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# Assessing Occupational Safety Risks and Prevention Strategies Among Ambulance Personnel In the Saudi Red Crescent Authority in Light of The Objectives of Vision 2030

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## Abstract

**Background:** Ambulance personnel in the Saudi Red Crescent Authority (SRCA) are routinely exposed to multiple occupational risks, including physical, biological, ergonomic, and psychosocial hazards. These risks directly influence workforce well-being and patient safety. Aligning occupational safety practices with the Health Sector Transformation Program (HSTP) under Saudi Vision 2030 is essential for ensuring sustainable and safe emergency medical services.

**Aim:** This systematic review aimed to synthesize evidence on occupational safety risks and preventive strategies among ambulance personnel in Saudi Arabia, with a focus on their alignment with Vision 2030 objectives.

**Methods:** A systematic review was conducted following the PRISMA 2020 guidelines. Electronic databases including PubMed, Scopus, Web of Science, and CINAHL were searched for studies published between 2015 and 2025 using combinations of keywords: "occupational safety," "ambulance personnel," "Saudi Red Crescent," and "Vision 2030." Inclusion criteria comprised studies addressing occupational risks, preventive strategies, and safety culture within EMS settings. Studies focusing solely on hospital-based staff or non-EMS healthcare workers were excluded. Data extraction and quality assessment were performed independently by two reviewers using the Joanna Briggs Institute (JBI) checklist.

**Results:** Fourteen studies met the inclusion criteria. The most prevalent hazards identified were musculoskeletal injuries (reported in 78% of studies), needle-stick injuries (64%), and psychological stress (57%). Evidence indicated that continuous safety training, leadership engagement, and simulation-based programs were strongly associated with improved compliance with safety standards. Barriers

included inconsistent PPE use, underreporting of incidents, and weak organizational safety culture. Studies emphasizing digital monitoring and data-driven safety frameworks demonstrated promising outcomes in enhancing compliance and early hazard detection.
**Conclusion:** The review concluded that occupational safety among SRCA ambulance personnel remains a critical yet underdeveloped domain. While Saudi Vision 2030 has catalyzed advancements in workforce safety and preventive health, gaps persist in standardization, leadership accountability, and technology integration. Reinforcing continuous professional education, digital incident reporting, and mental health support is vital to achieving sustainable workforce safety aligned with national transformation goals.

**Keywords:** Occupational safety, ambulance personnel, Saudi Red Crescent Authority, Vision 2030, emergency medical services, systematic review, workforce sustainability

## Introduction

Pre-hospital emergency medical services provided by Saudi Red Crescent Authority (SRCA) occupy a critical position within Saudi Arabia's healthcare transformation agenda under Saudi Vision 2030. The Health Sector Transformation Program (HSTP) emphasises enhancing service quality, advancing prevention strategies, and optimising the workforce. Accordingly, it is imperative to examine the occupational safety risks confronting ambulance personnel and to explore effective prevention strategies that align with national objectives (Vision 2030 Health Sector Transformation Program, 2021).

Ambulance crews operate in dynamic and high-risk environments characterized by rapid response demands, unstable scenes, heavy lifting, exposure to biological hazards, vehicular traffic risks, and psychological stressors. Research indicates that these front-line responders face elevated susceptibility to musculoskeletal injuries, needle-stick exposures, violence, and occupational burnout (Al-Buraidi et al., 2023; AlQraad Mohammed Mana et al., 2024). In the Saudi context, for instance, design-related issues in ambulance interiors have been shown to compromise safety for both patients and responders (Safety issues faced by paramedics in ambulances in Saudi Arabia…, 2020). Moreover, regulatory frameworks such as the Saudi "Occupational Safety and Health Management" regulation mandate proactive risk identification and mitigation, yet operational compliance and cultural adoption remain inconsistent (Ministry of Labor & Social Development, 2018).

Emergency medical services (EMS) form a vital component of Saudi Arabia's healthcare system, ensuring timely prehospital care across the nation. The Saudi Red Crescent Authority (SRCA) plays a central role in this system, deploying thousands of ambulance personnel who face diverse occupational hazards during high-stress and unpredictable emergency operations. These hazards include physical strain from patient transport, exposure to infectious materials, vehicular risks, and emotional trauma. Addressing these risks aligns directly with Saudi Vision 2030's objectives for preventive healthcare and sustainable workforce development.

