Review Article

Access this article online

Quick Response Code:

Website: www.jehp.net

DOI: 10.4103/jehp.jehp_1419_20

Systematic review on telemedicine platforms in lockdown periods: Lessons learned from the COVID-19 pandemic

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Received: 24-10-2020
Accepted: 21-11-2020
Published: 30-06-2021

Abstract:

With the onset of the coronavirus disease 2019 (COVID-19) outbreak, the transformation of the care delivery model from conventional in-person (face to face) to largely virtual or remote care has been accelerated to appropriately allocate resources and constrain the spread of the virus. In this regard, telemedicine is a breakthrough technology to battle against the COVID-19 emergency. Therefore, we sought to identify the telemedicine applications in the COVID-19 pandemic (tele-COVID) according to interaction modes, transmission modalities, and disease categories. This systematic review was conducted through searching five databases including PubMed, Scopus, ProQuest, Web of Science, and Science Direct. Inclusion criteria were studies clearly outlining any use of telemedicine interactive mode during the COVID-19 pandemic, written in English language and published in peer-reviewed journals in 2020. Finally, 43 articles met the inclusion out of the 1118 search results. Telemedicine provides a diversity of interaction modes and modalities affordable by patients and physicians including short message service, E-mail and web portals, secure telephone calls or VOIP, video calls, interactive mobile health applications (m-Health), remote patient monitoring, and video conferencing. Transmission of video data using synchronized video calls via common social media had the highest and exchange of data using store-forward service via secure messaging technology and prerecorded multimedia had the lowest popularity for virtual disease management during the COVID-19 outbreak. Selection of telemedicine communication services and interaction modes with regard to its use-case, disease category, and application plays a significant role in the success of remote disease management infrastructures in this scenario and their implication for a better future healthcare system.

Keywords:

Coronavirus, COVID-19, telehealth, telemedicine, virtual care

Introduction

The number of definite cases of coronavirus disease 2019 (COVID-19) is increasing sharply around the world, and as of March 11, 2020, the World Health Organization declared this outbreak a public health emergency.[1,2] As a retroviral disease transmitted by airborne droplets of the severe acute respiratory syndrome-coronavirus-2, it is highly contagious and patients may be catching even without clinical presentation.[3,4] Because there are currently no vaccine or an effective medical cure for COVID-19, major struggles are directed at containing the spread of the virus and flatten the COVID-19 epidemiological peak surge in the worldwide population.[5,6] These mitigation efforts included social-distancing mandates, closure of nonessential businesses, quarantine, suspending large assemblies, and enforcing strict hygiene measures, as well as encouraging residents to shelter in place.[7-12] During this unprecedented crisis, health-care facilities have been

How to cite this article: Shanbehzadeh M, Kazemi-Arpanahi H, Kalkhajeh SG, Basati G. Systematic review on telemedicine platforms in lockdown periods: Lessons learned from the COVID-19 pandemic. J Edu Health Promot 2021;10:211.

confronted with the challenge not only for treating COVID-19-afflicted cases but also for managing patients with emergency conditions and those suffering from other acute and chronic illnesses. This challenge necessitates drastic measures comply with imposing social-distancing and "stay-at-home" instructions to reduce the possibility of cross-contamination and nosocomial COVID-19 transmission to patients and medical staffs alike.[13,14] In response to the outbreak, the Centers for Disease Control and Prevention, as well as several national and international health authorities, issued recommendations that telemedicine should be considered for dealing some challenges facing health-care systems in the battle against the COVID-19 crisis.[15-17]

