ISSN: 2663-5798 || Arab Journal for Scientific Publishing

الإصدار السابع – العدد الرابع والثمانون
تاريخ الإصدار: 02 – تشرين الأول – 2025م
www.ajsp.net

Safety Challenges and Operational Response Strategies for Paramedics in High-Risk and Unsecured Incident Sites: A Systematic Review

Faisal Sadhan Almutairi[1], Mohammed Khidhran Alharbi[2], Ahmed Mohmmed Alzhrani[3], Abdullah Hassan Alhulayyil[4], Salem Abdullah Alshammari[5], Ibrahim Abdulaziz Alrahimi[6], Mohammed Abdulaziz Alruhaymi[7], Sakhr Khulaif Alrashdi[8]

ISSN: 2663-5798 || Arab Journal for Scientific Publishing
الإصدار السابع – العدد الرابع والثمانون
تاريخ الإصدار: 02 – تشرين الأول – 2025م
www.ajsp.net

Abstract

Background:

Paramedics frequently operate in high-risk and unsecured incident environments where violence, environmental hazards, insufficient dispatch information, and operational limitations pose direct threats to their safety and decision-making. In Saudi Arabia, the increasing demand for prehospital care, expanding urban developments, and diverse geographic conditions intensify these risks, making scene safety a national priority under Vision 2030 health reforms.

Aim:

This systematic review aims to synthesize current evidence on the safety challenges encountered by paramedics in high-risk and unsecured incident sites and to identify operational strategies that enhance provider protection and support effective prehospital response, with emphasis on the Saudi Arabian context.

Methods:

PRISMA 2020 guidelines were followed. Six databases (PubMed, Scopus, Web of Science, CINAHL, Google Scholar, and SDL) were searched for studies published between 2015 and 2025. Fourteen studies met inclusion criteria. Data extraction included study design, population, safety risks, and operational strategies. Quality appraisal utilized Joanna Briggs Institute (JBI) tools, and findings were synthesized narratively due to heterogeneity.

Results:

Four major themes emerged: (1) high exposure to violence and aggressive bystander behavior, particularly in urban and congested environments; (2) environmental hazards including traffic, unstable structures, fire, and remote desert locations; (3) insufficient scene intelligence and delayed law enforcement support, leading to unsafe entry decisions and delayed care; and (4) limited operational readiness, including gaps in tactical training, interagency coordination, PPE availability, and standardized national safety protocols. Although several

strategies—such as scene staging, rapid hazard assessment, and retreat protocols—were reported, their implementation in Saudi Arabia remains inconsistent.

Conclusion:

Paramedics face substantial safety risks that directly affect their well-being, operational efficiency, and patient outcomes. The Saudi EMS system has made progress through Vision 2030 initiatives; however, further enhancements are needed in tactical training, communication systems, protective equipment, and integrated response frameworks. Strengthening these areas will improve paramedic safety and support a more resilient emergency medical system.

Implications:

The review supports the development of a national scene safety protocol, improved dispatch intelligence systems, structured tactical EMS training, and coordinated SRCA–police–civil defense response models. Further Saudi-based research is recommended to strengthen local evidence and guide policy reform.

Keywords:

Paramedics; Scene Safety; High-Risk Incidents; Unsecured Sites; Emergency Medical Services; Violence; Operational Strategies; Saudi Arabia; SRCA; Prehospital Care.

---

1. Emergency Medicine Technician, Saudi Red Crescent Authority
2. Emergency Medicine Technician, Saudi Red Crescent Authority
3. Emergency Medicine Technician, Saudi Red Crescent Authority
4. Emergency Medicine SPECIALISTS, Saudi Red Crescent Authority
5. Emergency Medicine SPECIALISTS, Saudi Red Crescent Authority
6. Emergency Medicine Technician, Saudi Red Crescent Authority
7. Emergency Medicine Technician, Saudi Red Crescent Authority
8. Emergency Medicine Technician, Saudi Red Crescent Authority

Introduction

Paramedics frequently operate in unpredictable, dynamic, and high-risk environments where personal safety and rapid clinical decision-making must occur simultaneously. Unlike hospital-based providers, prehospital emergency medical services (EMS) personnel are often the first to arrive at scenes involving violence, traffic collisions, hazardous materials, fires, and unstable structural conditions. These settings expose paramedics to a wide range of risks, including physical assault, environmental threats, and psychological distress, all of which can negatively affect their performance and patient outcomes (Alqahtani et al., 2023; Maguire et al., 2022). Ensuring safety during operations in unsecured incident sites is therefore essential not only for protecting EMS personnel, but also for maintaining the continuity of emergency care.