Globally, EMS workers have been shown to experience higher rates of musculoskeletal injuries, needlestick exposures, and psychological distress compared to other healthcare professionals (Huang et al., 2024). In Saudi Arabia, these risks are compounded by rapid urbanization, climatic challenges, and varying regional resource capacities. Although SRCA has implemented occupational safety regulations and training programs, inconsistent adherence and underreporting remain prevalent (Al-Buraidi et al., 2023). Therefore, it became necessary to consolidate the available evidence to guide policy and practice.

This systematic review aimed to synthesize existing literature on occupational safety risks and preventive measures among SRCA ambulance personnel. It further sought to evaluate the extent to which these practices align with Vision 2030's Health Sector Transformation Program goals, emphasizing safety, prevention, and workforce sustainability.

## Study Objectives

### General Objective

To systematically assess occupational safety risks and evaluate prevention strategies among ambulance personnel in the Saudi Red Crescent Authority (SRCA), synthesizing evidence from existing literature in alignment with the objectives of Saudi Vision 2030.

**Specific Objectives**

1. To identify the most common occupational hazards faced by SRCA ambulance personnel, including physical, biological, ergonomic, and psychosocial risks reported in previous studies.
2. To analyze the preventive measures and safety management strategies implemented within SRCA and comparable EMS systems globally.
3. To evaluate the relationship between safety training, leadership commitment, and compliance with occupational safety standards.
4. To assess the extent to which current occupational safety practices in SRCA align with Vision 2030's health sector transformation goals of prevention, quality, and workforce sustainability.
5. To identify research and policy gaps related to occupational safety among EMS professionals in Saudi Arabia and recommend evidence-based improvements.

**Background and Justification**

Occupational safety in emergency medical services (EMS) is an emerging global priority due to the multidimensional hazards faced by healthcare responders in prehospital environments. Unlike hospital-based personnel, ambulance teams operate in unpredictable and uncontrolled settings, where exposure to physical, biological, ergonomic, and psychological risks is inherent in their daily tasks (Al-Buraidi et al., 2023).

These risks include musculoskeletal injuries from patient lifting and transfer, exposure to infectious materials, traffic-related accidents, and high emotional strain resulting from continuous exposure to trauma and critical incidents (Huang et al., 2024). Such challenges directly influence staff retention, job satisfaction, and the quality of patient care, particularly in low-visibility, high-demand situations typical of emergency field operations.

In the Saudi Red Crescent Authority (SRCA), these occupational hazards intersect with the national agenda of Vision 2030, which seeks to create a safe, productive, and high-performing healthcare workforce. The Health Sector Transformation Program (HSTP) underscores "prevention before treatment" and "sustainability of human capital" as guiding principles (Vision 2030, 2021). However, studies within Saudi Arabia have indicated variability in the application of safety protocols, inconsistent use of personal protective equipment, and insufficient reporting systems for occupational injuries (AlQraad Mohammed Mana et al., 2024). The absence of continuous monitoring and training mechanisms limits the implementation of international best practices such as ISO 45001 and WHO occupational health frameworks.

Furthermore, the cultural aspect of safety management within SRCA—where staff may underreport incidents due to fear of accountability or hierarchical constraints—poses an additional challenge. Recent research highlights that improving safety culture, incident reporting, and leadership commitment can significantly reduce occupational risks and enhance team resilience (Qassim et al., 2024). Integrating these dimensions with Saudi Vision 2030's emphasis on digital transformation provides a unique opportunity to strengthen safety governance through smart reporting tools, data analytics, and predictive risk assessment models.

Thus, the present study is justified by the need to bridge the knowledge gap between policy aspirations and field-level implementation of occupational safety practices among ambulance personnel. It aims to generate localized, evidence-based insights that can guide strategic decision-making and align SRCA's operational safety performance with national transformation objectives.

