Telehealth in Management of COVID-19 Pandemic: A Scoping Review

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Abstract- COVID-19 has created major health-related, economic, and social challenges in societies, and its high contagion has dramatically altered access to healthcare. COVID-19 management can be improved by the use of telehealth. This study aimed to examine different telehealth technologies in the management of COVID-19 disease in the domains of surveillance, diagnosis, screening, treatment, monitoring, tracking, and follow-up and investigate the challenges to the application of telehealth in COVID-19 management. This scoping review was conducted based on Arksey and O'Malley's framework. Searches were performed in Web of Science, PubMed, and Scopus databases to examine the evidence on the effectiveness of telehealth in COVID-19 management. Eventually, 36 articles were selected based on the inclusion criteria. The majority of these studies (33%) were conducted in China. Most services offered via telehealth focused on surveillance, tracking, and follow-up, in that order. Moreover, the most frequently used technologies were social networks, web-based apps, and mobile apps, respectively. The use of telehealth in COVID-19 disease management plays a key role in surveillance, diagnosis, screening, treatment, monitoring, tracking, and follow-up.
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Acta Med Iran 2021;59(11):629-640.

Introduction

The novel Coronavirus was identified in December 2019 in Wuhan, Hubei Province, China, and is currently known as Coronavirus 2 (SARS-CoV-2) (1). The World Health Organization (WHO) named the Coronavirus infection as a pandemic in 2020, and despite serious global efforts to inhibit and eradicate this virus, its prevalence is still on the rise, with> 15,257,287 laboratory-confirmed cases and> 628,240 cases of mortality up to 24 July 2020 worldwide (2,3). This pandemic disease has posed serious health-related, economic, and social challenges to societies (4,5), thereby increasing health-related costs and imposing a burden on healthcare providers. If the prevalence of this disease is not quickly managed and controlled, healthcare systems will face serious problems due to the shortage of healthcare personnel and medical facilities (6-8). The COVID-19 pandemic has dramatically altered the method of patient examination and treatment and access to healthcare services (9).

Telehealth is an attractive, effective, and inexpensive option for fighting COVID-19 (10). This term encompasses a wide spectrum of activities related to health, including remote prevention, surveillance, and counseling (11,12). Telehealth means the provision of diagnostic, treatment, and educational services when there is a distance between the service providers and the clients in terms of time and place, and this distance can be bridged by information and communication technology (12,13). Telehealth reduces commutes to hospitals, to which COVID-19 patients may be admitted, thereby helping the society and high-risk groups, e.g. the elderly and those with underlying diseases (14,15). Research shows that, in the past, telehealth was effective in the management of similar epidemics, such as the Ebola virus disease, SARS, and influenza (16-18). Studies also report that COVID-19 as a newly-emerging disease is rapidly evolving, and the use of telehealth for confronting these emergency conditions is quickly

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expanding (19,20).

The high prevalence and spread of this disease have put a heavy burden on healthcare centers. Concerns about COVID-19 are on the rise because its mitigation and management require diagnosis, treatment, surveillance, and follow-up over the course of the disease (10). Telehealth enhances access to care, promotes the management of diseases, facilitates the provision of healthcare services, improves health outcomes, helps the use of resources, and expands education and cooperation opportunities between patients and doctors, especially in emergencies and pandemics (19,21,22). Little time has passed since the first case of Coronavirus infection was reported, and so no comprehensive review has yet been conducted on the use of telehealth in COVID-19 management. Thus, it seems necessary to conduct a scoping review to identify, retrieve, and summarize evidence on this topic.

Scoping reviews try to identify, retrieve, and summarize information from studies relevant to a particular topic in order to find the key concepts and the main sources and types of evidence available in the literature (23). Scoping reviews are conducted to answer more general questions. One of their advantages is determining the feasibility and necessity of conducting a systematic review in a specific domain (24,25). The present scoping review aimed to examine different telehealth technologies in the management of COVID-19 disease in the domains of surveillance, diagnosis, screening, treatment, monitoring, tracking, and follow-up, and investigate the challenges to the application of telehealth in COVID-19 management. Accordingly, the following research questions were posed:

What are the telehealth technologies used in COVID-19 management?

What are the different types of telehealth services in COVID-19 management?

What are the challenges to the use of telehealth in COVID-19 management, and what are the solutions to these challenges?

