



The impact of COVID-19 on Digital health and care in Saudi Arabia

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Published on: 22 June 2022

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Abstract

Background: The first case of COVID-19 in Saudi Arabia was confirmed on March 3, 2020. Saudi Arabia, like many other countries worldwide, implemented lockdown of most public and private services in response to the pandemic and established population movement restrictions nationwide. With the

implementation of these strict mitigation regulations, technology and digital solutions have enabled the provision of essential services.

Objective: The aim of this paper is to highlight how Saudi Arabia has used digital technology during the COVID-19 pandemic in the domains of public health, health care services, education, telecommunication, commerce, and risk communication. **Methods:** We documented the use of digital technology in Saudi Arabia during the pandemic using publicly available official announcements, press briefings and releases, news clips, published data, peer-reviewed literature, and professional discussions. **Results:**

Saudi Arabia's government and private sectors combined developed and launched approximately 19 apps and platforms that serve public health functions and provide health care services. A detailed account of each is provided. Education processes continued using an established electronic learning infrastructure with a promising direction toward wider adoption in the future. Telecommunication companies exhibited smooth collaboration as well as innovative initiatives to support ongoing efforts. Risk communication activities using social media, websites, and SMS text messaging followed best practice guides. **Conclusions:** The Saudi Vision 2030 framework, released in 2017, has paved the path for digital transformation. COVID-19 enabled the promotion and testing of this transition. In Saudi Arabia, the use of artificial intelligence in integrating different data sources during future outbreaks could be further explored. Also, decreasing the number of mobile apps and merging their functions could increase and facilitate their use.

KEYWORDS: digital response; COVID-19; Saudi Arabia; digital health; containment; public health; pandemic; prevention

* Introduction

The outbreak of SARS-CoV-2, emerging from the markets of Wuhan, led to the COVID-19 pandemic [1,2]. The current population-wide measures of home quarantine that were simultaneously applied worldwide to slow and prevent the spread of COVID-19 are unprecedented. The COVID-19 pandemic has caused disruption of daily services due to the community-wide mitigation measures taken by many countries.

Due to the low likelihood of obtaining a vaccine in the near future, global efforts have vastly focused on social distancing and complete city and state lockdowns in many instances as the only solutions to contain the pandemic [3]. These mitigation measures have necessitated the use of technology to maintain functions in all aspects of life. The global experiences with the H1N1 influenza pandemic in 2009 [4] and Ebola virus in 2014 clearly indicated that timely and appropriate technology usage played a considerable role in controlling these pandemics [5-7]. A cloud computing tool for data collection and integration for confirmed cases of Middle

East respiratory syndrome coronavirus (MERS-CoV), a GPS-

based risk assessment tool [8], and Google Maps usage for the geographical representation of MERS-CoV cases worldwide are examples of the technological methods used to control the outbreak of Middle East respiratory syndrome (MERS) [8]. By establishing a national electronic surveillance system [9,10], Saudi Arabia also contributed to the global data pool of MERS-CoV information.

During the current COVID-19 pandemic, Saudi Arabia has been proactive in implementing disease containment measures and working to meet the community's needs and demands in a very short time [3]. It is currently estimated that 30,260,000 people in Saudi Arabia (89% of the population) use the internet, 96% of the population uses smartphones [11], and the majority of the population now has access to smartphones, laptop computers, desktop computers, and tablets; therefore, digital service provision is much easier than in the past and has aided the mitigation efforts established by the government.

Keeping in view the importance of quick and timely digital data sharing for policy actions, which is also emphasized by the World Health Organization (WHO) [12], our aim in

this paper is to highlight how Saudi Arabia has used digital technology during the COVID-19 pandemic.

Figure 1. Examples of digital apps available for various health care domains during the COVID-19 pandemic in Saudi Arabia.