Telemedicine involves a variety of digital and telecommunications tools to allow health-care workers to assess, diagnose, monitor, treat, and educate patients "remotely." With the advent of COVID-19, telemedicine has been a key strategy to continued care for patients while mitigating the spread of virus and conserving valuable health-care resources, particularly personal protective equipment, ventilators, and free intensive care unit (ICU) beds.[18,19] To this end, the health-care settings considerably adjust their practices in order to maximize the utilization of the virtual visits, and avoiding depletion of medical supplies and resources. In this regard, the current outbreak has promptly transitioned how clinicians triage and visit patients because shelter-in-place restrictions were issued throughout the world. Similarly, telemedicine can be predominantly advantageous for individuals who are particularly susceptible to COVID-19, such as cardiopulmonary diseases, diabetes, malignancies, and older adults with underlying health condition to avoid contact with potentially infected patients.[20-23]

Given the government-imposed severe restrictions on social interactions and travel, telemedicine offers a great potential for eliminating in-person visits during the COVID-19 pandemic while attempting to reduce the transmission of virus to patients, families, and health-care staff.[24,25] Hence, there is a need to change management strategies for enabling effective access to virtual care with strong physician–patient interaction. This raises the question: what telecommunication and informatics infrastructures are needed to provision virtual care during COVID-19 and to combat the crisis outbreak?

Materials and Methods

Our systematic literature review was reported according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses standard guideline. It consists of a 27-item checklist in the form of seven main classes and a four-phase flow diagram which describes the identification, screening, eligibility, and inclusion criteria of the articles that fall under the scope of review.[26]

Search strategy and study selection criteria

An extensive search was performed in 2020 to identify full-text valid articles of any design and in any setting dealing with remotely supported disease management via telemedicine during the COVID-19 pandemic.

PubMed, Scopus, Web of Science, Science Direct, and ProQuest databases were reviewed up to June 21, 2020. The following search terms were used (designed using English MeSH keywords and Emtree terms): (COVID-19 OR Novel coronavirus) AND (telemedicine OR telehealth) AND (transmission OR interaction). After adoption of advance search option (search formula: combining key terms, search operators, and search fields (title, title/abstract, and topic)) and applying inclusion and exclusion criteria (via search filter or refine), the titles and abstracts of potentially relevant studies were identified [Table 1].

Inclusion and exclusion criteria

In our study, we included every study that reported tele-COVID services with information on their interaction modes, approaches, and timing aspects. Full-text articles were obtained for detailed evaluation, and eligible studies were included in the systematic review. Letters, posters, conferences papers, lectures, duplicated, non-English articles, and articles published before 2020 were excluded. As COVID-19 is a rapidly evolving area, we included preprint literature.

Data extraction and summarizing

We designed a data extraction form to record data, which included the first author; country; year of publication; study design; and interaction modes including, communication type, timing attribute, and disease category. The studies that met our predefined inclusion criteria were screened based on title/abstract by two authors (H: K-A and M: SH), and the studies that completely fulfilled our inclusion criteria were extracted for deeper analysis. Any vagueness during the study selection process was resolved by further discussion and consensus. The results were organized under the following categories: (1) tele-COVID modes, (2) tele- COVID categories, and (3) tele-COVID interaction approaches.

Results

Characteristics of included studies

An extensive search was conducted in selected databases, in order to find the resources regarding tele-COVID types, categories, and interaction modes.

Table 1: Search syntax

Databases	Search syntax
Scopus	(Title (COVID-19) or title (novel coronavirus) or title (n-CoV2) and title-abs-key (Telemedicine) or title-abs-key (telehealth) and title-abs-KEY (transmission) or title-abs-key (interaction) and (limit-to (language, "English"))
WOS	Title: (COVID-19) or title: (novel coronavirus) or title: (n-CoV2) and topic: (telemedicine) or topic: (telehealth) and topic: (transmission) or topic: (interaction). refined by: languages: (English) and publication years: (2020)
ProQuest	Ti (COVID-19) or ti (novel coronavirus) or Ti (n-CoV2) and ab (telemedicine) or ab (telehealth) and ab (transmission) and ab (interaction). applied filter: time span: 2020-01-01–2020-06-21 and English
PubMed	((((((COVID-19 [title]) or (coronavirus [title])) or (n-CoV2 [title])) And (telemedicine [title/abstract])) or (telehealth [title/abstract])) and (transmission [title/abstract])) or (interaction [title/abstract]) and language: (English), limited to 2020
Science direct	Title ("COVID-19" OR "novel Coronavirus" OR "n-CoV" and title-abs-key ("telemedicine" OR "telehealth") and title-abs-key ("transmission" or "interaction") and English [language], limited to 2020

