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Evaluating Disaster Risk Management in Saudi Arabian Public Hospitals: Perceptions and Practices

by

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Thesis for the degree of Doctor of Philosophy

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Abstract

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This thesis examines disaster risk management (DRM) within public hospitals in Saudi Arabia through the perceptions of healthcare workers (HCWs) and the public. Public hospitals face major DRM challenges, including mass religious gatherings, industrial risks, and regional disparities. While global developmental frameworks (e.g., Sendai Framework, WHO Health Emergency & DRM Framework) emphasise preparedness, resilience, and trust, it remains unclear how stakeholder perceptions can inform effective DRM in Saudi Arabia. To address this issue, a multi-method design was employed across three studies to assess perceptions of DRM, and their implications for healthcare resilience. In Study One, 542 HCWs from 22 public hospitals across four regions were surveyed to assess their perceptions of DRM effectiveness across the four phases. Overall, HCWs rated mitigation as the most effective function and preparedness as the weakest. Significant regional disparities were identified: HCWs in the Central and Eastern regions reported greater confidence across all four phases compared with those in the Southern region. In Study Two, semi-structured interviews were conducted with 24 HCWs to examine how individual experiences, and organisational, geographical, and systemic factors shaped perceptions. Thematic analysis of the interviews indicated that strong leadership, effective communication, and ongoing training enhanced confidence in DRM, whereas poor infrastructure, weak departmental collaboration, and lack of psychological support reduced confidence. In Study Three, 436 members of the public were surveyed to examine trust in hospital DRM, focusing on four areas: perceived preparedness, knowledge of initiatives, quality of communication, and perceived satisfaction with hospital DRM. Perceived satisfaction and preparedness were strongest predictors of trust, followed by knowledge of initiatives, though communication alone had less significance. Collectively, these studies indicate that DRM practices in Saudi public hospitals can be shaped substantially by organisational, systemic, and perceptual factors. The findings suggest that key factors for the effective improvement of hospital resilience include inclusive leadership, equitable resource distribution, transparent risk communication, and proactive public engagement. These are all critical factors for preparing healthcare systems to respond to future crises.

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Abbreviations

3LC .....Three-Level Collaboration.

AFERM .....Association for Federal Enterprise Risk Management.

ANOVA.....A one-way analysis of variance.

AVE .....Average Variance Extracted.

CBAHI: .....Saudi Central Board for Accreditation of Healthcare Institutions.

COVID-19.....Coronavirus Disease 2019.

DRM.....Disaster Risk Management.

EFA .....Exploratory Factor Analysis.

ERGO: .....Ethics and Research Governance Online (University of Southampton).

ESCAP.....Economic and Social Commission for Asia and the Pacific.

EVD..... Ebola Virus Disease.

HDI .....Human Development Index.

HEPPUs ..... Hospital Emergency Planning and Preparation Units.

HSD .....Honestly Significant Difference.

HSTP..... The Healthcare Sector Transformation Program.

ICU .....Intensive Care Unit.

IPC.....Infection Prevention and Control.

IRBs ..... Institutional Review Boards.

KFMC .....King Fahad Medical City.

KSUMC .....King Saud University Medical City.

M .....Mean.

MERS-CoV.....Middle East Respiratory Syndrome Coronavirus.

MOH ..... Ministry of Health, Saudi Arabia.

NHS: .....National Health Service, United Kingdom.

NUPCO ..... National Unified Procurement Company.

PPE .....Personal Protective Equipment.

Abbreviations

PPPs .....Public–Private Partnerships.

SARS.....Severe Acute Respiratory Syndrome.

SARF .....Social Amplification of Risk Framework

SD.....Standard Deviation.

U.S.....United States.

UNDRR: .....United Nations Office for Disaster Risk Reduction .

WHO..... World Health Organisation.

Chapter 1 Introduction

Preface

This chapter establishes the framework for this research project by connecting global disaster risks with hospital resilience, public health in Saudi Arabia, and perceptions. Section 1.1 presents global disaster risks and their health, economic and systemic impacts. Section 1.2 examines hospital resilience, identifies vulnerabilities and good practice and makes the case for resilience as a central goal of disaster risk management (DRM). Section 1.3 locates hospitals within the DRM cycle – mitigation, preparedness, response, and recovery – highlighting enablers, constraints, and lessons learnt in maintaining continuity of care. Section 1.4 outlines the hazards and challenges facing healthcare services in Saudi Arabia, delineates the national DRM frameworks and their institutional implementation within hospitals, examines regional variations in disaster exposure and healthcare infrastructure capacity across the five administrative regions (Central, Eastern, Northern, Western, and Southern), and discusses the implications of ongoing health system reforms under Vision 2030. Section 1.5 explores stakeholders' perceptions, including those of healthcare workers and the public, and their influence on institutional trust and DRM effectiveness. Section 1.6 identifies gaps in current perception research, such as limited coverage, exclusion of non-clinical staff, lack of integration between internal and public perceptions, and insufficient consideration of geographic variation, and presents the rationale for an integrated perception-centred approach. Section 1.7 describes the study's scope and methodology, employing a multi-methods approach involving a national survey of health professionals (Study One), qualitative interviews (Study Two), and a public survey of trust (Study Three). Section 1.8 presents the study's theoretical and practical contributions, linking findings to the Saudi Vision 2030 and the Sendai Framework. Section 1.9 concludes by outlining the structure of the thesis and how the subsequent chapters will contribute to a perception-informed account of DRM in Saudi public hospitals.

1.1 Global Disaster Risks

In an era of increasing environmental and social crises, there is an urgent need for academic inquiry and practical action to understand the complex interaction of disasters and their cascading effects (Alyami et al., 2020; Eckstein et al., 2021; Intergovernmental Panel on Climate Change [IPCC], 2022; United Nations Office for Disaster Risk Reduction [UNDRR], 2023; World Health Organisation [WHO], 2019). Disasters can be defined as events that cause damage and suffering beyond the capacity of local communities to respond, thereby requiring external assistance (Alyami et al., 2020). They arise from the interaction of hazards, exposure, and vulnerability, resulting in immense loss of life, serious health consequences, economic disruption, and environmental degradation (UNDRR, 2020).Disasters are also characterised by their timing, intensity, and societal impact, which underscores the need for proactive risk management and resilient healthcare systems (UNDRR, 2023; WHO, 2019).For example, from 1993 to 2022, there were over 9,400 weather related disasters worldwide, with over 765,000 people killed and approximately $4.2 trillion in economic losses. In 2023, disasters impacted 93.1 million people, killed over 86,000 people, and caused $92.9 billion worth of damage, mainly as a result of flooding, storms, and heatwaves (The Zebra, 2024; Eckstein et al., 2021). Therefore, understanding the complex dynamics of disaster risk management is critical in developing risk mitigation actions and building resilience in institutions and society.

As stated in the Sendai Framework for Disaster Risk Reduction (2015-2030), disaster risk reduction prioritises risk reduction before a disaster occurs instead of responding to the disaster. It calls for a greater understanding of disaster risk, better governance, more investments in resilience, and better recovery (UNDRR, 2015). Similarly, the World Health Organisation Health Emergency and Disaster Risk Management (Health EDRM) framework adopts an all-hazards framework that encompasses health system capacity, communities, and intersectoral collaboration to reduce the health impacts of disasters (Kayano and Chan, 2022; WHO, 2019). A cross-sectional study of 474 major disasters in Central Europe from 2000-2023 found that 395 (83%) were weather-related hazards, mainly storms, floods, and extreme

temperatures, which all reached seasonal peaks. They led to surges in hospital admissions, creating a strain on hospitals, and the risk of the potential collapse of healthcare systems (Griebler et al., 2024). The findings from this study highlight the need for healthcare systems that are adaptable to seasonal disasters, with the capacity to maintain critical services as a central objective during the disaster event.

Having established the global context of disaster risk, the next section will illustrate that hospital resilience is a critical component of DRM, grounded in an understanding of both vulnerabilities and institutional capacities.

1.2 Hospital Resilience in DRM

Hospitals serve as critical first responders in DRM but are also among the most vulnerable organisations when disasters occur (UNDRR, 2019). Their vulnerability arises not only from direct hazard impacts such as structural damage caused by earthquakes, but also from systemic weaknesses, including supply chain disruptions, staffing shortages, and inadequate coordination during crises (Adini et al., 2012; Zhong et al., 2014). In a time of crisis, hospitals may manage to provide services. However, these institutions often face overwhelming demand for services while operating under critically compromised conditions. Therefore, hospital resilience is urgently needed to facilitate effective DRM (Coppola, 2021).

Hospital resilience is the ability of a health care facility to resist, absorb and recover from disaster impacts, while also having the capacity to provide essential health services (Abasabadi Arab et al., 2019; WHO, 2015). Resilience encompasses preserving activities during emergencies, continuity-of-care, and recovery time (Kruk et al., 2015). Despite the increase in the discussion about the importance of resilience, many hospitals around the world still do not meet minimum resilience standards (Pan American Health Organisation [PAHO], 2017). For example, one evaluation of healthcare facilities in high-risk areas found that the World Health Organisation reported that only 50% of these facilities met basic safety criteria (WHO, 2020). Furthermore, the World Bank estimates that investment in resilient infrastructure can reduce

the societal costs of disaster impacts by 31% (Hallegatte et al., 2018). Therefore, targeted investment in infrastructure and preparedness that places an emphasis on the resilience of hospitals will allow them to be available during disasters and better able to advance public health.

Hospitals may face heightened risk from disasters due to their inherent role and location. As a proportion of all global disasters, Asia experiences more disasters than any other continent, accounting for 44% of events between 2000 and 2019 (Abasabadi Arab et al., 2019). This high regional concentration underscores the scale of risk faced by hospitals in Asia. The burden of this disaster impacted more than 68.5 million people, meanwhile the economic cost of these disasters exceeded US$131.7 billion (Abasabadi Arab et al., 2019). There is ample evidence, as well as many historical case studies, that have shown that hospitals have faced significant consequences as a result of not being prepared. For example, in 2005, during Hurricane Katrina, the cascade of electrical outages, resource shortages, and limited healthcare access for populations created the largest hospital evacuation in the United States of America (USA) and in history. It was a situation that exposed critical limitations in resources and systems (Chaffee and Oster, 2006). Another significant event was the 2015 Middle East Respiratory Syndrome Coronavirus (MERS-CoV) incident in South Korea, which exposed the significant limitations of authorities to control the infection and share critical information during a crisis, ultimately exacerbating the public health burden (Lim and Sziarto, 2020). The recent COVID-19 global pandemic has also exposed vulnerabilities in health systems around the world. For example, the USA experienced extreme shortages of personal protective equipment (PPE), while also grappling with systems governance, as well as limitations in interagency coordination with PPE management and allocation (Kamerow, 2020; Lal et al., 2021). These problems reoccur regularly, and while they may not look the same, they pattern of unacceptable fragile, untrustworthy infrastructure, shortfalls in human resources, or entirely unacceptable weak or absent emergency planning are persistent issues that continue to take a toll on hospital resilience (Nekoie-Moghadam et al., 2018). These examples display the apparent need for

health care services to identify vulnerabilities in their systems and create a plan for preparedness, so that hospitals can be protected from every possible risk and threat in real time.

Goniewicz et al. (2020) highlighted that in addition to readiness for infectious disease, attention and resources should not detract from other risks such as geophysical and climate related hazards, which also have the potential to disrupt DRM. However, the point of increasing hospital resilience is not only to enable institutions to be sustainable in emergencies, but also to protect lives, and the public's confidence in health systems (Melnychuk et al., 2022). There should be a healthy balance between DRM which is equally applied to infectious and non-infectious hazards, supporting hospital resilience and maintaining public confidence in health systems during emergencies.

International examples of hospital DRM and resilience demonstrate some clear success but also highlight current vulnerabilities. In 2021, Turkey's Istanbul Seismic Risk Mitigation and Emergency Preparedness Project (ISMEP), which is supported by the World Bank, reported that it had successfully retrofitted 1,105 high-risk buildings, including 53% of Istanbul hospitals, reducing their vulnerability to earthquake damage from 40% to 5%, which is estimated to save up to 3,000 lives during a seismic event (World Bank, 2017). However, when Hurricane Maria hit Puerto Rico (2017) it exposed severe vulnerabilities, with 80% of hospitals losing electricity and water, thus contributing to approximately 3,000 excess deaths due to disruption of the healthcare system (Kishore et al., 2018). Conversely, Japan's multiple designated Disaster Base Hospitals and Disaster Medical Assistance Teams showcased the benefits of having pre-coordination and pre-established hospital networks and business continuity planning for the Great East Japan Earthquake in 2011 (Homma, 2015; Kudo et al., 2013). It should be noted that Nepal's health system was severely impacted by the 2015 earthquakes, with 446 public health facilities completely damaged, and 765 additional facilities partially damaged, significantly disrupting service delivery (Government of Nepal, National Planning Commission, 2015). This example underscores the critical role of public health preparedness and DRM, illustrating how

proactive infrastructure upgrades and coordinated planning can mitigate the impact of disasters and save lives.

Given hospital resilience is a significant element of successful DRM, the following section provides insight into how hospitals can be further integrated into the DRM cycle, which includes a systematic approach to disaster mitigation, preparedness, response and recovery.

1.3 Integrating Hospitals into the DRM Cycle

The DRM cycle's components, namely mitigation, preparedness, response and recovery, provide the building blocks to build resilience in healthcare systems (Olu, 2017). Mitigation refers to activities that can take place before an event to reduce risk and possibly increase resilience (Bullock et al., 2013). These activities can be structural, such as seismic retrofitting, measures aimed at reducing vulnerabilities, and strengthening data systems. Preparedness refers to a state of readiness through planning and training, enabling the response to be iterative and organised when a hazard occurs. It includes operational planning and ensuring there are adequate supplies (Gamboa-Maldonado et al., 2012). As a result of their last two earthquakes (Kobe in 1995 and Great East Japan in 2011), Japan has established leadership for its hospitals and integrated healthcare into national preparedness strategies, which can be utilised around the globe (Mulyasari et al., 2013). It has been documented and acknowledged that there are collegial and fiscal constraints to preparedness and that the absence of or the sub-par implementation of policies in these under-resourced regions is common. This includes the need to overcome barriers to preparedness, elevate hospital preparedness, target funding and create strong policies to further explore the integration of hospitals in the DRM cycle.

The series of actions enacted under the response phase of the DRM cycle are implemented during and immediately following an incident to spare lives and keep essential services beyond healthcare functional and in place. This consists of establishing staffing, the requisite resources and procedures (WHO, 2019). In addition, an effective response relies heavily on real time coordination and technology that enables digital communication (Troy et al., 2008). In that light,

recovery represents the post-acute phase, during which health system functions such as infrastructure, human resources and service delivery are restored and enhanced. This phase should also be leveraged to assist in improving short- and long-term recovery based on lessons learnt. Similarly, recovery requires sustained investment and attention, as neglecting this can result in resilience being compromised in the long term (Shavarani et al., 2019; WHO, 2019). Recent literature has more closely categorised DRM functions, with mitigation including infrastructure protection, hazard-specific strategies/plans, and the securing of resources (Khan et al., 2024; Lwin et al., 2024); preparedness comprising training, drills, similarly defined roles and the ready supply of resources (Lwin et al., 2024; response including emergency operations, triage and partner coordination (Lwin et al., 2024); and recovery consisting of resuming care, staff support, and lessons learned (Khan et al., 2024). Therefore, embedding hospitals within all phases of the DRM cycle (mitigation, preparedness, response and recovery) is indispensable for developing sustained resilience, as it ensures attention is given across the full spectrum of DRM phases.

Effective DRM in healthcare sector practices also requires the careful integration of risk assessments, community engagement, and emergency services (Lwin et al., 2024; WHO, 2019). Case reports, such as that of a German hospital which took the pre-emptive measure of evacuation during the accelerated flooding that impacted Europe in June 2021, highlight the significance of coordinated actions guided by risk forecasts (Krüger et al., 2025). The literature corroborates that proactively implemented DRM reduces both loss of life and associated economic consequences (Djalali et al., 2014). However, there is no doubt that DRM is often constrained by resources and often characterised by variability in practice. Vulnerabilities can emerge in the gap between DRM policy and its implementation, highlighting the need for a whole-system response, ongoing training, and reflective learning from real time experiences (Kayano and Chan, 2022). Therefore, strengthening existing health systems through more robust DRM planning that is informed by hazard risk and local community support can reduce the impact of disasters in terms of loss of life and the subsequent economic impact.

The following section examines Saudi Arabia's specific disaster risk landscape, delineating regional variations in hazard exposure and healthcare infrastructure capacity, alongside national-level DRM frameworks and their institutional implementation within the hospital sector.

1.4 Disaster Risks and Healthcare Challenges in Saudi Arabia

Saudi Arabia's diverse geographical and socio-economic landscape exposes its healthcare system to a broad spectrum of disaster risks, underscoring the imperative for comprehensive national DRM frameworks to bridge existing gaps and bolster hospital preparedness (Coppola, 2015; Kattan & Alshareef, 2024). The kingdom confronts multiple hazards, ranging from natural phenomena such as heat waves, droughts, floods, dust storms, and sandstorms to human-induced threats including terrorism, industrial and chemical incidents, and the strains of mass gatherings during religious pilgrimages. These hazards impose varied pressures on healthcare infrastructure, human resources, and emergency response capabilities (Al-Wathinani et al., 2023; Coppola, 2015; Kattan & Alshareef, 2024). Compounding these challenges is a fragmented governance structure and the absence of fully nationalised DRM plans, which impede coordination and exacerbate systemic vulnerabilities (Mitra et al., 2023). Furthermore, the lack of a standardised national hospital preparedness framework diminishes overall resilience (Al Kurdi, 2021). As Al Thobaity et al. (2019) observe, Saudi healthcare systems have occasionally faltered in activating disaster and care plans, particularly in areas such as surge capacity, inter-organisational communication, and survivor support. Regional variations in risk profiles further highlight disparities in organisational capacity and readiness, with distinct hazard patterns influencing healthcare responses. For instance, the Eastern region grapples with industrial and petrochemical perils; the Western region manages floods alongside the influx of religious pilgrims; the Southern region contends with border security issues; and the Central region faces rapid urbanisation and flash floods (Al-Wathinani et al., 2023; Coppola, 2015; Kattan & Alshareef, 2024). Consequently, national and regional health authorities must prioritise the development of

standardised hospital preparedness plans, anchored in centralised DRM frameworks, to mitigate shared risks and enhance adaptive capabilities.

1.4.1 Regional Variations in Disaster Risks and Healthcare Vulnerabilities

Saudi Arabia's geographical and demographic heterogeneity engenders substantial spatial variation in disaster exposure, hazard profiles, and healthcare infrastructure capacity. This regional differentiation necessitates geographically disaggregated analysis to inform targeted DRM strategies within the hospital sector. The Kingdom comprises five administratively distinct regions—Central, Eastern, Northern, Western, and Southern—each characterised by discrete environmental risks, population densities, and healthcare resource distributions (General Authority for Statistics, 2022; Ministry of Health, 2023). Understanding these regional disparities is fundamental to contextualising hospital resilience, as institutional preparedness and response capabilities are demonstrably contingent upon local hazard characteristics, infrastructural capacity, and demographic pressures. Table 1-1 synthesises key regional indicators, including geographic extent, population distribution, healthcare infrastructure, and predominant hazard types, whilst Figure 1-1provides a cartographic representation of the five regional divisions and their administrative capitals. These data establish the empirical foundation for subsequent analysis of region-specific vulnerabilities and institutional responses throughout this thesis.

The Western region, encompassing Mecca and Medina, experiences acute pressures on healthcare and infrastructure due to mass gatherings during Hajj and Umrah pilgrimages. These events necessitate tailored DRM strategies to address associated vulnerabilities (Gatrad & Sheikh, 2005; WHO, 2015). Hajj occurs annually on fixed dates, while Umrah can take place year-round, drawing millions of participants and posing significant risks to public health and safety. The 2015 crane collapse in Mecca, which claimed 111 lives, exposed critical deficiencies in hospital preparedness, including inadequate surge capacity, triage inefficiencies, patient flow bottlenecks, and communication breakdowns with ambulance services—though fatalities stemmed primarily from the incident itself rather than hospital failures (Mani et al., 2023).

Similarly, healthcare facilities in Medina have shown limitations in recovery coordination and inter-agency collaboration, revealing persistent gaps in regional preparedness research (Khan et al., 2021). These incidents emphasise the need for robust preparedness protocols for mass gatherings, coupled with seamless integration among health and non-health entities.

In the Eastern region, industrial hazards predominate, with facilities like King Fahad Specialist Hospital lacking essential trauma and decontamination resources while facing chronic disease management and infection control hurdles (Alruwaili et al., 2022; Aleanizy & Alqahtani, 2022). The Central region, including Riyadh, contends with flash floods and rapid urbanisation, exacerbated by a reliance on expatriate healthcare workers, whose high turnover, visa constraints, and cultural or linguistic barriers complicate hazard management (Al-Hanawi et al., 2019). Northern and Southern regions suffer from geographic isolation, which delays patient transfers, disrupts supply chains, and restricts specialist access during crises—as exemplified by Jazan General Hospital's infrastructural inadequacies Al-Anezi, 2025; Kattan, 2024).Targeted investments in infrastructure, staff training, and infection control are vital to redress these regional imbalances and fortify hospital resilience nationwide.

Table 1-1 Regional Disaster Risk and Healthcare Infrastructure in Saudi Arabia

Region	Major Cities	Area (km^2)	Population	Rural population	Urban population	Public hospital	Private hospital	Total hospitals	Primary Hazards
Central Region	Al-Qaseem, Riyadh, Hail	566,173	10,674,333	—	—	100	51	151	Flash floods, rapid urbanisation, traffic incidents
Eastern Region	Dammam, Dhahran, and Al Khobar,	672,522	5,125,254	—	—	51	33	84	Industrial accidents, petrochemical hazards, technological disasters
Northern Region	Tabuk, Northern Borders, Al-Jawf	358,081	1,855,435	—	—	39	3	42	Extreme temperatures, dust storms, geographical remoteness, sparse population
Western Region	Makkah, Madinah	305,118	10,159,446	—	—	80	47	127	Mass gatherings (Hajj/Umrah), floods, heat waves, communicable diseases
Southern Region	Najran, Al-Baḥah, Aseer, Jazan	247,796	4,360,756	—	—	79	16	95	Border security incidents, flooding, vector-borne diseases, geographical isolation
Saudi Arabia (Total)		2,149,690	32,175,224	4 ,913, 478	27, 261 ,746	349	150	499	—

Source: General Authority for Statistics (2022); Ministry of Health (2022)

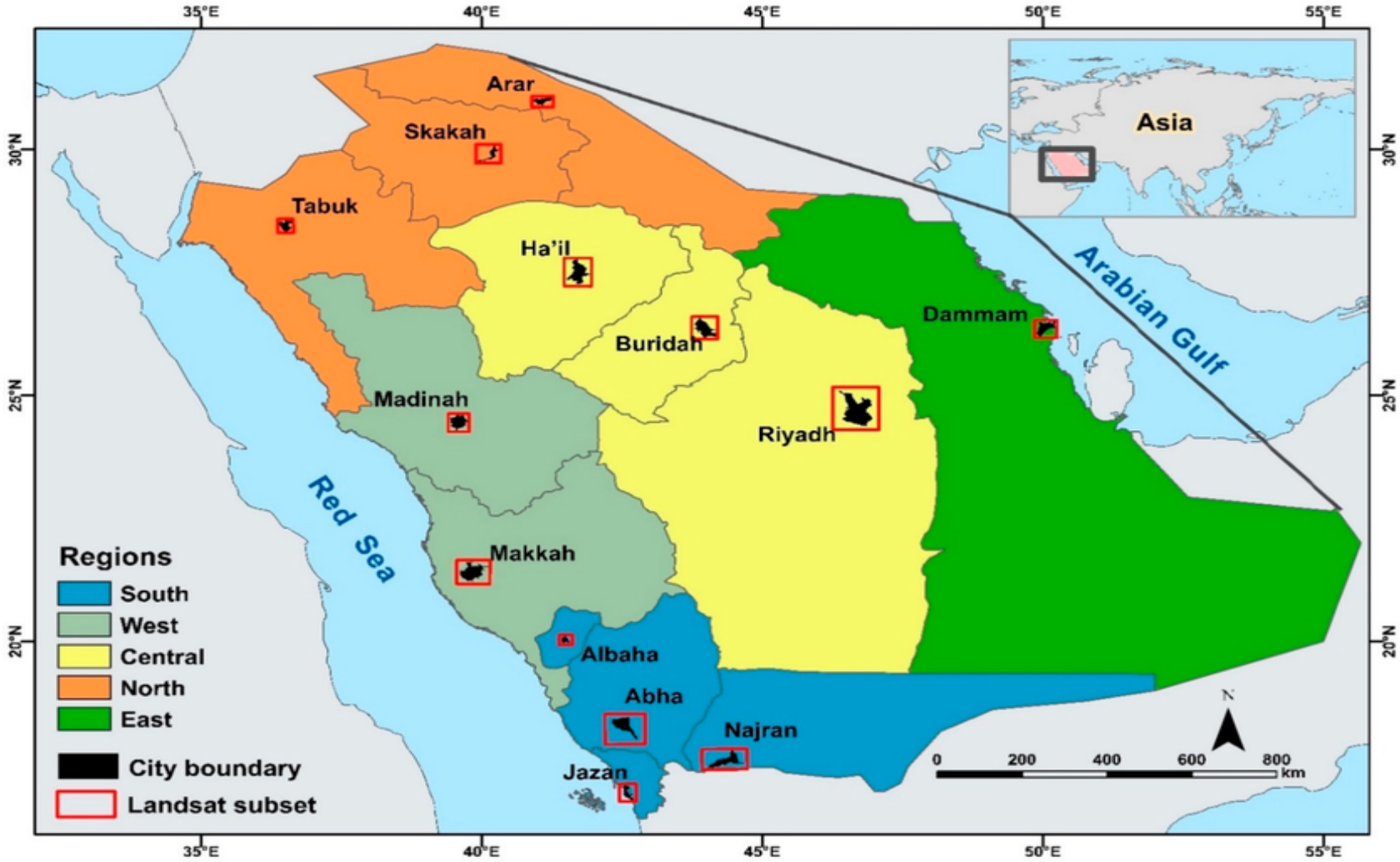


Figure 1-1 Geographic Distribution of Saudi Arabian Regions and Capital Locations

1.4.2 National DRM Frameworks and Hospital Implementation in Saudi Arabia

This section delineates the institutional architecture governing disaster risk management within Saudi Arabia's healthcare sector, distinguishing national-level frameworks from hospital-level implementation modalities. Nationally, Saudi Arabia's DRM operates via a top-down structure, informed by international benchmarks like the Sendai Framework for Disaster Risk Reduction (UNDRR, 2015). The National Risk Council, under the Crown Prince's leadership, oversees national risk assessments and strategy approvals (Saudi Press Agency, 2023; National Risk Council, 2024). Its General Secretariat coordinates initiatives, such as the 'Resilience Index,' to evaluate crisis management maturity across governmental bodies (General Secretariat of the National Risk Council, 2024).

The Resilience Index constitutes a standardised evaluative instrument developed by the General Secretariat of the National Risk Council to assess institutional maturity in crisis management and disaster preparedness across governmental entities (General Secretariat of the National Risk Council, 2024). The Index employs a multi-dimensional framework encompassing organisational readiness, resource adequacy, inter-agency coordination capacity, and recovery planning, thereby providing a quantitative metric for benchmarking institutional resilience. Within the health sector, this Index functions as both a diagnostic tool—identifying systemic vulnerabilities—and a performance monitoring mechanism, enabling the Ministry of Health to track preparedness improvements and prioritise resource allocation across healthcare facilities. By systematically quantifying crisis management maturity, the Resilience Index facilitates evidence-based policy formulation and supports the alignment of hospital-level DRM practices with national strategic objectives.

Within the health sector, the National Centre for Crisis and Disaster Management in Health, instituted by the Ministry of Health in 2019, serves as a central hub for health-related risk execution (Ministry of Health, 2022; Saudipedia, 2024). It collaborates with entities like the General Directorate of Civil Defence and the Saudi Red Crescent Authority to ensure cohesive

responses (Ministry of Interior, 2022; Ministry of Health, 2021). Sector-specific contributions from bodies such as the National Center of Meteorology and ministries for energy, transport, and environment integrate public-private partnerships for service continuity (National Center of Meteorology, 2023; Vision 2030, 2023). Although this framework enforces standardised guidelines for hospital preparedness, institutions enjoy limited flexibility to tailor them to local hazards and constraints (Ministry of Health, 2021). Hospitals may adapt training and resources within central guidelines, but large-scale events trigger escalation to national coordination (Saudipedia, 2024).

Critically, this centralised model promotes national cohesion but may stifle hospital innovation through bureaucratic rigidity, as seen in adaptive challenges during the COVID-19 pandemic (Ministry of Health, 2022). Integration with Vision 2030's Health Sector Transformation Program, however, advances proactive measures and digital tools, linking macro strategies to hospital practices for vulnerability reduction (Vision 2030, 2023).

Hospitals shoulder targeted duties across the DRM cycle, aligned with national and international standards to sustain care and resilience (Ministry of Health, 2021; WHO, 2019). In mitigation, they perform risk assessments, fortify structures (e.g., seismic or flood-resistant designs), and devise hazard-specific plans, including resource stockpiling—though regional disparities may undermine efficacy (Khan et al., 2024; Lwin et al., 2024; Al-Wathinani et al., 2023). Preparedness involves crafting emergency protocols, staff drills, role delineation, and supply readiness, drawing from models like Japan's post-disaster approaches to inform Saudi enhancements amid resource barriers (Gamboa-Maldonado et al., 2012; Lwin et al., 2024; Mulyasari et al., 2013). Response entails activating operations, triage, partner coordination, and resource deployment to safeguard lives (Troy et al., 2008; WHO, 2019), with digital tools aiding real-time efficiency despite procedural inconsistencies (Lwin et al., 2024). Recovery focuses on service restoration, staff support, care resumption, and lesson integration, demanding ongoing investment for long-term resilience (Khan et al., 2024; Shavarani et al., 2019; Kayano & Chan, 2022).

Vision 2030 embeds DRM within health reforms, emphasising infrastructure, sustainability, digital innovation, and partnerships (Saudi Vision 2030 Secretariat, 2024; Suleiman & Ming, 2025; Yousef et al., 2023). Tools like the Sehha telemedicine app and Tawakkalna for contact tracing address pandemics, yet persistent gaps endure (Hassounah et al., 2020). Proposals include expanding beds in high-risk areas and leveraging AI for emergencies, balanced by decentralised decision-making and governance (Global Health Saudi, 2025; Future Digital Communications, 2025; Jaziri & Miralam, 2021). Alignment with the Sendai Framework has spurred Hospital Emergency Preparedness Planning Units (HEPPUs) and training, but limited curriculum integration hampers capacity (Al-Wathinani et al., 2023; Sultan et al., 2023; Wright et al., 2020). Robust governance is thus essential for Vision 2030's resilient health system (Al-Hanawi et al., 2020).

Privatisation of 290 public hospitals and Saudisation policies pose acute challenges, with skilled national shortages and potential rural-urban inequities under public-private partnerships (Al-Hanawi et al., 2019; World Health Expo, 2023). Insights from the UK and Australia underscore the need for defined emergency contracts and monitoring to maintain surge capacity and equity (Jaziri & Miralam, 2021). Absent safeguards, equitable responses falter, jeopardising Vision 2030's resilience goals—necessitating stringent governance, monitoring, and resilience prioritisation (Al-Hanawi et al., 2020). Thus, whilst Saudi Arabia's DRM architecture demonstrates alignment with international frameworks, successful operationalisation at the hospital level remains contingent upon addressing resource disparities, enhancing coordination mechanisms, and ensuring that governance structures accommodate both centralised strategic direction and context-appropriate institutional adaptation.

Having established Saudi Arabia's regional disaster risk heterogeneity and institutional DRM architecture, the subsequent section examines stakeholder perceptions—encompassing both healthcare workers and the public—as critical determinants of DRM effectiveness, thereby situating perception as a central analytical construct for evaluating institutional resilience and informing targeted policy interventions.

1.5 Stakeholder Perceptions in Healthcare DRM

Perception is a complex and crucial concept in DRM, particularly in healthcare contexts, where subjective and collective responses to risk influence institutional resilience (Slovic, 2013). In risk psychology, risk perception is quite broadly defined as the cognitive and emotional evaluation of risk information, shaped by lived experience, cultural context, and social influences (Fischhoff et al., 2004; Slovic, 1987). It is not purely a logical appraisal of objective probabilities but is frequently driven by heuristic and affective processes (Finucane et al., 2000; Peters et al., 1997). For example, Slovic (2013) has described the "affect heuristic,", whereby individuals judge risks based on their emotional responses to the experience rather than analytical evaluation.

In healthcare, risk perception is especially relevant: healthcare workers (HCWs) and the public may perceive threats differently from technical risk assessments (Leppin and Aro, 2009). Perception shapes behaviours and decision-making at individual and organisational levels (Blake et al., 2020; Khan et al., 2022). For example, HCW's perceptions influence participation in preparedness activities, such as their willingness to take part in drills and organisations' compliance with emergency protocols, as well as their confidence in institutional approaches (Labrague et al., 2018; Alqahtani et al., 2023). When DRM efforts are seen as credible and feasible, HCWs engage meaningfully in training, simulations, and coordinated operations (Elsayed et al., 2023). Conversely, if preparedness plans are perceived as symbolic or disconnected from clinical reality, disengagement occurs (Adini et al., 2012). In Saudi Arabia, Al Khalili et al. (2021) found that some Saudi HCWs viewed hospital preparedness plans as bureaucratic exercises, resulting in scepticism and reduced participation. This finding aligns with international evidence that trust deficits and low efficacy perceptions can hinder DRM protocols, even when technical systems are in place (Gilson, 2003; Paton and Johnston, 2001).

Communication can play a central role in shaping risk perception (Covello, 1992; Reynolds and Seeger, 2005). Transparent, clear and consistent risk communication aligns perceptions with

institutional goals (Renn and Levine, 1991; Wachinger et al., 2013). Without credible risk communication, misinformation and anxiety that distort preparedness and risk perceptions (Malecki et al., 2021). For example, during the COVID-19 pandemic, misinformation about PPE and ambiguity around transmission risks created confusion and hesitance among HCWs across high-resource environments (Greenberg et al., 2020; Kamerow, 2020). Such examples serve to highlight how vulnerable perceptions are to institutional failure, and the potential for cascading effects of perception, where trust can erode quickly (Van Bortel et al., 2016; Hinderer et al., 2024). While perception is sometimes criticised as being too subjective to evaluate DRM strategies (Kasperson et al., 1988; Tierney et al., 2007), this critique fails to recognise that risk perception is not simply an output of risk management, it can also be an important input the effectiveness of the process it relies upon (Becker et al., 2013; Slovic, 2013). For example, in the context of the COVID-19 pandemic, HCWs' risk perceptions of institutional support influenced their compliance with safety protocols and contributed to the overall effectiveness of this response. This also illustrates how perceptual factors can influence the success of containment measures (Houghton et al., 2020; Greenberg et al., 2020; Labrague and De Los Santos, 2020; Malecki et al., 2021; Sim, 2020). By including perceptual sources in the preparedness planning process, healthcare organisations may better understand blind spots, enhance adaptive capacity, and promote applications of safety (Chandra et al., 2011).

Public perceptions also influence DRM outcomes. Perceptions of an organisation extend beyond those held by internal stakeholders to the public (Gilson, 2003; Visschers and Siegrist, 2008). Trust in hospitals affects health-seeking behaviours, adherence to emergency directives, and cooperation during emergencies (Rubin et al, 2009; WHO, 2015). For example, the public's willingness to seek care during disasters such as floods, earthquakes, or disease outbreaks, to comply with evacuation directions, or follow an infection control strategy is related to perceptions of and trust in healthcare organisations (Blake et al., 2020; Greenberg et al., 2020). When hospitals are perceived as unprepared or disorganised, the public may delay or avoid care, creating larger health risks and straining emergency services (Khan et al., 2022; Van Bortel

et al., 2016). The Ebola outbreak in West Africa highlighted this, where rumours of hospital mismanagement led to community resistance and violent acts towards HCWs (Van Bortel et al., 2016). These are all reminders about how there is nothing neutral about public perception - they are central to DRM success.

However, some researchers advise against placing too much weight on public opinion of DRM planning, noting that media, social networks, or cultural myths may distort perceptions (Kasperson et al., 1988; Tierney et al., 2007). While this is a valid point, it reinforces rather than diminishes the need to be explicit about perception itself (Renn and Levine, 1991). Whether inaccurate or constructed responses originate from misperception is not the point. Misperception should be addressed, and a key method for achieving this is by actively recognising the issue and, thereafter, actively engaging the public. For instance, public education campaigns, community engagement, and inclusive preparedness planning can be used to help establish more accurate and positive perceptions (Khan et al., 2022; Paton and Johnston, 2001). In this sense, perceptions are not a predetermined barrier to good disaster management but a flexible variable that can be shaped through intentional strategies to achieve stakeholder consensus and improve resilience (Blake et al., 2020; Chandra et al, 2011).

This thesis considers both internal (HCWs) and external (public) perceptions, examining how they operate simultaneously to influence DRM outcomes. The simultaneous perception framework highlights the importance of addressing both perspectives together, bridging the gap in the existing literature where HCWs and the public have largely been studied in isolation (Al Thobaity et al., 2015; Bullock et al., 2017). HCWs are an integral part of operational preparedness and disaster response, but their effectiveness in large scale emergencies is limited if the public does not trust the healthcare system and comply with external guidance, (Gilson, 2003; Khan et al., 2022). Conversely, the public's trust in hospitals is strengthened when hospitals demonstrate competence, coordination and compassion – qualities often conveyed through HCW behaviour and institutional capacity – during crises (Adini et al., 2012; Greenberg et al., 2020). By investigating both internal and external perceptions together, this

research provides a more comprehensive understanding of DRM in Saudi Arabian public hospitals, revealing how organisational strategies are not only designed, but also perceived, acted upon, and experienced (Becker et al., 2013; Blake et al., 2020).

Ultimately, perception functions as a signalling mechanism in health care appropriately determining risk governance. It reflects trust, initiates behaviour, and influences outcomes across the four DRM phases. Therefore, disaster management preparation is more than infrastructure and protocols; it involves understanding how non-healthcare actors perceive a healthcare disaster (risk events), preparedness, and how much they rely on institutional knowledge. Bridging technical planning with humanly observable risk perception is critical for achieving resilient health systems.

This thesis adopts a dualistic perspective, recognising the strong inter-relationship between internal (HCWs) and external (public) perceptions. The simultaneous perception framework bridges the gap in existing literature on both subjects, much of which has examined these groups separately without considering the effect one has on the other (Al Thobaity et al., 2015; Bullock et al., 2017). HCWs are integral to operational preparedness and response in both pre- or post-disaster contexts. However, unless the public has confidence and trust in the healthcare system, as illustrated during the COVID-19 pandemic and earlier disaster events, the HCWs alone cannot be effective in large-scale emergencies (Gilson, 2003; Khan et al., 2022). Conversely, during a health crisis, public trust is reinforced when hospitals demonstrate competence, cooperation and compassion, often embodied through HCWs' behaviour during crises (Becker et al., 2013; Blake et al., 2020). Therefore, this research contributes to a more holistic understanding of DRM in Saudi Arabian public hospitals, revealing how organisational approaches, strategies and policies are perceived, acted upon, and experienced throughout the system.

With an understanding of the importance of perception to DRM in healthcare in Saudi Arabia, the following section will address the gaps in the current perception research. The aim is to

assist in the development of a comprehensive model that can be used to strengthen the resilience of Saudi Arabian hospitals and healthcare systems during disasters across all four disaster phases.

1.6 Advancing Perception Research for Hospital Resilience

Although research on DRM in healthcare has increased, significant gaps in the literature remain regarding how perception is incorporated into evaluations of hospital resilience, particularly across the entire disaster cycle. Much of the existing literature adopts a segmented approach, concentrating solely on either preparedness or response, while, in many cases, neglecting critical phases like mitigation and recovery. For example, Al Thobaity et al. (2015) evaluated Saudi nurses' disaster knowledge in disaster situations. However, this evaluation emphasised emergency preparedness and provided very limited insight into mitigation or long-term recovery processes. Similarly, in their systematic review of nurse's disaster preparedness, Labrague et al. (2018) found that an overemphasis on acute response training risks detracting from holistic planning and the consideration of disaster processes as a whole.

This fragmented perspective undermines the development of integrated DRM strategies, given that each phase of the cycle (preparedness, response, mitigation and recovery) is interdependent and must be taken that evaluations occur in continuity. In this regard, feedback from WHO (2020) indicated that DRM frameworks must encompass each of the four phases if systemic resilience and continuity is to be achieved. Furthermore, understanding how perceptions evolve from the pre-event planning phase to post-event recovery is crucial for identifying institutional weaknesses and gauging levels of public trust. As Al-Wathinani et al. (2021) argued, perceptions of institutional preparedness not only affect healthcare workers' confidence, but also public trust, directly influencing the effectiveness of DRM strategies. In summary, the gaps in perception-focused DRM research are significant. Addressing these is essential for the development of robust and holistic DRM framework that can enhance hospital resilience across all disaster phases.

Additionally, the current DRM literature tends to focus heavily on clinical personnel, particularly doctors and nurses, while largely excluding nonclinical staff. In their systematic review, Almukhlifi et al. (2021) reported that most studies about disaster preparedness captured the perspectives of clinical roles and did not consider the work of administrative or logistics staff. The omission is significant, as hospital operations during crises rely heavily on non-clinical services such as administration, logistics, and other support. Balay-odao et al. (2021) emphasised the importance of including logistics and administrative personnel into emergency planning in Saudi hospitals, noting their key roles in coordinating many essential functions such as supply chain continuity and inter-agency communication.

Excluding non-clinical staff from DRM perception studies risks creating a skewed understanding of institutional capacity and subsequently fails to address operational vulnerabilities. While it may be argued that clinical personnel may be more directly involved in patient care during disasters, this view neglects the systems-level perspective required to understand true hospital resilience. Gowing et al. (2017) argued that hospital preparedness is a shared responsibility that requires cross-functional collaboration among clinical, operational and administrative personnel, especially during complex emergencies such as mass casualty incidents or infectious disease outbreaks. Therefore, a comprehensive evaluation of DRM must explicitly include the perceptions and contributions of nonclinical staff to capture the full scope of institutional resilience (Balay-odao et al., 2021).

A second limitation of the current body of trauma and DRM research relates to the disconnect between the perceptions of internal stakeholders (e.g. HCWs' confidence in their institution's DRM plans) and external stakeholders (e.g. public trust in hospitals during a disaster response). Existing studies have examined these two domains separately, using different instruments and theoretical foundations. For example, Nofal et al. (2018) examined HCWs' perceptions of disaster preparedness but did not consider whether HCWs views aligned with public expectations or levels of trust. This separation created an analytical issue, as the effectiveness

of hospital DRM strategies not only depends upon internal readiness in a hospital system, but also upon how the public perceives and responds to a hospital's actions.

Research highlights that trust is a central mediator of risk perception and communication. Visschers and Siegrist (2008) argued that trust strongly influences how people interpret and act upon health risk information, while Rubin et al. (2009) found that during the H1N1 influenza virus outbreak in the UK, public responses to health messaging were shaped not only by the accuracy of information, but also by the perceived credibility of the organisations delivering it. Thus, perception-based models of disaster management need to synthesise and interconnect the different views of HCWs and the perceptions of the public in order to demonstrate how their joined perceptions build trust and establish teamwork for hospital resilience (Alqahtani et al., 2023; Rubin et al., 2009; Visschers and Siegrist, 2008). Synthesising both HCWs' and public perceptions would help further align hospital DRM strategies with community expectations, develop trust, strengthen coordinated action during crises, thereby enhancing hospital resilience (Alqahtani et al., 2023).

One long-standing omission in the literature is the lack of attention to regional disparities in national disaster risk management systems. Much of the empirical evidence is informed by emergency departments in urban hospitals (i.e., well-resourced hospitals in urban centres or more centrally located regions), while the experiences of hospitals in peripheral, rural or underserved areas is underrepresented. Al-Wathinani et al. (2023) and Mani et al. (2023) noted that the introduction of DRM in the very north and south of Saudi Arabia, which are remote and often socio-economically underdeveloped regions, presents challenges due to under-developed infrastructure, limited specialist workforce and irregular coordination with civil defence agencies. Similarly, research has pointed to weaknesses in hospitals in Jazan, a region near the Yemen border facing unique security and humanitarian challenges, where limited trauma facilities and communication breakdowns can occur during emergencies (Moafa et al., 2021; Al-Anezi, 2025).These region-specific vulnerabilities influence both HCWs' perceptions of preparedness and the public's confidence in institutional responsiveness, yet they are rarely

incorporated into national DRM assessments. As argued by Kruk et al. (2015), inequities in the allocation of resources and infrastructure complicate the scaling of DRM frameworks nationally – particularly in de-centralised healthcare systems. Consequently, identifying regional inconsistencies in DRM assessments is crucial to ensure that resilience is equitably sustained across heterogeneous geographic and socio-economic settings (Haldane et al., 2021).

A perception-based approach that incorporates both clinical and non-clinical perceptions would strengthen DRM models for policy and practice (Gendeshmin et al., 2025). Such an approach should also connect internal and public systems while accounting for regional variability, thereby improving their accuracy and utility (Kruk et al., 2015). Unless these limitations are addressed, gaps in hospital resilience will persist, and equitable preparedness across diverse settings will continue to be constrained (Thomas et al., 2020). As Thomas et al. (2020) argued, neglecting diverse stakeholder perspectives and regional contexts in DRM research reinforces vulnerabilities in under-resourced settings and undermines overall health system resilience.

Developing a perception-centred approach that includes both clinical and non-clinical staff, bridges internal and public perceptions, and incorporates regional disparities would offer a more precise and actionable foundation for DRM research and policy. This need is especially important in the post-COVID context, where public expectations have shifted and the healthcare worker's experiences have been profoundly altered. The WHO (2021) noted that the pandemic exposed major deficiencies in risk communication and organisational transparency, resulting in an erosion of trust and resistance in many healthcare systems.

In Saudi Arabia, these issues are further complicated by recent Saudi Vision 2030 reforms. Decentralisation has challenged regional coordination, privatisation has heightened disparities in resource access, and digital transformation has created new demands for robust IT security and data systems to facilitate DRM (Goniewicz et al. 2023; Mani and Goniewicz 2024). Goniewicz et al. (2023) emphasised that Vision 2030 requires a deeper understanding of

stakeholder perceptions to strengthen public health infrastructure and emergency preparedness. Therefore, aligning DRM with these reforms will require evaluating stakeholder perceptions to ensure institutional legitimacy and improve responsiveness (Mani and Goniewicz 2024).

This thesis responds to the identified gaps in the knowledge by developing an integrated perception- centred assessment of DRM in Saudi Arabia, public hospitals. The study evaluates all four phases of the DRM cycle and incorporates the perspectives of both HCWs and the general public, while also giving explicit attention to often-overlooked voices of non-clinical hospital staff. In addition, it takes into account regional variation and health provision contexts, offering a more equitable and context-sensitive understanding of hospital resilience.

