findings. The researcher's personal experience in SRCA also introduces potential bias that was mitigated through data validation. There is also little existing research on this topic specific to Saudi Arabia or similar contexts. Further studies on larger samples across regions could provide greater insights into local implementation needs.

This study illuminates important stakeholder perceptions on adopting prehospital ultrasound within Saudi Arabia's emergency medical services system. Key explicit barriers center on costs, environmental constraints, and lack of ultrasound training. Implicit social barriers are also highlighted by conflicting transportation preferences revealing issues of trust and coordination. An educational initiative combined with collaborative policymaking is proposed to address these multifaceted challenges. This requires engaging diverse stakeholders to align emergency response with patient needs through context-appropriate training and protocols. The lessons learned can guide other regional efforts to improve trauma outcomes through appropriate ultrasound adoption.

## Conclusion

This study provides important insights into stakeholder perspectives on the implementation of prehospital ultrasound within the Saudi Red Crescent Authority. The findings can guide efforts to implement appropriate ultrasound use through tailored training programs and enhanced coordination across groups, aimed at improving trauma outcomes.

## Acknowledgment

The author declare that this paper is based on the author dissertation entitled Stakeholders' Perceptions of Inherent Barriers to the Potential Implementation of Ultrasound in the Prehospital Setting between the Saudi Red Crescent Authority and the National Guard Hospital.<sup>34</sup>

## Disclosure

The authors report no conflicts of interest in this work.

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