ORIGINAL ARTICLE

The impact of crisis and disasters risk management in COVID-19 times: Insights and lessons learned from Saudi Arabia

R. Jaziri [a,b,*], M.S. Miralam [a]

[a] *College of Business, University of Jeddah, Asfan Road 285, P.O. Box: 42801, Jeddah 21551, Saudi Arabia*
[b] *LAREMFIQ Laboratory, University of Sousse, Tunisia*

Summary

Background. — All countries all over the world strive to fight the outbreak of COVID-19 pandemic and their governments are facing unprecedented strains and challenges. Since COVID-19 has engendered socioeconomic recession and the deterioration of health systems, Insights and lessons from some countries can illustrate various approaches designing their people-centric health and socioeconomic policies. The kingdom of Saudi Arabia has implemented various measures and strategies to mitigate the spread of pandemic and to save the lives of people. Therefore, we investigate the role of the Saudi disaster risk reduction system (DRRS) to fight the virus outbreak and provide a safe environment for the well-being of its inhabitants.

Methodology. — We use a qualitative case study methodology to document and analyze the crisis and disasters risk management framework within the hazard management process. The case study methodology is suitable in investigating a phenomenon in its real-life settings and contexts. Thus, we outline lessons learned from Saudi disaster risk management experience in combating COVID-19 pandemic.

Results. — During COVID-19 disaster, we found that the Saudi disaster risk reduction system (DRRS) is structured into three main levels: strategic, operational and tactical. The strategic level represents the strategic planning division and runs audit and monitoring of overall decentralized units of crisis management at operational and tactical levels. The findings show that there are three policy implications: keep vigilance at the public national level, remaining flexible in a national management structure and good governance at local administration level.

* Corresponding author at: College of Business, University of Jeddah, Asfan Road 285, P.O. Box: 42801, Jeddah 21551, Saudi Arabia.
E-mail addresses: rmjaziri@uj.edu.sa (R. Jaziri), mmiralam@uj.edu.sa (M.S. Miralam).

Conclusion. — The application of disaster risk reduction framework in COVID-19 times requires the use of multi-level strategies to protect vulnerable peoples during the four stages of mitigation (readiness), preparedness, response (implementation) and recovery (post-COVID).

Introduction

Given its strategic geographic position at the crossroads of three continents: Asia, Europe and Africa, Kingdom of Saudi Arabia (KSA) is lucky enough to be safeguarded from main natural disasters such as storms, tsunami, seismic and volcanic activities. Nevertheless, this does not imply that the kingdom is secured from disasters. In 2020, the population of Saudi Arabia is 34,898,530, based on United Nations data.[1] Over the past decade, KSA's GDP (gross national product) has grown by about 520 billion USD due to its positive trade balance. Moreover, Saudi Arabia is considered as the heart of the Arab and Islamic worlds. The Kingdom is honoured as the land of the two holy mosques and the preferred destination of all Muslims all over the world for Hajj pilgrimage. The serious deadliest Hajj pilgrimage disaster in history have taken place in Mina, on 24 September 2015, owing to a ''crush and stampede'' caused deaths of 717 pilgrims. Furthermore, KSA is additionally at risk of both health and natural disasters such as flooding and epidemics [1].

During his history of 90 years, Saudi Arabia has been vulnerable and subjected to several natural disasters (floods, epidemic, earthquakes) and man-made crisis (overcrowding, terrorist attacks). Moreover, the kingdom has experienced a little number of health disasters such as the Middle East respiratory syndrome coronavirus (MERS-CoV), which appeared in January 2019 and the novel Coronavirus pandemic (COVID-19) emerging in March 2nd 2019. Fortunately, the outbreak was eventually contained through a series of risk-mitigating measures introduced by the Saudi government and therefore the responsiveness of all citizens and residents. It is imperative to illustrate that these risk-mitigating mechanisms, together with the public's compliance, were quickly used to deal with the unpredictable conditions especially when additional epidemiological cases were revealed.

Throughout this article, we present the hazard management system of Saudi Arabia as well as the lessons taken from the risk management experience of the kingdom with relevant references to the COVID-19 pandemic. We used a triangulation technique of different research methodologies to attain our research objective. To recognize the values and procedures of Saudi's disaster response to disaster risk management, we conduct a retrospective study by collecting data from specific Saudi government departments as well as from international organizations, literature reviews, quantitative and qualitative analysis of economic effects. We have used the case study method to illuminate Saudi Arabia's approach to managing disaster risk while fighting COVID-19 pandemic.

Referring to the hazard approach adopted by KSA, the case study seems to be suitable to explain contextual socioeconomic disparities. The aim of this case study is to illustrate the lessons learned from experiences in a particular context and timeline from which we can concentrate more on the risks' nature and the impacts of both disaster risk management and public policies intervention. We also conducted interviews with principal health policy decision-makers and experts for more understandings of the phenomenon. Our main objective is to guarantee via this rigorous methodology consistent and operating recommendations.

We think that our contribution is interesting as it provides empirical evidence of the public policies taken by Saudi government to combat risk extenuation of COVID-19 pandemic. The dominant viewpoint states that the government must be able to exert brute force and enforce its will on the population [2]. Furthermore, as our paper demonstrates, this dominant viewpoint is incomplete, because the government's exercise of authority and control is not automatically sufficient to contain transmission of transnational communicable disease Success in fighting epidemics, as one would agree, is also based on a concerted collaborative effort between governmental authorities and inhabitants.

This article is divided on four main parts. The first part offers background on the historical framework of disasters in Saudi Arabia. The second part, scrutinize the regulatory framework and public funds distribution to alleviate disaster risk in KSA. Third part is dedicated to outline a case study on the experience of Saudi Arabia in combating COVID-19 pandemic and the socioeconomic effect of the pandemic on the kingdom. The last part reveals recommendations to public decision-makers to improve disaster risk management policies and further insights for future studies.

Historical framework of disasters in Saudi Arabia

Different international instances have adopted the same definition of disaster. For example the United Nations International Strategy for Disaster Reduction' (UNISDR) have defined the concept of disaster as ''a serious disruption of the functioning of a community or a society causing

---

widespread human, material, economic and environmental losses which exceed the ability of the affected community/society to cope using its own resource'' [3].

Since its establishment in 1932, The Kingdom of Saudi Arabia has undergone a number of health and natural disasters (Table 1). As a result, we describe concisely the historical background of the disaster risk in Saudi Arabia such as floods, pandemics and earthquakes.

The Centre for Research on the Epidemiology of Disasters (CRED) has been founded 35 years ago, to focus on international disaster and to conduct epidemics studies. CRED [4] have classified a disaster as a catastrophe only if it fulfils the following circumstances: 10 or more dead victims, 100 persons are affected, invoke a national state of emergency and an international call for help. Table 1 illustrates an overview of the disasters experienced in the KSA from 1941 to 2019, as well as the number of dead victims, affected people and injuries [1,5].

According to the Emergency Events Database (EM-DAT), which published historical disaster statistics, Saudi Arabia has experienced only two epidemic-caused disaster events [6]. In 2012, Saudi Arabia suffered from the largest Middle East respiratory syndrome coronavirus (MERS-CoV), which has affected over 1030 people and caused 453 deaths. In September 2012, The World Health Organization (WHO) has reported 1626 confirmed cases of Middle East respiratory syndrome coronavirus (MERS-CoV) infection from 26 countries causing 586 deaths. Reported cases have essentially been from Middle East countries and a few number of European and East Asian countries have reported individuals who had travelled to the Middle East [7].

While, in 2020, COVID-19 pandemic has affected 321,456 inhabitants in Saudi Arabia and killed 4107 victims. The novel Coronavirus disease has infected more than 34 million people around the world and has caused more than one million deaths, 21% in USA. Facing the exponential augmentation of COVID-19 victims and the lake of ICU Beds and ventilators, the pandemic has imposed an ever seen ethical dilemma related to medical triage decision-making [8]. As a result, COVID-19 pandemic was deemed as the most destructive disaster in Saudi Arabia to date.

Institutional framework of disaster risk management in Saudi Arabia

Conceptual framework of disaster risk management (DRM)

Disaster risk management is defined by United Nations International Strategy for Disaster Reduction [3] as ''The systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster''.

The DRM includes three stages: pre-disaster, during-disaster and post-disaster:
- pre-disaster: this phase encompasses four steps:
  - identification and valuation of the risk,
  - risk prevention, mitigation and reduction,
  - risk transfer,
  - preparedness;
- during-disaster: it is to guarantee that the wants and requirements of victims are satisfied to minimize distress. This stage encompass emergency reaction including salvage, relief and recovery;
- post-disaster: this phase covers resilience and reconstruction. When the disaster is over, it's about quick retrieval to avoid the reproduction of vulnerable circumstances.

The main purposes of DRM comprise firstly the deployment of resilience against disasters. Secondly, is to reduce damages via the establishment and improvement of sustainability. Thirdly, DRM aims to diminish disaster risks, fight vulnerabilities and set both an institutional and an organizational context. Finally, DRM outline attributions, duties and responsibilities of all the stakeholders.

