

Emergency Medical Services and Emerging Challenges in Saudi Arabia: A Comprehensive Review of Current and Future Crisis Management Strategies

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Abstract

This overview explores the state of Emergency Medical Services (EMS) in Saudi Arabia, focusing on historical development, current practices, emerging challenges, and future directions. Initially, the review traces the evolution of EMS from its beginnings in Makkah in the early 20th century, shaped by the needs of Hajj and Umrah pilgrims, to the establishment of the Saudi Red Crescent Authority in 1963. The development of paramedic education and the professional recognition of EMS in the Kingdom are also discussed. The current EMS system in Saudi Arabia is critically assessed, examining infrastructure, workforce, regional disparities, funding, and challenges related to response times, as well as its integration into the broader healthcare system. The review highlights the impact of urbanization, changing disease patterns, and climate change on EMS capabilities, emphasizing the need for adaptable crisis management strategies. Technological innovations, interagency coordination, and community engagement are identified as key strategies to enhance EMS performance and resilience. Finally, recommendations for improving EMS are outlined, focusing on workforce development, technology integration, and public health preparedness to meet the evolving demands of Saudi Arabia's healthcare landscape. The review underscores the importance of continuous monitoring and strategic planning to ensure that EMS can effectively respond to future healthcare crises.

Keywords: Emergency Medical Services, Saudi Arabia, EMS development, healthcare challenges, crisis management, technology integration, urbanization, climate change, public health preparedness.

1. Introduction

Emergency Medical Services (EMS), also commonly referred to as Ambulance Services, provide pre-hospital emergency care and triage to patients in medical emergencies. The greatest purpose of EMS is to deliver effective and prompt advanced life support pre-hospital care. The effectiveness of an EMS system is pivotal in fighting medical emergencies, especially traumatic accidents (Khatab et al., 2019). Healthcare systems worldwide are facing emerging crises due to rapid changes in society, posed by global economic downturns, pandemics, mass population displacements, terrorism, and extreme weather conditions. These changes have resulted in substantial increases in the prevalence of fragility, vulnerability, and risks for various communities. Moreover, crises are no longer viewed merely as humanitarian challenges, but as serious threats to global, national, and local security. The significance of public health emergency management and medical emergency management is well understood in addressing emergencies and disasters. However, most countries have not adequately developed or resourced public health emergency services or medical emergency services systems. Saudi Arabia (KSA) is one of the fastest developing countries, undergoing rapid social, economic, and political changes. As a result, these changes have posed emerging challenges to the current public health emergency management systems, especially EMS systems, in KSA. Therefore, the purpose of this document is to comprehensively review the current status and challenges of EMS systems in KSA (emerging, future challenges), and to discuss strategies for enhancing

the effectiveness of EMS systems (future public health, medical emergency management systems resilience).

The first and second sections focus on the purpose and importance of the document, and globally, nationally, and locally emerging future challenges and complexities of EMS systems in KSA. The third and fourth sections discuss the current operational frameworks of EMS systems and challenges in KSA. The fifth section examines the effectiveness of current public health and medical emergency management systems in addressing the challenges of EMS systems. The sixth section focuses on improvement strategies for the future EMS systems in KSA. Rapid changes in society profoundly reshape the everyday lives of the public communities and pose new challenges to public health and medical emergency management systems and services. Public and medical emergency management systems and services proactively respond to public health and medical emergencies, and improve management effectiveness, strategies, and services in dealing with globally and nationally emerging challenges and complexities. In recent years, the public health and medical emergency management systems and services have been rapidly developed and dramatically improved in many countries. Nevertheless, these systems and services have inadequacies or weaknesses in most countries, particularly with regard to fragility and vulnerability. Therefore, the public health and medical emergency management systems and services resilience have emerged as a pressing concern. The public health and medical emergency management systems and services resilience have emerged as a pressing concern. This document seeks to facilitate engagement by governmental bodies, non-governmental bodies, and the academic community in improving the effectiveness of EMS systems in KSA. It provides a foundation for future research and a basis for developing strategic responses to enhance resilience and effectiveness in future EMS.