COVID-19=Coronavirus disease 2019

The search was started on June 4, 2020, and the last search was on June 21, 2020. Initial search yielded 1118 potentially relevant papers (202 from PubMed, 86 from WOS, 156 from Scopus, 486 from ProQuest, and 188 from Science Direct); 482 of which remained after omitting the duplicate and non-English resources, as well as those published before 2020, and the document-type ones.

Then by screening the titles/abstracts of remain articles, 246 number of them were also excluded, because their focus was on the tele-COVID technical (hardware and software required for tele-COVID) and administrative (challenges and opportunities of tele-COVID) aspects.

After evaluating 236 full texts for eligibility, 193 full-text articles were excluded due to the absence of comprehensiveness, relevancy, and enough analytical criteria. Finally, 43 articles that satisfied all criteria were included in the study. Figure 1 summarizes the selection process.

The main characteristics of the included studies in the systematic review are shown in Table 2.

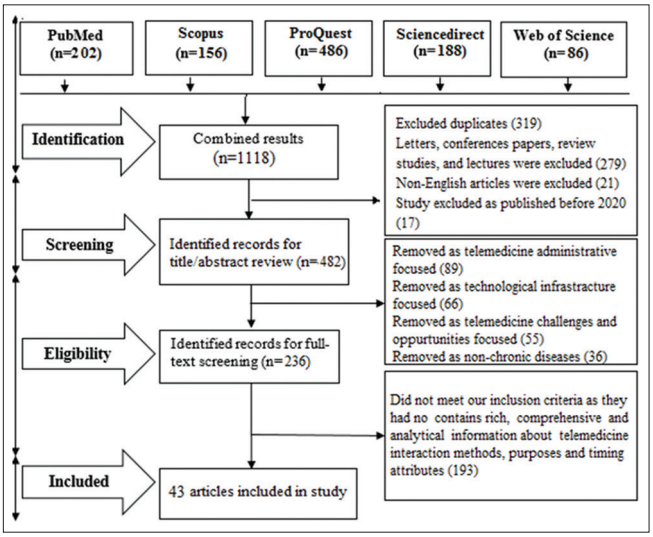

Figure 1: PRISMA chart in the study selection process

Analysis of the results

The included studies published in different journals up to June 21, 2020, were mostly carried out in the USA (33 articles, 76.75%). Five studies (11.63%) were conducted in four European countries: The UK (n = 2), Denmark (n = 1), Germany (n = 1), and France (n = 1). China as the emerging place of novel coronavirus has two articles (4.65%), and each of the other countries including Canada, Brazil, and India has one article (sum, 6.97%).

All included studies had adequate relevance to the subject of this review and categorized in three sections including: (1) tele-COVID modes [Table 3], (2) tele-COVID categories [Table 4], and (3) tele-COVID modalities [Table 5].

Tele-COVID categories

The finding of this study demonstrated that telemedicine services for virtual care were classified into nonvirtual urgent care (NUC) and virtual urgent care (VUC) classes. NUC is related to the delivery of virtual health-care services for common, routine, or nonemergency medical conditions. On the other hand, VUC is provision of remote medical services for critical, immediate, or emergency conditions.[67,68] The use of NUC[7,17,27-31,34,37-39,41-45,48-50,52,56] is more prominent than the emergency applications VUC during the COVID-19 pandemic.[21,31,39,40,45,50] Among tele-COVID services, tele-triage,[29-36] tele-quarantine,[27,28,34,36,44-46] and tele-education (distance learning)[7,31,36,40-43] provision, particularly via social media platforms,[27,37,39,41,44,45,47,56,61] were more significant for tele-COVID. However, other services including tele-screening (tele-CT scan and tele-LAB kit),[63] remote patient monitoring or telemetry,[40,47] tele-surgery,[7,44] and tele-ICU[40,50] have less applied in this pandemic due to their needs for expensive and complex technical infrastructures.