Enemark [9] argued that the International Federation of Surveyors [10] reported that DRM is a process or a cycle composed of the seven steps. In relation to disaster management, Chirisa et al. [11] argued the cycle is a sequential process made up of four steps: mitigation, preparedness, response and recovery. However, the lessons learnt will be investigated using four stages from the framework and guidelines of WHO [12]. These stages are:
- readiness: to ready disaster response systems, for instance, to rise the capability to identify and treat COVID-19 patients and to guarantee that hospitals provides the required healthcare services;
- preparedness: to prepare a response in order to reduce the spread of the disaster and to prevent the outbreak of COVID-19;
- implementation: to evaluate the risk of health disaster and to implement promptly the required actions;
- post-COVID 19: to decrease the pandemic effect on healthcare systems and on socioeconomic activities.

Fig. 1 summarizes all the above elements as a continuing loop of activities associated with the previous circumstances (risk identification, prevention, alertness and preparedness), through (emergency rescue plan) and post-disaster (recovery, reconstruction and resilience). Moreover, the reaction conducts to amelioration and resilience of vulnerable populations and contribute to decrease potential forthcoming risks leading to sustainable development [5,13].

It shows that both good governance and capacity building are the cornerstone of the implementation of DRM and of sustainable development [14]. Furthermore, the usage of early alerting systems providing a real time relevant information is deemed as the basis of the capability and reactivity to manage natural disasters. Moreover, the implementation of institutional structures and regulatory frameworks are keystones of establishing political commitment for he application of disaster risk reduction (DRR) into the administration systems.

The current disaster risk reduction system (DRRS) in KSA

Disaster risk reduction (DRR) strategy system has progressively becoming among the most crucial topics of the

Table 1 Major disasters in KSA from 1964—2019.

Year/disaster	Nature of disaster	Number of affected persons	Number of dead victims
1964/Flash flood	Natural	1000	20
1975/Fire during Hajj	Human	N.A.	200
1979/Occupation of Mosque in Makkah	Human/terrorist attack	600	250
1985/Floods in Northwest of Kingdom	Natural	5000	32
1990/Pilgrims Stampede inside tunnel	Human	N.A.	1426
1994/Pilgrims Stampede inside tunnel	Human	N.A.	270
1997/Yanbu and Asir floods	Natural	N.A.	26
1997/Fire during Hajj (Mina)	Human	1555	343
2000/Rift Valley fever epidemic	Natural	1700	179
2002/Makkah floods	Natural	N.A.	31
2005/Medina floods	Natural	43	29
2009/Jeddah floods	Natural	11,640	163
2011/Jeddah floods	Naturel	5000	10
2012/Middle East respiratory syndrome coronavirus (MERS-CoV)	Natural	1030	453
2012/Riyadh truck crash	Human	135	26
2013/Floods	Natural	—	25
2019/COVID-19 pandemic	Natural	334,605	4768

KSA: Kingdom of Saudi Arabia. NA: not available. Source: authors' elaboration based on data from United Nations Office for Disaster Risk Reduction (https://www.undrr.org/).

United Nations conference on Sustainable Development 2012 (Rio+20) which took place in Rio de Janeiro, Brazil from 20 to 22 June 2012 [15]. Being aware of the importance and repercussion of this issue, the kingdom of Saudi Arabia has made of DRR one of its priorities. The government of the kingdom has always showed a strong political willingness to implement both the Hyogo Framework in 2015 and the Arab Strategy for Disaster Risk Reduction 2020 [15,16]. Furthermore, under the patronage the Council of Arab Ministers Responsible for the Environment (CAMRE), the Socioeconomic Council of the League of Arab States have approved the strategy of DRR deployment in 2011. Moreover, the Gulf Cooperation Council (GCC) adopts an anticipatory mechanism in order to enhance and implement a Disaster Risk Reduction System (DRRS) (Table 5). Consequently, the secretary-general of the GCC called for a sustainable regional engagement in DRR by diminishing vulnerability and reinforcing recovery and resilience to disasters of all GCC members. As a result, it is legitimate to ask the following question: How the government of Saudi Arabia have faced and managed the COVID-19 pandemic hazards. Even though disaster risk reduction is vital and essential to realize sustainability in the kingdom, there is necessity to elucidate the concept of DRR and assess the level of readiness of the kingdom to fight COVID-19 pandemic and to enable good reactivity management of future disasters.

The disaster risk reduction (DRR) is defined by [3] as ''The concept and practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events''. This definition of DRR leads to divisive debate as the concept of disaster has been widely controversial and the phenomenon has not been adopted in the same way by researchers. In other word, the definition has technically used the same term 'disaster' to define disaster'. However, empirical studies propose that DRR focus on scrutinizing and managing hazards to lessen vulnerability to disasters including measures that reinforce readiness, prevention and mitigation. Moreover, Saudi Arabia is aware about the real contribution of DRR in sustainable development at make it as a priority. Various empirical research have confirmed that DRR may lessen disaster threats such as pandemic hazards, decrease operational vulnerability, increase the abilities to manage disasters, and ameliorate actions to acclimatize to disaster risks [17—20].

To fight disasters the government of Saudi Arabia have implemented a cross-ministerial structure for disaster risk reduction and disaster management [15]. This multidisciplinary structure outlines a framework that seeks to increase risk perception among all Saudi's government ministries and agencies, and helps to regularly recognize the full spectrum of risks. Moreover, in order to protect public health during and after the disaster, all governments must act through

Figure 1. Key elements of disaster risk management reduction.
Source: authors' elaboration based on International Federation of Surveyors (FIG) (2006).

multi-sectoral collaboration [21]. Additionally, the framework of the DRRSS defines cross-department structure that may have dropped due to program discrepancies. This Saudi DRR framework comprises Ministry of Health (MOH) especially National Crisis and Disasters Control Centre (NCDCC), Ministry of Interior (MI), General Directorate of Civil Defence (GDCD), Ministry of Defence (MD), Ministry of Municipal and Rural Affairs (MMRA) and public-private emergency preparedness partnerships. Saudi Arabia's DRR policy system works in times of stability and crisis. It refers to an integrated approach where all related ministries and agencies work together in a fixed structure, with smooth collaboration and risk management coordination [5,15,22].

Statistical considerations of COVID-19 outbreak in Saudi Arabia

In March 2020, the Coronavirus pandemic erupted Saudi Arabia. Late in 2nd of March on her return from Iran via Bahrain, the first Saudi national to acquire COVID-19 was hospitalized. Yet, what started as a few isolated cases quickly became a national public health emergency within a few short weeks reaching 1563 positive cases at the end of March.

The COVID-19 pandemic has reached and expanded in all countries of the Middle East and North Africa (MENA) region [8]. In late October 2020, the highest total deaths in MENA region was reported respectively in Iran (13,421), Iraq (11,795), Egypt (6481) and Saudi Arabia (5710), while the lowest fatalities are registered respectively in Djibouti (61), Qatar (235) and Bahrain (337) (Table 2).

The geographic analysis of the most COVID-19 infected regions in the kingdom show characteristics of these spatial units. GeoDa software. The 13 Saudi regions included in our analysis are shown in Fig. 1 in form of quantile and natural breaks maps, which are elaborated on the basis of the Jenks Natural Breaks algorithm (De Smith et al., 2009). Fig. 2 shows the outbreak of COVID-19 pandemic in all Saudi regions at the end of September 2020. Based on the quantile map, the most Covid-19 infected regions are eastern (alsharqiya) and Mecca Regions where positive cases range from 63,532 to 73,849. While the less infected regions are Al-Jawf and Northern Borders (Alhudud Alshamalia) with a number of infected people between 791 and 1695. However, the distribution of deaths shows that the regions of Riyadh and Mecca have the intensive number of COVID-19 victims between 300 and 1304 deaths. In a second level, the Eastern region (alsharqiya) reported between 117 and 300 deaths. On the contrary, the low level of deaths is associated with regions of Al-Jawf, Northern Borders (Alhudud Alshamalia), Ha'il, Najran and Al-Bahah with total fatalities between 4 and 26 people.

Fig. 2 illustrates also natural breaks maps related to the distribution of total confirmed cases and deaths caused by COVID-19 pandemic in different Saudi regions. The natural breaks maps provide a more adequate insight into the region affected by the pandemic compared to the quantile maps. The quantile maps hides the truth of many ''dark'' regions. That is to say, many regions seemed to be among the most

Table 2   COVID-19 statistics in the MENA region (October 18th 2020).

Country	Total cases	Total deaths	Total recovered
Iran	801,894	13,421	546,500
Egypt	111,284	6481	101,288
Saudi Arabia	354,208	5710	341,515
Algeria	70,629	2206	46,326
Iraq	526,852	11,795	455,176
Kuwait	138,337	857	129,839
UAE	154,101	542	145,537
Morocco	306,995	5013	253,351
Oman	121,129	1360	112,014
Qatar	136,441	235	133,473
Tunisia	81,726	2445	56,748
Bahrain	85,008	337	82,900
Djibouti	5656	61	5548
Lebanon	110,037	852	62,528
Jordan	163,926	1969	94,896
Palestine	66,186	589	56,843

MENA: Middle East and North Africa. Source: authors' analysis of data from WTO https://www.worldometers.info/coronavirus/.

COVID-19 infected regions such as 'Asir. In natural breaks maps, the distribution of regions indicates that the number of most infected regions is 3, while there are only 2 in quantile map.