**Literature Review**

**Overview of Occupational Safety in Emergency Medical Services**

Occupational safety in emergency medical services (EMS) has gained increasing global attention due to the demanding and unpredictable nature of prehospital environments. Ambulance personnel face multiple

categories of hazards—physical, biological, ergonomic, chemical, and psychosocial—that collectively impact workforce health, performance, and service quality. Globally, musculoskeletal injuries, needle-stick exposures, and psychological distress have been reported as the most prevalent occupational challenges among EMS professionals (Huang et al., 2024).

The physical and ergonomic burdens of lifting patients and medical equipment, combined with long working hours and limited rest, have been directly linked to chronic back pain and musculoskeletal disorders (Al-Buraidi et al., 2023). Moreover, emergency responders are frequently exposed to infectious diseases through contact with bodily fluids and contaminated surfaces, underscoring the importance of personal protective equipment (PPE) and proper infection control protocols. Despite available safety guidelines, adherence often varies by region and resource availability.

**International Context and Best Practices**

Internationally, several countries have established robust occupational safety systems for EMS personnel. For example, the United Kingdom's National Health Service (NHS) enforces a comprehensive framework incorporating ISO 45001 standards and mandatory risk assessments for all prehospital workers. Similarly, Canada's paramedic services integrate psychological resilience programs and safety debriefing mechanisms to mitigate trauma-related stress. These international models emphasize proactive leadership engagement, continuous training, and data-driven safety evaluation.

A systematic review by Huang et al. (2024) demonstrated that continuous safety training and leadership support significantly reduced workplace injuries and improved compliance with PPE standards. Simulation-based safety education, which mirrors real-life ambulance scenarios, has been shown to enhance staff readiness and confidence when managing occupational risks. However, resource constraints and high operational demands continue to limit implementation in developing EMS systems.

**Occupational Safety within the Saudi Red Crescent Authority (SRCA)**

Within Saudi Arabia, the SRCA represents the backbone of prehospital care and emergency medical response. Studies indicate that SRCA personnel are at elevated risk of physical and psychological harm due to heavy workloads, traffic-related hazards, and insufficient ergonomic support. AlQraad et al. (2024) found that 62% of SRCA respondents had experienced at least one work-related injury, with 21% reporting needle-stick incidents during emergency interventions.

Although the SRCA has developed safety guidelines aligned with the Ministry of Health's occupational safety regulations, compliance remains inconsistent across regions. This inconsistency stems from variable training opportunities, leadership commitment, and cultural perceptions of safety accountability. Qassim et al. (2024) emphasized that leadership visibility and non-punitive reporting systems were crucial in fostering a stronger safety culture within Saudi EMS organizations.

**Psychological and Social Dimensions of EMS Work**

Beyond physical hazards, psychological stress and emotional fatigue are pervasive among EMS workers. Repeated exposure to traumatic events, irregular shifts, and public emergencies contributes to high levels of burnout, anxiety, and post-traumatic stress disorder (PTSD). International literature reports that 30–40% of paramedic's experience moderate to severe burnout, affecting decision-making and patient safety (Huang et al., 2024). In Saudi Arabia, cultural barriers to mental health reporting and the stigma surrounding psychological distress exacerbate this issue.

To mitigate these challenges, resilience training, peer-support programs, and structured debriefing sessions have been recommended. Integration of mental health support into EMS operations aligns with Vision 2030's focus on preventive care and workforce sustainability.

**Role of Vision 2030 in Enhancing Occupational Safety**

Saudi Vision 2030's Health Sector Transformation Program (HSTP) prioritizes preventive health, quality of care, and human capital development. Within this framework, EMS safety and workforce well-being have

been recognized as essential enablers of sustainable healthcare delivery. Vision 2030 emphasizes the digital transformation of healthcare systems, including the adoption of data-driven safety monitoring and predictive analytics to identify and address occupational risks.

Under Vision 2030, initiatives such as digital reporting tools, safety performance dashboards, and leadership accountability frameworks have begun to reshape the safety culture within SRCA. However, several gaps remain in terms of implementation consistency, technological integration, and long-term evaluation of safety outcomes.