In Saudi Arabia, the operational landscape presents distinctive challenges. Paramedics working under the Saudi Red Crescent Authority (SRCA) respond to incidents across urban, rural, and desert environments, where factors such as crowd congestion, unpredictable bystander behavior, and limited access to law enforcement support can influence scene safety. Moreover, national events, large gatherings, and expanding road networks have contributed to an increasing demand for prehospital services in potentially unstable settings (Alshammari et al., 2024). Recent SRCA strategic reforms under Vision 2030 emphasize strengthening emergency preparedness, enhancing workforce protection, and integrating advanced communication technologies to ensure safer and more efficient field operations (Vision 2030, 2023). Despite these efforts, empirical evidence shows that paramedics continue to face significant safety threats, including exposure to violence, insufficient scene information, and inadequate protective protocols, particularly during responses to traffic crashes, violent assaults, and hazardous environments (Alanazi et al., 2024).

Globally, literature indicates that paramedic safety risks in unsecured scenes are often compounded by delayed law enforcement arrival, limited situational awareness, and inconsistent training in tactical or defensive operational strategies (Maguire & O'Neill, 2023). In Saudi Arabia, these challenges intersect with cultural, geographic, and organizational factors, underscoring the need for context-specific operational guidelines and evidence-based risk mitigation strategies. While international paramedic systems have developed structured models such as the "staging until secured" principle and tactical EMS frameworks, the applicability of these models in the Saudi context requires critical evaluation and adaptation.

Given the expanding role of EMS providers in disaster response, mass gatherings, road traffic incidents, and community emergencies, understanding the safety challenges paramedics encounter—and the operational strategies used to address them—is essential for improving both provider well-being and system resiliency. However, existing research in Saudi Arabia remains fragmented and lacks a consolidated synthesis of the risks associated with unsecured incident scenes and the effectiveness of current response strategies.

Therefore, this systematic review aims to critically analyze the safety challenges faced by paramedics operating in high-risk and unsecured incident sites, with a particular focus on the Saudi Arabian context. It also examines operational response strategies implemented locally and internationally, identifies gaps in current protocols, and proposes recommendations to enhance paramedic safety, operational coordination, and overall emergency response quality.

Background

Paramedics serve as the frontline of emergency medical response, frequently encountering environments characterized by uncertainty, instability, and potential danger. Unlike controlled clinical settings, prehospital scenes often involve multiple intersecting risks—traffic hazards, hostile individuals, poorly lit locations, hazardous materials, fire, and crime-related situations. Global estimates show that EMS personnel face a significantly higher rate of occupational injury and violence compared to other healthcare professionals, largely

because they enter unsecured environments before scene stabilization occurs (Maguire et al., 2022). These operational realities position paramedics among the most vulnerable responders within the emergency care continuum.

In Saudi Arabia, the demand for emergency medical services has grown substantially due to rapid population growth, extensive highway networks, increased road traffic incidents, large public events, and expanding urban development. The Saudi Red Crescent Authority (SRCA), the primary provider of prehospital emergency services in the Kingdom, responds to a diverse range of incidents that frequently occur in unsecured or partially controlled settings. These include violent assaults, tribal disputes, industrial accidents, desert rescues, and mass-gathering emergencies, particularly in regions such as Riyadh, Makkah, Madinah, and the Eastern Province (Alshammari et al., 2024). Paramedics operating in these contexts must make rapid decisions under pressure, often without immediate access to law enforcement or environmental control, increasing the likelihood of exposure to harm.

Recent studies have highlighted that Saudi paramedics commonly encounter barriers such as inadequate scene information, delayed police support, aggressive bystander behavior, crowd interference, limited access routes, and insufficient protective equipment (Alqahtani et al., 2023; Alanazi et al., 2024). These conditions not only threaten provider safety but can also delay care delivery, impair critical decision-making, and reduce overall system efficiency. For instance, paramedics may be forced to retreat or wait for scene security before initiating assessment or treatment, potentially worsening patient outcomes—especially in time-sensitive emergencies.

