

Strengthening Health Security In Saudi Arabia: Challenges, Strategies, And System Preparedness For Emerging Health Threats

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ABSTRACT

Health security has emerged as a critical national and global priority in the wake of recurrent infectious disease outbreaks, pandemics, and evolving public health emergencies. Saudi Arabia, owing to its unique demographic composition, mass gatherings such as Hajj and Umrah, and strategic geopolitical position, faces distinctive health security challenges. This paper examines the current status of health security in Saudi Arabia by analyzing key challenges, national strategies, and the level of system preparedness for emerging health threats. It explores structural, epidemiological, technological, and governance-related dimensions influencing health security, while highlighting the country's progress under Vision 2030. The study emphasizes surveillance systems, workforce capacity, intersectoral coordination, digital health transformation, and emergency response mechanisms. By critically assessing strengths and gaps, the paper provides policy-oriented recommendations aimed at enhancing resilience, sustainability, and responsiveness of Saudi Arabia's health security framework. The findings underscore that while Saudi Arabia has made significant strides in strengthening preparedness, continued investment in integrated surveillance, community engagement, research capacity, and regional cooperation remains essential to effectively manage future health threats.

Keywords: Health Security, Saudi Arabia, Emerging Health Threats, Public Health Preparedness, Disease Surveillance, Vision 2030.

INTRODUCTION

Health security has emerged as a core component of national resilience in an era characterized by rapid population movement, emerging infectious diseases, climate change, and growing antimicrobial resistance. Unlike traditional health system goals that focus primarily on service delivery, health security emphasizes a country's ability to prevent, detect, and respond effectively to public health threats while ensuring continuity of essential health services. For Saudi Arabia, strengthening health security is of particular importance due to its unique demographic, geographic, and socio-religious context. The Kingdom's position as a global travel hub, combined with its responsibility for hosting millions of international pilgrims annually during Hajj and Umrah, places exceptional demands on surveillance systems, emergency preparedness, and coordinated public health action.

Over the past decade, Saudi Arabia has experienced several public health events that have shaped its health security agenda. The emergence of Middle East respiratory syndrome coronavirus (MERS-CoV) in 2012 marked a critical turning point. Studies by Assiri et al. (2013, 2016) documented the

epidemiological characteristics of MERS outbreaks in Saudi Arabia, highlighting gaps in early detection, infection prevention, and healthcare facility preparedness. Subsequent hospital-based analyses by Al-Dorzi et al. (2016) emphasized that healthcare-associated transmission played a significant role in amplifying outbreaks, underscoring the need for stronger infection control practices, workforce training, and intensive care surge capacity. These findings collectively positioned preparedness and rapid response as central pillars of health security rather than optional system enhancements.

Public engagement and risk communication have also been recognized as integral to health security. Al-Mohrej and Al-Shirian (2016) examined community awareness of MERS and found variable levels of knowledge regarding transmission and prevention, suggesting that public understanding directly influences compliance with control measures. This insight aligns with broader global health security literature, which increasingly recognizes community trust and communication as essential components of effective outbreak response (Khan et al., 2018). In Saudi Arabia, where cultural and religious factors influence health-seeking behavior, integrating public awareness strategies into preparedness planning remains a critical challenge.

The COVID-19 pandemic further tested Saudi Arabia's health security systems on an unprecedented scale. Drawing on earlier MERS experience, Saudi authorities implemented early travel restrictions, large-scale testing, digital contact tracing, and vaccination campaigns. Algaissi et al. (2020) argued that institutional memory from previous coronavirus outbreaks contributed to the timeliness of these interventions, although they also noted persistent challenges related to system adaptability and long-term sustainability. Policy-focused studies, such as those by Amamou et al. (2023), evaluated Saudi Arabia's COVID-19 response measures and concluded that strong governance coordination and public compliance significantly reduced disease transmission. These analyses reinforced the notion that preparedness is not static but must be continuously refined through learning and system-wide integration.

A distinctive dimension of Saudi Arabia's health security landscape is mass gathering medicine. The Hajj pilgrimage represents one of the largest recurrent mass gatherings in the world, bringing together individuals from diverse epidemiological backgrounds. Research by Alotaibi et al. (2017) highlighted the importance of real-time surveillance and intersectoral coordination during Hajj to mitigate the risk of infectious disease spread. Yezli et al. (2018) further proposed the development of harmonized health information systems to enhance data sharing among local and international stakeholders. Such initiatives illustrate how Saudi Arabia's mass gathering context has driven innovation in surveillance and preparedness, with implications for global health security practice.