COVID-19 virtual care purposes (tele-COVID applications)

The telemedicine is used to delivery virtual care during current pandemic for COVID-19[21,31,39,50,53,54,61,66] and non-COVID-19-related

Table 2: Summary characteristic of the included studies in the systematic review

Row	Author	Country	Journal name	Method	Telemedicine mode
1	Nagra *et al*. (2020)	The UK	*Contact Lens and Anterior Eye*	Case study	Tele-ophthalmology via m-health
2	Pollock *et al*. (2020)	The USA	*American Journal of Otolaryngology*	Case study	Tele-ENT visit via telephone and video chat tech
3	Saleem *et al*. (2020)	The USA	*American Journal of Ophthalmology*	Literature review	Tele-optometry via VOIP, video chat messenger, and m-health apps
4	Shokri *et al*. (2020)	The USA	*American Academy of Facial Plastic and Reconstructive Surgery*	Cross-sectional	Live video visits via special social media and application software
5	Boehm *et al*. (2020)	Germany	*European Urology*	Cross-sectional	Tele-urological visit via store-forward
6	Kang *et al*. (2020)	The UK	*Eye*	Retrospective	Tele-ophthalmology via video-conference
7	Mihalj *et al*. (2020)	The USA	*Best Practice and Research Clinical Anaesthesiology*	Descriptive	COVID tele-care via synchronized and a synchronized tech
8	Shipchandler *et al*. (2020)	The USA	*Otolaryngology–Head And Neck Surgery*	Case study	Tele-ENT visit via formal telemedicine platforms
9	Gutierrez *et al*. (2020)	The USA	*Rural Health*	Retrospective	Video-conferencing visits through online platforms or smartphones
10	Blue *et al*. (2020)	The USA	*World Neurosurgery*	Descriptive	Tele-neurology and tele-stroke messenger chat (text and multimedia)
11	Lee *et al*. (2020)	China	*Head and Neck*	Case study	Tele-medical sessions via special messenger apps
12	Punia *et al*. (2020)	The USA	*Telemedicine and e-Health*	Case study	Tele-visit videoconferencing platforms and telephone
13	Triantafillou *et al*. (2020)	The USA	*Otolaryngology–Head and Neck Surgery*	Cross-sectional	Tele-ENT via video visits and call phone
14	Goodman *et al*. (2020)	Spain	*Medical Internet Research*	Clinical trial	Tele-psychology via basic technology and medias (telephone and TV)
15	Grimes *et al*. (2020)	The USA	*International Urogynecology*	Case study	Tele-urogynecology via video-conference visit or basic tech
16	Moring *et al*. (2020)	The USA	*Traumatic Stress*	Cross-sectional	Tele-mental supportive care via VOIP and store-forward tech
17	Rogers *et al*. (2020)	The USA	*AIDS and Behavior*	Case study	HIV telephone scheduling and video consultation via special messenger apps
18	Smith *et al*. (2020)	Denmark	*Telemedicine and Telecare*	Retrospective	Tele-ED video consultations via formal telemedicine platforms
19	Zhou *et al*. (2020)	China	*Telemedicine and E-Health*	Case study	Tele-psychology through online messenger platforms
20	Ghai *et al*. (2020)	India	*Indian Journal of Anaesthesia*	Review	Synchronized and a synchronized tele-consultation
21	Mann *et al*.	The USA	*American Medical Informatics Association*	Cross-sectional	Video-based VUC and NUC
22	Contreras *et al*. (2020)	The USA	*Gastrointestinal Surgery*	Retrospective	Online tele-surgery consultation via special application software's
23	Godzinski *et al*. (2020)	The USA	*Urology*	Case study	Tele-visit and tele-ED via video-conference and voice-call
24	Lee *et al*. (2020)	The USA	*Physical Therapy*	Literature review	Tele-rehabilitation virtual visit via basic tech
25	Smith *et al*. (2020)	The USA	*American College of Surgeons*	Case study	Outpatient tele-visit via video visit and calling
26	Gadzinski *et al*. (2020)	The USA	*Nature Reviews Urology*	Review	Tele-urology virtual check-in via video-visit and e-visit tech
27	Prasad *et al*. (2020)	The USA	*Head and neck*	Case study	Tele-visit via personal session: Web cam tech
28	Serper *et al*. (2020)	The USA	*Hepatology*	Case study	Tele-hepatology via video base tele-conference
29	Mgbako *et al*. (2020)	The USA	*AIDS and Behavior*	Cross-sectional	HIV tele-care via tele-conference and telephone tech
30	Peters *et al*. (2020)	The USA	*Diabetes Technology and Therapeutics*	Case study	Tele-health visit via video chatting special apps, video image, and telephone