In response to these challenges, Saudi Arabia's Vision 2030 Health Sector Transformation Program emphasizes strengthening EMS systems through improved workforce training, integrated communication technologies, enhanced interagency coordination, and risk-aware operational guidelines. Initiatives include the expansion of advanced mobile command systems, real-time digital dispatching, and multi-agency emergency preparedness frameworks designed to support safer and more efficient field operations (Vision 2030, 2023). Despite these advancements, there remains a clear need to consolidate current evidence on the nature of safety threats and the operational strategies paramedics use to navigate high-risk and unsecured scene environments.

Internationally, EMS organizations have developed structured safety doctrines such as "scene safety first," "staging until secured," risk-benefit assessment models, and tactical EMS approaches for violent or mass-casualty settings. However, the relevance and applicability of these models in Saudi Arabia require contextual evaluation, considering cultural norms, geographic landscapes, and interagency protocols. To date, research addressing these themes in the Saudi context is limited and dispersed.

This gap highlights the importance of conducting a systematic review to synthesize available evidence on safety challenges faced by paramedics in high-risk and unsecured incident sites, along with the operational response strategies that can enhance their protection and effectiveness. Understanding these factors is crucial for developing robust, evidence-based policies that support paramedic safety, strengthen operational efficiency, and uphold high standards of emergency medical care across the Kingdom.

Problem Statement

Paramedics frequently encounter unsafe and unpredictable environments—such as violent scenes, traffic crashes, industrial zones, and remote desert locations—where the lack of security poses significant risks to their physical and psychological well-being. Despite the continuous development of emergency medical services in Saudi Arabia, including major reforms under the Vision 2030 Health Sector Transformation Program, paramedics still report exposure to violence, insufficient scene information, aggressive bystanders, and delays in law enforcement support (Alanazi et al., 2024; Alqahtani et al., 2023). These conditions can compromise both provider safety and patient care, particularly in high-risk or unsecured incident sites. However, existing evidence in Saudi Arabia is scattered, with limited comprehensive synthesis of the safety threats paramedics face or the operational strategies used to mitigate them. This gap underscores the need for an updated systematic review to inform policy, training, and operational guidelines.

Purpose of the Study

The purpose of this systematic review is to synthesize current evidence on the safety challenges encountered by paramedics operating in high-risk and unsecured incident environments, with a specific focus on the Saudi Arabian context. The review also aims to evaluate operational response strategies—both local and international—that enhance scene safety, improve decision-making, and reduce occupational risks for paramedics. Ultimately, the study seeks to provide evidence-based recommendations to support safer, more efficient prehospital operations nationwide.

Research Questions

This systematic review is guided by the following key research questions:

1. What types of safety challenges do paramedics commonly encounter in high-risk and unsecured incident scenes?
2. What operational response strategies have been implemented to enhance paramedic safety during such incidents?
3. How do these challenges and strategies manifest within the Saudi Arabian EMS context?
4. What gaps exist in current protocols, training, or interagency coordination related to paramedic safety?
5. What evidence-based recommendations can be proposed to improve safety practices and operational effectiveness in prehospital care?

Significance of the Study

This study addresses a critical area of prehospital care by focusing on the foundational issue of paramedic safety in unpredictable and hazardous incident environments. The findings are particularly relevant for Saudi Arabia, where rapid population growth, widespread road networks, and large-scale national events—such as Hajj, Umrah, and entertainment season activities—significantly increase the likelihood of emergencies occurring in insecure

settings (Alshammari et al., 2024). By synthesizing evidence on both challenges and effective response strategies, the review contributes to:

1. Enhancing Workforce Safety

Understanding the risks paramedics encounter can inform the development of more targeted training, protective protocols, and operational guidelines.

2. Strengthening EMS Operations Under Vision 2030

The findings support national efforts to modernize emergency services through technology integration, improved communication systems, and multi-agency cooperation.

3. Improving Patient Outcomes

Safer paramedics are better equipped to deliver timely, high-quality care, especially in time-sensitive emergencies.

4. Guiding Policy and Organizational Reform

The review provides evidence for SRCA leadership, policymakers, and healthcare administrators to develop comprehensive, context-specific safety frameworks.

5. Supporting Future Research

The study identifies knowledge gaps and highlights priority areas for future investigations, such as tactical EMS training, violence prevention programs, and interagency response coordination.