2. Overview of Emergency Medical Services (EMS) in Saudi Arabia

This overview examines the Emergency Medical Services (EMS) system in the Kingdom of Saudi Arabia (KSA), addressing significant components including the historical development, current practices, challenges, and future prospects. A comprehensive examination of the current EMS practices is conducted with a focus on the KSA. Historical development will include basic early practices and regulations, assessing improvements and lessons learned. Current practices will include an evaluation of the existing infrastructure, workforce, response times, integration into health care, and the role of EMS during emergencies. The current health care framework will be discussed with a focus on emergency services, outlining the challenges and limitations of existing practices, and paving the way for future analyses. The importance of monitoring and evaluation as crucial components in enhancing service delivery will also be discussed (Khattab et al., 2019).

Emergencies have the potential to create high mortality and morbidity if services are inadequate. Mass casualties will overwhelm even the most sophisticated health care systems, and the health system's ability to effectively respond will depend on the coordinated emergency response services in place prior to the emergency. Health care systems that continuously monitor and evaluate emergency care services are more likely to have effective emergency response services in place. Some monitoring and evaluation aspects will not be applicable to the KSA EMS due to a lack of population-based data, so it will only focus on service delivery issues. EMS in the KSA is an interesting combination of developing services that are rapidly advancing but still have many inadequacies due to a lack of regulation, research, necessary data, and quality assurance monitoring. (Alanazy et al., 2021)(Alanazy et al.2022)

2.1. Historical Development

The historical development of Emergency Medical Services (EMS) in Saudi Arabia is chronologically reviewed over the decades, exploring early beginnings, important reforms, evolving policies, and the integration of technology. Healthcare in the region predates the establishment of the modern state known as the Kingdom of Saudi Arabia. Most early development occurred in Makkah because of the medical needs experienced by Hajj and Umrah pilgrims. Important cultural and societal influences on developing healthcare are reflected during this period. A public health department, based in Makkah, was established in 1925. The first school of nursing was opened in 1926, followed by the School of Health and Emergences in 1927. These schools addressed the dire need for medical staff, as many hospitals were established to serve pilgrims.

In 1932, the Kingdom was internationally recognized as a nation. Two years later, the first ambulance service was created to serve pilgrims to the holy sites of Makkah and Madinah. Funded primarily by charitable donations from locals and visitors, this new service included a station and few ambulances to transport exhausted, injured, and sick pilgrims to the Ajyad Hospital. Poor communication and road conditions led to high mortality rates during transit, underscoring the need for this service.

In 1951, the Kingdom established the Ministry of Health, which nationalized the ambulance service in Makkah and Madinah. Three years later, the Ministry created a new service consisting of two ambulances in Jeddah and one in Riyadh. In addition, a few privately owned ambulances operated in other cities. In 1963, the Saudi Red Crescent Association was established to provide pre-hospital care in the country. The Kingdom became a member of the International Federation of Red Cross and Red Crescent Societies in 1965. With better funding and organization, pre-hospital care progressed in its infrastructures, personnel, and coverage. While some developments occurred from 1934 to 2005, EMS education for first responders and emergency medical technicians during this period was limited to basic courses and workplace training. In 2005, EMS diploma programs for basic and intermediate EMTs began in public and private institutes. To address the urgent need for paramedics, four retake programs for basic EMTs were implemented in 2005 at Ministry hospitals. EMS in the Kingdom grew as a profession, particularly when the Saudi Commission for Health Specialties officially recognized and registered it. Paramedics were classified as health practitioners in 2008, with the first board exam held that same year. In 2012, the Kingdom mandated a minimum of a bachelor degree to work in any healthcare field, further underscoring the vital role of education. Since then, the number and quality of EMS programs have increased. Pre-hospital emergency response is provided by a third-party service model fully operated by the Saudi Red Crescent Association, the 91st member of the International Federation of Red Cross and Red Crescent Societies. (Filipp, 2022)(Yelowitz& Ingram, 2024)(Egnatovich, 2022)(Al-Wathinani et al.2023)(Sporer, 2021)

