

Artificial intelligence: the major role it played in the management of healthcare during COVID-19 pandemic

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ABSTRACT

The sudden arrival of COVID-19 called for new technologies to manage the healthcare system and to reduce the burden of patients in the hospitals. Artificial intelligence (AI) which involved using computers to model intelligent behavior became an important choice. Various AI applications helped a lot in the management of healthcare and delivering quick medical consultations and various services to a wide variety of patients. These new technological developments had significant roles in detecting the COVID-19 cases, monitoring them, and forecasting for the future. Artificial intelligence is applied to mimic the functional system of human intelligence. AI techniques and applications are also applied in proper examinations, prediction, analyzing, and tracking of the whereabouts of patients and the projected results. It also played a significant role in recognizing and proposing the generation of vaccines to prevent COVID-19. This study is therefore an attempt to understand the major role and use of AI in healthcare institutions by providing urgent decision-making techniques that greatly helped to manage and control the spread of the COVID-19 disease.

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1. INTRODUCTION

The recent advances in technologies have paved a way for the incorporation of artificial intelligence (AI) into the healthcare system as well. In the early 1950s, the idea of AI came up through a generation of physicists, mathematicians, and philosophers. AI is a general term that implies using computers to model intelligent behavior with minimal human intervention [1]. It has been used in many medical fields to help identify and avoid illnesses [2], [3]. After 1950's, there was a gradual transformation of healthcare from a fragmented distribution of healthcare services to an organized effort in terms of healthcare delivery [4]. Algorithms in machine learning also have advanced, and people have become more brilliant in understanding which algorithm to apply to their problems [4], [5].

The epidemic of COVID-19 has seriously affected several sectors, one of the most affected being the healthcare sector. The spread of the COVID-19 pandemic and the variants like Delta and the recent Omicron pose a severe burden on the healthcare system specially the primary health care centres and tertiary hospitals.

Different health innovations, such as big data, cloud computing, mobile health, and AI, were recognized and tested to overcome the pandemic. These tools and various data forms have been used for disease prediction, including social media data, radiological images, omics, medication databases, and public health organizations [6]–[8]. The AI applications have been used for disease prediction and forecasting also. We see a rollout of first, second and third doses of vaccines by different countries to the citizens and residents. In addition to the vaccines, various community mitigation measures have also necessitated the use of technology to maintain functions in all aspects of life [9]. During the modern COVID-19 pandemic, Saudi Arabia has been very proactive among other countries in imposing disease containment measures and running to fulfill the community's needs in a thoroughly brief time [10]. The aim of this study was to determine how artificial intelligence and its applications were used for healthcare management during the COVID-19 pandemic.

2. METHODS

The present study employed a cross-sectional research design. This study targeted patients, hospital staff and the general population during the ongoing COVID-19 pandemic. It was primary research undertaken in Makkah city of Saudi Arabia. A convenience sample was selected due to the difficulty of obtaining a complete sample frame. This study includes participants from the age of 16 years. The data was collected from both male and female respondents to minimize the chances of gender bias. An online electronic survey questionnaire was programmed in Google Forms, which is a free survey administration software for data collection. The questionnaire consisted of two sections. The first section described how artificial intelligence was used in different applications during the COVID-19 pandemic for health care management. The second section asked the respondents about the need and benefits of using these AI applications during the COVID-19 pandemic. The questionnaire was distributed as a link through social media groups by recruiting the patients, hospital staff and the general population for collecting the data. The survey link was open for one month. Six faculty members did the validation of the questionnaire from the Department of Health Information Technology and Management Department and the Department of Health Education and Promotion who were experts in the field of Health Informatics, Health Promotion and Epidemiology. Descriptive statistics, in the form of frequencies and percentages, were used to analyze the collected data. The Department Scientific Committee of the College approved this research study during the COVID-19 pandemic.

3. RESULTS AND DISCUSSION

This section consists of the results related to the major role played by the AI applications during the COVID-19 pandemic. It was found that 99% of the sample respondents had used the AI applications issued by Ministry of Health, Saudi Arabia as shown in Figure 1. The high number of respondents using these applications is an indication that its benefits and usefulness had guided the respondents to shift more towards these AI applications for their health needs.