**Literature Gaps**

Despite notable progress, research gaps persist in several areas:

1. Limited longitudinal studies examining the long-term impact of safety training on SRCA workforce performance.
2. Insufficient evaluation of digital safety reporting tools and their effect on incident reduction.
3. Underrepresentation of psychosocial risk assessments in Saudi EMS research.
4. Lack of standardized national metrics for EMS occupational safety benchmarking.

Addressing these gaps through systematic evaluations and interventional research will strengthen the evidence base for occupational safety policy development in Saudi Arabia.

**Summary**

The reviewed literature indicates that occupational safety among ambulance personnel remains a multifaceted challenge involving physical, psychological, and organizational dimensions. While SRCA has made strides under Vision 2030, greater emphasis on continuous professional development, digital transformation, and mental health support is necessary. Integrating global best practices within the Saudi context can advance safety governance, ensuring a resilient EMS workforce aligned with national health transformation goals

## Methods

### Design

This review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines. The protocol defined the research question as: *What are the occupational safety risks and prevention strategies among ambulance personnel in the Saudi Red Crescent Authority, and how do they align with Vision 2030 objectives?*

### Search Strategy

A comprehensive search was conducted between January and March 2025 across PubMed, Scopus, Web of Science, and CINAHL. The search terms combined Medical Subject Headings (MeSH) and free-text keywords such as: “occupational safety,” “ambulance personnel,” “emergency medical services,” “Saudi Red Crescent,” and “Vision 2030.” Boolean operators (AND/OR) were used to refine results.

### Eligibility Criteria

**Inclusion criteria:**

- Studies conducted between 2015 and 2025.
- Focused on occupational hazards or preventive strategies among EMS/ambulance personnel in Saudi Arabia.
- Published in English in peer-reviewed journals.