By adopting this inclusive approach, the research aims to generate grounded, actionable insights to improve DRM and support the implementation of Saudi Arabia's national health objectives. This reaserch is also aligned with the Sendai Framework for Disaster Risk Reduction (2015-2030), which calls for inclusive, multi-stakeholder engagement and attention to regional context as essential to achieving resilient health systems (Khan et al., 2018). Ultimately, the findings are intended to provide robust, evidence-based recommendations to inform policy and practices, therefore improving hospital resilience in line with both national and global disaster risk reduction objectives.

In outlining the rationale and detailing the gaps in perceptual research, the following section presents the scope and methodology of this thesis, demonstrating how this study addresses the gaps identified through a multi-stakeholder, multi-regional approach informed by OECD frameworks.

1.7 Scope and Methodology of the Research

This thesis systematically examines stakeholder perceptions of DRM strategies in public hospitals in Saudi Arabia, with a specific focus on the two stakeholder groups: HCWs and the

public. Informed by existing research, which shows that stakeholder perceptions are shaped by diverse disaster risks in Saudi Arabia – ranging from natural hazards such as floods and heatwaves to anthropogenic events such as mass gatherings for Hajj and Umrah or industrial accidents (AlDulijand et al., 2023; Yezli et al., 2018) – this thesis positions these perceptions as central to understanding hospital resilience. Importantly, Saudi Arabia follows international principles set out in the Sendai Framework for Disaster Risk Reduction, which emphasises inclusive approaches and the active involvement of stakeholders in resilience building (UNDRR, 2015). Guided by a perception-informed analytical framework, this research seeks to generate evidence-based recommendations that strengthen hospital resilience and advance DRM capacity within the Saudi public healthcare system.

The complexity of understanding this phenomenon within the specific context of healthcare in Saudi Arabia necessitated a multiple methods approach. Therefore, this thesis is structured around three complementary studies that integrate both quantitative and qualitative methods, thereby respecting the conclusions of each study and increasing the rigour and validity (Creswell and Plano Clark, 2011). All three studies were conducted in public hospitals across four regions—Central, Eastern, Western, and Southern—whilst excluding the Northern Region. This exclusion reflects methodological and ethical considerations rather than substantive dismissal of the region's significance. Specifically, the protracted timeline for obtaining research ethics approval from Northern Region health authorities exceeded the study's temporal constraints, thereby rendering inclusion methodologically infeasible without compromising the research schedule (Creswell and Plano Clark, 2011). Importantly, the Northern Region accounts for approximately 5.8% of Saudi Arabia's total population and 8.4% of public hospitals (General Authority for Statistics, 2022), rendering its exclusion less consequential for national representativeness than would be the case for more populous regions. Moreover, the four included regions encompass substantial diversity in hazard profiles, demographic characteristics, and healthcare infrastructure, thereby enabling robust examination of regional variation in DRM perceptions and practices. The included regions

collectively represent over 94% of the Kingdom's population and capture the breadth of disaster risk typologies relevant to Saudi Arabian healthcare (Ministry of Health, 2023).

The research objectives are threefold, each addressed by a corresponding study. First, to understand HCWs' perceptions of the effectiveness of DRM strategies across all four phases of the DRM cycle – mitigation, preparedness, response, and recovery – while accounting for demographic characteristics and regional differences. Second, to explore the drivers of HCWs' perceptions of the effectiveness of DRM strategies, with particular emphasis on organisational culture, individual experience, and regional context. Third, to investigate the drivers of public trust in hospital DRM, including perceived preparedness, awareness, effectiveness of communication, and satisfaction. By merging these stakeholder-focused studies, the research generates a greater understanding of DRM perceptions – encompassing both the operational dimension represented by HCWs and the societal dimension represented by the public. This integrated approach offers a robust foundation for developing policy-related insights to strengthen hospital resilience.

The first study examines HCWs' perceptions of DRM strategies across the four phases of the DRM cycle – mitigation, preparedness, response, and recovery – while accounting for demographic characteristics and regional differences. It addresses three research questions:

1. To what extent do HCWs perceive that their hospital's DRM strategies are capable of facilitating effective preparedness, response, and recovery in Saudi public hospitals?
2. How do demographic characteristics of HCWs shape their perceptions of their hospital's DRM strategies?
3. What are the similarities and differences in HCW perceptions between East, West, South, and Central in Saudi Arabia?

A quantitative cross-section survey was conducted across 22 public hospitals in four regions, excluding the North Region due to ethical approval constraints. A total of 542 HCWs, including nurses, physicians and administrators, voluntarily participated by completing a

structured questionnaire. Exploratory factor analysis and descriptive statistics were used to identify perceived DRM patterns and to highlight early regional and role differences, with statistical comparisons performed for relevant variables.

Building on the findings of the first study, which examined healthcare workers' overall perceptions of DRM effectiveness across the four phases, the second study extended this analysis by exploring HCWs' perceptions of DRM effectiveness as experienced in practice, with particular attention to organisational culture, individual experiences, and regional context. Three questions guided this study:

1. How does the organisational culture in Saudi hospitals influence HCWs' perceptions of DRM efficacy?
2. How do individual's experiences shape HCWs' perceptions of DRM efficacy across all the phases of implementation?
3. What factors explain regional differences in perceptions of DRM efficacy?

Twenty-four semi-structured interviews were conducted with HCWs from four public hospitals, each with over 100 beds and 500 HCWs, across the four regions. Thematic analysis was applied to identify cultural and regional similarities and differences, linking themes such as leadership clarity, past experiences of crises, and resource inequalities to perceived DRM effectiveness. These qualitative findings provided additional depth and new insights, consistent with patterns observed in the quantitative survey (Braun and Clarke, 2006; Kaiser, 2009; Silverman, 2017).

The third study investigates the drivers of public trust in hospital DRM, with a specific focus on perceived preparedness, awareness, communication effectiveness and satisfaction. Four hypotheses were tested:

1. Higher public perceptions of hospital preparedness are associated with greater trust in the hospital's ability to manage disasters
2. Greater knowledge of preparedness measures and messages is associated with higher trust.

3. Effective communication about preparedness is positive related with public trust.
4. Higher satisfaction with DRM practices is associated with higher trust.

A quantitative cross-sectional survey was conducted using a stratified random sample of 436 members of the public, representative of residents living in each of the four regions. The structured questionnaire provided insights into trust as well as perceptual variables, and the data were analysed using descriptive analyses, correlation, regression, and moderation analysis to test complex relationships and examine differences between urban and rural populations (Gille et al., 2022; Pallant, 2020; Siegrist and Cvetkovich, 2000).

With the scope and methodology of the study established, the following section discusses the theoretical and practical contributions of this research, as well as its limitations and delimitations, to clarify both its significance and boundaries.

1.8 Contributions and Significance

This thesis contributes to international discourse on hospital disaster resilience by prioritising stakeholder perceptions in the assessment of DRM strategies within Saudi public hospitals – an approach that is particularly timely given the Kingdom's complex cultural, geographical, and religious contexts (Aboshaiqah et al., 2009; UNDRR, 2015). Public hospitals in Saudi Arabia face diverse threats, including floods, heatwaves, industrial hazards, as well as the challenges associated with mass gatherings during Hajj and Umrah. Understanding how stakeholder perceptions influence the effectiveness of DRM Strategies is therefore essential. By incorporating the perspectives of HCWs and the public across the Eastern, Western, Southern, and Central regions, this study provides both theoretical and practical contributions, addressing a gap in the literature, while also providing concrete implications for policy and practice.

The first contribution of this thesis is its original, multi-stakeholder and regionally disaggregated analysis, which addresses a critical gap in the literature. While existing studies have tended to

examine the individual views of nurses (e.g. Al Thobaity et al., 2016; Alzahrani et al., 2019) or specific clinical specialties (e.g. Alshehri et al., 2017), and have often considered external stakeholders in isolation (Al Thobaity et al., 2019), none have integrated these perceptions. By bringing together the perceptions of HCWs and the public across different hospital settings, professional roles, and community backgrounds, this research provides a comprehensive picture of DRM effectiveness. Importantly, this contribution extends across all four phases of the DRM cycle – mitigation, preparedness, response, and recovery – offering an integrated analysis that has not previously been undertaken in the Saudi context. Moreover, the comparative analysis across the four regions of Saudi Arabia – Central, Western, Southern, and Eastern – each characterised by distinct environmental risks, such as industrial hazards in the Eastern region and Hajj and Umrah gatherings in the Western region – offers the first systematic evidence in Saudi Arabia of how both institutions and communities define and execute DRM strategies in practice, thereby clarifying the complementary roles they play in resilience-building (Al-Wathinani et al., 2023).

From a methodological perception, this thesis makes a novel contribution by employing a robust multiple-methods design, combining the quantitative breadth of structured surveys (Study One and Study Three) with the qualitative depth of semi-structured interviews (Study Two). This deliberate triangulation not only enhances the richness, external validity and representation of the findings but also directly addresses a gap in the literature by capturing both healthcare worker and public perceptions within the same research framework. This approach allows for the examination of complex relational and perceptual dynamics that would be difficult to capture using a single method of data collection (Creswell and Plano Clark, 2011). By drawing on the insights from both approaches, the research offers a methodologically original and contextually grounded understanding of how stakeholder perceptions shape DRM outcomes, establishing a strong model for future research in disaster-prone contexts (Creswell and Plano Clark, 2011).

From a practical perception, the thesis provides evidence-based recommendations for hospital administrators and policy makers. Findings from Study One demonstrate that many HCWs, particularly in the Southern region, expressed concerns about their institutions' level of preparedness and inadequate recovery capacities, highlighting the need for targeted investment in region-specific training, infrastructure enhancement, and emergency planning. The study identifies priorities areas for action, including region-specific training programmes and simulation drills, surge-capacity and supply chain improvements, clearly defined incident-command and inter-agency communication structures, infrastructure upgrades specific to each regions, and tailored recovery planning. These measures aim to improve hospital resilience in high-risk and resource-limited areas. Furthermore, this approach establishes a foundation for supporting institutional health system resilience in alignment with Saudi Arabia's Vision 2030 objectives, by strategically improving surge capacity and integrating region-specific stakeholder perceptions into health system planning and fiscal management (Alqahtani et al., 2021; Goniewicz and Goniewicz, 2021).

From a theoretical perception, the thesis contributes to the advancement of disaster governance frameworks by illustrating how perceptions of DRM efficacy and trust are shaped by institutional structures, organisational culture, emotional experiences, and regional characteristics. Findings from Study Two indicate that effective leadership – characterised as clear, decisive, and supportive – is an important factor in positive perceptions, whereas HCWs who reported past psychological strain were less likely to engage in future DRM activities. These findings highlight the importance of psychological and cultural factors in DRM theory, building on foundational models of risk perception (Slovic, 2000; Paton, 2019).

A key contribution of this thesis is the focus on public trust. Findings from Study Three demonstrate that public perceptions of hospital preparedness, familiarity with critical preparedness measures, perceived communication effectiveness, and satisfaction with DRM practices all contribute to increased trust in Saudi public hospitals’ capacity to manage disasters. Specifically, the study showed that greater perceived preparedness and effective

communication increased public trust levels, which increased compliance with disaster interventions and health-seeking behaviours during disasters, whilst increased satisfaction with DRM practices further reinforced public trust levels in disaster context. Conversely, negative public perceptions, such as distrust due to a perceived lack of clarity in communication, can reduce compliance and increase risk. This aspect of the research highlights how public trust is an important enabler of community cooperation, aligning with Saudi Vision 2030 objectives of that emphasise community engagement in healthcare resilience planning (Gille et al., 2022; Siegrist & Cvetkovich, 2000).

In line with the scope of this thesis, public hospitals under the auspices of the Saudi Ministry of Health were the focus, ensuring that DRM assessments could be consistently evaluated and conclusions drawn. Private hospitals were excluded due to their distinctive governance structures and preparedness processes (Alkhamis, 2012). The study focused on four regions of Saudi Arabia (Eastern, Western, Southern, and Central), each with unique disaster risks, such as industrial risk and flooding. The Northern region was excluded because ethical approval could not be obtained for the majority of hospitals there, limiting the applicability of the findings to the whole country. The analysis focused on HCWs and the public, excluding policymakers and private sector actors, to reflect the perceptions of those directly involved in or affected by disaster management outcomes. Focusing on perceptions rather than a technical assessment of infrastructure or operational efficiency was essential, highlighting how stakeholder views contribute to effective DRM and supporting international research into perception-driven resilience (Slovic, 2000; Paton, 2019).

To conclude the introduction, the final section provides an overview of the organisation of the thesis, which the subsequent chapters will build on to advance understanding of DRM in Saudi public hospitals.

1.9 Thesis structure

This thesis comprises three original research articles, which collectively explore ways to improve DRM in public hospitals in Saudi Arabia. A perception-centred approach that considers the views of HCWs and the public is applied across all four DRM phases: mitigation, preparedness, response, and recovery. While each study addresses a common theme, they are written as stand-alone works, allowing readers to understand each study independently. The first study is preceded by an introductory chapter, which outlines the global and regional disaster risk context for hospitals, emphasises the importance of resilience, and highlights the significance of stakeholder perceptions in enhancing DRM effectiveness. This introduction also provides the context for this research, detailing its limitations, aims and objectives, methods and methodology, contributions, and implications for the subsequent chapters of the thesis.

The structure of the dissertation is as follows: Chapter 1 (Introduction) presents the global and Saudi Arabian disaster risk context, outlining their relevance across the DRM cycle, the significance of stakeholders' perceptions, gaps in the literature, and the aims and methodology of the study. Chapter 2 presents the first article, a quantitative study examining HCWs' perceptions of DRM strategies across 22 public hospitals in the Eastern, Western, Southern, and Central regions of Saudi Arabia, analysing regional and demographic differences in preparedness and recovery capabilities. Chapter 3 presents the second study, which uses qualitative methods to explore HCWs' perceptions of enacted DRM efficacy, focusing on organisational culture, personal experience, and regional context through thematic analysis of interviews. Chapter 4 presents the third study, examining public trust in hospital DRM based on perceptions of preparedness, awareness of preparedness behaviours, perceived effectiveness of communication, and satisfaction with hospital actions, using quantitative survey data. Chapter 5 presents a synthesis of the findings from the previous studies into a proposed perception-informed DRM framework for Saudi public hospitals. This framework includes multi-stakeholder perceptions and regional factors to provide actionable pathways for enhancing

resilience in the public hospital system, aligning with the Saudi Vision 2030 and the Sendai Framework for Disaster Risk Reduction.

The final chapter synthesises the dissertation findings, discusses implications for practice and policy, and reflects on the limitations, such as the exclusion of participants from the Northern region of Saudi Arabia and private hospitals. It also outlines directions for future research, including longitudinal-based approaches, the inclusion of additional stakeholders, and technical assessments to further inform processes that reinforce DRM frameworks. Taken together, these chapters provide a coherent and comprehensive exploration of how DRM in Saudi Arabian public hospitals can be better designed and implemented, incorporating the perceptions of key stakeholders.

Chapter 2 How Do Healthcare Workers Perceive DRM in Saudi Public Hospitals?

Abstract

This study critically examines healthcare workers' (HCWs) perceptions of disaster risk management (DRM) in Saudi Arabia's public hospitals, with particular focus on the four DRM phases – mitigation, preparedness, response, and recovery – and how these perceptions vary by demographic and regional factors. A descriptive, cross-sectional study design was used to collect data from 542 HCWs across 22 public hospitals in the Central, Eastern, Southern, and Western regions of Saudi Arabia. Overall, HCWs rated DRM strategies as moderately effective, though HCWs' perceptions varied by phase: mitigation received the highest rating (M = 3.69), while preparedness was rated the lowest (M = 3.43), reflecting confidence in safety infrastructure but concern over training and funding. Leadership roles significantly shaped perceptions, as policymakers and decision-makers reported greater confidence in HCWs' preparedness (p = .036), and recovery (p = .009), reflecting hierarchical workplace norms. No statistically significant differences emerged across gender, education level or occupational role, which may be partly attributed to the cultural context limiting expression of critical attitudes in the workplace. Regionally, HCWs in the Central and Eastern regions reported significantly higher DRM perceptions than those in the Southern region (p < .008), indicating that HCWs continue to work in environments of inequitable healthcare readiness. The Western region had moderate perceptions, perhaps influenced by operational stress HWCs experience due to Hajj-related surges in patient care demands. These findings underscore the urgent need for targeted, regionally sensitive strategies to strengthen DRM, engage underrepresented HCW groups in planning, and address structural inequities in line with Saudi Arabia's Vision 2030 healthcare reform policies. Future research should employ qualitative methods to further explore the driving forces behind these perceptions and inform more representative and resilient DRM policy agendas.

2.1 Introduction

This chapter presents the first empirical study investigating healthcare workers' (HCWs) perceptions of disaster risk management (DRM) in Saudi public hospitals. The study explored how HCWs perceive their hospitals' DRM across the four internationally recognised phases – mitigation, preparedness, response and recovery – and whether these perceptions vary according to socio-demographic characteristics and regional contexts (Central, Eastern Southern and Western Saudi Arabia).

The first section of this chapter provides the background and conceptual framing for this study, situating it within the Saudi healthcare system and broader disaster management. It then outlines the study design, including the multi-site sampling strategy, survey development and validation, and the analytical approach used to interpret the data. The results section presents both descriptive and inferential findings, which are subsequently discussed in relation to existing literature. The discussion considers the implications for policy and practice, highlighting the role of perception in shaping effective DRM strategies. The chapter concludes by acknowledging the study's limitations, suggesting directions for future research and summarising its key contributions to strengthening hospital resilience in disaster contexts.

2.1.1 Background

Amid growing global uncertainties, such as pandemics and climate-driven disasters, healthcare system resilience has emerged as a focal point of concern. This is particularly salient in Saudi Arabia, where socio-cultural, environmental, and geopolitical pressures converge (Kruk et al., 2015; United Nations Office for Disaster Risk Reduction [UNDRR], 2023). The World Health Organisation (WHO)'s (2021) *Health Systems Resilience Framework* defines resilience as a healthcare system's ability to maintain essential functions during shocks. Specifically, the WHO views hospital resilience as being the capacity to anticipate, absorb, respond, and recover from disruptions such as health system shocks.

Saudi Arabia faces unique challenges due to the Hajj and Umrah pilgrimages, which place extraordinary demands on the healthcare system. These religious events, concentrated in Mecca and Medina, attract millions of global participants over a short period (Saleh, 2024). For example, in 2024 Hajj involved 1.83 million participants and Umrah attracted more than 35 million participants (16.8 million international and 18.88 million domestic). Such surges in demands are exacerbated by infectious disease pandemics, natural hazards and geopolitical tensions (Saudipedia, 2024; Statista, 2025). Therefore, these conditions necessitate a resilient healthcare system underpinned by robust DRM, coordinated interagency cooperation, and proactive scenario planning. In addition, key priorities include epidemic surveillance, mass-casualty preparedness, and strategies for addressing resource shortages (Al Thobaity et al, 2023; Yezli et al., 2024).

Similarly, broader system-wide concerns – such as systemic ineffectiveness and cultural obligations – further emphasise the need for hospital resilience (Alkhamis et al., 2023; Sultan et al., 2020). A systematic DRM approach is needed to enable hospitals to endure and effectively respond to a variety of crises. Distinct regional risks in Saudi Arabia highlight the need for nuanced, context-specific resilience strategies. In the Central Region of Saudi Arabia, centred on Riyadh, infectious-disease outbreaks are the greatest threat, as well as urban flooding linked to rapid urbanisation (Al-Wathinani et al., 2024). The 2014 Middle East Respiratory Syndrome Coronavirus (MERS-CoV) outbreak (255 cases; 93 deaths) exposed the vulnerability of hospitals to healthcare-associated infections and pushed stretched intensive-care capacity to its limits (Al-Tawfiq et al., 2016). As of 2022, Riyadh accounted for 30% of the nation’s 841,469 COVID-19 cases, reinforcing the need for additional epidemiological surveillance and flexible critical-care systems (Ministry of Health [MOH], 2023). Flooding also poses a significant threat. For example, major floods in 2018 disrupted access to healthcare, undermined chronic-disease management, and exposed weaknesses in disaster preparedness (Al-Wathinani et al., 2023). While some argue that Riyadh's more developed facilities may mitigate risks more effectively than rural or less developed areas (Alkhamis et al., 2023), capacity breaches during peak

demand periods related to Hajj or Umrah continue to expose gaps in surge capacity (Mahmoud et al., 2023). Taken together, these findings suggest that DRM in the Central Region, specifically in Riyadh, must prioritise surge-capacity planning and flood-resilient infrastructure to ensure continuity of care during crises.

The nation's oil infrastructure is primarily located in the Eastern Province, making the region highly vulnerable to industrial and environmental threats. Refinery incidents such as the Ras Tanura refinery fire in 2012, which injured 11 people, underscore these risks within the province (Almutairi et al., 2024). In addition, occupational injury rates in eastern Saudi Arabia average an estimated rate of 7.1 per 1,000 workers annually, with the highest rates in mining, quarrying and manufacturing (8.1) and agriculture, fishery, and forestry (7.4) (Al-Damigh et al., 2015). Recurring sandstorms affect over 50,000 residents per year with respiratory disease, heightening respiratory diseases burdens and straining hospitals such as King Fahad Specialist Hospital, which often lack adequate air-filtration systems (Alruwaili et al., 2022). Additionally, MERS-CoV cases related to camel exposure (68 cases in 2019) increase public health pressure (MOH, 2020). While Saudisation reforms have contributed to reducing incident rates of respiratory illness (Sultan et al., 2020), significant risks remain. Area-specific DRM strategies should prioritise occupational health, improved monitoring and the enhancement of hospital air-filtration and decontamination systems.

In Saudi Arabia’s Southern Region (Jizan, Najran, and Asir), the intersection of geopolitical conflict and the environment hazards presents severe challenges. Since 2015, Houthi attacks in have killed over 130 civilians in Jizan and Najran and damaged health facilities, including Jazan General Hospital (Friends Committee on National Legislation, 2022). Furthermore, flooding is an additional risk, with the 2016 flash floods impacting around 8,000 people and overwhelming under-resourced hospitals (Al-Wathinani et al., 2023). While diplomatic de-escalation of the Yemen conflict would reduce the immediate threat, persistent environmental hazards mean resilience planning is necessary (Jaziri and Miralam, 2023; Al-Wathinani et al., 2024).

Consequently, DRM strategies in the Southern Region must include both security preparedness and flood-proofing of health care facilities.

In the Northern Region (Tabuk, Al-Jawf, and Northern Borders), geophysical and climatic hazards are less frequent but remain significant. The 1995 Gulf of Aqaba earthquake (magnitude 7.3) exposed the region's vulnerability to seismic activity, while a cold snap in 2013 caused seven deaths and blocked access to care in areas such as Tabuk (Klinger et al., 1999; UNDRR, 2020). These events highlight the need for investment in hazard monitoring, rural infrastructure and preparedness measures tailored to remote communities. Although research suggests that southern provinces may face more pronounced challenges in healthcare access and transportation infrastructure (Kattan, 2024; Al-Anezi, 2025), the Northern Region's distinct vulnerabilities, stemming from its sparse population and geographic isolation, require targeted interventions to mitigate disaster risks (Alruwaili et al., 2021).Area-specific DRM strategies should therefore improve resilience, strengthen preparedness and enhance access to healthcare in rural and hard-to-reach areas.

Across the identified regions, both shared and unique challenges emerge. Common issues include resource constraints, workforce stress, logistical issues, and delayed service delivery, while unique risks such as industrial hazards, cross-border conflict or seismic activity demand region-specific strategies (Alshehri et al., 2024). Ultimately, effective crisis response is dependent on the engagement of emergency HCWs – including nurses, physicians, and other emergency response workers – whose perceptions of the DRM directly shape healthcare resilience (Sultan et al., 2020). Transparent, action-oriented DRM plans linking national policy to frontline realities were perceived to enhance HCW engagement, whereas the absence of such connections weakened operation responses (Alqahtani et al., 2021; Slovic, 1987). Existing research in Saudi Arabia has often focused narrowly on single phases of DRM or specific clinical populations, thereby neglecting wider organisational capability (Aleanizy and Alqahtani, 2022; Al Thobaity et al., 2023). This study addresses that gap by exploring HCWs' perceptions of disaster

preparedness across a number of hospitals within Saudi Arabia, thereby supporting resilience building and establishing a link between national policy and frontline practice.

2.1.2 HCWs' Perceptions of DRM

DRM in healthcare is a structured framework for identifying, assessing, and mitigating risks to healthcare facilities and service delivery. It encompasses four operational phases: mitigation, preparedness, response and recovery (WHO, 2019). Mitigation entails pre-disaster activities, such as strengthening infrastructure and implementing infection-control protocols (WHO, 2019). Preparedness includes structured training, allocation of resources and planning to ensure effective responses (Labrague et al., 2021). The response phase focuses on immediate actions (e.g. triage and evacuation), while recovery prioritises the resumption of services and the well-being of personnel once the disaster is over (Labrague et al., 2021; WHO, 2019). Together, these phases form a cycle aimed at enhancing resilience. In Saudi public healthcare, HCWs' perceptions of these phases can strongly influence efficiency, effectiveness and future disaster responsiveness (Emami et al., 2024; WHO, 2019).

Scholars agree that positive HCW perceptions of DRM phases enhance protocol adherence and operational efficiency, thereby strengthening resilience (Al Thobaity et al., 2015). For example, Labrague et al. (2018) found that structured training increased confidence in infection-control measures during mitigation, a finding echoed in Saudi Arabia by Aleanizy and Alqahtani (2022). Similarly, Adelaine et al. (2016) found that structural mitigation measures, such as earthquake-resistant buildings and water tanks, improved HCWs' perceptions of safety. In terms of preparedness, regular drills, as well as adequate personal protective equipment PPE and clearly defined triage procedures, have been associated with greater confidence, as shown among Saudi nurses (Al Thobaity et al., 2015) and Filipino HCWs (Labrague et al., 2021). During the response phase, effective leadership increased perceived efficacy, including during Saudi Arabia's response to COVID-19 (Aleanizy; Alqahtani, 2022; Aminafshar et al., 2023). For

recovery, institutional support – such as psychological debriefing – was associated with increased confidence in post-disaster strategies (Al Thobaity et al., 2015; Evans et al., 2023).

However, these positive perceptions may not always reflect actual DRM effectiveness. Cognitive biases can distort HCWs' views. Slovic (1987) highlighted that optimism bias, where risks or challenges are underestimated, can manifest as overconfidence, undermining preparedness when untested assumptions collapse under pressure. In resource-constrained contexts, Goniewicz et al. (2021), found that Polish HCWs reported inadequate response models, limited information-sharing, and reduced professional capacity, which were experiences mirrored in Saudi Arabia (Alharazi and Al Thobaity, 2023; Bullock et al., 2017). Perceptions of recovery were also vulnerable, as burnout and perceptions of inadequate resources contributed to a loss of trust in institutions to remain adequately supplied to manage future crises (Alharazi and Al Thobaity, 2023; Goniewicz et al., 2021). Therefore, regular simulations and exercises are needed to help align HCWs' perceptions with operational realities (Adelaine et al., 2016).

Research in this area remains very limited and fragmented. Some studies have examined specific phases – for example, mitigation and response (Aleanizy and Alqahtani, 2022) or preparedness (Al Thobaity et al., 2015), while ignoring others. This narrow focus obscures the cyclic interdependence of DRM phases, where perceptions in one phase influence perceptions and performance in the other phases (Labrague et al., 2021). Therefore, there is a need for more holistic research that integrates all four phases and examines the interconnection in practice.

The purpose of this study is to address the gaps in the literature, both unique to and shared across perceptions, to assess HCWs' future resilience under conditions of "critical mass" environmental hazards. Specifically, it examines the extent to which hospitals' DRM strategies enable effective preparedness, response, and recovery. The study also considers the roles of institutional positions, potential opportunities, and relevant legal frameworks in developing coherent policies that strengthen hospital resilience (WHO, 2019).

2.1.3 Demographic Influences on DRM Perceptions

Demographic variables – such as age, gender, education, occupation, and professional experience – can also influence how HCWs perceive and respond to DRM strategies (Gendeshmin et al., 2025). Researchers argue that understanding demographic differences can aid in more nuanced and context-specific policies that strengthen institutional resilience (Finucane et al., 2013; Visschers et al., 2007). For example, Mousavi et al. (2025) found that female HCWs and those aged 40–49-year-olds in Iran held less positive views of disaster preparedness than other demographics, suggesting that female HCWs may be more risk sensitive. These findings are particularly relevant to Saudi Arabia, where gender-segregated practices could reinforce such differences.

Experience and professional roles are also important. O'Sullivan et al. (2008) noted in their research that more experienced HCWs, particularly those in senior roles, reported lower levels of perceived risk, possibly because of greater familiarity with protocols. In the Saudi context, hierarchical workplace norms may reinforce this pattern, with the reassurance of senior HCWs fostering more positive engagement in DRM strategies (Sultan et al., 2020; Hofstede et al., 2010). Education adds another layer: Kably et al. (2021) found that more highly educated HCWs in Saudi hospitals expressed less confidence in disaster readiness, perhaps because education increased their awareness of institutional limitations. Collectively, these results suggest that demographic features not only moderate DRM perceptions, but also intersect with cultural norms, and organisational hierarchy and broader systemic pressures.

At the same time, demographics alone cannot fully explain variations in DRM perceptions. Psychological and cultural influences often intersect with or override demographic trends. Cognitive biases, such as optimism bias or excessive fear, can distort risk judgements regardless of an individual's professional background (Renn and Rohrmann ,2000; Slovic, 2013). Emotional fatigue or burnout also affect perceptions. For example, during the COVID-19 pandemic, UK HCWs' reported diminished readiness perceptions due to psychological fatigue and exhaustion, rather than demographic differences or characteristics (Greenberg et al., 2020).

In the Saudi context, strong workplace hierarchies may create additional perceptual gaps, with junior staff reluctant to express an opinion and/or participate in discussions (Sultan et al., 2020). In addition, senior members may not provide protection; some studies in the UK show that some senior staff resist the implementation of new protocols, which may occur in the strong hierarchy of professionalism and hierarchies in Saudi Arabia; (Alharazi and Al Thobaity, 2023; Greenberg et al., 2020).

Another overlooked issue concerns non-clinical staff. Much research has focused narrowly on doctors and nurses, overlooking the useful input of administrative, planning and logistical, planning personnel who are essential to DRM implementation (Bullock et al., 2017; Gowing et al., 2017). Non-clinical staff are critical during mass gatherings, such as Hajj and Umrah, yet insufficient training can lead to protocol misunderstandings or coordination breakdowns when stress levels rise (Alharazi and Al Thobaity, 2023; Almalki et al., 2011). The limited inclusion of these voices in research (Al Thobaity et al., 2015; Aleanizy and Alqahtani, 2022) and limited analysis of demographics (Sultan et al., 2020) highlight the need for more representative research studies. This study addresses these gaps by examining how age, gender, education, occupation, and professional experience shape HCWs' perceptions of DRM in Saudi Arabia's hierarchical healthcare system. By doing so, it aims to contribute more inclusive, representative and context-appropriate resilience strategies (Abolfotouh et al., 2020).

2.1.4 Regional Differences in DRM Perceptions

Geographic differences in healthcare infrastructure, funding and organisational capacity can significantly shape HCWs' perceptions of DRM, underscoring the need for policies that address regional inequities in resilience (AlQahtany and Abubakar, 2020). In metropolitan areas such as Riyadh, access to advanced medical facilities, including. King Fahad Medical City, enhances perceptions of preparedness and response capacity (Alruwaili et al., 2022). Similarly, sustained investment in Makkah through the annual Hajj supports confidence in DRM. However, local

healthcare systems there remain under pressure from seasonal surges in patient demand (Alatawi et al., 2020).

In stark contrast, more peripheral regions such as Asir and Jazan face significant challenges including limited surge capacity, outdated infrastructure, and fragile readiness and recovery, which adversely affect HCWs' perception of trust in DRM (Alharazi and Al Thobaity, 2023; Al Thobaity et al., 2015). Furthermore, historical conflicts in Jazan, alongside disparities in regional resources, have further undermined crises management capacity (Alharbi, 2018; Bajow and Alkhalil, 2014). In Dammam, frontline HCWs report that under-resourcing and hierarchical communication issues constrain perceptions of preparedness (Alsubaie et al., 2019). Together, these examples highlight how unequal resource distribution produces regionally uneven DRM perceptions.

However, some scholars suggest that regional differences may be less stark than they appear, citing national guidelines and training intended to standardise the DRM processes throughout the Kingdom (Almalki et al., 2016). National frameworks, including infection control measures and DRM frameworks, have provided a level of consistency and offer a sense of coherence across diverse healthcare settings (Aleanizy and Alqahtani, 2022). However, such standardisation is rarely context specific and often fails to account for the realities of under-resourced areas. Evidence of this can be seen in Asir, where Alruwaili et al. (2022) noted that local shortcomings continue to weaken HCWs' confidence in national DRM initiatives, despite overarching policy frameworks. A further limitation is that many of the existing research has been confined to a single region or institution, reducing opportunities for comparisons (Bin Shalhoub et al., 2017). Therefore, the question remains as to whether regional differences actually shape DRM perceptions and, if so, to what extent, are they interpreted in similar ways across diverse settings (Alharazi and Al Thobaity, 2023).

The current study seeks to address these gaps by systematically analysing HCWs' perceptions of DRM across four major Saudi regions and across all four stages of DRM: mitigation,

preparedness, response, and recovery. By identifying both the similarities and differences, this study provides more insight into how national policy is received and enacted at the regional level. This is vital because DRM policies must align with the realities of practice: when national strategies lack sensitivity to local conditions, they risk reinforcing inequities or overlooking peripheral needs. Linking national objectives with regionally grounded experiences offer a pathway toward more equitable, responsive, and sustainable resilience outcomes across the Kingdom (Pike and Sledge, 2021).

2.1.5 Summary and Research Questions

DRM in Saudi Arabia's public hospitals is shaped by a combination of contextual, organisational, and individual factors. These factors include the demands of mass gatherings, such as Haji and Umrah, disparities in resources across hospitals and regions, and the hierarchical structure of the Saudi healthcare system. Public hospitals and health services must have robust DRM plans and resilient operational strategies to manage these extraordinary demands effectively. While the technical characteristics of hospital readiness are important, the perceptions of HCWs regarding hospital readiness, and their acceptance of DRM plans, are equally critical for successful implementation across the four phases of DRM: mitigation, preparedness, response, and recovery.

Positive perceptions of DRM and hospital readiness increase HCWs' acceptance and adherence to protocols and plans. Perceptions are shaped by individual biases, experience and context. Factors such as training, visible leadership support, and infrastructure improvements tend to strengthen confidence in DRM, while challenges such as burnout, communication breakdowns and resource limitations decrease it. Demographic characteristics – including age, gender, education, and seniority – interact with Saudi Arabia's high power-distance culture to influence HCWs' perceptions. Regional differences further affect perceptions, as urban hospitals are generally perceived to be more prepared than rural facilities, despite national

guidelines intended to standardise DRM processes. Furthermore, localised conditions and practices can unintentionally limit the effective implementation of these guidelines.

There is a growing recognition of the necessity for inclusive research in this field. Existing gaps in the literature – such as the underrepresentation of non-clinical staff, limited attention to all DRM phases, and a lack of cross-regional analysis – highlight the need for a comprehensive approach. This study fills these gaps, examining HCWs' perceptions across a spectrum of roles, regions, and DRM phases, providing evidence that can be utilised to formulate coherent national policy while remaining relevant at the local level.

This study addresses the following research questions:

1. To what extent do healthcare workers perceive their hospital's disaster management strategies as capable of fostering effective preparedness, responses, and recovery in Saudi public hospitals?
2. How do demographic characteristics of healthcare workers influence their perceptions of disaster risk management strategies in Saudi public hospitals?
3. What are the similarities and differences in healthcare workers' perceptions of disaster risk management strategies across the Saudi regions studied?

The implications of this study are of practical value to policy makers, particularly to the Ministry of Health (MOH), in enhancing hospital resilience as part of Saudi Arabia's Vision 2030, which aims to improve the quality and preparedness of healthcare delivery (Alkhamis, 2012; MOH, 2023. Furthermore, the study identifies gaps, such as inadequate recovery support, that limit system resilience and informs targeted allocation of resources, training and coordination (Kruk et al., 2017; Labrague et al., 2021). Including non-clinical staff in the current study could identify coordination gaps and support role-specific training to improve institutional preparedness for high-demand events such as Hajj and Umrah (Al Thobaity et al., 2019; Bullock et al., 2017). Demographic patterns can also inform fair and effective engagement strategies. For example, leadership training may help address complacency among some senior staff, while inclusive

communications practices can strengthen the agency of women and younger healthcare workers, fostering a stronger culture of resilience in DRM (Sultan et al., 2020; Paton & Johnston, 2017). Similarly, regional analysis carries important implications for policy. Targeted measures, including expanding surge capacity in more vulnerable regions such as Asir, can be complemented by sharing best practices developed in better-resourced urban centres such as Riyadh (Al-Hanawi et al., 2020; Alruwaili et al., 2022). Most importantly, this study provides a foundation for monitoring progress in DRM as part of the Vision 2030 agenda, allowing national agencies to evaluate readiness and universities to adapt disaster preparedness course content accordingly (Alqahtani et al., 2021; Balicer et al., 2010). Ultimately, these contributions can help to strengthen the functioning and resilience of Saudi Arabia's healthcare system, equipping it to respond more effectively to an evolving risk landscape.

2.2 Methods

2.2.1 Study Setting

Data for this study were collected from 22 public hospitals across four major regions of Saudi Arabia – Eastern, Western, Southern, and Central – to assess regional influences on HCWs' perceptions of DRM. Data from the Northern region was not included, as ethics approval could not be obtained for the study within the study timeframe.

All of the participating hospitals are publicly funded medical and surgical hospitals, each with a minimum capacity of 100 beds and more than 500 HCWs. This ensured that the institutions had established DRM systems in place. For example, King Fahad Medical City (KFMC) in Riyadh, one of the largest hospitals in the country, has 1,200 beds (KFMC, 2022. Similarly, King Saud University Medical City (KSUMC), includes 1,446 beds, of which 140 are designated for intensive care (KSUMC, 2021). Since all of the surveyed hospitals operate under a centralised healthcare governance structure, this invariably affects how DRM policies are formulated, implemented, and perceived by staff (Jalilvand et al., 2024). Thus, by selecting hospitals from different

geographic and institutional context, this study captures a more representative picture Saudi Arabia's public health system and provides better insight into how disaster readiness is experienced by HCWs across diverse settings.

2.2.2 Participants

This study utilised a descriptive cross-sectional design with a non-probability sample to capture HCWs' perception of DRM in Saudi public hospitals. Eligibility was extended to Saudi and non-Saudi healthcare workers who met the following criteria: a) fluent in either English or Arabic, b) aged 18 years of age or older, and c) with a minimum of three years' professional experience. This three-year threshold was deliberately chosen to ensure participants had sufficient exposure to both pre- and post-COVID-19 contexts, enabling them to reflect meaningfully on the evolution of disaster risk management strategies during real-time crises. Previous research has demonstrated that HCWs active during the pandemic in Saudi Arabia provided valuable insights into institutional readiness and crisis response (Temsah et al., 2021).

The stratified sampling design was utilised to ensure representation across diverse roles, hospitals, and regions, while minimising the bias associated with convenience sampling. Participants included doctors, nurses, allied health professionals, medical students, and non-clinical healthcare workers such as medical administrators, health policymakers, and decision-makers. This mix was essential for capturing the multidisciplinary and hierarchical perspectives that shape DRM in public hospital contexts (Saunders et al., 2019).

2.2.3 Materials

To address the study objectives and align with its aims, a structured questionnaire was developed and divided into two sections. The first section gathered demographic information on HCWs, including age, years of work experience, level of education, role, and department. These variables were included to capture potential influences on DRM perceptions. The second section comprised 40 items equally distributed across the core four phases of DRM – mitigation, preparedness, response, and recovery. Each phase contained five items, adapted from

validated instruments in the published literature and tailored to reflect both the Saudi health system and the cultural context of healthcare work. Responses were recorded on a five-point Likert scale (1=strongly disagree, 5=strongly agree). The survey was designed to be time-efficient, with an average completion time of approximately 10 minutes (see Appendix A on p.219). To ensure accessibility for all HCWs across the Kingdom, the questionnaire was developed in both English and Arabic. A rigorous back-translation process was undertaken to maintain linguistic fidelity and conceptual equivalence, consistent with best practice in conducting cross-cultural research (Brislin, 1970; Temple and Young, 2004). Two certified Saudi translators carried out the forward (English to Arabic) and backward (Arabic to English) translations, with discrepancies reconciled by consensus. This process ensured accuracy, cultural relevance, and epistemological clarity. The development and validation procedures helped ensure that the survey instrument was reliable and meaningful across diverse hospital settings in the Saudi health system.

2.2.4 Validity and Reliability

Prior to commencing the main data collection, a pilot study was conducted to assess the clarity, relevance, administration, and reliability of the questionnaire, ensuring its suitability for evaluating HCWs' perceptions of DRM. The initial version of the instrument was reviewed by two internal academic supervisors and a multidisciplinary panel of ten external experts, including four family medicine physicians, three members of hospital disaster committees, one clinical pharmacist, and two nurses. This expert panel was intentionally selected to reflect a broad range of professional perspectives relevant to hospital-based disaster preparedness, response, and recovery. Semi-structured virtual consultations were conducted to refine item wording, improve clarity, and ensure conceptual accuracy and contextual relevance.

Construct validity was assessed using exploratory factor analysis (EFA) with principal axis factoring. The results confirmed that the questionnaire items aligned well with the theoretically established four-phase DRM framework: Mitigation, Preparedness, Response, and Recovery. All

items demonstrated strong factor loadings and satisfactory communalities (all > 0.50), indicating adequate representation of the underlying constructs (see Table 2-1).

Convergent validity was further examined using the Average Variance Extracted (AVE). The AVE values exceeded the recommended threshold of 0.50 for all constructs, indicating adequate convergent validity (Mitigation = 0.769, Preparedness = 0.660, Response = 0.750, Recovery = 0.751). Composite reliability (CR) values were also high across the four constructs (0.942, 0.906, 0.938, and 0.938, respectively), exceeding the recommended minimum of 0.70 and demonstrating strong internal consistency.

Discriminant validity was examined by comparing the square root of the AVE values with inter-construct correlations (Fornell & Larcker, 1981) (see Table 2-2) . The correlation analysis revealed strong and statistically significant associations between the four DRM phases. While this indicates a high degree of shared variance among the constructs, it also reflects the inherently integrated and sequential nature of disaster risk management processes within hospital settings, where mitigation, preparedness, response, and recovery are operationally interdependent rather than conceptually isolated. Similar patterns of high inter-construct correlations have been reported in perception-based DRM and resilience research. Accordingly, the four phases are interpreted as closely related dimensions of an overarching DRM construct rather than fully independent latent variables. While the Fornell-Larcker criterion for discriminant validity is not fully met in all cases, this finding is consistent with the theoretical framework of DRM as an integrated system, and the constructs demonstrate adequate convergent validity and reliability.

Internal consistency reliability was further assessed using Cronbach's alpha. The overall scale demonstrated excellent reliability ($\alpha = 0.946$), with strong reliability across all DRM phases: Mitigation ($\alpha = 0.860$), Preparedness ($\alpha = 0.904$), Response ($\alpha = 0.939$), and Recovery ($\alpha = 0.946$). These values exceed established benchmarks, where $\alpha > 0.70$ indicates acceptable reliability

and α > 0.90 indicates excellent internal consistency (Bland et al, 1997; Cronbach, 1951), supporting the robustness of the instrument for use in the main study.

Table 2-1 Exploratory Factor Analysis of HCWs' DRM Perceptions

Phase	Item No.	Factor Loading	Communality
Mitigation	1	0.979	0.958
Mitigation	2	0.847	0.717
Mitigation	3	0.830	0.688
Mitigation	4	0.868	0.753
Mitigation	5	0.854	0.723
Preparedness	6	0.798	0.636
Preparedness	7	0.739	0.546
Preparedness	8	0.859	0.737
Preparedness	9	0.839	0.703
Preparedness	10	0.822	0.675
Response	11	0.866	0.749
Response	12	0.864	0.746
Response	13	0.841	0.707
Response	14	0.877	0.769
Response	15	0.882	0.777
Recovery	16	0.872	0.760
Recovery	17	0.879	0.772
Recovery	18	0.864	0.746
Recovery	19	0.847	0.717
Recovery	20	0.870	0.756

Table 2-2 Convergent and Discriminant Validity of DRM Constructs

Construct	AVE	√AVE	Mitigation	Preparedness	Response	Recovery
Mitigation	0.769	0.877	—	0.863	0.867	0.827
Preparedness	0.660	0.812	0.863	—	0.897	0.869
Response	0.750	0.866	0.867	0.897	—	0.901
Recovery	0.751	0.867	0.827	0.869	0.901	—

2.2.5 Procedure

Ethical approval for this study was granted by ten Institutional Review Boards (IRB) representing public hospitals in Saudi Arabia, as well as the Ethics and Research Governance Online (ERGO) committee at the University of Southampton (Project ID: 77111). Following approval, executive directors of the participating hospitals were contacted regarding the study objectives, and formal permission was obtained to recruit HCWs and collect data. Each hospital appointed staff members to act as data collectors and assist with internal distribution of the survey link to eligible HCWs.

The self-administered survey was hosted on the Qualtrics platform and distributed via email and WhatsApp to maximise accessibility and encourage participation. Qualtrics was selected for its secure, user-friendly interface and ability to support multilingual survey formats, while WhatsApp was used due to its widespread familiarity and daily use among HCWs in Saudi Arabia, thereby reducing barriers to participation. Participation was voluntary, and anonymous, with the survey clearly outlining participants' right to withdraw from the study at any time without explanation.

Data collection was conducted over a six-week period, from 7th September to 17th October 2022. A total of 598 responses were received, of which 56 were excluded due to incompleteness or invalidity, leaving 542 fully completed surveys for analysis. Despite multiple reminder emails being sent to encourage participation, the response rates from the Southern and Eastern

regions were lower than those from Central and Western regions. This may reflect broader disparities in institutional communication or staff availability, which could have influenced engagement.

2.2.6 Data Analysis

Data analysis was conducted using the SPSS software (Version 28, English). Both descriptive statistics and inferential statistical methods were employed. Mean and standard deviation measurements were calculated to explore the level of agreement among HCWs regarding the implementation of DRM in hospitals. Following Pimental's (2010) framework, mean scores were interpreted as follows: 1.00–- 1.80 = strongly disagree, 1.81–- 2.60 = disagree ,2.61– 3.40 = neither agree nor disagree, 3.41–- 4.20 = agree and 4.21–- 5.00 = strongly agree.

Furthermore. an independent samples t-test and a one-way ANOVA test were conducted to examine differences in perceptions of DRM effectiveness among groups of respondents with similar demographic characteristics.

