DIGITAL TRANSFORMATION OF THE HEALTH SECTOR DURING THE COVID-19 PANDEMIC IN SAUDI ARABIA

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ABSTRACT

Background: *In March 2020, the first case of COVID-19 in Saudi Arabia was confirmed. In reaction to the outbreak, Saudi Arabia ordered the closure of the majority of governmental and private services. Technology and digital solutions have made it possible to provide essential services after the implementation of these severe protection requirements.*

Objective: *This study aims to show how Saudi Arabia used digital technology during the COVID-19 epidemic in the fields of public health and health care services, and shedding insight on the efficacy of digital transformation in Saudi Arabia for preventing the spread of Covid-19.*

Methods: *Using public announcements, press briefings and releases, news clips, published statistics, peer-reviewed literature, and professional debates, we documented Saudi Arabia's usage of digital technologies throughout the epidemic.*

Results: *The government and business sectors of Saudi Arabia jointly created and released around 19 applications and platforms that support public health duties and offer health care. Detailed descriptions of each are given. Companies in the telecommunications industry collaborated well and took steps to assist continuing efforts. Using social media, websites, and SMS text messages, risk communication initiatives adhered to best practice guidelines.*

Conclusions: *An important step toward digital transformation has been taken by Saudi Arabia's Vision 2030 framework. This shift was made possible by COVID-19. For future epidemics in Saudi Arabia, artificial intelligence might be used to integrate data from several sources. Reducing the number of applications and combining their operations may also boost and make it easier for people to utilize them.*

KEYWORDS

Digital Transformations, Digital Transformations in Health Sector, COVID-19.

1. INTRODUCTION

A process that tries to improve an entity by triggering significant changes to its properties through combinations of information, computation, communication, and networking technologies, according to the definition of digital transformation (DT) [1], The acquisition of digital resources, the design of digital growth strategies, the transformation of internal organizational structure, and the determination of relevant measurements and goals are all influenced by digital transformation (DT) The digital revolution in healthcare opens up new

business opportunities and yields new business models to solve concerns such as medical practice, value generation, and other issues such as the aging society [2].

In Saudi Arabia, the Ministry of Health (MOH) says in its vision that it wants to give the people the best-quality, integrated, and all-around health care [14]. To make this vision a reality, the Ministry of Health (MOH) has come up with a business strategy that relies on eHealth as the main policy change to improve the delivery of healthcare services to meet the growing demand and rising costs of these services. Also, the MOH has started using mhealth to make it easier for people to get health care, especially during the COVID-19 pandemic. To stop COVID-19 from spreading, the Saudi government took the steps that were needed, such as imposing a full or partial curfew and stopping large gatherings like mosque prayers, local and international airlines, and social and football games. Also, all schools and universities were shut down. Other ways to stop the spread of the disease were to stay away from people, make masks mandatory, and start awareness campaigns. In line with these measures, the Saudi Ministry of Health (MOH) has made and released a number of mhealth apps to continue to provide healthcare services, track the movement of people to make sure they don't get too close to each other, educate the population, track viruses, report test results, and track the status of infections. Most of the mhealth apps were made to help stop the spread of COVID-19 and provide health care during the pandemic.

The H1N1 in 2009 and the Ebola virus in 2014 influenza showed that effective and timely use of technology was critical in containing both pandemics [3, 4]. A cloud computing tool for data collecting and integration for confirmed MERS-CoV cases, a GPS-based risk assessment tool, and Google Maps for the geographical depiction of MERS-CoV cases worldwide are examples of technical solutions used to control the MERS outbreak [5]. Saudi Arabia contributed to the worldwide MERS-CoV knowledge pool by building a national electronic surveillance system [6]. It has taken Saudi Arabia a very short time to deploy disease containment measures and work to meet the community's demands during the current COVID-19 pandemic. According to the Saudi Arabian government, 89 percent of the population is currently online, and 96 percent of the population has access to smartphones, laptop computers, desktop computers, and tablets; thus, the government's efforts to mitigate the effects of climate change have been aided by the widespread availability of digital services. During the COVID-19 pandemic, Saudi Arabia has taken a very short time to deploy disease containment measures and work to meet the community's demands. According to the Saudi Arabian government, 89% of the population is currently online, and 96% of the population has access to smartphones, laptop computers, desktop computers, and tablets; thus, the government's efforts to mitigate the effects of the COVID-19 pandemic have been aided by the widespread availability of digital services [7]. Our goal in this study is o highlight how Saudi Arabia employed digital technology during the COVID-19 pandemic in light of the WHO's emphasis on the need for timely and accurate digital data exchange [8].

