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Monitoring of COVID-19 Disease based on Modern Technologies

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Abstract

Introduction: Coronavirus has become a global pandemic since early 2019. More than180 countries around the world are involved with COVID-19. One of the effective methods to monitor, detect, warn early, prevent, and control is Information Technology.
Methods: This study is a scoping review. This study aimed to describe the novel information technologies used during the COVID-19 pandemic. The literature was searched for types of information technologies on COVID-19 with the help of libraries, electronic databases (Scopus, PubMed, and Web of sciences), and search engines available at Google.
Results: In this study, three groups of telemedicine technologies including telediagnosis, telemonitoring, and teleconsultation were selected. In addition, several unique technologies such as artificial intelligence, smart wearable devices, big data, neural networks, robots, chatbots, close contact detectors, Internet of Things (IoT), smart drones, Electronic Health Records, and thermal scanners were included. More than 150 resources were collected, 68 of whom were selected based on their relevancy during 2021. The results showed that the role of modern technologies in healthcare systems monitoring was crucial during COVID-19 pandemic.
Conclusion: Therefore, telemedicine is one of the solutions that has been equivalent to or even better than face-to-face medicine, and governments should better learn about the experiences of different countries in the use and their branches such as Telemonitoring, Teleconsultation, Telediagnosis along with enforcing laws to follow the protocols and vaccination of different groups of society to prevent the spread of the disease.
Keywords: Telemedicine, Telediagnosing, Telemonitoring, Telecounsulting, COVID-19

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Introduction

The very fast outbreak and spread of COVID-19 made everybody surprised. In this case, there were two major issues: the high number of patients and limited medical resources. One of the methods used to monitor the community health is telemedicine. The telemedicine technologies have various items including thermal scanners (fever screening system), chatbots, close contact detectors with navigation apps, drones, robots, Electronic Screening Programme by Electronic Health Records, artificial intelligence, smart wearable devices, and big data. Therefore, telehealth applications can include warning, reminding, detecting, monitoring, and measuring the clinical symptoms and signs, so they should be used in the COVID-19 crisis (1). China is the leader in using IT such as; smartphones and thermal cameras based on artificial intelligence to detect fever and infected people; Face recognition cameras to track infected patients with a history of travel, Robots to distribute food and medicine; and Drones to disinfect public, patrol areas, and encourage of people to stay at home to fight COVID-19 disease (2, 3). In Taiwan, immigration and customs with the National Medical Insurance databases information were merged, to deal with it based on travel history and symptoms of COVID-19 patients (4, 5). COVID-19 pandemic posed a major challenge to the global health system and made governments take preventing and controlling measures. In this regard, the health informatics community has taken measures by using novel health information technologies to monitor, diagnose, warn, prevent, and control and accelerate health services. Up to now, a variety of contemporary technologies such as mobile Internet, artificial intelligence, wearable devices, robots, big data, neural networks, thermal scanners, remote monitoring, remote consulting, and electronic health records played a significant role during the COVID-19 crisis. For example, in China in all stages of the COVID-19 pandemic, information technologies have been used including disease prediction, monitoring, and close call tracking with remote diagnosis. The COVID-19 pandemic is a common and worldwide challenge with which human is faced, and as the epidemic spreads, health information professionals from all over the world must share their experiences and work together to discover a cure for the COVID-19 epidemic (6). Unfortunately, due to the lack of proper monitoring and practical solutions for disease management in several countries, including Iran, we witnessed the sixth wave peak with a new Omicron variant of COVID-19. Therefore, early detection of appropriate treatment to optimize treatment and reduce mortality using various new technologies is a priority and importance.

This study aimed to describe the novel information technologies used during the COVID-19 pandemic. Thus, for reaching this goal, telemedicine was divided into three groups of diagnosing, counseling, and monitoring to manage and control the COVID-19 epidemic crisis.