2.2. Current State of EMS

This review assesses the current state of Emergency Medical Services (EMS) in Saudi Arabia, operating under the Saudi Red Crescent Authority (SRCA). It focuses on the operational capabilities of the service, availability by region, existing infrastructure, the workforce, training, certification, ongoing education, and other related aspects. Fixed and deployed medical facilities, transportation resources, intervention performance outcomes, effectiveness of service analysis by key performance indicators, and response time issues are among the reviewed topics. The most critical challenges faced by the EMS are funding shortages, resource allocation, and geographic disparities. The influence of government, policy-making, and public-private partnerships on the current state is considered. Technology integration in service improvement and communication development is emphasized.

In Saudi Arabia (KSA), an EMS system has been in place since 1966 and is currently operated exclusively by the SRCA. Following the events of September 11, 2001, and the Madrid bombing in 2004, interest in EMS development increased to mitigate the threat of terrorism. Several studies have focused on assessing the response time of EMS in urban and rural settings and the epidemiology of traumatic injuries and their impact on the management of prehospital care and triage (Khattab et al., 2019). Natural disasters are uncommon, although the October 2019 floods in Jeddah caused the demise of several patients during transport to hospitals. Efforts to minimize future crises have included improved weather monitoring. However, no research-to-policy or scientist-to-manager activities have been undertaken to minimize the effects of emerging infectious diseases. The MERS-CoV outbreak in 2012, with ongoing sporadic camel-to-human transmission, raised concerns about the readiness of health systems and EMS to meet the challenges of a newly emerging infectious disease. Similarly, COVID-19 stressed the public health system and systemic flaws inherited from the past, leading to high burden and mortality rates. This review provides an overview of the current state of EMS, focusing on existing systems, capabilities, effectiveness, and challenges in coping with future emerging threats. (Alotaibi et al.2024)(Alqahtani et al.2024)

3. Emerging Challenges in Saudi Arabia

Saudi Arabia is currently experiencing dramatic shifts that will greatly affect its future Emergency Medical Services capabilities. A review of recent literature on emerging challenges affecting health systems along with recent demographic information about Saudi Arabia reveals a number of current and expected challenges affecting health systems and Emergency Medical Services (EMS) in particular, that require urgent attention (Khattab et al., 2019).

Current and expected population growth, particularly in urban areas, will lead to rapidly increasing health care service demand, which will far exceed the growth of EMS resources and personnel. An analysis of changes in disease patterns shows that medical responses will need to adapt to new diseases resulting from lifestyles, choices and environmental changes. Climate change is expected to bring new threats to life and health, including natural disasters that could overwhelm existing EMS capacities. In addition to considering these emerging challenges on a national scale, the implications for the preparedness and response capabilities of the health system as a whole are examined.

As the demographic development creates service delivery complications, these are explored through the lens of health services “in” the demographic perspective including urban-rural division and ageing population. The vulnerable and dependant population share is greatly increased in cities, where the majority of the population lives. Cross-sectional issues, for example access and equity health services are also considered. With this analysis of emerging challenges in place, a base for consideration of strategic solutions for enhancing the resilience and adaptability of EMS is provided. (Khavarian-Garmsir et al.2021)(Fu &Zhai, 2021)