Based on Table 3, we remark that the low intensity of COVID-19 regional infection rate (RIR) is reported in Northeast regions such as: Al-Jawf (0.32%), Tabuk (1.35%) and Al-Baha (1.2%). While the largest RIR is registered respectively in Mecca (24.52%) and Riyadh (20.47%).

Concerning the average regional death rate at national level (ARDR), while the largest is reported respectively in Mecca (38.59%) and Riyadh (21.83%), the lowest one is registered in Al-Baha (0.01%). Nevertheless, the highest regional death rate (RDR) is reported in Al-Jawf (4.05%) and the lowest one is in Medina (0.5%). However, with regard to the regional recovery rate (RRR), we see that all Saudi regions have recovery rate more than 90%. However, the average regional recovery rate at the national level (ARRR) is recorded in the Eastern Region-alsharqiya (24.72%). This positive trend can be attributed to the efforts of the kingdom government to fight the COVID-19 pandemic in all regions.

COVID-19's impact and measures taken by Saudi government in combatting COVID-19 pandemic

To illustrate the Saudi government's approach to disaster management, we use a qualitative case study methodology; data were collected through observations and documents. We try to demonstrate the learning policy and lesson-drawing for a public policy in a particular context and timeline. There are three parts of the case study. Firstly, we outline the economic, cultural, healthcare, and psychosocial consequences of COVID-19 pandemic on Saudi Arabia. Secondly, we elucidate the risk mitigation steps pursued by

the Saudi government to control the pandemic. Thirdly, we explain the government Steps to regulate public health.

Many scholars acknowledge the urgency of taking urgent short-term action to intensify global efforts to combat the COVID-19 crisis [23,24]. In a strongly globalized world, the effects of the disease beyond fatality and morbidity has been developed since the outbreak. Since the decelerating of the world economy with disruptions of production, the operations of worldwide supply chains has been disturbed [25]. In this section we will elucidated the initiatives taken by the Saudi government to tackle COVID-19 pandemic.

Initiatives of the kingdom to tackle COVID-19 pandemic

The Saudi government has taken many initiatives in response to the impact of the repercussions of the novel Coronavirus pandemic. In addition, to emphasize the support of the medical sector as well as stimulating the private sector as an essential partner in the growth of the Saudi economy. Besides, the government helps the stability of the Saudi citizen, contributes to adding value to local market consumption and allocate additional amounts to the healthcare sector as needed. The government support to the healthcare sector reached an additional 47 billion riyals, with the aim of raising the sector's readiness, securing medicines, operating additional beds and providing the necessary medical supplies (Table 4).

COVID-19's impact on the healthcare system and its psychosocial consequences

COVID-19 reduced service and treatment rates in Saudi Arabia's healthcare system as the government mobilized its medical services to tackle the COVID-19 outbreak. The flood of positive cases into hospitals and clinics overcrowded even other patients with less urgent care medical conditions.
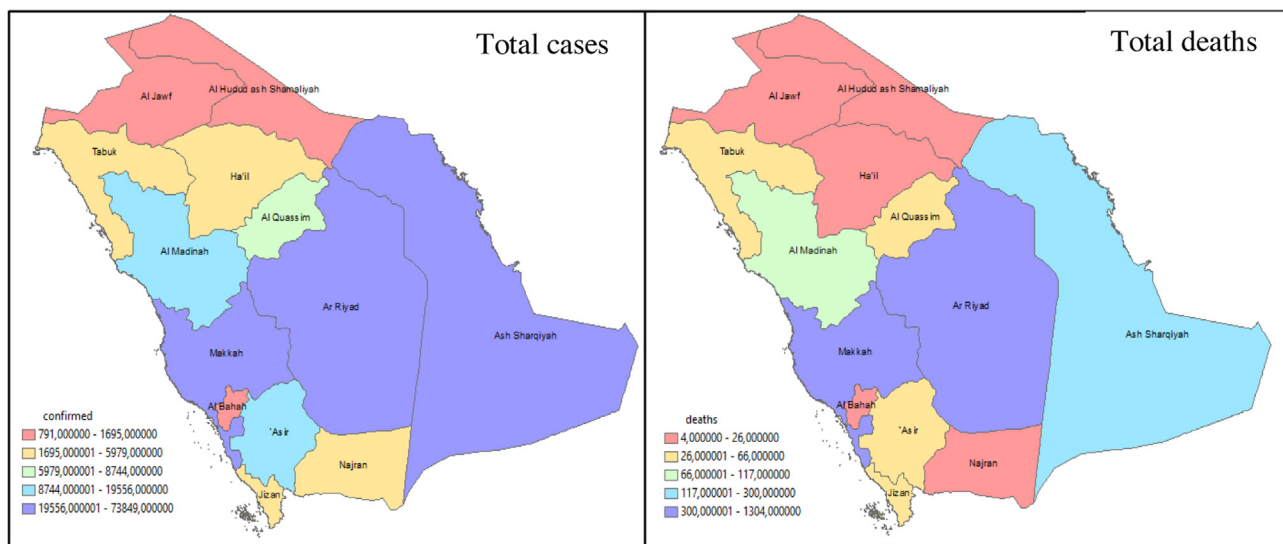
Quantile maps
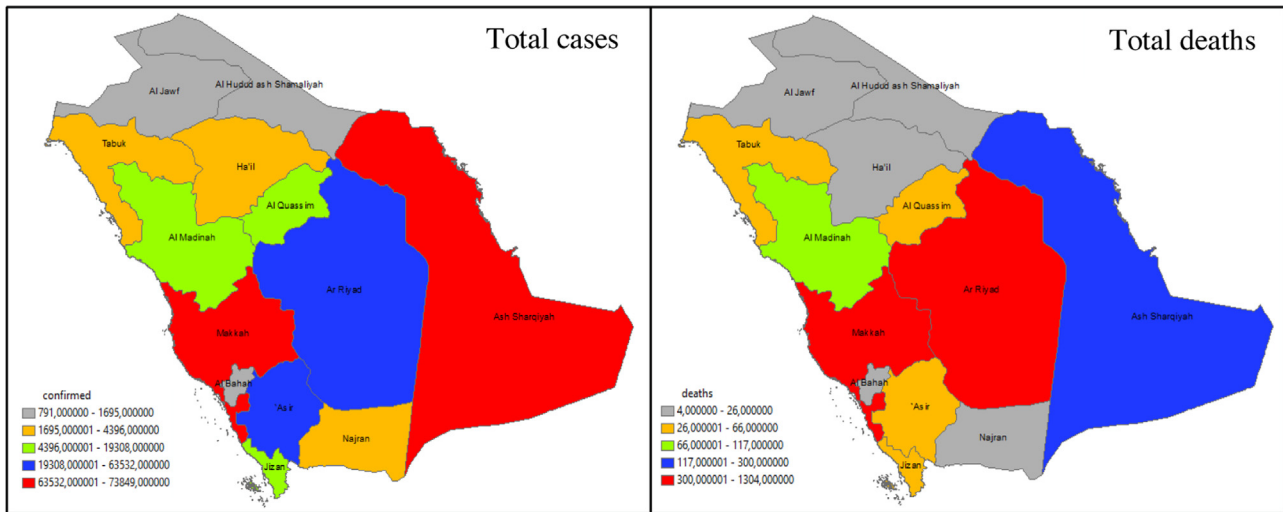
Natural breaks maps

Figure 2. Quantile and natural breaks maps of COVID-19 infected cases and deaths in Saudi regions (end of September 2020). Source: authors' elaboration using data from https://covid19.moh.gov.sa/ (ArcGis and GeoDa software outputs).

Nevertheless, the Saudi Ministry of Health has ordered citizens who feels having COVID-19 symptoms to go immediately to the nearest private clinics to be treated for free.

COVID-19 also seriously impacted the healthcare workers in Saudi Arabia. There was a shortage of medical and nursing practitioners at the peak of COVID-19 from June 2020 to July 2020. There was a shortage of medical and nursing practitioners as there was a significant rise in demand for COVID-19 patients. Moreover, there was a reduction in healthcare workers, as some were also affected by the outbreak. Hospitals and other public health facilities have experienced a high rate of worker absenteeism and found difficulties in sustaining regular operations. This contributed to a further decrease in service efficiency [26].

The limited medical understanding of the novel coronavirus have exacerbated COVID-19's psychosocial effect on citizens. In response to the threat of transmission of disease, the government of Saudi Arabia has implemented several stringent public policies, such as social distancing, quarantine and isolation, as risk mitigation steps. All those regulation mechanisms created for the general population an instinctive detachment from society. This lead to a public behaviour in avoiding human contact with crowds in public places. Saudi Ministry of education had closed all educational institutions especially primary, secondary and higher schools and they shift to e-learning mode.

Community activities have been postponed to prevent direct interaction among crowds. All citizens and residents were told to respect the lockdown and stay home for a period of time to prevent the pandemic outbreak. Harsh punishments were levied on those who violated quarantine orders, such as large fines of more than 10,000 riyals. Kelman and Harris [27] argued that the use lockdown in UK

Table 3 COVID-19 statistics by Saudi regions.