Materials and Methods

This study adopted Arksey and O'Malley's framework to conduct a scoping review (23). Based on this framework, a scoping review follows five main stages and one selective stage:

1) Identifying the research question, 2) identifying the relevant studies, 3) selecting the studies, 4) charting the data, 5) collating, summarizing, and reporting the results, and 6) consultation exercise. This review did not include the final stage. The present scoping review was conducted based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Review (PRISMA-ScR) guidelines (26).

Eligibility criteria
Table 1 shows the inclusion and exclusion criteria for this review.

Results

Thirteen studies out of the initial 34,848 titles met the criteria to be included for final review and analysis. Some general information about included articles is provided in Table 1.

Search strategy and information sources
Articles were retrieved upon an electronic search in some scientific databases, namely Web of Science, PubMed, and Scopus. Moreover, a scatter search was performed to find the articles. The search strategy comprised MeSH terms and other relevant keywords, and the two groups of terms (A and B) were combined using Boolean operators AND and OR. Table 2 lists the key terms used.

Table 1. Inclusion and exclusion criteria

Inclusion criteria	The published English articles in peer-reviewed journals and conferences paper with an available full-text Articles published from 31 December 2019 to 20 January 2020 Articles using telehealth technologies in COVID-19 management the quantitative, qualitative, trial, and experimental studies that provide evidence
exclusion criteria	Review articles, case reports, case studies or study protocols, letters to editors, and corresponding and conference papers (absence or lack of access to full text) Articles using telehealth technologies in management other diseases during Covid-19 Articles in languages other than English Published before 2019 Studies that do not provide any practical, theoretical, trial, or statistical evidence

Table 2. Search strategy

Search strategy	
A	Coronavirus OR Coronavirus Infections OR 2019 novel coronavirus disease OR COVID19 OR COVID-19 OR SARS-CoV-2 OR SARS-CoV-2 infection OR 2019 novel coronavirus infection OR 2019-nCoV infection OR coronavirus disease 2019 OR 2019-nCoV disease
B	Telemedicine OR ehealth OR e-health OR electronic health OR mobile health OR mobile app OR telehealth OR Smartphone OR Patient Portals OR social media OR Internet-Based Intervention OR health information technology
	A AND B

Study selection

The electronic search was performed in the three mentioned databases. In addition, manual searching was performed in Google Scholar, and 52 articles were retrieved. The retrieved articles were then inputted to EndNote, and the duplicates were identified and removed by using the software. Subsequently, the titles and abstracts of the articles were inspected by two authors based on the research questions and objectives. In the next step, the full text of the articles was examined by two authors with respect to the inclusion and exclusion criteria. Any disagreements between the two authors were resolved upon discussion.

Data extraction, charting, and synthesis

A data extraction form was used to extract the data. This form included the name of the first author (reference), year of publication, country, the technology used, types of telehealth services in COVID-19 management, challenges to the use of telehealth in COVID-19 management, and recommendations as to the proper use of telehealth tools for the better management of COVID-19. Finally, the data extracted from the articles were inputted into Excel for categorization, collation, and reporting (Table 3).

Table 3. Summary characteristic of the included studies

The first author (Ref)	Year	Country	Technology	Telehealth services	Challenge	Recommendation
Krausz (19)	2020	Canada	Web-based app	Screening, remote monitoring, surveillance, follow up, tracking	Lack of integration with other systems and patient data confidentiality issues are the challenges of web-based apps.	-
Gao (27)	2020	China	Social media platform(Weibo Chats)	Surveillance	The disseminated information may cause alarm and panic in society.	In fighting COVID-19, governments must pay more attention to public mental health by monitoring and filtering misinformation and disseminating correct information.
Han (28)	2020	China	Social media platforms(Weibo Chats)	Surveillance, tracking	There is misinformation and fake news on social media.	-
Huang (29)	2020	China	Social media platforms(Weibo Chats)	Surveillance, tracking	-	-
Liao (30)	2020	China	social media platform(Weibo Chats)	Surveillance, tracking	-	To control diseases, governments should have more supervision on the data in social media.
Shen (31)	2020	China	Social media platform(Weibo Chats)	Surveillance, tracking	-	-
Zhao (32)	2020	China	Social media platform(Weibo Chats)	Surveillance, tracking		
Gong (33)	2020	China	Cloud computing, social media platform (Wechat)	Surveillance, follow-up, tracking diagnostic, treatment	Communication and hardware infrastructure is a challenge to cloud computing implementation.	-
Ni (34)	2020	Hong Kong	Social media platform(Wechat)	Surveillance, tracking	-	-
Davarpanah (35)	2020	Iran	Social media platforms (WhatsApp)	Screening	The security of patient data and privacy are among the most important challenges to the use of social networks in the healthcare setting.	Sufficient and to-the-point training for doctors, radiologists, and healthcare workers on the use of social networks for transferring health-related data;

