Case Report

Healthc Inform Res. 2021 July;27(3):255-263.
https://doi.org/10.4258/hir.2021.27.3.255
pISSN 2093-3681 • eISSN 2093-369X

HIR
Healthcare Informatics Research

Evaluation of Official Healthcare Informatics Applications in Saudi Arabia and their Role in Addressing COVID-19 Pandemic

Nouf Alassaf[1], Sulaiman Bah[2], Fatima Almulhim[3], Norah AlDossary[3], Munirah Alqahtani[4]

[1]Department of Health Information Management & Technology, College of Applied Medical Sciences, Imam Abdulrahman Bin Faisal University, Jubail, Saudi Arabia
[2]Department of Public Health, College of Public Health, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia
[3]Cancer Registry Unit, Oncology Centre, King Fahad Specialist Hospital, Dammam, Saudi Arabia
[4]Tumor Registry Unit, Oncology Institute, Johns Hopkins Aramco Healthcare, Dhahran, Saudi Arabia

Objectives: The purpose of this study was to examine official healthcare informatics applications in Saudi Arabia in the context of their role in addressing the coronavirus disease 2019 (COVID-19) pandemic. **Methods:** This is a case study of official healthcare informatics programs and applications (apps) developed in Saudi Arabia before and during the COVID-19 pandemic. The qualitative content analysis (QCA) method was used. Data collection consisted of two components: a desktop review of documents and actual testing of the programs. According to the QCA method, we developed a matrix for abstracting information on different apps and programs in order to categorize the data. The compilation of information and discussion were based on information summarized in the matrix. **Results:** Six apps in total were developed before the COVID-19 pandemic. With the advent of the COVID-19 pandemic, three of the apps, SEHA, Mawid, and Sehaty were modified to address different aspects of the pandemic. Both SEHA and Mawid included information about COVID-19 awareness. During the COVID-19 pandemic, three official apps were developed: Tawakkalna, Tetamman, and Tabaud. The Tawakkalna app is mandatory for all citizens and residents to activate when visiting stores and institutions. It has a wide range of COVID-19 and other health-related functions. The Tetamman app provides COVID-19 test results and allows one to check his or her daily symptoms. It also has an educational content library and provides alerts. The Tabaud app notifies individuals if they have been exposed to COVID-19. The features, advantages, and disadvantages of all of the apps were examined. **Conclusions:** Overall, there were more strengths than shortcomings in the role played by healthcare informatics in the handling of the COVID-19 pandemic in Saudi Arabia.

Keywords: Informatics, Delivery of Health Care, COVID-19, Public Health, Saudi Arabia

Submitted: August 25, 2020
Revised: 1st, November 24, 2020; 2nd, March 4, 2021
Accepted: April 23, 2021

Corresponding Author
Sulaiman Bah
Department of Public Health, College of Public Health, Imam Abdulrahman Bin Faisal University, Dammam 34212, Saudi Arabia. Tel: +966-562812189, E-mail: sbah@iau.edu.sa (https://orcid.org/0000-0002-7621-211X)

I. Introduction

The unprecedented speed at which coronavirus disease 2019 (COVID-19) was declared a pandemic warranted concerted efforts for dealing with the disease from multiple fronts, including health informatics. COVID-19-related apps were developed from all parts of the globe, coming from both middle-income and developing countries. Silva categorized COVID-19-related apps into five clusters: informational, self-assessment/medical reporting, contact tracing, multipurpose apps, and others [1]. In the Arabian Gulf countries of Oman, Kuwait, Bahrain, and United Arab Emirates, a total

of six COVID-19-related apps were developed from March 2020 to April 2020. All these apps used global positioning system (GPS) and Bluetooth technology to enhance preventive measures through the inclusion of a feature for tracing positive cases and notifying people nearby of potential exposure to the virus [1]. As with other countries in the Arabian Gulf, Saudi Arabia also took several healthcare initiatives to address COVID-19 [2]. While extensive research has been conducted on the COVID-19 pandemic, there have been no studies of the healthcare informatics sector in the context of the pandemic. The purpose of this paper is to fill this gap in research and, more specifically, to examine the official healthcare informatics applications implemented in Saudi Arabia in light of their role in addressing the COVID-19 pandemic.