Contd...

Table 2: Contd...

Row	Author	Country	Journal name	Method	Telemedicine mode
31	Zughni *et al*. (2020)	The USA	*Otolaryngology–Head and Neck Surgery*	Clinical trial	Tele-evaluation for ENT via video-conference and VOIP
32	Ohannessian *et al*. (2020)	France	*JMIR Public Health and Surveillance*	Case study	Tele-consultation via video and audio tech
33	Prasad *et al*. (2020)	The USA	*Head and Neck*	Review	Virtual visit via video-conference
34	Layfield *et al*. (2020)	The USA	*Head and Neck*	Retrospective	Tele-care of heal and neck via telephone or video-based platform
35	Tenforde *et al*. (2020)	The USA	*Practice Management*	Cross-sectional	Tele-treatment via synchronous audiovisual: formal platform
36	Parikh *et al*. (2020)	The USA	*American College of Cardiology*	Retrospective	Online video-conference tele-cardiology via web-cam tech
37	Aziz *et al*. (2020)	The USA	*American Journal of Perinatology*	Cross-sectional	Telehealth virtual visits for maternal care via special messenger apps
38	Hogland *et al*. (2020)	Brazil	*The Brazilian Journal of Infectious Diseases*	Case study	Tele-phone based tele-consultation for HIV care
39	Berg *et al*. (2020)	The USA	*Pediatric Gastroenterology and Nutrition*	Case study	Tele-visit via store-forward, video visit tech. And special social medias
40	Siniscalchi *et al*. (2020)	The USA	*Digestive and Liver Disease*	Cross-sectional	Telemedicine remote visit
41	Parisien *et al*. (2020)	The USA	*American Academy of Orthopaedic Surgeons*	Cross-sectional	Tele-health video-conference and store-forward via special apps
42	Fatyga *et al*. (2020)	The USA	*Polish Archives of Internal Medicine*	Cross-sectional	Tele-supportive diabetic care via basic and store-forward tech
43	Baidal *et al*. (2020)	The USA	*Obesity* (Silver Spring, md)	Review	Tele-health consolation via special video chatting medias and apps

ENT=Ear, nose, and throat, VOIP=Voice over internet protocol, COVID=Coronavirus disease, HIV=Human immunodeficiency virus, VUC=Virtual urgent care, NUC=Nonvirtual urgent care, JMIR=*Journal of Medical Internet Research*, AIDS=Acquired immunodeficiency syndrome