Saudi regions	Total cases		Recovered			Deaths		
	352,160 (1)		339,114 (2)			5605 (3)		
	Total (4)	Regional infection rate % = (4)/(1)	Total (6)	Average regional recovery rate (%) = (6)/(2)	Regional recovery rate (%) = (6)/(4)	Total (7)	Average regional death rate = (7)/(3)	Regional death rate = (7)/(4)
Riadh	72,112	**20.47**	69,772	20.57	96.75	1224	**21.83**	**1.69**
Mecca	86,369	**24.52**	83,357	24.58	96.51	2163	**38.59**	**2.5**
Medina	28,317	8.04	27,302	8.05	96.41	143	2.55	**0.5**
Qasim	13,380	3.79	12,735	3.75	95.17	177	3.15	0.13
Eastern region (alsharqiya)	86,736	24.62	83,856	**24.72**	96.67	725	12.93	0.83
'Asir	27,400	7.78	26,783	7.89	97.74	350	6.24	1.27
Tabuk	4780	1.35	4630	1.36	96.86	78	1.39	1.63
Northern Border	2353	0.68	1980	0.58	84.14	80	1.42	3.39
Jizen	12,022	3.41	10,835	3.19	90.12	397	7.08	3.30
Najran	6269	1.78	6066	1.78	96.76	59	1.05	0.94
Al-Baha	4256	1.2	4032	1.18	94.73	56	**0.01**	1.31
Ha'il	7007	1.98	6684	1.97	95.39	106	1.89	1.5
Al-Jawf	1159	**0.32**	1082	0.31	93.35	47	0.83	**4.05**

In bold: key results. Source: authors' calculation using data from https://covid19.moh.gov.sa/.

contributed to reducing the limited accessibility of health-care system since COVID-19 cases peaked.

The effect of social distancing remains uncertain, but these preventive measures have been suggested by the WHO depending on the severity of the disease, the risk groups affected and transmission epidemiology [28]. Saudi MOH supported social distance activity during COVID-19 outbreak. The main purpose of social distancing was to restrict physical interactions and to have a psychological effect on close contact in specific public areas. The practice of social distancing has led to a social reaction in industries that have suffered from economic losses. COVID-19 has longer lasting psychological effects. The most serious and devastating consequences were the loss of loved ones.

The role of Saudi risk reduction management framework

One of the most important lessons learnt from the COVID-19 outbreak by the Saudi Arabia government was the vital role that the bureaucracy has played in disaster management. The institutional system then in place was seriously inadequate for coping with a situation that was both complex and unprecedented. The battle against COVID-19 also needed more than a medical solution, as resources had to be drawn from governmental bodies other than MOH. In response to COVID-19, a three-tiered national control structure was established and defined by the Council of Ministers (CM). Within this section, we outline the crisis management structure of Saudi Arabia, the legal framework for combating COVID-19, as well as the risk mitigation initiatives within cultural, healthcare and psychosocial perspectives.

During novel Coronavirus, the kingdom government institutional structure involved in fighting COVID-19 pandemic encompassed three main levels especially: strategic, operational and tactic. The strategic level of the disaster risk reduction strategy system (DRRSS) headed by the Council of Ministers. The top crisis management level demonstrates the Strategic Planning Division and runs audit and monitoring of overall decentralized units of crisis management especially bodies of state administration in operational and tactical levels (Fig. 1).

The strategic level of DRRSS is deemed as the front-line of crisis management system in Saudi Arabia. It is responsible for planning and controlling all kinds of disasters affecting the kingdom. There are various governmental bodies involved in crisis management with different roles. There are different crisis managers at the operational level who supervise the implementation and management of resources. The government of Saudi Arabia keeps related ministries responsible according to the extent and severity of the disaster.

The Saudi Council of Ministers is the major player in risk mitigation at the strategic level and the civilian emergency management is almost embodied in government risk management policy. The Saudi Civil Defence Authority (SCDA) is the leading operating force in the kingdom for public incidents protection. The ministry of Health (MOH) operates at the operational level in fighting COVID-19 pandemic,

Table 4 The initiatives of the Kingdom to tackle the COVID-19.

Governmental body	Initiatives and measures
Council of Ministers	Rapid activation of Cabinet Resolution No. 649 to compel companies in which the state owns more than 51% of its capital, by taking into account the general principles and rules for offering business and purchases and giving preference to local content and small and medium enterprises
Saudi Arabian Monetary Agency	A program worth 50 billion riyals aimed at supporting the private sector and enabling it to play a role in promoting economic growth
Ministry of Health	Providing free treatment for coronavirus for all citizens, residents, and violates of residency regulations in Saudi Arabia
Ministry of Municipal and Rural Affairs	Postponing the collection of municipal services fees due on the private sector for a period of 3 months for more than 1400 economic activities
Ministry of Commerce	Postponing the payment of fees for commercial records for more than 116 thousand commercial records for records ending in the period 18/3/2020 to 16/6/2020 for a period of 90 days from the date of expiry
Ministry of Human Resources and Social Development	Lifting the suspension of wages work during the current period & lifting the suspension temporarily from the private sector establishments to correct the activity and lifting the suspension due to not paying the fines collected & calculating the employment of Saudis in ranges immediately for all establishments
Ministry of Energy, Industry and Mineral Resources	30% discount on the value of the electricity bill. In the commercial, industrial and agricultural sectors for a period of two months (April—May), with the possibility of extension if necessary
	Optional allowance for subscribers in the industrial and commercial sector to pay 50% of the value of the monthly electricity bill for the months' bills (April—May—June) provided that the remaining dues will be collected in divided installments for a period of 6 months starting from January 2021 AD with the possibility of postponing the payment period if the need arises
Human Resources Development Fund (Hadaf)	Allocating 5.3 billion riyals to support private sector establishments to employ and train Saudis as part of the government support initiative to enable the facilities and develop their performance
Social Development Bank	A subsidy of 12 billion riyals to support citizens, families and small and emerging enterprises to face the effects of the Corona virus and the economy
General Authority of Transport	Supporting individuals working directly who are not under the umbrella of any company and registered with the General Authority of Transport in the activities of passenger transport and were stopped due to the precautionary measures of the Corona virus, by paying an amount of the minimum amount of salaries to them
The General Authority for Small and Medium Enterprises ''Monshaat''	Allow personal and SMEs loan payments to be postponed for a year, starting from 3/17/2020

with the association of Saudi Arabian Monetary Authority (SAMA) and the governorates. In fact, the MOH is responsible for overseeing and organizing the hygienic and sanitary protocols of risk management during the pandemic life cycle. While the principle mission of SAMA is to ensure the monetary equilibrium using suitable financial policies, the governorates operates as a catalyst for tactic protagonists. Nevertheless, in case of COVID-19 pandemic, the SAMA has quickly activate a budgetary processes and funding lines and ensure that those lines are properly resourced with sufficient financial capacity.

The Ministry of Interior (MI) and specially the SCDA is given the authority to coordinate all response emergencies forces. However, the Saudi Data and Artificial Intelligence Authority (SDAIA) launched the ''Tawakkalna'' application to manage electronic permits during the period of ''curfew''. On June 14, 2020, SDAIA, in cooperation with the Ministry of Health, launched ''Tabaud'' application to notify users that they had contact with a person infected with the emerging coronavirus COVID-19, and ''Sehaty'' application to register for vaccine where Available [29]. The Ministry of Hajj and Umrah has launched the application ''Eatmarna'' to enable pilgrims to book an appointment to perform Umrah or to visit the Two Holy Mosques. Disaster Health Management (DHM) was been a systemic landmark for Saudi Arabia's approach in fighting the COVID-19 outbreak to reducing risk and managing disasters [1].