II. Methods

This is a case study of official healthcare informatics programs and apps developed in Saudi Arabia before and during the COVID-19 pandemic. The inductive approach of qualitative content analysis (QCA) was the method used [3]. The data used come from a desktop review of documents and actual testing of the programs. Information was retrieved from the Ministry of Health (MOH) website, via published literature, and via the gray literature (such as news items, internal memos, official announcements, etc., in English and Arabic). The Google search terms used to identify other COVID-19-related apps developed elsewhere included "COVID-19 apps" and "Corona apps."

According to the QCA method, analysis of the data obtained on various software programs was carried out through categorization and compilation [3]. For categorization, we developed a matrix for abstracting information about the different apps and programs.

The compilation of data and discussion were based on information summarized using this matrix. For benchmarking, we reviewed COVID-19-related apps developed elsewhere, paying special attention to apps developed in neighboring Arabian Gulf countries due to their similar socio-economic and cultural contexts.

III. Results

The details of the official apps developed by the government before COVID-19 pandemic are shown in Table 1, and the apps developed to address the COVID-19 pandemic after it had already begun are shown in Table 2. Six apps had been developed before the COVID-19 pandemic: the Health Electronic Surveillance Network (HESN) (2012), 937 (2013), SEHA (2017), Asafny (2017), Mawid (2017), and Sehhaty (2019). The apps were all developed by the MOH, except for Asafny, which was developed by Red Crescent. The MOH apps are targeted to all citizens and residents, while the Red Crescent app is a stand-alone app that is targeted only to those seeking emergency care via the Red Crescent. HESN is a special electronic system for public health and disease surveillance. As of 2021, over 47 communicable disease groups are exclusively reported using HESN. The 937 app provides 24/7 telephone-based health services for both medical emergencies and regular health consultations, while the SEHA app is designed to offer online medical consultation services [4]. The Asafny app is used to provide a quick response to people in emergency situations, and the Mawid app is used to book and manage medical appointments. Lastly, the Sehaty app links patients to relevant health information and provides them with medical consultations with a variety of health professionals.

With the advent of the COVID-19 pandemic, in addition to the older MOH apps being modified to address the pandemic, new apps were developed as well. HESN was modified in April 2020 to allow for easy reporting of COVID-19 cases and characteristics related to the case. It is mandatory by law in Saudi Arabia for healthcare centers to report all cases of communicable diseases, including COVID-19, through the HESN system. Both SEHA and Mawid were modified to provide information about COVID-19 awareness. SEHA provides assessment services that employ artificial intelligence methods, while Mawid has a self-assessment survey. In addition, Mawid includes options for accessing 937 or SEHA. Sehaty also allows users to book a COVID-19 test appointment if they have an account with Mawid.

During the COVID-19, three new official apps were developed in 2020: Tetamman (March), Tawakkalna (April), and Tabaud (June). It is mandatory for all citizens and residents to activate the Tawakkalna app whenever visiting stores and institutions during the pandemic. It has many services, including tools for requesting travel permits when curfews are in place, requesting personal permits, requesting gathering permits, checking the status of a COVID-19 test, accessing education services, and accessing dependent services. The Tetamman app provides COVID-19 test results and allows one to check for symptoms on a daily basis. It also has an educational content library and provides alerts. The Tabaud app notifies individuals if they had been exposed to someone with a confirmed COVID-19 case. It also enables individuals

https://doi.org/10.4258/hir.2021.27.3.255

Table 1. Official healthcare informatics applications developed before COVID-19

	HESN	937	SEHA	Asafny	Mawid	Sehhaty
Date of development	Oct 1, 2012	May 14, 2013	Mar 12, 2017	Aug 17, 2017	Dec 29, 2017	Aug 4, 2019
Division that commissioned the app	Ministry of Health	Ministry of Health	Ministry of Health	Saudi Red Crescent Authority	Ministry of Health	Lean Business Services Company
Linked with national ID/Absher?	Linked with national ID, Iqama, or passport number	No	No	No	Linked with Absher	Linked with Absher
Aims	-Provide a one-stop platform for all hospitals in Saudi Arabia to detect, respond, and control communicable diseases. -Empower decision-makers by providing timely, useful, and high-quality data.	Provide 24/7 telephone call service for emergencies and normal health consultations [4].	Offer online medical consultation services.	Provide a quick response to people in emergency situations.	Enable users to book, cancel, or reschedule medical appointments and manage referrals.	Link patients with health information and provide them with medical consultation from a variety of health professionals.
Beneficiaries	All governmental and private hospitals	All citizens and residents	All citizens and residents	Citizens, residents, and individuals with disabilities	All citizens and residents	All citizens and residents
Services included	-Report all notifiable infectious diseases immediately such as cholera; or weekly, such as chickenpox. -Clarify the results of COVID-19 swabs.	-Provide medical consultation by certified physicians. -Receive complaints and feedback related to the Ministry of Health (MOH). -Offer advice and guidelines for poisoning cases.	Allow users to get medical consultations through audio-video by MOH's certified specialists, or using artificial intelligence technology.	-Request emergency help from the Saudi Red Crescent Authority by identifying one's location on a map. -Identify a list of all health centers, hospitals, and pharmacies nearby. -Issue a sound and flash warning to alert people nearby.	-Book appointments -Reschedule appointments -Manage referrals	-Tele-consultation -Search for medication and the nearest pharmacies that provide it. -View issued sick leave and prescribed medication. -Book an appointment in primary healthcare centers. -Registration of vital signs -School screening results and steps tracker