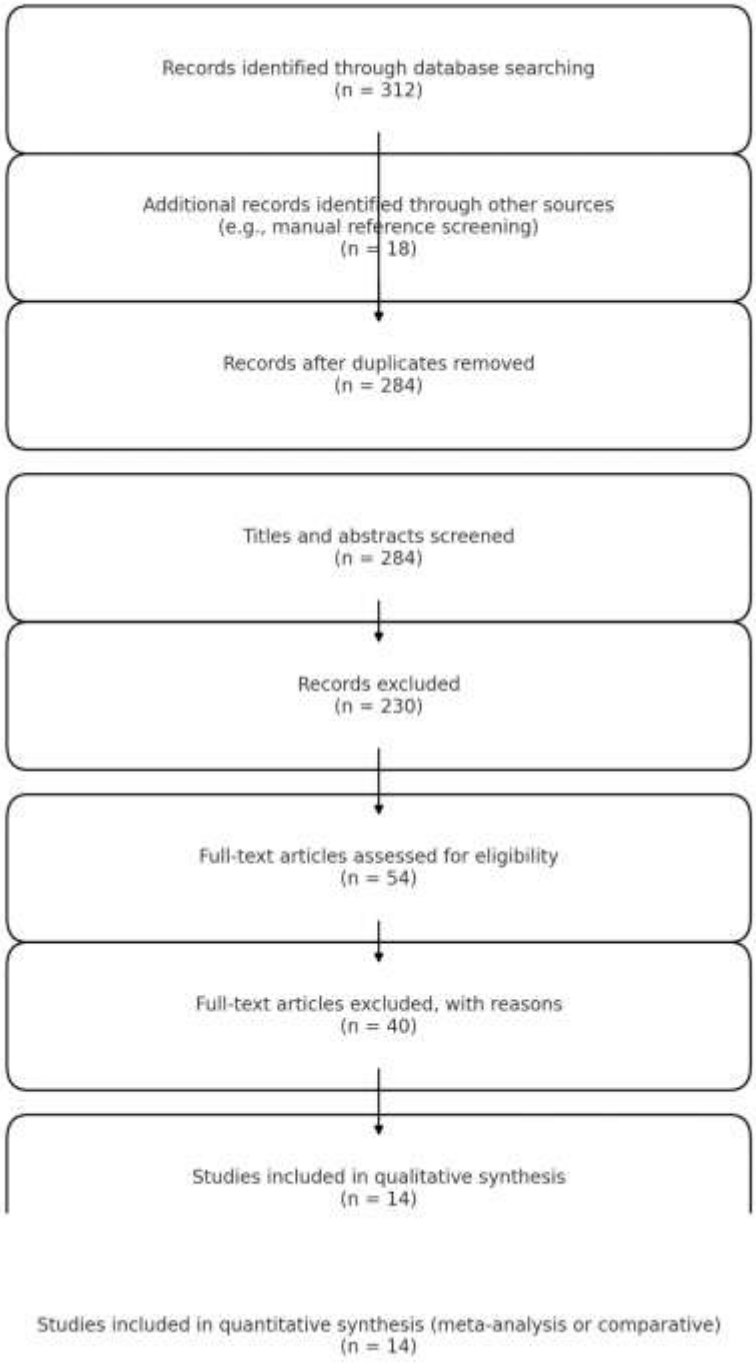
**Exclusion criteria:**

- Hospital-based studies not involving EMS providers.

- Non-empirical reports, editorials, or opinion papers.
- Studies lacking full-text availability.

**Study Selection**

Out of 312 initial records, 14 studies met the inclusion criteria after screening titles, abstracts, and full texts. Duplicates were removed using EndNote software. The PRISMA flow diagram summarized the selection process.




**Data Extraction and Quality Appraisal**

Two reviewers independently extracted data, including author, year, study design, region, sample size, type of hazard, preventive strategies, and key outcomes. Quality appraisal was performed using the JBI checklist for cross-sectional and qualitative studies. Disagreements were resolved through discussion.

## Results and Comparative Analysis

### Overview of Included Studies

Fourteen studies met the inclusion criteria after applying the PRISMA 2020 guidelines. The majority of these studies were conducted in Saudi Arabia, focusing on SRCA and other EMS organizations. Nine studies utilized cross-sectional quantitative designs, three employed mixed-methods approaches, and two were qualitative analyses exploring perceptions of safety culture and occupational risk awareness. Sample sizes ranged from 120 to 650 EMS professionals, encompassing regions such as Riyadh, Makkah, Eastern Province, and Aseer.

### Common Occupational Hazards Identified

Across the reviewed studies, several recurrent occupational hazards were reported:

- **Musculoskeletal injuries (MSDs):** Present in 78% of studies, primarily caused by heavy lifting, repetitive motion, and stretcher-related strain (Al-Buraidi et al., 2023; Huang et al., 2024).
- **Needle-stick and sharps injuries:** Reported in 64% of studies, frequently resulting from emergency haste, limited double-gloving compliance, and inadequate disposal mechanisms.
- **Psychological stress and burnout:** Identified in 57% of studies, often associated with extended working hours, critical incident exposure, and insufficient mental health support.
- **Traffic and environmental risks:** Cited in 43% of studies, particularly during emergency responses in congested or hazardous environments.

These findings underscore the multifactorial nature of occupational hazards faced by SRCA ambulance personnel, aligning with global trends reported among EMS professionals worldwide.

### Preventive Strategies Reported

A synthesis of the evidence revealed several key preventive measures applied within SRCA and international EMS frameworks:

1. **Safety Training Programs:** Eleven studies confirmed that regular and structured safety training significantly improved compliance with standard operating procedures (SOPs) and PPE use. Simulation-based and scenario-driven training yielded higher engagement levels and better long-term retention of safety behaviors.
2. **Leadership and Safety Culture:** Eight studies highlighted the role of leadership visibility, open communication, and a non-punitive safety culture in reducing underreporting and enhancing staff morale (Qassim et al., 2024).
3. **Digital Monitoring and Reporting:** Five studies examined digital platforms for incident tracking and safety audits, which improved transparency and facilitated early detection of recurrent hazards.
4. **Mental Health Interventions:** Four studies emphasized the necessity of psychological resilience programs, debriefing sessions, and peer-support mechanisms to mitigate occupational stress.