2. BACKGROUND

On March 3, 2020, the first case of COVID-19 was confirmed in Saudi Arabia. In reaction to the outbreak, Saudi Arabia, like many other countries, shut down most public and private services and imposed nationwide limits on people's freedom to move. The introduction of tight mitigating measures has enabled the provision of key services through the use of technology and digital solutions.

3. METHODS

The authors documented Saudi Arabia's experience using compiled utilizing official pronouncements, press briefings and releases that were made available to the public, news clips,

published data, peer-reviewed literature, and professional conversations. The information sources that were searched had content in both the English and Arabic languages. A search of the available literature was carried out during the period of the COVID-19 pandemic. Each team member was responsible for collecting, analyzing, and synthesizing information regarding a specific industry; after that, the material was compiled and debated, and everyone reached a consensus regarding the findings. The information had to meet three requirements to be considered for inclusion: it had to reflect a significant occurrence during the COVID-19 pandemic response; it had to involve technology or digitalization, and it had to be unique to Saudi Arabia. A narrative format is used to present the findings.

4. DIGITALIZATION OF HEALTHCARE

Multiple informatics solutions have been established by Saudi health authorities amid the COVID-19 pandemic to supply individuals and the community with health information. There are several different platforms and apps used in Saudi Arabia during the COVID-19 pandemic, as shown in Figure 1 [14].

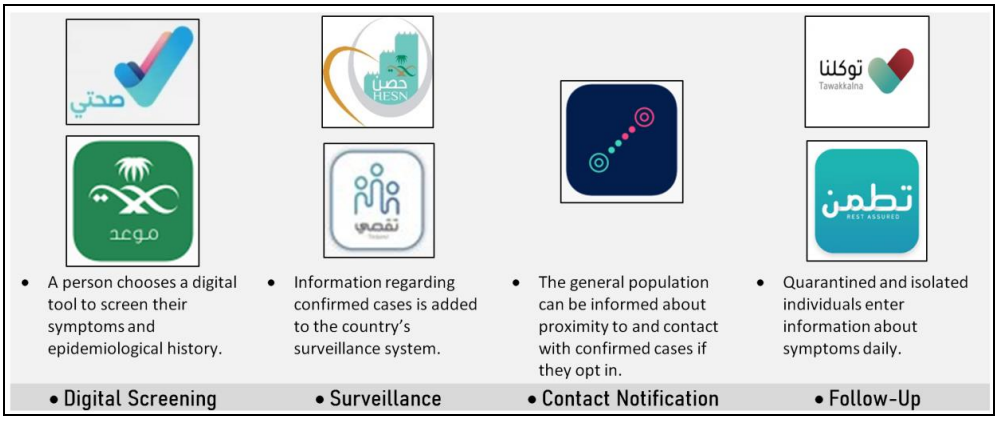

Figure 1. During the COVID-19 pandemic in Saudi Arabia, digital apps were available.

Table 1. Summary of applications available in Saudi Arabia during the COVID-19 pandemic.

Name	Type	Short description
Sehhaty	Smartphone app (iOS/Android)	Teleconsultations (synchronous live video messaging).
Mawid	Smartphone app (iOS/Android), web-based application	Electronic service provided by The Saudi Ministry of Health enables patients to book their appointments across primary health care centers.
Anat	Smartphone app (iOS/Android)	The platform aims to provide channels of communication for health practitioners. Besides presenting services that facilitate their work and raise the level of health services offered to patients:
Wasfaty	web-based	The official e-prescription gateway provider
Asefni	Smartphone app (iOS/Android)	GPS-enabled requests for emergency services.
Labayh	Smartphone app (iOS/Android)	Teleconsultations (mainly provides psych health services).
Maya Clinic	Smartphone app (iOS/Android)	Teleconsultations (nonsynchronous text providers).
Tabaud	Smartphone app (iOS/Android)	Tabaud App that delivers identified data to persons who were in close proximity to verified instances of COVID-19.
Tetamman	Smartphone app (iOS/Android)	«Tetamman» Clinics are devoted to serving those who develop Novel Coronavirus (COVID-19) symptoms
Tawakkalna	Smartphone app (iOS/Android), web-based application	Tawakkalna App to support government efforts aimed at countering Covid-19.

