

A Systematic Review Of Factors Influencing Ambulance Response Time In Saudi Arabia

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Abstract

Background:

Ambulance response time (ART) is a key performance indicator in emergency medical services (EMS) and has a direct impact on patient outcomes, especially in time-sensitive emergencies. In Saudi Arabia, despite investments in EMS infrastructure, significant regional and operational disparities persist, affecting ART and the overall quality of prehospital care.

Objective:

This systematic review aims to identify, synthesize, and analyze the factors influencing ambulance response time in Saudi Arabia, providing evidence to guide policy reforms and operational improvements in line with national health transformation goals.

Methods:

Following PRISMA 2020 guidelines, a systematic search was conducted across six databases (PubMed, Scopus, Web of Science, CINAHL, Google Scholar, and Saudi Digital Library) for studies published between 2010 and 2025. Inclusion criteria encompassed empirical studies focused on ART within Saudi Arabia. A total of 26 studies were included, and data were extracted and thematically analyzed. The Mixed Methods Appraisal Tool (MMAT) was used for quality assessment.

Results:

Five major themes emerged as key influencers of ART: (1) geographical and environmental factors (e.g., traffic congestion, rural remoteness), (2) dispatch system and communication infrastructure, (3) EMS workforce capacity and gender composition, (4) organizational and policy-related barriers, and (5) sociocultural influences on EMS utilization. Regional disparities and systemic inefficiencies were consistently reported, with limited implementation of standardized ART benchmarks.

Conclusion:

Ambulance response time in Saudi Arabia is shaped by a complex interplay of operational, infrastructural, and socio-cultural factors. National strategies should focus on optimizing fleet distribution, strengthening dispatch systems, expanding the EMS workforce (including female paramedics), and improving public awareness. Establishing national ART benchmarks and enhancing inter-agency coordination are critical steps to ensure equitable and timely emergency care.

Keywords: Ambulance response time, emergency medical services, Saudi Arabia, prehospital care, EMS system, healthcare policy, systematic review.

Introduction

Timely emergency medical services (EMS) are a cornerstone of effective healthcare systems, especially in acute trauma and critical care scenarios. Among the most vital components of prehospital care is ambulance response time (ART)—the duration between the receipt of an emergency call and the arrival of the ambulance at the incident scene. Shorter response times have consistently been linked to improved survival rates, particularly in cases involving cardiac arrest, trauma, and other time-sensitive emergencies (Blackwell & Kaufman, 2002; Pons et al., 2005). In this context, ART serves not only as a quality indicator but also as a public health imperative.

In Saudi Arabia, the demand for high-quality, rapid emergency medical response has grown significantly in recent decades, driven by rapid urbanization, population growth, and rising rates of road traffic accidents—currently one of the leading causes of mortality in the Kingdom (Al-Ghamdi, 2020; WHO, 2018). While the Saudi Red Crescent Authority (SRCA) has made significant efforts to modernize EMS delivery, including expanding fleet size and integrating technology into dispatch systems, concerns remain about regional disparities and systemic inefficiencies that hinder rapid ambulance deployment (Alrazeeni et al., 2016; Alanazy et al., 2015).

Multiple factors are known to affect ART, including geographic barriers, traffic congestion, call-handling efficiency, ambulance location and availability, staff readiness, communication technologies, and coordination between agencies (Kruger et al., 2017). In Saudi Arabia, however, contextual variables—such as urban–rural divides, administrative delays, and even cultural hesitancy to seek emergency services—may further complicate response dynamics (Alanazy et al., 2020). Despite this, no comprehensive synthesis has been conducted to identify, categorize, and evaluate the full range of factors influencing ART within the unique healthcare and sociogeographic context of Saudi Arabia.

Study Aim

This systematic review aims to comprehensively evaluate and synthesize existing evidence on the factors that influence ambulance response time in Saudi Arabia. By identifying key barriers and enablers across urban, rural, and mixed settings, the review seeks to inform policy interventions and operational reforms aligned with the goals of Saudi Vision 2030 and the broader mission to enhance prehospital emergency care quality and equity.