Methods

This study is a scoping review and a sub-systematic method was used, which was divided into three phases: literature collection, assessment, and selection based on what was available. The literature was searched for types of information technologies on COVID-19 with the help of libraries, data banks (Scopus, PubMed, and Web of sciences), and also search engines available at Google. In our study, three groups of telemedicine including telediagnosis, telemonitoring, and teleconsultation were selected, and their technologies to use these groups were identified. These technologies included artificial intelligence, smart wearable devices, big data, neural networks, robots, chatbots, close contact detectors, Internet of Things (IoT), smart drones, Electronic Health Records, and thermal scanners (fever screening systems). From the obtained resources, only the cases of the information technology tools during the Coronavirus outbreak were selected. More than 150 resources were collected during 2019-2021. When we read these 150 works of the kinds of literature with consideration of de-duplication and applying the inclusion and exclusion criteria were screened; out of them, 68 eligible studies were selected.

Results

In this study, the information technologies were recognized, categorized, and described to show how to respond to and manage rapidly an outbreak of COVID-19 to do telemedicine.

Telemedicine

Telemedicine is the delivery of health care services at a distance using electronic and digital tools for diagnosing, consulting, monitoring, curing, preventing disease and injuries, doing research and evaluating, and educating health care providers to improve health (7). In our study, telemedicine was divided into Telediagnosing, Teleconsulting, and Telemonitoring as well as demonstrating the technologies and techniques which can manage COVID-19 disease (Figure 1). Telemedicine has become a success in the fight against epidemics and pandemics (8). It is another effective way to diagnose, counsel, monitor, and treat people without needing to go to healthcare centres (9). Boehm et al. in their study examined Telemedicine and Teleconsultation from a perspective in the context of the COVID-19 pandemic. They selected 399 outpatients with a scheduled appointment at the healthcare centre from October 2019 to February 2020. Overall, 54.1% of patients were eligible and willing to use

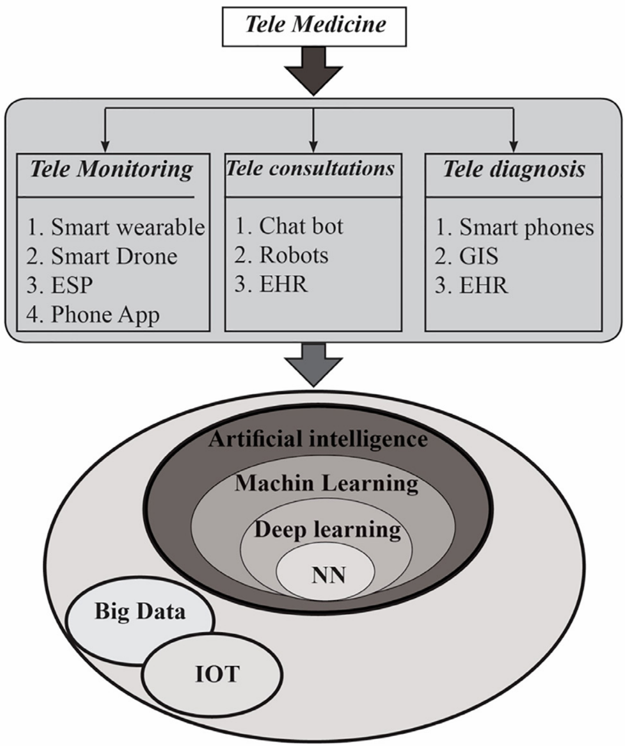

Figure 1: Proposed formation technologies framework for responding to the COVID-19 pandemic [Ajami, Nopour, and Mohammadi] *Electronic Screening Programmes (ESP), Thermal Scanner(S), Electronic Health Records(HER), Internet of Things, Neural Network (NN)

Telemedicine. About 84.7% of them were willing to use Teleconsultation in case of COVID-19 diseases. The rest of the patients (2.5 %) desired to have face-to-face visits. Therefore, on the one hand, significant pressure on hospital resources, and on the other hand, positive view of patients regarding the use of telemedicine, prove that Telemedicine is a suitable solution in this situation (10).

1. Telemonitoring

Telemonitoring is a communication and information technology to monitor and transmit information about isolated patients' health status geographically to healthcare centres (11).

1.1. Smart wearable and Tele-Monitoring

Tavakoli et al. (2020) conducted a study in Canada on the measurement, analysis and transmission of information through smart electronic wearable technology. This information, for example, is related to vital signs and physical activity that were transmitted through signals. In times of severe health crises, including the Coronavirus, smart electronic wearable technology can be very effective for Telemonitoring (12).