Table 3: Tele-coronavirus disease modes

Applications	Telemedicine virtual care classes	References
NUC	Virtual check in	[27,28]
	Tele-triage	[29-36]
	Tele-screening	
	Tele-radiology (remote CT scanning)	[27,34]
	Tele-laboratory(remoteRT-PCR)	
	Tele-care	[34,37,38]
	Tele-scheduling	[21,38,39]
	Tele-education	[7,31,36,40-43]
	Tele-quarantine consultation	[27,28,34,36,44-46]
	RPM	[40,47]
	Tele-rehabilitation	[28,48,49]
	Tele-surgery (pre- and post-operation follow-up)	[7,44]
VUC	Emergency care (tele-ED)	[21,31,39,45,50]
	Critical care (tele-ICU)	[50]

NUC=Nonvirtual urgent care, VUC=Virtual urgent care, RPM=Remote patient monitoring, CT=Computed tomography, ICU=Intensive care unit, RT-PCR=Reverse transcription-polymerase chain reaction, ED=Emergency department

conditions.[23,27-31,33,34,36-38,41-43,47-49,51-58,61-65] In our literature review, 13 studies reported the application of telemedicine in managing the head-and-neck and ENT morbidities;[17,27,28,30,46,49,51-57] eight studies reported the application of telemedicine for virtual care of COVID-19;[21,31,39,50,53,54,61,66] five studies were related to the tele-supportive applications such as lifestyle and self-care management for at-risk population;[23,31,34,48,58] four studies reported the management of neuropsychology;[38,43,48,59] six studies were related to the tele-urology[29,37,60] and hepatocellular remotely care;[58,61,62] six studies in the tele-gastroenterology,[33,36] malignancy remotely treatment,[51,55] and HIV virtual care;[42,47] and finally five studies were related to tele-obstetric,[63] tele-cardiovascular,[64] tele-respiratory,[31] tele-rehabilitation,[41] and musculoskeletal remote care.[65] It should be noted that four articles have dealt with more than one condition.[48,55,58,61]

Tele-COVID interaction mode (synchronous vs. asynchronous)

This paper also outlines the dissimilarity between tele-COVID applications in terms of their timing perspective for data transmission during the pandemic. The three types of telemedicine modes are synchronous, asynchronous, and combined. Synchronous virtual meetings that happen in real time, live, and reciprocal modes use noninteractive and store-forward technologies to data transmission between two sides of communication.[50,69] In the current study, the results indicated that real-time interaction modalities, for example, online chatting, telephonic communication, VOIP, and video conference technologies[7,17,27,37,39-45,47-49,51,52,54-56,61,62,66] offer immediate and easy-to-use ways of providing care remotely during the current pandemic than store-forward services such as E-mail, fax, forums, file transfer technologies, and prerecorded multimedia.[17,27,34,37,40,41,44,45,52,61] However, some studies suggested the use of combined approach

Table 4: Tele-coronavirus disease categories

Categories	Tele-consultation classes	References
COVID-19-related conditions	Tele-COVID care	[21,31,39,45,50]
Nonrelated COVID-19 conditions	Tele-ENT	[17,27,28,30,46,49,51-57]
	Tele-supportive	[23,31,34,48,58]
	Tele-neuropsychology	[38,43,48,58]
	Tele-urology	[29,37,60]
	Hepatocellular remote care	[58,61,62]
	HIV remote care/treatment	[42,47]
	Tele-gastroenterology	[33,36]
	Malignancy remote treatment	[51,55]
	Tele-obstetric	[63]
	Tele-cardiovascular	[64]
	Tele-respiratory	[31]
	Tele-rehabilitation	[41]
	Musculoskeletal remote care	[65]

ENT=Ear, nose, and throat, COVID-19=Coronavirus disease 2019, HIV=Human immunodeficiency virus