The COVID-19 outbreak has questioned the traditional system of crisis and disaster management, as the pandemic transcended the control of disaster health management. The policy makers in the kingdom realized that a robust system for disaster management was required to fight the COVID-19
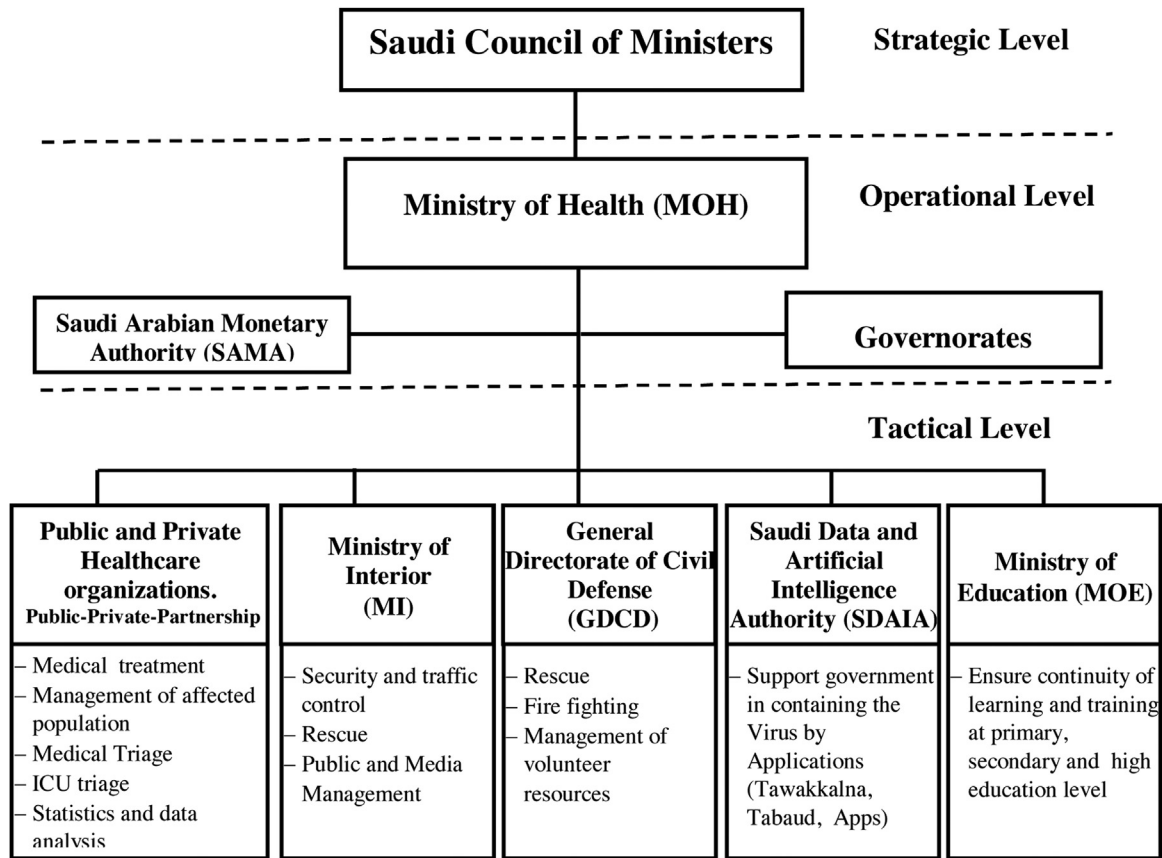
Figure 3. Saudi Government RRM Framework in fighting COVID-19 pandemic.

pandemic. As a result, a clear framework of multi-sectoral governance was deemed necessary to deal with COVID-19 pandemic (Fig. 3).

Many countries have developed their own DRRS to fight devastating accidents and disasters such as China [30], Philippines [31], Oman [32], Singapore [2] and Czech Republic [33]. For instance, since the crisis of severe acute respiratory syndrome (SARS), China has modernized its national emergency management system (NEMS) which revealed its efficacy in fighting COVID-19 pandemic. The Chinese NEMS was been organized by vertical administrator-sector lines' [34]. However, after 2003 SARS crisis, China rebuilt a new NEMS based on ''one plan and three subsystems'' [35]. The Saudi institutional framework of DRRS in comparison with other international systems, shows that is very similar to that of Singapore that is structured in a multi-level governance and which shows its success in fighting SARS pandemic [2].

As the COVID-19 pandemic outspread at the beginning of March 2020, causing an enormous impact on healthcare services and on socioeconomic level in the kingdom. As a result, the Saudi government has applied severer measures to combat the spread of the virus. Fig. 4 Elucidate some of the stricter measures taken by the Saudi government.

Based on the efforts made by the Saudi Risk Reduction Management Framework between September 2020 and January 2021, Fig. 5 in form of dot density maps shows the outbreak of COVID-19 pandemic in all Saudi regions before (September 2020) and after (January 2021) the strict measures taken by Saudi government.

Government steps to regulate public health

Monitoring and monitoring is crucial in the battle against COVID-19 pandemics as it helps to provide early notice and also to predict potential outbreaks. The monitoring method includes searching for potential variations of virulent strains and diseases both within the boundaries of a country and at major border crossings [1,8,37−39].

The existence of the virus was largely unknown when COVID-19 first appeared. As a result, health and healthcare professionals across the globe were increasingly unable to identify and track suspicious cases. Yet, Saudi Arabia managed to develop identification and reporting protocols in a timely manner with the assistance of WHO technical advisors. In addition, the MOH has extended the concepts of the WHO for reported COVID-19 cases (including any healthcare staff with fever and/or respiratory symptoms) to broaden the surveillance network [40].

Although these monitoring measures were laudable, COVID-19 also revealed the shortcomings of the fragmented epidemiological surveillance and reporting processes in Saudi Arabia [26]. A number of new surveillance initiatives were implemented as a major part of the lesson-drawing in the post-COVID-19 pandemic period to incorporate
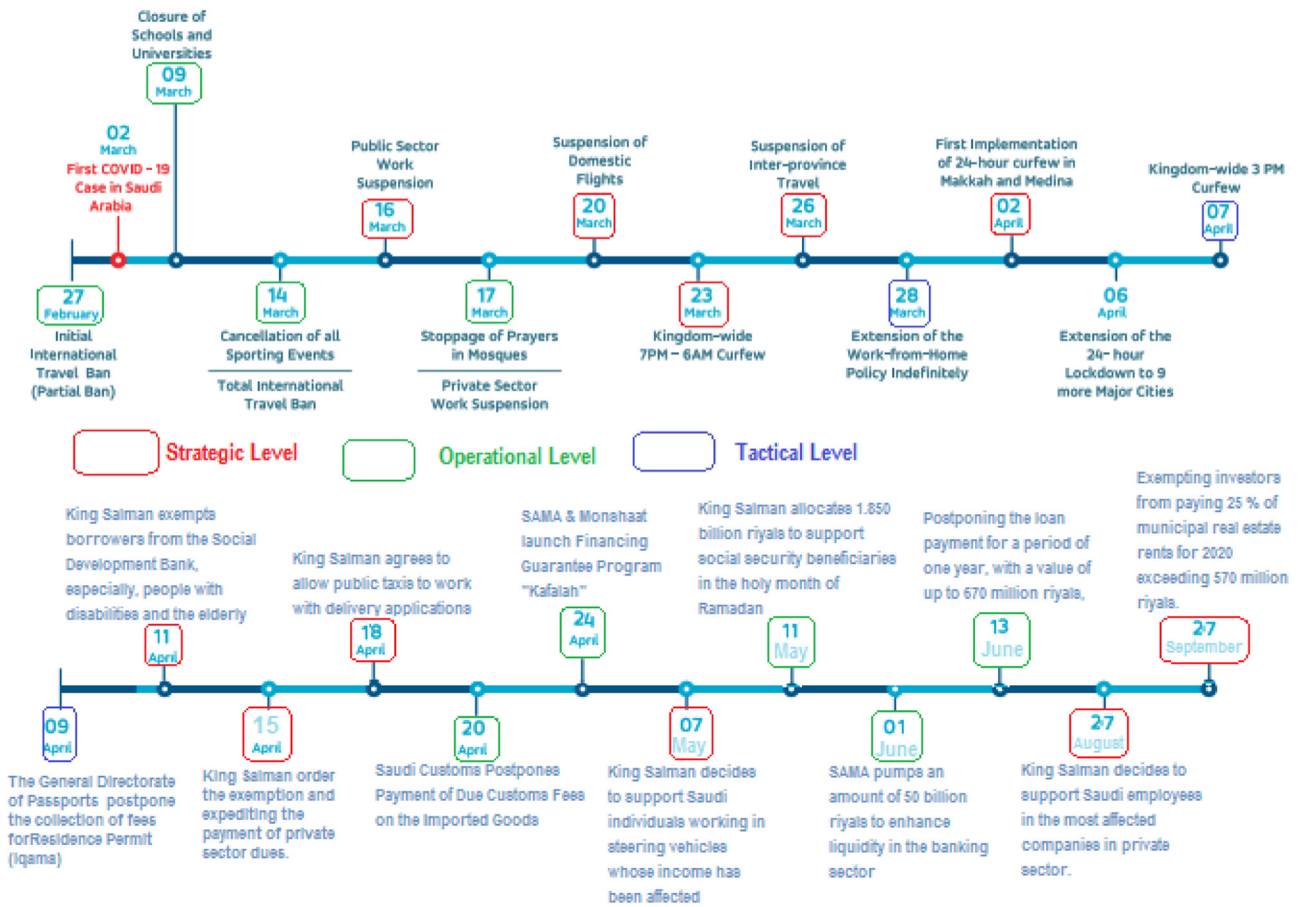
Figure 4. Some stricter measures taken by the Saudi government.
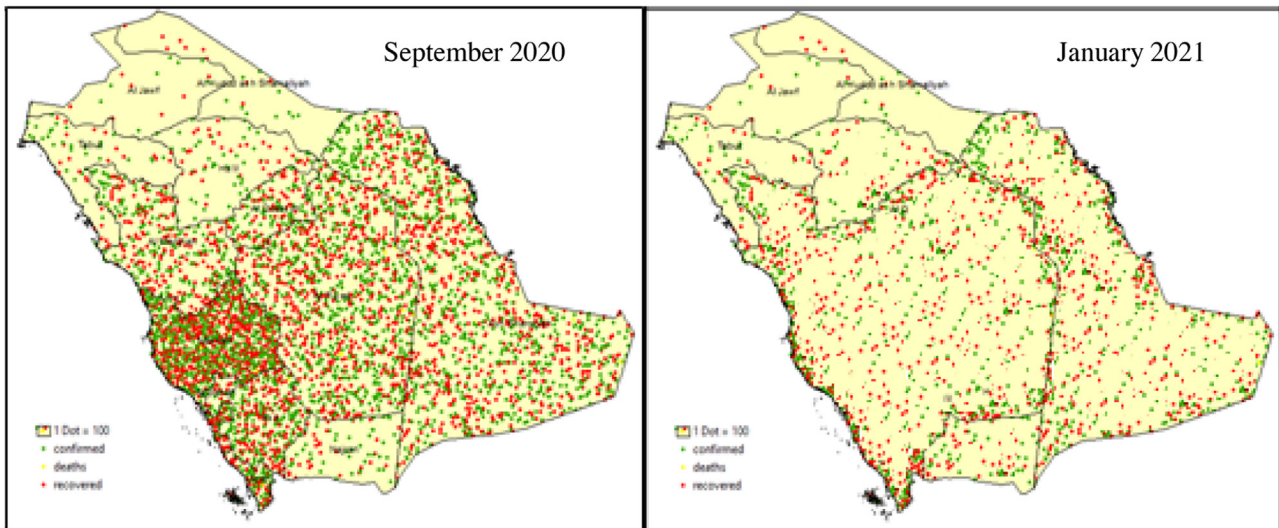Source: adopted from [36] and modified by authors.