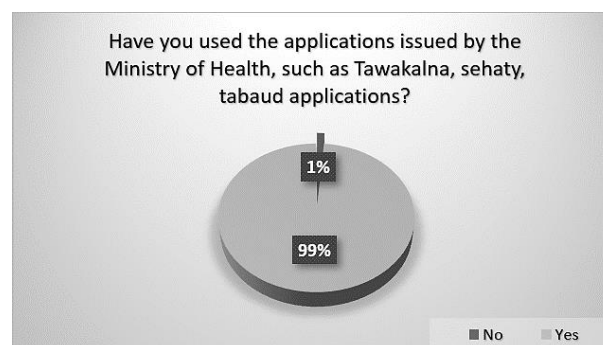


Figure 1. Use of AI applications by respondents

In addition, the results show a positive perception about these applications among the respondents. The first part of the table as shown in Table 1 indicates that 71% of the respondents who used these applications were females and 29% were males. The next part explains that the respondents between the age range of 20-29 years were higher users of these artificial intelligence applications followed by 40-49 years, then followed by 30-39 years, then by 50 years and more and finally by the age group of less than 20 years.

Table 1. Demographic characteristics of the respondents

Gender of the respondents	Frequency
Female	71%
Male	29%
Total	100%
Age of the respondents (years)	Frequency
Less than 20	10%
20-29	35%
30-39	22%
40-49	26%
50 and more	17%
Total	100%

The results regarding awareness about AI applications among the respondents show that social media and applications published by the Ministry of Health (MoH) had contributed greatly to help people understand and acquire information about the AI applications as shown in Figure 2. It was found that MoH applications, hospitals, social media, and websites were prime contributors of information and awareness. Also, as patients were mostly confined to their homes, the awareness was mostly through the internet.

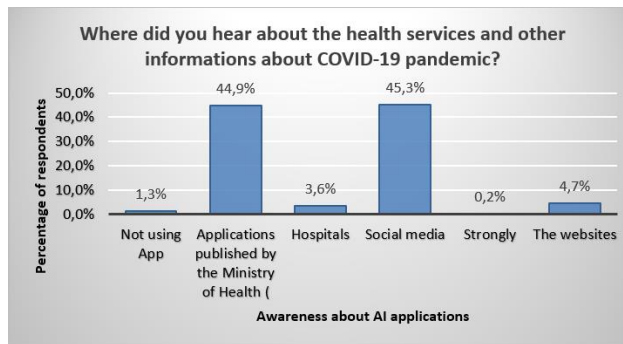


Figure 2. Awareness about AI related health services applications during COVID-19

Majority of the respondents strongly agreed that they preferred to use the AI applications for booking the health services rather than using the traditional way. It was found that the majority of respondents preferred to use the AI applications when they had to use any healthcare service during the COVID-19 pandemic as shown in Figure 3. The applications made it easy for users, reduce excess personal contact with hospitals and clinics, and finally save time for booking the health services rather than following the traditional method of going to the hospital for booking the services.

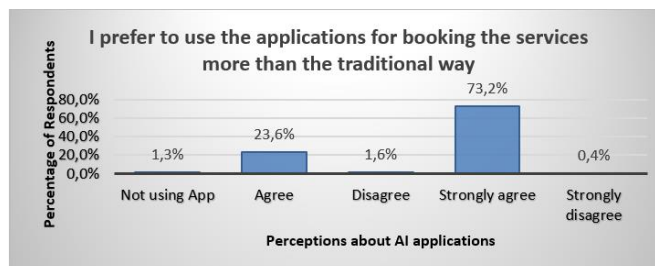


Figure 3. Perceptions about using the AI applications during COVID-19

The AI applications also have been significant in protecting the privacy of individual information, such as personal health data. The study found that 56% of the sample respondents strongly agreed and 37% agreed with the protection of their personal information while using these AI applications as shown in Table 2. A few respondents however disagreed with the protection of privacy in these applications.

Table 2. Protection of privacy while using the AI applications

Responses	Frequency
Not using App	1%
Agree	37%
Disagree	4%
Strongly agree	56%
Strongly disagree	1%
Total	100%

The study also found that the most frequently used applications during COVID-19 were Tawakkalna and Sehhaty followed by Mawid and Tabaud, then Tetamman, Sehha, Assafni and finally Wasfaty as shown in Figure 4. The Tawakkalna and Sehhaty AI applications have proven their effectiveness in providing the services to the population. There were a lot of benefits of these AI applications during the COVID-19.