Cont. table 3						
Abd-Alrazaq (36)	2020	Qatar	Social media platforms (Twitter)	Surveillance	Social media can act as a two-edged sword, being destructive in crises if not used correctly and disseminate fake news.	Healthcare systems should focus on the construction of national and international systems for the diagnosis of the disease and monitoring on social networks. Moreover, to prevent the dissemination of fake news, a more active presence in social media is a necessity.
Ahmad (37)	2020	Iraq	Social media platforms(facebook, instagram, twitter, snapchat,…)	Surveillance	Social networks play a key role in spreading fear and concern among users about the COVID-19 crisis.	Social network users need training and enhanced media literacy with regard to the information disseminated in social networks. Since the majority of these users are young and help spread information in their families, universities are ideal places for developing courses and holding symposia to teach students the correct methods of searching, finding, and evaluating health-related information in pandemics.
Mackey (38)	2020	USA	Social media platform(Twitter)	Surveillance, tracking	-	-
Massaad (39)	2020	USA	Social media platform(Twitter)	Surveillance, tracking	-	-
Park (40)	2020	South Korea	Social media platform(Twitter)	Surveillance, tracking	-	-
Wahbeh (41)	2020		Social media platforms(Twitter)	Surveillance	-	-
Basch(42)	2020		Social media platforms (YouTube)	Surveillance	YouTube has great potentials for educating people on practicing behaviors that reduce the transmission of COVID-19	-
Li (43)	2020	Canada	Social media platforms(YouTube)	Surveillance	YouTube has been a major source of disseminating misinformation during public health crises.	Public health agencies should use YouTube better for providing timely and precise information and minimizing the dissemination of misinformation. This may greatly contribute to the successful management of COVID-19.
Li (44)	2020	China	Social media platform(YouTube)	Surveillance, tracking	-	-
Bae (45)	2020	South Korea	Mobile app, dashboards, an electronic prescription system, Cloud-based medical image sharing system, electronic health record template	Remote monitoring	-	Adopting a multidisciplinary approach to the development of healthcare support and disease management systems in crises such as the COVID-19 pandemic by the government, medical communities, civil groups, and politicians; Providing a strong information and communication infrastructure helps the expansion and implementation of eHealth tools for better management of COVID-19.
Bai (46)	2020	China	Mobile app	Remote monitoring, diagnostic, treatment, follow-up, tracking	-	-

Cont. table 3

Ekong (47)	2020	Nigeria	Mobile app	Surveillance, tracking	Concerns as to the confidentiality of data are a major obstacle.	Establishing a balance between the use of this technology and protecting the confidentiality and privacy of patients; Developing guidelines on the protection of patient privacy for data distributors to limit misuse and unauthorized access; Creating audio recognition technologies for poorly educated patients;
Hernandez-Orallo (48)	2020	Spain	Mobile app	Surveillance, tracking	A considerable percentage of people should use smartphone tracking apps for better tracking and monitoring.	-
Hong (49)	2020	China	Mobile app, internet	Diagnosis, treatment	The main problem in using telehealth is a diminished relationship between doctors and their patients. The gap in the relationship between healthcare providers; problems related to the quality of health information; organizational and bureaucratic problems;	The pre-requisites of success include sufficient financial resources, technological infrastructure, and general coordination among policymakers.
Yasaka (50)	2020	USA	Mobile app	Surveillance, tracking	Complexity of usage and lack of observance of confidentiality;	-
Denis (51)	2020	France	Web app	Surveillance, Remote monitoring, tracking	Lack of direct patient evaluation by doctors is a disadvantage of online self-evaluation apps.	-
Schinköthe (52)	2020	Germany	Web app	Remote monitoring, screening	-	-
van Agteren (53)	2020	Australia	Web app	screening	-	-
Kamel Boulos (54)	2020	China	Dashboard	Surveillance, tracking	-	This solution can be implemented in countries with advanced technology and communication infrastructure. If it is up-to-date and has high precision, it can help policymakers at all levels.
Komenda (55)	2020	Czech Republic	Dashboard	Surveillance, tracking	-	-
Cuan-Baltazar (56)	2020	Mexico	Internet	Surveillance	In crises, the public may panic in the absence of supervision on the information disseminated online. People do not wish to seriously evaluate what they read when making important decisions about their life and health, and this misinformation can endanger the health and life of people.	The scientific community should be aware of the quality of the data it reads and produces. The use of misinformation available online poses a risk to public health. In these cases, governments must provide guidelines about the dissemination of health-related information without alarming the public. Governments and organizations such as the WHO should cooperate in developing guidelines and mechanisms for controlling the information flow on the Internet and develop universal codes of ethics based on which health-related data are to be disseminated since this also affects the politics and economy of different countries.
Khairat (57)	2020	USA	Virtual care	Screening, remote monitoring	-	-
Mavragani (58)	2020	United Kingdom	Internet	Surveillance, tracking	-	-
Chou (59)	2020	USA	Videoconference	Screening	Absence of sufficient bandwidth for establishing audio and video calls simultaneously; Some doctors' and nurses' concerns about the confidentiality of patient data;	