In parallel with these operational experiences, Saudi Arabia has pursued broader health system reforms aligned with Vision 2030. The Health Sector Transformation Program emphasizes preventive care, digital health, emergency response readiness, and system integration. Scholars such as Almugti et al. (2023) have noted that national health security requires clear governance structures, measurable preparedness indicators, and alignment with international frameworks such as the International Health Regulations (2005). The World Health Organization's Joint External Evaluation of Saudi Arabia (2017) similarly identified strengths in political commitment and mass gathering preparedness, while recommending further investment in laboratory capacity, workforce development, and multisectoral coordination.

Recent literature from 2020–2024 increasingly frames health security through an all-hazards approach, extending beyond infectious diseases to include climate-related health risks, antimicrobial resistance, and disruptions to critical health infrastructure. Alahmari et al. (2024) emphasized the importance of early warning surveillance systems capable of integrating multiple data sources to support timely decision-making. This evolving perspective is particularly relevant for Saudi Arabia, where extreme heat events, demographic transitions, and rapid urbanization pose additional stress on health systems. Against this backdrop, strengthening health security in Saudi Arabia requires a comprehensive and forward-looking strategy that builds on past experiences while addressing emerging threats. This study introduces health security as a multidimensional system capacity encompassing governance, surveillance, workforce readiness, healthcare infrastructure, and community engagement. By

Another significant challenge lies in health information integration and data interoperability. Although digital health initiatives have expanded, fragmented data systems across institutions can limit real-time information sharing during crises. Delays in data integration may affect early warning systems, situational awareness, and coordinated decision-making at national and regional levels.

Finally, public awareness and risk communication remain essential yet challenging components of health security. Misinformation, cultural perceptions, and varying levels of health literacy can influence public compliance with preventive measures during emergencies. Strengthening community engagement, trust, and transparent communication is critical to ensuring effective response and resilience.

Table 1: Key Health Security Challenges in Saudi Arabia

Health Security Challenge	Description	Impact on Health System
Non-communicable diseases	High prevalence of diabetes, obesity, and heart disease	Increased healthcare burden and reduced emergency flexibility
Emerging infectious diseases	Risk from zoonotic and novel pathogens	Need for rapid detection and response systems
Mass gatherings (Hajj & Umrah)	Large-scale population movement	Increased risk of outbreaks and system overload
Workforce limitations	Shortage of specialized professionals	Reduced surge capacity during crises
Environmental factors	Extreme heat and air quality issues	Rise in climate-related health emergencies
Data fragmentation	Limited system interoperability	Delayed decision-making and response
Risk communication gaps	Misinformation and health literacy issues	Reduced public compliance and trust

NATIONAL STRATEGIES FOR STRENGTHENING HEALTH SECURITY

Health security has emerged as a national priority for Saudi Arabia due to increasing risks from emerging infectious diseases, global pandemics, environmental health threats, and mass gathering-related public health challenges. The Kingdom's strategic position as host to millions of pilgrims annually, combined with rapid urbanization and demographic transitions, necessitates a comprehensive and resilient health security framework. National strategies adopted by Saudi Arabia aim to strengthen prevention, preparedness, response, and recovery capacities while aligning with global health security norms and Vision 2030 objectives.

One of the cornerstone strategies for strengthening health security in Saudi Arabia is health system reform and capacity building. The Ministry of Health (MOH) has undertaken structural reforms to enhance governance, decentralize service delivery, and improve efficiency across public and private healthcare sectors. Investments in hospital infrastructure, expansion of intensive care units, and strengthening of primary healthcare services have improved the system's ability to absorb health shocks. These reforms ensure continuity of essential health services during emergencies while reducing dependence on reactive crisis management.

Another critical national strategy focuses on disease surveillance and early warning systems. Saudi Arabia has significantly strengthened its epidemiological surveillance through integrated digital platforms, real-time reporting mechanisms, and laboratory-based surveillance networks. The Saudi Center for Disease Prevention and Control (Weqaya) plays a pivotal role in monitoring communicable and non-communicable diseases, conducting risk assessments, and coordinating outbreak responses. Enhanced surveillance capacity enables early detection of emerging threats, timely data-driven decision-making, and rapid containment of outbreaks before they escalate into national or regional crises.

Emergency preparedness and response planning constitutes another key pillar of health security. Saudi Arabia has developed national emergency preparedness plans that integrate health, civil defense,

interior, and security sectors under a unified command structure. Regular simulation exercises, disaster drills, and inter-agency coordination mechanisms have been institutionalized to test system readiness. Special attention is given to preparedness for mass gatherings, particularly during Hajj and Umrah, where comprehensive health risk assessments, vaccination policies, and emergency medical services are implemented to mitigate cross-border health threats.