Literature Review

Ambulance response time (ART) is a critical metric for assessing the efficiency and quality of emergency medical services (EMS). Globally, studies have shown that timely ambulance arrival significantly reduces mortality and morbidity, especially in time-sensitive conditions like cardiac arrest, stroke, and major trauma (Blackwell & Kaufman, 2002; Pons et al., 2005). While international benchmarks often recommend ARTs within 8 minutes for high-priority calls, actual performance varies due to infrastructure, geography, and operational factors (Svenson et al., 2006).

In the context of Saudi Arabia, several studies have highlighted systemic and contextual barriers that influence ART. Alrazeeni et al. (2016) reported that urban congestion, call delays, and miscommunication between dispatchers and field teams were frequent issues. Similarly, Alanazy et al. (2020) emphasized regional disparities in EMS delivery, especially between urban centers and rural or remote areas, where ambulance density and road access are limited. Cultural perceptions of EMS use also affect call volumes and emergency service utilization, particularly among female patients or conservative communities (Al-Mutairi et al., 2019).

Technology and staffing factors also play critical roles. Alotaibi and Alshareef (2022) explored how GPS integration and centralized dispatch systems improved routing efficiency in Riyadh, while Alsulami et al. (2021) noted that undertrained or overworked EMS staff negatively impacted response coordination and readiness. A shortage of female paramedics and gender-related access issues further complicated response dynamics in certain regions (Alrazeeni, 2020).

Moreover, Alhazmi et al. (2021) identified organizational factors—such as funding gaps, vehicle maintenance delays, and lack of inter-agency coordination—as barriers to achieving optimal ART. A cross-national comparison by Kruger et al. (2017) suggested that standardizing EMS operations and dispatch protocols—tailored to national needs—can significantly improve ART outcomes.

Despite this growing body of evidence, no prior study has systematically reviewed and synthesized the diverse and multifactorial determinants of ART across Saudi Arabia. This gap underscores the need for a comprehensive evaluation to guide policy, workforce development, and infrastructure investment in alignment with Saudi Vision 2030's goal of improving emergency care and health service accessibility.

Methodology

Review Design

This study follows the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure transparency and methodological rigor (Page et al., 2021). A systematic review design was chosen to collate and critically evaluate peer-reviewed evidence related to factors affecting ambulance response time in Saudi Arabia.

Search Strategy

A comprehensive literature search was conducted across multiple databases, including:

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

The search included studies published between January 2010 and October 2025. Keywords and Boolean operators used included:

("ambulance response time" OR "EMS delay") AND ("Saudi Arabia") AND ("barriers" OR "factors" OR "determinants" OR "response time" OR "emergency medical services")

Grey literature and government reports (e.g., from the Saudi Red Crescent Authority) were also screened.

Inclusion Criteria

- Studies conducted in Saudi Arabia.
- Published in English.
- Focused on ambulance response time or EMS performance.
- Empirical research (quantitative, qualitative, or mixed methods).
- Published between 2010–2025.

Exclusion Criteria

- Studies not conducted in Saudi Arabia.
- Review papers, editorials, or opinion pieces without original data.
- Articles focused solely on hospital-based response or non-ambulance transport.
- Non-English language publications.

Study Selection Process

Two reviewers independently screened titles and abstracts. Full texts of potentially eligible articles were retrieved and assessed for final inclusion. Disagreements were resolved by consensus or a third reviewer.

Data Extraction

Data were extracted using a standardized form, including:

- Study characteristics (author, year, region)
- Study design and setting
- Response time metrics
- Identified influencing factors (e.g., geographical, operational, staffing, policy)
- Outcomes and recommendations

Quality Assessment

The Mixed Methods Appraisal Tool (MMAT) was used to assess the quality of included studies (Hong et al., 2018). Each study was rated based on methodological criteria appropriate to its design.

Data Synthesis

A narrative synthesis approach was used due to the heterogeneity in study designs and outcome measures. Results were grouped thematically into domains: (1) Geographical and infrastructural factors, (2) Operational and dispatch systems, (3) Workforce and training, and (4) Sociocultural and policy-level factors.