Table 2-3 Exploratory Factor Analysis of HCWs' DRM Perceptions

Phase	Item No.	Factor Loading	Communality
Mitigation	1	0.979	0.958
Mitigation	2	0.847	0.717
Mitigation	3	0.830	0.688
Mitigation	4	0.868	0.753
Mitigation	5	0.854	0.723

Phase	Item No.	Factor Loading	Communality
Preparedness	6	0.798	0.636
Preparedness	7	0.739	0.546
Preparedness	8	0.859	0.737
Preparedness	9	0.839	0.703
Preparedness	10	0.822	0.675
Response	11	0.866	0.749
Response	12	0.864	0.746
Response	13	0.841	0.707
Response	14	0.877	0.769
Response	15	0.882	0.777
Recovery	16	0.872	0.760
Recovery	17	0.879	0.772
Recovery	18	0.864	0.746
Recovery	19	0.847	0.717
Recovery	20	0.870	0.756

2.3 Results

2.3.1 Quantitative Descriptive Analysis

Table 2-4 presents the demographic characteristics of the study participants. The mean (M) age was 36.01 years with a standard deviation (SD) of 8.2, with participant ages ranging from 22 to 64 years. Participants' work experience averaged 10.28 years (SD =7.41), ranging from 3 to 40 years. Regarding educational background, nearly half of the participants held a bachelor's degree (49.6% of participants), followed by a master's degree (22.3%), diploma (13.7%) and a PhD or higher (12.5%), with a smaller proportion reporting a high school level of education

(0.9%) or other qualifications (0.9% total). Participants represented a variety of occupational roles, including nurses (29.7%), physicians (24.7%), specialists (20.8%), administrative staff (8.3%), technicians (6.3%), pharmacy staff (4.2%) and other roles (5.9%). Approximately half of the respondents (49.8%) worked in clinical departments, while the remaining 50.2% were in non-clinical departments. In terms of organisational responsibilities, 39.9% identified as policy makers and 36.7% as decision-makers.

Table 2-4 Characteristics of Participants

Variable	Groups	N (%)
Age	*M*=36.01	Minim (22)
	SD=8.2	Maxim (64)
Experience	*M*=10.28	Minim (3)
	SD=7.41	Maxim (40)
Gender	Female	251 (46.3)
	Male	291 (53.7)
Education Level	Doctoral degree or above	68 (12.5)
	Master's degree	121 (22.3)
	Diploma degree	74 (13.7)
	Bachelor's degree	269 (49.6)
	High school	5 (.9)
	Other	5 (.9)

Variable	Groups	N (%)
Occupation	Doctor	134 (24.7)
	Nurses	161 (29.7)
	Pharmacy	23 (4.2)
	Specialist	113 (20.8)
	Technician	34 (6.3)
	Administrators	45 (8.3)
	Other	32 (5.9)
Department	Clinical Staff	270 (49.8)
	Non- Clinical Staff	272 (50.2)
Policy Maker	Yes	216 (39.9)
	No	326 (60.1)
Decision Maker	Yes	199 (36.7)
	No	343 (63.3)
Regions	Central Region	146 (26.9)
	Eastern Region	53 (9.8)
	Southern Region	57 (10.5)
	Western Region	286 (52.8)

2.3.2 HCWs' Perceptions on Effective DRM in Saudi Public Hospitals

presents the means, standard deviation, levels of agreement and percentage of responses for each DRM phase and its corresponding items. Overall, participants perceived their hospital DRM strategies as moderately effective, as indicated by the mean scores and percentage of positive responses. The mitigation phase was rated highest (*M*= 3.69; 63.5% positive), followed by response (*M*= 3.61; 59.8%), recovery (*M*=3.49; 54.5%), and preparedness (M= 3.43; 54.4%).

However, a notable percentage of respondents considered the strategies inadequate, with the figures being 36.5% for mitigation, 40.2% for response, 45.5% for recovery and 45.6% for preparedness. This highlights mixed perceptions of the effectiveness of DRM across the four phases.

To elaborate, the mitigation phase (*M* = 3.69, *SD* = 1.25) achieved the strongest endorsement, with 63.5% of respondents agreeing positively. The most favourably rated item concerned hospital safety and security functions (*M* = 4.28, *SD* = 0.69; 86%), while hospital infrastructure was rated lowest (*M* = 3.44, *SD* = 1.35; 57.9%). The preparedness phase (*M* =3.43, *SD* = 1.28; 54.4% positive) reflected more critical views. The highest rated item was the activation of disaster plans to sustain essential services (*M* = 3.60, *SD* = 1.30; 61.3%), whereas allocation of financial resources for preparedness received the lowest score (*M* = 3.21, *SD* = 1.29; 43.9%). In the response phase (*M* =3.61, *SD* = 1,30; 59.8% positive), the emergency triage protocol was the strongest area (*M* = 3.70, *SD* = 1.32; 63.4%). Conversely, assigning staff roles during disaster planes was viewed least favourably (*M* = 3.60, *SD* = 1.27; 50.8%). Lastly, in the recovery phase (*M* =3.49, *SD* = 1.27; 54.5% positive) the highest-rated item related to clear recovery procedures and strategies (*M* = 3.54, *SD* = 1.28; 58.3%), while the lowest was the hospital's ability to recover quickly (*M* = 3.45, *SD* = 1.23; 53.7%).

Table 2-5 presents the means, standard deviation, levels of agreement and percentage of responses for each DRM phase and its corresponding items. Overall, participants perceived their hospital DRM strategies as moderately effective, as indicated by the mean scores and percentage of positive responses. The mitigation phase was rated highest (*M*= 3.69; 63.5% positive), followed by response (*M*= 3.61; 59.8%), recovery (*M*=3.49; 54.5%), and preparedness (M= 3.43; 54.4%). However, a notable percentage of respondents considered the strategies inadequate, with the figures being 36.5% for mitigation, 40.2% for response, 45.5% for recovery and 45.6% for preparedness. This highlights mixed perceptions of the effectiveness of DRM across the four phases.

To elaborate, the mitigation phase (*M* = 3.69, *SD* = 1.25) achieved the strongest endorsement, with 63.5% of respondents agreeing positively. The most favourably rated item concerned hospital safety and security functions (*M* = 4.28, *SD* = 0.69; 86%), while hospital infrastructure was rated lowest (*M* = 3.44, *SD* = 1.35; 57.9%). The preparedness phase (*M* =3.43, *SD* = 1.28; 54.4% positive) reflected more critical views. The highest rated item was the activation of disaster plans to sustain essential services (*M* = 3.60, *SD* = 1.30; 61.3%), whereas allocation of financial resources for preparedness received the lowest score (*M* = 3.21, *SD* = 1.29; 43.9%). In the response phase (*M* =3.61, *SD* = 1,30; 59.8% positive), the emergency triage protocol was the strongest area (*M* = 3.70, *SD* = 1.32; 63.4%). Conversely, assigning staff roles during disaster planes was viewed least favourably (*M* = 3.60, *SD* = 1.27; 50.8%). Lastly, in the recovery phase (*M* =3.49, *SD* = 1.27; 54.5% positive) the highest-rated item related to clear recovery procedures and strategies (*M* = 3.54, *SD* = 1.28; 58.3%), while the lowest was the hospital's ability to recover quickly (*M* = 3.45, *SD* = 1.23; 53.7%).

Table 2-5 HCWs' Responses of DRM Effectiveness in Saudi Public Hospitals

DRM Phase	M	SD	Level of Agreement*	Agreement Response (%)
1. Mitigation Phase	3.69	1.25	Agree	63.5
1.1. My hospital has effective security and safety department that reduces the risk of disasters and build hospital resilience.	4.28	.69	Strongly Agree	86
1.2. My hospital has effective and participatory leadership that reduces the risk of disasters and builds hospital resilience.	3.58	1.35	Agree	61.5
1.3. My hospital has a strong infrastructure that can minimise the impact of a disaster.	3.44	1.35	Agree	57.9
1.4. My hospital reduces the risk of disasters and builds resilience by collecting, analysing and effectively utilising disaster information related.	3.51	1.30	Agree	59.4
1.5. My hospital has a disaster command committee that develops and implements policies for a disaster.	3.70	1.33	Agree	65.2
2. Preparedness Phase	3.43	1.27	Agree	54.4
2.1. The financial resources that my hospital has for enhancing disaster preparedness are adequately allocated.	3.21	1.29	Neither agree nor disagree	43.9
2.2. In the case of a disaster, my hospital can increase the number of health professionals, other staff members and volunteers.	3.37	1.33	Neither agree nor disagree	53.7
2.3. In the case of a disaster, my hospital can activate the disaster plan to maintain essential hospital services (surge capacity of beds, space, resources, and key staff).	3.60	1.30	Agree	61.3

DRM Phase	M	SD	Level of Agreement*	Agreement Response (%)
2.4. My hospital plans to cooperate with other hospitals and National Centre for Crisis and Health Disaster Management to secure additional resources and transfer patients.	3.62	1.28	Agree	60.1
2.5. My hospital provides training and workshops on disaster management skills to the workforce and volunteers to ensure they can manage a disaster effectively.	3.50	1.32	Agree	60.3
3. Response Phase	3.61	1.30	Agree	59.8
3.1. My hospital has an effective emergency plan involving a triage protocol for a disaster.	3.70	1.32	Agree	63.4
3.2. In response to a disaster, my hospital can provide medical resources and supply products in a timely manner.	3.51	1.26	Agree	57.2
3.3. During a disaster, my hospital uses technology effectively for communication and sharing information with other healthcare organisations.	3.54	1.32	Agree	57.7
3.4. My hospital has an effective strategy to evacuate and protect its staff, patients, and visitors in the case of a disaster.	3.64	1.30	Agree	62
3.5. In order to prioritise and maintain essential functions during a disaster, my hospital implements efficient strategies to assign staff to roles.	3.60	1.27	Agree	50.8
4. Recovery Phase	3.49	1.27	Agree	54.5
4.1. Following a disaster, my hospital effectively utilises information about losses and	3.51	1.24	Agree	55.5

DRM Phase	M	SD	Level of Agreement*	Agreement Response (%)
damages in the incident report and assessment.				
4.2. My hospital utilises the feedback and analysis of emergency information to enhance and develop a hospital disaster plan.	3.51	1.27	Agree	56
4.3. My hospital has clear procedures and strategies to recovery from a disaster.	3.54	1.28	Agree	58.3
4.4. Following a disaster, my hospital updates its courses and workshops on disaster management.	3.47	1.28	Agree	55.7
4.5. My hospital can recover rapidly from disasters.	3.45	1.23	Agree	53.7

2.3.3 Demographic Influences on HCWs' Perceptions of DRM Effectiveness

An independent samples t-test was conducted to determine whether HCWs' perceptions of DRM effectiveness differed according to gender, hospital department, and/or policymakers and those in authority's decision making. The dependent variables were perceptions of DRM across the four DRM phases: mitigation, preparedness, response, and recovery.

The results indicated no statistically significant differences between the perceptions of female and male HCWs in any of the DRM phases: mitigation, t (540) = 0.098, p = .922; preparedness, t (540) = –0.345, p = .730; response, t (540) = 0.247, p = .804; and recovery, t (540) = 0.137, p = .890. Similarly, no statistically significant differences were found between clinical and non-clinical HCWs across any phase: mitigation, t (540) = 0.032, p = .975; preparedness, t(540) = 0.200, p = .842; response, t(540) = 0.915, p = .361; and recovery, t(540) = 0.861, p = .391 (see Table 2-6). These results suggest that gender and departmental affiliation did not meaningfully influence HCWs' perceptions of DRM effectiveness in Saudi public hospitals.

Table 2-6 DRM Perceptions by HCW Gender and Department

DRM Phase	Gender	M	SD	p	Department	M	SD	p
Mitigation	Female	3.71	1.27	.922	Clinical	3.76	1.26	.975
	Male	3.68	1.25		Non-Clinical	3.63	1.24	
Preparedness	Female	3.43	1.27	.730	Clinical	3.48	1.26	.842
	Male	3.44	1.27		Non-Clinical	3.39	1.27	
Response	Female	3.63	1.30	.804	Clinical	3.64	1.28	.361
	Male	3.58	1.30		Non-Clinical	3.57	1.31	
Recovery	Female	3.54	1.28	.890	Clinical	3.58	1.25	.391
	Male	3.44	1.27		Non-Clinical	3.40	1.29	

The analysis showed statistically significant differences in DRM perceptions between policy makers and other HCWs. Policymakers reported higher mean scores for preparedness (M = 3.55, SD = 1.33), compared with other HCWs (M = 3.36, SD = 1.21), $t(540) = 1.873$, $p = .036$ (one-tailed). Similarly, policymakers indicated higher recovery scores (M = 3.56, SD = 1.36), than other HCWs (M = 3.44, SD = 1.21), $t(540) = 1.273$, $p = .009$ (one-tailed). No statistically significant differences were observed between policymakers and other HCWs for mitigation, $t(540) = 1.630$, $p = .103$, or response, $t(540) = 1.548$, $p = .060$, suggesting perceptions of these phases were relatively consistent across roles.

Comparisons between decision-makers and other HCWs showed statistically significant differences in the response and recovery phases. Decision-makers reported higher mean scores for response (M = 3.69, SD = 1.39) compared to other HCWs (M = 3.56, SD = 1.24), $t(540) = 1.203$, $p = .013$ (one-tailed). They also reported higher recovery scores (M = 3.53, SD = 1.36) than other HCWs (M = 3.46, SD = 1.22), t (540) = 0.929, $p = .017$ (one-tailed). No significant differences were found between decision-makers and other HCWs in terms of mitigation, $t(540) = 1.537$, $p = .125$ or preparedness, $t(540) = 1.042$, $p = .150$ (see Table 2-7).

These results suggest that professional roles and responsibilities influence perceptions of DRM, particularly in phases requiring active operational decision-making and post-disaster recovery.

Table 2-7 DRM Perceptions by Role Differences

DRM Phase	Policymaker	M	SD	*p*	Decisionmaker	M	SD	*p*
Mitigation	Yes	3.78	1.32	.103	Yes	3.78	1.32	.125
	No	3.64	1.21		No	3.65	1.21	
Preparedness	Yes	3.55	1.33	.036*	Yes	3.56	1.32	.150
	No	3.36	1.21		No	3.36	1.23	
Response	Yes	3.70	1.35	.060	Yes	3.69	1.39	.013*
	No	3.54	1.25		No	3.56	1.24	
Recovery	Yes	3.56	1.36	.009*	Yes	3.53	1.36	.017*
	No	3.44	1.21		No	3.46	1.22	

(*) Indicates the mean different is statistically significant at 95% confidence level

A one-way analysis of variance (ANOVA) was conducted to examine differences in DRM perceptions across levels of education. The analysis showed no statistically significant differences across any of the DRM phases. The results were as follows: mitigation, $F(5, 536) = 1.086$, $p = .367$; preparedness, $F(5, 536) = 1.159$; $p = .328$; response, $F(5, 536) = 1.743$, $p = .123$; and recovery, $F(5, 536) = 1.578$, $p = .164$ (see Table 2-8). These findings indicate that education level did not significantly influence HCWs' perceptions of DRM effectiveness across the four phases in Saudi public hospitals.

Table 2-8 DRM Perceptions by Education Level

DRM Phase	Sum of Squares	df	Mean Square	F	p
Mitigation	8.606	5	1.721	1.086	.367
Preparedness	9.341	5	1.868	1.159	.328
Response	14.634	5	2.927	1.743	.123
Recovery	12.817	5	2.563	1.578	.164

A one-way ANOVA was also conducted to examine the effect of occupation on DRM perceptions. The analysis revealed no statistically significant differences across any of the four DRM phases. The results were: mitigation, $F(6, 535) = 1.445$, $p = .195$; preparedness, $F(6, 535) = 1.265$, $p = .272$; response, $F(6, 535) = 1.294$, $p = .258$; and recovery, $F(6, 535) = 1.328$, $p = .243$ (see Table 2-9). These findings indicate that occupation did not significantly influence HCWs' perceptions of DRM effectiveness across the four phases in Saudi public hospitals.

Table 2-9 DRM Perceptions by Occupation

DRM Phase	Sum of Squares	df	Mean Square	F	*p*
Mitigation	13.684	6	2.281	1.445	.195
Preparedness	12.219	6	2.036	1.265	.272
Response	13.083	6	2.181	1.294	.258
Recovery	12.961	6	2.160	1.328	.243

2.3.4 Regional Perceptions of DRM Effectiveness in Saudi Public Hospitals

A one-way ANOVA was conducted to examine regional differences in HCWs' perceptions of the effectiveness of DRM strategies across the four DRM phases. Statistically significant differences were found between regions for all four phases: mitigation, $F(3, 538) = 7.445$, $p = .001$; preparedness, $F(3, 538) = 4.406$, $p = .004$; response, $F(3, 538) = 4.406$, $p = .004$; and recovery, $F(3, 538) = 4.001$, $p = .008$.

Post hoc comparisons using Tukey's Honestly Significant Difference (HSD) test demonstrated several significant regional differences. Participants from the central region (*M* = 3.96, *SD* = 0.90) reported significantly higher perceptions of DRM effectiveness than those in the Western region (*M* = 3.61, *SD* = 0.96, *p* = .001) and the southern region (*M* = 3.24, *SD* = 1.18, *p* = .003). Similarly, participants from the Eastern region (*M* = 3.83, *SD* = 0.92) reported significantly higher scores compared with the Southern region (p = .003). In the preparedness phase, the Central region (*M* = 3.69, *SD* = 1.09) scored significantly higher than the Southern region (*M* = 3.09, *SD* = 1.39, *p* = .010), indicating a marked regional difference in perceived preparedness effectiveness. For the response phase, both the Central region (*M* = 3.81, *SD* = 1.08) and the Eastern region (*M* = 3.79, *SD* = 0.97) reported significantly higher compared with the Southern region (*M* = 3.15, *SD* = 1.47) with p values of .001 and .003, respectively. Finally, in the recovery phase, perceptions from the Central region (*M* = 3.70, *SD* = 1.09) were significantly higher than those from the Southern region (*M* = 3.12, *SD* = 1.44), *p* = .006 (see Table 2-10). These findings indicate that HCWs' perceptions of DRM effectiveness varied significantly across regions, with the Central and Eastern regions reporting higher scores than the Southern and Western regions across multiple phases.

Table 2-10 DRM Perceptions Across Regions

DRM Phase	Region	M	SD	p
Mitigation	Central	3.96	0.90	
	Eastern	3.83	0.92	
	Southern	3.24	1.18	
	Western	3.61	0.96	
	Total	3.70	0.98	.001*
Preparedness	Central	3.69	1.09	
	Eastern	3.48	0.99	
	Southern	3.09	1.39	
	Western	3.41	1.09	
	Total	3.46	1.11	.004*

DRM Phase	Region	M	SD	p
Response	Central	3.81	1.08	
	Eastern	3.79	0.97	
	Southern	3.15	1.47	
	Western	3.55	1.14	
	Total	3.60	1.16	.001*
Recovery	Central	3.70	1.09	
	Eastern	3.59	1.04	
	Southern	3.12	1.44	
	Western	3.45	1.10	
	Total	3.50	1.14	.008*

(*) Indicates the mean different is statistically significant at 95% confidence level

2.4 Discussion

2.4.1 HCWs' Perceptions of DRM Effectiveness

The findings indicate that HCWs perceived their hospitals' DRM strategies as moderately effective overall, with mitigation rated the highest and preparedness rated the lowest. This pattern suggests that HCWs place greater confidence in structural and safety measures (e.g., visible protocol, disaster committees), while identifying gaps in resources and training that underpin preparedness.

These components are emphasised as core indicators for mitigation (e.g., safety protocols, disaster committees) and preparedness (e.g., finance and training,) and have been widely recognised in DRM literature. HCWs' perceptions of mitigation as the highest factor is consistent with earlier studies that highlighted structural measures – such as visible safety protocols and disaster committees – as enhancing perceptions of HCW effectiveness (Adelaine et al., 2016; Aleanizy and Alqahtani, 2022). In contrast, preparedness was rated the lowest, particularly in relation to the financial allocation of resources. Within the Saudi Arabia context, resource constraints during large public gatherings such as Hajj and Umrah limited hospital

capacity (Alharazi and Al Thobaity, 2023). This finding diverges from expectations that the existence of national guide lined would strongly influence HCWs' perceptions of preparedness (Almalki et al., 2016. Instead, it reflects the limitations of a centralised policy approach that does not sufficiently account for the local operational contexts.

Perceptions of response were rated as moderately effective, which aligns with Labrague et al.'s (2021) findings that protocols and leadership enhance effectiveness by building HCWs' confidence during crises. However, recovery was rated relatively low, indicating gaps in securing post-crisis support and reflecting Goniewicz et al.'s (2021) observations of resource shortages that undermine recovery efforts. Another possible explanation is the influence of cognitive biases. For example, optimism bias may lead HCWs to overestimate the adequacy of mitigation measures, while underestimating training needs due to limited past experiences with disaster (Alharazi and Al Thobaity 2023; Slovic, 1987). This interpretation is particularly plausible in the Saudi context, where many HCWs had had limited experience of large-scale crises prior to the COVID-19. Overall, these observations underscore the interdependence of DRM phases, as weaknesses in preparedness can compromise a hospital's ability to anticipate, absorb and recover from disasters (WHO, 2019).

2.4.2 Demographic Influences on DRM Perceptions

The analysis indicates that organisational role – specifically being a policymaker or decision-maker – significantly influenced HCWs' perceptions. These groups consistently rated preparedness, response and recovery strategies as more effective than HCWs in other roles did. However, gender, education, occupation, and hospital department were not found to have a statistically significant effect on HCWs' perceptions.

This greater positivity among policymakers and decision-makers aligns with O'Sullivan et al. (2008), who argued that seniority and involvement in guideline development can shape more favourable views of DRM strategies. Given Saudi Arabia's bureaucratic culture, policymakers and decision-makers are likely to have greater exposure to strategic planning in their roles,

which may influence their perceptions of effectiveness when rating DRM strategies (Sultan et al., 2020). While unsurprising –given that leadership roles are closely linked to the implementation of DRM policies – the lack of differences by gender, education, or occupation contrasts with the findings of previous studies, which found that female HCWs were more critical of preparedness (Mousavi et al., 2025). This may be attributed to Saudi Arabia's high power-distance culture, in which junior staff often comply with instructions and may hesitate to voice critical opinions (Hofstede et al., 2010). Alternatively, the inclusion of non-clinical staff, who typically have little DRM training, may create a homogenised perception across demographic groups (Bullock et al., 2017). The absence of education effects also contradicts Kably et al. (2021), who found that advanced qualifications significantly enhance awareness of the preparedness gaps. This suggests that training in standardised procedures may reduce differences typically associated with education.

Together these findings highlight the importance of organisational culture in shaping perceptions and underscores the need for research on ensuring inclusive DRM engagement across all staff groups.

2.4.3 Regional Differences in DRM Perceptions

The findings reveal marked regional differences in HCWs' perceptions of DRM effectiveness. Respondents from Central and Eastern regions reported significantly higher ratings across all DRM phases, while those from the Southern region consistently rated DRM strategies lowest. Perceptions in the Western region were moderate overall, although notably lower than the Central region in relation to mitigation.

The strong perceptions in the Central region – particularly for Riyadh – were consistent with findings by Alruwaili et al., (2022), who linked advanced facilities, such as King Fahad Medical City, with positive views of preparedness and response capacity. Similarly, the Eastern region's higher ratings may be attributed to comparable resource availability. In contrast, the lower scores in the Southern region reflect Alharazi and Al Thobaity's (2023) observations of limited

surge capacity in rural areas, such as Asir and Jazan. This outcome aligns with the literature highlighting how the disparity in resources shapes HCWs' perceptions (AlQahtany and Abubakar, 2020).

The Western region's moderate perceptions – despite significant Hajj-related investment in pre-hospital and emergency preparedness –suggest that the resource strain of mass gathering events could undermine perceived effectiveness (Alatawi et al., 2020). This finding partly contradicts Almalki et al. (2016), who argued that national guidelines promote standardised perceptions of DRM, and instead points to local factors, such as staffing shortages, as meaningful drivers of variation. Moreover, HCWs in historically disaster-affected areas, such as Jazan, may hold a more critical perspective due to heightened risk awareness and past experiences (Alharbi, 2018).

Taken together, these regional differences demonstrate the importance of adapting DRM strategies to local contexts, ensuring that disparities in resources and experience are addressed to strengthen resilience across all regions.

2.4.4 Implications and Future Directions

For the Saudi MOH and policymakers, these findings provide important guidance for strengthening hospital resilience, in line with Vision 2030. The perception that preparedness is less effective highlights the need to improve both training and allocation of resources, particularly in relation to strategic financial planning. Surge capacity and operational readiness rely on flexible and upfront funding to cover temporary staffing, overtime, rapid procurement, stockpiles, and standby contracts – planning budgets is therefore central, as operational plans cannot accelerate effectively without them (Al Thobaity et al., 2019). By prioritising financial planning, hospitals will be better positioned to enhance surge capacity, particularly during mass gatherings (Al Thobaity et al., 2019).

Expanding the participation of non-clinical roles in DRM training could also promote improved coordination and higher readiness, as noted by Bullock et al. (2017). Additionally, the impact of

organisational roles implies the value of leadership development programmes that foster reflexive learning, inclusive communication, and empowerment of junior staff and female HCWs (Sultan et al., 2020). Addressing regional differences offers opportunities for system-wide improvements: for example, increasing investment in rural communities in the Southern region – not only in surge capacity but also in recovery support – could help narrow the gap with urban centres (Al-Hanawi et al., 2020). Collectively, these initiatives represent actionable steps towards embedding national DRM guidelines into practice and advancing Vision 2030's goal of standardised excellence and integration across the health system.

For future research, adopting mixed-method approaches would be beneficial. Combining quantitative surveys with in-depth qualitative interviews or focus group could provide a richer understanding of the cultural, organisational, or psychological factors shaping HCWs' perceptions of DRM. In particular, interviewing both clinical and non-clinical staff could offer valuable insights into the lived experiences, contextual barriers, and operational shortcomings that influence health workers' of DRM effectiveness. Such qualitative exploration would help illuminate differences across DRM phases, as well as regional disparities, thereby supporting more inclusive and context-sensitive disaster preparedness strategies.

2.4.5 Limitations of the Study

This study has numerous limitations that should be acknowledged. Firstly, the Northern region was excluded due to restrictions in ethical approval. As a result, the generalisability of the findings at the regional level is limited, and potential differences in HCWs' perceptions specific to that region may have been overlooked. Secondly, the use of self-reported data introduces the possibility of response bias. While this limitation is not unique to any one region, it may have been more pronounced in areas with lower response rates, such as the Southern and Eastern regions. Cognitive biases, such as optimism bias, may also have influenced participants' responses, with some HCWs potentially overestimating the effectiveness of DRM strategies. Thirdly, although the cross-sectional design provides valuable insight into HCWs' perception at

a single point in time, it does not capture how these perceptions may evolve in response to new threats or institutional change. Finally, the reliance on a non-probability stratified sampling strategy limits the representativeness of the sample. In particular, regions with lower response rates (e.g., Southern and Eastern regions) may not be adequately reflected in the findings.

2.5 Conclusion

This study examined HCWs' perceptions of DRM strategies in Saudi public hospitals across the four DRM phases – mitigation, preparedness, response, and recovery – while also considering demographic and regional factors. Overall, participants rated DRM strategies as moderately effective. Mitigation was perceived as the most effective phase, reflecting confidence in established safety processes and infrastructure. In contrast, preparedness was rated the least effective, pointing to concerns about funding, resource allocation and training.

The findings also highlighted the influence of organisational roles. Policymakers and decision-makers consistently rated DRM strategies more positively than other HCWs, which may indicate a potential disconnect between senior leadership and frontline staff – an issue with important implications for DRM implementation and success. In contrast, demographic variables such as gender, education, and occupation showed no significant influence on perceptions, possibly reflecting the hierarchical culture in Saudi hospitals, where junior staff may be less likely to express critical viewpoints.

In terms of regional variations, HWCs in the Central and Eastern region reported confidence in DRM strategies compared with those in the Southern region, where ratings were lowest across the board. This likely reflects disparities in resources, institutional capacity, and infrastructure, and illustrates that the national guidance process of DRM is insufficient to support local area challenges. Meanwhile, individuals from the Western region expressed the view that DRM strategies were moderately effective, suggesting that even well-resourced areas face challenges, particularly during large-scale mass gathering events such as the Hajj.

By incorporating both clinical and non-clinical staff perspectives across multiple regions, this study addresses gaps in the literature, which has often focused on specific DRM phases or predominately clinical perspectives. These findings reinforce the need for policy action under the Saudi Vision 2030 initiative, particularly in areas such as strengthening preparedness training, increasing participation of non-clinical staff in DRM, and directing funding to under-resourced areas to reduce inequities and improve system-wide resilience.

Future research should adopt qualitative methods to better capture the cultural and psychological factors shaping HCWs' perceptions. Expanding to include Northern region and employing probability sampling would further enhance the reliability and generalisability of the findings. These steps are essential for developing a healthcare system that is resilient in the face of a full spectrum of risks.

Reflection on Chapter Two and Overview of Chapter Three

In healthcare, the importance of disaster risk management (DRM) for emergency response and long-term resilience is critical. As demonstrated in Study 1 (Chapter 2), in the Saudi Arabian context, healthcare workers' (HCW) perceptions of DRM provide valuable insights into the strengths and weaknesses of existing strategies.

Study 1 (Chapter Two) used a quantitative approach to examine HWCs' perceptions of DRM across all four phases – mitigation, preparedness, response and recovery – within 19 hospitals and 3 medical cities across the Central, Eastern, Southern and Western regions of Saudi Arabia. Using a validated 20-item questionnaire, the study achieved a high response rate of 90.6% (*n*=542). Findings revealed moderate overall confidence in DRM strategies, with mitigation receiving the highest ratings (*M*=3.69, *SD*=1.25) and preparedness the lowest (*M*=3.43, *SD*=1.27). Notably, a substantial proportion of HCWs perceived DRM strategies as ineffective: 36.5% for mitigation (*M*=3.69, *SD*=1.25), 45.6% for preparedness (*M*=3.43, *SD*=1.27), 40.2% for response (*M*=3.87, *SD*=1.087), and 45.5% for recovery (*M*=3.87, *SD*=1.087). These perceptions pointed to systemic gaps in resources, training, and infrastructure.

There were notable differences among regions: HCWs in the Central (*M*=3.96) and Eastern region (*M*=3.83) rated DRM effectiveness higher than those in the Southern region (*M*=3.24, *p*=.001), suggesting inequities in resource allocation. Moreover, policymakers and decision-makers reported higher confidence levels than frontline HCWs in both preparedness (*p*=.036) and recovery (*p*=.009), underscoring the influence of hierarchical position and strategic planning involvement. These findings highlighted opportunities to examine the underlying reasons for phase-specific and regional variation in DRM perceptions.

Study 2 (Chapter Three) builds on these insights by employing a quantitative approach to explore the factors shaping HCWs' perceptions, particularly the low ratings of preparedness

and the regional differences observed. Semi-structured interviews were conducted with 24 HCWs across four public hospitals in the same regions. Four themes were identified: organisational culture (e.g., weak leadership and poor communication); personal evidence (e.g., previous crisis experience and access to psychological support); geographical conditions (e.g., inequities between rural and urban resources); and regional specific enhancements (e.g., workforce coordination, training and communication improvements).

The findings emphasised that effective leadership, transparent communication, and regular training foster confidence among HCWs, whereas outdated infrastructure, gaps in training, and poor leadership communication undermine resilience. Personal experiences of crisis increased preparedness but also highlighted the need for psychological support to mitigate burnout. Geographical factors – including rural-urban inequities in resources, as well as risks tied to specific events such as Hajj or industrial based risks – required tailored strategies. Region-specific recommendations included: strengthening workforce coordination (Central), addressing resource shortages (Eastern), improving communication systems (Western) and enhancing education and training (Southern).

Together, these two studies demonstrate the complexity of DRM in the Saudi context. They identified leadership, resource allocation, and organisational culture as key variables influencing resilience. Recommended actions include expanding inclusive training, ensuring equitable resource distribution, and tailoring DRM strategies to regional risk profiles while aligning with the broader goals of the Saudi Vision 2030.

Chapter 3 Factors Influencing Perceived Disaster Management Efficacy in Saudi Public Hospitals

Abstract

Hospitals are central to disaster response, yet their resilience depends not only on infrastructure but also on the perceptions and engagement of healthcare workers (HCWs). In Saudi Arabia, where risks include industrial accidents, floods, and the mass gatherings of Hajj and Umrah, understanding HCWs' views of disaster risk management (DRM) is critical. This study examined the factors shaping healthcare workers' perceptions of DRM effectiveness in Saudi Arabian public hospitals, with a particular focus on organisational culture, individual experiences, and geographical context. Semi-structured interviews were conducted with 24 HCWs –both medical and non-medical – across four public hospitals in the Central, Eastern, Western, and Southern regions. Thematic analysis identified four overarching themes: organisational culture, personal experiences, geographical influences, and region-specific recommendations for improvement. The findings suggested that effective leadership, consistent interdepartmental communication, and regular training were key drivers of HCWs' confidence in DRM. Conversely, DRM effectiveness was perceived as being undermined by poor leadership communication, inadequate infrastructure, and limited training opportunities. Personal experiences of crises generally strengthened HCWs' readiness but were less impactful when insufficient psychological support was available. Geographical challenges included inequities in rural-urban resource distribution and event-specific risks such as the Hajj pilgrimage (Central region) and industrial hazards (Eastern region). Region-specific recommendations emerged, including improved workforce coordination (Central), strategic resource sequencing (Eastern), improved communication infrastructure (Western), and prioritised training (Southern). The findings provide a coherent account of HCWs' working interactions with DRM. This study contributes to the broader global discourse on healthcare resilience by offering a contextualised, evidence-based framework for strengthening DRM in Saudi Arabia. Specifically, it underscores the need for inclusive leadership, equitable resource allocation, and comprehensive stakeholder support. Addressing these influences could help to build a more resilient healthcare system capable of safeguarding frontline staff and responding effectively to future disasters.

3.1 Introduction

Chapter Three presents the second empirical study, which examines the factors shaping healthcare workers' (HCWs) perceptions of disaster risk management (DRM) effectiveness in public hospitals in Saudi Arabia. Building on the findings from Chapter Two, this qualitative study explores how organisational culture, individual experiences, and regional differences influence HCWs' perceptions of DRM across its four phases: mitigation, preparedness, response, and recovery.

The chapter begins by outlining the study background and rationale, situating it within the existing literature on healthcare resilience and disaster management. It then describes the study design, including participant selection, interview procedures, and the thematic analysis process. The results section presents the main themes and subthemes identified followed by a discussion that interprets the findings in relation to previous studies. Practical and theoretical implications and theoretical implications are considered, alongside the study's limitations and recommendations for future research. Finally, the chapter reflects on how the qualitative findings extend the insights gained for the quantitative study in Chapter Two, highlighting the added value of contextually grounded perspectives. In doing so, it demonstrates of more inclusive, resilient, and contextually relevant DRM strategies to strengthen collaboration and preparedness across the Saudi healthcare system.

3.1.1 Factors Influence HCWs' Perceptions of DRM Effectiveness

HCWs' perceptions of hospital-based DRM are closely linked to broader assessments of with health system resilience during public health emergencies (Kruk et al., 2015). As frontline responders, HCWs have unique insights into the strengths and limitations of DRM practices during pandemics, natural disasters or other emergencies (Gillani et al., 2021; Shapira et al., 2018). Evidence from Saudi Arabia's Eastern Province of (Mohtady et al., 2022) and Iran (Azizpour et al., 2022) illustrates how practical exposure, coupled with personal and

institutional confidence, directly influences HCWs' beliefs in both their personal and institutional ability to prepare for, respond to and recover from disaster (Labrague et al., 2018).

Higher perceived DRM effectiveness is associated with improved psychological readiness, morale and performance among HCWs, which in turn has direct implications for patient safety and health system resilience during emergencies (Shapira et al., 2018). These perceptions are shaped not only by individual and institutional experiences, but also by organisational culture, past disaster exposure, training quality, and regional context (Ayyad et al., 2025; Nava, 2022).

The 2014-16 Ebola outbreak in West Africa provides a notable example of the importance of HCWs' perceptions and input into planning and managing disasters. Their real-time feedback informed revisions to infection prevention and control (IPC) guidelines for every country in West Africa, leading to enhancements in personal protective equipment (PPE) protocols and establishing appropriate treatment centres (Jacobsen et al., 2016, Verbeek et al., 2020). This experience highlights how HCWs' perceptions when incorporated into planning, can strengthen institutional responses and outcomes (Busari et al., 2017; Chemali et al., 2022). Conversely, insufficient training, limited resources, or poor communication can erode trust in DRM systems, while a supportive organisational culture and a clear vision can foster greater confidence and readiness (Panagiotou and Nikezis, 2024). Consequently, mechanisms such as feedback loops, debriefings and participatory planning are vital in aligning DRM strategies with on-the-ground reality (Few et al., 2015; Rosen et al., 2018).

Incorporating HCWs' perceptions into DRM planning is essential for developing evidence-based, adaptive DRM systems that protect both primary responders and institutions (Wiig and O'Hara, 2021). This study examines HWCs' perceptions of DRM across four public hospitals located in the Central, Eastern, Western, and Southern regions of Saudi Arabia. Capturing these perceptions offers insight into regional disparities in resources, cultural contexts and logistical access, thereby contributing to more context-sensitive, evidence-informed strategies for enhancing hospital preparedness and resilience (Al Harthi et al., 2020; Wiig and O'Hara, 2021).

3.1.2 Influence of Organisational Culture on HCWs' Perceptions

Organisational culture – defined as the shared beliefs, values and practices within a hospital – plays a pivotal role in shaping HCWs perceptions of DRM effectiveness (Schein, 2010). Cultures of preparedness emphasise collaboration, transparency and trust, which in turn fosters confidence in an institution's disaster response capacity (Sultan, 2024). Evidence from both international and Saudi contexts demonstrates this relationship: Mannix et al. (2013) found that open channels of communication and trusted enhanced preparedness, while Al Knawy et al. (2019) reported that collaborative cultures in Saudi hospitals sustained operational capacity and staff morale during the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) outbreak. Therefore, the studies highlight how cultural values are closely tied to DRM effectiveness.

In contrast, rigid hierarchies, poor communication, and limited frontline participation undermined perceptions of DRM effectiveness (Ravaghi et al., 2023). In hospitals in the Al-Jouf region, Alruwaili et al. (2024) observed that centralised decision-making and low staff participation limited preparedness. Such hierarchical and traditional leadership styles reduce HCWs' sense of agency and contribute to disengagement in crisis situation (Arcury et al., 2005). In contrast, inclusive cultures that facilitate dialogue, empower staff, and provide equitable access to resources are more likely to build resilience (Georgescu et al., 2024).

Leadership is the principal mechanism through which culture influences HCW's attitudes and perceptions of DRM. Effective leaders establish trust, articulate goals, and allocate resources strategically (Northouse, 2019). Furthermore, Al Knawy et al. (2019) demonstrated that adaptive leadership enabled rapid response and effective coordination during the MERS-CoV crisis, while Mannix et al. (2013) highlighted how leadership practices that prioritise training and psychological safety enhanced preparedness. However, leadership failures – such as symbolic decision-making, unclear goals, or poor communication – erode trust and increase the psychological strain on senior leaders (Block et al., 2014; Chemali et al., 2022; Janis, 1989; Walumbwa et al., 2014). Moreover, while strong leadership can compensate for structural or

procedural weaknesses, relying solely on individual leaders without systemic support risks inconsistency (Wiig and O'Hara, 2021). Sustainable DRM therefore requires leadership embedded within a participatory culture that fosters collective responsibility and experiential learning (Pureza and Lee, 2020).

Despite recognition of the importance of organisational culture and leadership, few studies have explored HCW's lived experiences of institutional these dynamics in Saudi hospitals (Al-Otaibi, 2010; Abolfotouh et al., 2020; Cleary-Holdforth et al., 2022). This study aims to fill this gap by examining the cultural and leadership factors that shape HCWs' perceptions of DRM effectiveness, contributing to the development of culturally responsive and systemically grounded resilience frameworks (Karunaratne et al., 2025).

3.1.3 Influence of Individual Experiences on HCWs' Perceptions

HCWs' prior experiences, including exposure to disaster events, prior disaster training, and trust in the institution, play a key role in shaping HCWs' perceptions of DRM effectiveness (Billings et al., 2021). Practical experience often enhances confidence and decision-making in crises. For example, Azizpour et al. (2022) reported that Iranian emergency nurses with prior disaster training demonstrated higher-level triage decision-making, while Al-Hunaishi et al. (2019) found that workplace trust and personal efficacy increased Yemeni HCWs' willingness to respond during conflict-related emergencies. These findings suggest that personal experience, when supported by institutional resources, strengthens HCWs' perceived capacity to respond effectively.

However, experience alone is not uniformly protective. Related exposure to crises can lead to psychological fatigue, burnout, and even distrust of preparedness systems (Li et al., 2023; Restauri and Sheridan, 2020). Additionally, past crises may also predispose HCWs to inflexible patterns of response, limiting adaptability in new situations (Shapira et al., 2018). Burnout, particularly among emergency staff, has been shown to impair crisis responsiveness (Panagioti et al., 2018). In context such as these, structured psychological support is critical to ensuring

resilience (Pollock et al., 2020). These support systems reduce over-reliance on previous experiences, enabling HCWs to engage more effectively across a range of disaster scenarios (Chemali et al., 2022). Moreover, inadequate systemic conditions – such as shortages of PPE or limited infrastructure – may lessen the benefits of training and reduce perceptions of readiness (Aghapour et al., 2019; Muze et al., 2021).

This underscores that the impact of individual experience on DRM perceptions is contingent upon broader organisational and systemic support. Access to mental health resources, robust feedback mechanisms, and an enabling environment are essential for translating experience into confidence in DRM strategies (Elendu et al., 2024; Reeves et al., 2024). Without these supports, even highly experienced HCWs may regard institutional DRM with scepticism.

In Saudi Arabia, research has addressed aspects of disaster knowledge and preparedness among Saudi nurses (Al Thobaity et al., 2015; Ibrahim, 2014) and shown that perceptions vary based on exposure to high-risk scenarios such as mass gatherings or pandemics (Alzahrani and Kyratsis, 2017; Alreshidi et al., 2020). However, few studies have examined how personal experiences relating to emotional challenges, and institutional support directly influence HCWs' perceptions of DRM effectiveness. While some studies highlight the psychological distress and emotional challenges facing HCWs during times of crisis (Altwaijri et al., 2022) and regional disparities in preparedness (AlDulijand et al., 2023), these factors have not been connected together meaningfully.

This study therefore seeks to address this gap by investigating how HCWs in Saudi public hospitals make sense of their disaster-related experiences and how these shape thie perceptions of DRM effectiveness. By linking professional confidence, emotional challenges, and institutional trust, this research aims to generate insights that can inform for more responsive supports mechanisms and contextually relevant preparedness strategies.

3.1.4 Influence of Geographical Context on HCWs' Perceptions

Geographical context is a key determinant of HCWs' perceptions of DRM effectiveness, as regions differ in hazards, resources, and sociocultural factors (Mosadeghrad, 2014). In Saudi Arabia, these variation present HCWs with unique DRM challenges that influence their sense of preparedness.

In the Southern region, hospitals – often in rural areas and underserved areas – face persistent resource and staffing shortages, undermining HCWs' perceptions of preparedness (Al-Hanawi et al., 2019). Proximity to the Yemen border also introduces conflict-related risks, requiring additional layers of emergency planning (Khan et al., 2018.

In the Western region, most notably Mecca, mass gatherings during the Hajj pilgrimage place unique demands on surge capacity, surveillance and casualty management (Shujaa and Alhamid, 2015). Yet, more than half of trauma and emergency nurses were not aware of DRM protocols (Chemali et al., 2022), while Corless et al. (2018) found that participants reported uncertainty about their roles during high-pressure events increased feelings of unpreparedness, particularly when planning for mass gatherings where many key players need to coordinate methods. These findings suggest the need for risk-based training programmes that clearly delineate HCWs' responsibilities in mass gatherings contexts,

The Central region, which includes Riyadh, demonstrates a similar pattern. Nofal et al. (2018) reported complacency and limited participation in preparedness training, while Al-Wathinani et al. (2021) revealed an alarming discrepancy between perceived and actual readiness: although 65% of HCWs expressed confidence in responding to floods, only 21% knew the correct procedures, and even fewer had completed drills. This points to a pressing need for ongoing, practical training to bridge the gap between perceived and actual readiness.

In the Eastern region, the concentration of introduces risks if industrial incidents, such as fires and toxic exposures, requiring specialised DRM training (Al-Naami et al., 2010). Khan et al. (2019) further observed that culturally tailored messaging enhanced public trust in DRM

strategies, emphasising the impotence of context-sensitive approaches. Evidence across the regions suggests that regular drills, hazard-specific training, and culturally relevant messages are central to aligning perceptions with operational realities.

The distinctions between each region indicate the limitations of standardised DRM protocols at the national level. While these studies highlight region-specific challenges, most have examined them in isolation (e.g. Al-Hanawi et al., 2019; Chemali et al., 2022; Nofal et al., 2018). Furthermore, there is no evidence of cross-regional analysis of how contextual factors interact to shape HCWs' perceptions of DRM. This gap limits the development of integrated, regionally adaptive frameworks for hospital preparedness (Corless et al., 2018; Khan et al., 2019). Addressing this need, the present study explores HCWs perceptions across diverse Saudi regions through a geographically informed lens, with the aim of informing disaster strategies and policies that are both more equitable and contextually effective.

3.1.5 Summary and Research Questions

HCWs' perceptions of DRM are shaped by the interplay of their working environment, organisational culture and geographic context. In Saudi Arabia, where hospitals operate across diverse cultural, institutional, and risk landscapes, these factors collectively influence how DRM strategies are interpreted and applied in practice.

At the organisational level, culture strongly affects HCWS' sense of preparedness and empowerment. Environments characterised by inter-professional collaboration, open communication, and trustful relationships foster engagement and preparedness. By contrast, hierarchical or opaque cultures undermine morale, discourage participation and reduce willingness to respond effectively in crises.

At the individual level, previous experiences of emergencies and participation in training programmes can enhance HWCs' confidence in disaster response. However, repeated exposure to extreme events without adequate psychological support or institutional assistance,

can result in a loss of confidence in the DRM systems, as well as diminish resilience, reduce perceived effectiveness.

Geographic context further complicates DRM perceptions, as regional differences create distinct challenges that resist standardised solutions. Hospitals in Southern region face persistent resources shortages and security concerns along the Yemen border. The Western region must contend with the unique pressures of the Hajj, while the Eastern province faces industrial hazards due to old infrastructure. Furthermore, urban areas in the Central region, encounter gaps between perceived and actual preparedness. These diverse risk profiles demonstrate that region-specific contexts shape the challenges hospitals face and HWCs' perceptions of readiness.