Figure 5. Dot density map of COVID-19 before and after Saudi government measures.
Source: authors' elaboration using data from https://covid19.moh.gov.sa/ (ArcGis and GeoDa software outputs).

epidemiological data and classify Current virulent strain evolving more rapidly. One of the most prominent was the development of a clinical database and infectious disease warning system to incorporate essential clinical, laboratory and contact tracing information. The monitoring program currently has three major operational elements, including group surveillance, laboratory surveillance, and external surveillance.

Infection prevention at hospitals

To limit the risk of transmission in healthcare institutions once the COVID-19 epidemic broke out, the MOH implemented a series of stringent infection-control measures to which all healthcare professionals and hospital visitors had to adhere. It has made the use of personal protective equipment compulsory. Visitors to public hospitals in those areas were barred healthcare professionals activities in public hospitals have also been heavily prohibited. Sadly, these essential steps were not enforced in all healthcare sectors until the end of March 2020, and this failure resulted in a number of intra-hospital infections [26]. Moreover, the approach of limiting healthcare professionals and visitors' movements to hospitals has been taken further. Patient movement between hospitals, meanwhile, was strictly restricted to medical transfers. The number of visitors to hospitals was also limited and their particulars recorded during each visit.

It is also important to note that strong public support and cooperation were needed for these rather stringent control measures. Indeed, if these two elements had been missing their implementation would not have been successful.

Public contact and education

Public education and communication are two key components of handling health emergencies [41,42]. Communication difficulties are likely to complicate the challenge, particularly when there is no existing, high-status entity that can serve as a centre for gathering and disseminating information. Hence, critical information needs to be disseminated transparently to the targeted population. The Saudi MOH maintained a high degree of openness during the COVID-19 outbreak, when it shared details with the public. Nonetheless, the MOH's simple and distinct communications have greatly contributed to raising the possibility of public panic. The MOH has worked closely with the media to provide daily, timely reports and advisories on health. In addition to the media (e.g., television and radio), knowledge pamphlets were distributed to every household, and the Saudi MOH website provided the population with regular alerts and health advisories.

Notably, a government information portal was established (https://covid19awareness.sa/en/home-page) when the WHO released a global warning, dedicated to providing timely updates. A series of dedicated awareness-raising television spots to protect against COVID-19 was launched. A common message received during the COVID-19 outbreak has been the importance of social responsibility and personal hygiene, in order to treat new COVID-19 positive cases, such as public hospitals and local clinics. Children at the school were told to wash their hands daily and check their body temperature. They told the public to wear masks and to postpone non-essential travel to other countries. Saudi education policies corroborate with the study performed in Japan by [43], which analyzed the COVID-19 response in the education sector using the Sendai Framework for disaster risk reduction.

Social distancing and measures of psychosocial affairs

During COVID-19 outbreak the Saudi MOH promoted the practice of social distancing. Of course, the sole purpose of social distancing was to restrict physical encounters and near communication in public places, thus slowing the COVID-19 transmission rate. As a result, from 9 March 2020 all preparatory, primary and secondary schools and universities were closed. In the meantime, Saudi MOH also urged businesses to take social distancing steps, such as encouraging workers to work from home and use peer production platforms. Those most at higher risk of contracting complications were transferred if infected and removed from frontline work to other locations where they were less likely to contract the virus. As mentioned earlier, the practice of social distancing also drew strong criticisms from those businesses that suffered economic losses as a result. Apart from providing economic compensation, measures to mitigate psychosocial impacts are also important.

As mentioned above, the government's public health control measures drew strong criticism from businesses and the public during the COVID-19 outbreak because of the invasive nature of those actions. Besides these, total jobs and personal income have been affected by economic slowdown. In response to public concerns, King Salman agreed to exempt borrowers from the Social Development Bank, who are most in need especially people with disabilities and the elderly. He offered economic assistance to those individuals and businesses that had been affected by home quarantine orders.

At the same time, the MOH worked with various government ministers to provide essential social services to those affected by the lockdown order. For example, housing was offered to stranger residents those who lives in crowded houses. During their lockdown, the Saudi Arabia Civil Defence Force openly offered emergency services to those undergoing quarantine at home to see their physicians. Not only were all of these risk management steps effective in combating the outbreak, but they were also relevant for applications in managing disaster risks.

Research implications

This section outlines the lesson learning from the experience of Saudi Arabia in combating the COVID-19 outbreak, and discuss the implications of disaster risk management for future research. The implications are explained in three aspects: staying vigilant at the level of the community, remaining flexible in a national management structure and collaborative local governance.

Stay alert at community level

It remains unclear that the strict health protection measures taken by Saudi government might not be acceptable or replicable in other countries. The evidence suggests that punitive government policies such as the set out of new fines for COVID-19 breaches, the lockdown and travel bans are

less effective than voluntary interventions for instance good personal hygiene and the voluntary wearing of face masks [26,44]. Recalling the public to maintain a high degree of vigilance and promoting individual social responsibility may be a technique of coercion by the government authority to control and exert pressure. Nevertheless, not to complicate the policy with individuals or groups [45,46]. Promoting social responsibility is therefore crucial in terms of slowing the pace of COVID-19 infection in all settings through good personal hygiene and wearing respiratory masks.

To accomplish this goal, two essential components of health crisis management (HCM) are public awareness and risk communication [41,42]. The community needs to be aware of the nature and extent of the disasters. They need to be informed about the value of emergency preparedness and engagement in drills, training and physical preparations. Institutions and capacities are established and strengthened at community level, which in effect contribute systematically to the vigilance against potential risks. This is best demonstrated in the good communication policy of the government of Saudi Arabia for avoiding public fear and panic during COVID-19 outbreak [47]. Throughout the epidemic, the Saudi government has steadfastly raised the level of personal hygiene and awareness of social responsibility. It has to depend in large part on public awareness and coordination of threats. Political leaders were seen as doing and initiating a series of countermeasures to reassure the public, in order to effectively disseminate the idea of vigilance across the public.

By showing the people that government leaders practiced what they were preaching, the examples served to naturalize and legitimize the social responsibility public discourse for all Saudi citizens and residents. Through showing the people that policy officials were practicing what they were teaching, the examples helped to naturalize and legitimize the popular debate on social responsibility for all citizens and residents. The evolving circumstance is adapting flexibly, and even more quickly than in the case of disease transmission.

Staying flexible within a national coherent strategy

All local emergency response bodies will operate under the authority of a single National Management system to organize multi-institutional cooperation in emergency response and disaster management. In addition to promoting strong inter-institutional cooperation, the power of this robust framework lies in its ability to ensure a rapid response to such disease outbreak through the more effective and efficient execution of risk reduction steps.

Structural versatility includes the rapid deployment of forces to mitigate the accident at the tactical level and the provision of professional guidance at the operational level to reduce life and property harm. The endogenous versatility of this management structure facilitates lead to the building of trust between the government and people. This in effect ensures timely acceptance by the population of policy initiatives.

As shown in this article, the Saudi MOH has been entrusted by the government and designated as the public health emergency incident manager. Where a sudden incident involves public health or a large-scale loss of life, the MOH is responsible for the planning, coordination and implementation of a range of disease control programs and activities.

During the COVID-19 outbreak a national management and control system was created by the Saudi government. This national framework was able to respond to rapidly changing circumstances emerging from the outbreak. As more cases of COVID-19 were identified and better epidemiological knowledge became available, the Saudi Council of Ministries quickly formed an Inter-institutional cooperation to ensure planning and implementing all risk reduction steps. Although this overarching system of governance is more or less ordinary worldwide [48].

From the experiences of Saudi Arabia in fighting COVID-19 pandemic, we learned that a national management structure's strength lies in its flexibility to connect relevant ministries on the same framework. These linkages guarantee a timely, coordinated response and delivery of services. Being flexible in structure was not the only reason behind COVID-19's successful defeat. In the case of Saudi Arabia, we also note the effectiveness of having to depend on expansion capacity to withstand an unexpected, high-impact catastrophe.