* Methods

The authors documented Saudi Arabia's experience using publicly available official announcements, press briefings and releases, news clips, published data, peer-reviewed literature, and professional discussions. The searched information sources were in both English and Arabic languages. A literature search was conducted from March 2021 to Jan 20, 2022. Each author collected, examined, and synthesized information on a designated sector; then, all the authors consolidated, discussed, and agreed on the final findings. The inclusion criteria for information were that the information depicted a prominent event during the COVID-19 pandemic response, included technology or digitalization,

and was specific to Saudi Arabia. The findings are mainly presented in narrative form.

* Results

An implementation plan for the new standards is needed in order to build support for digital transformation in areas where it is most needed and to realize the promise of integrated care. Figure 1 visualize and summarize some of the applications and platforms used for various health sectors during the COVID-19 pandemic in Saudi Arabia.

Therefore King Fahad Medical City signed a contract with EPIC, which is a step that would develop the provided health services and rely on the state-of-the-art technology to identify patient information at different healthcare stages, thereby ensuring the provision of accurate treatment plans in accordance with accurate and comprehensive data, to keep pace with current upgrade of health sector in the Kingdom, in order to meet the requirements of the National Transformation Program 2020 and Saudi Arabia's Vision for 2030.

KFMC stated, "EPIC system will be an effective way to deal with patients who come in large numbers to KFMC suffering various health

problems. This requires an electronic system that records health information in the patient's file, including blood tests, radiology, pharmacy, and the medical history."

"EPIC system is characterized by several advantages, the most important of which is its adoption of international medical standards, which are important in raising quality of healthcare provided to patients. In addition, it supports transformation in health sector into the trend of going to patients at homes instead of waiting them to come to the hospital. This is done by EPIC's ability to study the patient's behavior and family history. EPIC can identify potential diseases and collect the information needed by medical team to start taking preventive measures and provide necessary awareness on how to live a healthy life, follow a healthy diet, exercise, and other information that cannot be applied by paper-based system, because it is based on collecting and analyzing information, and then taking the necessary action.

The application is an electronic system to record information, including patients referred to KFMC, or those who come directly to it, especially those suffering from

advanced conditions and several health problems that require them to move within KFMC from one specialty to another. EPIC is one of the best systems worldwide and has been implemented

*** Health Sector Digitalization**

Amid the COVID-19 pandemic, the Saudi Ministry of Health has implemented multiple informatics tools to provide public health information for individuals as well as the community. During the COVID-19 reaction, telehealth became a viable, practical, and crucial concept.

Data collecting was a time-consuming and occasionally chaotic burden on physicians and administrators, but it turned out to be essential for care coordination, forecasting, and quality improvement.

In the delivery of healthcare and public health evaluations, data interoperability and scale have shown to be more idealistic than practical. In order to effectively respond to crises, public-private collaborations were crucial. While the digital divide was occasionally closed, it frequently worsened health disparities and continued to do so. AI and other digital tools have become essential for

increasing knowledge and managing information overload.

*** Public Health Informatics Tools**

In 2018, the Ministry of Health launched a national central health care appointment gateway through a mobile app and web-based application called Mawid, which translates to “Appointment”. Soon after, in August 2019, the Sehhaty (“My Health”) app was launched in the pursuit of a wide range of health promotional campaigns that target healthy lifestyles, using gamification and community-wide challenges. However, both apps were updated to respond to the COVID-19 pandemic by introducing a symptom checker to enable people who suspect they have COVID-19 to directly book appointments at dedicated COVID-19 clinics and drive-through mass testing locations around the Kingdom. For COVID-19 surveillance, the Health Electronic Surveillance Network (HESN) has been mainly used as a reliable source of data for all COVID-19 laboratory tests in the Kingdom. The HESN serves as a national communicable disease surveillance platform. It was launched in 2012 and piloted during the largest public health event in Saudi Arabia: the annual pilgrimage season, or the Hajj .