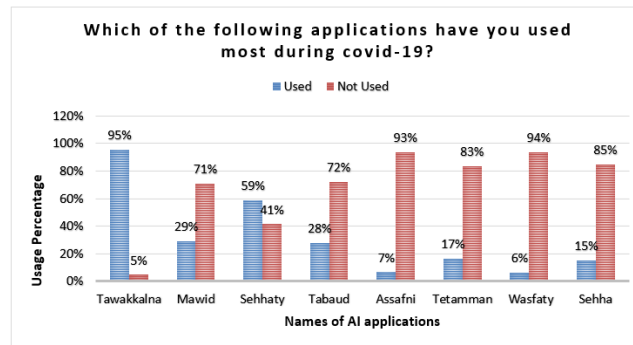


Figure 4. AI applications used during COVID-19

Many respondents applied AI technologies in seeking information on coronavirus pandemic which include requesting permissions during travel restrictions or lockdowns and searching trending records and other COVID-19 statistics as shown in Figure 5. This implies AI methods continued to gain more acceptance during COVID-19. Again, this indicates the widespread applications of AI technologies during the COVID-19 pandemic and gaining awareness about the spread of the disease.

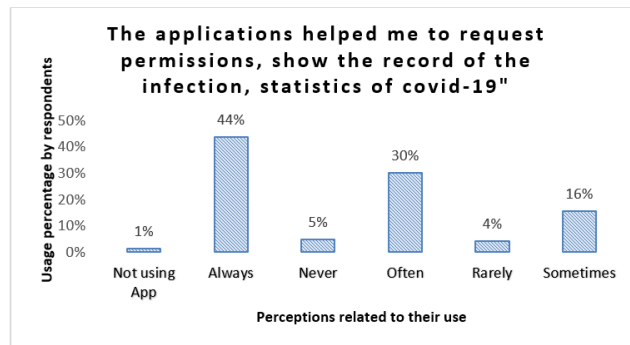


Figure 5. Benefits of AI applications during COVID-19

One of the importance of AI technologies was booking appointments for COVID-19 disease tests after asking few questions to the patients. Also, it helped in booking and receiving COVID-19 vaccine doses. Because these AI applications have been widely used during the pandemic period, this helped in the prevention and management of the COVID-19 disease as shown in Figure 6. A majority of the respondents namely -36%, 24% and 20% indicated that the AI applications have greatly helped the respondents to book online medical appointments and consultations services. A smaller margin indicated less usage of these applications as shown in Figure 7.

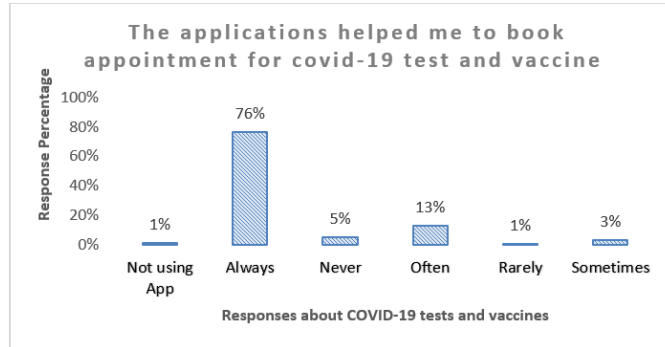


Figure 6. Booking appointments for COVID-19 test and vaccines



Figure 7. Usage of AI applications for online medical consultation services

The next figure discusses the results regarding the associated health conditions while using these AI applications during COVID-19 pandemic. It was found that obesity, hypertension, asthma, thyroidism, diabetes and arthritis were some of the conditions that were reported while using the AI applications by the respondents as shown in Figure 8. This is a clear indication that AI applications can be used for prevention and management of disease.

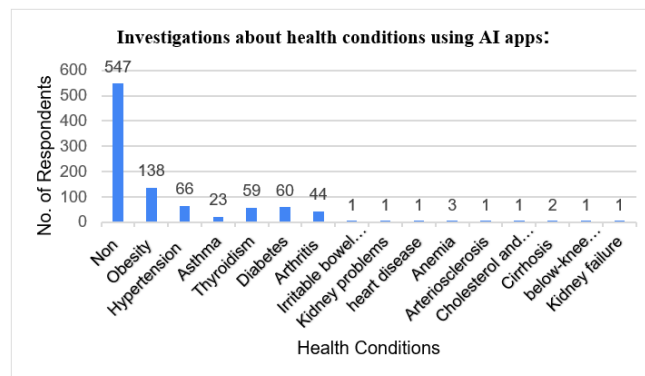


Figure 8. Use of AI applications for other health complications during COVID-19

Finally, the study found that the AI applications played an effective role in controlling the spread of COVID-19 disease as shown in Figure 9. The responses show that it reduced the contact between people. Other respondents said that it helped to access the services that they needed. On the other hand, some respondents said that it detected the COVID-19 cases at an early stage and finally some respondents said that it helped to suggest isolation for travelers.