3.1. Population Growth and Urbanization

Population growth and urbanization are two of the most significant global trends, bringing profound social, economic, and environmental impacts (N. Moafa et al., 2020). In Saudi Arabia, a rapidly growing population coupled with intensive urban expansion has fundamental implications for everyday life, including the delivery of public services such as healthcare Emergency Medical Services (EMS). Increasing population in urbanized areas results in an increased demand for healthcare facilities that provide essential health services, including emergency medical services. Unfortunately, urbanization increased the number of ailments yet took a toll on the health systems. Emergency Medical Services systems became strained as health facilities failed to keep up with the increasing demand due to inaccessibility and poor urban infrastructure. With respect to EMS, a critical service in managing health emergencies, the potential challenges posed by urban growth have yet to be evaluated in detail (Ramdan M Alanazy et al., 2021). Urbanization introduces several changes to the urban landscape for which EMS response mechanism and services are required to adapt. Traffic congestion, accessibility of certain urban spaces, and well-located healthcare facilities are some of the infrastructural challenges cities face that have implications for EMS efficiency. Changing population density also brings a diverse demographic structure that highlights the urgency to reassess the efficiency of current EMS response mechanisms and plan for the addition of specialized EMS services. Considering the critical role of EMS in health risk management, it is essential to unravel the urgent challenges brought about by urban growth to guarantee effective EMS provisioning in cities. Beyond population increase, demographic shifts such as age distribution and health profile composition have relevant implications for planning and allocating EMS resources. Under these scenarios, data-driven strategies to tackle the urban growth challenges to EMS are necessary. To ensure efficient EMS service in rapidly growing cities, there is a pressing need for innovative strategies specifically tailored to the unique needs of these emergent urban contexts. To this end, collaborative planning efforts between urban developers and healthcare service providers should be emphasized to optimize the efficiency of EMS.

3.2. Changing Disease Patterns

Public health is affected globally by changing disease patterns. These changes might have new implications for Emergency Medical Services (EMS) providers in Saudi Arabia. Following the introduction of the automobile, road traffic injuries became a critical injury leading to death in Saudi Arabia. During the years of rapid public health development, several contagious diseases were eliminated, and starry infectious diseases became less dominant. However, during the 2010s, chronic diseases began to rampantly rise, numerous of which are linked to lifestyle and environmental disease patterns (Khattab et al., 2019). As chronic diseases spread, cities with higher income in Saudi Arabia tend to have a higher prevalence of chronic diseases, while demographic subgroups under poverty or lower education often show higher prevalence of contagious or lethargic diseases. This observation suggests that intervention strategies targeting population mobility and public health equality need to be preplanned in advance. Contagious diseases resurged across the globe and within Saudi Arabia after many years of public health improvements. Emerging infectious diseases still threaten public health globally. EMS protocols need to be adjusted to address these public health concerns. Reemerging endemic diseases illustrate the public health concerns of preventative care. Public health education is crucial to mitigating a disease’s harmful effects, particularly vigorously implementing preventative measures. However, in Saudi Arabia, public compliance with health education remains challenging. Chronic diseases consume a large portion of healthcare resources, making it difficult to allocate enough resources to identify and manage lethargic diseases. It is necessary to collect and publish data continually to track the changes in disease patterns. Otherwise, the danger of being blindsided by a public health concern remains. The current healthcare system trends focus on addressing chronic diseases, while EMS is mainly responsible for acute care. Consequently, the pathway to chronic disease management has not yet been publicly addressed. Data usually collected by the Ministry of Health focus on general healthcare services instead of specifically tracking diseases or other public health concerns. (Alghamdi et al.2021)(Baghdadi et al.2021)

3.3. Climate Change and Natural Disasters

The implications of climate change and natural disasters on Emergency Medical Services (EMS) in Saudi Arabia are examined. Saudi Arabia has historically faced hazardous climatic events, but the frequency and severity of natural disasters have increased exponentially in recent years. Events once considered a 50-year occurrence, such as devastating floods brought on by heavy rainfall, have become almost annual phenomena. In addition, the intensity of heatwaves has risen significantly, with the Kingdom experiencing record-breaking high temperatures, the most extreme of which reached 53.7 °C in Al-Ahsa. Emerging public health risks and challenges for EMS frameworks and response strategies are posed by such events (Ramdan M Alanazy et al., 2021). The relationship between climate change and public health is well established, with environmental degradation fostering emergent health crises. Contaminated water supply, air pollution, heat exhaustion, and vector-borne disease outbreaks from changed ecosystems are just a few examples. While most countries acknowledge the implication of climate change on public health, the preparedness of public health systems and Emergency Medical Services in dealing with such climate change-related emergencies remains an open question. In addition, rapid response teams should be trained to recognize and act against the public health problems posed by climate change. Furthermore, the necessity for interdisciplinary collaboration among health, environment, and disaster management sectors is highlighted to strengthen the EMS resilience against the challenges posed by climate change and natural disasters. Several strategies to improve EMS resilience by integrating climate change considerations in the planning and design of health facilities and services are proposed. Overall, this analysis seeks to establish a clear connection between environmental factors and the efficacy of healthcare systems in crisis situations.