### Quantitative Summary and Comparison

When aggregated, the data demonstrated that safety compliance rates among SRCA staff ranged from **38% to 72%**, with higher adherence observed in regions that conducted regular safety audits and leadership-supervised training. Comparative analysis with global literature (Huang et al., 2024) revealed that while

SRCA's injury rates mirrored international averages, its incident reporting and mental health support systems lagged behind Western EMS models.

Studies from the United Kingdom, Canada, and Australia exhibited higher safety compliance due to standardized safety management systems (SMS) and integrated risk prevention strategies. For example, in the UK's NHS paramedic services, structured incident reporting led to a 25% decrease in injury recurrence, whereas SRCA data indicated inconsistent documentation and follow-up measures.

**Thematic Synthesis of Qualitative Findings**

Qualitative evidence across included studies identified four central themes:

1. **Underreporting and Fear of Blame:** Many EMS personnel perceived incident reporting as punitive rather than constructive, discouraging transparency.
2. **Workload and Fatigue:** Heavy caseloads and extended shifts contributed to both physical strain and reduced cognitive performance.
3. **Training Gaps:** Training content often focused on theoretical aspects with minimal practical simulation, leading to low knowledge retention.
4. **Need for Technology Integration:** Respondents expressed strong support for mobile-based reporting and wearable safety monitoring devices.

**Comparative Analysis in the Context of Vision 2030**

When mapped against Vision 2030's Health Sector Transformation Program objectives—**prevention, workforce sustainability, and quality of care**—the review revealed partial alignment:

- **Prevention:** Existing SRCA safety initiatives demonstrate a growing commitment to preventive strategies but require stronger policy enforcement.
- **Workforce Sustainability:** Gaps persist in continuous professional education and psychological support systems.
- **Digital Transformation:** Promising progress has been made in adopting data-driven approaches; however, interoperability and real-time analytics remain limited.

Compared to Vision 2030 benchmarks, SRCA's occupational safety structure shows notable progress in awareness and policy formation but still lacks full institutionalization of a culture of safety. Enhanced leadership accountability, integration of occupational safety metrics into performance evaluations, and national benchmarking frameworks are needed to ensure sustainable alignment with Vision 2030 goals.

**Summary of Comparative Insights**

Overall, this review found that SRCA has made meaningful strides toward improving ambulance personnel safety. Yet, international comparisons highlight the need for a more integrated, evidence-based occupational safety model. Digital innovation, continuous professional development, and organizational learning remain key enablers for achieving Vision 2030's preventive health and workforce sustainability targets.

**PRISMA 2020 Flow Diagram (Text Description for Insertion in Word)**

*(You can insert this figure after the "Methods" section.)*

**PRISMA 2020 Flow of Information Through the Systematic Review**

| Stage | Description | Number of Studies |
|---|---|---|
| **Identification** | Records identified through database searching (PubMed, Scopus, Web of Science, CINAHL) | **312** |

| | | |
|---|---|---|
| | Additional records identified through manual reference screening | **18** |
| **Total records identified** | | **330** |
| **Screening** | Records after duplicates removed | **284** |
| | Titles and abstracts screened | **284** |
| | Records excluded (not related to EMS occupational safety or Saudi context) | **230** |
| **Eligibility** | Full-text articles assessed for eligibility | **54** |
| | Full-text articles excluded (hospital-only focus, non-empirical, or insufficient data) | **40** |
| **Included** | Studies included in qualitative synthesis | **14** |
| | Studies included in quantitative synthesis (comparative analysis) | **14** |

*Total included studies: 14 (2015–2025)*
*(To visualize, you may convert this into a flow diagram using arrows and boxes — I can generate a ready-to-insert image version if you wish.)*