				Cont. table 3		
Judson (60)	2020	USA	Portal-based self-triage	Screening	-	-
Li (61)	2020	China	Open EHR template	Diagnosis, treatment	Incompatibility of the openEHR version with the systems used in healthcare providing organizations;	-
Basch (62)	2020	USA	Social media platforms (YouTube)	Surveillance	YouTube has great potentials for educating people on practicing behaviors that reduce the transmission of COVID-19 but may also disseminate misinformation about this disease.	The continuous follow-up of the content of YouTube videos is necessary for improving people's understanding of different types of information required for making informed decisions. This is especially important in the current pandemic. Further activity of public health-related agencies in social networks to produce high-quality content;

Results

Selection of sources of evidence

A total of 918 articles were retrieved following the search in the databases. In the next step, by using EndNote, 207 duplicates were removed, and 710 articles remained. Subsequently, the titles and abstracts of the articles were read, 658 articles were removed, and 52 remained. Then, the full text of the articles was examined, 16 articles were removed, and finally, 36 articles were included in this review. The process of selecting the articles is illustrated in Figure 1.
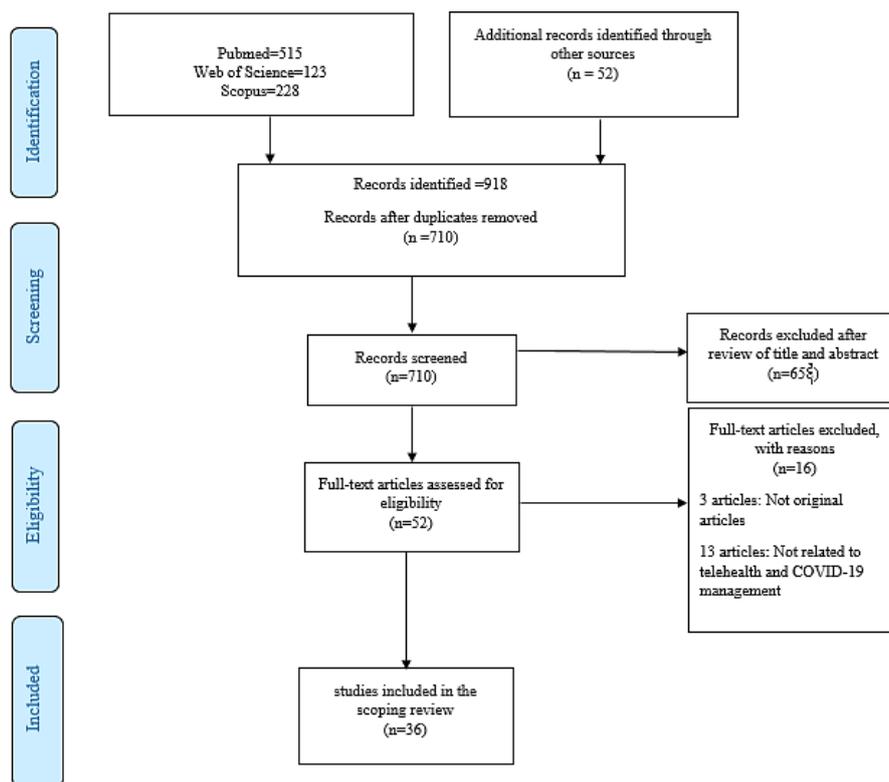

Figure 1. Scoping review flowchart

Characteristics of the sources of evidence

The majority of the included studies were conducted in China (n=12, 33%), followed by the US (n=7, 19%).