1.2. Smart Drones and Tele-Monitoring

Mastaneh and Mouseli conducted a study in Iran in 2020 and stated that drones had an important role in COVID-19 disease management due to their various applications. Some countries use drones to identify patients and people with high-risk situations and behaviors in large populations. These devices can control and monitor the activities of people such as their temperature, sneezing, and coughing, which helps to identify suspicious cases by using specialised sensors with high-resolution cameras and powerful computer systems. Another application of drones is logistics services. Due to the need for social distance, food and water, medicine, laboratory samples of patients, and other essential items are transported quickly. Drones are also used by the government during quarantine (13).

1.3. Electronic Screening Programmes and Tele-Monitoring

The Health Deputy of the Iranian Ministry of Health asked the Iranians to participate in the Corona Electronic Screening Program by referring to salamat.gov.ir. According to the Ministry of Health, the majority of patients do not have corona symptoms, but if they visit the hospital, they are at risk. Hereby, they will be able to screen remotely the coronavirus prevalence and recognize infected, clean, and suspicious people by electronic health records (14).

1.4. Phone Applications and Telemonitoring

A geographic information system (GIS) is a satellite-based radio navigation system that can provide real-time geolocation and time information to a GPS receiver anywhere on Earth. GeoAI is the combination of artificial intelligence (AI) and GIS and has been used in public health. Therefore, Wang et al. suggest that improving the resolution of monitoring and forecasting could enable accurate contact tracing and precise individual-level protection, both of which are critical in the management of COVID-19 (15). John Leon Singh et al. did a scoping review of mHealth app; a total of 46 articles was reviewed from 19 countries. Among the apps were contact tracing, quarantine, symptom monitoring, and information provision with 52%, 24%, 24%, and 3%, respectively. This review identified that the majority of COVID-19 apps were for contact tracing and symptom monitoring. (16).

1.5. Thermal Scanner for COVID-19(Iran) and Tele-Monitoring

Regarding detection systems through the thermal scanner for COVID-19 cases in Iran, after the outbreak of the coronavirus in the country, committed professionals in the defense industry, through day-to-day efforts and continuous research, succeeded in using smart thermal cameras to screen for coronavirus patients in busy centres such as the country airports. For reaching the mass production stage, first of all, they were tested in the airports, and then distributed throughout the country, according to the need for installation in other places and centres (17).

1.6. Robot and Tele-Monitoring

Khan et al. in their paper explained how robots in healthcare and allied areas can manage and control the spread of the COVID-19 disease. They mentioned that prime utilisation of such robots was to minimise person-to-person contact and ensure the cleaning, sterilisation, and support in hospitals and similar facilities such as quarantine (18).

2. Teleconsultation

Teleconsultation is a communication and information technology to simultaneous or asynchronous counseling using and eliminating geographical and operational distance. Its goals are for diagnostics or treatment between two or more geographically separated health providers (e.g. physicians or nurses) or between health providers and patients (19). Zhai et al. has published an article on how telemedicine can help the Chinese government fight COVID-19. The Chinese government has set up a telemedicine counseling centre that can be installed on Chinese mobile phones and Huawei technologies to prevent and control the COVID-19 disease called the emergency telemedicine counseling system. The results showed that out of 654 patients with the COVID-19 disease who used this counseling centre, 420 were discharged from the hospital after 20 days. Another benefit of this counseling centre is the prevention of direct physical contact between doctors and nurses to patients. Therefore, it prevents the possible transmission of the infection to doctors and nurses. Also, since not enough specialised group therapy is available everywhere, patients can communicate with patients through technologies such as video conferencing (20).

2.1. Chatbots and TeleCounsultion

Beyond screening: How do COVID-19 chatbots support patient navigation and health checks?To remain as agile as possible, organisations should consider using chatbots, smart speaker applications, and other modalities, but caution must be taken to ensure these solutions fully address healthcare privacy and security requirements (21).