The need for expansion capacity and collaborative regional governance

In the context of this paper, the capacity for surge refers to the ability to mobilize resources (health professionals, facilities, medical devices, vaccines, etc.) to combat a pandemic outbreak. The strategic responsiveness of Saudi Arabia to COVID-19 illustrates the importance of rapidly increasing the capacity to deal with an outbreak of infectious disease. This problem continues to hinder the ability of many countries to counter infectious diseases. It is a matter of fact for many public health organizations that they are unable to cope with pandemics because the means for doing so are clearly lacking [49,50].

In the meantime, there is evidence suggesting that expanding capacity alone is not the full answer. For instance, abundant resources during the COVID-19 outbreak contribute to a significant but not all-encompassing factor in the fight against this pandemic. When it turned out, as different stakeholders brought their specific skill sets and tools to the task-at-hand, they simply complicated the battle because of their lack of synergy. Indeed, abundant resources without collaboration could potentially undermine collaborative efforts. Therefore, the ability to connect various stakeholders needs to be complemented by some form of synergy between them. These abilities can be improved by close cooperation. This takes us to the third concept for disaster management: national collective governance.

The transboundary complexity of disasters needs a prepared and organized strategy for successful rescue and relief operations to disaster response [49]. Combating epidemics includes close coordination between various states and government bodies [1,51,52].

It is also clear that various stakeholders' collaborative ability is essential to the battle against transboundary

Table 5 Disaster risk reduction framework.

Key recommendations

1. Mitigation/readiness
    At the strategic level, government needs to opt for strict quarantine measures for people coming from other red zones
    There is a necessity to establish village committees to furnish basic healthcare and hygiene information using door to-door communication
    At operational level, there is a need to convince the population about the need to take vaccine and to fight against disinformation and fake news
    Community volunteers, at tactical level, can be trained to make quick COVID-19 tests that deliver quick results or the government, at operational level, can make recruitment of healthcare professionals to achieve this
    There is a need to give subventions to private labs to rise the number of COVID-19 tests by decreasing the costs for the population
2. Preparedness
    At a strategic level, there is a need to build a pandemic insurance solution for the community to cover significant economic losses
    Healthcare facilities need to provide free vaccine to more than two-third of inhabitants
    Government bodies, at operational and tactical levels, have to oblige individuals to respect social distancing
    It is interesting to prioritize the funding of the most affected ventures by the pandemic
3. Response/implementation
    Healthcare professionals have to be well rewarded by the government, at the operational level, for their brave efforts during the pandemic
    The government can use information and communication technology, in public places, to recognize individuals who are not wearing masks and who have fever
    The government, at a strategic level, can continue to support small and medium enterprises (SMEs) to survive during COVID-19 crisis
    Saudi banks have no liquidity shortage and can permit companies in economic difficulty to postpone loan payment
    At tactical level, securities officials can be given more authority to force individuals to respect social distancing
4. Recovery/post-COVID-19
    After the COVID-19 pandemic, it is necessary to think about human capital development especially in the strategic fields of education, healthcare facilities and agriculture
    In the future, there is a need to develop bilateral cooperation agreements with other developed countries to manage scientific research project, share knowledge and technology
    At the strategic level, Saudi government, need to review its monetary policy by reducing taxes and expenditures
    It is important to help many SMEs affected by the pandemic by providing them reasonable loans to support their resilience and to boost economic growth

communicable diseases [49,53]. Although advanced economic development member states usually lead these efforts, it is important and ultimately unavoidable to include other developing countries and organizations. Indeed, with the assistance of regional cooperation, significant countermeasures such as border protection and surveillance are also made possible such as the Gulf Cooperation Council (GCC), which adopts an anticipatory mechanism in order to enhance and implement a disaster risk reduction system (DRRS).

Discussion, conclusions and policy recommendations

The COVID-19 is not only a health crisis but also socioeconomic and political crisis that will have serious repercussions in societies and people. Loss of jobs and incomes are main challenges facing governments. The immediate lesson from Saudi experience in fighting the pandemic is about the need to reiterate the operational responsiveness of the Risk Reduction Management system in dealing with crisis. Villarin and Basilio [54] argued that local government and

political-administrative structure are on the front line for COVID-19 preparedness. Bogati and Gautam [55] show that rapid recovery after COVID-19 crisis requires the capability of governments and local communities to mobilize diverse stakeholders and managing available financial and human resources.

Today the world is much more interconnected than ever before, owing to globalization, international trade and cross-border migration. No nation is spared being directly or indirectly affected by catastrophes. Saudi Arabia is vulnerable to both natural and man-made disasters alongside its remarkable economic growth. In response, the Saudi Arabia government adopts an approach of integrated risk management, a concerted, coordinated effort based on a universal national response.

We observed the disaster risk reduction system (DRRS) of Saudi Arabia in this case study, with clear references to the COVID-19 outbreak. In its combat against COVID-19 pandemic, The Saudi health authority was sufficiently responsive to take action when it realized that the flexible inter-institutional was suitable to facilitate close cooperation between various key government bodies to tackle the

on-going health crisis. So, a crisis management structure was established quickly. The nature of a versatile management system, the way and extent it was used determines how effectively an outbreak was managed. Flexibility has actually improved the potential of organizations by making organizations more productive under some circumstances. Epidemic prevention strategies such as surveillance, social distancing and lockdown need broad public support for their efficacy. Saudi Arabia's COVID-19 experience strongly indicates that risk reduction strategies can only be successful when a number of partners and stakeholders are involved such as ministries, civil society (associations) participate appropriately. This is also important for controlling risk of a disaster. Whether all these aspects can be transferred elsewhere in future research needs to be assessed.

Today, this particular approach has definitely helped Saudi Arabia periodically recover from public health crisis. Saudi Arabia's response to the COVID-19 outbreak provides useful insights into the kinds of strategies required to battle future pandemics. Furthermore, [56] confirm that, the use of a framework for Disaster Risk Reduction, needs the use of wide-ranging strategies that protect vulnerable peoples during the four stages of Mitigation (readiness), preparedness, response (implementation) and recovery (post-COVID) (Table 5).

Human and animal rights

The authors declare that the work described has been carried out in accordance with the Declaration of Helsinki of the World Medical Association revised in 2013 for experiments involving humans as well as in accordance with the EU Directive 2010/63/EU for animal experiments.

Informed consent and patient details

The authors declare that this report does not contain any personal information that could lead to the identification of the patient(s) and/or volunteers.

Funding

This work did not receive any grant from funding agencies in the public, commercial, or not-for-profit sectors.

Author contributions

All authors attest that they meet the current International Committee of Medical Journal Editors (ICMJE) criteria for Authorship.

Disclosure of interest

The authors declare that they have no competing interest.

References

[1] Alraga SM. An investigation into disaster health management in Saudi Arabia. J Hosp Med Manag 2017;3(2):18.

[2] Lai AY, Tan SL. Impact of disasters and disasters risk management in Singapore: a case study of Singapore's experience in fighting the SARS epidemic. Resilience Recov Asian Disast 2015;18:309—36.

[3] United Nations International Strategy for Disaster Reduction (UNISDR). Terminology on disaster risk reduction; 2009 [Retrieved from https://www.unisdr.org/files/7817_UNISDRTerminologyEnglish.pdf on October 9, 2020].

[4] Center for Research on the Epidemiology of Disaster (CRED); 2021 [Available at http://www.cred.be/ (last accessed Mai 5, 2021)].

[5] Abosuliman SS, Kumar S, Alam F. Disaster preparedness and management in Saudi Arabia: an empirical investigation. Inter J Soc Edu Eco Manag Eng 2013;7:1972—6.

[6] Emergency Events Database (EM-DAT). Saudi Arabia Country Profile — Natural Disasters [Online]. The OFDA/CRED International Disaster Database. Brussels, Belgium: Université Catholique de Louvain (UCL); 2014 [Available: http://www.emdat.be/result-countryprofile?disgroup=natural&country=sau&period=2005$2014 (Accessed 04/03 2021)].

[7] Badawi A, Ryoo SG. Prevalence of comorbidities in the Middle East respiratory syndrome coronavirus (MERS-CoV): a systematic review and meta-analysis. Int J Infect Dis 2016;49:129—33.

[8] Jaziri R, Alnahdi S. Choosing which COVID-19 patient to save? The ethical triage and rationing dilemma. Ethics Med Public Health 2020;15, http://dx.doi.org/10.1016/j.jemep.2020.100570.

[9] Enemark S. Sustainable land administration infrastructures to support natural disaster prevention and management. In: UN Regional Cartographic Conference for the Americas New York, 10—14 August 2009; USA. 2009.

[10] International Federation of Surveyors (FIG). The contribution of the surveying profession to disaster risk management. Copenhagen, Denmark: FIG Publication No. 38; 2006 [https://www.fig.net/resources/publications/figpub/pub38/pub38_screen.pdf].

[11] Chirisa I, Mutambisi T, Chivenge M, Matamanda AR, Ncube R. Disaster mitigation and response in cities: drawing lessons from COVID-19 pandemic. J Soc Sci 2020;63:21—31, http://dx.doi.org/10.31901/24566608.2020.63.1-3.2262.

[12] World Health Organization. Disaster risk management for health: mental health and psychosocial support. Disaster risk management for health fact sheets. Geneva, Switzerland: World Health Organization; 2011.