All the studies were conducted in 2020. The most frequently used technology was social networks (n=18), including messaging services such as WeChat (27-32),

Weibo Chats (33,34), WhatsApp (35), and other social networks such as Twitter (36-41) and YouTube (42-44). The other technologies were mobile apps (n=6) (45-50), web-based apps (n=4) (19,51-53), and dashboards (n=3) (45,54,55).

The most frequently provided service using telehealth focused respectively on Surveillance (n=27) (19,27-34,36-44,47,48,50,51,56-58), tracking (n=21) (19,28-34,38-40,44,46-48,50,51,57,58), screening (n=7) (19,35,52,53,55,59,60), follow-up (n=3) (19,33,46), monitoring (n=6) (19,45,46,51,52,55), diagnosis (n=4) (33,46,49,61), and treatment (n=4) (33,46,49,61), in that order.

Telehealth technologies for services provided in COVID-19 management

Twenty-six studies had used telehealth technologies for surveillance. The most frequently used technologies respectively were social media platforms (n=17) (27-34,36-44), mobile apps (n=3) (47,48,50), web-based apps (n=2) (19,51), and dashboards (n=2) (54,55). In the domain of surveillance, infodemiology was used for analyzing user comments to determine the prevalence of COVID-19 (29-31,36,38,40,41,44,56,58). For tracking, the most frequently used technologies were social media platforms (n=11) (28-34,39,40,44,62), mobile apps (n=4) (46-48,50), web-based apps (n=2) (19,51), and dashboards (n=2) (54,55), in that order. For screening, the most frequently used technology was web-based apps (19,52,53), followed by video conferencing (59), social media platforms (35), and portals (60), in that order. For remote monitoring, the most frequently used technologies were web-based apps (19,51,52) and mobile apps (45,46), respectively. For diagnosis and treatment, the technologies included mobile-based apps (46,49), social media platforms (33), and the open EHR template (61). For follow-up, the technologies included mobile-based apps (46), web-based apps (19), and social media platforms (33).

Challenges to the use of telehealth and solutions to these challenges

Social networks are major sources of dissemination of information about COVID-19. Their main challenges include: dissemination of fake news and spreading fear and concern about the COVID-19 crisis (27,28,36,37,42,43); lack of accurate evaluation of information by people, thus risking their health and life (56); and security of data and privacy of patients (35). These challenges can be resolved by implementation of national and international diagnosis and social media

monitoring systems by the healthcare system of every country (36), more active presence of public health-related agencies in social media for producing a higher-quality content (42,43), monitoring and filtering misinformation and dissemination of accurate information by governments when fighting COVID-19 (27,30), and enhancing media literacy as to the information published on social media (37). Since the majority of users are young and help spread information in their families, universities are ideal places for developing courses and holding symposia to help students identify the correct methods of searching, finding, and evaluating health-related information in pandemics (37). The continuous examination of the content of social media is necessary for improving people's understanding of different types of information they need for making informed decisions. This is especially important in the current viral pandemic (42). Sufficient and to-the-point training is required for doctors and healthcare workers on the use of social networks for transferring health-related data (35).

As for the use of other telehealth technologies in COVID-19 management, such as mobile apps, web-based apps, video conferencing, and dashboards, the challenges include lack of sufficient bandwidth for establishing audio and video communication simultaneously; doctors' and nurses' concerns about patient data confidentiality (59); lack of doctors' direct evaluation of patients when using online self-evaluation apps (51); concerns about lack of data confidentiality (47); the fact that some people do not use smartphones to allow tracking (48); the gap in the communication between healthcare service providers; issues related to health data quality; organizational and bureaucratic problems (49); and lack of integration with other systems (19,61). The solutions to these issues include: adopting a multidisciplinary approach to the development of healthcare support and disease management systems in crises such as the COVID-19 pandemic by governments, medical communities, civil groups, and politicians; providing powerful communication and information infrastructure (45); establishing a balance between the use of this technology and protecting data confidentiality and patient privacy; developing guidelines on the protection of patient privacy for data distributors to limit misuse and unauthorized access; and creating audio recognition technologies for poorly educated patients (47). In general, the pre-requisites of success in the appropriate use of telehealth are having sufficient financial resources, powerful technological infrastructure, and

general coordination between policymakers (49,54).