2.2. Robot and TeleConsultation

Other Chinese tech companies have used their robots to eliminate human-borne communications. The elimination of humans from the process has kept employees more secure. Also, a startup called TMIRob has taken dozens of robots to Wuhan city hospitals. The virus has spread from there, disinfecting isolated areas, intensive care, and operating rooms, so they use robots to clean ICU and isolated rooms in health care centres (22).

2.3. EHR and TeleConsultation

Das et al. conducted a study in India in 2020. This study was hospital-based cross-sectional and included 7,008 telephone consultations from March 23 to April 19, 2020. The rapid spread of viral cases has sparked countries, to observe "physical and social distance" among people. In this study, data included demographic information, clinical manifestations, inquiries, and advice for analysis. Follow-up consultation and access to patient information from electronic medical records (EMR) will allow timely response in a continuing public lockdown due to the COVID-19 pandemic. Current experience has provided valuable insights into the possibility of managing visits and remote patient follow-up in the future (23).

3. Telediagnosis

Telediagnosis is diagnosing from a distance, generally using communication and information technology.

3.1. Smartphones and Telediagnosis

Some studies suggested the use of smartphone thermometers as a valid and alternative device for assessing the temperature of infected people. It is also possible to diagnose the type of cough in a relatively large population of healthy and sick people using a wide range of audio features (24, 25). Denis et al. in March 2020 had done a research project about self-assessment through the web - application for COVID-19 in France. Data were collected about underlying conditions, demographic data, postal code, and main COVID-19 symptoms. The population reported three situations: stay at home, contact a general practitioner, and call the emergency phone number (26). Other research shows on March 29, 2020, the app was used about four million times, in which 3 485 218 e-questionnaires and 2 304 742 users had at least one symptom. This study suggests that anosmia may be strongly associated with COVID-19 and its severity. Self-checking application of data could be a relevant tool to follow the outbreak dynamic (27).

3.2.Geographic Information System App and TeleDiagnosis

Identifying high-risk areas with a high number of COVID-19 diseases is one of the most important measures to prepare people, especially in low-incidence areas. Chen et al. studied the time and place distributions of the COVID-19 disease pandemic by using GIS. Statistics show that the death in China due to the COVID-19 disease was 95.7%, of which 59.91% were related to Wuhan. Immigrants from Wuhan were, therefore, the main cause of the outbreak in other cities. The first cases of the COVID-19 disease in other cities came mainly from Wuhan. During the Corona epidemic, information technology and the media played an important role in supporting communities (28).

3.3. EHR and Telediagnosis

Many research projects were done on using Electronic Health Records to conduct remote visits and diagnoses during the time of COVID-19 through the integration of telemedicine services in the health sector services (29-30).

1. Big Data and Telehealth

In this regard, Chen et al. and Ye mentioned how to use big data to forecast the spread of Coronavirus in telehealth (31, 32).

2. Artificial Intelligence

Artificial intelligence (AI) is the simulation of human intelligence processes by machines, especially computer systems which able to have reactions similar to intelligent human behaviors, including understanding complex situations, simulating thought processes, using human reasoning and successful response methods, learning, and having the ability to acquire knowledge and reasoning to solve problems (33).

AI capabilities can be effective in diagnosing, predicting, analysing, and treating COVID-19 patients and helping to reduce costs. UP to now, most clinical applications of the AI in response to COVID-19 are on the clinical imaging-dependent diagnosis. The AI has been used to help analyse the CTscan results and has used the patients' clinical information to predict the progression of infection (34). Also, AI can be used to predict and track patients with COVID-19 based on time and place (35).

3. Machine Learning

Machine Learning (ML) is the study of computer algorithms that are automatically improved and is the subset of AI. The algorithms of ML create a mathematical model based on sample data, known as "training data," to make predictions or decisions without without human intervention (36).

Ajami and Mohamadi quoted Rao and Vazquez and emphasized the need to identify patients with the coronavirus through mobile-based machine learning algorithms. Then, they referred to Moazzami et al. in their article that telemedicine could be used by smartphones or computers with webcams, allowing physicians to diagnose patients with early signs of COVID-19 disease. They are evaluated effectively before they get to the hospital (37).