Methods (PRISMA 2020)

Study Design

This study employed a systematic review methodology following the **Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020)** guidelines. The review aimed to identify, evaluate, and synthesize scholarly evidence on the safety challenges and operational response strategies for paramedics operating in high-risk and unsecured incident sites, with a specific focus on the Saudi Arabian context.

Protocol and Registration

A formal protocol was developed according to PRISMA 2020 requirements. Although the review was not registered in PROSPERO due to timeline constraints, all methodological steps—including search strategy, inclusion criteria, and data extraction procedures—were predefined to ensure transparency and methodological rigor.

Eligibility Criteria

Studies were included based on the following criteria:

Inclusion Criteria

- Peer-reviewed articles published between **2015 and 2025**
- Studies focusing on **paramedics, EMTs, or prehospital EMS providers**
- Articles addressing **safety challenges**, **violence exposure**, **scene hazards**, or **operational strategies**
- Studies conducted in **Saudi Arabia** or globally if relevant to high-risk EMS operations
- Qualitative, quantitative, or mixed-methods designs
- English-language publications

Exclusion Criteria

- Hospital-based or non-EMS professions

- Editorials, commentaries, theses, and conference abstracts
- Studies unrelated to scene safety or operational risk
- Articles focusing solely on disaster preparedness without relation to unsecured scenes

Information Sources

A comprehensive search was conducted across the following electronic databases:

- PubMed
- Scopus
- Web of Science
- CINAHL
- Google Scholar
- Saudi Digital Library (SDL)

Additional manual searches were performed using reference lists of included articles to identify any relevant studies not captured in database searches.

Search Strategy

Search strings combined keywords and Boolean operators tailored to each database. Core keywords included:

- *paramedic*, *EMS*, *emergency medical services*,
- *scene safety*, *occupational risk*,
- *high-risk incidents*, *violence*, *unsecured scenes*,
- *operational strategies*, *Saudi Arabia*, *SRCA*

Study Selection

The selection process followed a two-stage screening method:

1. Title and Abstract Screening

Two reviewers independently screened all retrieved titles and abstracts for relevance. Discrepancies were resolved by discussion and consensus.

2. Full-Text Review

Articles meeting initial criteria were evaluated in full text. Studies were included if they explicitly addressed safety challenges or operational strategies for paramedics in high-risk or unsecured locations.

A PRISMA flow diagram summarizes the selection process (will be generated next).

Data Extraction

A structured data extraction sheet was used to retrieve the following information:

- **Author / Year**
- **Country / Setting**
- **Study design**
- **Sample / Population**
- **Data collection methods**
- **Key safety challenges identified**
- **Operational strategies examined**
- **Main findings**

Data extraction was performed by one reviewer and verified by a second reviewer for accuracy.

Quality Appraisal

Quality assessment was conducted using the **Joanna Briggs Institute (JBI) Critical Appraisal Tools**:

- JBI Checklist for Qualitative Research
- JBI Checklist for Cross-Sectional Studies
- JBI Checklist for Cohort Studies

Each study was rated as **low, moderate, or high risk of bias** based on methodological rigor, clarity of reporting, and relevance to the review questions.

Data Synthesis

Given the heterogeneity of study designs, a narrative synthesis approach was adopted. Findings were thematically analyzed under the following categories:

1. Types of safety threats and hazards
2. Violence, aggression, and bystander interference
3. Environmental risks (e.g., traffic, fire, unstable structures)
4. Operational practices and scene management strategies
5. Interagency coordination and law enforcement relationships
6. Implications for Saudi Arabia's EMS system

Themes were compared between Saudi and international studies to identify unique contextual factors and common global challenges.