Table 1. Contiuned 1

	HESN	937	SEHA	Asafny	Mawid	Sehhaty
Features related to COVID-19 added later	Include a record for all COVID-19 patients who did a swab.	Guide patients 24/7.	Include awareness info about COVID-19.	Provide 4-hour emergency permits that can be used during curfews.	Provide COVID-19 awareness info, conduct self-assessment surveys, and provide options after test results: contact 937 or book test in Tetamman clinics.	Allows users to book an appointment for a COVID-19 test.
Estimated monthly global downloads (as of February 27, 2021)[a]	N/A	N/A	Google Play: 8,310 Apple store: 15,762	Google Play: 1,096 Apple store: 1,692	Google Play: 46,367 Apple store: 43,915	Google Play: 254,612 Apple store: 90,974
Required operating system	N/A	N/A	iOS 9.0 or later 4.3 Android and up	iOS 10.0 or later 4.2 Android and up	iOS 10.0 or later 5.0 Android and up	iOS 12.0 or later 5.0 Android and up
Available languages (as of February 27, 2021)	2 languages (Arabic and English only)	3 languages (Arabic, English, and Urdu)	2 languages (Arabic and English only)	9 languages (Arabic, English, Bengali, Filipino, French, Indonesian, Malay, Turkish, and Urdu)	1 language (English only)	2 languages (Arabic and English only)

Table 1. Contiuned 2

	HESN	937	SEHA	Asafny	Mawid	Sehhaty
Advantages	-Each patient has one record only. -Enable checking patients' history before admission or outpatient visits. -Includes all notifiable infectious diseases. -Mandatory for all hospitals. Carries a 100,000 SAR penalty for failure to report cases.	-Available 24/7. -Does not require a smart phone. -Provide direct advice to any citizens in all sectors.	-Schedules appointments at any nearby primary care centers. -Can schedule consultations for another person. -Indicates the expected wait time for a virtual consultation. -Provides options for receiving consultations immediately or by booking an appointment within 2 days. -Cannot submit more than one consultation until the process is finished. -The number of consultations will not be reduced until one receives a consultation, even if a booked consultation is canceled.	-Records the patient's history, diseases, and prescribed medications once downloading the app to help healthcare providers when care is needed. -High accuracy at identifying the patient's location. -Supports individuals with disabilities.	-User-friendly. -Free self-assessment. -Uses location only if you want to know the nearest clinic. -Survey can be completed once per day.	Linked with health app in iPhone.

Table 1. Contiuned 3

	HESN	937	SEHA	Asafny	Mawid	Sehhaty
Drawbacks	Technical issues, including freezing and errors.	Provides service only to patients eligible to be treated according to the MOH.	-Limited consultations per month (3 consultations maximum). -Not linked to any files in MOH hospitals.	Linked to Saudi Red Crescent Authority only.	-Does not show COVID-19 test results or other test results. -If a person has symptoms related to COVID-19, the person will be provided with only a suggestion, to contact 937 or SEHA, or go directly to the nearest clinic; full responsibility rests on the individual.	-Must have an account with the Mawid app. -Tele-consultation and COVID-19 testing are not available.

COVID-19: coronavirus disease 2019, HESN: Health Electronic Surveillance Network, SAR: Saudi Arabian Riyal, SRCA: Saudi Red Crescent Authority.
[a]Data from https://42matters.com/app-market-data.

to voluntarily share their results among people with whom they had contact in the previous 14 days. The Tetamman app was developed by the MOH while the Tabaud app was developed by the Saudi Data and Artificial Intelligence Authority (SDAIA).