In summary, this study investigates how these factors – organisational culture, individual experience and regional contexts – intertwine to influence HCWs' perceptions of DRM effectiveness in hospitals across the country. To guide this exploration, the following research questions are posed:

1. How does organisational culture in Saudi Arabian hospitals influence HCWs' perceptions of DRM efficiency?

2. How do individual experiences influence Saudi HCWs' perceptions of DRM efficiency in each implementation stage?

3. What explains the regional variations in HCWs' perceptions of DRM effectiveness across hospitals in Saudi Arabia?

By addressing these questions, this study seeks to generate context-grounded, equitable, and coordinated insights that can inform disaster preparedness strategies and ultimately enhance resilience within the Saudi healthcare system.

3.2 Methods

3.2.1 Study Setting

This study was conducted in four public hospitals located across the Eastern, Western, Southern, and Central regions of Saudi Arabia. All four hospitals are public medical and surgical centres with a capacity of over 100 beds and a workforce exceeding 500 HCWs. The hospitals were chosen to capture varied perceptions across regions, ensuring diversity in the experiences and perceptions of DRM strategies.

3.2.2 Participants

Participant recruitment was facilitated through internal hospital investigators who help identify eligible participants. The interviewees were selected based on availability, willingness to participate, and professional role, with participants representing both direct and indirect involvement in DRM activities. Clinical staff included physicians and nurses, while non-clinical staff included administrative managers, department leads, and emergency and logistics personnel.

In total, 24 HCWs participated in in-depth semi-structured interviews, comprising 12 clinical and 12 non-clinical staff (see Table 3-1). In some hospitals, interviews included either all-male or all-female participants, reflecting staff availability at the time of data collection. Factors such as shift patterns, staff rotations, and institutional gender distribution policies sometimes restricted participant diversity. As a result, the gender of the interviewees reflected workforce availability rather than an explicit selection based on gender.

Standardised interview questions, supported by follow-up probes, encouraged participants to share their perceptions, experiences, and beliefs in detail. These questions were specifically designed to explore participants' views of DRM effectiveness in Saudi Arabia hospitals across its phases, and to elicit the reasoning underlying their perceptions.

3.2.3 Data Collection Methods and Interview Design

Ethical approval was obtained from four institutional review boards (IRBs), in Saudi public hospitals, as well as from the University of Southampton's Ethics and Research Governance Online (ERGO) committee (Project ID: 87749). Data were collected between 1st November to 24th December 2023.

Interviews were conducted online using Zoom and recorded over a secure connection. An online format was employed, primarily due to the temporal restrictions of this study and the wide geographical distribution of participants. Each interview lasted between one and two hours, with was recorded securely with participant consent. Participants were informed about the study prior to the interviews and were given appropriate information sheets and consent forms in advance, allowing them time to review the study's purpose and procedures before providing informed consent (Dillman et al., 2014).

The interview questions were developed to comprehensively explore a range of factors influencing HCWs' perceptions and attitudes related to the effectiveness of DRM in public hospitals in Saudi Arabia (see Appendix B on p.224). The questions were developed by drawing on existing literature on DRM and healthcare (Patton, 2015), as well as consultation with experts in Saudi healthcare and input from research supervisors. The initial draft of questions went to a panel of Saudi healthcare workers to ensure both culture appropriateness and clarity. Feedback from these HCWs and the research supervisors were incorporated to strengthen both face and content validity.

The semi-structured format allowed consistent across interviews while also providing greater flexibility for follow-up question. This enabled participants to respond in depth and share contextually rich account of their perceptions and experiences within the time allotted to them (Creswell and Poth, 2018). In addition, key terms were clarified at the start of the interview, and clarification was provided when necessary, during discussion (Patton, 2015).

Data saturation was reached when no new themes or insights emerged from consecutive interviews, suggesting that the data was sufficient to provide comprehensive findings towards meeting the research objectives. This was monitored throughout the data collection process, by monitoring the transcripts of the interviews and noting when responses began to repeat. Open-ended questions and probing techniques supported this process by encouraging participants to elaborate on their answers, contributing to both richness and credibility of the findings.

3.2.4 Data Analysis Technique

All interviews were audio recordings and transcribed verbatim using Trint software (Trint, 2024). To ensure both linguistic and cultural accuracy, two accredited translators from Saudi Arabia, sourced through a certified translation agency, translated the documents from English to Arabic and then back-translated into English to confirm consistency and preserve meanings.

Thematic analysis was then conducted following Braun et al. (2006) the six-phase approach. First, familiarisation with the data – transcripts were read and re-read alongside listening to audio recordings to ensure accuracy and immersion. Second, generating initial codes – relevant data features were systematically coded across the dataset. Third, searching for themes – codes were grouped into potential themes reflecting patterned responses. Fourth, reviewing themes – candidate themes were checked against the coded extracts and the dataset as a whole. Fifth, defining and naming themes – themes were refined, clarified, and given concise, meaningful labels. Finally, producing the report – themes were synthesised and supported with illustrative quotations.

The use of repeated reading and re-listening ensured the accuracy of transcripts and deepened familiarity with the dataset, allowing for a deep understanding of participants' accounts. In addition, equal importance was given to all transcripts, with every dataset treated equally. Codes were examined for their relationships and collated into themes that captured broader patterns in perceptions of DRM. It was important that all relevant codes were retained within each theme to ensure comprehensive representation of the data.

3.3 Results

3.3.1 Participant Demographics

The study included 24 participants, comprising both male and female HCWs working in public hospitals in four geographical areas of Saudi Arabia (Central, Southern, Western, and Eastern), as shown in Table 3-1. Participants were both clinical (e.g., doctors and nurses) and non-clinical staff (e.g., administrators and managers). The participants had between 4 and 30 years of experience, ensuring a broad spectrum of perspectives. To maintain confidentiality, participants were assigned alphanumeric codes rather than being identified by name.

Table 3-1 Participant Demographics

Name	Gender	Health Sector	Profession	Exp. Years	Workplace
Participant 1	Female	Clinical	Nurse	25 years	Central Region
Participant 2	Female	Clinical	Doctor	9 years	
Participant 3	Male	Clinical	Doctor	4 Years	
Participant 4	Male	Non-Clinical	Clinics Supervisor	14 Years	
Participant5	Male	Non-Clinical	Administrative	10 Years	
Participant6	Male	Non-Clinical	Health Informatics Specialist	12 Years	
Participant 1	Male	Clinical	Nurse	18Years	Southern Region
Participant 2	Male	Clinical	Doctor	10 Years	
Participant 3	Male	Clinical	Nurse	8 Years	
Participant 4	Male	Non-Clinical	Administrative in epidemiology and biostatistics	25 Years	
Participant5	Male	Non-Clinical	Head of the Risk Management Department	4 Years	
Participant6	Male	Non-Clinical	Hospital Director	12 Years	

Name	Gender	Health Sector	Profession	Exp. Years	Workplace
Participant 1	Female	Clinical	Senior Laboratory Medicine Specialist	12 Years	Western Region
Participant 2	Female	Clinical	Nurse	4Years	
Participant 3	Female	Clinical	Nurse	9 Years	
Participant 4	Male	Non-Clinical	Head of the Nursing Department	16 Years	
Participant5	Male	Non-Clinical	Head of the Risk Management Department	5 Years	
Participant6	Male	Non-Clinical	Head of control infectious diseases	30 Years	
Participant 1	Female	Clinical	Doctor	15 Years	Eastern Region
Participant 2	Female	Clinical	Nurse	4 Years	
Participant 3	Female	Clinical	Nurse	7 Years	
Participant 4	Female	Non-Clinical	Health administrator	8 Years	
Participant5	Female	Non-Clinical	Head of the Risk Management Department	23 Years	
Participant6	Female	Non-Clinical	Quality manager	5 Years	

3.3.2 Thematic Analysis Process

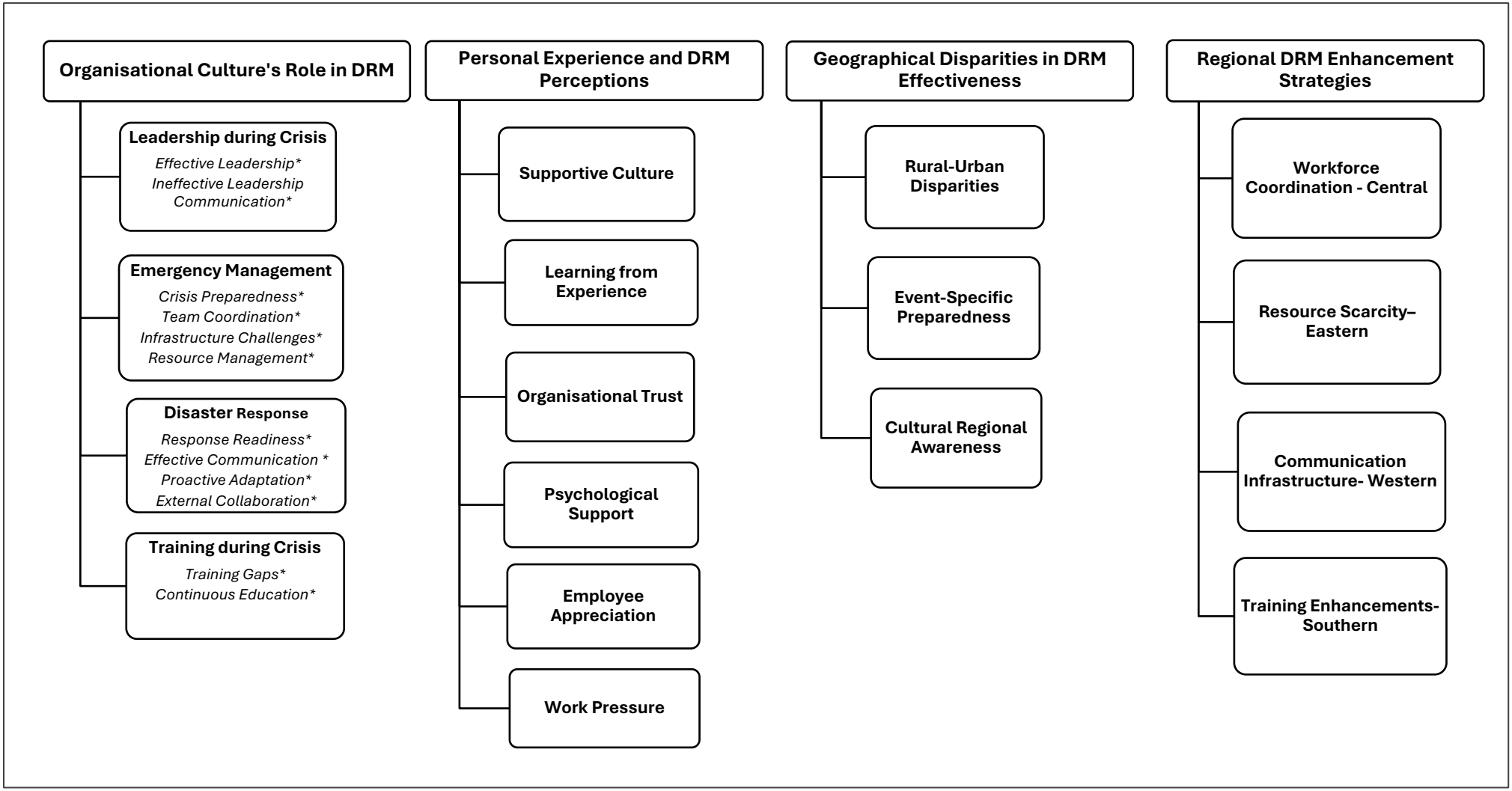
Interview transcripts were read and re-read to familiarise myself with HCWs' perceptions of DRM effectiveness in public hospitals in Saudi Arabia (Braun & Clarke 2006, 2019). The data were organised and coded at the level of meaningful segments. A hybrid coding approach was employed, drawing codes both deductively from the research questions and interview guide (e.g., 'leadership support', 'preparedness training', 'clarity of roles') as well as inductively from participants' own language and emphases (e.g., 'consistent training', 'communication options').

A draft provisional codebook was produced after the first transcripts and was iteratively refined throughout the dataset. A process of constant comparison was used, supported by analytic

memos, to ensure clear definitions of codes and to address potential overlaps (Fereday et al. 2006).

The codes were subsequently collated into candidate themes by grouping conceptually related codes and examining their interconnections. The themes were reviewed against the coded extracts and the dataset as a while to ensure that the themes were internally coherent and distinct, before being clearly defined and named (Braun & Clarke, 2006; Nowell et al., 2017). For example, the theme 'Organisational Culture's Role in DRM' emerged from codes relating to leadership engagement, a culture of drills and learning, and the availability of resources. Similarly, 'Geographical Disparities in DRM Effectiveness' was developed from codes related to uneven access to training, staffing issues, and region-specific risk factors.

The final themes were then mapped against the research questions, and representative quotations were selected to illustrate each theme. The thematic analysis identified four major themes describing how HCWs communicate their perceptions of DRM effectiveness in Saudi public hospitals: (1) Organisational Culture's Role in DRM, (2) Personal Experience and DRM Perceptions, (3)Geographical Disparities in DRM Effectiveness , and (4) Regional Strategies for Enhancing DRM(see Figure 3-1).



* *Micro-Theme*

Figure 3-1 Key Patterns and Insights: A Thematic Analyse

3.3.2.1 First Theme: Organisational Culture's Role in DRM

The thematic analysis identified four sub-themes and twelve micro themes concerning the role of organisational culture in shaping perceptions of DRM effectiveness across the regions (Central, Eastern, Western, and Southern). The sub-themes were: “Crisis Leadership”, "Emergency Management”, "Disaster Response”, and "Crisis Training”. To maintain transparency and to alleviate concerns related to selective reporting, the number of quotes and unique participant counts are presented in Appendix C.1. In total, this theme comprised 88 quotations.

Sub-theme: Leadership During Crisis

The thematic analysis identified two micro themes regarding crisis leadership: "Effective Leadership," and "Ineffective Leadership Communication." These themes represent perceptions of HCWs regarding crisis leadership to enhance or impede DRM across the Central, Eastern, Western, and Southern regions in Saudi Arabian hospitals in the study.

Micro-theme: Effective Leadership

Eleven HCWs described how effective leadership fostered shared organisational values, prioritised patient care, and cultivated a positive work culture during crises. They highlighted leaders who led by example, encouraged interdepartmental collaboration and acted decisively. These quotes illustrate these viewpoints:

> *"Strong leadership supports the care of patients as it encourages collaborative decision-making and puts the patient at the centre..."* (Participant 1, Central Region)
>
> *"Our organisation had the strong leadership and high level of workforce involvement in DRM..."* (Participant 4, Southern Region)
>
> *"Strong leadership was shown through daily meetings; this was from the top management level down to the operations level; it helped with fast decision-making to help address requests to respond fast."* (Participant 6, Western Region)
>
> *"The leadership has been good and responsive during decision-making."* (Participant 6, Eastern Region)

Micro-theme: Ineffective Leadership Communication

Conversely, eight HCWs in all regions identified poor leadership communication as one of the greatest barriers to DRM. They expressed concern about the lack of administrative specialisations (a common issue among physicians), demonstrating performative behaviours rather than creating actionable measures, maintaining bureaucratic barriers, and being resistant to engage with expertise outside of medical. The following quotes illustrate these viewpoints:

> *"Most of them were administrators as they lacked a specialisation in the applicable discipline."* (Participant 1, Eastern Region)
>
> *"Unfortunately, there is an apparent lack of accountability, undying stubbornness, and a lack of respect from both the employees and the leadership team."* (Participant 1, Western Region)
>
> *"The ineffectiveness stemmed from... the absence of leaders who are scientifically qualified to do DRM."* (Participant 3, Southern Region)
>
> *"I worry that our leadership does not value the relationships present in specialised areas like risk and disaster management..."* (Participant 4, Central Region)

Sub-theme: Emergency Management

In addition, the thematic analysis also revealed three micro-themes under the "Emergency Management" sub-theme: "Crisis Preparedness," "Team Coordination", and "Infrastructure Barriers" and "Resource Management". These micro-themes represent different understandings of emergency management, shaped by the organisational culture in Saudi Arabian hospitals.

Micro-theme: Crisis Preparedness

Seven HCW from across all regions highlighted how built on comprehensive plans and cross-unit cooperation reflected organisational culture. The following quotes illustrate their views:

> *"We were receiving updates in a timely manner, fully developed plans."* (Participant 1, Eastern Region)

"I believe that (DRM) works well. The infection control unit, the emergency unit, the clinics were cooperating, and they were able to enact our plans." (Participant 2, Central Region)

"Our organisation has a disaster preparedness plan that covered the building, employee qualifications, restarting operations, and supply and service management prior to disaster." (Participant 4, Southern Region)

"Our clear planning and structures are a result of previous experiences dealing with a crisis. We have learned from our experiences to improve our preparedness and response methods, especially during COVID-19." (Participant 6, Western Region)

Micro-theme: Team Coordination

Six HCWs across three regions (Central, Eastern, and Southern) stressed that effective DRM required strong coordination and communication from crisis management team and commanders.

"The organisation has a competent crisis management team, and they are able to prepare in advance when any crisis occurs. The team was communicated to through the crisis commander or manager. The crisis commander or manager communicated all actions that pertained to the team." (Participant 1, Central Region)

"All communication went through email officiated, and some decisions were made internally and were done quickly." (Participant 1, Western Region)

"Our disaster management team is important from how we manage the hospital operations, particularly with COVID-19." (Participant 2, Eastern Region)

"The key for us was communicating quickly and effectively." (Participant 6, Southern Region)

Micro-theme: Infrastructure Challenges

Three HCWs from two regions (Western and Southern) described inadequate hospital infrastructure issues, ranging from outdated infrastructure to poorly placed emergency exits and flooding risks.

"All the hospitals in the region are old as far as their facilities are concerned, and only some meet current safety standards. None of the hospitals have adhered to the most

recent fire and emergency code guidelines that have been recently issued; most of the facilities are old, and had no upgrades in 20 years." (Participant 1, Southern Region)

"I am concerned about the infrastructure of the hospital, the building and emergency exits. For example, during a fire explosion the egresses, are too far away from patient areas." (Participant 3, Western Region)

"The infrastructure in some of the hospitals here is not suitable for emergencies when the weather is poor, ie. heavy rain or rainwater leaks." (Participant 5, Southern Region)

Micro-theme: Resource Management

Four HCWs across all four regions emphasised that adequate resources were fundamental for successful disaster management, while shortages undermined patient care and institutional resilience. The following quotes illustrate HCWs' perceptions regarding resources:

"Sufficient resources makes for better outcomes for disaster management through good preparedness, education, and availability of equipment." (Participant 1, Central Region)

"Limited medical resources and limited human resources are apparent and it impacts not just our institution, but many hospitals in the region." (Participant 2, Southern Region)

"We need human resources for rapid response, and even with technical or medical resources, the absence of supplies, equipment and budget restricts the application of proper standards." (Participant 4, Eastern Region)

"Not having safety resources, e.g., water sprinkler systems, is sometimes because the expense." (Participant 4, Western Region)

Sub-theme: Disaster Response

The thematic analysis identified four micro-themes under the sub-theme of "Disaster Response": "Response Readiness," "Good Communication," "Proactive Adaptability" and "Collaboration with Outside Sources." These micro-themes captured HCWs' perceptions about the various elements of disaster response embedded in the organisational culture of Saudi Arabian hospitals.

Micro-theme: Response Readiness

Four HCWs across all four regions stressed that response readiness depended on: planning, mitigation, ensuring resources and equipment were ready, and training. Confidence in their role was seen as vital, in conjunction with teamwork and understanding the role of others. Training was also emphasised as important for understanding expectations and limitations and increasing self-confidence in disaster response. The subsequent quotes illustrate these sentiments:

> *"Preparation is key,... planning, mitigation, readiness of resources/equipment and training. Teamwork, and confidence in one's role is essential. Training allows for a clear understanding of expectations and limitations. Other things being equal, being informed and attended a drill can contribute to increased self-confidence during a disaster."* (Participant 1, Central Region)

> *"We have made a hypothesis and outlined our organisational structure on the operations wall so that in the case of a disaster, every department and team knows exactly what their roles and responsibilities are. For example, if we admitted 20 critically ill patients into the emergency department, every team member knew what their roles were, allowing great communication throughout all staff."* (Participant 2, Western Region)

> *"The organisational culture of our health institution is preparedness and response to disasters, as safety for patients and in the workplace at all times, is paramount."* (Participant 4, Southern Region)

> *"Recovery processes and communicating with patients were noted to be really great."* (Participant 6, Eastern Region)

Micro-theme: Effective Communication

Nine HCWs across all four regions highlighted communication as central to effective DRM, ensuring timely updates, collaboration, and patient satisfaction. The following extracts speak to these perceptions:

> *"Receiving high-quality information in a health crisis matters because it means increased patient satisfaction, effective healthcare, and improved service outcomes."* (Participant 1, Central Region)

"Our communication is effective because of training for catastrophic events. Even in a mass casualty situation, every department comes together." (Participant 2, Western Region)

"We were kept well-informed through the hospital's portal, where they would post updates and standards we were to use, so the information was easy to access once we all knew it was there." (Participant 2, Eastern Region)

"Strength was rapid and effective communication." (Participant 6, Southern Region)

Micro-theme: Proactive Adaptation

Six HCWs from all four regions noted proactive adaption in hospital culture, including rapid uptake of technology (e.g., the use of the Tawakkalna application and telehealth) and responsiveness to health directives:

"Good communication begins with the leader giving the information to the employee. Technology exists, but that technology has to be properly used." (Participant 1, Western Region)

"It is critical to invest in the latest technology... communication and coordination are facilitated during emergencies." (Participant 4, Southern Region)

"During the Corona pandemic, we used 2 platforms to manage information... and make certain that no matter which hospital, the Red Crescent or Health maintained situational awareness and coordination." (Participant 5, Eastern Region)

"We were very innovative with telehealth in our department... This was a very successful initiative and was very smooth and effective through collaboration." (Participant6, Central Region)

Micro-theme: External Collaboration

Six HCWs from the four regions valued partnerships with accreditation agencies and suppliers, as strengthening DRM. This included compliance with agencies, such as the Saudi Central Board for Accreditation of Healthcare Institutions (CBAHI) which is the official accreditation agency for health facilities in Saudi Arabia and sets standards for quality and safety for evaluation purposes. Also mentioned were efforts to coordinate with parties, such as the National Unified Procurement Company (NUPCO), the largest procurement and supply

company for governmental hospitals in Saudi Arabia (NUPCO, 2024). The following quotes illustrate those perceptions:

> *"Working with external sectors was very seamless and flexible."* (Participant 1, Eastern Region)
>
> *"Our success in managing the disaster was greatly facilitated by our speakers' proctored health assessments and [by achieving] JCI international accreditation..." (*Participant *1, Western Region)*
>
> *"Sahbi... has a disaster management certification in its health accreditation service..."* (Participant 4, Central Region)
>
> *"Consolidating vendors under NOBECO has alleviated issues related to supply chain fragmentation..."* (Participant 5, Southern Region)

Sub-theme: Training During Crisis

Two micro-themes emerged under the sub-theme of "Training Through Crisis". The two micro-themes were "Training Gaps" and "Continuous Education". The micro-themes capture HCWs' perceptions of training practices and reveal the cultural context of DRM within Saudi Arabian hospitals.

Micro-theme: Training Gaps

Five HCWs from all four regions identified gaps between available training and actual DRM needs, citing self-directed learning and limited institutional provision:

> *"We did our training on our own. There were no outside educators brought in for us."* (Participant 1, Western Region)
>
> *"I wish the hospital would be more involved with providing educational opportunities rather than relying on the individual or the Director."* (Participant 3, Eastern Region)
>
> *"As far as training was concerned, my personal experience was mostly self-directed... the framework came from other colleagues, primarily nurses..."* (Participant 4, Central Region)

"We have identified major gaps in our personal development and staff development, and this has created numerous organisational challenges..." (Participant 6, Southern Region)

Micro-theme: Continuous Education

Eleven HCWs from all four regions recognised the importance of continuous education, drills and simulations as essential for DRM preparedness:

"The drills and annual refresher training provide huge opportunities for preparedness." (Participant 1, Central Region)

"The drills were great, and they have been done continuously and timely." (Participant 2, Eastern Region)

"The hospital always do drills and offer training, so staff has awareness." (Participant 4, Southern Region)

"Training is important, and linked to the renewal of your contract... Management does basic training, and nurses and doctors have extensive training." (Participant 6, Western Region).

3.3.2.2 Second Theme: Personal Experience and DRM Perceptions

The thematic analysis revealed six sub-themes demonstrating how personal experience influenced HCWs' perceptions of DRM in public hospitals across four regions of Saudi Arabi (Central, Eastern, Western, and Southern). These sub-themes were "Supportive Culture", "Learning for Experience", "Trust", "Psycho-logical Support", "Employee Acknowledgment", and "Work Pressure. To ensure transparency and minimise suspicion of selective reporting, the frequency of quotes and the number of participants contributing to each sub-theme are provided below, reflecting the full dataset of 36 quotes for this theme (see Appendix C.2).

Sub-theme: Supportive Culture

Six HCWs across all four regions emphasised the importance of a supportive organisational culture during crises. They highlighted psychological and material support from colleagues (e.g. food, equipment, etc..), teamwork, and clear communication channels as key contributors to resilience:

"I am always able to manage my stress at any point in time, and giving to my colleagues also has a positive effect." (Participant 1, Western Region)

"We went through this period with full understanding of our work and coverage, along with psychological support from our colleagues." (Participant 2, Central Region)

"There was great organisation, especially in each of our departments... If there were any questions from employees, she would have the answers ready." (Participant 2, Eastern Region)

"There was a tremendous spirit of contributions; health sector colleagues voluntarily cancelled their vacation time early, and worked more hours to help." (Participant 6, Southern Region)

Sub-theme: Learning from Experience

Four HCWs from all four regions observed that prior crises helped them maintain their resilience, adaptability, preparedness, and stress management strategies:

"Learning from past experiences allows you to have the strength and courage to address and improve upon those failures for future use." (Participant 1, Central Region)

"I think going through Middle East Respiratory Syndrome has increased our capacity to deal with COVID-19 better." (Participant 2, Eastern Region)

"Absolutely, my knowledge has increased my confidence in dealing with these types of situations." (Participant 4, Southern Region)

"We have an understanding of how we develop readiness and response plans, and if you look back at our prior crisis experiences, it helps with putting together improved preparedness and response plans." (Participant 2, Central Region)

Sub-theme: Organisational Trust

Four HCWs from all regions expressed that trust in their hospital's DRM systems stemmed from robust training, comprehensive preparedness planning, sufficient resources, and external support from the Ministry of Health and other organisations.

"I have complete confidence in our organisation's ability to deal with a disaster because I have received significant training and the preparedness planning is thorough..." (Participant 1, Central Region)

"The system I'm in is always available to respond, which is made easier by the recent anaesthetist bed capacity and improvements to emergency and other departments." (Participant 1, Western Region)

"I know our hospital has the resources to respond and react to emergencies immediately, and the Ministry of Health as the first responder is what I rely on..." (Participant 3, Eastern Region)

"I feel really comfortable in our ability to respond to a disaster because we have a plan." (Participant 4, Southern Region)

Sub-theme: Psychological Support

Seven HCWs identified variable across to psychological support across hospitals. While some institutions offered online programmes or clinic, others had not services for staff despite acknowledging the need for mental health services due to the psychological trauma linked to crisis work.

"There was a noted lack of focus delivering psychological clinics for employees in the hospital during the crisis. There is also an overall lack of awareness of the psychological health component, which is still stigmatised." (Participant 1, Southern Region)

"At this point we don't have a psychiatric clinic for employees which is a big gap. Our staff deals with work-related pressure and burnout.... Although there are psychiatric services available for patients, none [exists] for employees." (Participant 1, Eastern Region)

"With respect to psychological clinics, none are available for our staff." (Participant 2, Western Region)

"At the organisational level, health specialties including support for psychological support, are accessible online whenever they want to be. The Commission for Health Specialties has rolled out a support programme for health administrative staff, including, not only doctors, but all health professionals, supervised by psychiatrists and mental health professionals". (Participant 3, Central Region)

Sub-theme: Employee Appreciation

Four HCWs in the four regions stressed that employee recognition – whether verbal, financial or some symbolic – was important to their satisfaction and performance, as well as the team's morale during crises. Conversely, a lack of recognition to diminish their motivation to participate in DRM activities.

> *"Organisational culture can have either a negative or positive effect on satisfaction and performance in our work."* (Participant 1, Central Region).
>
> *"In regard to a new disaster, I was hesitant to participate due to a lack of recognition, appreciation, and incentives for those of us who worked from home in the last crisis."* (Participant 1, Eastern Region).
>
> *"Although my colleagues became supportive, the recognition of their efforts was absent from hospital management."* (Participant 2, Southern Region)
>
> *"Recognition is shown through appreciation" gratitude" and praise, as well as hard awards, such as lump sum payments to acknowledge the risk taken, and certificates."* (Participant 6, Western).

Sub-theme: Work Pressure

Nine HCWs from all four regions reported experiencing heavy workloads, and psychological stress during crisis situations due to a range of factors, including volume of critical cases, limited decision making, and emotionally draining situations. These pressures negatively influenced their sense of efficacy, safety and mental health.

> *"The breakdown was definitely work pressure, not bad management."* (Participant 2, Central Region)
>
> *"To be honest, since there were so many cases of the elderly dying, it has made me psychologically exhausted going to work."* (Participant 2, Western Region)
>
> *"It's really disappointing to speak out about the failings of the hospital and for nothing to change."* (Participant 2, Southern Region)
>
> *"In my previous job, the amount of pressure on me and the lack of control clearly affected my mental health and created stress and psychological strain. I wanted to help the patients but could not."* (Participant 6, Eastern Region)

3.3.2.3 Third Theme: Geographical Disparities in DRM Effectiveness

The thematic analysis highlighted three sub-themes related to geographical inequalities shaping HCWs' perceptions of DRM effectiveness across public hospitals in Saudi Arabia: "Rural-Urban Disparities", "Event Specific Preparedness" and "Cultural Regional Awareness". To ensure transparency and to reduce the risk of selective reporting, the number of quotes and distinct participants contributing to each sub-theme are reported, based on full dataset of 20 quotes for this theme (see Appendix C.3).

Sub-theme: Rural-Urban Disparities

Nine HCWs from all four regions described inequalities between central (urban) and rural areas in terms of emergency response capabilities, accessibility, and quality of care. Urban centres were seen to benefit from advanced equipment, multi-disciplinary specialities, and larger, better-trained cohort of healthcare professionals, while rural areas often faced limited resources and slower access to medical facilities.

> *" The central region has better emergency communications, compared to rural areas..."* (Participant 1, Central Region)

> *"There are easier access to resources, including facilities that are better equipped, better infrastructure, and more manpower in urban areas compared to rural areas."* (Participant 1, Eastern Region)

> *"Yes, there is a significant cultural difference between urban cities compared to rural cities, especially concerning attitude/preference towards vaccinations. There is more hesitancy with the older population, regardless of what science they are presented."* (Participant 4, Western Region)

> *"...yes, geographical location has an impact on the access to medical resources in the southern region... Providing access in rural areas is often much slower, and harder than in urban areas."* (Participant 5, Southern Region)

Sub-theme: Event-Specific Preparedness

Seven HCWs from all four regions reported that DRM preparedness varied depending on the type of event or local threat. This was the case in strategic locations such as Mecca during Hajj season, or the Eastern region with oil fields and air bases, which required highly specialised protocols and significant government investment.

> *"I worked in Mecca, and emergency response is prepared for contingencies related to disasters during the Hajj season...The emergency response organisation during Hajj is the only one of its kind anywhere in the world."* (Participant 1, Eastern Region)
>
> *"In the central region with a larger consumer population, you have multi-disciplinary specialties, so the government invests political freedoms and money..."* (Participant 1, Central Region)
>
> *"We are capable because Hajj only exposes us to unusual cases... All the human resources and medical resources were available..."* (Participant 2, Western Region)
>
> *"The Eastern region has faced some political problems that could challenge the oil fields... With risk to the airbase at Dhahran, to Aramco, and oil wells."* (Participant 4, Eastern Region)

Sub-theme: Cultural Regional Awareness

Four HCWs from all four regions observed that cultural differences across regions influenced DRM responses. Local values, religious beliefs, education levels, and community attitudes affected compliance with health measures, patient behaviours, and trust in medical authorities.

> *" Yes, it does affect the process greatly, as divisions can impede the process of problem-solving. For example, the vaccination issue had one group refusing to get the vaccination, and another group waiting for it to be mandatory."* (Participant 2, Central Region)
>
> *"The community is very aware and compliant with regard to the regulations and implementing the decisions."* (Participant 3, Eastern Region)
>
> *"The most compliant, understanding, and educated people I've ever met are in Jeddah"* (Participant 4, Western Region)

"Yes, patient behaviours can vary by region… Local culture, value systems, and religious beliefs encoding values have huge impacts on estimates for healthcare decisions." (Participant 4, Southern Region)

3.3.2.4 Fourth Theme: Regional DRM Enhancement Strategies

The thematic analysis identified four sub-themes reflecting HCWs' recommendations to strengthen DRM in all four regions of Saudi Arabian hospitals that were part of the study. These were: "Workforce Coordination" (Central Region), "Resource Scarcity" (Eastern Region), "Communication Infrastructure" (Western Region), and "Training Enhancements" (Southern Region). To ensure transparency and reduce the risk of selective reporting, the number of quotes and distinct participants for each sub-theme are included, based on the full dataset of 38 for this theme (see Appendix C.4).

Sub-theme: Workforce Coordination – Central Region

All participants from the Central Region highlighted workforce coordination as essential for DRM improvement. Recommendations focused on enhancing workforce skills, reviewing licensing requirements, improving pay and working conditions and ensuring transparency in line with risk management phases. Participants also emphasised the importance of effective collaboration across hospitals to ensure equitable resource distribution during crises.

"Health facilities can address quality and quantity issues of the workforce, alter licensing requirements, and also make the profession appealing by improving pay and working conditions." (Participant 1, Central Region)

"We have very little coordination between hospitals if we had to respond to a disaster to ensure fair distribution of resources …. We need to communicate better across all the hospitals, with flexibility so we can respond as efficiently as possible." (Participant 3, Central Region)

"We want developing technologies to be accessible to all, and to educate patients on the importance of developing technology, how to use it, and its benefits." (Participant 6, Central Region)

Sub-theme: Resource Scarcity – Eastern Region

Every participant from the Eastern Region clearly recognised resource scarcity as a major barrier to effective DRM. Key concerns included shortages of essential medications, limited medical supplies, insufficient staff in specialist areas, and outdated infrastructure. The need for modernisation and investment in facilities was widely recognised.

> *"We are missing many elements in this hospital, especially medications. This shortage is a real issue within our oncology department."* (Participant 1, Eastern Region)
>
> *"It is all about communication... as shown by the amount of training and responsibility we have placed on our clinical staff."* (Participant 2, Eastern Region)
>
> *"The organisational structure is complicated... with the resources and older buildings"* (Participant 4, Eastern Region)

Sub-theme: Communication Infrastructure – Western Region

All Western Region participants emphasised the importance of communication infrastructures for effective DRM. This included both physical facilities (such as hospital buildings) and technological systems for patient updates, guidelines, and circulars. Participants advocated for more formal communication strategies, regular drills, and investments in infrastructure to support timely responses:

> *"The communication strategy should mirror that of the National Guard Hospital with a quality well-established disaster plan*." (Participant 1, Western Region)
>
> *"Technology was imperative, especially with surgical operations, in holding an update on patient remains..."* (Participant 2, Western Region)
>
> *"To assist the hospital to have risk management.... do more exercises and drills.... use as part of the staff's residential review process."* (Participant 5, Western Region)

Sub-theme: Training Enhancements- in Southern Region's DRM

Every participant in the Southern Region emphasised the need for systematic, ongoing training to strengthen DRM capacity. Suggested strategies included regular refresher courses, simulations, improved supply chain management, greater investment in technology, and better coordination through command- and-control centres.

> *" Initially, we start by sourcing from suppliers with satellite capabilities... however, we quickly face a significant shortage of basic supplies..."*(Participant 1, Southern Region)
>
> *"The hospital needs to build knowledge for DRM with staff, via education and certification resources."* (Participant 4, Southern Region)
>
> *"Investing in technology is crucial for better communication and coordination in the [event] of an emergency."* (Participant 4, Southern Region)

3.4 Discussion

3.4.1 Organisational Culture's Influence on HCWs' DRM Perceptions

The findings highlight the significant role of organisational culture in shaping HCWs' perceptions of DRM effectiveness in Saudi Arabian hospitals. Effective leadership, robust emergency management processes, proactive disaster response procedures, and appropriate training emerged as driving factors. In contrast, poor communication from leaders, outdated hospital resources, and limited opportunities for formal training were identified as areas for improvement.

These findings are consistent with the existing literature which has identified leadership as central to fostering cultures conducive to effective DRM (Northouse, 2019; Schein, 2017). Decisive leadership that coordinated across departments and prioritised both patient care and communication was found to build trust and morale among HCWs. Interestingly, HCWs' perceptions that ineffective communication stemmed from a lack of training among medically trained leaders contextualises the literature more specifically, given that Mannix et al. (2013) concluded leadership fosters resilience across all settings.

In relation to emergency management processes – particularly preparedness and team building – the findings support Gillani et al. (2021) and Shapira et al. (2018), who emphasised the importance of solid planning and collaboration. However, the observation that some hospitals lacked sufficient infrastructure, despite Saudi Arabia's classification as a high-income setting with abundant resources, challenges accepted assumptions regarding healthcare investment in the country. This implies that organisational culture may be limited by systemic factors such as resource allocation. Lastly, the reliance on self-directed learning rather than structured educational programmes highlights a disconnect between organisational priorities and HCWs professional development needs. This extends Labrague et al.'s (2018) original argument that cultural and administrative barriers restrict access to formal training.

Overall, this study offers a more nuanced conceptualisation of organisational culture in DRM, by positioning administrative competence and resources availability as mediators of leadership effectiveness. There is a clear opportunity for leadership development in crisis communication and cross departmental coordination, along with investment in modernising hospital infrastructure to meet HCWs' expectations. Collectively, these findings enhance theoretical models of organisational resilience by incorporating context specific considerations, namely the development of administrative practice and the limitations of resources.

3.4.2 Personal Experiences and HCWs' DRM Perceptions

The findings of this study demonstrate a clear link between HCWs' personal experiences of DRM and their perceptions of its overall effectiveness. Supportive organisation culture, learning from previous events, trust in institutional capability, access to psychological support, recognition and appreciation, and manageable workload pressure all contributed to greater willingness among HCWs to engage in DRM. However, inconsistent provision of psychological support and experiences of unmanageable workload revealed gaps in current practice.

These results confirm the conclusions of Burke et al. (2010) and Al Khalaileh et al. (2012), who identified previous experience and self-efficacy as predictors of readiness for disaster

response. Positive experience of learning from prior events (e.g., MERS) aligns with Azizpour et al. (2022), who argued that experiential knowledge strengthens triage and stress-management skills. However, the inconsistent delivery of psychological support services – with some hospitals reporting no provision at all – sits uneasily with resilience theory's assumption that mental health services are widely available (Pollock et al., 2020).

The prominence of employee recognition as a motivator supports the conclusions of Moore et al. (2004). However, the reluctance reported by some HCWs to engage in future disaster events without recognition adds a contextual nuance, highlighting expectations of tangible rewards in the Saudi healthcare context. Similarly, the deleterious effects of heavy workloads on well–being resonated with Restauri and Sheridan (2020). Limited control over decision–making was found to worsen strain, suggesting that empowerment may help to alleviate burnout even in high demand situations.

Altogether, this study provides valuable insights into how the interplay between personal experiences, psychological support, and cultural expectations of recognition influences HWCs' engagement with DRM. Therefore, hospitals may wish to consider embedding consistent psychological support services and establish structured recognition initiatives within their DRM frameworks. Theoretically, these findings underscore the importance of empowerment and cultural expectations in maintaining HWCs' long-term engagement in disaster response.

3.4.3 Geographical Disparities in Saudi Arabian Hospitals' DRM

The findings highlight considerable geographical disparities in HCWs' perceptions of DRM effectiveness across Saudi Arabia. Urban centres – particularly the Central Region – were seen as advantaged due to stronger infrastructure and greater resource, while rural areas were consistently described as struggling with conditions of scarcity. Event-related preparedness, such as the Hajj in Mecca or the management of industrial accidents in the Eastern Region, appeared to enhance readiness in specific contexts. Culturally relevant considerations were also reported to support more effective responses during DRM, despite structural challenges.

This rural–urban divide aligns with Chen et al. (2019), who linked inequitable access to resources with disparities in healthcare. However, problems were also reported within urban systems during acute events. For example, emergency nurses in Mecca described providing amidst recognised knowledge gaps, underscoring the need for greater focus on urban resilience. Even well-resourced systems were reported to be strained under surge conditions, suggesting that preparedness is uneven across hospital contexts. Although some evidence of preparedness during acute events in Mecca supports Chemali et al. (2022), the persistence of knowledge gaps challenges Al-Thobaity et al.'s (2019) claim that Hajj inherently supports readiness for acute crises, as there is little indication that event-specific protocols can be adapted to diverse types of emergencies.

Cultural influences also emerged as mediators of DRM effectiveness. For example, Khan et al. (2019 observed that vaccine uptake in rural areas was strongly shaped by cultural factors, providing insight into how patient behaviours can affect the success of DRM. This illustrates the dual role of cultural contexts as both barriers and facilitators of DRM, depending on how flexibly they are adopted.

Overall, these findings suggest that while events such as Hajj can drive targeted resource procurement and preparedness, they also expose a structural vulnerability within what is otherwise a high-income country. Policy implications therefore include the need to address regional inequities in resource allocation and to foster sustained community engagement across all regions. Taken together, the measures could help reduce regionally based disparities and strengthen national public health resilience.

3.4.4 HCWs' DRM Enhancement Recommendations in Saudi Public Hospitals

HCWs' recommendations for DRM enhancement varied by region, reflecting distinct contextual priorities. Workforce planning and co-ordination emerged as the most pressing concern in the Central Region; resource scarcity was the most dominant issue in the Eastern Region; communication systems were seen as a hindrance in the Western Region; and training and

capacity development were the principal recommendations in the Southern Region. Collectively, these findings provide a regional picture of DRM needs, highlighting both contextual considerations and practical priorities for improving outcomes.

In the Central Region, HCWs' emphasis on prioritising workforce coordination is consistent with Smith et al. (2020), who argued that such alignment is shaped by culturally specific factors, such as licencing conditions and compensation, which serve as incentives for participation. This suggests that professional incentives may hold greater validity within an urban context.

HCWs in the Eastern Region highlighted resource scarcity, with particular reference to shortages in oncology resources. This example underscores a broader concern regarding systemic resource limitations, offering direction for practitioners and policymakers to address both specific and generalised shortages in DRM planning.

In the Western Region, HCWs prioritised improvements to communication systems, echoing is Ahmed et al. (2020), who advocated for integrated disaster plans. These findings also suggest underlying resource challenges, as poor communication was viewed as contributing to coordination failures during Hajj – an event requiring particularly robust preparedness.

In the Southern Region, training and capacity development were the key recommendations, consistent with Patel et al. (2021). Notably, HCWs proposed expanding training beyond clinical competencies to include areas such as supply-chain management, which would enhance operational capacity and strengthen resource-based resilience.

Overall, the evidence supports shifting from generic DRM interventions to regionally tailored approaches that address context-specific priorities. The findings highlight the strength of regional agendas and point to the paradox of continued scarcity within a high-income country. By adopting regionally responsive strategies, policymakers can advance resource resilience and strengthen DRM effectiveness nationwide.

3.4.5 Future Research Recommendations and Limitations

The generalisability of this study is limited, as data collection was confined to four public across the Central, Eastern, Western, and Southern regions in Saudi Arabia. Although these hospitals were chosen to reflect regional perspectives, the findings may not be representative of smaller or private hospitals, nor of socio-cultural and economic contexts in other countries. Organisational cultures and resource environments are not uniform across healthcare systems, thereby limiting transferability (Alruwaili et al., 2019).

Reliability was also affected by the difficulty of achieving gender balance among the interviewees. Despite efforts to diverse role groups (clinical and non-clinical) across all regions, gender distribution was uneven due to scheduling and staff availability. For example, interviews in the Eastern Region were mainly with female HCWs, while those in the Southern region were exclusively male. This imbalance may have restricted the breadth of perspectives, as gender-specific experiences (e.g., work-life balance, role-related stressors) can shape DRM perceptions differently. A more balanced sample may have provided greater thematic richness (Chemali et al., 2022).

Methodological considerations further limit the findings. The study relied on semi-structured interviews with 24 participants, offering depth of insight but also exposing the analysis to potential bias and subjective interpretations. Furthermore, no objective measures (e.g., hospital performance data, outcomes of disaster exercises) were included to triangulate the findings, which may have enhanced validity (Creswell and Plano Clark, 2017). In addition, the reliance on self-reporting allowed for the possibility of recall bias when participants reflected on prior crises. Importantly, a disconnect emerged between HCWs' perceptions and public expectations, particularly regarding communication and resource availability during crises. For example, rural populations were perceived as distrusting local hospitals and assuming urban centres were better resourced (Albahri et al., 2024). To address this, hospitals could strengthen community engagement through outreach and consistent communication, including use of social media, to counter misinformation and build public trust and confidence in hospitals. The

absence of recalled information gaps is critical for fostering stronger community relationships, thereby enhancing the capacity to work collaboratively during and after a disaster. This requires urgent and responsive action from hospitals to ensure practices reflect public needs (Pollock et al., 2020).

Another limitation is that the study measured only perceptions and did not evaluate the actual effectiveness of DRM practices. Potential confounding variables (such as hospital funding levels or recent policy changes) were not controlled for, which may have influence participants' perceptions. Nevertheless, the robustness of the findings rests in the comprehensive thematic analysis, and the inclusion of varied professional groups across multiple regions.

Future research should address these limitations to broaden the applicability of these findings within different healthcare systems such as primary care, private hospitals, and other international settings. Furthermore, researchers could use stratified sampling to ensure balanced participation of male and female HCWs, thereby enabling the identification of gender-specific priorities in perceptions of DRM (Chemali et al., 2022). Comparative research conducted across different cultural and economic context would further illuminate the influence of cultural values and resource availability on DRM (Few et al., 2015; Oishi and Komiya, 2017; Mhlongo et al., 2024). Studies conducted in Western healthcare systems may also aid in identifying universal versus context specific factors.

Methodologically, mixed-methods designs incorporating both qualitative and quantitative data (e.g., hospital preparedness scores, training competition rates) could provide a richer understanding of DRM perceptions. Longitudinal studies would allow researchers to monitor HCWs' perceptions over time and assess how incremental DRM interventions shape both perceptions and behaviours (Creswell and Plano Clark, 2017). Exploring specific facets of DRM and digital technologies, including artificial intelligence for crisis communication and data management, represents another opportunity for positive change (Albahri et al., 22024; Min, 2019).