Wang et al. (2020) did a study in China entitled "Prediction of epidemic trends in COVID-19 with logistic model and machine learning techniques". This study aimed to create a reliable model based on time series data to predict the trend and long-term spread of COVID-19 in the world as well as in some highly infected countries. They collected time series for periodic analysis from January 22, 2020 to June 16, 2020. They selected five countries: Brazil, Russia, India, Peru, and Indonesia as predictors as these countries were among the highest in the world in terms of the total number of COVID-19 infected patients. According to the model, they predicted that by the end of June, the whole epidemic in Brazil would reach its peak with 384,998 active infections. The total size of the epidemic was predicted to be 1,737,272, with the fastest growth point occurring on 10 June. For Russia, the fastest growing peak of the epidemic was predicted on May 18 and June 4, with 283,029 and 256,535 active infections, respectively. It was predicted for India that the peak of the epidemic was still ahead. At that time, the number of active infections predicted by the model was 161185. The fastest growth point occurred on June 14 with an overall epidemic size of 330,043, and a turning point in India was predicted in early June. The model also predicted that the Pro epidemic would peak in mid-June, resulting in 108,217 active cases and an epidemic size scale of 357,812. They also predicted 22,127 active cases in Indonesia on June 23. Brazil has seen a widespread outbreak of the disease; the projected results showed that by the late July or mid of August 2020, the healing rate will increase and Brazil will have about 1.7 million confirmed cases at the end.

According to the model, as of June 16, 2020, the death rates in Russia, Brazil, and Peru were 1.35%, 4.90%, and 2.98%, respectively, and there were increasing cases every day. According to mathematical estimates in this model, the global prevalence peaked in late October, with an estimated 14.12 million people being infected cumulatively by then (38).

4. Deep learning and Neural Network

Deep learning is an AI function that imitates the workings of the human brain in processing data and creating patterns for use in decision making. Deep learning is a subset of machine learning in artificial intelligence that has networks capable of learning unsupervised from data that is unstructured or unlabeled. Also, it is known as deep neural learning or deep neural network. Deep learning has evolved hand-in-hand with the digital era, which has brought about an explosion of data in all forms and from every region of the world. (39). Li et al. (2020) in the United States conducted a study which aimed to diagnose COVID-19 using chest CT and assess lung function through a deep learning and neural network diagnostic model. Data were collected from 6 hospitals from August 2016 to February 2020. The collected data set included 4356 chest CT examinations from 3322 patients with a mean age of 49±15 years. The results showed that male patients were somewhat more than female patients (1838 vs. 1484). The findings of this study suggest that an in-depth learning model can accurately diagnose COVID-19 and distinguish it from pneumonia and other lung diseases in the community (40).

A study was done by Wieczorek et al. (2020) in Poland entitled "Neural network powered spread, COVID-19 forecasting model". Their purpose was to express the advantages, disadvantages, and solutions for predicting Coronavirus-infected cases using neural networks. To find the best solution for predicting COVID-19 expansion using a neural network, they performed some tests using the most popular ptimization algorithms.

After analysis, the best accuracy and the fastest neural network to learn from Nadam(Nesterov-accelerated Adaptive Moment Estimation, or the Nadam, is an extension of the Adam algorithm that incorporates Nesterov momentum and can result in better performance of the optimization algorithm.). The highest final accuracy was used because it had the best accuracy. The findings showed that many factors have been influential in the spread and increase of infections, including population behavior in a given region, the behavior of governments in certain countries, as well as access to medical knowledge and equipment, so that the neural network with its unique architecture can work in which it can forecast with very high accuracy about 87.70%. Finally, it can be concluded that neural network predictors can have better accuracy and adjustment than other random methods and the use of statistical models can extend the accuracy of specific predictions and increase network efficiency (41).