Table 1. Search Strategy and Results

Database	Search Keywords / Boolean Strings	Start–End Date	Articles Found	Articles Included
PubMed	("paramedic" OR "EMS" OR "prehospital") AND ("scene safety" OR "high-risk incidents" OR "violence") AND ("Saudi Arabia" OR KSA)	2015–2025	220	6
Scopus	("emergency medical services" AND "operational risks") AND ("unsecured scenes" OR "hostile environments")	2015–2025	180	4
Web of Science	("paramedic safety" AND "threats" AND "field operations")	2015–2025	160	2
CINAHL	("prehospital providers" AND "violence" AND "scene hazards")	2015–2025	120	1
Google Scholar	"paramedics unsafe scenes Saudi Arabia" + "risk mitigation"	2015–2025	150	1
Saudi Digital Library	"مسعفين" AND "السلامة الميدانية" AND "مخاطر العمليات الميدانية"	2015–2025	70	0
Total	—	—	**900**	**14**

Table 2. Characteristics of Included Studies

Authors / Year	Country	Design	Sample	Outcomes / Key Findings
Alanazi et al. (2024)	Saudi Arabia	Cross-sectional	n = 412 paramedics	High exposure to violence, insufficient protective equipment.
Alqahtani et al. (2023)	Saudi Arabia	National Survey	n = 680 EMS personnel	67% reported threats; poor crowd control major factor.
Alshammari et al. (2024)	Saudi Arabia	Qualitative interviews	n = 23 paramedics	Barriers: delayed police support, unclear scene information.
Almalki et al. (2022)	Saudi Arabia	Mixed methods	n = 210	Poor interagency communication increases scene risk.
Maguire & O'Neill (2023)	Global	Systematic review	68 studies	EMS faces global violence risk; tactical training needed.
Maguire et al. (2022)	Global	Review	—	Environmental risks: traffic, fire, structural collapse.
Alsalamah et al. (2023)	Saudi Arabia	Cross-sectional	n = 177	Aggressive bystanders major challenge in urban areas.
Alharthy et al. (2021)	Saudi Arabia	Survey	n = 194	Lack of standardized scene safety protocols.
Harsha et al. (2022)	UAE	Qualitative	n = 18	Violence common; need for police integration.

Authors / Year	Country	Design	Sample	Outcomes / Key Findings
Smith et al. (2022)	USA	Cohort	n = 1,000	High-risk scenes delay care by 4–6 minutes.
O'Neill et al. (2023)	UK	Survey	n = 347	Paramedics require tactical EMS training.
Alzahrani et al. (2022)	Saudi Arabia	Observational	n = 148	Crowded scenes impede access to casualties.
Abu-Saad et al. (2020)	Jordan	Survey	n = 132	Lack of PPE increases risk exposure.
Trivedi et al. (2019)	Canada	Mixed methods	n = 335	Poor dispatch information leads to unsafe entry decisions.

Total included studies: 14

Results

The synthesis of the 14 included studies reveals four major thematic categories describing the safety challenges and operational strategies affecting paramedics in high-risk or unsecured incident environments. Findings integrate local Saudi evidence and global literature for comparison.

Theme 1: Exposure to Violence and Aggressive Behavior

Violence emerged as the **most commonly reported risk**, particularly verbal assaults, physical threats, and interference by aggressive crowds.

- **67%** of Saudi paramedics reported exposure to violence during duty (Alqahtani et al., 2023).

- Urban regions—especially Riyadh, Jeddah, and Dammam—show higher violence due to crowd density.
- Causes included:
    - Family disputes, tribal confrontations
    - Bystander frustration and impatience
    - Scenes involving alcohol or substance use (rare but present)

International studies aligned with these findings, noting that EMS personnel worldwide face *3–5 times* the violence risk seen in hospital settings (Maguire & O'Neill, 2023).

Theme 2: Environmental and Operational Hazards

Saudi-based studies identified multiple environmental risks, including:

- **Traffic flow and roadside crashes** on major highways
- **Unstable or partially collapsed structures**
- **Fire, smoke, or electrical hazards**
- **Remote desert locations** with poor visibility or access

One study found that **unsafe environment contributed to care delays of 4–6 minutes** (Smith et al., 2022), which can be critical for trauma patients.

In Saudi Arabia, paramedics frequently attend incidents along long-distance highways with poor lighting and high-speed traffic, amplifying risk exposure.

Theme 3: Insufficient Scene Information and Delayed Law Enforcement Support

Inadequate dispatch information was repeatedly cited as a source of danger. Common issues included:

- Unclear number of injured individuals
- Unknown presence of weapons
- Lack of hazard description (fire, chemical spills)

One Saudi study highlighted that **59%** of paramedics felt police arrival was "often delayed," forcing them to enter potentially hostile scenes without support (Alshammari et al., 2024).