From a practical perspective, hospital administrators should invest in regular training programmes, simulation exercises, and supply-chain resilience to enhance HCWs' preparedness. Policymakers should prioritise resource equity, including partnerships with the private sector to improve rural facilities (Gillani et al., 2021) Psychosocial services should be established in all hospitals, tailored to regional needs, to strengthen HCWs' resilience (Pollock et al., 2020). Taken together, these recommendations in this study are intended to develop the knowledge and practice by situating the study's limitations as opportunities for further inquiry. Addressing these gaps will improve understanding of DRM in Saudi Arabia and support the development of more resilient healthcare systems globally.

3.5 Conclusion

This study has examined the multiple factors influencing HCWs' perceptions of DRM capability within Saudi Arabian public hospitals and healthcare systems in general. Organisational culture, individual experiences, and geographical disparities emerged as key determinants shaping how DRM is perceived and enacted. While protocols and resources remain essential, leadership, individual resilience, and contextual geographical factors were equally critical in determining DRM effectiveness.

Organisational culture was shown to be central with leadership influencing HCWs' confidence in responding to crises. Effective leaders communicated clearly, supported staff and prioritised training, all of which fostered trust and preparedness. Conversely, inadequate communication and reliance on outdated systems undermined staff perceptions of DRM capacity. At the individual level, prior crisis exposure, access to psychological support, and recognition of personal resilience shaped readiness, although clear inconsistencies in mental health support highlighted an ongoing weakness. Geographical disparities revealed contrasting risks and resource allocation between urban and rural areas, as well as event-specific challenges, such as managing Hajj-related surges or industrial incidents.

The thematic analysis generated four over-arching themes: organisational culture, personal experience, geographical disparities, and region-specific strategies. These findings highlight the need for DRM strategies that are both contextually responsive and citizen-informed. HCWs recommended improvements to workforce coordination, communication infrastructure, and training provisions as key steps to enhance resilience in hospitals.

Limitations included the study's focus on public hospitals, uneven gender representation and the reliance on qualitative perceptions rather than objective measures. Nevertheless, the use of semi-structured interviews provided rich, nuanced insights that contribute significantly to understanding how HCWs perceive DRM in Saudi Arabia.

Overall, this research advances the discourse on healthcare system resilience by demonstrating that HCWs' perceptions are a critical component of DRM effectiveness. The findings call for hospital administrators and policymakers to embrace inclusive leadership, ensure equitable distribution of resources, expand access to psychosocial and mental health support, and embed ongoing training for all stakeholders. An intersectional approach that values HCWs' perspectives can foster evidence-based frameworks for DRM that uphold safety for frontline service delivery, accountability and rapid responsiveness. By addressing these interrelated influences, Saudi healthcare systems can strengthen resilience and sustainability in navigating the complex demands of future crises.

Reflection on Chapters Two and Three and Overview of Chapter Four

Chapter Two presented a comprehensive evaluation of HCWs' perceptions of DRM approaches in Saudi Arabian public hospitals, structured around the four DRM stages: mitigation, preparedness, response, and recovery. The study revealed a generally moderate view of overall effectiveness across four regions. While confidence in hospital infrastructure and mitigation measures was evident, concerns centred on gaps in preparedness training and limited financial and organisational support for disaster readiness. Leadership emerged as a crucial factor shaping perceptions of preparedness and recovery, reflecting the influence of hierarchical workplace cultures. Regional disparities were also apparent, with Central and Eastern hospitals perceived as better resourced than those in the South, while hospitals in the West faced unique pressures associated with mass gatherings such as Hajj. These findings underline the importance of strengthening leadership, ensuring equitable distribution of resources, and addressing region-specific challenges in order to enhance hospital resilience in line with Saudi Arabia's Vision 2030.

Chapter Three examined factors impacting HCWs' perceived efficacy of DRM through a qualitative approach using thematic analysis. Semi-structured interviews with HCWs across four regions of Saudi Arabia identified four key themes: organisational culture (e.g., leadership and communication), personal experiences (e.g., exposure to crises), geographical limitations (e.g., rural-urban access to resources), and region-specific improvement strategies (e.g., workforce coordination and training). These themes highlighted institutional, experiential, and contextual influences on HCWs' engagement with DRM and identified barriers such as ineffective communication, insufficient resources and limited decision-making authority. Organisational culture, particularly leadership and coordination, directly influenced HCWs' confidence, while personal experience and supportive environments enhanced perceived

efficacy. Geographical differences underscored disparities between urban and rural settings, with resource limitations particularly evident in regions such as Asir.

The qualitative insights of differing HCW groups, particularly from non-clinical staff, provided a more nuanced understanding of institutional and contextual variables, informing practical strategies to improve DRM in Saudi public hospitals. While the small sample size (N = 24) and exclusion of the Northern region limited representation, the findings offer an important foundation for targeted interventions and policy enhancements consistent with Vision 2030.

Chapter Four shifts the focus from the perspectives of HCWs to public trust in DRM processes. It explores how public trust in Saudi public hospitals is influenced by perceived preparedness, public awareness, communication effectiveness, and overall satisfaction. By focusing on public trust, this important study addresses a significant gap in the DRM literature, highlighting that effective DRM requires community trust and a sense of collective benefit to ensure compliance with emergency protocols and health-seeking behaviours during times of crisis. This compliments the healthcare provider perceptions examined in Chapters Two and Three because it adds to the narrative of disaster risk practices in Saudi public hospitals from the perspective of the public. Public perceptions are important because they influence trust, cooperation, and willingness to follow hospital guidance, all of which directly affect the effectiveness of DRM strategies. This quantitative study collected data from a stratified random sample of 436 public respondents across four regions, using descriptive statistics, correlation, multiple regression and moderation analyses. Moderation analyses examined variables such as region, gender, age, and presence of any long-term health conditions to identify understanding differential impacts on trust.

The chapter begins with an introduction that provides essential context for understanding public trust in Saudi healthcare system. This is followed by a detailed methodology, outlining the study setting, participant selection, and data analysis techniques, including sampling from public respondents. The results quantify the relationships between key drivers and trust, while

moderation analyses examine how demographic and contextual factors influence these relationships. The discussion integrates the findings, highlighting implications for practice and policy, with a particular focus on enhancing public engagement, communication strategies, and trust in hospitals.

Chapter Four complements the HCW-focused narratives in Chapters Two and Three because, together, the three chapters provide a comprehensive empirical examination of DRM processes and their effectiveness from the perspective of both providers and users. The quantitative design and focus on moderation effects provide a more holistic understanding of how trust develops, which is essential for policymakers aiming to enhance community resilience and trust in Saudi Arabia's healthcare system.

Chapter 4 What Drives Public Trust in Hospital DRM? Evidence from Saudi Arabia

Abstract

Public trust is critical for effective disaster response, as it supports public cooperation with emergency measures, collaboration with health authorities, and confidence in hospital decision-making. To address this knowledge gap, this study investigated trust in Saudi Arabian public hospitals' DRM practices, focusing on how trust is affected by four key variables: (i) public perception of hospital preparedness, (ii) awareness of hospital preparedness measures, (iii) effectiveness of hospital communication, and (iv) the satisfaction in hospitals' DRM practices. A cross-sectional survey of 436 adult residents across four regions in Saudi Arabia used a structured questionnaire. Descriptive statistics, correlation, multiple regression, and moderation analyses were employed to explore demographic and experiential differences.

Findings indicated that all four variables were positively associated with trust, with hospital preparedness and satisfaction emerging as the most significant predictors, with satisfaction proving strongest. Moderation analysis showed that gender and age strengthened the relationship between trust and both perceived preparedness and satisfaction – particularly for women and older participants. Trust in communication and satisfaction was higher among those without long-term health conditions. Exploratory analysis showed that past hospital performance generated greater trust that expectations of future preparedness.

Overall, the findings suggest that trust in hospital DRM depends not only on communication, but also on perceived performance and the fulfilment of public expectations. Satisfaction and visible preparedness (e.g., drills and infrastructure) are especially important for building trust among vulnerable group such as women, older adults, and those with chronic health conditions. The study provides actionable insights to strengthen DRM policy in Saudi public hospitals. Policies are likely to be more effective if aligned with community needs and supported by improved communication and visible preparedness. The study also advances disaster resilience research by deepening understanding of how public trust is formed within the Saudi healthcare context.

4.1 Introduction

This chapter addresses public trust of hospital disaster risk management (DRM) within the Saudi Arabian public healthcare system. It builds on the healthcare worker (HCW) focused analyses presented in Chapters Two and Three, extending the investigation to include public perspectives, in order to gain a more comprehensive understanding of stakeholder perceptions.

Specifically, this chapter provides an understanding of how public trust is shaped by perceptions of hospital preparedness, knowledge of DRM, the perceived effectiveness of communication, and satisfaction with healthcare services. Trust is further examined in relation to the moderating influences of region, gender, age, and the presence of long-term health conditions. The chapter is organised as follows: section 4.1 provides an overview of public trust within the Saudi healthcare system and presents the research questions. Section 4.2 (Methods) outlines the study design, including the setting, participant selection, questionnaire design, and presents an overview of the data analysis techniques. Section 4.3 (Results) presents the descriptive statistics, correlations, regression models, and moderation analyses. Section 4.4 (Discussion) presents the main findings, implications for policy and practice, study limitations, and directions for future research; and section 4.5 (Conclusions) summarises the key insights and offers recommendations for enhancing public trust and community resilience.

4.1.1 Overview

The growing frequency and intensity of both natural and human-made disasters continue to challenge healthcare systems worldwide, both in terms of their operational capacity and resources. While hospitals must maintain resilient infrastructure, they must also build public confidence in their ability, competence, and overall disaster management capability (UN Office for Disaster Risk Reduction [UNDRR], 2015). Although preparedness within the context of DRM at the institutional level is important, the literature highlights that public trust and community participation – particularly during preparedness planning, emergency exercises and risk communication – are equally central to building true preparedness (Paton, 2008; UNDRR, 2015).

Public trust in hospital DRM is underpinned by expectations that hospitals are capable of preparing for, responding to, and recovering from disasters. This trust rests on public confidence in hospital resources and staff preparedness training (World Health Organisation, 2019). Trust is also shaped by the public's perception of hospitals' ability to manage crises in a coordinated manner, including timely and accurate communication, patient triaged during acute events, and collaboration with emergency services (Kruk et al., 2015). The recovery phase is just as vital: the capacity of hospitals to restore full operations demonstrates resilience and sustains long-term public trust (Paton and Johnston, 2017).

Theoretical models of risk perception support this understanding. Public trust correlates with evaluative beliefs about institutional capacity and perceived competence in managing risks (Slovic, 1987; Paton, 2008). Empirical studies support this claim, showing that behaviours such as transparent planning, coordinated delivery of emergency services, and openness in sharing information strengthen public trust in hospital DRM (Labrague et al., 2021; Bonfanti et al., 2023).

Trust in hospital DRM has tangible benefits. Communities with higher trust levels are more likely to follow emergency protocols, seek care at hospitals during crises, and collaborate with relevant authorities. These behaviours lead to reduced injury and death, speedier recovery, and stronger community resilience (Wachinger et al. 2013). Furthermore, proactive public engagement – such as making personal emergency plans and participating in community disaster simulations – contributes to disaster risk reduction (Shaw et al., 2016). Public compliance with evacuation orders and adherence to safety protocols during emergencies also enhances hospitals' capacity to respond effectively (Cutter et al., 2008; Twigg, 2009).

On the other hand, when trust is eroded – due to institutional unpreparedness, inconsistent messages around risk, or exclusion of communities from DRM processes – resistance, confusion, and reduce collaboration occur during emergencies (Bonfanti et al., 2024). These behaviours exacerbate community vulnerability (Abbas and Miller, 2025). In high-risk contexts, hospitals' ability to meet public expectations and incorporate community perceptions is

therefore essential. Public engagement not only enhances trust, but also improves the efficiency and legitimacy of emergency response (Shah et al.,2023; Gendeshmin et al.,2025). This is consistent with the Sendai Framework for Disaster Risk Reduction (2015-2030), which advocates for local participation, transparency, and empowerment as pathways to resilience (UNDRR, 2015).

This shift away from rigid, top-down DRM approaches recognises that public perceptions of hospital preparedness, communication, and responsiveness are not merely contributors to, but ongoing influences on trust, cooperation, and disaster response performance (Nkombi and Wentink, 2022).This is particularly important in health care contexts, where rapid, coordinated action can mean the difference between life and death. Understanding public perceptions ensures collaborative and responsive hospital DRM approaches that address community needs, expectations, and capacity (Sheehan et al.,2021). Public participation and engagement are, therefore, crucial for reducing preparedness gaps, building communication systems, and promoting risk-reducing behaviours within communities.

These considerations are particularly critical in settings characterised by increasing cultural and social diversity and frequent exposure to disasters, such as i) countries experiencing rapid urbanisation, ii) cross border threats that often worsen disaster effects, and iii) countries plagued with regular natural hazards (Alshehri et al.,2015). In such contexts, public hospitals remain central to emergency response systems, but their effectiveness ultimately depends on how prepared, communicative, and trustworthy they are perceived to be by the community they serve (Braun et al.,2006; Lal et al.,2022). Examining public perceptions of hospital DRM thus offers an opportunity to identify weaknesses, validate evidence-based policies, and build collaborative relationships grounded in trust (Bajow and Alkhalil, 2014).

The analysis of public perceptions highlights that trust plays a critical role in disaster-related behaviours, including compliance with evacuation orders and willingness to use hospital services. At the same time, barriers such as misinformation, mixed messages or limited public

understanding of hospital capabilities can undermine the trust (Waddell et al.,2021; Berardi et al.,2024). Addressing these dynamics is critical to fostering robust, inclusive, and adaptable health systems capable of navigating the growing challenges posed by disasters.

4.1.2 Public Perception of Hospital Preparedness and Its Influence on Trust

Public perceptions of hospital preparedness refer to individual's subjective beliefs about a hospital's ability to respond to disasters, including perceptions related to resource capacity, staff training, operational protocols, and infrastructure resilience (Wang et al., 2022). These perceptions are crucial in building trust in health institutions, particularly during disasters when uncertainty and risk are heightened (Paton, 2008). When the public perceives hospitals as capable, well-organised, and sufficiently resourced to respond to emergencies, they are more likely to comply with protocols, collaborate with authorities, and support institutional disaster response efforts (Paton, 2008; Wachinger et al., 2013).

For example, a 2022 study in China during the COVID-19 pandemic found that public perceptions of hospital preparedness – reflected in observable indicators such as resource stockpiling and staff training – enhanced trust and increased compliance with health measures (Huang et al., 2025). Similarly, Gliadkovskaya (2022) reported that in the United States, 84% of respondents who believed hospitals were adequately prepared to deliver event-specific vaccinations expressed high trust in the hospitals' ability to manage crises. Conversely, perceptions of inadequate preparedness, often evidenced by resource inadequacies, lack of staffing training, or unclear communication or plans, reduce public trust in health institutions and hinder compliance and cooperation during disasters (e.g., Bonfanti et al., 2024; Fornalé, 2023).

Filip et al. (2022) examined hospital structural safety during the late-2020 and early-2021 waves of COVID-19 and found that visible structural investments (e.g. expanding intensive care capacity and improving air circulation) restored public trust and mitigated panic. Consequently,

perceived hospital preparedness is a key contributor to public trust, cooperation and reduced uncertainty during a crisis (Bonfanti et al., 2024; Fornalé, 2023).

Negative public perceptions of hospital preparedness, such as perceived insufficient resources or unreliable messaging, erodes trust and limits response capacity during a crisis (Costa-Font et al., 2023; İzmir et al., 2025; Larson et al., 2024). In the UK, Williams et al. (2021) identified systemic failures, including inadequate healthcare infrastructure and government policy measures during COVID-19, which undermined public trust and adherence to public health measures. Similarly, Brooks et al. (2021) also found that perceptions of resource insufficiency in the National Health Service (NHS), particularly regarding personal protective equipment (PPE) and critical care capacity, reduced compliance with quarantine measures. However, these studies were qualitative and cross-sectional, limiting data causal inferences and generalisability due to the small sample sizes potential media amplification of perceived hospital shortcomings (Khosravi, 2020).

Addressing negative public perceptions requires targeted communication and visible resource allocation to build trust and compliance during emergencies (Han et al., 2021; Vinck et al., 2019). In regions exposed to recurring natural hazards or rapid urbanisation, the link between hospital preparedness and public trust remains unexplored (Alshehri et al., 2015; AlQahtany & Abubakar, 2020; Sheehan, 2024). The evidence also suggests that socio-cultural differences, such as high community expectations for government oversight of healthcare, affect individual's levels of confidence and trust in public governing institutions (Alshehri et al., 2015; Appleby-Arnold et al., 2021; Ocloo et al., 2021). Perceived inefficiencies in resource allocation or training programmes, particularly in less urbanised regions, can quickly undermine public confidence and compliance (Murphy et al., 2025; İzmir et al., 2025).

Given the increased frequency of climate-induced disasters and the global emphasis on resilient health systems, it is imperative to investigate how public perceptions of hospital preparedness shape trust to improve disaster resilience (UNDRR, 2015; AlDulijand et al., 2023).

Research of this kind could support targeted interventions that foster community-healthcare partnerships, aligning with people-centred approaches to disaster resilience, as promoted in the Sendai Framework (UNDRR, 2015).

Drawing on findings from the extant literature, the following hypothesis is proposed:

Hypothesis 1 (H1): Higher public perceptions of hospital disaster preparedness are associated with higher levels of trust in public hospitals' ability to manage disasters.

4.1.3 Public Knowledge of Disaster Preparedness and Trust in Hospital DRM

Public knowledge of disaster preparedness strategies is a key factor in shaping trust in healthcare systems (Bonfanti et al., 2023). Perceived knowledge refers to an individual's subjective understanding of disaster planning, including hospital protocols, available resources, and response strategies, often communicated through campaigns or news sources (Löfstedt, 2020). Higher levels of public knowledge and understanding promote trust, particularly when accompanied by transparent practices.

For example, a study in South Korea following the COVID-19 pandemic found that public knowledge of hospital infection control measures ultimately increased trust in hospitals and reduced anxiety related to the Delta variant (Kim et al., 2020). Public awareness campaigns that communicate hospital preparedness measures have been shown to contribute to elevated levels of trust in healthcare systems (Vaughan and Tinker, 2009; Gesser-Edelsburg et al., 2014). For example, visible preparedness activities such as publicised drills and transparent resource allocation can enhance public confidence in hospitals' disaster management capabilities (Wray et al., 2006). The review also noted that the evidence from low Human Development Index (HDI) countries was limited. For example, countries with weaker social or healthcare infrastructure and lower literacy rates may face challenges in effectively disseminating preparedness information. Consequently. the review may over-represent the findings from higher HDI countries, where communication channels are more accessible and reliable. This represents a bias, as the capacity of awareness campaigns in low-HDI areas has not been adequately

explored, limiting the scope of initiatives, public knowledge and the generalisability of the findings.

Evidence from Indonesia further supports the importance of public knowledge in fostering trust. Post-tsunami preparedness studies demonstrated that awareness of a hospital's evacuation plans within whole community DRM processes increased trust in local healthcare institutions and encouraged reliance on these services during emergencies (Rasyif et al., 2020; Ayuningtyas et al., 2021; Benazir et al., 2023). Effective public knowledge dissemination, therefore, is essential for building trust in hospital's disaster preparedness capabilities.

Conversely, low levels of public knowledge correspond with reduced trust levels and heightened uncertainty. Following Cyclone Amphan, a study conducted in India in 2022 showed that limited public awareness of hospital DRM contributed to distrust and reluctance to seek care (Banerjee et al., 2022). Similarly, Ayuningtyas et al. (2021) found a clear correlation between limited awareness of hospital evacuation protocols following the post-tsunami preparedness campaigns in Indonesia with reduced levels of public trust. Thus, these findings indicate that simply possessing knowledge of hospital protocols is insufficient to build trust; rather, this knowledge must be effectively communicated and understood in ways that reduce mistrust and confusion during emergencies.

Research in regions prone to recurring natural hazards, such as floods, and with diverse social and environmental contexts, has found that public knowledge of hospital DRM remains inconsistent or underdeveloped. Alruwaili et al. (2023) found that less than half of the surveyed population in these contexts understood local hospital disaster protocols, leading to confusion during emergencies and a reduced likelihood of compliance with hospital guidance. Similarly, Alshehri et al. (2016) and Al-Thobaity et al. (2019) identified that levels of knowledge of first-response practices and protocols related to evacuation were low across all communities served, but particularly in rural and other under-served regions, where access to accurate information may be impeded by logistical and economic barriers. Both of these studies highlight

that improving public knowledge in these areas is critical to building trust and supporting people-centred approaches to DRM, as emphasised in the Sendai Framework (UNDRR, 2015).

In light of the evidence from the existing literature, the following hypothesis is proposed:

H2: Greater public knowledge of hospital disaster preparedness measures is positively associated with higher levels of trust in public hospitals' ability to manage disasters.

4.1.4 Perceived Effectiveness of Hospital Communication and Public Trust

Perceived effectiveness of communication related to hospitals disaster preparedness plans is an important component of public trust (Paton, 2008). Clear and transparent communication reassures communities about hospitals' capabilities, increases trust, and helps clarify required actions during crises (Covello, 2021; Wachinger et al., 2013). For example, public health authorities in Australia and Canada have highlighted the role of hospital-led communication during wildfires. The Canadian Wildfire Toolkit, also applied in Australian, notes that trust can be enhanced and misinformation reduced through mixed media alerts, webinars, and community workshops (Vien et al., 2024). Similarly, risk communication evaluations in the Netherlands following severe pluvial floods emphasised the importance of clear, specific actionable messages, such as evacuation routes or flood-risk maps, for public confidence (Schmitt and Scheid, 2018). In the United States, transparent communication via social media and trusted institutions during wildfire events increased public trust in preparedness (Sandoval, Bui and Hopfer, 2025). In addition, During Typhoon Vamco in the Philippines in 2020, clear communication from hospitals regarding shelter plans and safety procedures increased public trust during recovery (OCHA, 2020). Overall, these studies suggest that systematic, transparent, and actionable communication is essential to enhance public trust in hospital disaster preparedness.

However, if information is poorly communicated to start with, it undermines trust, which may cause confusion, and reduced engagement with health services (Tiwary et al., 2019; Souvatzi et al., 2024). In India, inconsistent hospital communication regarding COVID 19 bed availability

and safety measures increased rumours and reduced healthcare utilisation during the Delta wave (Souvatzi et al., 2024). Similarly, post-flood analysis in Australia showed that vague evacuation messaging contributed to reduced levels of trust and missed opportunities to access to care (Australian Institute for Disaster Resilience, 2019). Conversely, a notable distinction between hospitals that shared generic social media posts and those who provided timely, organised and clear messages, with the latter resulting in increased public confidence (Marx et al., 2020).

Communication challenges are particularly pronounced in multicultural areas with linguistic diversity and varying levels of digital literacy. Globally, inconsistent hospital messaging during epidemics has led to distrust, confusion and decreased compliance, particularly in linguistically diverse populations (Bauder et al, 2023). During the MERS outbreak, Arabic-speaking communities reported unclear, delayed, and culturally insensitive communications, which reduced trust and adherence to safety measures. Contributing factors included language barriers, lack of recognition of culturally meaningful patient needs, and differences in tone, all of which reduced trust, particularly during public health crises (Al Shamsi et al., 2020; Sharkiya et al., 2023). Effective use of digital channels such as Twitter, WhatsApp, and government applications can help address these challenges and strengthen hospital–public engagement (Walsh et al., 2021; Tan et al., 2022). In Saudi Arabia, however, uncertain and outdated evacuation recommendations during the 2009 Jeddah floods contributed to confusion and distrust in local hospitals (Abosuliman et al., 2013). This highlights that disaster communication requires more than information delivery; it must be timely, culturally relevant, clear, and engaging.

In light of the reviews evidence, the following hypothesis is proposed:

H3: Effective hospital communication about their disaster preparedness plans is positively correlated with public trust in hospitals' ability to manage disasters.

4.1.5 Perceived Satisfaction with Hospital DRM and its Impact on Trust

Public trust is strongly affected by perceived satisfaction with hospital DRM practices (Paton, 2008). Perceived satisfaction reflects the degree of approval or disapproval regarding preparedness, response efficiency, and recovery efforts, often based on direct experiences or by observing the experiences of others (Mata et al., 2023). High levels of perceived satisfaction reinforce trust by signalling competency (Slovic, 2010). For example, Wang et al. (2022), in their study of the 2021 Henan floods, found that public satisfaction with hospitals' rapid mobilisation significantly contributed to trust. Akbasli and Serin (2024) reported that communities' trust in hospitals' disaster response after the Southern Turkey earthquakes of 6 February 2023 increased with effective triage systems, particularly when supported by digital tools. Aqtam et al. (2024) also found a strong association between trust and satisfaction with hospital practices in managing major disasters, such as surge capacity and evacuation protocols during COVID-19 in Palestine. However, studies in single disaster contexts limit the generalisability of these findings. In Chile, Arrizaga et al. (2023) observed that public satisfaction with hospital DRM practices following the 2021 wildfires contributed to a public perception of trust and facilitated recovery. Collectively, this evidence highlights that perceived satisfaction with hospital DRM is essential for building and maintaining public trust during disasters.

Conversely, dissatisfaction can also erode trust, discouraging communities from seeking care when needed (Wachinger et al., 2013). For example, Iqbal (2022) found that dissatisfaction with hospitals' slow response to monsoon floods in Pakistan undermined trust in hospital competence, leading many to bypass formal care. Ali et al. (2023) similarly reported that poor disaster management practices in Punjab led communities to seek alternative providers. A World Bank assessment (World Bank et al., 2022) found that inconsistent or unreliable delivery of healthcare during floods diminished public trust in formal health systems, particularly in rural areas. Clearly, while satisfaction fosters trust in hospital DRM, dissatisfaction has the opposite effect, exacerbating disengagement and mistrust.

In Saudi Arabia, satisfaction with hospital DRM is a particularly important determinant of public trust, given the country's distinct socio-cultural context. The Saudi healthcare system is shaped by rapid urbanisation, regional disparities, and disaster risks linked to climate change, including flooding (Alshehri et al., 2015). Existing evidence suggests that satisfaction is often undermined by inefficiencies in response or resource allocation, disproportionately impacting rural areas (Alruwaili et al., 2023). However, most studies are geographically limited and focus on a single disaster type, leaving little understanding of how satisfaction influences trust across different healthcare settings and hazard contexts in Saudi Arabia. Addressing this knowledge gap is critical to designing interventions that strengthen resilience and improve hospital DRM effectiveness (Alruwaili et al., 2023; Alshehri et al., 2015).

In light of the evidence from the existing literature, the following hypothesis is proposed:

H4: Higher satisfaction with hospital disaster management practices is positively associated with greater trust in Saudi public hospitals' ability to manage disasters.

4.2 Methods

4.2.1 Study Setting

The data were collected across four distinct regions of Saudi Arabia (Southern, Eastern, Central, and Western) selected to maintain consistency with the original four-region framework established in previous healthcare provider studies (Alshehri et al, 2023; Alshehri et al., 2024) and to maximise the representativeness of the national population. Data collection was conducted in phases: the Southern region (15-31 December 2024), the Eastern region (1-15 January 2025), the Central region (16-31 January 2025), and finally the Western region (1-28 February 2025).

4.2.2 Participants

This study investigated perceptions of hospital DRM among residents of Saudi Arabia (citizens and non-citizens) aged 18 years and above. To maximise variation and representativeness, a

purposive sampling strategy was used to secure proportional representation across age cohorts (18-65+ years), gender (male and female), and the four regions. Sample quotas were implemented to ensure balanced representation (Palinkas et al., 2015). A deliberate strategy was also adopted to capture regional differences across Saudi Arabia's four geographic regions (Southern, Western, Eastern, and Central). In total, 436 participants were recruited from 445 individuals approached (98% response rate): Southern (n = 108), Western (n = 100), Eastern (n = 100), and Central (n = 128). This sample size was sufficient to support the planned statistical analysis (Vasileiou et al., 2018).

Participants were approached using face-to-face recruitment in public spaces (e.g., coffee shops, shopping malls, or busy main streets), supplemented by local engagement strategies to enhance diversity. Prior to engagement, verbal consent was obtained from the relevant business owner or manager, and all procedures adhered to ethical standards for responsible research (Creswell and Poth, 2018). Participants were offered two options for completing the survey: (1) directly on an iPad provided on location, or (2) independently via a survey link shared via AirDrop, allowing completion at their convenience. When participants used the iPad, a respectful physical distance was maintained to safeguard privacy and minimise researcher influence, thereby reducing the risk of response bias (Kaiser, 2009).

Additionally, snowball sampling was employed as a supplementary method to extend reach and include harder-to-access groups (e.g., rural residents or those with limited access to public spaces). Participants were encouraged to share the survey link with family, friends and acquaintances to complement purposive sampling efforts (Bryman, 2016). To ensure sample representativeness and mitigate the risk of network homogeneity inherent in snowball sampling, several quality control measures were implemented: demographic monitoring was conducted throughout data collection to track participant distribution across age, gender, and region; recruitment efforts were adjusted in real-time when imbalances emerged; and predetermined quotas were strictly maintained to prevent over-representation of any demographic group (Biernacki and Waldorf, 1981). These measures ensured that snowball recruitment did not

compromise the overall representativeness of the sample. This approach successfully enhanced sample diversity, offering opportunities for participation without direct researcher presence. Collectively, the purposive and snowball sampling methods yielded a relatively large and diverse sample, enabling analysis of patterns of perceptions among adult residents of Saudi Arabia.

It is acknowledged that a proportion of participants identified as HCWs. HCWs were not the target population for this study, as the research aimed to capture general public perceptions of hospital disaster risk management rather than professional insider perspectives. However, HCWs were not excluded from participation, as occupational screening was not part of the eligibility criteria, and their exclusion would have introduced selection bias. HCWs hold personal perceptions as community members and potential service users that are conceptually distinct from their professional expertise (Baernholdt et al., 2012; Laverack and Manoncourt, 2016). To ensure robustness and transparency, an additional analysis was conducted excluding HCW respondents to examine whether their inclusion influenced the overall findings.

4.2.3 Materials

To obtain public perceptions of hospital DRM, a structured questionnaire was developed and administered using the Qualtrics platform (for the full questionnaire, see Appendix D on p.257). The questionnaire included a variety of items concerning public attitudes, disaster-related experiences, and demographic characteristics, it was organised into three main sections.

Section 1: Public Perceptions of DRM in Saudi Hospitals

A structured set of items was developed to examine five key variables, each measured using five items on a five-point Likert scale ranging from 1 ("strongly disagreed") to 5 ("strongly agreed"). The variables of interest were informed by established frameworks for public perceptions of disaster preparedness (Slovic, 1987; Paton, 2008):

- Perceived Hospital Disaster Preparedness (e.g. the perceived ability to manage surges in patient demand; adequacy of resources and equipment).
- Perceived Knowledge of Hospital Disaster Preparedness Measures (e.g. awareness of hospital plans; availability of emergency information).
- Perceived Efficacy of Hospital Communication of Disaster Preparedness (e.g. clarity, timeliness, and accessibility).
- Perceived Satisfaction with Hospital DRM Practices (e.g. satisfaction with hospital preparedness; satisfaction with expectations being met).
- Perceived Trust in the Hospital's ability to Manage Disaster Situations (e.g. perceived reliability in crises; confidence in preparedness).

Section 2: Disaster Experience Profile in Saudi Arabia

This section gathered information on participants' direct or indirect experiences with disasters, frequency of hospital visits, presence of long-term health conditions, and perceptions of community vulnerability. These items provided contextual data on participants' exposure to disaster-related events, and their experiences with healthcare systems (Phuong et al., 2021).

Section 3: Sociodemographic Information

This section gathered data on participants' region of residence, age, gender, level of education, and occupation. These variables were intended to provide an overview of the sample's diversity for subsequent demographic analysis (Saunders et al., 2015).

The questionnaire was made available in both English and Arabic to accommodate Saudi Arabia's linguistically diverse population. A rigorous back-translation procedures was employed to ensure linguistic and conceptual equivalence (Brislin, 1970; Temple and Young, 2004). Two certified Saudi translators independently carried out the forward translation (English to Arabic) and backward translation (Arabic to English). Discrepancies were resolved through consensus, ensuring both accuracy and cultural relativity.

4.2.4 Validity and Reliability

A pilot study was carried out prior to the main data collection to examine the clarity and reliability of the survey instrument designed to explore public perceptions of hospital DRM. The primary purpose of this pilot was to identify ambiguities in the survey items and address them enhance validity and ensure appropriateness for the target population.

During the pilot, two items in Section 1 were identified as potentially problematic because they were negatively worded and contained double negatives, making them difficult for respondents to interpret:

- *" I believe hospitals in my region could struggle to handle the large number of patients during major disasters "*
- *"I am concerned about the ability of hospitals in my region to respond to sudden disaster events".*

To address this issue, the items were retained in their original negatively worded form but reverse coded during analysis to align with the positive direction of the overall scale. Specifically, while the respondents answered using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), the coding for these two items was reversed (i.e., 5 = strongly disagree and 1 = strongly agree). This adjustment reduced ambiguity for participants and ensure consistency in the scale's construction and reliability analysis (DeVellis, 2017).

Reliability analysis was then carried out using Cronbach's alpha, a widely accepted measure of internal consistency (Bland and Altman, 1997). Data from the main study were used to evaluate the psychometric properties of the instrument. The results were as follows:

- Public Perception of Hospital Disaster Preparedness: α = .712 (acceptable)
- Public Awareness of Hospital Disaster Preparedness Measures: α = .773 (acceptable)
- Effectiveness of Hospital Communication About Disaster Preparedness, α = .908 (excellent)
- Public Satisfaction with Hospital DRM Practices: α = .930 (excellent)

- Trust in Hospital Ability to Handle Disasters: α = .904 (excellent)

All values exceeded the recommended threshold of .70, indicating good to excellent internal consistency across the five constructs. These findings indicate that the survey instrument is both reliable and appropriate for measuring public perceptions and trust in the context of hospital disaster preparedness (Nunnally and Bernstein, 1994).

Construct validity was assessed using exploratory factor analysis (EFA) with principal axis factoring and Promax rotation. The KMO value (.96) and a significant Bartlett's test of sphericity ($\chi^2(300) = 9{,}122.57$, $p < .001$) confirmed the suitability of the data for factor analysis (see Table 4-1). The results confirmed that the questionnaire items aligned well with the five theoretically established constructs representing public perceptions of hospital DRM. All items demonstrated strong factor loadings (all > .40) and satisfactory communalities (all > .50), indicating adequate representation of the underlying constructs (see

Table 4-2).

Convergent validity was further examined using the Average Variance Extracted (AVE). The AVE values exceeded the recommended threshold of .50 for all constructs, indicating adequate convergent validity: Public Perception of Hospital Disaster Preparedness = .548, Public Awareness of Hospital Disaster Preparedness Measures = .575, Effectiveness of Hospital Communication About Disaster Preparedness = .711, Public Satisfaction with Hospital DRM Practices = .770, and Trust in Hospital Ability to Handle Disasters = .704. Composite reliability (CR) values were also high across all five constructs (.877, .889, .925, .943, and .922, respectively), exceeding the recommended minimum of .70 and demonstrating strong internal consistency.

Discriminant validity was examined by comparing the square root of the AVE values with inter-construct correlations (Fornell & Larcker, 1981) (see

Table 4-3). The correlation analysis revealed moderate to strong and statistically significant associations between the five constructs. While this indicates shared variance among the constructs, it also reflects the conceptually interconnected nature of public perception domains in the context of hospital disaster preparedness. The constructs demonstrate

adequate convergent validity and reliability while maintaining sufficient distinctiveness to be interpreted as related but separate dimensions of public trust and perception in hospital DRM.

Table 4-1 Kaiser–Meyer–Olkin Measure and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.961
Bartlett's Test of Sphericity	Approx. Chi-Square	9122.565
	df	300
	Sig.	<.001

Table 4-2 Exploratory Factor Analysis of Public Perceptions of Hospital DRM

Predictor Variables	Item No.	Factor Loading				Communality	
		Factor 1	Factor 2	Factor 3	Factor 4	Initial	Extraction
Perceived Hospital Disaster Preparedness	1			.766		.457	.519
	2					.626	.618
	3			.762		.512	.587
	4				.599	.215	.338
	5			.403		.683	.676
Perceived Awareness of Hospital Disaster Preparedness	1	.668				.598	.563
	2	.844				.727	.750
	3	.905				.650	.674
	4	.824				.599	.620
	5			-.403	.410	.222	.268
Perceived Effectiveness of Hospital	1	.876				.781	.763
	2	.971				.799	.796
	3	.636				.650	.593

Communication About Disaster Preparedness	4	.759		.711	.723
	5		.418	.561	.500
Perceived Satisfaction with Hospital DRM Practices	1		.504	.823	.805
	2		.690	.662	.607
	3		.761	.785	.726
	4		.751	.746	.727
	5		.971	.773	.772
Perceived Trust in the Hospital's Ability to Manage Disasters	1		.878	.800	.790
	2		.896	.793	.797
	3		.865	.734	.731
	4		.501	.396	.405
	5		.763	.688	.697

Table 4-3 Convergent and Discriminant Validity of Public Perception Constructs

Factor	AVE	√AVE	1	2	3	4
1	.685	.828	—	.725	.508	.190
2	.687	.829	.725	—	.628	.404
3	.594	.771	.508	.628	—	.258
4	.303	.550	.190	.404	.258	—

4.2.5 Procedure

Ethical Approval for this study was granted by the University of Southampton's Ethics and Research Governance Online (ERGO) Committee (Project ID: 100036). Informed consent and obtained from all participants, who were assured that participation was voluntary, and they

could withdraw at any time without consequence. Data collection was conducted between 15 December 2024 and 28 February 2025.

4.2.6 Data Analysis

In this study, data were analysed using IBM SPSS Statistics (Version 28). Both descriptive and inferential statistical techniques were applied to address the study's aims. The following subsections outline the analysis approach: Main Analysis, Exploratory Moderation Analysis, and Temporal Framing Analysis.

4.2.6.1 Main Analysis

Descriptive statistics, including means (*M*) and standard deviations (*SD*), were calculated to summarise participants' responses across the five key variables in Section 1 of the questionnaire: public perception, awareness, communication effectiveness, satisfaction, and trust. This step provided an overview of the data distribution and variability (Vetter, 2017).

To further examines the relationships among these variables – public perception of hospital preparedness, awareness of hospital preparedness, effectiveness of hospital communication, satisfaction with the DRM practices, and trust in hospital DRM of the hospital – bivariate correlation analyses were conducted. For clarity, the constructs were defined as:

- Awareness: Knowledge of hospital disaster preparedness plans, engagement with emergency action plans, awareness of available resources to support the public, and education regarding access and use of emergency measures during a disaster.
- Communication effectiveness: The clarity, consistency, and accessibility of hospital communication regarding disaster preparedness, including channels such as social media announcements, community briefings, and official notifications.
- Satisfaction: The public's evaluation of hospital disaster preparedness and response, including prior experiences and the perceived adequacy of institutional actions.

- Trust: Public confidence in hospitals' ability to manage disasters effectively, encompassing perceptions of institutional competence, reliability and crisis response.

These analyses provided insight into potential associations between the variables, laying the groundwork for subsequent inferential analyses (Alem, 2020).

4.2.6.2 Exploratory Moderation Analysis

To investigate the role of demographic and health-related factors in shaping the relationships between key predictors and public trust in hospital DRM, hierarchical moderation analyses were conducted. The moderators examined included age, gender, region, and the presence of a long-term health condition. These factors were selected based on prior evidence indicating their significance in shaping public perception, trust, and behaviour during emergency events, as well as their relevance to understanding trust formation among vulnerable populations (Paton, 2008; Slovic, 1987; Appleby-Arnold et al., 2021).

Age was considered due to its association with risk literacy and institutional trust. Older individuals may demonstrate higher levels of trust in disaster management systems due to their greater life experience and accumulated interactions with healthcare institutions, whilst younger individuals may place more value on innovative technological developments and contemporary communication channels (Paton, 2008). Gender was included as previous research has shown differences in risk perception and institutional trust during crises, with women often expressing greater concern about institutional preparedness (Slovic, 1987). Region was examined to explore whether trust formation processes differ across Saudi Arabia's four geographic regions (Southern, Western, Eastern, and Central), given known disparities in healthcare infrastructure and service delivery (Alshehri et al., 2016). Long-term health conditions were included as they are associated with increased vulnerability and a greater reliance on emergency healthcare systems, often resulting in increased scrutiny of hospitals' preparedness and heightened expectations for communication and service quality (Tomio & Sato, 2014).

To ensure methodological rigour and strengthen causal inference, hierarchical regression modelling was employed for all moderation analyses (Aiken & West, 1991; Cohen et al., 2003). This approach involves building regression models in sequential steps: Step 1 examines the main effect of the predictor alone (e.g., Trust = $\beta_0 + \beta_1$[Satisfaction] + ε), Step 2 adds the moderator variable as a main effect (e.g., Trust = $\beta_0 + \beta_1$[Satisfaction] + β_2[Age] + ε), and Step 3 includes the interaction term (e.g., Trust = $\beta_0 + \beta_1$[Satisfaction] + β_2[Age] + β_3[Satisfaction × Age] + ε) (Hayes, 2017). All continuous predictor variables were mean centred prior to creating interaction terms to reduce multicollinearity and facilitate interpretation of main effects (Aiken & West, 1991).

This gradual inclusion of variables enables researchers to (a) isolate the unique contribution of each variable whilst controlling for variables entered in previous steps, (b) assess incremental validity through changes in R^2 (ΔR^2), indicating whether newly added variables explain additional variance beyond variables already in the model, and (c) ensure that any moderation effect detected is not confounded with the main effect of the moderator variable (Aguinis et al., 2010; Darlington & Hayes, 2017). By demonstrating that interaction effects account for variance beyond main effects, this hierarchical approach reduces the likelihood that observed moderations are spurious and provides stronger evidence for the conditional nature of relationships (Cohen et al., 2003). For each moderation analysis, model fit statistics (R^2, adjusted R^2, F-statistic) were reported at each step, along with change statistics (ΔR^2, ΔF) to evaluate the incremental contribution of moderators and interaction terms.

For significant interactions, conditional effects or simple slopes analyses were conducted to examine the nature of the moderation. For continuous moderators (age), conditional effects were calculated at three values corresponding to the 16th, 50th, and 84th percentiles of the sample distribution, representing low, average, and high levels of the moderator (Hayes, 2017). For dichotomous moderators (long-term health condition), simple slopes were computed separately for each group to illustrate how the predictor-outcome relationship differs across groups.

Overall, these moderators reflect the diverse demographic and health-related factors that may influence public trust in hospital DRM, particularly among vulnerable populations, whilst also enabling examination of whether trust formation processes differ across Saudi Arabia's geographic regions.

4.2.6.3 Temporal Framing Analysis

An exploratory analysis was conducted to examine the extent to which temporal framing (past vs. future survey items) influenced public perception of hospital DRM. Drawing on construal level theory (CLT), temporal framing reflects the idea that individuals interpret events differently depending on temporal proximity. Past events are typically processed concretely, relying on particular important experiences, whereas future events are processed more abstractly, based on expectations (Trope and Liberman, 2003). For example, a past-oriented items (i.e., *"My past experience with hospitals during disasters was positive and comforting*") could prompt respondents to reflect on concrete experiences, whereas a future-oriented items (i.e., *"I have confidence that hospitals provide adequate education and resources to deliver during future disaster events"*) might elicit anticipatory beliefs about their future capacities. Temporal framing has been shown to shape institutional trust and credibility: past framing enhances concrete recall, whereas future framing enhances anticipatory confidence (Liberman and Trope, 1998; Earle and Siegrist, 2008). In health communication, present-focused messages are often more persuasive than future-oriented ones (Wang et al., 2024), while in disaster communication, participants have been found to underestimate perceived risks when framed in future terms compared to historical framing (Retchless and Ross, 2022).

In this study, survey items were categorised according to their temporal focus: six past-oriented items addressed retrospective evaluations of hospital actions and communications, while nine future-oriented items captured anticipatory beliefs about hospitals' future capabilities. Composite variables were then created by averaging the items to generate PASTSCORE and FUTURESCORE. A paired-samples t-test was performed to assess differences between

PASTSCORE and FUTURESCORE, addressing whether temporal framing influenced perceptions of hospital DRM.

This analysis (a) helps to determine the extent to which the design of the study materials could have influenced participants responses and (b) contributes to developing a theoretical lens for understanding public trust by contrasting lived experiences with anticipated expectations. The findings of this analysis serve to highlights the potential importance of tailoring institutional communication strategies and risk messaging to different temporal perspectives (Trope and Liberman, 2003).

4.3 Results

4.3.1 Descriptive Statistics

Table 4-4 presents the demographic characteristics pf the sample. The participants included 269 females (61.7%), 161 males (36.9%), and six individuals who preferred not to disclose their gender (1.4%). The mean age of the sample was 35.43 years (*SD* = 10.46).Regarding educational attainment, the majority held a bachelor's degree (n = 245, 56.2%) or master's degree or higher (n = 123, 28.2%), with smaller proportions holding a diploma (n = 26, 6.0%), high school certificate (n = 34, 7.8%), secondary school certificate (n = 6, 1.4%), or primary school education (n = 2, 0.5%). With respect to occupational status, government employees constituted the largest group (n = 159, 36.5%), followed by private sector employees (n = 92, 21.1%), unemployed individuals (n = 55, 12.6%), healthcare workers (n = 45, 10.3%), students (n = 44, 10.1%), retired individuals (n = 25, 5.7%), and self-employed participants (n = 16, 3.7%).

The high proportion of government employees reflects Saudi Arabia's public sector-dominant employment structure, where 30-40% of nationals work in government due to Saudization policies, while expatriates predominate in the private sector (General Authority for Statistics, 2022; Hertog, 2021). The overrepresentation of healthcare workers likely results from targeted

recruitment through healthcare networks, a common strategy in health behaviour research (Alyami et al., 2020; Temsah et al., 2021).

To assess the potential influence of HCW inclusion on study findings, a sensitivity analysis was conducted comparing responses with HCWs included (n = 436) versus excluded (n = 391). Table 4-5 presents public perceptions of hospital disaster risk management in Saudi Arabia for both samples, demonstrating minimal variation in mean scores and standard deviations across key constructs. This pattern suggests that the inclusion of HCWs did not substantially alter the overall findings regarding public perceptions of hospital disaster preparedness, awareness, and communication effectiveness (Thabane et al., 2013; Van Smeden et al., 2019).

Similarly, Table 4-6 presents participants' responses to survey items relating to disaster experiences for both the full sample (HCWs included n = 436) and the restricted sample (HCWs excluded, n = 391). The consistency of response patterns between the two samples further supports the robustness of the findings and confirms that HCW inclusion did not introduce meaningful bias into the assessment of disaster experience variables (McCaffrey et al., 2016; Sedgwick, 2014).