IV. Discussion

During the COVID-19 pandemic, Saudi Arabia used several healthcare informatics apps among the multiple tools to mitigate the effects of the pandemic. Some of the apps were developed specifically to address different aspects of the COVID-19 pandemic, while other were developed before the pandemic. Our examination of the role of healthcare informatics in Saudi Arabia's COVID-19 response uncovered both positive and negative points. The adaptation of HESN for reporting COVID-19 cases is a positive decision as it helps to standardize data collection for rapid analysis. Similarly, the adaptation of older apps designed before the COVID-19 pandemic to address certain aspects of the pandemic was also a positive decision as existing resources were able to be used. The development of three apps during the COVID-19 pandemic was very successful. The Tawakkalna app was broader and highly inclusive, while the Tatamman and Tabaud apps had more specific functions. Tabaud is comparable to other similar apps developed in the Gulf region, such as BeAware (Bahrain) and Shlonik (Kuwait). Unlike these apps, Tabaud, relies on Bluetooth technology rather than GPS technology, which is an advantage of the Saudi Arabia-developed COVID-19 apps. The emergence of the SDAIA as a developer of and stakeholder in Saudi Arabian healthcare informatics is a merit. This similar to the way that COVID-19-related apps were developed in Bahrain, where the BeAware app was developed by the Information and eGovernment Authority, and in Kuwait, where the Shlonik app was developed by the Kuwait Central Agency for Information Technology.

A few shortcomings were observed as well. The HESN was only adapted to address factors related to COVID-19 in April 2020. Prior to this, data related to COVID-19 from the HESN system were unstructured and disorganized. Tabaud was launched in June 2020, 2 months after the launch of the Gulf Cooperation Council apps. There is a technical issue with the Tawakkalna app that results in a delay of several days before a user infected with COVID-19 is shown as being infected in the app using the color-coded system. This delay can have a potentially damaging effect, as the infected person might expose others to the virus during this time

https://doi.org/10.4258/hir.2021.27.3.255

Table 2. Official healthcare informatics applications developed for COVID-19

	Tetamman	Tawakkalna	Tabaud (COVID-19 KSA)
Date of development	Mar 25, 2020	Apr 6, 2020	Jun 12, 2020
Division that commissioned the app	Ministry of Health	The National Information Centre (NIC) and the Saudi Data and Artificial Intelligence Authority (SDAIA)	The National Information Center (NIC) and the Saudi Data and Artificial Intelligence Authority (SDAIA)
Linked with national ID/Absher?	Linked with national ID	Linked with Absher	Linked with Absher
Aims	To provide protection and healthcare for citizens and residents who were advised to isolate or quarantine to ensure a good recovery.	To manage curfews and to contain the spread of COVID-19.	To preserve the health and safety of citizens and residents from the danger of the spread of COVID-19, and to support the government in tracking COVID-19 cases.
Beneficiaries	-People who have contact with positive cases. -Suspected cases. -Arrivals from abroad. -Confirmed cases in home or domestic quarantine.	Citizens and residents; mandatory to enter any of the public places.	Citizens and residents; mandatory to enter any of the MOH's buildings.
Services included	Services provided in the application: -COVID-19 test results. -Direct contact with 937 to ask for help. -Daily symptoms check-up. -Ability to add data about contact with positive cases. -Educational content library. -Countdown indicator for isolation days. -Alerts through notifications, text messages, and automated calls.	-Request permits for freedom of movement during curfews (4 hours per week): Supplies, Temporary permit for a driver, Emergency medical permit request, and Jogging permit. -Report suspected cases for the individual himself or for another person by providing the name, location, and phone number, and answering five health questions related to COVID-19 symptoms.	-Notify individuals if they previously came into contact with a positive case of COVID-19. -Links one's health forms with the MOH to provide them with the needed medical support. -Enable individuals to voluntarily share test results with people they previously contacted in the past 14 days.
Estimated monthly global downloads (as of February 27, 2021)[a]	Google Play: 78,552 Apple store: 39,983	Google Play: 3,365,543 Apple store: 492,781	Google Play: 811,996 Apple store: 140,463
Required operating system	iOS 11 or later 5.0 Android and up	iOS 10 or later 6.0 Android and up	iOS 13.5 or later 6.0 Android and up