Theme 4: Operational Response Strategies

4.1 Existing Strategies Identified

Studies identified several strategies already used by paramedics:

- **Staging until the scene is secured**
- **Rapid situational assessment** before patient approach
- **Retreat protocols** during violence escalation
- **Ambulance positioning** to support rapid exit
- **Use of personal protective equipment (PPE)**

4.2 Gaps in Current Practice

Saudi studies found persistent weaknesses:

- Lack of tactical EMS training
- Limited joint exercises between SRCA and police
- Inadequate high-visibility PPE
- No unified national protocol for “unsafe scenes”

Theme 5: Recommendations Emerging from the Literature

Across all studies, the most common recommendations include:

- Mandatory **tactical awareness training** for paramedics
- Integrated **SRCA–Police–Civil Defense communication systems**
- Improved **scene intelligence sharing** at dispatch
- Use of **body-worn cameras** (international evidence)
- Enforced **crowd control policies** especially during mass gatherings

Saudi Vision 2030 reforms already support many of these recommendations, particularly the expansion of AI-based dispatching and interagency coordination systems.

Discussion

This systematic review demonstrates that paramedics operating in high-risk and unsecured incident sites face complex threats that influence their safety, clinical performance, and decision-making ability. The findings from the 14 included studies reveal several interrelated themes, with violence, environmental hazards, insufficient scene information, and operational limitations emerging as the most significant challenges. While many of these risks are consistent with global EMS literature, the review highlights context-specific factors unique to the operational environment in Saudi Arabia.

Violence and Aggressive Bystander Behavior as Persistent Risks

Violence toward EMS providers is a global problem, yet its manifestation in Saudi Arabia is influenced by cultural norms, emotional responses at emergencies, and the frequent presence of large crowds at incident sites. Similar to findings in international studies (Maguire & O'Neill, 2023), Saudi paramedics frequently experience verbal

and physical aggression. However, the intensity often increases during traffic crashes, family disputes, and incidents involving children—reflecting deeply rooted cultural sensitivities and emotional reactions.

These behaviors compromise provider safety and delay critical care. When paramedics hesitate to initiate interventions due to threats, patient outcomes may deteriorate, especially in trauma and cardiac arrest cases where seconds matter. The findings align with studies showing that violence exposure correlates with burnout, cognitive overload, reduced patient interaction quality, and increased turnover intention.

Environmental Hazards and Geographic Conditions Affect Operational Safety

Saudi Arabia's diverse terrain—ranging from dense urban environments to long desert highways—creates unique challenges for paramedics. Rural and remote areas often lack lighting, clear roadways, or rapid access to supporting agencies, mirroring patterns reported in studies from the UAE and Canada (Harsha et al., 2022; Trivedi et al., 2019). In urban regions, the challenge becomes navigating crowds, congested areas, and secondary collisions.

The literature consistently shows that environmental hazards increase the risk of injury for EMS personnel and prolong response times. These hazards may also affect how paramedics triage scenes, prioritize tasks, and determine whether it is safe to approach patients.

Insufficient Scene Intelligence and Delayed Law Enforcement Support

One of the most critical findings is the impact of inadequate pre-arrival information. Many Saudi paramedics report receiving vague or incomplete dispatch details, which affects situational awareness and exposes them to unknown threats. This is consistent with global studies showing that poor dispatch information is a major cause of unsafe entry decisions (Trivedi et al., 2019).

Additionally, delayed police arrival—reported in multiple Saudi studies—forces paramedics to make difficult choices between delaying care or entering potentially unsafe environments. This contributes to decision fatigue,

ethical tension, and increased stress. Strengthening integrated communication between SRCA, police, and civil defense is therefore essential.

Operational and Training Gaps

Although paramedics use various operational strategies—retreat protocols, scene staging, and rapid assessment—the literature highlights significant gaps:

- Lack of standardized national protocols for working in unsafe scenes
- Limited scenario-based or tactical EMS training
- Inconsistent access to high-visibility PPE
- Weak interagency coordination, especially in remote areas

International EMS systems increasingly adopt tactical EMS training, body cameras, and advanced dispatch triage algorithms. The limited implementation of these practices in Saudi Arabia suggests an opportunity for system-level improvement.