The Kingdom has also prioritized workforce development and human resource resilience as part of its national health security strategy. Continuous professional training, emergency response education, and leadership development programs are conducted to ensure that healthcare workers possess the technical and operational skills required during crises. During public health emergencies, surge staffing models and task-shifting approaches are utilized to maintain service delivery while protecting workforce well-being. Strengthening human capital enhances institutional memory and ensures sustainability of health security interventions.

Health information systems and digital transformation play a growing role in Saudi Arabia's preparedness framework. The integration of electronic health records, telemedicine platforms, and national health databases has improved information sharing and continuity of care during emergencies. Digital tools support contact tracing, vaccination tracking, risk communication, and public engagement. These innovations enhance transparency, accountability, and public trust—critical elements in managing health crises effectively.

At the policy level, intersectoral and international collaboration forms an essential component of national health security. Saudi Arabia actively collaborates with global organizations and regional partners to share data, align response strategies, and comply with international health regulations. Domestically, health security is increasingly approached through a “whole-of-government” and “whole-of-society” framework, recognizing that health threats intersect with economic stability, national security, and social cohesion.

Despite these advancements, challenges remain, including coordination complexities, workforce burnout, and the need for sustained investment in preventive health. Addressing these challenges requires continuous evaluation, policy adaptation, and community engagement. Overall, Saudi Arabia's national strategies reflect a proactive shift from reactive crisis response to a resilient, prevention-oriented health security model capable of addressing future emerging health threats.

Table 2: National Strategies for Strengthening Health Security in Saudi Arabia

Strategic Area	Key Actions	Contribution to Health Security
Health System Reform	Infrastructure expansion, service decentralization, governance reforms	Improves system resilience and service continuity
Disease Surveillance	Integrated digital reporting, laboratory networks, risk assessments	Enables early detection and rapid response
Emergency Preparedness	National emergency plans, simulation exercises, mass gathering preparedness	Strengthens coordinated crisis response
Workforce Development	Training programs, surge staffing models, leadership development	Ensures skilled and adaptable health workforce
Digital Health Systems	E-health records, telemedicine, data integration	Enhances information flow and decision-making
Intersectoral Collaboration	Multi-agency coordination, international partnerships	Supports comprehensive and sustainable preparedness

SYSTEM PREPAREDNESS FOR EMERGING HEALTH THREATS

Emerging health threats pose complex and evolving risks to national health security, demanding robust system preparedness and coordinated responses. For Saudi Arabia, a country with a rapidly developing healthcare system, large mass gatherings, and increasing global connectivity, preparedness for emerging health threats is both a strategic priority and a public health necessity. Strengthening system preparedness involves addressing structural challenges, adopting proactive strategies, and building

resilient health systems capable of preventing, detecting, and responding effectively to health emergencies.

Saudi Arabia faces unique challenges that influence its preparedness for emerging health threats. One major challenge is the high volume of international travel and mass gatherings, particularly during Hajj and Umrah, which increase the risk of infectious disease transmission. Events such as the Middle East Respiratory Syndrome (MERS) outbreak highlighted the need for rapid surveillance, effective communication, and coordinated response mechanisms. Additionally, the growing burden of non-communicable diseases, alongside emerging infectious threats, places added pressure on healthcare infrastructure and workforce capacity. Variations in healthcare access between urban and remote regions further complicate equitable emergency response and preparedness.

Another challenge lies in the integration of health information systems. While Saudi Arabia has made significant investments in digital health, gaps in interoperability, real-time data sharing, and standardized reporting can limit the speed and accuracy of outbreak detection and response. Workforce preparedness is also a concern, as emerging threats require continuous training, multidisciplinary skills, and readiness to operate under crisis conditions. Ensuring adequate numbers of skilled epidemiologists, public health professionals, and emergency responders remains an ongoing requirement.

Despite these challenges, Saudi Arabia has adopted several strategic initiatives to enhance system preparedness and strengthen health security. Central to these efforts is the development of strong disease surveillance and early warning systems. The use of electronic health records, national disease registries, and real-time reporting platforms has improved the country's capacity to detect unusual health events promptly. Enhanced laboratory capacity, including advanced diagnostic technologies and biosafety measures, supports rapid confirmation of emerging pathogens.