4.1. Public Health Informatics Tools

In 2018, the Ministry of Health introduced Mawid, a mobile app and web application that translates to "Appointment" and serves as a national central appointment gateway for health services (Figure 1). Subsequently, in August 2019, the Sehhaty ("My Health") app was released in pursuit of a vast array of health promotion initiatives promoting healthy lifestyles [9]. Both apps were upgraded in response to the COVID-19 pandemic by adding a symptom checker that allows anyone who fears they have COVID-19 to immediately schedule appointments at specialized COVID-19 clinics and drive-through mass testing locations in KSA [10]. Health Electronic Surveillance Network (HESN) is the primary data source for all COVID-19 laboratory tests in Saudi Arabia for COVID-19 surveillance purposes. The HESN acts as a nationwide platform for tracking infectious diseases. The Hajj, Saudi Arabia's annual pilgrimage, is the country's significant public health event, and it was begun in 2012 [11]. It was also implemented in March 2020 for the COVID-19 pandemonium. Its goal is to use the HESN's laboratory results to improve and manage contact tracing in the Kingdom of Saudi Arabia. Home isolation, documented daily follow-ups, and tracking of symptoms for mild and moderate cases are among the recommendations in local preventative and clinical guidelines. Tama, or "Rest Assured," is a smartphone app developed by the National Health Emergency Operation Center to perform these responsibilities. It was announced in May 2020 that the Tetamman app would be linked to a smart wristband for people returning from overseas or who are confined to their houses [12].

As a crucial epidemiologic tool for limiting the COVID-19 outbreak and enforcing future plans for securely lifting the lockdown, contact tracing has been deemed. The Saudi Data and Artificial Intelligence Authority (SDAIA) has published two smartphone apps to do this. With Tawakkalna [24], a GPS-enabled app that keeps tabs on where people are during curfew hours and may offer

special permissions, people can avoid being tracked. Tabled, whose name translates to "Distancing" [13], is a second app that delivers identified data to persons close to verified instances of COVID-19. The software adheres to Google's and Apple's worldwide privacy guidelines.

4.2. Health Care Delivery

Saudi Arabians rely upon the Saudi Ministry of Health (MOH) for accurate and up-to-date health information because it is the country's primary health care provider. The Ministry of Defense, academic teaching hospitals, and the commercial sector are all sources of health care. Both nationals and non-nationals can use tertiary, secondary, and primary care institutions, which treat both. Electronic communication and information technology can improve the standards, availability, and quality of health care in the Kingdom of Saudi Arabia, according to the Saudi Ministry of Health 2011. Increased access to health care was one of the Visions 2030 National Transformation Program's [14] health care strategic goals for the years 2018 to 2020. The National Health Information Center (NHIC) is tasked with producing multispectral, coherent eHealth services as a vital facilitator of the health care transition. The Saudi Arabian government and the private health care sector stepped up their use of digital health solutions to combat the spread of COVID-19 during the aforementioned community-wide actions. Concerning COVID-19, the MOH Call (937) Service Center was formed. As a bonus, one hospital has begun using a remote-controlled robot to check on patients in intensive care units. In the public and private sectors, King Saud Medical City and Dr. Sulaiman Al Habib Medical Group have made use of apps that were already in place prior to COVID-19 to serve patients who do not require in-person hospital visits. A number of hospitals and medical cities in the Eastern Region of the Kingdom, such as Qatif Central Hospital and its primary care centers, have established WhatsApp numbers to help patients register their medication refill requests, arrange for remote routine follow-ups, and inquire about their laboratory results [7]. Fear of the unknown and solitude have been linked to a rise in stress during pandemics. As a result, academic research emphasizes the need of providing communities with mental health services at times like this. With the help of Labayh [15], a local mobile counseling app, the National Center for Mental Health Promotion was able to provide no-cost therapy sessions to those who needed it most during the present crisis. SCFHS has created a nationwide system of mental health support services for all Saudi health care workers as part of its Emtenan project, which also includes residents in training (Daem). SMS text messages were sent to the SCFHS's registered health care workers, asking them about their safety and warning them to be safe [16]. Medical institutions like the MOH and tertiary health care facilities supplied medications to patients' homes through delivery services or formed tele-pharmacy services in the field of the-pharmacy. It is possible for certified and licensed health care providers to electronically prescribe medicine to patients using the Anat mobile app [17]. In recent years, applications like Wasfaty [18] and Sehha [19] have been active in Saudi Arabia, providing patients with e-prescriptions by SMS text message after a medical consultation with a physician. Assist their COVID-19 efforts, private tele-health provider Maya Clinic [20] provides comparable services for free or at low costs.