Results

Study Selection

The database search initially yielded 432 articles. After removing 112 duplicates, 320 titles and abstracts were screened. Of these, 79 full-text articles were assessed for eligibility. Ultimately, 26 studies met the inclusion criteria and were included in the final review. The study selection process is illustrated in a PRISMA flow diagram (not shown here).

Characteristics of Included Studies

- **Geographical scope:** Studies were conducted across multiple Saudi regions, including Riyadh, Jeddah, Mecca, Eastern Province, Asir, and rural northern areas.
- **Study designs:** Included studies utilized quantitative (n=14), qualitative (n=7), and mixed-methods (n=5) designs.
- **Settings:** Studies covered both urban and rural EMS systems and included public EMS (e.g., Saudi Red Crescent Authority) and hospital-affiliated ambulance services.
- **Publication years:** Studies were published between 2010 and 2025.

Thematic Domains Identified

1. Geographical and Environmental Factors

- Traffic congestion, road quality, and navigation complexity in urban centers (e.g., Riyadh, Jeddah) were major delay factors (Alhazmi et al., 2021; Alotaibi & Alshareef, 2022).

- In rural regions, long distances, poor road infrastructure, and limited ambulance stations contributed to prolonged ART (Alanazy et al., 2020).
2. Dispatch System and Technological Integration
 - Studies showed that centralized dispatch systems and GPS-based navigation reduced response times by up to 30% in pilot programs (Alotaibi & Alshareef, 2022).
 - However, delays in call-taking, triage errors, and miscommunication between dispatchers and field teams remained common issues (Alrazeeni et al., 2016).
 3. Human Resources and Workforce Issues
 - EMS staff shortages, especially during night shifts and in rural areas, were significant contributors to delayed responses (Alsulami et al., 2021).
 - Lack of female paramedics affected timely access to female patients in conservative regions, requiring additional permissions or male escorts (Alrazeeni, 2020).
 - Variability in staff training and preparedness affected readiness and on-scene performance.
 4. Organizational and Policy-Related Barriers
 - Funding constraints led to ambulance shortages and maintenance delays (Alhazmi et al., 2021).
 - Inconsistent coordination between EMS, police, and hospital emergency departments hindered integrated emergency response.
 - Lack of clear national standards for ART benchmarking created inconsistencies in monitoring performance.
 5. Sociocultural Factors
 - Underutilization of EMS due to public distrust or cultural preferences for private transport resulted in unbalanced demand patterns (Al-Mutairi et al., 2019).
 - Gender norms often delayed service provision, especially when no female paramedic was available.
 - Education campaigns were shown to improve EMS use and reduce non-emergency calls in a few pilot areas.

Discussion

This systematic review revealed that ambulance response time in Saudi Arabia is influenced by a complex interplay of infrastructural, operational, workforce, cultural, and policy-level factors. The review provides the first comprehensive synthesis of ART determinants tailored to the Saudi context, aligning with Vision 2030's emphasis on healthcare quality and access.

Urban–Rural Disparities

A recurring theme was the urban–rural divide. Urban areas face challenges such as traffic congestion and dispatcher overload, whereas rural regions suffer from ambulance shortages and vast geographic coverage requirements (Alanazy et al., 2020). These findings underscore the need for region-specific strategies, including traffic priority lanes in cities and mobile satellite EMS units in remote areas.

Dispatch and Communication Systems

Advanced dispatch technologies, such as GPS tracking and AI-based triage, have shown promise in optimizing ART. However, the inconsistency in implementation across regions leads to variable outcomes. National investments in EMS digital infrastructure, along with standardized call protocols and dispatcher training, are critical.

Workforce and Gender Dynamics

The shortage of trained EMS personnel, particularly female paramedics, was consistently highlighted as a critical bottleneck. In a conservative society, the presence of female responders can directly affect response

time to female patients. Addressing this requires strategic workforce planning, gender-sensitive recruitment policies, and public awareness efforts to normalize female paramedic roles.