Moreover, the Patient Tracing Unit (Taqasi) platform was implemented in March 2020 for the COVID-19 pandemic. Its purpose is to enhance and manage contact tracing around the Kingdom based on the laboratory results generated from the HESN. Locally published preventative and clinical guidelines give directions for home isolation with documented daily follow-ups and for tracking symptoms for mild cases and contacts. To provide these functions, the National Health Emergency Operation Centre launched a smartphone app, Tetamman, which translates as “Rest Assured”. In May 2020, the Ministry of Health announced that the Tetamman app will also be associated with a smart bracelet for individuals returning from abroad as well as those who are isolated in their homes . Contact tracing has been termed as an essential epidemiologic tool for containing the COVID-19 outbreak and enforcing future plans for lifting lockdown safely.

To achieve this, the Saudi Data and Artificial Intelligence Authority (SDAIA) released two smartphone apps. The first is Tawakkalna, a GPS-enabled app to monitor and restrict individuals’ movement during curfew hours with the capacity to issue permits

for exceptions. The second app, Tabaud, whose name means “Distancing” , sends deidentified data to people who came in close contact with confirmed cases of COVID-19. The app follows the international Google and Apple guidelines on data privacy

* **Health Care Delivery**

The Saudi Ministry of Health (MOH), as the main health care provider in the Kingdom of Saudi Arabia, is looked upon as the main source of authentic and reliable health information for the Saudi population. Other channels of health care delivery include the Ministry of Defense, university teaching hospitals, and the private sector. Similarly, tertiary, secondary, and primary care facilities provide health care to both nationals and non-nationals.

In 2011, the Saudi MOH agreed upon a vision to improve the standards, equitability, availability, and quality of health care in the Kingdom of Saudi Arabia by the use of electronic communication and information technology in this sector by:-

- 1- To increase transparency in inventory tracking across various health systems and enable the fair and reliable distribution of hospital goods,

providers and suppliers must provide accurate, timely, and real-time data.

2- increasing safety stockpile investments, which would lessen reliance on just-in-time orders and give a sense of supply availability prospects.

3- utilising AI predictive modelling that takes into account data on the production of individual parts and sourcing from current and potential sources.

4- Data integration with user workflows for effective data mining by product, geography, and chronology will improve supply-chain analytics.

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The Vision 2030 National Transformation Program health care strategic objectives for the years 2018 to 2020 aimed to increase access to care, improve quality, and promote the prevention of health risks. It highlights electronic health (eHealth) as an essential enabler to the health care transformation; hence, it tasks the National Health Information Centre with creating multisectoral coherent eHealth services. During the aforementioned community-wide

measures to combat the spread of COVID-19, the government of Saudi Arabia and the private health care sector activated existing digital health solutions and produced new ones. The MOH Call (937) Service Center was established to answer inquiries related to COVID-19. Moreover, one hospital initiated a remotely controlled robot for rounding and monitoring of intensive care unit patients .

For hospitals that had teleconsultation apps in place before COVID-19, whether well-established or in pilot phases, some activated their apps to serve patients who do not require in-person hospital visits, such as King Saud Medical City in the public sector and Dr Sulaiman Al Habib Medical Group in the private sector. The group messaging app WhatsApp remains the preferred messaging app in the Kingdom; some hospitals and medical cities in the Eastern Region, such as Qatif Central Hospital and its primary care centers, initiated WhatsApp numbers to help patients register their medication refill requests, arrange for remote routine follow-ups, and inquire regarding their laboratory results. Periods of pandemics have been shown to cause a surge in stress related to fear of the

unknown and isolation. Hence, the literature highlights the need for establishment of psychological support to communities during such periods. To achieve this objective, the National Centre for Mental Health Promotion collaborated with the developers of a local mobile counselling app, Labayh, to provide free sessions for people experiencing anxiety and panic symptoms in the current situation. In another instance, the Saudi Commission for Health Specialties (SCFHS) nationally launched a set of mental health support services for all health care professionals in the Kingdom under its Emtenan initiative as well as for residents in training (Daem) . The SCFHS not only called its registered health care professionals but also sent them SMS text messages, enquiring about their safety and advising them to keep safe. In the area of telepharmacy, the MOH and other tertiary health care facilities sent medications to patients' homes via courier companies or established telepharmacy services. Furthermore, the MOH sent out SMS text reminders to all health care providers with active professional registration to use its electronic prescription (e-prescription) services in collaboration with private