Table 4-4 Participant Characteristics

Sociodemographic		Mean	Std. Deviation	Frequency	Percent
Region	Southern	2.57	1.154	108	24.8
	Wester			100	22.9
	Eastern			100	22.9
	Central			128	29.4
Gender	Male	1.64	.507	161	36.9
	Female			269	61.7
	Prefer not to say			6	1.4

Age		35.431	10.455		
Education (highest level completed)	Primary school	5.01	.927	2	.5
	Secondary school			6	1.4
	High School			34	7.8
	Diploma			26	6
	Bachelor's degree			245	56.2
	Master's degree or higher			123	28.2
Occupation	Student	3.60	1.634	44	10.1
	Healthcare worker (e.g., nurse, doctor, hospital staff)			45	10.3
	Government employee			159	36.5
	Private sector employee			92	21.1
	Self-employed			16	3.7
	Unemployed			55	12.6
	Retired			25	5.7

Table 4-5 Public Perceptions of Hospital DRM in Saudi Arabia

Understanding Public Perceptions of DRM in Saudi Hospitals	HCWs Included		HCWs excluded	
	Mean	Std. Deviation	Mean	Std. Deviation
1. Perceived Hospital Disaster Preparedness	2.47	.84	2.47	.84
1.1. I believe hospitals in my region could struggle to handle the large number of patients during major disasters.	3.43	1.342	3.44	1.334

1.2. Hospitals in my region have sufficient resources and equipment to handle large-scale disasters.	2.21	1.122	2.20	1.108
1.3. I am concerned about the ability of hospitals in my region to respond to sudden disaster events.	3.07	1.375	3.06	1.373
1.4. The level of preparedness in hospitals reduces the risk of hospital failure during disasters.	1.55	.935	1.54	.930
1.5. I am confident in the preparedness of hospitals in my region to address potential disaster-related risks.	2.13	1.082	2.13	1.075
2. Perceived Awareness of Hospital Disaster Preparedness	2.47	.90	2.49	.90
2.1. I am well-informed about the disaster preparedness procedures at the hospitals in my region.	2.72	1.267	2.77	1.257
2.2. Hospitals in my region make sufficient efforts to keep the public informed about their disaster plans.	2.71	1.368	2.72	1.366
2.3. I have access to clear information about what hospitals will do in the event of a disaster (e.g., evacuation plans, emergency services, or available resources).	2.75	1.375	2.81	1.387
2.4. Public education and campaigns have effectively increased my knowledge about disaster preparedness at hospitals in my region.	2.61	1.332	2.64	1.336
2.5. I believe there should be more public awareness efforts about hospital disaster preparedness.	1.56	.871	1.55	.881

3. Perceived Effectiveness of Hospital Communication About Disaster Preparedness	2.51	1.09	2.52	1.09
3.1. Hospitals in my region communicate their disaster preparedness strategies clearly and regularly.	2.61	1.278	2.63	1.266
3.2. Hospitals in my region provide consistent and transparent information about their disaster preparedness plans.	2.75	1.259	2.79	1.253
3.3. Hospitals use accessible platforms (such as social media, TV, or radio) to inform the public about disaster preparedness.	2.37	1.323	2.37	1.321
3.4. Hospitals are open and clear in sharing information about how they handle disaster situations.	2.63	1.306	2.65	1.308
3.5. The communication I receive from hospitals during a disaster builds my confidence in their readiness.	2.21	1.238	2.21	1.219
4. Perceived Satisfaction with Hospital DRM Practices	2.19	1.02	2.21	1.02
4.1. I am satisfied with the level of disaster preparedness in hospitals in my region.	2.39	1.222	2.43	1.232
4.2. My past experiences with hospitals during disasters have been positive and comforting.	2.24	1.150	2.24	1.153
4.3. Hospitals in my region have demonstrated a commitment to strong disaster management practices.	2.19	1.135	2.20	1.139
4.4. Hospitals in my region have the necessary tools, equipment, and resources to manage disaster situations effectively.	2.18	1.160	2.18	1.152

4.5. I am confident that hospitals will provide adequate care and resources during future disaster events.	2.01	1.108	2.03	1.102
5. Perceived Trust in the Hospital's Ability to Manage Disasters	1.98	.91	2	.91
5.1. I trust hospitals in my region to manage disaster situations effectively and efficiently.	2.05	1.108	2.08	1.116
5.2. The hospitals in my region have earned my confidence in their ability to handle emergencies.	2.17	1.141	2.20	1.148
5.3. I believe that hospitals in my community can be relied upon during major disaster events.	2.12	1.151	2.13	1.148
5.4. My confidence in hospitals increases when I see them well-prepared for emergencies.	1.58	.892	1.58	.902
5.5. Hospitals' past performance during disaster events has strengthened my trust in their services.	2.01	1.045	2.02	1.041

Table 4-6 Participants' Disaster Experience Profile

Disaster Experience Profile	HCWs Included		HCWs excluded	
	Mean	Std. Deviation	Mean	Std. Deviation
1. On average, how many times per year have you visited a hospital, GP surgery, or drop-in clinic as a patient in the last five years? (Please enter numbers only)	6.86	5.66	6.95	5.73
2. Do you have any long-term health conditions that would make you	1.83	.38	1.82	.38

	dependent on hospitals during a disaster?				
3.	Have you personally experienced an emergency that required hospital treatment in the last 10 years?	1.52	.50	1.51	.50
4.	Has someone you know experienced an emergency that required hospital treatment in the last 10 years?	1.19	.39	1.20	.40
5.	Have you personally been directly affected by a disaster in the last 10 years?	1.66	.473	1.66	.47
6.	Has someone you know been directly affected by a disaster in the last 10 years?	1.52	.50	1.52	.50
7.	How familiar are you with disaster preparedness procedures in your community (e.g., blocking external doorways with sandbags prior to a flood, storing non-perishable food items in case of a pandemic or natural disaster, keeping a first aid kit at home)?	3.17	1.34	3.18	1.34
8.	To what extent do you believe your community is vulnerable to natural disasters (e.g., sandstorms, extreme heat, flash floods)?	3.14	1.04	3.15	1.03

Furthermore, descriptive statistics for public trust in hospital disaster risk management across regions are presented in Table 4-7. A one-way analysis of variance was conducted to examine regional differences in trust. The results indicated that the effect of region on public trust was not statistically significant, $F(3, 432) = 2.33$, $p = .074$(see Table 4-8).

Table 4-7 Descriptive Statistics of Public Trust in Hospital DRM by Region

Region	N	M	SD
Southern	108	2.14	0.92
Western	100	2.01	0.95
Eastern	100	2.01	0.99
Central	128	1.83	0.78

Table 4-8 One-Way ANOVA of Regional Differences in Public Trust

Source	Sum of Squares	df	F	p
Between groups	5.76	3	2.33	.074
Within groups	355.60	432		
Total	361.36	435		

Furthermore, Descriptive statistics for public trust in hospital disaster risk management across gender are presented in Table 4-9 . A one-way analysis of variance was conducted to examine gender differences in public trust. The results indicated that the effect of gender on public trust was not statistically significant, $F(2, 433) = 2.70$, $p = .068$ (see Table 4-10).

Table 4-9 Descriptive Statistics of Public Trust in Hospital DRM by Gender

Gender	N	M	SD
Male	161	1.90	0.89
Female	269	2.02	0.90
Prefer not to say	6	2.67	1.57

Table 4-10 One-Way ANOVA of Gender Differences in Public Trust

Source	Sum of Squares	df	F	p
Between groups	4.46	2	2.70	.068
Within groups	356.90	433		
Total	361.36	435		

Descriptive statistics for public trust in hospital disaster risk management across education levels are presented in Table 4-11. A one-way analysis of variance was conducted to examine differences in public trust by education level. The results indicated a statistically significant effect of education on public trust, $F(5, 430) = 2.96$, $p = .012$ (see Table 4-12).

Table 4-11 Descriptive Statistics of Public Trust in Hospital DRM by Education Level

Education level	N	M	SD
Elementary school	2	1.50	0.71
Middle school	6	1.73	0.64
High school	34	1.67	0.74
Diploma	26	1.98	0.81
Bachelor’s degree	245	1.92	0.89
Master’s degree or higher	123	2.22	0.98

Table 4-12 One-Way ANOVA: Public Trust by Education Level

Source	Sum of Squares	df	F	p
Between groups	12.03	5	2.96	.012
Within groups	349.33	430		
Total	361.36	435		

Descriptive statistics for public trust in hospital disaster risk management across occupational groups are presented in Table 4-13. A one-way analysis of variance was conducted to examine occupational differences in public trust. The results indicated that the effect of occupation on public trust was not statistically significant, $F(6, 429) = 1.21$, $p = .302$ (see Table 4-14).

Table 4-13 Descriptive Statistics of Public Trust in Hospital DRM by Occupation

Occupation	N	M	SD
Student	44	1.86	0.88
Healthcare worker	45	1.85	0.87
Government employee	159	2.13	0.96
Private sector employee	92	1.89	0.86
Self-employed	16	1.94	1.12
Unemployed	55	1.96	0.88
Retired	25	1.95	0.76

Table 4-14 One-Way ANOVA of Public Trust by Occupation

Source	Sum of Squares	df	F	p
Between groups	5.99	6	1.21	.302
Within groups	355.36	429		
Total	361.36	435		

4.3.2 Correlation Analysis

Tests of normality using the Shapiro–Wilk test indicated that all key variables violated the assumption of normal distribution ($p < .001$). Consequently, Spearman's rho was employed to examine the strength and direction of relationships among the study variables.

The results revealed statistically significant and positive correlations for all variables of interest. Perceived hospital disaster preparedness ($\rho = .67$, $p < .001$) was positively correlated with perceived trust, suggesting that individuals who perceive hospitals as well prepared are more likely to trust them during disasters. Similarly, perceived awareness of hospital preparedness activities ($\rho = .64$, $p < .001$) was positively associated with trust, indicating that greater awareness is linked to higher confidence in institutional responses(see Table 4-15).

Perceived effectiveness of hospital communication also demonstrated a significant positive relationship with trust ($\rho = .69$, $p < .001$), underscoring the importance of clarity, accessibility, and consistency in communication for fostering public trust. Among all variables, the strongest correlation with trust was observed for public satisfaction with hospital DRM ($\rho = .87$, $p < .001$), highlighting satisfaction as the most influential factor in shaping trust.

Overall, these findings provide support for all four hypotheses: higher public perception of hospital preparedness, greater awareness of preparedness activities, more effective communication, and higher satisfaction with DRM practices were each associated with stronger public trust in hospital DRM.

Table 4-15 Correlation Matrix

			1	2	3	4	5	6	7	8	9	10
1.	Region	Correlation	-									
		Sig.	-									
2.	Age	Correlation	.083	-								
		Sig.	.083	-								
3.	Gender	Correlation	-.161**	-.020	-							
		Sig.	<.001	.672	-							
4.	Education	Correlation	.120*	.205**	-.024	-						
		Sig.	.012	<.001	.615	-						
5.	Occupation	Correlation	.006	.274**	.085	-.132**	-					
		Sig.	.907	<.001	.076	.006	-					
6.	Perceived preparedness	Correlation	-.256**	-.037	.018	.095*	-.048	-				
		Sig.	<.001	.435	.712	.048	.316	-				

7.	Awareness	Correlation	.001	.043	.008	.175**	.088	.472**	-		
		Sig.	.990	.370	.872	<.001	.067	<.001	-		
8.	Communication	Correlation	-.020	.077	-.012	.214**	.058	.492**	.839**	-	
		Sig.	.672	.106	.798	<.001	.225	<.001	<.001	-	
9.	Satisfaction	Correlation	-.104*	.044	.077	.208**	.015	.668**	.714**	.771**	-
		Sig.	.029	.361	.108	<.001	.749	<.001	<.001	<.001	-
10.	Trust	Correlation	-.111*	.011	.086	.158**	.001	.667**	.666**	.719**	.880**
		Sig.	.020	.815	.071	<.001	.977	<.001	<.001	<.001	<.001

4.3.3 Multiple Regression Analysis

A multiple linear regression was conducted to assess each the contribution of each variable to public trust in hospital disaster management. Overall, the regression model indicated a strong relationship between the four predictors and public trust, as summarised in Table 4-16.

Table 4-16 Model Summary for Predicting Public Trust

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	0.886	0.785	0.783	.424

The ANOVA results in Table 4-17 indicate that the regression model was statistically significant.

Table 4-17 ANOVA Summary for Public Trust Model

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	283.51	4	70.879	392.437	< .001
Residual	77.843	431	.181		
Total	361.357	435			

The regression coefficients for each predictor are presented in Table 4-18. The model indicated that public perception of hospital preparedness and public satisfaction with DRM practices were statistically significant predictors of the public trust in hospital DRM. In contrast, public awareness of preparedness measures and perceived effectiveness of communication were not statistically significant predictors in this model.

Table 4-18 Regression Coefficients for Public Trust

Predictor Variable	t	p
Constant	.137	.891
Perception	4.589	< .001
Awareness	.301	.763
Communication	.85	.058
Satisfaction	.036	< .001

*Note: Perception = Hospital Preparedness Perception; Awareness = Disaster Preparedness Awareness; Communication = Communication Effectiveness; Satisfaction = DRM Satisfaction. B = Unstandardised coefficient; β = Standardised coefficient; t = t-value; p = p-value; 95% CI = 95% confidence interval; VIF = Variance Inflation Factor. Values are rounded to two decimal places. *p < .05*

Additionally, a multiple linear regression analysis was conducted to examine the contribution of demographic variables—occupation, region, education level, gender, and age—to public trust in hospital DRM. The model summary presented in Table 4-19 shows that the regression model produced an R value of .226, with an R^2 of .051 and an adjusted R^2 of .040. The standard error of the estimate was .893, indicating the level of dispersion of observed trust scores around the predicted values .

The ANOVA results indicate that the overall regression model was statistically significant, F(5, 430) = 4.609, p < .001, confirming that the set of demographic predictors was significantly associated with public trust in hospital DRM (see Table 4-20).

The regression coefficients for each demographic variable are reported in Table 4-21. Region (p = .006) and education level (p < .001) were statistically significant predictors of public trust. In contrast, age (β = .027, p = .602), gender (p = .172), and occupation (p = .930) were not statistically significant predictors in the model. The constant term was statistically significant (p < .001) .

Table 4-19 Model Summary for Sociodemographic Predictors of Public Trust

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	.226[a]	.051	.040	.893

Table 4-20 ANOVA Summary for Sociodemographic Model for Public Trust

Source	Sum of Squares	df	Mean Square	F	p
Regression	18.381	5	3.676	4.609	<.001
Residual	342.976	430	.798		
Total	361.357	435			

Table 4-21 Regression Coefficients for Sociodemographic Predictors of Public Trust

Predictor	SE	t	p
(Constant)	.308	3.703	<.001
Region	.038	-2.783	.006
Age	.005	0.522	.602
Gender	.086	1.367	.172
Education	.048	3.514	<.001
Occupation	.029	-0.088	.930

4.3.4 Exploratory Moderation Analysis

To build on the main findings and investigate the conditions under which public trust in hospital DRM occurs, a series of exploratory moderation analyses were conducted. These analyses examined whether the relationships between four independent variables and public trust in hospital DRM were moderated by participants' region, gender, age, or the presence of a long-term health condition. Additionally, an exploratory analysis was conducted to determine

whether public perceptions of hospital DRM differed depending on the temporal framing of survey items (past- versus future-oriented). Survey items were categorised accordingly, and statistical comparisons were made between the two temporal groups.

4.3.4.1 Age as a Moderator of the Satisfaction-Trust Relationship

Hierarchical regression analysis was conducted to examine whether age moderated the relationship between satisfaction with hospital DRM practices and public trust. As shown in Table 4-22, the analysis progressed through three steps. Step 1 established that satisfaction alone accounted for 77.0% of the variance in trust ($R^2 = .770$, $F(1, 434) = 1453.82$, $p < .001$), with satisfaction demonstrating a strong positive effect ($B = 0.78$, $SE = 0.02$, $t = 38.13$, $p < .001$).

Step 2 introduced age as an additional predictor. The addition of age did not significantly improve model fit ($\Delta R^2 < .001$, $\Delta F(1, 433) = 0.00$, $p = .958$), and age itself was not a significant predictor ($B < -0.01$, $SE < 0.01$, $t = -0.05$, $p = .958$). This indicates that age, as a main effect, does not independently predict trust after accounting for satisfaction. However, Step 3 revealed a significant interaction between satisfaction and age ($B = 0.004$, $SE = 0.002$, $t = 2.00$, $p = .046$), accounting for an additional 0.2% of variance ($\Delta R^2 = .002$, $\Delta F(1, 432) = 3.99$, $p = .046$). The final model explained 77.2% of the variance in trust ($R^2 = .772$, Adjusted $R^2 = .771$). The statistically significant interaction term indicates that the relationship between satisfaction and trust strengthens with increasing age.

Conditional effects analysis (see Table 4-23) illuminated this pattern across three age values corresponding to the 16th, 50th, and 84th percentiles of the sample distribution. For younger adults (age 25), each one-unit increase in satisfaction predicted a 0.74-unit increase in trust ($B = 0.74$, $SE = 0.03$, $t = 24.92$, $p < .001$). This effect increased to 0.78 units at the median age of 35 years ($B = 0.78$, $SE = 0.02$, $t = 37.90$, $p < .001$) and to 0.82 units for older adults aged 46 ($B = 0.82$, $SE = 0.03$, $t = 27.63$, $p < .001$). All conditional effects were statistically significant at $p < .001$, demonstrating that while satisfaction robustly predicts trust across all ages, older individuals rely more heavily on their satisfaction with DRM practices when forming trust judgements.

Table 4-22 Age as a Moderator of the Satisfaction-Trust Relationship

Step	Predictor	B	SE	β	t	p	R^2	Adj. R^2	ΔR^2	ΔF
1	Satisfaction	0.78	0.02	.88	38.13***	<.001	.770	.770	—	—
2	Satisfaction	0.78	0.02	.88	38.19***	<.001	.770	.769	<.001	0.00
	Age	<−0.01	<0.01	<−.01	−0.05	.958				
3	Satisfaction	0.78	0.02	.88	37.90***	<.001	.772	.771	.002*	3.99*
	Age	<−0.01	<0.01	<−.01	−0.05	.958				
	Satisfaction × Age	0.004	0.002	.05	2.00*	.046				

Note. N = *436. All continuous variables were mean-centred prior to creating interaction terms.* B = *unstandardised coefficient;* SE = *standard error; β = standardised coefficient; ΔR^2 = change in R^2; Δ*F = F-*change statistic.* p < .05. p < .01. *p < .001*.

Table 4-23 Conditional Effects of Satisfaction on Trust at Different Age Values

Age (years)	Age Percentile	*B*	*SE*	*t*	*p*	95% CI
25	16th	0.74	0.03	24.92	<.001***	[0.68, 0.80]
35	50th (Median)	0.78	0.02	37.90	<.001***	[0.74, 0.82]
46	84th	0.82	0.03	27.63	<.001***	[0.77, 0.88]

*Note. Age values represent the 16th, 50th, and 84th percentiles of the sample distribution. All effects are statistically significant at p < .001. ***p < .001.*

4.3.4.2 Age as a Moderator of the Awareness-Trust Relationship

A second hierarchical regression examined whether age moderated the relationship between public awareness of hospital preparedness measures and trust. As presented in Table 4-24, Step 1 demonstrated that awareness accounted for 41.8% of the variance in trust (R^2 = .418, F(1, 434) = 250.35, p < .001), with a strong positive effect (B = 0.67, SE = 0.04, t = 15.82, p < .001).

Step 2 added age as a predictor, which did not significantly improve model fit ($\Delta R^2 < .001$, $\Delta F(1, 433) = 0.11$, $p = .739$). Age was not a significant predictor of trust ($B < 0.01$, $SE < 0.01$, $t = 0.33$, $p = .739$), indicating no independent main effect after accounting for awareness. Step 3 introduced the interaction term, which proved statistically significant ($B = 0.008$, $SE = 0.003$, $t = 2.34$, $p = .020$), explaining an additional 0.7% of variance ($\Delta R^2 = .007$, $\Delta F(1, 432) = 5.49$, $p = .020$). The final model accounted for 42.6% of variance in trust ($R^2 = .426$, Adjusted $R^2 = .422$). The positive interaction coefficient indicates that the association between awareness and trust strengthens with increasing age.

Conditional effects analysis (see Table 4-25) demonstrated that at age 25, awareness predicted trust with a coefficient of 0.59 ($B = 0.59$, $SE = 0.05$, $t = 11.02$, $p < .001$). This effect strengthened to 0.67 at age 35 ($B = 0.67$, $SE = 0.04$, $t = 16.27$, $p < .001$) and to 0.76 at age 46 ($B = 0.76$, $SE = 0.05$, $t = 14.69$, $p < .001$). The pattern suggests that whilst awareness contributes to trust across all age groups, its influence is particularly pronounced among older adults.

Table 4-24 Age as a Moderator of the Awareness-Trust Relationship

Step	Predictor	*B*	*SE*	β	*t*	*p*	R^2	Adj. R^2	ΔR^2	Δ*F*
1	Awareness	0.67	0.04	.65	15.82***	<.001	.418	.417	—	—
2	Awareness	0.67	0.04	.65	15.85***	<.001	.418	.415	<.001	0.11
	Age	<0.01	<0.01	.02	0.33	.739				
3	Awareness	0.68	0.04	.66	16.27***	<.001	.426	.422	.007**	5.49**
	Age	<0.01	<0.01	.02	0.49	.624				
	Awareness × Age	0.008	0.003	.11	2.34*	.020				

Note. N = *436. All continuous variables were mean-centred.* B = *unstandardised coefficient;* SE = *standard error; β = standardised coefficient.* p < .05. p < .01. *p* < *.001*.

Table 4-25 Conditional Effects of Awareness on Trust at Different Age Values

Age (years)	Age Percentile	*B*	*SE*	*t*	*p*	95% CI
25	16th	0.59	0.05	11.02	<.001***	[0.48, 0.69]
35	50th (Median)	0.67	0.04	16.27	<.001***	[0.59, 0.75]
46	84th	0.76	0.05	14.69	<.001***	[0.66, 0.87]

*Note. Conditional effects calculated at the 16th, 50th, and 84th percentiles of age. All effects significant at p < .001. ***p < .001.*

4.3.4.3 Long-term Health Condition as a Moderator of the Communication-Trust Relationship

Hierarchical regression analysis tested whether the presence of a long-term health condition moderated the relationship between perceived communication effectiveness and trust. Table 4-26 presents the results. Step 1 established that communication effectiveness accounted for 48.0% of the variance in trust (R^2 = .480, F(1, 434) = 408.56, p < .001), demonstrating a strong positive effect (B = 0.60, SE = 0.03, t = 20.21, p < .001).

Step 2 added long-term health condition status as a predictor, resulting in minimal improvement in model fit (ΔR^2 = .002, $\Delta F(1, 433) = 1.40$, p = .237). Health condition status was not a significant predictor (B = −0.15, SE = 0.13, t = −1.18, p = .237), indicating no independent main effect after controlling for communication effectiveness. Step 3 revealed a significant interaction between communication effectiveness and health condition status (B = −0.17, SE = 0.07, t = −2.40, p = .017), accounting for an additional 0.7% of variance (ΔR^2 = .007, $\Delta F(1, 432) = 5.77$, p = .017). The final model explained 48.9% of the variance in trust (R^2 = .489, Adjusted R^2 = .485). The negative interaction coefficient indicates that the positive relationship between communication effectiveness and trust is weaker among individuals with long-term health conditions.

Simple slopes analysis (see Table 4-27) revealed that for individuals without long-term health conditions (n = 360), each one-unit increase in perceived communication effectiveness corresponded to a 0.61-unit increase in trust (B = 0.61, SE = 0.03, t = 18.91, p < .001). However, for individuals with long-term health conditions (n = 76), this effect was attenuated to 0.44 units (B = 0.44, SE = 0.06, t = 7.13, p < .001). Although communication remained a significant predictor of trust in both groups, the relationship was approximately 28% weaker among those with chronic health conditions.

Table 4-26 Long-Term Health Condition as a Communication–Trust Moderator

Step	Predictor	*B*	*SE*	β	*t*	*p*	R^2	Adj. R^2	ΔR^2	ΔF
1	Communication	0.60	0.03	.69	20.21***	<.001	.480	.479	—	—
2	Communication	0.60	0.03	.70	20.32***	<.001	.482	.479	.002	1.40
	Health Condition	−0.15	0.13	−.06	−1.18	.237				
3	Communication	0.61	0.03	.71	18.91***	<.001	.489	.485	.007**	5.77**
	Health Condition	−0.14	0.13	−.06	−1.10	.270				
	Communication × Health	−0.17	0.07	−.11	−2.40*	.017				

Note. N = *436. Health Condition coded as 0 = No long-term condition (*n = *360), 1 = Has long-term condition (*n = *76). Communication was mean-centred.* B = *unstandardised coefficient;* SE = *standard error; β = standardised coefficient.* p < .05. p < .01. *p* < *.001*.

Table 4-27 Effect of Communication on Trust by Health Condition Status

Health Condition Status	*n*	*B*	*SE*	*t*	*p*	95% CI
No long-term condition	360	0.61	0.03	18.91	<.001***	[0.55, 0.67]
Has long-term condition	76	0.44	0.06	7.13	<.001***	[0.32, 0.56]

*Note. Simple slopes represent the effect of communication effectiveness on trust for each group separately. ***p < .001.*

4.3.4.4 Long-term Health Condition as a Moderator of the Satisfaction-Trust Relationship

A final hierarchical regression examined whether long-term health condition status moderated the relationship between satisfaction with hospital DRM practices and trust. As shown in Table 4-28, Step 1 established that satisfaction accounted for 77.0% of the variance in trust (R^2 = .770, F(1, 434) = 1453.82, p < .001), with a strong positive effect (B = 0.78, SE = 0.02, t = 38.13, p < .001).

Step 2 added health condition status, which produced no significant improvement in model fit (ΔR^2 < .001, $\Delta F(1, 433) = 0.04$, p = .851). Health condition status was not a significant predictor (B = −0.01, SE = 0.07, t = −0.19, p = .851), indicating no independent main effect. Step 3 introduced the interaction term, which was statistically significant (B = −0.12, SE = 0.05, t = −2.24, p = .025), accounting for an additional 0.3% of variance (ΔR^2 = .003, $\Delta F(1, 432) = 5.03$, p = .025). The final model explained 77.3% of the variance in trust (R^2 = .773, Adjusted R^2 = .771). The negative interaction coefficient indicates that the positive relationship between satisfaction and trust is weaker among individuals with long-term health conditions.

Simple slopes analysis (see Table 4-29) showed that among individuals without chronic health conditions (n = 360), satisfaction strongly predicted trust (B = 0.80, SE = 0.02, t = 35.69, p < .001). For individuals with long-term health conditions (n = 76), this relationship remained

significant but was reduced (B = 0.68, SE = 0.05, t = 13.74, p < .001), representing a 15% attenuation in effect size.

Table 4-28 Long-Term Health Condition as a Satisfaction–Trust Moderator

Step	Predictor	B	SE	β	t	p	R^2	Adj. R^2	ΔR^2	ΔF
1	Satisfaction	0.78	0.02	.88	38.13***	<.001	.770	.770	—	—
2	Satisfaction	0.78	0.02	.88	38.15***	<.001	.770	.769	<.001	0.04
	Health Condition	−0.01	0.07	−.01	−0.19	.851				
3	Satisfaction	0.80	0.02	.91	35.69***	<.001	.773	.771	.003*	5.03*
	Health Condition	−0.01	0.07	<−.01	−0.08	.937				
	Satisfaction × Health	−0.12	0.05	−.09	−2.24*	.025				

Note. *N* = 436. Health Condition coded as 0 = No long-term condition, 1 = Has long-term condition. Satisfaction was mean-centred. *B* = unstandardised coefficient; *SE* = standard error; β = standardised coefficient. *p* < .*05*. *p* < .*01*. p < .001.

Table 4-29 Effect of Satisfaction on Trust by Health Condition Status

Health Condition Status	n	B	SE	t	p	95% CI
No long-term condition	360	0.80	0.02	35.69	<.001***	[0.76, 0.85]
Has long-term condition	76	0.68	0.05	13.74	<.001***	[0.58, 0.78]

Note. Simple slopes calculated for each health condition group separately. ***p < .*001*.

4.3.4.5 NON-SIGNIFICANT MODERATIONS

In addition to the four significant moderations reported above, a comprehensive set of moderation analyses was conducted to examine other potential interaction effects. Table 4-30 presents a summary of all non-significant moderation effects tested. This included gender moderating the relationships between awareness, communication, and satisfaction with trust; age moderating the relationships between perception and communication with trust; health condition moderating perception and awareness relationships; and region moderating all four predictor-trust relationships. The absence of significant moderation effects for these tested interactions provides theoretically meaningful information about the consistency of trust formation processes across different demographic subgroups.

Table 4-30 Summary of Non-Significant Moderation Effects

Predictor	Moderator	B	SE	t	p	95% CI
Gender Moderations						
Awareness	Gender	0.03	0.07	0.35	.728	[−0.12, 0.17]
Communication	Gender	0.08	0.06	1.45	.147	[−0.03, 0.19]
Satisfaction	Gender	−0.01	0.04	−0.16	.872	[−0.09, 0.08]
Age Moderations						
Perception	Age	0.01	<0.01	1.45	.148	[<−0.01, 0.01]
Communication	Age	<0.01	<0.01	0.73	.468	[<−0.01, 0.01]
Health Condition Moderations						
Perception	Health Condition	−0.20	0.10	−2.05	.041	[−0.39, −0.01]

Awareness	Health Condition	−0.11	0.09	−1.16	.247	[−0.29, 0.08]
Region Moderations						
Perception	Region	−0.03	0.04	−0.95	.342	[−0.10, 0.04]
Awareness	Region	−0.03	0.03	−0.84	.403	[−0.09, 0.03]
Communication	Region	−0.05	0.03	−2.10	.037	[−0.10, <−0.01]
Satisfaction	Region	−0.02	0.02	−1.13	.261	[−0.06, 0.02]

Note. N = 436 for most analyses; n = 430 for gender moderations (participants selecting "prefer not to say" excluded). Interaction terms represent the final step (Step 3) of hierarchical models. All continuous predictors were mean-centred. Region coded as 1 = Southern, 2 = Western, 3 = Eastern, 4 = Central. Gender coded as 1 = Male, 2 = Female. Health Condition coded as 0 = No, 1 = Yes.

4.3.4.6 Comparison of Past- and Future-Oriented Perceptions

A paired-samples t-test was conducted to compare past-oriented and future-oriented survey items. Participants rated the past-oriented items (M = 4.02, SD = 0.71) significantly higher than the future-oriented items (M = 3.76, SD = 0.67), t(657) = 8.41, p <. 001. These results indicate that participants expressed greater confidence in hospitals' past DRM performance compared to anticipated future DRM capabilities.

4.4 Discussion

4.4.1 Perceived Hospital Preparedness as a Determinant of Public Trust

The current study clearly indicates a positive relationship between public perception of hospital disaster preparedness and trust in hospitals' ability to manage disasters. Regression analysis confirmed that perception is a strong predictor of trust, indicating that public evaluations of hospital preparedness – particularly public perceptions of tangible resources, infrastructure

quality, and clarity of action-orientated plans – substantively shape confidence in hospitals during emergencies. This finding supports (H1), which proposed that higher public perception of preparedness predicts higher trust, and aligns with prior research emphasising the role of perceived institutional competence in trust development (Paton, 2008; Siegrist et al. 2005). Internationally, similar patterns have been observed; for example, Li et al. (2022) found that visible preparedness efforts, such as resource stockpiling during COVID-19, enhanced pandemic trust in hospital services.

In the context of Saudi Arabia, which is prone to natural hazards such as recurrent flooding and inadequate housing (King Abdullah University of Science and Technology, 20265), strong perceptions of hospital preparedness may reduce uncertainty and encourage public engagement (Wachinger et al. 2013). Nevertheless, the study suggests that overall trust levels are moderate, highlighting that perceptions of resource allocation, staff training, or preparedness actions influence the degree of public trust (Negm et al., 2024). This moderate level of trust reflects widespread public scepticism about hospital disaster risk management capabilities in Saudi Arabia. This finding aligns with international evidence indicating that trust is not simply granted but must be continuously earned through demonstrable preparedness actions (Earle and Siegrist, 2008; Siegrist, 2021). Several factors may contribute to this pattern. First, limited transparency regarding resource allocation and DRM planning may foster uncertainty (Alshehri et al., 2015). Second, cultural expectations of state-led healthcare delivery create high standards that hospitals may struggle to meet consistently (Alruwaili et al., 2023).

Third, inadequate public engagement and communication about disaster preparedness measures leave citizens uninformed and disconnected from institutional efforts (Wachinger et al., 2013). These findings underscore that trust deficits arise not necessarily from inadequate institutional performance alone, but from failures to visibly demonstrate competence and maintain transparent dialogue with communities (Paton and Johnston, 2017; Covello, 2021).

While the potential relationship between perceived preparedness and trust may appear intuitive – particularly as perception items often relate to tangible or spatial aspects of preparedness – it is unlikely to follow a simple linear pathway. Trust is not only contingent upon perceptions of resource adequacy but also upon the extent to which hospitals demonstrate clear and credible preparedness plans. Public judgements in this regard are often formed in the absences of direct knowledge. Individuals rarely have access to hospital infrastructure assessments or emergency protocols and therefore rely on secondary or tertiary sources, such as media coverage, government representatives, or personal experiences (Wachinger et al., 2013). Such sources may be limited, biased or incomplete, thereby shaping trust in ways that do not necessarily align with verified levels of preparedness (Wachinger et al., 2013; Steelman and McCaffrey, 2013).

Perceptions of preparedness, efficacy, and trust are also filtered through individual experiences and biases, which are further contextualised within Saudi culture. Higher expectations of publicly funded health services may foster greater public scrutiny. Even hospitals perceived as resource-rich may encounter scepticism if the public identifies inconsistent service delivery, weak communication, evidence of systemic failures in other institutions (Tiwary et al., 2019; Buzelli et al., 2022). Thus, trust is not only merely grounded in rational assessments of observable resources but is also shaped by emotional and relational dimensions. This complexity helps explain why strong perceptions of preparedness do not necessarily translate into high levels of trust. Trust is not a single, linear outcome of preparedness but emerges from multiple interacting perceptions, including reliability, transparency, consistency, and governance credibility. Members of the public may acknowledge the presence of preparedness measures whilst simultaneously doubting hospitals' overall capacity to manage disasters effectively. Such scepticism may be rooted in previous institutional failures, weak communication regarding preparedness investments, or broader distrust in governance structures.

Additionally, when individuals evaluate hospitals' future disaster capabilities, confidence appears to weaken, suggesting concern about whether current preparedness efforts will be

sustained over time. Rather than contradicting the role of preparedness, this pattern highlights that preparedness alone is insufficient to secure trust. Trust formation is contingent upon how preparedness is communicated, demonstrated, and maintained across time (Slovic, 1993; Earle and Siegrist, 2008; Siegrist, 2021).

Feelings of fear, uncertainty, or historical distrust may undermine confidence in health institutions, even where operational competence is recognised (Slovic, 1993; Siegrist, 2021). These findings suggest that whilst the link between perceived preparedness and trust may appear straightforward, it indicates a more complex and context-specific interaction. Its significance lies not in its apparent simplicity but in what it reveals about institutional credibility, which can be either strengthened or eroded within a socio-cultural context.

The findings suggest that, although the connection between perceived preparedness and trust may seem straightforward, it reflects a more complex, context-dependent relationship. Its significance lies not in its apparent simplicity but in what it reveals about institutional credibility, which can be either strengthened or weakened depending on the socio-cultural context. Notably, this pattern of moderate trust appears to be consistent across different regions of Saudi Arabia, suggesting that low trust in hospital DRM is a nationwide phenomenon rather than being confined to specific geographic areas. This finding is noteworthy because it contradicts expectations based on known urban-rural disparities in healthcare infrastructure and service delivery across Saudi Arabia (Alshehri et al., 2016). One possible explanation is that public dissatisfaction with hospital DRM transcends regional boundaries, reflecting systemic issues such as inadequate national-level communication strategies, inconsistent preparedness standards, or widespread public unawareness of DRM protocols (Alruwaili et al., 2023). The absence of regional variation also suggests that interventions to enhance trust must be implemented nationally rather than targeted to specific regions. Future research could employ qualitative methods to explore whether regionally specific factors—such as prior disaster experiences, local governance structures, or cultural differences—influence trust in ways that quantitative measures alone cannot capture (Appleby-Arnold et al., 2021).

Perceived preparedness also acts as a signal of institutional competence, reducing uncertainty and anxiety during disasters (Earle and Siegrist, 2008). When hospital is perceived as prepared, the public expects timely and effective care. However, the study's focus on general preparedness perceptions masks the effect of specific components, such as operational readiness, inter-agency coordination, or evacuation plans. Future research should disentangle these components to identify which aspects most strongly influence public trust (Paton and Johnston, 2017; Chisolm et al., 2023).

An additional exploratory analysis revealed that trust may depend on whether participants were asked to consider hospitals' capacity in relation to the past or future. Specifically, trust was found to be higher for past-oriented items compared with future-oriented items. This suggests that participants expressed greater confidence in hospitals' ability to respond appropriately to disasters in the past than in their anticipated ability to respond effectively in the future. Importantly, this does not imply overall trust is high, rather, it highlights a discrepancy in confidence when assessments are framed temporarily. This distinction is particularly salient in the Saudi Arabian context, where communication about disaster preparedness is often limited. Public discourse tends to emphasise retrospective evaluations of hospitals' performance following crises, rather than transparent discussion of ongoing and future preparedness. The findings underscore the need for hospitals not only to enhance their preparedness, but also to communicate their strategies more openly and proactively, particularly with regard to future planning and disaster preparedness.

This temporal pattern helps explain an apparent paradox in the findings: participants may recognise certain preparedness efforts but remain sceptical about hospitals' overall capacity to manage disasters effectively. Trust is not a unidimensional construct but emerges from multiple interacting perceptions including competence, reliability, transparency, and consistency (Earle and Siegrist, 2008). Whilst perceived preparedness emerged as a significant predictor of trust, this does not imply that preparedness alone determines trust levels. Rather, public scepticism may stem from past experiences of institutional failures, inadequate communication about

preparedness investments, or distrust in governance systems more broadly (Wachinger et al., 2013; Slovic, 1993). The temporal framing analysis revealed that trust in future hospital capabilities was significantly lower than trust based on past performance, suggesting that the public questions whether current preparedness translates into sustained future competence. Therefore, trust formation is complex and contingent upon multiple factors beyond perceived preparedness alone (Paton and Johnston, 2017; Siegrist, 2021).

Future research could further investigate the role of temporal framing in shaping perceptions of trust. For example, it may be valuable to explore whether participants' responses were influenced by past lived experiences, cultural beliefs surrounding risk, or the nature of hospital communications regarding future preparedness. Such insights could advance understanding trust development and support efforts to strengthen how hospitals articulate their current initiatives and readiness plans for the future.

In summary, improving public perceptions of hospital preparedness represents an important step towards building institutional trust; however, enhancing perceptions alone is insufficient. Addressing existing public information deficits and ensuring transparent communications, coupled with culturally meaningful engagement with communities, are equally vital (Löfstedt, 2020). To this end, disaster preparedness planning should integrate culturally appropriate strategies as well as community-designed approaches, thereby fostering greater inclusivity and ensuring that public trust in hospital DRM is both established and maintained.

4.4.2 Public Awareness and Trust in Hospital Disaster Preparedness

These results show a positive correlation between public awareness of hospital disaster preparedness efforts and trust. However, regression analyses demonstrate that when other variables are accounted for, awareness of preparedness measures – such as hospital plans, resources, and responses – does not emerge as a significant predictor of trust. That is, whilst awareness contributes to trust, its effect is weaker than that of perception or satisfaction. The

following analysis therefore examines the role of awareness in shaping trust in hospital disaster management.

The positive association between awareness of hospital disaster preparedness measures and trust supports Hypothesis 2 (H2), which proposed that higher public awareness leads to greater trust in hospital DRM. This finding aligns with Slovic's (2010) claim that transparency fosters trust. Empirical evidence further supports this link; for example, Kim et al. (2022) found that public awareness of infection control measures during COVID-19 in South Korea enhanced trust in health institutions. However, the non-significant regression result in this study is noteworthy, as it challenges assumptions that awareness alone is the primary driver of trust or that information campaigns alone can create or maintain public trust (Löfstedt, 2020). Rather, awareness must be accompanied by demonstrable DRM actions, such as visible resource allocation or effective disaster response, in order to foster confidence (Paton and Johnston, 2017). This highlights an important limitation of awareness campaigns and underscores the need for multifaceted trust-building strategies. In Saudi Arabia, where studies report low levels of public awareness regarding hospital preparedness protocols (Alruwaili et al., 2023), this may stem from inadequate outreach and inconsistent access to relevant information (Alshehri et al., 2016). Overall, these findings suggest that whilst awareness has a role, it is most effective when translated into visible, actionable measures, offering fresh insight into how information dissemination interacts with the formation of trust in Saudi Arabia.

Additionally**,** age emerged as a significant moderator of the awareness-trust relationship, with the association strengthening with increasing age. This pattern suggests that older adults rely more heavily on awareness of preparedness measures when forming trust judgements. The finding aligns with life-span developmental theories proposing that older adults place greater weight on informational cues due to accumulated experience and cognitive maturity (Paton, 2008). Older individuals may be better positioned to integrate awareness of preparedness measures into their trust evaluations, potentially due to greater health literacy and more extensive interaction with medical institutions over their lifetimes (Löfstedt, 2020). Beyond

experiential factors, cultural explanations may also account for the link between older age and greater trust, particularly in relation to social norms that emphasise respect for institutional authority (Samarkandi et al., 2022). Existing evidence suggests that older populations are consistently more engaged with public health messaging (Bindhim et al., 2025), highlighting their importance as a target group for disaster awareness campaigns.

These findings carry practical implications for hospital DRM planning and public engagement strategies. Awareness campaigns may be particularly effective in building trust among older adults, who constitute a demographically important and vulnerable group during disasters. Hospitals should prioritise clear, accessible information dissemination for this demographic. However, interventions targeting younger adults may require different approaches, as awareness appears less influential in shaping their trust evaluations. Future research should explore what factors most strongly influence trust among younger populations and whether alternative strategies, such as technology-enabled engagement or peer-driven communication, might prove more effective.

Interestingly, the study found no significant effect of long-term health conditions on the awareness-trust relationship. This result is somewhat counterintuitive, given prior research indicating that individuals living with chronic illnesses are typically more vulnerable and therefore more motivated to seek health information and preparedness resources (Helgeson and Zajdel, 2017; Tomaschek et al., 2022). One possible explanation is the overall low level of public awareness of hospital preparedness across the sample, which may have reduced the potential for variation in responses. Another limitation may be the broad measurement of awareness used in the current study, which may not have captured the depth, accuracy, or scope of participants' knowledge about specific DRM protocols. Future research could address this gap by examining how different modes of awareness and education – such as social media, public service announcements, or community based workshops – shape public understanding whilst tailoring awareness campaigns to the needs of specific groups, particularly older adults,

and ensuring that communication strategies move beyond general awareness to provide accessible, accurate, and actionable information that strengthens trust in hospitals' DRM.

4.4.3 Perceived Communication Effectiveness and Its Association with Trust

Despite the study demonstrating a significant positive correlation between the perceived effectiveness of hospital communication about disaster preparedness and trust, the regression analysis indicates that communication functions as a predictor of trust but with comparatively weaker effect than satisfaction or perception. This suggests that, although communication is important for building trust, it does not exert as strong an influence as other determinants.

The positive correlation aligns with the hypothesis that effective communication fosters trust, supporting Covello's (2021) assertion that transparent communication strengthens institutional credibility. Similarly, Jacob et al. (2023) found that proactive communication strategies, such as webinars, can reduce misinformation and increase public confidence. In Saudi Arabia, where digital platforms such as Twitter and WhatsApp are dominant modes of communication (Ogie et al., 2022), effective communication may help to bridge gaps in public awareness and understanding. However, the regression analysis suggests that whilst communication effectiveness is important, it is not a strong driver of trust without demonstrable preparedness actions to support the messages delivered. This finding echoes Paton's (2008) assertion that communication has limited value if it is not actionable. Additionally, inconsistent messaging or cultural influences may contribute to public scepticism, as evidenced during the MERS-CoV outbreak (Bawazir et al., 2018). Taken together, these findings indicate that communication effectiveness is an essential, but insufficient, factor in building public trust in hospital DRM unless it is accompanied by tangible and transparent preparedness measures.

Furthermore**,** the presence of a long-term health condition significantly moderated the communication-trust relationship, with the association being weaker among individuals with chronic health conditions compared to those without such conditions. This pattern suggests that individuals living with long-term health conditions evaluate hospital trustworthiness

differently than the general population, potentially holding higher expectations or demonstrating greater scrutiny of institutional performance due to their increased dependence on healthcare systems (Helgeson & Zajdel, 2017; Tomaschek et al., 2022).

The attenuation of the communication-trust relationship among individuals with chronic conditions may reflect heightened expectations for communication quality. These individuals typically have more frequent interactions with healthcare systems and may hold hospitals to higher standards for clarity, timeliness, and cultural sensitivity in communication (Schwarz et al., 2022). When communication falls short of these elevated expectations, trust is more readily undermined (Asan et al., 2021). At first glance, this finding may seem counterintuitive, as individuals with chronic conditions are generally expected to place greater value on effective communication given their higher reliance on hospitals. However, a plausible explanation is that individuals living with a long-term condition may have heightened expectations for communication, and thus a negative or inconsistent experience is more likely to reduce their trust. This interpretation highlights the importance of developing communication approaches tailored to the needs of vulnerable populations.

These findings underscore important considerations for health equity and disaster preparedness. Standard communication strategies may be insufficient for building trust among individuals with long-term health conditions, who represent a particularly vulnerable group during disasters. Targeted interventions are needed, including communication approaches specifically designed to address the heightened expectations and concerns of this population, explicit protocols for medication continuity during emergencies, and dedicated resources for managing chronic conditions in disaster contexts (Krist et al., 2017; Tomio & Sato, 2014). Failure to address these specific needs risks exacerbating health disparities during disasters and undermining the effectiveness of institutional disaster response efforts.

The absence of significant moderation effects for region or gender suggests that communication challenges are more generalised across Saudi Arabia, perhaps reflecting issues of linguistic

diversity and disparities in digital literacy (Algahtani et al., 2020). A limitation of the present study is that it assessed only perceptions of communication effectiveness, without accounting for other dimensions such as the frequency, timing or accessibility of messaging, which may also shape public trust. Future research could usefully examine how different communication strategies – such as optimised timing, choice of platform, and targeted framing – affect public engagement with hospital DRM.

Taken together, these findings underline the need for more nuanced communication strategies, particularly for individuals living with chronic health conditions, in order to strengthen trust in hospitals' DRM efforts.

4.4.4 Perceived Satisfaction with DRM Practices and Hospital Trust

The findings indicate that public satisfaction with hospital DRM practices is the strongest predictor of trust, with both correlation and regression analyses demonstrating a statistically significant positive association. In the context of Saudi public hospitals as providers of disaster response management, this suggests that satisfaction is a central driver of public trust.