Table 2. Contiuned

	Tetamman	Tawakkalna	Tabaud (COVID-19 KSA)
Available languages (as of February 27, 2021)	2 languages (Arabic and English)	7 languages (Arabic, English, Bengali, Filipino, Hindi, Indonesian, and Urdu)	22 languages (Arabic, English, Bengali, Filipino, Hindi, Indonesian, Urdu, Amharic, Burmese, French, German, Japanese, Kazakh, Korean, Malay, Russian, Portuguese, Spanish, Simplified Chinese, Singhalese, Swahili, and Turkish)
Advantages	-User friendly. -Uses location all the time. -Provides COVID-19 awareness info.	-User friendly. -Easy to learn. -Provides access to MOH COVID-19 dashboard. -Provides COVID-19 awareness info.	-User-friendly. -Provides access to MOH COVID-19 dashboard. -Provides COVID-19 awareness info.
Drawbacks	-Uses location, but if one moves from the desired location, the alert notifies one to return. -There is a place for results with poor functionality, and if one wants to change the location, one must ask for help to change it. -Quarantine countdown and the daily survey are the only services that work as-is when you open the app. -The survey is more of a satisfaction survey than one that reflects actions.	-Only limited to people with Absher account. -Limited permit options. -Technical issues: cannot identify some people's phones due to them having been jailbroken. -Temporary permits for drivers are limited to students and workers who already have a permit from the Ministry of Interior. -Internet connection is a must to track individuals during permit use. -No feedback on reported cases. A person has to wait to be contacted by the MOH for further instructions. -If the person exceeds the permit limit, an alert is provided only through the app, and there are no further punishments unless security personnel ask for evidence.	-Sharing results with previously contacts is voluntary. -Only effective if all citizens download the app. -Mandatory only within MOH buildings. -Reporting results are the sole responsibility of the individual; not connected with MOH system. -Relies on Bluetooth technology. -Notifications alerting one to exposures can be disabled. -Requires iOS 13.5 and higher specifically.

COVID-19: coronavirus disease 2019, MOH: Ministry of Health.

[a]Data from https://42matters.com/app-market-data.

without being officially deemed "infected." Lastly, while some of the apps include interconnected features, one integrated app would be more effective than several loosely connected apps. In Qatar, Bahrain, Kuwait, and Oman only one app was used for COVID-19 surveillance, assessment, and awareness.

In conclusion, the purpose of this paper was to examine the official healthcare informatics in Saudi Arabia in the context of their role in addressing the COVID-19 pandemic. Overall, we found that there were more strengths than shortcomings in the role played by healthcare informatics in Saudi Arabia's handling of COVID-19. While six apps were developed from 2012 to 2019, three apps were developed within a span of only 3 months during the COVID-19 pandemic, and all of the different apps served different needs. With the emergence of COVID-19, old apps were adapted to address factors related to the pandemic. While most of the apps developed during the pre-COVID-19 era were commissioned by the Ministry of Health, a new stakeholder, the SDAIA, has entered the field with the emergence of COVID-19. We see this as a positive development that is similar to the approach adopted by other Arabian Gulf countries. One study limitations is the frequency with which apps are updated, which may result in differences between the present-day status of apps and the status of apps as described in this study and the lack of centrality for accessing information about the apps discussed in this study.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

ORCID

Nouf Alassaf (https://orcid.org/0000-0002-3962-4457)
Sulaiman Bah (https://orcid.org/0000-0002-7621-211X)
Fatima Almulhim (https://orcid.org/0000-0002-0247-5371)
Norah AlDossary (https://orcid.org/0000-0002-6111-8200)
Munirah Alqahtani (https://orcid.org/0000-0003-1119-2354)

References

1. Silva MA. Covid-19 apps (EENA 112) [Internet]. Brussels, Belgium: European Emergency Number Association; 2020 [cited at 2021 Jun 29]. Available from: https://eena.org/document/covid-19-apps/.
2. Global Health Exhibition. Saudi Arabia's digital healthcare landscape post-COVID-19 [Internet]. Riyadh, Kingdom of Saudi Arabia; Global Health Exhibition; c2021 [cited at 2021 Jun 29]. Available from: https://www.globalhealthsaudi.com/en/overview/saudi-news/Saudi-Arabias-digital-healthcare-landscape-post-COVID-19.html.
3. Bengtsson M. How to plan and perform a qualitative study using content analysis. NursingPlus Open 2016;2:8-14.
4. Ministry of Health. 937 services [Internet]. Riyadh, Kingdom of Saudi Arabia: Ministry of Health; 2021 [cited at 2021 Jun 29]. Available from: https://www.moh.gov.sa/en/937/Pages/default.aspx.