5. The Internet of Things

This paper proposes a real-time COVID-19 detection and monitoring system. The proposed system would employ an Internet of Things framework to collect real-time symptom data from users to early identify suspected coronaviruses cases, monitor the treatment response of those who have already recovered from the virus, and understand the nature of the virus by collecting and analysing relevant data. The framework consists of five main components: Symptom Data Collection and Uploading (using wearable sensors), Quarantine/Isolation Centre, Data Analysis Centre (that uses machine learning algorithms), Health Physicians, and Cloud Infrastructure. To quickly identify the potential coronaviruses cases from this real-time symptom data, this work proposes eight machine learning algorithms, namely Support Vector Machine (SVM), Neural Network, Naïve Bayes, K-Nearest Neighbour (K-NN), Decision Table, Decision Stump, OneR, and ZeroR. An experiment was conducted to test these eight algorithms on a real COVID-19 symptom dataset, after selecting the relevant symptoms. The results show that five of these eight algorithms achieved an accuracy of more than 90%. Based on these results, we believe that real-time symptom data would allow these five algorithms to provide effective and accurate identification of potential cases of COVID-19, and the framework would then document the treatment response for each patient who has contracted the virus (42).

Tables 1 and 2 show quite different methods of information technology to control the prevalence in different countries. As shown, the used technologies include smartphone services, IoT, artificial intelligence (including drones, robots, and Smart clothing), telemedicine, and clinical information systems which facilitate the public health management of COVID-19. Information technology was used in all stages of the pandemic, including prediction, close call tracking, remote detection, community monitoring, disinfection, warning, treatment, and counseling.

Discussion

In this review, a variety of information technology methods used during the COVID-19 pandemic were assessed. The results of these studies showed that the use of various information technologies had been effective during the outbreak of COVID-19 disease. As the results showed, the scope of technology goals in the studies is to diagnose COVID-19 disease and reduce the prevalence of this disease. Most studies have shown that machine learning algorithms and artificial intelligence techniques can be used to diagnose COVID-19 disease. These results show that researchers pay attention to research in the field of intelligent systems and also their awareness of the application and power of these algorithms. One of the major challenges in the advancement of intelligent systems is the problem of acquiring knowledge; for example, in designing a neural network, the number of samples required for system training is one of the main problems. On the other hand, GIS is a good tool for detecting and linking patients with Coronavirus to other environmental data. Nothing can be more effective in controlling the prevalence of pandemics than

how the geographical distribution of the epidemic

Table 1: Managing the COVID-19 Outbreak by the Information Technologies during COVID-19

#	Information Technology	Country	Applications
1	Smart Mobile apps (16, 26, 43, 44)	France, Germany, Singapore, South Korea, China, Hong Kong, Iceland, Indonesia, India, Iran, Italy, Malaysia, Poland, Russia, Taiwan, Turkey, Spain, and England	Identifying exposed individuals for testing and quarantine, Tracking contact Viral spread, Monitoring hand hygiene, Detecting technologies, Thermal imaging, Identifying potential patients, Symptom monitoring, Providing information
2	Smart Drones (2, 45-57)	India, Malaysia, and U.S.A	Warning; Monitoring; Disinfecting places such as hospitals; Identifying people with high-risk behaviors and guiding them; Transporting water and food, medicine, and laboratory samples of patients
3	Artificial intelligence (48-50)	China, Turkey, Canada, and the U.S.A	Assisting doctors in CT diagnosis, reducing work pressure, and improving diagnostic accuracy
4	Chatbots (20)	China	WebDoctor, China Mobile
5	Robots (51, 52)	China and Netherlands	Disinfecting and Delivering: Medications, Foods & Other supplies; Measuring vital signs, Providing Healthcare Services (Robot doctor & nurse)
6	Electronic health records (53-55)	The U.S.A	The Corona Electronic Screening Program by Electronic Health Record
7	Thermal scanner (fever screening system (4, 24)	China and Iran	Fever Monitoring in the: Airports, Schools, and Clinics
8	Smart wearable devices (56)	The U.S.A	Monitoring and Warning
9	Neural networks (48-50, 34, 40)	China, Turkey, Canada, and the U.S.A	The deep learning-based computer-aided diagnostic system is applied to a broad range of problems; Assess many different types of inputs including images, videos, files, databases, and more
10	Close contact detector with navigation application (57)	China	Health QR codes are color-coded phone apps.