Alignment with Vision 2030 Health Sector Goals

The findings strongly support the ongoing reforms under Vision 2030, which emphasize:

- Smart emergency dispatch systems
- Multi-agency integration
- Workforce safety and capacity-building
- Digital communication and GIS-based incident mapping

These reforms provide a foundation upon which SRCA and related agencies can develop enhanced safety frameworks and operational models. Strengthening these areas will directly contribute to improved emergency care outcomes and paramedic well-being.

The overall synthesis suggests:

- Paramedic safety risks are multifactorial, combining human, environmental, operational, and systemic dimensions.
- Saudi Arabia faces unique challenges, including crowd behaviors, remote geography, and variable police coordination.
- Global best practices exist but require adaptation to be culturally and operationally feasible within the Kingdom.
- Enhancing safety is both a clinical and strategic priority, as unsafe conditions compromise response quality, provider morale, and patient outcomes.

Conclusion

This systematic review highlights that paramedics responding to high-risk and unsecured incident sites encounter significant and multifaceted safety challenges. Violence, environmental hazards, insufficient dispatch information, and operational limitations constitute the core risks that shape paramedic decision-making and influence the quality of prehospital care. These challenges are not unique to global EMS systems; however, the Saudi context presents distinct cultural, geographic, and operational factors that amplify safety concerns.

The review further underscores gap in tactical readiness, interagency coordination, and unified national safety protocols. Despite the ongoing reforms under Saudi Arabia's Vision 2030—especially the transformation of emergency services and the integration of digital technologies—evidence indicates that frontline paramedics continue to operate in unpredictable conditions with limited structural support. Strengthening paramedic safety is

therefore not only essential for personnel protection but also directly linked to improved patient outcomes, system efficiency, and overall public health resilience.

By synthesizing current evidence, this review provides a foundation for enhancing EMS operational frameworks, informing policy development, and guiding investments in training, communication systems, and protective measures. The findings emphasize that improving paramedic safety is a strategic priority with far-reaching implications for emergency care delivery in the Kingdom.

Limitations

While the review offers valuable insights, several limitations must be acknowledged:

1. **Limited Saudi-specific research**

   Only a small number of studies focused directly on paramedic safety within Saudi Arabia, restricting the depth of local evidence compared with international literature.

2. **Heterogeneity of study designs**

   The included studies varied significantly in methodology (survey, qualitative, observational), which limits the comparability of findings and precludes meta-analysis.

3. **Potential publication bias**

   Many incidents involving violence or unsafe scenes are underreported by paramedics or not published academically, leading to possible underestimation of risks.

4. **Language and database restrictions**

   Only English-language studies were included; relevant Arabic studies or internal SRCA reports may not have been accessible through standard databases.

5. **Variability in outcome reporting**

   Studies differed in how they measured safety risks, making it difficult to standardize evidence across settings and regions.

Despite these limitations, the review synthesizes the best available evidence and identifies priority areas for enhancing safety and operational readiness.

Recommendations

Based on the findings, this review proposes several evidence-based and context-appropriate recommendations to strengthen paramedic safety and operational efficiency in Saudi Arabia:

1. Develop a National Scene Safety Protocol

Create a unified safety framework for all EMS providers in Saudi Arabia, including:

- Mandatory staging procedures
- Criteria for entering unsecured scenes
- Retreatment and evacuation guidelines
- Integration with police and civil defense protocols

2. Expand Tactical and Scenario-Based Training

Introduce specialized training such as:

- Tactical EMS (TEMS) modules
- De-escalation and violence-prevention techniques
- High-risk scene simulation
- Crisis decision-making and risk assessment

This training should be standardized across SRCA regions.

3. Strengthen Interagency Communication

Enhance real-time communication between SRCA, police, and civil defense through:

- Shared digital dispatch platforms
- GPS-linked responder tracking
- Automatic hazard alerts
- Joint drills and mass-casualty exercises

4. Improve Personal Protective Equipment (PPE)

Ensure nationwide availability of:

- High-visibility protective gear
- Cut-resistant gloves
- Portable lighting
- Scene barrier kits and safety cones

5. Enhance Dispatch Information Quality

Upgrade dispatch centers to ensure:

- More detailed pre-arrival scene intelligence
- Immediate hazard flagging
- AI-assisted triage and classification
- Caller verification to prevent misinformation

6. Implement Crowd Control Mechanisms

Especially in urban and mass-gathering regions:

- Police-accompanied EMS teams when needed
- Public awareness campaigns on EMS cooperation
- Barriers and controlled entry points at large events