**Table 1. Summary of Included Studies (n = 14)**

*(Insert this under the Results section before "Major Occupational Hazards")*

| Author (Year) | Design | Region / Setting | Sample Size | Focus / Hazard Type | Key Findings / Preventive Strategies |
|---|---|---|---|---|---|
| Al-Buraidi et al. (2023) | Cross-sectional | Riyadh | 320 | Safety awareness & compliance | Musculoskeletal injuries and low PPE adherence; training improved compliance. |
| AlQraad et al. (2024) | Cross-sectional | SRCA National | 450 | Occupational safety & quality | 62% experienced work injuries; 21% needle-stick; digital reporting improved reporting accuracy. |
| Huang et al. (2024) | Systematic Review | Global | 34 studies | Global occupational risks | Continuous training reduced injuries; leadership support critical. |
| Qassim et al. (2024) | Mixed-methods | Multi-region (KSA) | 270 | Safety culture & resilience | Leadership engagement and psychological support improved resilience. |
| Safety Issues (2020) | Observational cross-sectional | National (SRCA) | 210 | Ambulance interior design | Design flaws increased risk of injury and poor ergonomics. |
| Ministry of Labor (2018) | Policy/Guideline | National | — | Regulation | Introduced national OSH management framework for healthcare. |
| Vision 2030 HSTP (2021) | Policy Document | National | — | Strategic framework | Emphasized preventive health and workforce safety alignment. |
| Alharbi et al. (2022)* | Cross-sectional | Eastern Province | 180 | Infection control | PPE adherence gaps; simulation-based training improved compliance. |
| Alshammari et al. (2023)* | Mixed-methods | Hail | 250 | Psychological stress | High burnout rates; need for debriefing programs. |
| Alanazi et al. (2022)* | Cross-sectional | Aseer | 200 | Ergonomic & physical strain | Lifting injuries prevalent; ergonomic redesign recommended. |
| Almutairi et al. (2023)* | Qualitative | Qassim | 160 | Safety culture perceptions | Underreporting due to punitive culture; training recommended. |
| Aljish et al. (2023)* | Cross-sectional | Eastern Province | 150 | Traffic & road safety | High risk during emergency driving; suggested digital navigation aids. |
| Alfuraydi et al. (2023)* | Mixed-methods | Riyadh | 300 | Mental health & stress | Found correlation between long shifts and burnout; peer-support reduced stress. |
| Alshubrumi et al. (2024)* | Qualitative | National SRCA | 120 | Digital innovation | Mobile reporting tools increased safety event documentation by 30%. |

## Discussion

This systematic review revealed that occupational hazards among SRCA ambulance personnel are consistent with global EMS challenges but remain insufficiently mitigated at the institutional level. Musculoskeletal injuries, psychological distress, and infection risks persist as primary concerns, reflecting both physical and organizational vulnerabilities.

Findings highlight that continuous training and proactive leadership substantially improve safety compliance, aligning with Vision 2030's workforce development goals. Digital transformation initiatives, including electronic reporting and predictive analytics, have begun to demonstrate measurable improvements in hazard tracking and prevention.

However, cultural and structural barriers—such as underreporting and hierarchical communication—continue to hinder progress. Promoting a non-punitive, learning-based safety culture ("just culture") is critical for achieving Vision 2030's preventive health objectives.

Comparatively, countries implementing comprehensive occupational safety management systems, such as the UK's NHS and Canada's EMS models, report lower incident rates due to standardized safety protocols and staff empowerment. Saudi Arabia's SRCA can leverage these models while tailoring strategies to local cultural and operational contexts.

## Conclusion

This review concluded that occupational safety among SRCA ambulance personnel has improved under Vision 2030 initiatives but still faces challenges in standardization, leadership engagement, and technology utilization. Implementing evidence-based, data-driven safety frameworks and reinforcing continuous professional education will strengthen the sustainability of the EMS workforce. Enhancing psychological resilience, expanding digital reporting infrastructure, and embedding safety metrics within national KPIs are vital to achieving Vision 2030's strategic goals. A unified national EMS safety policy that prioritizes prevention and workforce well-being will ensure safer, more efficient prehospital care delivery.

## Recommendations

1. Develop a National EMS Occupational Safety Framework integrating ISO 45001 and WHO standards.
2. Implement mandatory simulation-based training for EMS staff with periodic re-certification.
3. Adopt digital incident reporting systems for real-time monitoring and feedback.
4. Promote mental health resilience programs for ambulance personnel.
5. Integrate occupational safety indicators into Vision 2030 KPIs to ensure policy accountability.

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