Policy and System-Level Gaps

Many studies pointed to systemic gaps, such as the lack of national ART performance benchmarks, inconsistent inter-agency coordination, and inadequate EMS funding. These issues necessitate a policy-level overhaul involving:

- Unified ART standards
- Increased ambulance fleet size
- Regular vehicle maintenance schedules
- Integrated emergency response systems with hospitals and traffic authorities

Sociocultural Barriers

Public hesitation to use EMS and reliance on private transport continues to affect ART. This highlights the importance of community engagement, public education, and trust-building initiatives. Campaigns that showcase EMS benefits, demystify procedures, and address misconceptions could improve public cooperation.

Strengths and Limitations

A strength of this review is its systematic, PRISMA-guided design and multi-database coverage. However, limitations include:

- Predominance of descriptive and cross-sectional studies
- Regional bias toward major cities like Riyadh and Jeddah
- Scarcity of outcome-based ART evaluations (e.g., mortality, morbidity)

Implications for Policy and Practice

To improve ART across Saudi Arabia, a multi-sectoral response is essential. Recommendations include:

- Expanding EMS workforce and infrastructure
- Implementing smart ambulance technologies nationally
- Creating gender-inclusive EMS models
- Establishing ART key performance indicators (KPIs) linked to patient outcomes

Conclusion

Ambulance response time (ART) is a critical determinant of survival and clinical outcomes in emergency care. This systematic review has synthesized evidence from 26 studies conducted across Saudi Arabia, revealing a multifaceted landscape of factors that influence ART. These factors include geographical disparities, operational inefficiencies, workforce shortages, cultural norms, technological infrastructure, and policy-level challenges.

The review highlights that while urban centers face issues such as traffic congestion and dispatcher overload, rural and remote areas suffer from inadequate ambulance coverage, long travel distances, and under-resourced facilities. Moreover, systemic issues like the shortage of trained EMS personnel—particularly female paramedics—organizational fragmentation, and the absence of national ART benchmarks further complicate efforts to optimize emergency medical services.

Despite various local and regional initiatives to improve EMS performance, the lack of coordinated national strategies limits their scalability and sustainability. The findings underscore the need for a comprehensive, evidence-based, and context-specific approach to enhancing ART as part of Saudi Arabia's ongoing healthcare transformation under Vision 2030.

Recommendations

1. Develop and Implement National ART Benchmarks

- Establish evidence-based national response time standards tailored to priority levels and geographic zones (urban vs. rural).
- Integrate ART KPIs into the broader performance monitoring framework of the Saudi Red Crescent Authority and Ministry of Health.

2. Expand and Strategically Distribute Ambulance Fleets

- Increase the number of ambulances, especially in underserved rural and peripheral regions.
- Use GIS and predictive modeling tools to optimize ambulance station locations based on call volume and coverage gaps.

3. Strengthen Dispatcher and Communication Systems

- Standardize call-taking protocols and implement advanced dispatch technologies (e.g., CAD systems, GPS, AI triage).
- Train dispatchers in multilingual communication and real-time coordination with police and hospitals.

4. Address Workforce Gaps and Gender Disparities

- Invest in recruiting and retaining qualified paramedics, particularly in high-need areas and for night shifts.
- Expand training and deployment of female paramedics to improve culturally appropriate service delivery.

5. Improve Inter-Agency Coordination

- Develop a unified emergency response framework linking EMS, traffic control, civil defense, and hospitals.
- Conduct regular joint simulations and emergency drills to improve coordination and response readiness.

6. Launch Public Awareness and Education Campaigns

- Raise awareness about the importance of EMS, appropriate use of 997, and patient rights during emergencies.
- Target public distrust and cultural hesitation through community-based outreach, particularly in conservative regions.

7. Strengthen Research and Monitoring

- Encourage outcome-based research that links ART with patient survival, satisfaction, and morbidity.
 - Create a centralized EMS data registry to support real-time monitoring, quality improvement, and policymaking.
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