sector pharmacies. One example is the Anat mobile app, which enables providers to directly electronically prescribe medications to patients by credentialed and licensed providers. Other apps that have been active in recent years in Saudi Arabia are Wasfaty, translated as “My Prescription,” which is the official gateway for e-prescriptions under the Ministry of Health’s free services, and the Sehha mobile teleconsultation app, which can provide patients with e-prescriptions via SMS text message following a medical consultation with a physician. Private telehealth services such as Cura and Maya Clinic are offering similar services either freely or with modest charges to support their COVID-19 efforts. With the success of telemedicine services, King Salman bin Abdulaziz Al Saud of Saudi Arabia issued a royal decree to amend health professionals’ practice regulations to allow telemedicine use for diagnostic and management purposes from the workplace and at home. This royal order also directs all relevant sectors to amend their regulations to accommodate this change .

* **Educational Sector Digitalization**

According to Saudi national statistics, approximately 1,353,619

students are enrolled in 28 governmental and 34 private higher education institutes. Moreover, there are approximately 5000 schools in the Kingdom that provide secondary level education; these include both public and private sector institutions. Electronic learning (e-learning) is not new in the Kingdom. Its first decade (1990-2000) in Saudi Arabia's education system was supported well by the evolution of computer technology and the World Wide Web. By 2002, Saudi Arabia had established a national school e-learning platform with tailored electronic lessons . The following years witnessed expansion and enhancement of e-learning in collaboration with international partners. In 2017, as part of Vision 2030, the Ministry of Education (MOE) established the National Center for e-Learning. This center serves to supervise and support eLearning in Saudi Arabia. The current COVID-19 pandemic poses immense challenges to maintaining continuity of educational services across the Kingdom. This challenge was most evident in the health educational sector due to the absence of a standard and unified method of eLearning and because educational methods depend on patient

interactions. It is already known that major universities in the Kingdom such as King Saud University, Taibah University, King Khalid University, Qassim University, Islamic University of Madinah, Al-Baha University, and King Abdul-Aziz University are the most active e-learning university partners in the Kingdom. However, higher education institutions were challenged by the COVID-19 situation to continue tutoring and assessment of technical skills . Hence, universities offered different methods of e-learning support depending on the course requirements and interim assessment needs. Later, the Minister of Education congratulated higher educational institutes on their successful shift to distance learning since the COVID-19 outbreak. The universities reported that collectively, 1.2 million users were conducting 107,000 hours of web-based learning in more than 7600 virtual classes . The MOE also directed higher education students and faculty to its website "Shams," an open education resource. The aforementioned SCFHS is Saudi Arabia's accreditation and registration body for health care professionals. It offers a series of accredited educational webinars for continuing

medical education hours. The SCFHS has collaborated with local and international platforms such as Virtual Medical Academy, Up-to-date, and MDBriefcase . The topics listed therein include a COVID-19 overview, physician burnout, a COVID-19 critical care crash course, and ethical issues during pandemics using COVID-19 as an example . Other nonprofit public and private initiatives have followed the SCFHS's lead . It is worth noting that all educational institutions, including higher education institutions, continued delivery of education during lockdown. Both public and private institutions used various two-way e-learning methods to continue teaching and student learning. This ranged from individual institute-based platforms such as Blackboard and McGraw-Hill Connect to common commercial platforms such as Zoom, Google Class, and FaceTime. An interesting and unique step taken by the MOE was to shift public school education to its distant learning portals, namely Ein (translated as "Eye") and Vschool.sa . Ein, which was launched by the Ministry of Education before the COVID-19 outbreak, features a television channel that broadcasts daily lessons based on the national