Discussion

The present scoping review aimed to examine the effectiveness of different telehealth technologies in the management of COVID-19 in the domains of surveillance, diagnosis, screening, treatment, surveillance, tracking, and follow-up, and investigate the challenges to the application of telehealth in COVID-19 management and the solutions to these challenges. The results revealed that telehealth is effective in COVID-19 management with respect to the limitations posed by this disease on commutes, methods of examination and treatment, and patients' access to healthcare services (9). The use of telehealth in COVID-19 management is a logical and justified method for surveillance, diagnosis, screening, treatment, monitoring, tracking, and follow-up. The use of telehealth can reduce the number of visits, facilitate access to healthcare services in remote regions, increase continuous interaction with patients (synchronous and asynchronous communication), tracking, and controlling the prevalence of the disease (57,63). Tracking of mobile phones during the Ebola crisis and video conferencing during SARS are examples of the application of telehealth (18). Moreover, the remote emergency counseling system has provided the possibility of remote monitoring on 63 severe cases and 591 patients with mild forms of respiratory infections, of whom 420 cases were treated and discharged (64). The most frequently used services offered by using telehealth focused on surveillance, tracking, and screening, and the most frequently utilized technologies included social networks and web- and mobile-based apps, respectively. Social networks are the main channel for disseminating up-to-date information on COVID-19 (65). Due to their popularity, social networks demonstrated great potentials for further surveillance on society to increase people's knowledge and let them practice appropriate behaviors when fighting previous epidemics such as the Zika virus and Ebola (66,67). Furthermore, due to their extensive use by people regardless of their socioeconomic status, mobile phones and apps facilitate the provision of healthcare services and controlling the prevalence of diseases (68,69). The positioning capability of smartphones contributes to patient tracking and thus enhances the management of emergency conditions by the government (70,71). The results of the present study showed that, in surveillance, infodemiology has been used for analyzing user comments on social networks. In a 2010 study, by using infodemiology, tweets were collected and underwent

thematic analysis; it was found that a direct correlation exists between the weakly incidence of H1N1 during the epidemics and the number of posts on Twitter (72). Infodemiology, that uses the Internet, social media, and other electronic data for tracking and prediction of disease prevalence, was employed in previous epidemics (e.g. H1N1, Ebola, MERS-CoV, and measles) (73-76). Analyses performed in social networks by using infodemiology can help governments and the health sector to identify high-risk patients and accelerate emergency responses to the needs of society (29). Despite its good potentials for COVID-19 management, telehealth has certain challenges, too. Telehealth, including social networks, is a source of disseminating misinformation and, as a result, increasing anxiety in society (67,68). Results of this study showed that a direct relationship exists between depression, anxiety, and concerns in social networks during the COVID-19 pandemics (27); these results are in line with other results reporting an increase in psychological disorders during Ebola (77) and SARS (78) epidemics. The relationship between psychological disorders and presence in social networks during crises may have two reasons. First, during the COVID-19 pandemic, misinformation and fake reports about the disease have bombarded social media, and have created baseless fears in people (79), which may confuse them and harm their mental health (80). Second, many people express their negative emotions such as fear, concerns, and anxiety on social media, thereby increasing fear, concerns, and anxiety in society (81-83). Governments and health-related organizations such as the WHO should play a more effective role and be present in social networks during pandemics such as COVID-19. Some measures that must be taken for disseminating accurate and reliable information on the Internet include sharing reliable information and recommending credible sources of information on governmental websites (56). Moreover, the requirements of a successful implementation of telehealth are having sufficient financial resources and information and communication infrastructure (49,54).

Telemedicine during epidemics has great potentials for improving epidemiological research, disease control, and management of clinical cases. Despite the challenges in using telehealth for the management of COVID-19, which spreads quickly, telehealth can be useful in surveillance, diagnosis, screening, treatment, monitoring, tracking, and follow-up if proper information and communication infrastructure is in place, sufficient financial resources are provided, there is coordination at all decision-making levels, regulations for monitoring the content of social media are passed, incentives are paid to

healthcare providers, and the confidentiality of data and patient privacy are ensured.

Limitations and future studies

Little time has passed since the first report of a case of COVID-19 (December 2019, in Wuhan, China) (1). Moreover, COVID-19 is a novel and complex disease without a definitive cure. As a result, there are limited studies on its diagnosis, tracking, treatment, and follow-up. Thus, it is recommended that more studies be conducted on the effectiveness of telehealth in COVID-19 diagnosis, tracking, treatment, and follow-up.

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