[13] RICS. The built environment professions in disaster risk reduction and response. London: RICS; 2009.

[14] Enemark S. The International Federation of Surveyors (FIG). Denmark: Land Management Aalborg University; 2010 [https://www.fig.net/organisation/council/council_2007-2010/council_members/enemark_papers/2010/jbgis_fig_final.pdf].

[15] Al-Qahtani A-M. Disaster risks and preparedness: effects of petrochemical hazards on the environment in Saudi Arabia. J Environ Earth Sci 2014;4:129—39.

[16] International Strategy for Disaster Reduction (ISDR). Hyogo Framework for Action 2005—2015: building the resilience of nations and communities to disasters; 2007 https://www.unisdr.org/files/1217_HFAbrochureEnglish.pdf.

[17] IPCC. Statistics on disasters, in IPCC Climate Change 2001; Working Group II: impacts, adaptation and vulnerability, special issues in developing countries, IPCC Third Assessment Report. New York: Cambridge University Press; 2014.

[18] ISDR. Disaster risk and sustainable development: understanding the links between development, environment and natural hazards leading to disasters. Background document for the World Summit on Sustainable Development (WSSD). Geneva: International Strategy for Disaster Reduction; 2002.

[19] Quarantelli EL. What is a disaster? Perspectives on the Question 1998. London: Routledge; 2002.

[20] Ikeda S, Sato T, Fukuzono T. Towards an integrated management framework for emerging disaster risks in Japan. Nat Hazards 2008;44:267—80.

[21] World Health Organization (WHO). Disaster risk management for health overview. Disaster risk management for health fact sheets. Geneva, Switzerland: World Health Organization; 2011.

[22] Mlybari E, Ahmed I, Khalil M. Current state of practice in disaster risk management. In: Komurlu R, Gurgun AP, Singh A, Yazdani S, editors. Interaction between theory and practice in civil engineering and construction. 2016 [ISBN: 978-0-9960437-2-4].

[23] Atkeson A. What will be the economic impact of COVID-19 in the US? Rough estimates of disease scenarios. NBER Working paper series, 26867; 2020.

[24] Lesschaeve C, Glaurdić J, Mochtak M. Health versus wealth: saving lives or saving the economy during the COVID-19 pandemic? Public Opinion Quarterly 2021 [in press. https://orbilu.uni.lu/bitstream/10993/46702/1/Health%20versus%20wealth_POQ.pdf].

[25] McKibbin W, Fernando R. The economic impact of COVID-19. In: Baldwin R, Di-Mauro BW, editors. Economics in the time of COVID-19. London: CEPR Press; 2020.

[26] Qureshi MN, AlRajhi A. Challenge of COVID-19 crisis managed by emergency department of a big tertiary centre in Saudi Arabia. Int J Pediatrics Adolesc Med 2020;7:147—52.

[27] Kelman I, Harris M. Linking disaster risk reduction and healthcare in locations with limited accessibility: challenges and opportunities of participatory research. Int J Environ Res Public Health 2020;18:248, http://dx.doi.org/10.3390/ijerph18010248.

[28] World Health Organization. WHO guidelines on the use of vaccines and antivirals during influenza pandemics 2005. Geneva: Word Health Organization; 2005 [http://www.who.int/csr/resources/publications/influenza/11_29_01_A.pdf (accessed June 29, 2020)].

[29] Kassem LM, Alhabib B, Alzunaydi K, Farooqui M. Understanding patient needs regarding adverse drug reaction reporting smartphone applications: a qualitative insight from Saudi Arabia. Int J Environ Res Public Health 2021;18:3862, http://dx.doi.org/10.3390/ijerph18083862.

[30] Liu Y, Yin K, Chen L, Wang W, Liu Y. A community-based disaster risk reduction system in Wanzhou, China. Int J Disaster Risk Reduct 2016;19:379—89, http://dx.doi.org/10.1016/j.ijdrr.2016.09.009.

[31] Badoc-Gonzales BP, Tan J, Mandigma MBS. Institutional change of disaster risk reduction management offices in selected areas of post-Haiyan Philippines. In: Faghih A, Samadi H, editors. Legal-economic institutions, entrepreneurship, and management. Switzerland: Springer Nature; 2021 [AG-2021-249-N, https://doi.org/10.1007/978-3-030-60978-8_11].

[32] Al-Manji S, Lovett J, Mitchell G. Factors affecting disaster resilience in Oman: integrating stakeholder analysis and fuzzy cognitive mapping. Risks Hazards Crisis Public Pol 2021;12:29—50.

[33] Kratochvilova D, Rehak D. Disaster risk reduction system at the regional level in the Czech Republic. The State of DRR at the local level: a 2015 report on the patterns of disaster risk reduction actions at local level 1; 2015.

[34] Lu X, Han A. Emergency management in China: towards a comprehensive model? J Risk Res 2019;22:1425—42, http://dx.doi.org/10.1080/13669877.2018.1476901.

[35] Lu X, Sun L, Fu S, Sun Y, Shao K. Understanding China's national emergency management system. In: Jing Y, Han JS, Ogawa K, editors. Risk management in East Asia: systems and frontier issues. Palgrave Macmillan; 2021.

[36] Strategic Gears Management Consultancy (SGMC). Saudi Arabia's response to the COVID-19 pandemic. Report 7th of April 2020 [18 p.].

[37] Jebara KB. Surveillance, detection, and response: managing emerging diseases at national and international levels. Rev Scientif Techn Internat Office Epizootics 2004;23:709—15.

[38] Ansell C, Boin A, Keller A. Managing transboundary crisis: identifying the building blocks of an effective response system. J Contingencies Crisis Manag 2010;18:195—207.

[39] Narain J, Bhatia R. The challenge of communicable diseases in the WHO southeast Asia region. Bull World Health Organ 2010;88:162 [http://www.who.int/bulletin/volumes/88/3/09-065169/en/index.html (accessed Mars 29, 2021)].

[40] Yang BY, Barnard LM, Emert JM, Drucker C, Schwarcz L, Counts CR, et al. Clinical characteristics of patients with coronavirus disease 2019 (COVID-19) receiving emergency medical services in King County, Washington. JAMA Netw Open 2020;3:e2014549.

[41] Reynolds B, Seeger MW. Crisis and emergency risk communication as an integrative model. J Health Communic 2005;10:43—55.

[42] Reddy MC, Paul SA, Abraham J, McNeese M, DeFitch C, Yen J. Challenges to effective crisis management: using information and communication technologies to coordinate emergency medical services and emergency department teams. Int J Med Informat 2009;78:259—69.

[43] Shaw R, Sakurai A, Oikawa Y. New realization of disaster risk reduction education in the context of a global pandemic: lessons from Japan. Int J Disaster Risk Sci 2021, http://dx.doi.org/10.1007/s13753-021-00337-7.

[44] Bruine BW, Fischhoff B, Brilliant L, Caruso D. Expert judgments of pandemic risks. Global Public Health 2006;1:1—16.

[45] Aimone F. The 1918 influenza epidemic in New York City: a review of public health response. Public Health Rep 2010;125:71—9.

[46] Aledort JE, Lurie N, Wasserman J, Bozzette SA. Non-pharmaceutical public health interventions for pandemic influenza: an evaluation of the evidence base. BMC Public Health 2007;7:208 [Retrieved 3 April 2021 from http://www.biomedcentral.com/1471-2458/7/208].

[47] Alanezi F, Aljahdali A, Alyousef S, Alrashed H, Alshaikh W, Mushcab H, et al. Implications of public understanding of covid-19 in Saudi Arabia for fostering effective communication through awareness framework. Front Public Health 2020;8:494, http://dx.doi.org/10.3389/fpubh.2020.00494.

[48] LaPorte TR. Critical infrastructure in the face of a predatory future: preparing for untoward surprise. J Contingencies Crisis Manag 2007;15:60—4.

[49] Lai AY. Organizational collaborative capacity in fighting pandemic crisis: a literature review from the public management perspective. Asia-Pacific J Public Health 2012;24:1—14.

[50] Oshitani H, Kamigaki T, Suzuki A. Major issues and challenges of influenza pandemic preparedness in developing countries. Emerg Infectious Dis 2008;14:875—80.

[51] Shalala DE. Collaboration in the fight against infectious diseases. Emerg Infectious Dis 1998;4:355—8.

[52] Webby RJ, Webster RG. Are we ready for pandemic influenza? Science 2003;302:1519—22.

[53] Leung GM, Nicoll A. Reflections on pandemic (H1N1) 2009 and the international response. PLoS Med 2010;7:e1000346.

[54] Villarin T-S, Basilio E. DILG and its governance role in the time of COVID-19 pandemic. Preprint November 2020. doi: 10.13140/RG.2.2.26907.69926.

[55] Bogati R, Gautam M-S. Disaster recovery toward attaining sustainable development goals. In: Filho L, et al., editors. No poverty, Encyclopedia of the UN sustainable development goals. Switzerland: Springer Nature; 2020 [https://doi.org/10.1007/978-3-319-69625-6_56-1].

[56] Raju E. Five years post-Sendai: where is the Sendai framework for disaster risk reduction in the COVID-19 response? Disaster Prevent Manag 2020;29:421—3, http://dx.doi.org/10.1108/DPM-08-2020-400.