Table 2: Challenges and solutions of technologies for managing the COVID-19

#	Technologies	Challenges	Solutions
1	Internet of Things (41)	Security challenges in IoT environments	Authenticating allows the integration of different IoT devices that are deployed in different contexts. Authentication of routing peers that involve transferring data as well as authentication of the source of data
2	Close Contact Detector with Navigation Application (15, 16)	The cost associated with setting up, integrating, and maintenance of emerging technologies	Developing the countries, improving healthcare service delivery through integrating ICTs
3	Smart Drones (58-59)	Used by malicious entities to conduct physical and cyber attacks, and threaten society.	Increasing the areas of cybersecurity, privacy, and public safety
4	Robots (51)	Widespread robots may also mean prolonged isolation of individuals from social interaction, which may harm mental health.	Social robots could be deployed to provide continued social interactions and adherence to treatment regimes without fear of spreading disease because social interactions require building and maintaining complex models of people, including their knowledge, beliefs, emotions, as well as the context and environment of the interaction.
5	Artificial Intelligence (40)	The strong need to develop software more rapidly, Privacy and security issues.	Using transfer learning from existing algorithms
6	Smart Wearable Devices (60)	Battery destruction of smartphones, smart watches, smart thermometers	Balancing regulatory requirements for adequate testing of the safety
7	Neural networks (60)	Did not available in time to impact clinical care	Improving the efficacy of these algorithms
8	Thermal Scanner (fever screening system) (60)	Screening error of people suspected of having a COVID-19 using body temperature	Increasing the accuracy of temperature and sensitivity to body temperature

is (46). Analysing these connections with the help of software can reduce the adverse effects of exposure to patients with the virus and also help improve the health of high-risk and vulnerable people. However, because GIS software is not capable of performing complex statistical calculations, many researchers believe that it is not a good tool for epidemiological studies (61). However, the ability of GIS to communicate between patients and geographic and spatial data is a valuable asset to help the health system in the event of an epidemic. In the last decade, the demand for telemedicine services has increased in developing countries (62). Yahya et al. in their article showed the ability of prediction analysis using artificial intelligence procedures and GIS (63). The results of studies have shown that for various reasons, such as the inability of people to leave home or reach healthcare centres due to lockdown, fear of infection, and limited health care centres, telemedicine has been equivalent to or even better than face-to-face medicine.

Conclusion

Successful experiences of different applications of information technology in countries during the outbreak of COVID-19 can be a solution to manage infectious diseases in communities where my literature was not able to present a lot of them. Coronavirus pandemics around the world have shown that there has not been a proper plan to manage critical situations such as the COVID-19 disease. Thus, this lack of a plan has led to an epidemic from a city to a pandemic around the world. Information technologies play an important role in people having less contact with each other and managing this disease. In this regard, the governments are better considering the experiences of different countries in the use of information technologies such as Telemonitoring, Teleconsultation, and Telediagnosis along with the application of laws to observe the protocols and public vaccination of different groups of society to prevent the spread of the disease. For example on February 19, Iran confirmed two cases of death due to COVID-19 in the city of Qom. This was the first report of death officially diagnosed as COVID-19 in West Asia, the Middle East, and North Africa. Despite the identification of the disease within a few weeks, measures taken to contain the pandemic were insufficient. The virus spread was rapid in Iran and by March 5, 2020, all 31 provinces were infected. Now, the total number of confirmed cases in the world and Iran were 660,131,952, and 7,562,060,, respectively from 3 January 2020 to 4:25pm CET, 10 January 2023 which was announced by the World Health Organization (64). Experience in Iran has shown that when mortality rates fall, people feel relieved and neglect to observe health protocols. The result of these reactions was the arrival and the outbreak of the Alpha, Beta, Gamma, Delta, and Omicron variants of Coronavirus. Applying advances in information technology along with proper strategic planning, monitoring, and tracing can improve health responses in times of crisis. This approach plays an important role in increasing the ability of the country and government to deal with epidemics before engaging in pandemics.

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Authors' Contribution

S.A. Conceptualisation, Data curation, Supervision, Writing - review & editing, Writing - original draft. S.N. Conceptualisation, Data collecting, Writing an original draft. Z.P. Conceptualisation, Data collecting, Writing an original draft. M.M. Conceptualisation, Data collecting, Writing an original draft.

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