5. RELATED WORKS

The Keywords section begins with the word, “Keywords” in 13 pt. Times New Roman, bold italics, “Small Caps” font with a 6pt. spacing following. There may be up to five keywords (or short phrases) separated by commas and six spaces, in 10 pt. Times New Roman italics. An 18 pt. line spacing follows.

5.1. Principal Findings

Concerns about how the world will change after COVID-19 have been raised by the many digital responses to COVID-19. Digital response's importance has been underlined, but it has also brought to light substantial difficulties related with its implementation. T Several examples of governments using technology to stop the spread of disease include electronic databases and Google Maps. When global markets were shut down, hit curfews were imposed, and many tales have emerged about how technology was used to save lives. For example, in the United Kingdom, a COVID-19 symptom tracker app has been launched, allowing users to record their symptoms, identify risks, refer patients, and monitor their progress [21]. It has been proposed that mobile data might be used to identify those who are more susceptible to travel-related infectious illness and target mass screening activities appropriately. It has been incorporated into the Tabaud app by Google and Apple, serving as a location checker. People who have been quarantined or who have been confined at home are tracked by public health authorities using location data acquired from cell phones. The Lancet [22] recently released a paper on using AI to reduce void-9. AI was utilized to upgrade Taiwan's national health insurance database and combine it with its immigration and customs database to produce Big Data for analytics and crosshatching individuals. Help in the identification of cases, this system sent notifications to doctors during clinical visits based on travel history and clinical symptoms. For the previous 14 days, it employed QR code scanning and web-based reporting of travel history and health symptoms to categorize passengers' infectious risks. Border passes for individuals with minimal risk (no travel to Level 3 warning regions) were provided through SMS text message; those with greater risk were quarantined at home and watched using their mobile phones to ensure they stayed at home during the incubation period. Patients in the United States and Singapore may get treatment without leaving their homes thanks to Chatbot and telehealth. Despite the COVID-19 outbreak, Saudi Arabia's digital reaction is worthless. In terms of digital tools for public health and health care, the ones listed above are right up there with the best of the best. It's still in its infancy regarding the usage of artificial intelligence, for example. Successfully activating interoperability across multiple technologies, may be desired to integrate all the official and nonprofit applications generated during the COVID-19 epidemic. Such data sets may subsequently be utilized for diagnosis, management, and policy implementation since they are constantly updated. The amount of public health mobile applications used during a subsequent epidemic should be reduced, though. This is done to make things easier for the end-user prevent misunderstandings, and ensure greater adherence. Among the five apps for COVID-19 screening, follow-up, and contact tracing is the COVID-19 symptoms and history screening application. Final point: Apple and Google have expressed worries about adhering to the Health Insurance Portability and Accountability Act (HIPPA) laws surrounding the activation of digital location identifiers through these apps [23]. Saudi Arabia was evaluated during a WHO Joint External Evaluation for worldwide health risk assessment and risk communication in 2017 This study examined the MOH's web-based social listening technology to track rumors and tailor communications to the audience's preferences. A similar approach was used by Finland, which utilized social media and email to classify the community reaction to COVID-19 and generate recommendations for evidence-based risk communication. COVID-19 risk communication experience should be documented for future reference, decision-making, and simulation training by the Ministry of Health. It seems that Saudi Arabians continue to study and share despite the broad use of different technology platforms during the present epidemic. To keep the epidemic curve under control and lessen its effects, the community will have to transition to digital solutions. This transition has yet to be fully understood and investigated regarding its ramifications and effects.

5.2. Limitations

It is predicted that there may be some omissions in this article because we tried to include all of the digital solutions and technologies that were in use in Saudi Arabia, the corvid-19 pandemic is an ever-changing scenario. This document also contains a list of apps, but none of the apps are evaluated or tested by actual users. As a result, discussion and consensus were employed by the members to reduce the impact of subjectivity.

6. CONCLUSION AND FUTURE WORK

Since Vision 2030, Saudi Arabia's national vision, was unveiled in 2017 [14], the country has been attempting to digitally change several sectors. COVID-19 has sped up this information transfer. Digital infrastructure is being evaluated, and decision-makers are alerted to potential flaws. These services and communications have been conducted statewide to see how Saudi citizens respond to and utilize digitalization. A comprehensive assessment of the Saudi experience with population-wide digital solutions is premature at this time. To further understand the benefits and drawbacks of this digital experience for various groups of people, such as institutions, employees, and customers, more research is needed.

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