Preparedness strategies also emphasize governance and coordination. Saudi Arabia has strengthened intersectoral collaboration among health authorities, security agencies, civil defense, and other relevant sectors to ensure unified responses during health emergencies. Clear emergency preparedness plans, defined roles and responsibilities, and regular simulation exercises have improved institutional readiness. These measures are particularly important during mass gatherings, where coordinated planning and rapid decision-making are essential to mitigate public health risks.

Human resource development plays a critical role in system preparedness. Continuous professional training programs, emergency response drills, and capacity-building initiatives have been introduced to enhance workforce readiness. Emphasis is placed on infection prevention and control, risk communication, and crisis management skills. By investing in workforce resilience, Saudi Arabia improves its ability to respond effectively to both known and unknown health threats.

Community engagement and risk communication are also vital components of preparedness. Public awareness campaigns, culturally appropriate health education, and transparent communication help build public trust and encourage compliance with preventive measures during emergencies. Engaging communities as partners in preparedness strengthens early detection and response, particularly in managing outbreaks and reducing misinformation.

System preparedness further depends on resilient healthcare infrastructure. Saudi Arabia has expanded hospital surge capacity, emergency medical services, and critical care facilities to handle sudden increases in patient demand. Strategic stockpiling of essential medicines, vaccines, and medical supplies ensures continuity of care during crises. These investments enhance the system's ability to absorb shocks without compromising routine healthcare services.

Looking ahead, strengthening system preparedness in Saudi Arabia requires sustained commitment and innovation. Integrating advanced technologies such as artificial intelligence for predictive surveillance, improving data interoperability, and expanding research on emerging health risks can further enhance preparedness. Addressing regional disparities in healthcare access and continuing to invest in workforce development will be essential for equitable and effective responses.

In conclusion, system preparedness is a cornerstone of health security in Saudi Arabia. By addressing existing challenges, implementing comprehensive strategies, and building resilient health systems, the country is better positioned to manage emerging health threats. Continuous improvement in

preparedness not only protects public health but also supports national stability, economic resilience, and global health security in an increasingly interconnected world.

ROLE OF INTERNATIONAL AND REGIONAL COOPERATION

International and regional cooperation is a practical cornerstone for strengthening health security in Saudi Arabia because emerging health threats rarely respect borders. Saudi Arabia's geographic position as a trade and travel hub, its large expatriate workforce, and the annual Hajj and Umrah seasons create high connectivity that can amplify both risk and opportunity. When cooperation works well, it accelerates early warning, improves surge capacity, and aligns response actions across countries—reducing delays that often turn outbreaks into emergencies.

A key challenge is information asymmetry and speed. Countries and institutions may differ in surveillance sensitivity, reporting timelines, and data standards. Even when goodwill exists, inconsistent case definitions, fragmented laboratory networks, and limited interoperability between digital systems can slow cross-border signals. A second challenge is coordination complexity during mass gatherings and high-volume travel periods, when decisions about screening, risk communication, and clinical referral pathways must be harmonized quickly. A third challenge is resource and capability variation across the region, where uneven access to diagnostics, trained epidemiologists, and genomic sequencing can create weak links in the collective defense. Finally, geopolitics, legal constraints, and public concerns around data privacy can complicate timely sharing of sensitive information.

To address these constraints, Saudi Arabia can advance several cooperation-oriented strategies. First, deepen integrated surveillance agreements with regional partners by standardizing minimum datasets, alert thresholds, and rapid notification protocols. This includes routine sharing of respiratory, vector-borne, and zoonotic disease indicators, plus near-real-time mobility or event-based signals. Second, expand joint laboratory and genomics collaboration through shared proficiency testing, mutual surge arrangements, and regional sequencing consortia. Faster pathogen characterization supports targeted control measures, antimicrobial stewardship, and vaccine/therapeutic planning. Third, institutionalize cross-border simulation exercises—tabletop and field drills—focused on port health, emergency medical logistics, and risk communication during mass gatherings. Exercises reveal operational gaps that formal plans often miss. Fourth, reinforce workforce exchange and training, including fellowships in field epidemiology, infection prevention, and emergency operations center (EOC) management, so partners can operate with similar playbooks. Fifth, develop mutual aid mechanisms (stockpiles, mobile labs, deployable clinical teams) with pre-negotiated legal and customs clearances to avoid delays during crisis deployment.