curriculum [39]. During the COVID-19 pandemic, the Ein channel and a corresponding YouTube channel have been redirected to provide live tutoring of all school level subjects and lessons daily from 8:30 AM to 12 PM on weekdays [46]. This great effort was conducted by 127 teachers in 112 subjects. Ein also provides a website through which students can practice lesson exercises and communicate with their teachers . The vschool.sa portal is unique to Saudi Arabia and is a unified learning portal by the Ministry of Education that complements Ein. It provides synchronized web-based tutoring, assessment tools, learning material, and apps for smartphone access .

Telecommunication, Commercial, and Miscellaneous Digital Services The major telecom companies in Saudi Arabia, namely the Saudi Telecom Company (STC), Mobily, and Zain Saudi Arabia, have announced free-of-charge data services to the most used educational platforms as well as health and telehealth applications to facilitate the smooth delivery of e-learning as well as health care delivery during the pandemic. The expected high usage of internet services, which exceeded the current

capacity by around 33%, was also supported by the Saudi Communication and Information Technology Commission (CITC), which developed related infrastructure to accommodate the sudden high demand . In an unprecedented move, prior to the COVID-19 pandemic, the CITC had also launched a guide to inform consumers about the trusted available mobile apps that are officially registered within the commission . Internet providers also enabled users to access the Ministry of Health and governmental educational websites without consuming their personal data. When a call is placed on an STC or Mobile mobile number, a voice recording plays that reiterates Ministry of Health messages to help prevent the spread of COVID-19. Telecom companies changed their network names to display a message saying “Stay Home” . All these measures contributed to health education and the awareness drive

One of the most notable initiatives in Saudi Arabia is “Move to Tech.” This initiative was launched by the Saudi Ministry of Communications and Information Technology on March 10, 2020 . It facilitates the use of current digital tools and the creation of

new ones in response to COVID-19. This has increased the use of digital tools in several sectors, but mainly in education, the food industry and health care. Following this initiative, a COVID-19 Hackathon was launched to provide innovative remote and virtual solutions to combat the pandemic.

In 2018, the Saudi Red Crescent Authority launched a mobile app, “Asefni,” which translates to “Save Me.” The aim of this app was to facilitate emergency service requests with accurate GPS locations [17]. When strict local curfew and travel restrictions were imposed on all Saudi citizens, the app was updated to provide movement permits during the curfew order for individuals who required essential medical consultations. This permit is issued for each case only after an initial web-based assessment [53]. Similarly, Saudi Public Security launched an online portal, “Tanaqul,” to receive requests for domestic land travel permits between cities for people with extenuating circumstances . Electronic commerce, on the other hand, was a prosperous industry in the Kingdom even before COVID-19. Major retailers had established web-based ordering and home delivery services

throughout the major cities for everyday grocery items, home essentials, and furniture. The community-wide quarantine has highlighted the role of these web-based commercial services in aiding the mitigation process.

Risk Communication Directed at the Public Through Social Media The year 2011 witnessed a boom of social media and user-generated content in Saudi Arabia. The current social media scene in Saudi Arabia with regard to the percentage of internet users shows that the most preferred and used social media platforms are YouTube, WhatsApp, Facebook, Instagram, and Twitter . In April 2011, the Saudi Ministry of Health joined Twitter and successfully built its audience's trust over the years until it reached nearly 3 million followers in early 2020 . Before the first confirmed case of COVID-19 in Saudi Arabia, the MOH used its website and social media platforms, including Twitter, Facebook, YouTube, Snapchat, Instagram, and TikTok, to distribute health education materials. Different formats were used, such as WhatsApp stickers for proper hygiene. The topics included what COVID-19 is, how it is transmitted,