The robust predictive validity of satisfaction supports Hypothesis 4 (H4), indicating that higher levels of satisfaction are positively associated with trust in hospital DRM constructs. This finding aligns with established research on institutional trust, which demonstrates that individuals' direct experiences with institutions reinforce confidence in the services provided (Earle and Siegrist, 2006), and is consistent with Wang et al. (2022), whose study in China demonstrated that trust in rapid response measures significantly enhance public confidence in institutional disaster management. Within the Saudi context, citizens possess elevated expectations of government healthcare provision (Alsherehi et al., 2015), and satisfaction with DRM practices may therefore serve as a proxy for perceived institutional competence, engendering greater reliance on hospitals during periods of perceived crisis.

However, the findings of this study highlight dissatisfaction as a significant construct, suggesting that hospitals may not be meeting the high expectations of the public. The

dissatisfaction may stem from perceived delays in service delivery or inadequate availability of resources, as noted by Alruwaili et al. (2023). The results appear to contradict expectations based on the substantial investment in healthcare infrastructure in Saudi Arabia; however, public satisfaction and performance indicators emerge as distinct vectors. Therefore, the present study proposes that public satisfaction constitutes a critical determinant of trust in DRM. Accordingly, efforts to strengthen trust must not only address performance factors, but also prioritise strategies that enhance public satisfaction through scheduled improvements and more effective service delivery.

Moreover**,** two significant moderations emerged involving satisfaction: age and long-term health condition status. Age moderated the satisfaction-trust relationship, with the association strengthening with increasing age. This pattern suggests that older adults rely more heavily on their satisfaction with DRM practices when forming trust judgements. The strengthening effect of age on the satisfaction-trust relationship may reflect older adults' greater familiarity with healthcare systems and their enhanced capacity to evaluate institutional performance based on direct experiences (Löfstedt, 2020). This finding aligns with life-span developmental theories proposing that older adults place greater weight on concrete institutional performance indicators due to accumulated experience and cognitive maturity (Paton, 2008).

The presence of a long-term health condition also significantly moderated the relationship between satisfaction and trust, with a weaker association observed among individuals with chronic health conditions. This finding suggests that individuals with chronic health conditions may hold elevated expectations or possess prior negative experiences that attenuate satisfaction and, consequently, trust (Krist et al., 2017). The weakened satisfaction-trust relationship among this population may indicate that individuals with chronic conditions base their trust evaluations on a broader range of factors beyond satisfaction alone, such as continuity of care, medication management during emergencies, and specialised preparedness for vulnerable populations. These findings extend the work of Hasan et al. (2024), highlighting the necessity of targeted interventions to enhance satisfaction among vulnerable populations.

These moderation findings carry important practical implications. Satisfaction improvement efforts may be particularly effective in building trust among older adults, who constitute a demographically important and vulnerable group during disasters. Hospitals should ensure high-quality service experiences that meet their elevated expectations. However, for individuals with long-term health conditions, standard satisfaction improvement strategies may be insufficient for building trust. Targeted interventions are needed, including personalised disaster preparedness plans, explicit protocols for medication continuity during emergencies, and dedicated resources for managing chronic conditions in disaster contexts (Tomio & Sato, 2014). Failure to address these specific needs risks exacerbating health disparities during disasters.

Although no significant moderation by gender or region was observed, this pattern may indicate that dissatisfaction is more widespread than satisfaction within the general population, potentially reflecting inequities in healthcare provision and DRM outcomes (Alruwaili et al., 2023). Disparities between urban and rural programmes in Saudi Arabia – particularly in rural communities – may include limited resources, insufficient staff training, and challenges in logistics, coordination, communication, and public dissemination. Such constraints can result in slower and less effective disaster response, which may lead to lower satisfaction relative to hospitals in urban centres (Alshehri et al., 2016). These structural differences and perceptions likely contribute to heightened public concern regarding hospital DRM preparedness.

In summary, these findings underscore the importance of addressing the needs of populations with chronic health conditions and acknowledging urban-rural disparities in healthcare delivery to design more effective interventions that enhance satisfaction and, ultimately, strengthen public trust in hospital DRM.

4.4.5 Theoretical Implications of Moderation Findings

The moderation patterns observed in this study provide important theoretical insights into trust formation processes. The findings support differentiated trust formation models (Earle &

Siegrist, 2008), which propose that individuals with varying characteristics and experiences use different cognitive pathways to evaluate institutional trustworthiness. Four significant moderations emerged—age moderating satisfaction and awareness relationships, and health condition moderating communication and satisfaction relationships—demonstrating that trust in hospital DRM is not uniformly determined across population subgroups but rather follows differentiated pathways depending on individual characteristics.

The selective nature of moderation effects provides theoretical insight. Age moderated relationships involving satisfaction and awareness but not perception or communication, suggesting that age-related differences in trust formation are domain-specific rather than universal. Similarly, health condition status moderated relationships involving experiential and communicative aspects of hospital DRM but not perceptual or awareness-based relationships, indicating that individuals with chronic conditions scrutinise some institutional dimensions more critically than others.

Contrary to some prior research suggesting gender differences in risk perception and institutional trust (Slovic, 1987), gender did not significantly moderate predictor-trust relationships in this sample. This suggests that the pathways through which awareness, communication, and satisfaction influence trust operate similarly for males and females in the Saudi Arabian context. Similarly, despite known regional disparities in healthcare infrastructure across Saudi Arabia (Alshehri et al., 2016), region did not significantly moderate relationships between predictors and trust. This finding suggests that trust formation processes are relatively consistent across geographic contexts, though baseline levels of trust may differ regionally.

The absence of gender and regional moderations may reflect the pervasive nature of trust-related challenges across Saudi Arabia's healthcare system, where systemic issues such as inadequate communication strategies and inconsistent preparedness standards transcend regional and gender boundaries. Alternatively, it may indicate that the measured predictors

represent such fundamental determinants of trust that their effects are robust across demographic subgroups.

The findings extend previous research by demonstrating that the hierarchical approach to moderation analysis, which controls for main effects before testing interactions, provides more rigorous evidence that moderation is not an artefact of confounded main effects—a critical consideration for causal inference in cross-sectional research (Aguinis et al., 2010; Hayes, 2017). Although statistically significant, the incremental variance explained by interaction terms was modest. This is common in moderation research (Aguinis et al., 2010) and reflects the reality that interactions often explain limited variance beyond main effects. Nevertheless, even small moderations can have practical significance when applied to large populations, particularly in the context of disaster preparedness where targeted interventions for vulnerable subgroups may yield substantial benefits in terms of lives saved and trust maintained during crises.

4.4.6 Study Theoretical and Practical Implications

This study advances the theoretical understanding of public trust in DRM by emphasising the importance of perceived satisfaction with institutional performance, particularly in the Saudi Arabian context, over mere awareness or communication. Existing models, such as Slovic's framework (1993), highlight the importance of information provision, public consultation, and engagement in shaping trust in organisations. However, the current findings suggest that in the absence of demonstrable institutional action – such as effective responses to community needs or crises – awareness and communication alone are insufficient to establish trust.

This study extends Slovic's model by demonstrating that trust is most strongly influenced by public perception of resources, operational capacity, and anticipated performance, including staffing, equipment availability, and infrastructure resilience. This supports a performance-based view of trust development, as articulated by Siegrist and Cvetkovich (2000), whereby institutional credibility depends on tangible actions. Without visible operational competence,

institutions risk undermining public confidence, and trust is only secured when institutions demonstrate transparency and efficacy in both preparedness and response activities.

In the Saudi Arabian context, where the healthcare system is predominately state-driven, transparency regarding resource allocation, expenditure, and operational decisions is particularly critical (Alshehri et al., 2015). Citizens hold high expectations for state-led healthcare, and cultural norms emphasise deference to authority. Consequently, hospitals must demonstrate visible preparedness to meet societal expectations; any perceived deficiencies have the potential to significantly undermine public trust (Gille et al., 2015; Platt et al., 2018).

The findings indicate that Saudi Arabian hospitals seeking to cultivate public trust must actively demonstrate operational readiness to their communities in tangible and visible ways. This could include conducting regular disaster preparedness drills that are observable by both staff and the public, openly allocating resources, and clearly communicating that staff have received comprehensive training in DRM and crisis response (McEntire, 2021).

Communication strategies should extend beyond the mere dissemination of information and awareness campaigns. They must be culturally attuned, incorporating interactive messaging that addresses the specific needs of different community groups, thereby fostering participation and engagement in DRM, particularly in contexts previously affected by disasters (Bogdan et al., 2024). The moderation findings suggest particular attention should be paid to tailoring interventions for specific subgroups. Targeted outreach to older adults, as well as contextualised messaging that draws on preparedness information, can enhance public engagement amongst this demographic who demonstrate stronger reliance on awareness and satisfaction when forming trust judgements (Bogdan et al., 2024). For individuals with long-term health conditions, communication strategies must be specifically designed to meet heightened expectations for clarity, timeliness, and relevance, whilst satisfaction improvement efforts must

extend beyond general service quality to address continuity of care and specialised preparedness for managing chronic conditions during disasters.

Hospitals may also benefit from adopting participatory approaches to disaster planning within communities. Such engagement can directly improve public understanding of DRM, provide educational opportunities, and foster civil society involvement. Additionally, the establishment of structured feedback mechanisms allows the public to contribute concerns and recommendations, aligning societal expectations with institutional practices. This, in turn, supports the development of social norms that reinforce trust in hospital DRM and enhance the resilience of healthcare systems (Paton and Johnston, 2001).

4.4.7 Study Limitations and Future Research Directions

Whilst this study offers valuable insights, several limitations should be acknowledged. Firstly, the reliance on self-reported data introduces the possibility of social desirability and recall biases, which may have influenced participants' responses regarding disaster experiences and their evaluations of trust (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Secondly, the absence of a longitudinal design limits the ability to draw causal inferences, meaning that the observed associations should be interpreted as correlational rather than definitive (Bryman, 2016). The cross-sectional design limits causal inferences regarding moderation effects. Whilst hierarchical regression provides stronger evidence for relationships than simple regression by demonstrating that interaction effects persist after controlling for main effects, longitudinal research is needed to examine how changes in predictors relate to changes in trust over time and whether moderation effects remain stable or evolve with individual experiences. Thirdly, the study did not incorporate qualitative data, thereby limiting the ability to explore the depth and nuance of public perceptions and experiences (Silverman, 2017).

Moreover, there are potential unmeasured variables that may have influenced outcomes. For example, factors such as political trust and general satisfaction with the healthcare system could play a role in shaping perceptions of trust in hospital disaster risk management (Siegrist &

Zingg, 2014). Depending on whether these levels of trust and satisfaction are high or low, they could exert either positive or negative effects, yet these dynamics were beyond the scope of the present study. Other potentially relevant moderators (e.g., prior disaster experience, political trust, health literacy, cultural values) were not examined or were examined but showed non-significant effects. Future research should expand the range of tested moderators to develop more comprehensive models of trust formation and should explore whether cultural factors specific to Saudi Arabia or other contexts in the Middle East and North Africa region shape trust dynamics in unique ways.

Although these limitations are acknowledged, the findings provide a valuable starting point for examining public trust in Saudi hospitals' DRM and for identifying directions for future inquiry. Subsequent studies would benefit from adopting longitudinal or experimental designs to more robustly examine causal relationships over time, particularly in relation to the impact of DRM interventions (Menard, 2002). In addition, the use of qualitative methods, such as interviews and focus groups, would enable researchers to explore in greater depth the reasons underlying trust and distrust, whilst also generating rich accounts of cultural and individual differences (Silverman, 2017).

Future research could also expand the analytical framework to include wider contextual factors such as political trust and satisfaction with healthcare services, which may provide a more comprehensive understanding of the processes underpinning public trust (Siegrist & Zingg, 2014). Future studies should therefore build upon this research orientation, not only to advance theoretical knowledge, but also enhance applied strategies for developing more resilient and trusted healthcare systems.

4.5 Conclusion

This study set out to investigate how public perceptions influence trust in DRM with in Saudi Arabian public hospitals. By examining four interrelated variables – perceived hospital preparedness, public awareness of preparedness measures, perceived effectiveness of

communication, and satisfaction with hospital DRM practices – the study provides a comprehensive account of the key determinants influencing public trust in healthcare disaster preparedness.

The findings confirm that trust in hospital DRM is primarily determined by public perceptions of hospital performance (e.g., resource availability, response efficiency) rather than by communication effectiveness or awareness alone. Notably, satisfaction with hospital DRM emerged as the strongest predictor of trust, indicating that visible, consistent, and effective institutional action carry greater weight in shaping public judgement than informational efforts. Although public awareness and communication were positively correlated with trust, their predictive power diminished once satisfaction and perceived preparedness were taken into account. This distinction highlights that trust is cultivated not merely through institutional messaging, but more critically through what demonstrable and credible actions.

Reflecting on the study's methodological approach, the use of a regionally stratified survey combined with moderation analyses enabled a nuanced examination of how demographic factors shape trust dynamics in hospital DRM. While gender, age, and the presence of chronic health conditions revealed specific moderating effects, the findings also underscored a broader consistency in the determinants of trust across the Saudi population. These findings suggest that, although public expectation of healthcare institutions are widely shared, certain groups remain more vulnerable or critical in their trust evaluations. This reinforces the importance of DRM strategies that are simultaneously inclusive – addressing public expectations – and targeted, by responding to the distinct needs and concerns of specific demographic groups.

This study contributes to the growing body of literature by advancing an outcome-oriented perception on trust formation in healthcare DRM. By situating public trust within the socio-cultural and hazard-prone context of Saudi Arabia, the research addresses a critical gap and provides empirically grounded insights for health policymakers. The findings suggest that strengthening public trust requires a multidimensional approach encompassing institutional

transparency (e.g., clear reporting of preparedness measures), operational excellence (e.g., effective resource allocation and continuous staff training), and targeted public engagement (e.g., community workshops and feedback mechanisms).

Ultimately, building resilient healthcare systems in disaster-prone regions such as Saudi Arabia depends on alignment of hospital capabilities with public expectations. Trust in hospital DRM is fundamental to achieving effective DRM, as it underpins public willingness to engage with, participate in, and support institutional preparedness and response efforts. When the public trusts hospitals, individuals are more likely to comply with emergency protocols, seek timely care during crises, and collaborate in community-based preparedness initiatives, thereby strengthening both DRM and societal resilience in line with the priorities of the Sendai Framework for Disaster Risk Reduction. Importantly, trust is not passively conferred; it must be continuously earned through demonstrable preparedness, timely responsiveness, and sustained accountability. In this regard, this present study provides an essential foundation for the development of trust-based DRM strategies capable of withstanding future crises and fostering sustainable public–institutional partnerships.

Chapter 5 Conclusion

This thesis comprises three interrelated studies that examine public perceptions and institutional practices of disaster risk management (DRM) in public hospitals across different regions of Saudi Arabia. The chapter begins by restating the overarching aims and methodological foundations of the thesis, before turning to its principal contributions. Specifically, it underscores the value of a perception-centred, multi-stakeholder approach to understanding DRM, highlighting how public and institutional perceptions jointly shape trust and resilience in healthcare systems. This chapter then considers the theoretical, policy, and practice implications of the findings, while also acknowledging the study's limitations and their implications for interpretation. Building on these insights, avenues for future research are identified, leading to a concluding discussion that offers a balanced, yet optimistic suggestions for strengthening DRM within the Saudi Arabia's health care system.

5.1 Aims and Scope

The thesis focuses on stakeholder perceptions and practices of DRM in Saudi Arabian public hospitals. It does so by examining the perceptions of two key groups: HCWs and members of the public, across multiple regions of the country. Stakeholder perceptions are used as an analytical lens to evaluate how perceptions influence practices, and thereby affect the effectiveness of DRM strategies within the context of Saudi Arabia's unique disaster risk profile (e.g. floods, heatwaves, mass religious gatherings, and industrial accidents). The research aligns with global discourses on proactive risk reduction, aimed at enabling communities to thrive under conditions of reduced risk and enhanced security – while also emphasising stakeholder engagement and system resilience, consistent with frameworks such as the Sendai Framework for Disaster Risk Reduction (2015 – 2030) and the World Health Organisation's Health Emergency and DRM (Health EDRM) framework (UNDRR, 2015; WHO, 2019). By integrating perceptions from both internal (HCWs) and external (public) stakeholders, the study

addresses a critical gap in existing research, which has often examined either HCW or public perceptions in isolation, or has solely focused on the preparedness and response phases of DRM (Al Thobaity et al., 2015; Labrague et al., 2018).

The first study examined HCWs' perceptions of DRM strategies across all four phases of the DRM cycle (mitigation, preparedness, response and recovery), while also considering demographic and regional factors. This objective was addressed through a quantitative cross-sectional survey of 542 HCWs from 22 public hospitals across Eastern, Western, Southern, and Central regions of Saudi Arabia (the Northern region was excluded due to ethical considerations) (Chapter Two). The results indicate that HCWs perceived mitigation as the most effective DRM phase, whilst preparedness consistently received lower ratings than the other three phases. Considerable variability in perceptions was observed across regions: HCWs in the Central and Eastern regions reported higher perceived DRM effectiveness, while those in the Southern region rated preparedness and recovery particularly low. Additionally, differences emerged based on professional role, with policymakers and decision-makers expressing more favourable perceptions of DRM effectiveness compared with frontline HCWs.

The second study explored the factors impacting HCWs' perceptions of DRM efficacy, including organisational culture, individual experiences, and contextual geography. Semi-structured interviews were conducted with 24 HCWs from four hospitals, and the data were analysed using thematic methods (Braun and Clarke, 2006; Chapter Three). The analysis identified leadership, communication, training, and infrastructure as key determinants of perceived DRM efficacy. HCWs reported more positive perceptions when leadership was transparent, communication was effective, and training was conducted regularly. Conversely, limited resources, poor communication, and inadequate preparedness diminished perceived DRM effectiveness. Prior crisis experiences enhanced perceived readiness and highlighted the importance of psychological support for staff. Regional variations were also apparent: urban hospitals faced distinct challenges compared with rural hospitals, and hospitals in the Western region encountered unique pressures associated with managing Hajj. Suggested improvements for

DRM practices included better coordination of workforce capacity, enhanced regional training programmes, and investment in hospital infrastructure.

The third study examined the determinants of public trust in hospital DRM. Four hypotheses were tested, focusing on perceived hospital preparedness, perceived public awareness of hospital preparedness measures, perceived effectiveness of hospital communication regarding disaster preparedness, and perceived public satisfaction with hospital DRM. The study employed regression and moderation analyses, drawing on 436 members of the public across four regions of Saudi Arabia (Chapter Four). The results demonstrated that all four constructs were significantly and positively associated with public trust in hospital DRM. Among these, perceived satisfaction emerged as the strongest predictor of trust, while perceived communication also played a notable role within the context of service delivery. Additionally, regional, demographic, and health status variables were found to moderate several of these relationships, underscoring the importance of contextual factors in shaping public trust and informing DRM strategies.

Importantly, these studies addressed notable gaps in the literature, including the limited inclusion of non-clinical staff, the disconnection between internal and external stakeholder perceptions, and regional variations in DRM practices (Almukhlifi et al., 2021; Al-Wathinani et al., 2023). The interrelated studies adopt a multiple-methods approach, combining surveys and interviews, which provides a more comprehensive understanding of factors influencing DRM and enables the development of tailored recommendations aligned with the healthcare reforms outlined in Saudi Vision 2030 (Yousef et al., 2023). Consequently, this research represents a significant contribution to the evolution of a perception-centred models of DRM, offering insights to inform resilience-building initiatives within healthcare systems operating in disaster-prone contexts.

5.2 Contributions

This thesis advances understanding of DRM in Saudi Arabian public hospitals by providing a perception-centred, multi-stakeholder analysis that includes the perceptions of HCWs and members of the public across diverse regions. By doing so, it addresses critical gaps in existing research that have often examined these stakeholder groups in isolation.

The findings contribute to international frameworks for disaster resilience. Specifically, the study supports the Sendai Framework's imperative to understand disaster risk by examining how DRM is perceived by both HCWs and the public. It also reinforces the Sendai Framework's emphasis on strengthening disaster risk governance because the results show that leadership, communication, training, and interorganisational collaboration are perceived to be fundamental determinants of DRM effectiveness. Furthermore, the research aligns with the WHO Health Organisation's Health Emergency and Disaster Risk Management (Health EDRM) framework not simply through the act of examining perceptions, but by using these insights to identify barriers and enablers of DRM. For instance, understanding HCWs' concerns about leadership clarity and training enables targeted capacity-building, while recognising public scepticism about communication highlights the need for more transparent engagement strategies. When acted upon, these findings inform reforms that strengthen institutional readiness, thereby making resilience improvements evidence-based and context-specific. Hence, by integrating these perspectives, the thesis offers a more holistic account of DRM effectiveness and provides a foundation for inclusive strategies by ensuring that both professional and community voices inform planning, rather than privileging only clinical or managerial perspectives. It also supports sustainability by revealing systemic gaps (such as uneven regional resource distribution) that, if addressed, promote long-term institutional resilience rather than short-term, reactive fixes.

Building on this foundation, the research advances current scholarship on the role of perceptions in shaping the effectiveness of DRM strategies by elucidating the interactions between internal and external stakeholders and accounting for the influence of regional,

cultural and organisational contexts. Study One demonstrated how regional factors shaped HCWs' perceptions of preparedness and recovery, with notable variation across Saudi regions. Study Two highlighted that organisations can enhance perceptions of DRM efficacy by improving leadership clarity, fostering supportive organisational cultures, and investing in training initiatives. Study Three established that perceived satisfaction and perceived communication were the strongest predictors of public trust in hospital DRM. Collectively, the findings illustrate how perceptions across stakeholder groups and contexts amalgamate to inform DRM outcomes.

In comparison with prior research, this study provides a significant contribution, as most existing studies have focused exclusively on HCWs (Al Thobaity et al., 2015; Almukhlifi et al., 2021), examined only discrete phases of the DRM cycle – particularly preparedness (Labrague et al., 2018) – or failed to incorporate public perspectives. By encompassing the perceptions of both HCWs and the public across four regions, this thesis delivers a more comprehensive and holistic assessment of DRM effectiveness in Saudi Arabian public hospitals. This breadth is helpful because it exposes interdependencies between internal readiness and public trust that would otherwise remain invisible if each group were studied in isolation. It also highlights region-specific disparities, ensuring that proposed reforms are not generalised but tailored to the contexts in which hospitals operate.

A key contribution of the thesis lies in its comprehensive investigation of stakeholder perceptions across all stages of the DRM cycle – mitigation, preparedness, response, and recovery. This approach directly addresses a gap in prior DRM research, which has often focused disproportionately on preparedness and response, while neglecting mitigation and recovery (Al Thobaity et al., 2015; Labrague et al., 2018). By adopting a multiple-methods design, the study strengthens this contribution: quantitative surveys identified patterns such as regional and demographic variations in perceived DRM effectiveness, while qualitative interviews provided explanatory depth, revealing how mitigation, preparedness and recovery were consistently shaped by resource shortages, insufficient training, and limited leadership

clarity. The use of multiple data sources therefore enables a more nuanced and holistic account of DRM, offering both theoretical and practical insights into the interconnected nature of the DRM cycle. This contribution is significant because earlier research has tended to examine discrete phases—most often preparedness—thereby leaving critical blind spots in mitigation, response, and recovery. By systematically linking all four phases and demonstrating how weaknesses in one (e.g. preparedness) can undermine others (e.g. recovery), this thesis generates actionable knowledge that can reshape how hospitals prioritise resources and training. The result is a more integrated and forward-looking approach to resilience than was previously available.

Another notable contribution of this thesis is its integration of HCW and public perceptions within a single study. To the best of the researcher's knowledge, previous DRM research has not examined these two stakeholder groups concurrently. By doing so, this thesis highlights the reinforcing relationship between internal and external perceptions: effective leadership, communication, and resource provision were shown to enhance HCWs' perceptions of DRM, while transparent communication and visible preparedness emerged as key drivers of public trust in hospital's DRM capabilities. Evidence of this dynamic is evident across all three studies, but particularly in Study One, which revealed regional variations in perceptions of preparedness and recovery, and Study Three, which demonstrated that effective hospital communication significantly increased public trust. Taken together, these findings illustrate how internal readiness and external confidence are mutually reinforcing, thereby offering novel insights into the interconnected dynamics of DRM in the Saudi Arabian healthcare context.

Examining these dual perspectives more closely reveals how HCWs and the public assess hospital DRM differently, with important implications for policy and practice. HCWs evaluated DRM based on their direct operational experience—including resource availability, training quality, and leadership effectiveness—positioning them as insiders with firsthand knowledge of system capabilities and constraints (Al Thobaity et al., 2015; Almukhlifi et al., 2021). In contrast, the public judged hospitals based on observable factors such as communication quality,

satisfaction with previous care experiences, and general institutional trust (AlQahtany and Abubakar, 2020). This insider-outsider difference reflects fundamentally different ways of understanding hospital DRM effectiveness.

These different perspectives led to different priorities across the DRM cycle. HCWs rated mitigation highly when they observed concrete infrastructure improvements and safety measures. However, they rated preparedness lower because they directly experienced problems such as training gaps and resource shortages that remained invisible to external observers (Al Thobaity et al., 2019; Almukhlifi et al., 2021). The public did not distinguish between specific DRM phases. Instead, they formed overall judgements based on their routine healthcare experiences and information about disaster readiness (AlQahtany and Abubakar, 2020). This difference matters because HCWs base evaluations on participation in DRM activities and knowledge of operational challenges, whilst the public relies on visible indicators such as infrastructure improvements, media coverage, and general care satisfaction.

This gap creates an important dynamic. HCWs' critical views reflect professional awareness of areas needing improvement (Al Thobaity et al., 2015). However, if hospitals fail to address these concerns, staff confidence and morale may decline (Almukhlifi et al., 2021). Conversely, high public satisfaction might conceal operational weaknesses that only emerge during actual disasters. The 2015 Mecca crane collapse illustrated this issue—public confidence remained high despite hospitals facing significant challenges with surge capacity and patient management (Almehmadi and Alqahtani, 2023). Both groups agreed that leadership matters, though they defined it differently. HCWs emphasised operational aspects: clear roles, efficient resource use, and effective crisis decision-making (Al Thobaity et al., 2019; Al-Wathinani et al., 2023). The public prioritised communicative aspects: transparency, acknowledging problems, and demonstrating accountability (AlQahtany and Abubakar, 2020). This overlap suggests that leadership development addressing both operational and communication competencies could simultaneously improve internal capability and external trust. These findings demonstrate that

stakeholder perceptions operate as connected rather than independent processes, with implications for how hospitals approach DRM improvement.

A further contribution of this thesis lies in its regional emphasis. By examining HCWs across four distinct areas of Saudi Arabia – Eastern, Western, Southern, and Central – it highlights how regional contexts shape DRM perceptions and practices. For example, HCWs in the Eastern region reported concerns associated with industrial risks, while those in the Western region emphasised the unique challenges of managing mass religious gatherings such as Hajj (Al-Wathinani et al., 2023). The analysis also revealed that hospitals in the Southern region perceived more pronounced deficits in surge capacity and recovery compared to other regions. These findings underscore the need for regionally specific strategies, including enhanced training, context-sensitive surge workforce capacity, and the development of culturally appropriate recovery protocols that draw upon available local resources.

Regional analysis further reveals that both HCW and public assessments are strongly influenced by local context, including disaster types and available infrastructure. HCWs in Central and Eastern regions reported more positive DRM perceptions, associated with better resource access and more frequent training (Al-Hanawi et al., 2019; Alruwaili et al., 2022). Southern region HCWs reported substantially lower confidence, reflecting limited resources and geographic isolation (Al-Anezi, 2025; Alruwaili et al., 2021).These HCWs expressed feeling overlooked in national planning processes, believing that resource allocation favoured urban centres over peripheral regions, which created scepticism about Vision 2030 reforms (Al-Hanawi et al., 2020).

The Western region showed complex patterns. Overall perceptions were moderate, but this masked variation related to Hajj management. HCWs reported strong preparedness for managing mass gatherings but expressed concerns about the temporal pattern of intense preparation before Hajj followed by reduced focus afterwards (Almehmadi and Alqahtani,

2023). This cyclical pattern raised questions about sustained, year-round resilience (Al-Wathinani et al., 2023).

Public perceptions differed notably from HCW assessments. Public trust was highest in the Western region, likely reflecting the visibility of Hajj preparations and extensive media coverage of successful mass gathering management (AlQahtany and Abubakar, 2020). This occurred despite HCW concerns about sustainability, suggesting that public judgements respond more to visible demonstrations than underlying operational realities. In the Southern region, both HCWs and the public reported the lowest confidence levels (Al-Anezi, 2025; Alruwaili et al., 2021). This convergence suggests that resource constraints were severe enough to be apparent to both internal and external stakeholders.

These regional patterns have clear policy implications. First, uniform approaches risk misallocating resources by ignoring regional differences (Al-Wathinani et al., 2023). Second, the gap between HCW and public views in the Western region indicates that visible preparations require complementing with sustained operational readiness. Third, the Southern region's convergence of negative views signals a serious trust problem requiring immediate attention to prevent cascading failures where poor performance reduces confidence, subsequently undermining community cooperation during disasters (Al Kurdi, 2021).

These regional insights gain additional significance when considered within Saudi Arabia's unique context. Saudi Arabia presents distinctive features that make it important for advancing DRM research. This thesis demonstrates how cultural, institutional, geographic, and developmental factors create a DRM environment different from typical research settings—usually Western, high-income countries with decentralised healthcare systems (Al Kurdi, 2021).

First, mass religious gatherings create exceptional challenges. Hajj brings millions of pilgrims to a concentrated area, creating extreme healthcare demands that exceed typical emergency scenarios studied elsewhere (Gatrad and Sheikh, 2005; Memish et al., 2019). Unlike unpredictable disasters, Hajj timing is fixed, but actual health impacts vary annually based on

weather, geopolitical conditions, and disease patterns (Almehmadi and Alqahtani, 2023). This creates unique preparedness requirements: hospitals must maintain routine operations whilst developing rapidly deployable surge capacity. This dual requirement creates difficult resource allocation decisions and affects long-term planning (Al-Wathinani et al., 2023).

Second, Vision 2030's rapid modernisation situates DRM within major system transformations—including privatisation, workforce nationalisation (Saudisation), and digital infrastructure development—unlike incremental improvements in established Western systems (Al-Hanawi et al., 2020; Yousef et al., 2023). This enables researchers to observe how DRM capabilities develop during major transitions rather than stable conditions. However, privatisation introduces concerns about whether profit-focused organisations will adequately invest in disaster preparedness, which generates limited short-term financial returns (Al-Hanawi et al., 2020).

Third, Saudi Arabia's geographic diversity enables within-country comparisons that usually require multi-country studies. This approach controls for national-level factors whilst examining how local variations affect DRM perceptions and practices (Al-Wathinani et al., 2023). The findings contribute to debates about centralised versus decentralised disaster management, showing how centralised systems can concentrate resources in strategic regions whilst potentially neglecting peripheral areas where vulnerabilities may be most acute (Kattan, 2024; Alruwaili et al., 2021).

Fourth, Saudi cultural context—emphasising collective values and hierarchical authority—shapes perceptions differently than individualistic Western societies (Al-Shahri, 2002). These cultural dynamics influence how DRM policies are implemented and how stakeholders respond. The findings suggest that international frameworks may require adaptation to align with local governance structures and cultural expectations (Al Kurdi, 2021).

Finally, Saudi Arabia has received limited attention in existing DRM scholarship, which focuses disproportionately on conflict-affected Middle Eastern settings (Al Kurdi, 2021). This creates

gaps in understanding how resource-wealthy Gulf states approach disaster resilience during rapid modernisation (AlQahtany and Abubakar, 2020). By systematically examining stakeholder perceptions across regions and groups, this thesis establishes Saudi Arabia as a valuable research focus, offering insights relevant to other rapidly developing healthcare systems with centralised governance facing complex disaster challenges (Al Kurdi, 2021; Al-Wathinani et al., 2023).

In addition to these stakeholder and regional contributions, this thesis advances discussions of DRM by expanding the scope of HCWs to include non-clinical HCWs, such as administrators and directors, whose roles are crucial in ensuring logistics and communication during emergencies. Their perceptions, particularly regarding shortcomings in communication and ambiguities in leadership, underscore the organisational dimension of resilience – an aspect often overlooked in research that concentrates primarily on clinical staff (Almukhlifi et al., 2021). At the same time, insights from intensive care staff regarding situational awareness and role clarity reinforced the importance of hospital staff focused emergency plans, which are equally vital to DRM as clinical preparedness for crisis response.

From a methodological perspective, the integration of survey and interview data strengthened the robustness of the findings by enabling methodological triangulation (Creswell and Plano Clark, 2011). For example, the quantitative evidence in Study One revealed preparedness as the lowest-rated DRM phase among HCWs, while the qualitative data from Study Two contextualised this by identifying significant barriers – such as limited training and resource constraints – that shaped respondents' perception of preparedness. The convergence of both data sources thus provides a richer understanding of why preparedness was evaluated less favourably than the other DRM stages.

The findings further show that stakeholder perceptions are shaped by knowledge, prior experience and cultural context. HCWs with prior crisis management experience (e.g., managing Hajj surges) often articulated stronger perceptions of readiness, while shortages of

materials and resources contributed to scepticism and diminished confidence. Among the public, trust and confidence in hospital DRM were enhanced when hospitals demonstrated clear communication and visible preparedness, signalling institutional reliability and trustworthiness (Siegrist and Cvetkovich, 2000). These dynamics are situated within the broader Saudi cultural context, where collectivist values foster cooperative behaviours and amplify expectations of institutional accountability (Hofstede, 2010).

5.3 Implications

The findings of this thesis have significant implications for theory, policy, and practice in DRM within Saudi Arabian public hospitals. The research not only reveals pathways for strengthening resilience, but also demonstrates how stakeholder perceptions shape disaster outcomes, with regional variation exerting a notable influence.

Theoretically, this research does not propose a new departure in risk perception studies but instead provides empirical support for the Social Amplification of Risk Framework (SARF), which highlights that risk perceptions are shaped not only by cognitive judgements, as emphasised in Slovic's (1987) psychometric paradigm, but also by organisational, institutional, and cultural dynamics (Kasperson, 2022). Evidence from Study Two demonstrated that clarity of leadership, organisational culture, and prior crisis experiences significantly shaped HCWs' evaluations of DRM effectiveness, illustrating how these amplification processes operate within healthcare institutions.

In this way, the findings extend existing applications of risk perception research (e.g., Slovic, 1987; Paton, 2019) by situating organisational and cultural influences within the healthcare context, thereby reinforcing SARF's argument that perception is socially mediated rather than purely individual. Furthermore, Study Three established that public trust in hospital DRM is strongly associated with perceptions of communication and satisfaction. This finding aligns with earlier work on epistemic uncertainty (Siegrist & Cvetkovich, 2000) but applies it in a new context, namely healthcare institutions managing disaster risks.

Taken together, these insights support SARF's call to integrate cognitive, cultural, and organisational processes into understandings of risk, while also showing how these dynamics manifest in healthcare disaster scenarios. By demonstrating the interplay of these factors in Saudi hospitals, this thesis refines the specificity of SARF's application in a new sector and regional context.

The findings also carry significant policy implications, particularly in the context of the Saudi Vision 2030 initiative and the Healthcare Sector Transformation Program. Study One revealed that HCWs in the Southern region reported lower levels of preparedness and recovery capacity compared with other regions. This evidence could inform policy decisions by supporting the strategic allocation of resources at the regional level, ensuring that funding is distributed equitably, with greater support directed towards areas perceived as having weaker capacity. Study Two demonstrated that a perceived absence of leadership undermines the effectiveness of DRM, highlighting the need for targeted organisational leadership development and improved communication practices within hospital emergency planning units. Finally, the results of Study Three indicated that public trust in hospital DRM is strongly shaped by communication and satisfaction, suggesting that national health authorities should expand the use of public campaigns – through the Tawakkalna app and other infrastructures – to strengthen trust and provide reassurance during crises.

At the hospital practice level, the evidence points to clear and actionable priorities. Study One identified specific gaps in preparedness – particularly in the Southern region – many of which could be addressed through simulation training aimed at strengthening recovery planning and managing post-incident surges. The findings of Study Two underscored the need for strong leadership, justifying investments in programmes that establish a clear command structure and enhance coordination with teams. Study Three highlighted that public trust in hospital DRM is shaped largely by communication and satisfaction, emphasising the importance of communication strategies that highlight hospital preparedness and clarify available services. Hospital records also provided anecdotal evidence of e-health applications being used to share

live updates during mass gatherings, including Hajj, illustrating the roles of digital platforms in building reassurance. Nevertheless, public perceptions appear to be influenced not only by visible preparedness but also by the perceived credibility and experience of key stakeholders. Taken together, these findings suggest that effective hospital-level action depends on aligning HCW insights with public expectations, while ensuring that evidence-based measures are supported by political will and translated into targeted, practice-oriented interventions.

There are also important opportunities for greater inter-organisational collaboration. For example, hospitals, the Ministry of Health, and civil defence authorities could work together more systematically within a national DRM protocol, supported by regionally contextualised data. Such an approach would allow methodologies for future risk assessment to incorporate not only professional expertise, but also regional public interests. The evidence from Study One, which highlighted inequities in regional preparedness, could inform more equitable resource allocation, while the gaps in communications identified in Study Three point to areas requiring targeted intervention. Incorporating stakeholder engagement and perceptions into planning and development is particularly valuable. By involving diverse groups of stakeholders in preparedness design, measures can be tailored to regional needs and public expectations, thereby enhancing the responsiveness of service delivery. In turn, this collective approach strengthens the resilience of the health system to manage complex, sudden-impact events, such as climate-related disasters or other major incidents (IPCC, 2022).

In summary, this thesis presents implications across several levels. At the theoretical level, the research underscores the continuing relevance of SARF and highlights the need for greater contextual precision in risk perception studies, particularly in exploring how cognition, culture, and organisational practices interact to shape DRM perceptions in healthcare systems. At the policy level, the findings provide levers for more equitable resource distribution by drawing on contextual evidence, strengthening leadership capacity, and recognising that transparent communication models are aligned with the ambitions of Vision 2030. At the practice level, the results point to actionable opportunities in training, leadership governance, and public

awareness initiatives grounded in the evidence generated by three studies. Finally, the findings underscore the importance of inter-organisational collaboration and stakeholder engagement in developing national DRM planning, while also emphasising that public recognition of HCWs' perceptions and trust is integral to building resilient health systems.

5.4 Limitations and Future Directions

While this thesis provides valuable insights into stakeholder perceptions of DRM in Saudi Arabian public hospitals, several limitations constrain the scope and generalisability of its findings. Acknowledging these limitations facilitates the identification of areas where further inquiries or alternative approaches could prove beneficial. Each limitation identified points towards future research opportunities that could deepen understanding of DRM in the Saudi context and contribute to strengthening the resilience of its healthcare systems.

Firstly, the exclusion of the Northern region of Saudi Arabia – due to time constraints in obtaining ethical approval – limits the study's ability to present a fully national profile of geographic risk (Al-Wathinani et al., 2023). The Northern region may face distinct challenges for DRM effectiveness, particularly owing to geographic isolation and the resulting difficulties in accessing specialist resources For example, during disasters, remote areas such as Jazan may experience delays in receiving medical assistance (Moafa et al., 2021; Al-Anezi, 2025).Future research should therefore aim to include the Northern region in order to strengthen geographic representation across Saudi Arabia. Employing a comparative mixed-methods design could further examine how geographic isolation influences HCW perceptions of inter-facility coordination, as well as public trust in remote hospitals. Expanding the geographic scope of future studies would improve national representativeness and generate a stronger evidence base to inform equitable policy interventions.

Secondly, the study focused exclusively on public hospitals governed by the Ministry of Health, and did not include private hospitals operating under alternative resource and governance frameworks (Alkhamis, 2012). Given that privatisation is a central component of Vision 2030,

the restriction to public hospitals limits understanding of how different governance models may shape perceptions of DRM (Al-Hanawi et al., 2019). Addressing this gap would require comparative research examining private hospitals alongside public institutions alongside public institutions, to evaluate differences in perceived preparedness and public trust. Such comparative studies could determine whether the resource advantages of the private sector translate into higher stakeholders' perceptions of preparedness and trust and could also inform the development of a policy framework for public-private partnerships in DRM.

Thirdly, the use of self-reported perceptions introduces potential bias, as respondents' answers may be influence by prior experiences, cultural norms, or social desirability (Slovic, 1987; Hofstede, 2010). For example, HCWs who have managed high demand events such as Hajj surges may overestimate levels of preparedness, while public trust may rely more on media portrayals than on actual hospital performance (Kasperson et al., 1988). Future research could address these limitations by combining perception-based data with objective DRM indicators, such as supply chain audits and assessment of infrastructure resilience (Zhong et al., 2014). Mixed-methods approaches offer an opportunity to triangulate stakeholder perceptions against operational metrics – such as the WHO Hospital Safety Index – to evaluate whether stakeholders accurately represent capacities of healthcare facilities.

Fourthly, limitations in the sample may affect the representativeness of the findings. While the study included 542 HCWs and 436 members of the public across four geographic regions, the exclusion of small hospitals and rural populations may have under-represented the perceptions of under-resourced communities (Creswell and Plano Clark, 2011). Similarly, the qualitative sample of 24 HCWs did not achieve full thematic saturation (Vasileiou et al., 2018). Future research could address these limitations through longitudinal or large-scale designs, such as national surveys or repeated cross-sectional studies, which would capture changes over time and enhance representativeness. Tracking perceptions over the course of ongoing Vision 2030 reforms (Hassounah et al., 2020) – including Saudisation and digital transformation – would

provide robust, evidence-based insights into how policy changes influence the perceptions of both healthcare workers and the general public regarding disaster risk management.

Fifth, while this thesis has predominantly focused on perceptions and perception-based outcomes, it has not directly addressed structural and operational factors, which the literature identifies as crucial to effective DRM (e.g. Zhong et al., 2014; Almukhlifi et al., 2021). Perceptions are inherently subjective and limited (Perrow, 1984), and focusing solely on them carries the epistemological risk of overlooking how structural and operational realities – such as the availability of funding or staffing – affect disaster response. Future research could integrate perception data with objective assessments of structural and operational conditions. For example, experimental designs could evaluate whether targeted digital communication strategies (via platforms such as Tawakkalna or Sehha) enhance public trust during floods or Hajj-related surges, thereby improving the credibility and effectiveness of DRM interventions (Covello, 1992; Hassounah et al., 2020).

Finally, this project has acknowledged but not fully explored the role of non-clinical HCWs in DRM. Nevertheless, the interviews highlighted that contributions from non-clinical staff, particularly in logistics and communication, are essential to effective healthcare response (Balay-odao et al., 2021). Future research could employ case studies, simulations, or experimental designs to examine how ambiguities in the roles of administrative staff, interactions with other team members, and overall team collaboration influence perceived preparedness. Such studies would address the current clinical bias in disaster management literature (Almukhlifi et al., 2021) and provide a more comprehensive understanding of organisational behaviour and system resilience beyond strictly clinical considerations.

In conclusion this research contributes to a nuanced understanding of DRM in Saudi Arabian public hospitals. The identified limitations indicate that future research should expand the geographic and institutional scope, integrate perception-based and objective indicators, develop larger and more representative samples, and actively engage under-represented

stakeholder groups in disaster resilience (Almuhri et al.,2022). Addressing these gaps will enable more comprehensive evidence generation, supporting national DRM objectives aligned with Vision 2030, while also contributing to global priorities for health system resilience.

5.5 Conclusion

This thesis provides a foundation for understanding DRM in Saudi Arabian public hospitals from the perspective of stakeholders, highlighting how HCWs and the public contribute to resilience across different regional contexts. Integrating perceptions from both groups across all phases of DRM – mitigation, preparedness, response, and recovery – offers a more holistic assessment of hospital preparedness and aligns with both national and international frameworks for health system resilience. However, several limitations, including the exclusion of the Northern region and private hospitals, as well as reliance on self-reported data, caution against the universal application of the findings. It is therefore important to recognise the promising insights regarding the development of hospital-based DRM in Saudi Arabia, while also situating these findings within the specific contexts that shaped stakeholder perceptions and the outcomes or this research.

The results highlight a dynamic interplay between HCWs' perceptions of DRM effectiveness and public trust, both of which are shaped by organisational culture, prior experiences of crises or disruption, and prevailing regional risk perceptions. For example, HCWs in the Southern region reported lower perceptions of preparedness and recovery capacity compared with colleagues in other regions. Members of the public emphasised the importance of effective communication for building trust. Taken together, these findings indicate that strong leadership, consistent communication, and sufficient resources within disaster response frameworks can enhance both HCW confidence and public trust, thereby supporting more resilient responses. Such interactions are particularly critical during high-pressure events, such as the Hajj, where robust hospital preparedness and clear communication can alleviate systemic strain and improve crisis management outcomes.

By synthesising findings from the three combined qualitative and quantitative studies, this thesis provides a comprehensive account of DRM (hazard management) informed by multiple stakeholders, thereby extending beyond previous research that focused solely on HCWs or on individual DRM phases such as preparedness or response. The inclusion of non-clinical staff and the consideration of regional risk perceptions adds further complexity, demonstrating that hospital resilience is non-linear and encompasses not only clinical expertise, but also organisational capacity, governance and administration. These findings contribute to the existing healthcare DRM literature by delineating how stakeholder perceptions influence overall outcomes, while also highlighting areas for future development, including addressing leadership deficits and communication barriers that may hinder effective disaster response and resilience-building.

Future research could build on this work by including private hospitals, extending coverage to the Northern region, examining stakeholder perceptions longitudinally across multiple events, and integrating both perception-based and objective measures of DRM. Pursuing these avenues would strengthen the evidence base, providing more robust guidance for policy and practice.

In summary, this thesis has advanced a perception-based understanding of DRM in Saudi Arabian public hospitals. While recognising structural and cultural challenges, it demonstrates how simultaneously considering HCW and public perceptions can inform tailored interventions and foster trust, thereby supporting ongoing resilience and preparedness in health systems that regularly face disasters. Furthermore, these findings are considered within the context of international frameworks, such as the Sendai Framework and WHO Health EDRM plans, as well as national priorities under Saudi Vision 2030, providing foundational recommendations for evidence-based interventions that are well-suited to the Saudi healthcare context.