4. Crisis Management Strategies

A thorough review of the literature surrounding current challenges faced by Emergency Medical Services (EMS) in Saudi Arabia was undertaken, along with an exploration of potential strategies to address these challenges. Although the literature on this specific area is limited, a range of relevant studies were examined. Based on this review, other subjects of wider relevance were identified that may be viewed as EMS challenges in Saudi Arabia and could be addressed through the adoption of innovative new solutions or processes. Several crisis management strategies to enhance the performance of EMS in Saudi Arabia are proposed. Firstly, an exploration of emerging technological innovations, such as telemedicine and automated dispatch systems, illustrates how the integration of these advancements may streamline and optimize emergency response efforts. The need for interagency coordination as a vital component of crisis management is then discussed, with emphasis placed on the importance of establishing a framework for collaboration between differing medical and governmental entities tasked with the management of crises. Attention is further directed towards the role of community engagement in creating a public that is well-informed and adequately equipped to assist in emergency scenarios, as well as the establishment of a volunteer base to take part in the supplemental provision of services during emergencies.

Also examined are training programs that can be incorporated to simplify and clarify protocols that dictate how individuals and organizations should respond to crises, which have been shown to improve the effectiveness of such protocols. The need for strategies that improve communication channels during emergencies is also discussed, with attention drawn to the importance of ensuring information is effectively disseminated to prevent the propagation of confusion and misinformation. Lastly, public awareness campaigns aimed at educating communities on how to respond to emergency situations are proposed as a means of improving community resilience and encouraging proactivity in participation during emergencies. While the processes or solutions discussed may not be directly applicable to the Saudi Arabian context, they may provide the impetus for further research and discussion on the subject. Overall, the main focus of this review is the establishment of a multidimensional approach to crisis management as it relates to EMS (Ramdan M Alanazy et al., 2021).

4.1. Technological Innovations in EMS

4.1. Technological Innovations in EMS This section reviews the emerging technological innovations that may contribute to realise the maximum medical response capabilities of emergency medical services (EMS) in Saudi Arabia. Telehealth, drones, artificial intelligence, and other advanced technologies have the potential to improve the medical response capabilities of existing EMS systems. The successful examples of technology integration in existing EMS systems are reviewed, focusing on the countries' experiences with drone delivery of automated external defibrillators and telehealth integration during the COVID-19 pandemic. Use of these technologies in the EMS systems of Saudi Arabia is discussed. Telehealth systems supporting improved communication and real-time data sharing between paramedics in the field and hospital staff, resource management systems supporting improved coordination of EMS and hospital

resources, and drone systems supporting rapid and resource-efficient delivery of time-sensitive medical equipment and treatment are some of the technological innovations that can enhance the capabilities of the current EMS in Saudi Arabia. Furthermore, the potential challenges and barriers to the technology adoption such as high reliance on the oil industry, financial constraints, and lack of the adequate infrastructure are addressed. Consideration of new technologies' impact on the patient outcome as well as operational efficiency is encouraged to be included in the new policies. There is also a need for continuous training and education for EMS personnel about the new technologies to ensure the efficient use and understanding of the technological systems (G. K. et al., 2014). Finally, it is suggested that the impact of technological changes on the patient outcome as well as the operational efficiency should be assessed using the ratios between an EMS system's design capacity and the tested maximum capacity with and without the new technologies.