how to prevent getting it, and where it originated. As the pandemic progressed and new scenarios emerged, the literature was modified and expanded to accommodate these changes. It was also translated into other languages, including but not limited to English, Portuguese, French, Russian, Tagalog, Spanish, and Urdu, ensuring a wider spread of relevant information. The MOH and other ministries also used SMS text messages in both English and Arabic to raise awareness and emphasize the practice of precautions. Regular messages were sent to all citizens in different languages. After the first case of COVID-19 in Saudi Arabia was confirmed on March 3, 2020, the Twitter account of the official spokesperson of the MOH was activated to directly and quickly announce and respond to COVID-19 news . Rumors and misinformation are an expected and organic part of risk communication. According to the WHO, the best practices to address rumors and misinformation in risk and crisis communication include prevention, monitoring, and strategies for approaching a rumor when it occurs . The spokesperson of the MOH incorporated this WHO strategy of

dissolving original rumors. On Twitter, he would retweet the rumor with a comment to directly spread the correct information.

The MOH has also collaborated with other government and nongovernment health entities to establish the Prevention Ambassador Initiative. The initiative is a web-based course for the layperson that provides certification in baseline information on COVID-19 to help prevent and control the COVID-19 infodemic . Another effort to contain internet rumors and misinformation is a Saudi Public Prosecution release stating that intentional spread of rumors about COVID-19 or sharing material that causes panic among the public is an electronic crime that can be punished with up to 5 years of imprisonment or a fine of SR 3 million (US \$799,888.20) .

*** Discussion**

*** Principal Findings**

Concerns about how the world might change after COVID-19 have undoubtedly been aroused by the attempts the world has made to respond to it digitally. The need for digital response has been strongly emphasized, but there are also serious problems with its use that have come to

light. We have already seen successful cases in the past where nations employed Google Maps and computerized databases to stop the spread of epidemics. Even during the present pandemic, there have been a number of success stories where technology use helped save lives when markets around the world closed and harsh curfews were implemented. A COVID-19 symptom tracker app was developed in the UK, for example, allowing users to register their symptoms for risk assessment, referral, and follow-up.

Mobile data usage has been advocated as a way to target mass screening initiatives toward those who are most at risk of contracting infectious diseases associated with travel. The Tabaud app now uses a decision-support tool that was developed by Google and Apple and serves as a location checker.

Location data gathered from smartphones is used by public health officials to track patterns of movement of quarantined or home-isolated individuals. A recent article published in *The Lancet* highlighted the use of AI in curbing COVID-19. Taiwan used AI to improve its national health insurance database and integrate it with its

immigration and customs database to create Big Data for analytics and cross matching of individuals. This system generated alerts during clinical visits based on travel history and clinical symptoms to aid case identification. It also used QR-code scanning and web-based reporting of travel history and health symptoms to classify travelers 'infectious risks based on their flight origins and travel histories for the past 14 days. Persons with low risk (no travel to Level 3 alert areas) were sent a health declaration border pass to their phones via SMS text message for faster immigration clearance; those with higher risk were quarantined at home and tracked through their mobile phones to ensure they remained at home during the incubation period . The use of telehealth and chatbots in the United States and Singapore has shown promising results in enabling remote triaging of care and providing rapidly accessible information; these measures enable the provision of care to patients without requiring them to leave their homes . Saudi Arabia's digital response to the COVID-19 pandemic is noteworthy. The aforementioned digital tools of public health and health care services are on par with those used worldwide. A few

areas still require more exploration, such as the use of AI. It may be desirable to connect all the governmental and nongovernmental apps created during the COVID-19 pandemic to effectively activate interoperability across different technologies. This can lead to the creation of large, continuously updated data sets, which can be later used for diagnosis, management, and policy implementation. However, we do recommend decreasing the number of public health mobile apps available for use during a future outbreak. This is to decrease the burden on the end user, avoid confusion, and ensure better adherence. As mentioned previously, there are five applications for COVID-19 symptoms and history screening, follow-up of cases, and contact tracing. Last, it should be ensured that digital location identifiers activated via these applications do not breach privacy and agreed-upon permissions, as both Apple and Google have raised concerns regarding adherence to Health Insurance Portability and Accountability Act (HIPPA) regulations . Wuhan was the first city to implement complete lockdown and initiate the policy of "Suspend Classes Without Stopping Learning." Lessons