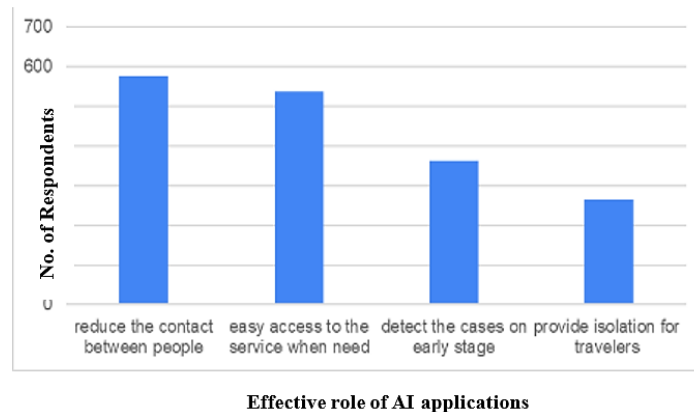


Figure 9. Effective role of AI applications in controlling the spread of COVID-19

Therefore, it is evident from the study findings that COVID-19 has brought new challenges for the health sector. In this study, an attempt was made to find out how artificial intelligence was used in different applications during the COVID-19 pandemic for health care management in terms of prevention and control of the disease at a global level. From the implications of the collected and analyzed data, AI technologies were used in different applications designed by the MoH, Saudi Arabia. The applications were actively used across different age groups among the respondents, and they came to know about these applications from the social media or the MoH websites. During the pandemic, the MoH published many COVID-19 related information to make the citizens, residents, and visitors aware about the various health care applications launched for the benefit of the people [7], [11]–[14]. The technologies have been important in helping people to book appointments rather than using the traditional methods. The generated request permissions during lockdowns, helped monitor the progress of the disease, enquire about other health conditions, and acquire information about the trending issues caused by COVID-19 pandemic. There are positive indications from other studies also that these applications have immense benefits, particularly to individual users [15]–[18]. The apps have been important in helping patient medically to evaluate and recover from their medical situations, suggest isolation as well as book polymerase chain reaction (PCR) tests in case of infected respondents. These applications also helped to book the vaccine doses during the pandemic. Generally, communication has been another aspect that developed with the inventions in artificial intelligence and developments of apps that can ease the stages and processes of acquiring medical services in hospitals and other care centers. The nature of these applications is that they do not require one to wait in a line like traditional services to acquire services. Every individual visiting the websites or apps that use AI were attended to or received the services that they required. The medical field is one of the sectors that have embraced the usage of AI technologies [6], [8], [17], [19]. All the major sectors in the medical world have applied different methods of ensuring that their clients have been satisfied and this was possible through the innovation and developments of apps that makes the delivery processes to be effective [16], [20]–[22]. More importantly, since people have been spending time at home, many have preferred the application of these AI technologies to ensure that they control the spread of the virus. Therefore, AI tools have not only revolutionized the medical industry, but they have also advanced in developing other significant fields that contribute to growth and development. The findings of our study suggest that there are innumerable benefits to the people as well as patients who are infected. This has indirectly transformed many processes in the field of medical, educational, and transport. All applications that were developed had a specific goal as well as a specific target audience and most of them were used globally for COVID-19 control, awareness and education, healthcare management, self-monitoring of the disease during isolation [23]–[25]. The most widely used application in Saudi Arabia was Tawakalna and it worked for COVID-19 containment via contact tracing and information dissemination. Presently, it is also performing a host of other functions.

4. CONCLUSION

Indeed, technologies developed as a result of artificial intelligence have made a significant impact not only in the delivery of services and ensuring fulfilment of dynamic processes, but also in the creation of ideas and boosting generation of new economic models. All AI applications have gone a long way to achieve the goal of containing the COVID-19 pandemic through awareness, education, forecasting, self-monitoring,

isolation and health management. Moreover, COVID-19 pandemic has called for a united effort from healthcare and information technology sectors in order to contain the spread of the virus and prevent more deaths all over the world.

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