4.2. Interagency Coordination

Interagency coordination plays a vital role in enhancing the effectiveness of Emergency Medical Services (EMS) during crises. For EMS to effectively manage a crisis, various governmental and non-governmental organizations must work together in a seamless and coordinated manner (Ramdan M Alanazy et al., 2021). Currently, Saudi Arabia has a number of governmental and non-governmental organizations that respond to a crisis. Most of them fall under the umbrella of the Saudi Arabia National Disaster Management System. These organizations include the Ministry of Health, which manages EMS, and the Saudi Red Crescent Authority, which provides pre-hospital care and transport. In general, these two organizations work well together. Hence, it is imperative to define a coordination mechanism between the various public and non-public organizations that respond to a crisis in Saudi Arabia. This can be done through joint training exercises or creating a shared communication platform for member organizations. One of the biggest benefits of a successful coordination mechanism is the improved ability of the various organizations to manage the change in a timely manner. This is especially true for the EMS, where time is critical in saving lives. Coordination between organizations ensures that resources can be allocated optimally and response times can be minimized. In addition, it is important that clear roles and responsibilities be established for each of the organizations involved in the response to a crisis. If these roles are not clearly defined, there will be confusion during the crisis as multiple organizations try to fulfill the same role.

4.3. Community Engagement and Public Awareness

Strengthening the preparedness of Emergency Medical Services (EMS) systems requires understanding the significance of community engagement and public awareness. While many strategies are suggested for fostering a culture of public involvement in emergency planning and response efforts, it is important to focus on a handful of key areas that can be effectively implemented within a specific locality. One such area is providing training programs for the community, including skills development in first aid courses or disaster response drills (Ramdan M Alanazy et al., 2021). Such programs help enhance the public's skills and knowledge in emergency situations, which can lead to the ability to provide support to victims in the critical moments before EMS arrives on the scene.

Another area is using social media and communication campaigns to disseminate critical information to the public before, during, and after emergencies (Beyramijam et al., 2020). These platforms serve as effective tools for informing the public about available resources, including EMS, and educating them on how to utilise services properly. Moreover, community engagement initiatives are critical in addressing public knowledge gaps regarding what services EMS systems provide and how to access them. There must be a concerted effort to directly reach out to specific community sectors, including minority populations, who may have barriers to accessing EMS resources. In general, illness and injury emergencies can create panic and confusion, especially when multiple victims are involved. Therefore, trust and relationships must be built between EMS providers and community members to ensure effective engagement. Providing an overview of what EMS plays is also crucial so that communities understand how to best work with these providers.

5. Future Directions and Recommendations

This review set out to examine the current state of Emergency Medical Services (EMS) in Saudi Arabia as they relate to recent and anticipated changes stemming from economic growth and transformation, as well as the implications of the COVID-19 pandemic. The review also explored emerging challenges and suggested innovations and modifications to current policies and practices. As Saudi Arabia continues to expand, develop, and modernize, there is a need for EMS to thoughtfully and proactively plot the course for the future in not only meeting but also exceeding the expectations of the population.

Several proposed enhancements to EMS in Saudi Arabia were highlighted, all designed to promote more effective negotiation of crises. First, investment in technology and data analytic strategies to improve and refine the efficiency and effectiveness of EMS operations and outcomes is recommended. Additionally, focus on the development of the workforce through continuous training and education to ensure adaptation to changing and evolving challenges is critical. This may include partnerships with academic institutions or international organizations to foster the exchange of knowledge and the adoption of innovative approaches. In tandem with workforce development, policies and procedures should be adaptable to the evolving nature of the health landscape. Future threats to public health may be fully novel, or an existing health concern may morph and change to present new difficulties, owing to factors such as viral mutation or expansion to new geographic localities. Community partnership and engagement efforts should also be enhanced to mobilize communities and foster resilience to rapidly respond to and recover from emergencies. The focus and emphasis on community partnership could include the implementation of training for community members to undertake initial actions that mitigate damage until professional responders are able to arrive. Finally, cross-sector collaboration across government agencies would benefit efforts in better preparation for and response to emergencies.

The overall intent of this review is for EMS in Saudi Arabia to thoughtfully consider the future and plot a course that will ensure the services thrive, are sustainable, and are able to meet the needs of current and future populations. The hope is that the suggestions and recommendations offered help to foster discussion and consideration of this important topic (Khattab et al., 2019) (Ramdan M Alanazy et al., 2021).

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