from this policy show the importance of having a strong web-based teaching infrastructure, the necessity of building the capacity of teachers, and finding solutions to bridge up the information gap that may occur because of distance teaching. Fortunately, Saudi Arabia already possessed public and private e-learning infrastructure at the time of the COVID-19 pandemic. Saudi universities conducted webinars and training to rapidly increase their faculty's capacity for e-learning . In one of the MOE's COVID-19 webinars, a group of education experts found that the COVID-19 experience proved successful in breaking educators' psychological barriers to use technology and distant learning methods. They also highlighted the future potential of e-learning to enhance web-based question banks and electronic resources, further engage faculty, adopt remote administrative meetings, decrease costs, and improve outcomes. The Minister of Education hinted that distance learning would be made part of the Kingdom's regular education system , as it appears to be the new norm. The main challenge posed by the COVID-19 pandemic has been the provision of efficient, accurate, and timely information to

populations at risk worldwide . The experience of COVID-19 risk communication by the Saudi Ministry of Health was perceived as very useful by 72% and very satisfactory by 74% of a survey population of 3133 Twitter users . Through previous evaluation and improvement efforts, as well as experience with MERS-CoV, the risk communication infrastructure for this pandemic had already been built. Previous literature showed the types and sources of information that people in Saudi Arabia were seeking during the MERS-CoV outbreak. One study showed that 40% of people preferred the internet as a source of information . In 2017, Saudi Arabia underwent a WHO Joint External Evaluation for international health risk assessment, including risk communication. This evaluation documented the use of the MOH web-based social listening tool to monitor rumors and adapt messaging according to the audience . Similarly, Finland used social media messages and email to thematically categorize the community response to COVID-19 and develop recommendations for evidence-based risk communication . Here, we urge the Ministry of Health to document its risk communication experience with

COVID-19 for future reference, decision making, and simulation training. Despite Saudi Arabia's widespread usage of various technical platforms during the current pandemic, this experience of learning and sharing seems to be ongoing. The community shift toward digital solutions will unravel further challenges and advantages as we continue to control and mitigate the epidemic curve. The implications and impact of this shift are yet to be known and studied. Whether the emerged digital dynamics and new norms among different sectors should be continued after the end of community quarantine remains unanswered.

*** Limitations**

We attempted to encompass all digital solutions and tools used during the COVID-19 outbreak in Saudi Arabia up to the time of manuscript revision; however, shortcomings are expected. The COVID-19 pandemic is a rapidly changing scenario with weekly updates. Although this article includes apps, it does not assess them or look into user experiences. Furthermore, the standards for inclusion in this study were arbitrary. The writers used consensus-building techniques and debate to try and lessen

the impact of this subjectivity. Conclusion Since the introduction of the national vision, Vision 2030, in 2017, Saudi Arabia has been attempting to digitally modernise several of its industries. This transition has been accelerated by the COVID-19 epidemic. It has put the nation's digital infrastructure to the test and made dubious holes clear to decision-makers. Saudi people' acceptance of, capacity for using, and engagement with the digitization of these services and communications have been put to the test across the country.

At this point, it is too early to evaluate the unique Saudi experience of population-wide digital solutions. Future research should further explore and analyze the successes and pitfalls, hindrances, and challenges of this digital experience for specific sectors, including institutions, employees, and consumers.

*** Acknowledgments**

The authors are grateful to the Deanship of Scientific Research, King Saud University, for funding through the Vice Deanship of Scientific Research Chairs. The authors would like to acknowledge Mrs Sadia Javaid for her help in editing the manuscript.

* Conflicts of Interest

None declared.

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