Appendix A Questionnaire

Section 1: Basic Information of Respondent Biodata

1.1. What is your gender?

- Female
- Male

1.2. What is your age in years?

1.3. What is the highest level of education you have already achieved?

- Doctoral degree or above
- Master's degree
- Diploma degree
- Bachelor's degree
- High school
- Other------

1.4. What is your occupation?

- Doctor
- Nurses
- Pharmacy
- Specialist
- Technician
- Administrators
- Other-------

1.5. Please select the region where your hospital is located:

- Central Region
- Eastern Region
- Southern Region
- Western Region

1.6. Please indicate your departmental affiliation

- Clinical Staf
- Non-Clinical
- Other-----

1.7. How many years of experience do you have working in a hospital?

- ------

1.8. Have you participated in creating new guidelines and emergency plans and making decisions during disasters?

- Yes
- No

Section 2: Disaster Resilience in Hospitals

Statements For each of the statements listed below, please indicate your level of agreement.	Please tick one for each statement				
2.1. Mitigation: *The mitigation phase occurs before a disaster and is the effort made to reduce the future effects of disasters.*	Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
2.1.1. My hospital has effective security and safety department that reduces the					

	risk of disasters and build hospital resilience.					
2.1.2.	My hospital has effective and participatory leadership that reduces the risk of disasters and builds hospital resilience.					
2.1.3.	My hospital has a strong infrastructure that can minimise the impact of a disaster. *(Disaster resilient infrastructure; includes vital buildings, public communal facilities, transit systems, telecommunications, and power systems that are strategically designed to withstand the impact of a disaster)*					
2.1.4.	My hospital reduces the risk of disasters and builds resilience by collecting, analysing and effectively utilising disaster information related.					
2.1.5.	My hospital has a disaster command committee that develops and implements policies for a disaster.					
2.2.	Preparedness: *The preparedness phase includes the actions taken in a disaster to facilitate response and promote readiness*.	Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
2.2.1.	The financial resources that my hospital has for enhancing disaster preparedness are adequately allocated.					
2.2.2.	In the case of a disaster, my hospital can increase the number of health					

	professionals, other staff members and volunteers.					
2.2.3.	In the case of a disaster, my hospital can activate the disaster plan to maintain essential hospital services *(surge capacity of beds, space, resources and key staff)*.					
2.2.4.	My hospital plans to cooperate with other hospitals and National Centre for Crisis and Health Disaster Management to secure additional resources and transfer patients.					
2.2.5.	My hospital provides training and workshops on disaster management skills to the workforce and volunteers to ensure they can manage a disaster effectively.					
2.3.	Response: *In the response phase, actions taken during disasters can save lives, reduce losses and alleviate suffering*.	Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
2.3.1.	My hospital has an effective emergency plan involving a triage protocol for a disaster.(Triage protocols in this context prioritise treatment for the people with the most significant medical needs)					
2.3.2.	In response to a disaster, my hospital can provide medical resources and supply products in a timely manner.					
2.3.3.	During a disaster, my hospital uses technology effectively for communication and sharing					

	information with other healthcare organisations.				
2.3.4.	My hospital has an effective strategy to evacuate and protect its staff, patients, and visitors in the case of a disaster.				
2.3.5.	In order to prioritise and maintain essential functions during a disaster, my hospital implements efficient strategies to assign staff to roles.				
2.4.	Recovery: *The recovery phase consists of the actions taken after a disaster to restore and resume normal operations.*	Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
2.4.1.	Following a disaster, my hospital effectively utilises information about losses and damages in the incident report and assessment.					
2.4.2.	My hospital utilises the feedback and analysis of emergency information to enhance and develop a hospital disaster plan.					
2.4.3.	My hospital has clear procedures and strategies to recovery from a disaster.					
2.4.4.	Following a disaster, my hospital updates its courses and workshops on disaster management.					
2.4.5.	My hospital can recover rapidly from disasters.					

Appendix B Interview Questions

Section 1: Some general definitions

Disaster risk management:

It is a set of policies, procedures, and activities followed to reduce the impact of natural and human-made disasters and confront them efficiently. This process includes four main stages: mitigation, preparedness, response, and recovery.

In the hospital context, Disaster risk management is essential, as hospitals are vital places for medical care and emergency response.

Mitigation:

General definition: It is the application of procedures designed to reduce the potential impact of disasters before they occur.

In the hospital context, it refers to actions taken to reduce the negative effects of potential disasters, such as strengthening hospital infrastructure to withstand earthquakes or preparing plans to confront outbreaks of infectious diseases.

Preparedness:

General definition: It is planning and training to deal with disasters that may occur in the future.

In the hospital context: This includes training staff on how to deal with emergency situations, storing necessary medical resources and equipment, and preparing emergency response plans.

Response:

General definition: It is the application of specific procedures and plans to deal with disasters at the moment they occur.

In the hospital context: These procedures include providing medical care to the injured organising and distributing resources and communicating with other concerned parties.

Recovery:

General definition: It is the stage that comes after disasters and aims to restore the normal state.

In the hospital context: This phase involves addressing the long-term consequences of disasters, such as providing psychological care to patients and staff and rebuilding or renovating damaged facilities.

Organisational culture:

It is a set of values, beliefs, expectations, and behavioural patterns shared by members of an organisation and considered distinctive of that organisation. Organisational culture significantly affects how individuals interact within an organisation and how the organisation interacts with its external environment.

Self-efficacy:

It is the belief in an individual's ability to successfully carry out the tasks required of him. In other words, it is the extent to which a person believes he can achieve his goals.

Sction2: Interview guide for semi-structured interviews

Thank you for taking the time to answer the questions. I want to assure you that the identity of the person participating is kept strictly confidential.

Section 2: General questions

2.1. Occupation:

2.2. Years of Experience:

2.3. General assessment of disaster risk management

- How do you feel disaster risk management is effective at your hospital?
- If you feel it's not effective , please answer the next question:
- What caused the failure?
- What barriers did you face in the mitigation, preparedness, response, and recovery phases (you will want to review some general definitions)?
- What recommendations do you have to improve effective in these phases?
- If you feel it is effective please answer the following questions:
- What strengths can you see in risk management?
- What worked well in the mitigation, preparedness, response, and recovery phases (you will want to review some general definitions)?
- What recommendations do you have to further improve the effectiveness of disaster risk management?

2.4. : Impact Organisational culture on healthcare workers' perceptions

- How would you describe the culture of your health organisation and, in particular, the culture surrounding disaster preparedness and response.
- What is the impact of culture on your job satisfaction and performance?
- What role do you think good leadership plays in healthcare workers' perceptions and preparedness?
- Does your organisation communicate effectively as leaders when faced with crisis situations?
- What is the importance to you, of quick access to high-quality information during health crises?

- Have you experienced crises for which, as in the case of COVID-19, you felt your organisation was unprepared? What effect did this have on you and your colleagues?
- How does your organisation ensure healthcare workers receive correct, timely information during a crisis? Does an increasing knowledge of disaster preparedness improve the sense of capability to manage these situations? Do you understand what your organisation expects from you in disasters? Do you feel prepared in that regard? How confident are you in your and your organisation's response to a disaster? What influences your confidence in that?
- How do you view collaboration between your organisation and other organisations when undertaking disaster planning and response to events with external stakeholders including government/policy agencies? What could improve that collaboration?

Third: Influence Experiences related to perceptions of healthcare workers

- Have you experienced any unusual emergency? How did this impact your preparedness?
- Have your prior disaster experiences changed how you managed stress in a crisis?
- Do past disasters help or hinder your urge to be involved in disaster responses?
- Does a sequence of disaster events contribute to a greater preparedness and resilience to help in the future?
- Have your worries around personal safety curtailed your participation in disaster response?
- How might organisations help healthcare workers mitigate their own personal safety concerns?
- Have mental health issues impacted your work in a disaster negatively?
- How should issues of stress and anxiety be addressed during disasters?
- How much did disaster management training increase your confidence in your ability to deal with any emergence?
- What were the key elements of your disaster planning training?
- Are you aware of your hospital's disaster plan?
- In what way do access (or lack of access) to resources affect your ability to be prepared for disasters?
- Have you experienced a lack of resource issues in your disaster experiences, that impacted your ability to care?
- Does your workplace's culture and your safety practices give you confidence or reassurance your ability to operate in disasters?

- How does your self-efficacy affect your ability to engage with disaster response?
- Are you more or less likely to engage in disasters because of infectious disease (i.e., COVID)?
- What responsibilities will you need to consider engaging in disasters with an element of infectious disease?

Fourth: The effect of geography on the perceptions of healthcare workers

- How does the geographic location of a hospital (urban or rural) affect your strategies involved in disaster preparedness?
- Does geographic location also relate to the number of medical resources available in your area of the country?
- Does the hospitals location pose barriers or benefits relating to emergency communications?
- How do the learning and development opportunities in the central Region compare with the rest of The Kingdom?
- How do the geographic location and culture of the X region affect health issues?
- What unique opportunities to network in the X region affect your professional development?
- Are there systemic issues in health care in the central region that are different from other regions?
- Aside from people, what health resources are plentiful in the X region?
- Aside from geography, what are the mechanisms for health resource allocation throughout The Kingdom?
- To what extent is health care practice being influenced by local culture?
- To what extent do patient habits/behaviours differ across regions and how does that effect health care?
- What suggestions will you make to improve health care in x region?

Section 3: Closure

We have covered a lot today. Thank you for all of your willingness to discuss.

- Do you think there is anything we have not touched upon?
- Do you have anything further you would like to add relating to what we discussed or the research?
- We will provide you with the recorded transcript of the interview so you can ensure that your comments and my interpretations were clear.

You are free to request a full copy of the report when the study is complete.

Appendix C Additional Insights into HCWs' Quotes

C.1 HCWs' Quote on the Role of Organisational Culture in DRM

Theme	Sub-theme	Sub-sub theme	Definition	Quotes
Organisational Culture's Role in DRM	Leadership during crisis	Effective Leadership	Effective crisis leadership is characterised by strategic guidance, decisive action, and fostering collaboration.	• "Competent leadership is an integral part of enhancing patient care by changing the orientation of its value system, focusing on patient centeredness, and creating a positive work culture." (P1, Central Region). • "The effectiveness of leading and communicating in times of crisis in the organization, is key. Good leadership lays the groundwork by identifying drivers driving the issues, developing a response, and providing suggestions that would help us avoid the crisis in the future." (P1, Central Region). • "Yes, we have good leadership." (P3, Central Region). • "Yes, we have great leaders, we have a great executive director, who has great leadership skills, who can help them balance both intellectual, emotional and administrative body work and the pressure." (P4, Central Region). • "My hospital handled COVID-19 really well, because of our leadership and how they manage issues and process." (P4, Central Region). • "Leadership at this level is really effective in communication and actions." (P5, Central Region). • "The Task Force and Command Team both did incredible work, there was collaboration from every department and everyone was prepared." (P6, Central Region).

				• "Leadership was proactive with lots of circulars that provided updates and alerts on standards and plans that were sent out regularly on the hospital's page." (P2, Eastern Region). • "The leaders were excellent and very nimble." (P6, Eastern Region). • "The current generation exhibit great discipline, mental capacity and willingness to be informed and situationally aware." (P4, Western Region). • "An effective commander greatly influences the ability of personnel to be prepared by taking risks seriously and clearly articulating what to expect in a disaster." (P5, Western Region). • "Excellent leadership was apparent when the command meeting happened every day from the top of management down to the operational level to support swift decision making. Issues and requests move quickly to deploy action." (P6, Western Region). • "Our hospital has strong leadership and engaged staff for disaster risk management." (P4, Southern Region).
		Ineffective Leadership Communication	Ineffective leadership in DRM is marked by communication gaps, administrative inadequacies,	• "One of my big concerns is the leadership's lack of respect for specialised areas like risk and disaster management. Many administrators fall back on the medical experts who may not have the administrative training to accompany the medical expertise. Besides, there is not much administration to clinical staff communication, and where it exists, there is performative action instead of genuine concern for the impact." (P4, Central Region). • "There is a clear disconnect with senior leaders and administrators and doctors in clinical decision-making." (P4, Central Region).

			and bureaucratic challenges.	• "At the level of leadership when I communicate and act, there is a response. However, the responses diminish further down the hierarchy where education and respect for administrative protocol is necessary. " (P5, Central Region). • "Unfortunately, it is with no responsibility, and obnoxious obstinacy, within the employee group, as well as the leadership team. " (P1, Western Region). • I can voice my complaints about the current ubiquitous bureaucracy related to the Ministry of Health. " (P1, Southern Region). • "Bureaucratic process has been ineffective with emergency situations." (P1, Southern Region). • "There are many administrators, no specialism in the necessary area." (P1, Eastern Region). • "After an emergency, we gather for a debrief and critically analyse the event. What worked well and what could we have changed?" (P2, Southern Region). • "The ineffectiveness is due to factors such as lack of training and absence of leaders scientifically knowledgeable in disaster risk management." (P3, Southern Region). • "There is a mentality of not being open to the knowledge in areas outside of speciality: nursing or medicine personal care, that can contribute to job performance. For example, the challenge in convincing management to consider the risk of preparation for practice and emergencies whether they are internal and external emergencies despite direction from the National Centre for Crises and Disasters. " (P5, Southern Region).

				• "I have observed no effective communication from the management of the health facility during an emergency or disaster." (P5, Southern Region).
	Emergency Management	Crisis Preparedness	Crisis preparedness is characterised by effective interdepartmental collaboration, well-developed response plans, and a culture of safety and employee awareness in DRM.	• "I think the risk management is clearly working. I say this because the infection control unit correctly collaborated with the emergency unit, clinics, and we executed our plans" (P2, Central Region). • "In the beginning, it seemed like things happened overnight, and quickly. But we talked, we had meetings, we developed plans and we made effective decisions" (P2, Central Region). • "We received timely updates and we had very comprehensive plans in place" (P1, Eastern Region). • "The standards that we had in place were not only clear but we also executed them effectively" (P4, Western Region). • "Our clear planning mechanisms come from past experience during crises, which we both learned and were prepared for, and we improved our response strategies, especially due to COVID-19." (P6, Western Region). • "I am confident in this hospital's disaster risk management. The mechanisms are generally effective, and the facility has a solid plan and appropriate disaster response procedures." (P4, Southern Region). • "Even though our pre-planning and structure are top level in terms of operations and nothing is unplanned, I think that we do not practice what we preach." (P1, Southern Region).

				• "Our disaster preparedness plan encompasses building infrastructure, employee requalification, the ability to resume operations in the wake of a disaster, as well as the supply and service position before the disaster. It takes seriously increasing employee awareness of disaster risk management through safety training, providing employees with appropriate safety equipment, and developing a culture that ascribes to the safety of healthcare workers" (P4, Southern Region). • "Every health facility/institution has a disaster and crisis management department that has a detailed plan for how to follow each of the emergency procedures explained" (P6, Southern Region).
		Team Coordination	Team coordination is demonstrated through a crisis management team's proactive preparation and unified response to crises	• "The organization has a superior reliance on a crisis management team that is well trained in advance, and will act on instructions from the crisis commander or manager, who will keep the team informed of all actions to be taken by the team" (P1, Central Region). • "In my opinion the risk management is well done, as I have seen the meeting of the infection control unit, emergency unit, clinics and how they were implementing their plan" (P2, Central Region). • "With the COVID-19 pandemic, importance was given to infection control with security and safety management team looking after organizational issues" (P4, Central Region). • "I think our disaster management team is beneficial because they advised the hospital during COVID-19 in managing the operations of the hospital" (P2, Eastern Region). • "It is the team that managed the security and safety aspects, and they have managed to make us aware of how to deal with chemical incidents" (P5, Eastern Region).

				• "The support from the clinical staff was great, which was demonstrated by the formation of a disaster management team in the hospital" (P6, Southern Region). • "Every health facility, institution, must always have a disaster and crisis management department that develops a comprehensive plan identifying all procedural procedures for any disaster. It is irrelevant whether the disaster occurs due to war, traffic accidents, earthquakes or floods, once it involves the hospital it is an organization that deals with treating the victims of any events and saving lives" (P6, Southern Region).
		Infrastructure Challenges	Infrastructure challenges in DRM point to outdated hospital facilities, inadequate emergency exits, and susceptibility to environmental damages such as flooding.	• "Most of the hospitals in the area are old - only a small handful are new. Only three or four have very modern facilities, otherwise most have dated infrastructure." (P1, Southern region). • "The hospital's infrastructure was disturbing, including its building and emergency exits. For instance if there was a fire, the distance of the exits from patients is a worry. Also, we had storage that was subject to flooding; we experienced loss from significant rains." (P3, Western region). • "Several hospitals here are ill-equipped for the weather, particularly heavy rain or leaks." (P5, Southern region).

		Effective Communication	Effective communication is integral to DRM, ensuring timely and accurate information flow and interdepartmental coordination.	• "Receiving quality information at a time of health crisis is important because it leads to a higher level of patients satisfaction, better health care, and ultimately better results." (P 1, Central Region) • "I think the coordination between infection control, emergency services, and housing management was appreciated. For example, during the Corona, if a nurse was diagnosed with the virus or a close contact, housing offered a separate building for isolation." (P 2, Central Region) • "There was teamwork and communication 24 hours a day, every day, on WhatsApp." (P 6, Central Region) • "We got information from the portal, which was updated and standard process, made sure the information was available in a timely manner and everyone knew." (P 2, Eastern Region) • "All communication was official through email, and some decisions were discussed internally and quickly." (P1, Western Region) • "We find communication works well because of the training for catastrophic events. The plan for a mass casualty is that all departments work together, and provide communication and management across all departments." (P 2, Western Region) • "We pull information together, and produce an analysis of the information, and we provided updated and accurate information to our staff. We use twitter, Snapchat, channels to stream instructions and information." (P5, Western Region)

				• "Because we are associated with the MoH, and tied into the Red Crescent and Civil Defence, we receive instant notification of incidents when it is reported by the Red Crescent." (P 2, Southern Region) • "We have team meetings after any emergency to evaluate what happened - This was helpful in determining our successes and challenges and identified what we do well and what we need to improve." (P2, Southern Region). • "In the end it came down to fast and effective communication." (P6, Southern Region)
		Proactive Adaptation	Proactive adaptation in DRM involves early plan updates and technological integration for improved health service delivery and communication	• "We take initiative with our plans and strategies for the hospital ahead of time before reporting to the Ministry of Health. For example, prior to the implementation of the Tawakkalna application, we implemented a protocol for patients who received a clearance to work after recovering from the Corona virus. The patients needed to secure a clearance from the employee's clinic to confirm they were no longer infected and could return to work. By the time the Tawakkalna application arrived, we were ahead, and we reported with it! I believe this was a collaborative initiative: infection control unit, emergency departments, clinics, and we implemented our plans." (P2, Central Region). • "Our department took the lead foreseeing the future of telehealth and the potential of virtual family medicine clinics at Al Saud University. Surprisingly, we got the online patient communication process started as fast as we could. This included taking time to instruct the patients to use the technology-the learning curve was very steep for some-

				and helping them get past the system and prescription challenges- particularly the aged. But it was totally successful through collaboration and networking." (P6, Central Region). • "It is important to keep technology, laws, regulation and resources updated." (P2, Eastern Region). • "During the time of Corona, we had two platforms for information management. The first platform was for updating bed availability, whether we had openings or were full, and the availability of personal protective equipment. All hospitals, the Red Crescent, and the Ministry of Health were accurately informed and coordinated." (P5, Eastern Region). • "Communication begins with the leader to communicate to a employee. You can have all the technology in the world, but it must be activated and used properly." (P1, Western Region). • "Although it is important to consider advanced technology for coordination and communication purposes as emergencies unfold. (P4, Southern Region).
		External Collaboration	External collaboration enhances DRM through certification, assessments, and supply chain centralisation.	• "Spahi is an organization that assesses health facilities and issues accreditation based on their compliance with Canadian standards. The accreditation has developed disaster management certification in its health accreditation program, which is a requirement for all health practitioners for contract renewal. The certification with regards to disaster and management has an oversight via the infection control unit, prevention focus as well as security and safety certificate. This was the second year it was implemented. The training has been excellent and very informative, to be honest." (P4, Central Region). • "Working with outside sectors was extremely well and adaptable." (P1, Eastern Region).

				• "Our success of disaster management was greatly enabled us to manage the disaster by SPH assessments, and JCI which is an international accreditation periodically every third year. They have assessments that allowed us to adapt. The disaster piece was my first experience with a disaster with Corona pandemic. We developed the team and made sure we followed the safety measures." (P1, Western Region). • "At first we were struggling with COVID-19 testing availability, we started to send samples to the Ministries of Health's regional and central labs." (P6, Western Region). • "The hospital developed relationships with a large number of external governmental organizations, international organizations for future preparedness in any disaster." (P4, Southern Region). • "Supply chain fragmentation was eliminate by having our vendors consolidated with NOBECO, as they are a company with an A to Z approach to solutions and supplies. Centralization made communication simple as we coordinate with one company, making transitions between contract suppliers easier." (P5, Southern Region).
	Training during crisis	Training Gaps	Training gaps in DRM are identified as disparities between provided and required crisis management	• "On the subject of training, my experience was primarily self-directed. It was not my expectation to receive formal training. Most of the guidance was from other nurses who explained how to use it, and what processes to follow" (P4, Central Region). • "I can say that there has been a lot of shortcoming from the administrative staff with training. And to be honest, while the frontline employees received some training, I could not say if it was effective. The best I can say is that our hospital departments have tried to plan regular training bi-weekly or monthly, focusing on emergency planning such as responding to a fire and gas leak, or patient emergencies" (P5, Central Region).

			training within the hospitals.	• "I wish our hospital would make education a hospital program, not an initiative or product of a person or manager" (P3, Eastern Region). • "We trained ourselves. No educator was brought in for us" (P1, Western Region). • "Although we do drills every six months, the seriousness level of how the staff treat the exercise is not the same as responding to a real emergency" (P6, Southern Region). • "We have identified some very significant gaps in our own professional development and our own staff training; and as a result there are many organizational problems and frustrations with the hospital" (P6, Southern Region).
		Continuous Education	Continuous education for DRM includes periodic and comprehensive training sessions to maintain a high level of preparedness.	• Yes, the periodic and annual training and drills go a long way to preparing us. (Pt 1, Central Region). • "The training was excellent, being periodic and timely," (P2, Eastern Region). • "The periodic updates make us always ready for everything. For example, we are either annually or semi-annually trained on the protocol for outside emergencies." (P 2, Eastern Region). • "When it comes to internal disasters, we are doing training on a weekly basis, and part of that training is simulations which allows for understanding by all as to their role in a crisis," (P3, Eastern Region). • "Within our department, they can experience training as a new hire including a general orientation on the hospital which covers safety, risk, and disaster management. Also, any contract renewals require employees to take a written and practical test, and that information is in written form in a performance report sent to HR," (P4, Eastern Region).

				• "We make regular updates, unannounced training practices - like we had for 'Code Black' (explosion) to evaluate our response to emergencies and to know employee participation, and to highlight any gaps." (P 5, Eastern Region). • "we are trained on the management of 'Code Orange' around chemicals incidents. The safety and security department has trained us well on the procedures and provided us materials to help us around plans, standards, and actions." (P6, Eastern Region). • "We are regular to the training especially with our comprehensive and pragmatic exercises even before there is a disaster ever." (Participant 3, Western Region). • "We have a training and it is ongoing for emergency situations." (P4, Western Region). • "Disaster risk management training is regularly exercised and or activated based on need." (P4, Western Region). • "Training is important and is also linked to the renewal of contracts. Everyone in management will receive basic and nurses and doctors will be provided more intense training." (P6, Western Region). • "The hospital has training exercises that regularly take place to allow for informing employee awareness." (4, Southern Region).

C.2 HCWs' Quote on Personal Experience and DRM Perceptions

Theme	Sub theme	Definition	Quotes
Personal Experience and DRM Perceptions	Supportive Culture	Supportive culture in DRM encompasses organisational responsiveness, psychological and material aid, and collaborative spirit among staff.	• "I would say we went through this step with an understanding and coverage of the work that was extensive and we also had psychological support from our colleagues" (P2, Central Region). • "The hospital dealt with everything by housing employees, they offered both material and psychological support quickly, and offered what was needed as resources and equipment" (P3, Central Region). • "There was a lot of order in our units, our departments mainly. The director was very involved in this, and we supported each other and showed her some attention. If employees had questions, she would answer them without delay" (P2, Eastern Region). • "Of course, if the manager is there to talk to, listen to any questions or comments I have, it will enhance my working environment" (P2, Eastern Region). • "Fortunately, every time we made a request, we would either get an answer to it, or my supervisor would tell me quickly what our actions or developments would be, along with any updates providing new information about the question" (P6, Eastern Region). • "I can manage my stress at virtually any time, and it helps to provide that support to my co-workers" (P1, Western Region). • "There was an excellent initiative, as health sector colleagues completed their holiday early and worked overtime to assist" (P6, Southern Region).

	Learning from Experience	Experiential learning in DRM fosters self-efficacy, improved preparedness, effective stress management, and confident crisis response.	• "Learning from past experiences empowers you with the strength and courage to address and improve upon failures for future betterment" (P1, Central Region). • "Self-efficacy aids in enhanced preparedness, leading to diminished fear, anxiety, and potential losses to the institution. Experiences from past disasters shape your approach to stress management in crises, fostering the development of strategies to manage stress effectively in future scenarios. It also encourages a focus on the constructive actions taken during these experiences, rather than the emotions experienced" (P2, Central Region). • "I believe that our experiences with the Middle East Respiratory Syndrome have expanded our capacity to manage COVID-19 effectively" (P2, Eastern Region). • "Our readiness and response mechanisms are well-defined, drawing from prior crisis experiences to improve our preparedness and response strategies. Notably, the availability of personal protective equipment during the COVID-19 pandemic was a testament to this preparedness" (P6, Western Region). • "Indeed, my previous experiences with disasters have shaped my approach to managing stress in crisis situations. I've learned that focusing on the immediate tasks and taking incremental steps is the most effective way to manage stress. Additionally, I've recognised the importance of communication and seeking assistance when necessary" (P4, Southern Region). • "Certainly, my increased knowledge has bolstered my confidence in handling these situations effectively" (P4, Southern Region).

	Organisational Trust	Organisational trust in DRM is based on preparedness, capacity, and continuous improvement, leading to confidence in crisis management.	• "I feel very confident in my organisation's disaster response capability, given my training, the preparedness planning, training, resource allocations, etc., our institution has in place as well as having recovery strategies, etc. Planning may change, we may not have resources or manpower, we may not have post-crisis psychological support, etc, which makes me less confident" (P1, Central Region). • "I trust my Hospital's capabilities of crisis management and it is willing to continue to learn and develop solutions" (P2, Central Region). • "Because of xx Hospital, I have the skillset and resilience to deal with any disaster no matter where it is in the world. I believe this has made us incredibly stronger, and I have confidence I can handle any type of emergency situation" (P1, Eastern Region). • "I have confidence that our hospital can respond quickly to crises because Ministry of Health will be the first responder, followed by the military. So there is more preparation, otherwise it would only be responding to the life-threatening situation" (P3, Eastern Region). • "I think our medical city could manage most disaster scenarios. The challenge is the unknown disasters that are not in the risk assessment" (P5, Western Region). • "Our hospital's capacity is clearly highlighted by the number of beds we have as well as the enhancements undertaken recently within the emergency department and other departments within our hospital" (P1, Western Region). • "I have trust in our hospital, it is safe and secure" (P4, Western Region). • "Is there trust? Yes absolutely, the bed capacity for the hospital and the most recent upgrades makes me more assured" (P1, Western Region).

			• "I am confident that we can respond to disaster events due to having a robust plan" (P4, Southern Region).
	Psychological Support	Psychological support in DRM is critical for HCW well-being and involves dedicated clinics, online programs, and efforts to reduce stigma.	• "The organisation can support healthcare providers provided them comfort and psychological comfort" (P1, Central Region). • "Prior to the COVID-19, we created a psychiatric clinic for staff only; it started in 2019, and had developed from a doctor's individual idea but with two clinics: One for medical students, one for staff, both were very broad. Both were closed because of the COVID-19, but some doctors provided services online after regular clinic hours for staff. When the location reopened, we recognised that the COVID-19 created a psychological burden on our workers, and reopened both clinics. In the interest address stigma, we changed the name of the clinic. The clinic is connected to the employees' clinic so no one would really tell if it was for a psychological or medical visit" (P2, Central Region). • "At the organisational level, health specialities just , including psychological helps, are available online at all times. The Commission for Health Specialties has implemented a supportive program for all health administrative staff, which does not only have doctors and all health professionals as well. This system is supervised by psychiatrists and mental health professionals that are engaged in the psychological" (P3, Central Region). • "We currently do not provide a psychiatric clinic for staff, which is a big gap. Our staff is work unsafe and are burning out, and we could use a clinic. We have psychiatric services available for patients, but we do not have clinics for employees" (P1, Eastern Region).

			• "With respect to psychological clinics, I haven't any for staff" (P2, Western Region). • "The existence of psychological clinics or people who could be dedicated for mental health help does not seem to be there, however I think as supervisors, we often give advice and lend a hand at the recommendation of others" (P6, Eastern Region). • "While many positive leadership practices have occurred, psychology clinics are not considered important for staff by all. I think for both management as well as staff, simply having been patient for a long time" (P2, Eastern Region). • "During the crisis, there is no overt mention of providing psychological clinics for staff within the hospital. There is only an explicit lack of awareness of facilities and health impacts related to psychological health as something which could be stigmatised" (P1, Southern Region).
	Employee Appreciation	Employee appreciation in DRM is associated with enhanced job satisfaction, loyalty, and a positive impact on performance.	• "Organisational culture can have a great impact on our job satisfaction and performance, negatively or positively. All being equal, a good organisational culture provides employees job satisfaction and better performance. On the contrary. poor job satisfaction negatively affects performance and patient care" (P1, Central Region). • "Acknowledgement of leadership in hard times creates loyalty in employees, so they feel part of the organisation while being recognised and valued for the risks and work they do" (P3, Central Region). • "With another disaster coming, I am not interested in participating because there is no appreciation, acknowledgement, and incentive for those of us who worked remotely in the last disaster" (P1, Eastern Region).

			• "Looking back at the COVID-19 situation, it had its ups and downs for patient care. With alternating work shifts, I can say it was managed well either three days at work, four days off, and so forth. However; post-COVID, I was disappointed that I did not have any financial incentive and that preferential treatment existed despite my direct contact with patients" (P2, Western Region). • "Recognised through a time of appreciation, thanks, praise, and tangible recognition through lump sums for taking risks, and certificates for previous work which is why we were searching for it before then" (P6, Western Region). • "The colleagues were great and supportive, but the hospital's management acknowledgement of their efforts were lacking" (P2, Southern Region).
	Work Pressure	Work pressure in DRM encompasses the stress and psychological challenges faced by HCWs, potentially affecting their efficiency and mental well-being.	• "Wasn't because of poor leadership - it was work stress" (P2, Central Region). • "In my previous job - having to put up with the insane stress, and not having the power to do anything, had dire consequences for my mental health; it was stressful and a psychological burden. I just wanted to help patients. It felt like I couldn't do anything" (P6, Eastern Region). • "A lack of motivation led to ineffectiveness at work" (P1, Western Region). • "I have to be honest, there have been so many cases of old people dying, I leave working feeling psychologically burdened" (P2, Western Region). • "The way we respond to an incident is determined by the type and scale of the incident. While we all feel affected and certainly sympathize with people who have suffered, we need to suppress our feelings and concentrate on the response" (P5, Western Region).

			• "Improving awareness of disasters is an important step in reducing staff anxieties about the implications of a disaster" (P5, Western Region). • "The frustration arose when we realized that all of the administrative and departmental levels were dealing with this without any intention of working together; each was doing it individually" (P5, Western Region). • "When I was walking into the hospital I am thinking - 'Am I going to die?' 'Is the world going to get through COVID-19'" (Participant 1, Southern Region). • "It is sad to raise concerns about the hospital's failures, and to be ignored" (P2, Southern Region). • "During COVID-19, I experienced being let down by the organization; that negatively affected me" (P4, Southern Region). • "Organizations can take a number of steps to support health care workers and be proactive to alleviate self-concerns for safety" (Participant 4, Southern Region).

C.3 HCWs' Quote on Geographical Disparities in DRM Effectiveness

Theme	Subtheme	Definition	Quotes
Geographical Disparities in DRM Effectiveness	Rural-Urban Disparities	Geographical location significantly impacts DRM effectiveness, with urban areas generally better equipped and resourced than rural areas.	• "The Central region has better emergency communication services than in the rural region." (P1, Central Region) • "The Central region has more advanced medical resources because they have well-resourced, equipped, trained, and qualified staff. The government additionally provides more funding for providing services in the central region than in the rural region." (P2, Central Region) • "I think the key difference is that Central City has better equipment, better quality of services, and more people, and other things..." (P4, Central Region) • "The health care providers and the clinical staff in Central City are more distinguished or educated than in the other region." (P3, Central Region) • "The Central regions have better emergency communication services than in the rural." (P6 Central Region) • "Generally, urban has better access to resources, more equipped facilities, better infrastructure, and more workforce capabilities than the rural." (P1, Eastern Region) • "Culturally, there is a significant difference between cities in the urban and rural areas; especially their views on getting vaccines, and this is a larger problem for the older population regardless of their scientific knowledge." (P4, Western Region)

			• "The geographic location of a hospital is a major factor in how we determine our disaster preparedness plans. Urban areas may have more timely access to medical resources, but risk the chance of higher population density and possibly higher rates of infections. Rural areas may have longer access to medical resources but have smaller populations to manage when a crisis occurs." (P4, Southern Region) • "Access to medical resource is different in the urban versus rural areas. You generally have more timely access to hospitals and other medical centres in urban, while rural access is more difficult." (P2, Southern Region) • • "Of course geographic location affects access to medical resources in the southern region. In the rural area, access is limited with slower response times." (P5, Southern Region)
	Event-Specific Preparedness	Adaptation to event-specific DRM involves heightened readiness and resource mobilisation in response to regional challenges and high-profile events.	• "Because of having a larger consumer base in the central part of the region, we have multi-disciplinary specialties. As a result, the government allocates more funding, as well as a higher number and better quality of health facilities. Also, better equipment is available for better care." (P1, Central Region) • "I've worked in Mecca, and they are exceptionally well prepared for disasters particularly during the Hajj. There have been some pilgrim deaths. The overall level of preparation and organisation for Hajj is unrivalled anywhere in the world and everything is done practically well." (P1, Eastern Region) • "The Eastern region had political situations which then put the oil fields at risk for explosions, including threats to the airbase in Dhahran, threats to Aramco and then threats to the oil wells." (P4, Eastern Region)

			• "At the moment only hospitals that are in the Western region are part of the Hajj season." (P6, Western Region) • "Inshallah we are capable because our experiences at Hajj have available unique cases. Personally I have been a part of Hajj twice and as a witness, the preparations were thorough and the staff were ready, in constant communication with the Red Crescent. All available human resources were available, so were medical resources." (P2, Western Region) • "The civilian and military health authorities are completely prepared to face the challenges in the Southern region." (P4, Southern Region) • "The Southern region stands out because of what they are able to accomplish, especially in places that are close to the southern border." (P4, Southern Region) • "One of the strong points is the direct communication from active local authorities in the southern border region with active higher management, allowing quick total resolution of issues." (P6, Southern Region)
	Cultural Awareness	Cultural factors significantly impact DRM, affecting patient cooperation, education on health crises, and community engagement.	• "Yes, it greatly complicates matters, as divisions can obstruct you from solving problems. For example, the problem of vaccinations where a group doesn't get vaccinated at all, while there is another group waiting until the pandemic makes vaccinations mandatory exemplifies this" (P2, Central Region). • "The National Centre for Health Crisis and Disaster Management in Riyadh works with other centres and organisations and is also under the Ministry of Health. It holds an annual conference pertaining to improving our systems or protocols of dealing with

			health crises and disasters. This ultimately gives a level of assurance to citisens and a greater sense of awareness nationally" (P3, Central Region). • "Yes, I commend the patient culture here. Having worked in the West prior to work here, I notice it. The culture here in the East, where the eighty-year-old patient can speak fluently in English, is incredibly educated. I have come to love the patients here it now feels like I am great friends" (P1, Eastern Region). • "The community also has a great understanding and compliance of the policies and enforcement of decisions" (P3, Eastern Region). • "To discuss the difference in the urban and rural settings, there is definitely a difference. In Dammam, for example, we are more educated and informed than those in remote areas. Hence, the level of participation in urban settings like Dammam is significantly more, and in fact, they are much more educated, aware, cultured" (P4, Eastern Region). • "Yes, in Jeddah, I found the most cooperative, understanding and educationally orientated people I have ever encountered" (P4, Western Region). • • "Yes, in terms of patient behaviours, they may differ regionally. For example, patients in rural areas may lean towards more traditional methods of health care. This diversity influences how care is delivered between rural and urban areas. As far as I see, local context is primarily a result of cultural, value systems, and religion. Additionally, local practices and customs occasionally affect the delivery of care in the community" (P4, Southern Region).

C.4 HCWs' Quote on DRM Enhancement Strategies

Theme	Subtheme	Definition	Quotes
Regional DRM Enhancement Strategies	Workforce Coordination - Central	Effective DRM requires robust workforce coordination, improved licensing, fair compensation, comprehensive risk management phases, and strategic technology use.	• "Health organizations can not only increase the quality and quantity of their workforce, and licensing standards, but can also create a more favorable working environment by raising salaries and improving working conditions. Workforce satisfaction directly influences the quality of service and productivity." (P1, Central Region). • "The first thing we can do in a crisis is to start thanking our staff." (P2, Central Region). • "During disasters, hospitals need improved coordination and equitable resource allocation. Currently some hospitals are focused on their own resources and on their staff. This places Ministry of Health hospitals at a disadvantage in a crisis. We should have more open communication between all hospitals, since our current system only utilises Ministry of Health hospitals, which is a very inadequate emergency response. The COVID-19 pandemic demonstrated this." (P3, Central Region). • "We have a fire emergency plan at our health facility, however, we do need disaster management plans for multi emergency cases like cardiopulmonary resuscitation so that we do not always find ourselves with distressful situations. I hope we will improve upon disaster management and communication with other hospitals." (P4, Central Region). • "I want to emphasis raising awareness and forcing education." (P5, Central Region).

			• "We want to use technology to make it easier for people to use it and to educate them how important it is, how to make use of it and the benefits of using technology." (P6, Central Region). • "First of all, we can fix things very quickly, as proven when we had to operate swabs out of a parking lot even though we didn't prepare anything! Secondly, when hospitals make improvements in technology, it should be on ease of use for everybody because when we have to rush things, everyone will try to rush." (P6, Central Region). • "Finally, we have to meet patients where they are and educate them about the importance and benefits of technology so we can give them education instead of saying that they already have the knowledge." (P6, Central Region).
	Resource Scarcity–Eastern	Effective DRM requires addressing resource scarcity, improving staff conditions, and updating healthcare infrastructure.	• "The hospital has significant deficiencies in a lot of areas, particularly in medications. My hints at musical, is often lacking many crucial (and pill) medications, especially with oncology" (p1, Eastern Region). • "Once again, communication has been the important factor in a lot of success. As far as our crises go, there are several issues that can be quickly sorted once we communicate to our highly trained and very responsible doctor and nurse specialist" (p2, Eastern Region). • "We miss big volumes of workload and exhaustion that makes up question about the purpose of changes to working conditions and staff ratios. This would not only support our wellbeing, never mind better, more effective, safer care of patients" (p1, Eastern Region).

			• "Keeping everything current, eg technology, regulations, systems and resources is important. There is a shortage of basic resources, eg syringes, but even developing more staff, particularly nursing staff is high impact" (p2, Eastern Region). • "I am of the mindset that, with education, having a greater presence in the hospital is preferable to relying on individuals or as a manager endorsing this type of presence. It also can include increasing income personally" (p3, Eastern Region). • "The structures of the organisation create problems, specifically; resource allocations and not any maintenance of some older facilities that can pose high risks. We see some updates and changes, such as a ceiling sprinkler fire suppression system, that appear to be slowly, if at all, progressing. Even setting prioritisation by perceived needs or risk there is no room to be innovative or develop strategically" (p4, Eastern Region). • "The solution to job burnout we have devised is to add more staff but to also add more facility to put staff" (p5, Eastern Region). • • "The solution to the burnout of job staff is to build more staff to alleviate current resource shortfalls and improve the current normal facility" (p6, Eastern Region).
	Communication Infrastructure-Western	Optimisation of communication infrastructure and hospital facilities is essential for effective DRM in the Western Region.	• "The communications strategy should be similar to the National Guard Hospital, including a comprehensive disaster plan" (P1, Western Region). • "The facility was a limitation. The building and exits created a limitation -- e.g. with a fire, exits are not accessible for patients. Flooding in our storage area from heavy rain impacted our stored materials" (P2, Western Region).

			• "Technology was key, especially for surgical in how we kept patient status current. We were able to reassure families in the waiting room by messaging updates, e.g. "in surgery - waking, etc." to the family" (P2, Western Region). • "We were not too late in getting to circulars and regulations that impacted our approach, including through WhatsApp" (P2, Western Region). • "We could strengthen risk management in hospitals by; more regular exercises and integration of training throughout annual evaluations would help. Also, it is important for the administration to provide the disaster and risk management department the support to reach its full capacity" (P5, Western Region). • "We initially wanted to continue to deploy negative pressure rooms over the floors and departments. After COVID-19, we knew we wanted to deploy the negative pressure rooms in groups and similar location to manage disease spread by grouping all the patients with similar disease" (P6, Western Region).
	Training Enhancements-Southern	Enhancements in DRM training are crucial for preparing HCWs with up-to-date knowledge, practical experience, and appropriate resources to manage disasters.	• “Initially we source from suppliers who have satellite, but then we run out of all the basic supplies, like cannulas, until we can get back to business.” (P1, Southern Region). • “Think about the continuous training council. Why? Because disasters happen suddenly and then it is chaos, when there is nothing to fall back on." (P2, Southern Region). • "The hospital should raise employee awareness of disaster risk management through training and educational materials." (P3, Southern Region). • "The hospital needs to increase funding of maintenance and renewal activities in order to improve preparedness against disaster." (P4, Southern Region).

			• "Investment in technological resources, was center on improving communication and coordination." (P4, Southern Region). • "The hospital should follow recommendations to improve the effectiveness of disaster risk management such as, conducting a review of its disaster management role and improve disaster communication and coordination." (P4, Southern Region). • "There was a need highlighted for more training in critical thinking and decision making for health care workers to better inform their risk and disaster management." (P4, Southern Region). • “First, it is about training on the specific protocols for each type disasters that are to be used operationally, not just on paper as in an emergency plan." (P5, Southern Region). • “Whether, the protocol had been accepted, reviewed, and practised? After the hypothetic analysis, we talked about if the protocol was possible. That was what we could be tried." (P5, Southern Region). • "Learnt that continuing education was imperative to whole team ..." (P6, Southern Region). • "Second recommendation was for government to provide "financial remuneration" to nurses in emergency care environments for advocates to work in rural areas. " (P6, Southern Region). • • "The fourth recommendation was that "Command and control" centres would need to exist at the highest level within the hospital." (P6, Southern Region).

Appendix D Questionnaire

Section 1: Public Perceptions of Disaster Risk Management in Saudi Hospitals

		Please tick one for each statement				
1.	**Public perception of Hospital Disaster Preparedness*:***	**Strongly Agree**	**Agree**	**Neither**	**Disagree**	**Strongly Disagree**
1.1.	I believe hospitals in my region could struggle to handle the large number of patients during major disasters.					
1.2.	Hospitals in my region have sufficient resources and equipment to handle large-scale disasters.					
1.3.	I am concerned about the ability of hospitals in my region to respond to sudden disaster events.					
1.4.	The level of preparedness in hospitals reduces the risk of hospital failure during disasters.					
1.5.	I am confident in the preparedness of hospitals in my region to address potential disaster-related risks.					
2.	**Public Awareness of Hospital Disaster Preparedness Measures**	**Strongly Agree**	**Agree**	**Neither**	**Disagree**	**Strongly Disagree**
2.1.	I am well-informed about the disaster preparedness procedures at the hospitals in my region.					
2.2.	Hospitals in my region make sufficient efforts to keep the public informed about their disaster plans.					
2.3.	I have access to clear information about what hospitals will do in the event of a disaster (e.g., evacuation plans, emergency services, or available resources).					

2.4.	Public education and campaigns have effectively increased my knowledge about disaster preparedness at hospitals in my region.					
2.5.	I believe there should be more public awareness efforts about hospital disaster preparedness.					
3.	**Effectiveness of Hospital Communication About Disaster Preparedness**	**Strongly Agree**	**Agree**	**Neither**	**Disagree**	**Strongly Disagree**
3.1.	Hospitals in my region communicate their disaster preparedness strategies clearly and regularly.					
3.2.	Hospitals in my region provide consistent and transparent information about their disaster preparedness plans.					
3.3.	Hospitals use accessible platforms (such as social media, TV, or radio) to inform the public about disaster preparedness.					
3.4.	Hospitals are open and clear in sharing information about how they handle disaster situations.					
3.5.	The communication I receive from hospitals during a disaster builds my confidence in their readiness.					
4.	**Public Satisfaction with Hospital Disaster Risk Management Practices**	**Strongly Agree**	**Agree**	**Neither**	**Disagree**	**Strongly Disagree**
4.1.	I am satisfied with the level of disaster preparedness in hospitals in my region.					
4.2.	My past experiences with hospitals during disasters have been positive and comforting.					
4.3.	Hospitals in my region have demonstrated a commitment to strong disaster management practices.					

4.4.	Hospitals in my region have the necessary tools, equipment, and resources to manage disaster situations effectively.					
4.5.	I am confident that hospitals will provide adequate care and resources during future disaster events.					
5.	**Trust in the Hospital's Ability to Manage Disasters**	**Strongly Agree**	**Agree**	**Neither**	**Disagree**	**Strongly Disagree**
5.1.	I trust hospitals in my region to manage disaster situations effectively and efficiently.					
5.2.	The hospitals in my region have earned my confidence in their ability to handle emergencies.					
5.3.	I believe that hospitals in my community can be relied upon during major disaster events.					
5.4.	My confidence in hospitals increases when I see them well-prepared for emergencies.					
5.5.	Hospitals' past performance during disaster events has strengthened my trust in their services.					

Section 2: Disaster Experience Profile in Saudi Arabia

1. On average, how many times per year have you visited a hospital, GP surgery, or drop-in clinic as a patient in the last five years? (Please enter numbers only)
   ----
2. Do you have any long-term health conditions that would make you dependent on hospitals during a disaster?
   - Yes
   - No
3. Have you personally experienced an emergency that required hospital treatment in the last 10 years?
   - Yes
   - No
4. Has someone you know experienced an emergency that required hospital treatment in the last 10 years?
5. Have you personally been directly affected by a disaster in the last 10 years?
   - Yes
   - No
6. Has someone you know been directly affected by a disaster in the last 10 years?
   - Yes
   - No
7. How familiar are you with disaster preparedness procedures in your community (e.g., blocking external doorways with sandbags prior to a flood, storing non-perishable food items in case of a pandemic or natural disaster, keeping a first aid kit at home)?
   - Extremely vulnerable
   - Very vulnerable
   - Moderately vulnerable
   - Slightly vulnerable
   - Not at all vulnerable
8. To what extent do you believe your community is vulnerable to natural disasters (e.g., sandstorms, extreme heat, flash floods)?
   - Strongly Agree
   - Agree
   - Neither
   - Disagree
   - Strongly Disagree

Section 3: Basic Information of Respondent Biodata

1. What is your gender?

- Female
- Male
- Prefer not to say

2. What is your age in years?

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3. What is the highest level of education you have already achieved?

- Primary school
- Secondary school
- High School
- Diploma
- Bachelor's degree
- Master's degree or higher

4. What is your occupation?

- Student
- Healthcare worker (e.g., nurse, doctor, hospital staff)
- Government employee
- Private sector employee
- Self-employed
- Unemployed
- Retired

5. Please select the region where your hospital is located:

- Central Region
- Eastern Region
- Southern Region
- Western Region

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