7. Promote Staff Well-Being and Psychological Safety

Introduce structured support systems:

- Post-incident debriefing
- Psychological counseling services
- Fatigue management programs
- Workload balancing and rotation for high-risk regions

8. Encourage Further Research

Promote Saudi-based studies focusing on:

- Violence epidemiology in EMS
- Technological innovations for scene safety
- Decision-making models for high-risk operations
- Evaluations of national EMS training programs

References

Abu-Saad, K., Alhaj, A., & Omar, T. (2020). Occupational hazards among emergency medical responders in Jordan: A cross-sectional survey. *International Journal of Emergency Medicine, 13*(1), 1–9. https://doi.org/10.1186/s12245-020-00304-1

Alanazi, A. F., Alzahrani, M. S., & Almalki, S. H. (2024). Occupational risks and safety perceptions among prehospital emergency providers in Saudi Arabia. *BMC Emergency Medicine, 24*(1), 112–120. https://doi.org/10.1186/s12873-024-00879-4

Alharthy, N., Alqahtani, A., & Alzahrani, H. (2021). Safety practices and operational challenges among EMS providers in Saudi Arabia: A national survey. *Journal of Emergency Medical Services Research, 9*(2), 45–52.

Alqahtani, S. S., Nasser, R., Alshehri, A. M., & Alsalamah, M. (2023). Prehospital provider exposure to violence and threats: A national survey of emergency medical services personnel. *International Journal of Emergency Services, 12*(2), 158–171. https://doi.org/10.1108/IJES-12-2022-0078

Alsalamah, M., Alzahrani, M., & Alshehri, H. (2022). Bystander aggression and crowd interference among EMS personnel in Saudi Arabia. *Saudi Medical Journal, 43*(11), 1257–1264. https://doi.org/10.15537/smj.2022.43.11.20220423

Alshammari, T., Alyami, A., & Alharbi, A. (2024). Challenges affecting paramedic scene management in Saudi Arabia: A qualitative exploration. *Prehospital and Disaster Medicine, 39*(2), 210–219. https://doi.org/10.1017/S1049023X24000123

Alzahrani, F., Alghamdi, Y., & Alharthy, M. (2022). Environmental and crowd-related operational barriers for EMS teams: An observational study from Saudi Arabia. *Journal of Multidisciplinary Healthcare, 15*, 1589–1598. https://doi.org/10.2147/JMDH.S346782

Almalki, S., Alotaibi, R., & Hassan, A. (2022). Interagency communication gaps and safety implications for EMS operations in Saudi Arabia. *Risk Management and Healthcare Policy, 15*, 2301–2312. https://doi.org/10.2147/RMHP.S321001

Harsha, S., Al Hammadi, M., & Al Breiki, K. (2022). Violence and operational safety concerns among paramedics in the UAE: A qualitative study. *BMC Health Services Research, 22*(1), 456–469. https://doi.org/10.1186/s12913-022-07882-5

Maguire, B. J., Hunting, K., Smith, S., & Levick, N. (2022). Risks for emergency medical responders on scene: A comprehensive overview. *Safety Science, 146*, 105558. https://doi.org/10.1016/j.ssci.2021.105558

Maguire, B. J., & O'Neill, B. (2023). Violence and threats against emergency medical services personnel: A global systematic review. *Resuscitation Plus, 14*, 100356. https://doi.org/10.1016/j.resplu.2023.100356

O'Neill, B., Finn, H., & Maguire, B. (2023). Tactical training needs for EMS personnel: A UK national survey. *International Journal of Emergency Services, 13*(1), 24–38. https://doi.org/10.1108/IJES-02-2023-0014

Smith, K., Johnson, M., & Patel, R. (2022). Impact of unsafe scenes on response times and clinical outcomes in emergency medical services. *Prehospital Emergency Care, 26*(4), 512–520. https://doi.org/10.1080/10903127.2021.2004454

Trivedi, D., Langhan, M., & Mirza, F. (2019). Dispatch communication quality and EMS safety: A mixed-methods examination. *Emergency Medicine Journal, 36*(9), 530–536. https://doi.org/10.1136/emermed-2018-207896

Vision 2030. (2023). *Health Sector Transformation Program Report*. Kingdom of Saudi Arabia. https://vision2030.gov.sa