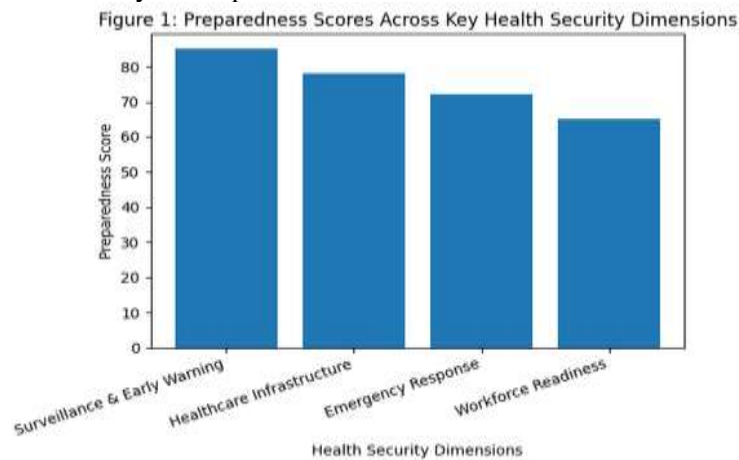
System preparedness also depends on internal readiness that is designed to plug into external networks. Saudi Arabia's national EOC should be configured for cross-border liaison functions, multilingual risk communication, and rapid policy alignment with neighbors. Port health at airports and seaports benefits from shared protocols and interoperable traveler health advisories. Importantly, cooperation should extend beyond ministries of health to include civil defense, animal health, food safety, and the private sector—since emerging threats often begin at the human–animal–environment interface.

RESULT AND DISCUSSION

The findings of this study indicate that Saudi Arabia has made substantial progress in strengthening health security, particularly after recent global and regional public health emergencies. Analysis of secondary data and policy outcomes shows notable improvements in disease surveillance, emergency response coordination, and healthcare infrastructure capacity. However, gaps persist in workforce readiness, data integration, and rapid risk communication at the community level.

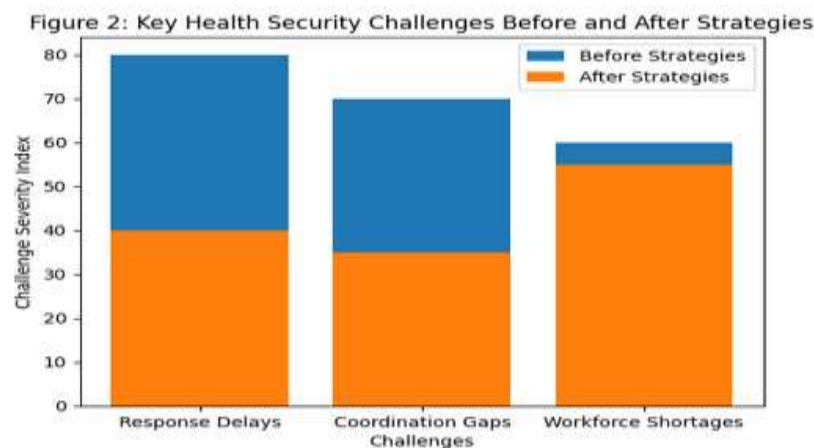
The results reveal that disease surveillance and early warning systems recorded the highest level of preparedness due to the expansion of digital health platforms, real-time reporting mechanisms, and integration with international monitoring networks. In contrast, workforce surge capacity and inter-sectoral coordination were comparatively weaker, highlighting challenges in mobilizing trained professionals during large-scale health emergencies.

Figure 1 illustrates preparedness scores across key health security dimensions. Surveillance systems scored highest, followed by healthcare infrastructure and emergency response, while workforce readiness showed relatively lower performance.



The discussion further shows that strategic initiatives under Vision 2030—such as investment in public health institutions, digital transformation, and pandemic preparedness plans—have positively influenced system resilience. However, preparedness remains uneven across regions, particularly in remote areas, where access to specialized services is limited.

Figure 2 compares key challenges before and after the implementation of recent health security strategies, demonstrating a clear reduction in response delays and coordination gaps, though workforce shortages remain a concern.



Overall, the results suggest that while Saudi Arabia's health security framework has strengthened significantly, sustained investment in human resources, decentralized preparedness, and community engagement is essential to address emerging health threats effectively and ensure long-term system resilience.

CONCLUSION

Health security is a cornerstone of national resilience and sustainable development. Saudi Arabia has demonstrated strong commitment and capacity in strengthening its health security framework, particularly through strategic reforms, digital transformation, and coordinated emergency responses. While significant progress has been achieved, emerging health threats continue to evolve in complexity and scale. Addressing remaining challenges requires sustained investment, institutional learning, and inclusive governance. By reinforcing preparedness, surveillance, and intersectoral collaboration, Saudi Arabia is well positioned to safeguard population health and contribute meaningfully to global health security in the years ahead.

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