Table 5: Tele-coronavirus disease modalities

Timing attributes	Modalities	Platforms	References
Synchronized (real time)	Plain text	Online chat (Chatbot's)	[45,56,66]
		SMS	[40,48,49,51,62]
		Websites	[41,43,48,56]
		Web-based portals	[41,43,56]
		Online auto questionnaires	[41,56]
		FAQ	[56]
		Social media messengers[37,39,41,44,45,47,56,61]	
		Facebook	[37,39,47]
		WhatApp	[37,39,47,57]
		WeChat	[37,39]
		Instagram	[37,47,56]
		Other medias (linked in, Twitter, Google +)	[27,37,41,44,45,47,61]
	Audio	Call phone	[37,39,41,43,47,48,51]
		VOIP	[39,44,51,66]
		Mobile apps	[37,39,41-43,45,47-49,51,54,55,61,66]
	Video	Telemedicine facility (tele-conference platforms)	[37,39,47,55]
		Personal session (webcam technology)	[7,17,27,28,42,45,55,62]
		Video on chat platforms (social medias)	[17,27,37,39,41-45,47-49,51,52,54-56,61,66]
		Special application software[7,39,43,47,48,52,56,57,61,66]	
		Skype	[7,39,40,43,47,48,52,54-57,60,61,66]
		Zoom meetings	[7,47,52,56,57,60,61]
		Go to meeting	[7,55,56]
		Other (Epic, FaceTime, Doximity, MyChart)	[7,39,40,48,60,66]
		Mass media (TV, radio)	[43]
A synchronized (store and forward)	Plain text, text, and numeric, image	E-mail	[27,34,37,41,44,45,61]
		Fax	[17,34,60]
		Outlook Express	[17,60]
	Prerecorded audio and video	Electronic communications systems	[34,47]
		Socialmedias/specialapps(e.g.,WhatsApp,WeChat, and Zoom)	[52,61]
	Combined (real time+store-forward)		[17,37,39,41,51]

VOIP=Voice over internet protocol, SMS=Short Message Service, FAQ=Frequently asked question

during the COVID-19 pandemic.[17,37,39,41,51] Telemedicine data exchange templates contain different content ranges from plain text, text-numerical, and even image transfer via real-time technologies[40,41,43,45,48,49,51,56,62,66] and nonreal-time platforms;[17,27,34,37,40,41,44,45,61] synchronous[37,39,41-43,45,47-49,51,54,55,61,66] and asynchronous[47,52,61] voice transfer infrastructures; and finally online video calls or real-time teleconferencing[7,17,27,37,39-45,47-49,51,52,54-57,61,62,66]

and prerecorded (store forward) video transmission technologies.[34,47,52,61]

Discussion

In the COVID-19 pandemic, given the lack of definitive and effective treatment, social isolation and containment strategies[70] have been the best preventive interventions, creating a compelling reason for traditional office encounter alternatives.[46] Application of telemedicine technology, especially with the aim of maintaining social distancing, provides a great potential to minimize the possibility of cross-contamination and nosocomial infections.[71] With this transition, telemedicine is being leveraged with huge quickness and large scale to combat the outbreak.[15,72] In this situation, the delivery of health care throughout the world has brought sweeping changes. One of the most important achievements of this change is coincidence of COVID-19 crisis with incremental adoption of telemedicine services.[73] The COVID-19 emergency also encouraged governments, health authorities, and payers to support extended use of virtual health care. This transition should be regarded as a potential win-win circumstance in every way, which makes for more cost-effectiveness and sustainable health-care systems internationally.[61,74] Hence, the aim of this study was the review of tele-COVID applications to identify the most common and effective services in terms of their interaction mode, time, and purpose.

In the time of the COVID-19 emergency, government-posed social distancing requires crucial importance to establishing communication infrastructures for virtual care models, in which the patient is geographically separated from health-care providers.[74,75] Combining the functions of online conversation and real-time clinical data exchange technologies, technical support can be provided to the emerging need for workflow virtualization. Virtual care delivery can be synchronous or asynchronous. Each mode has different IT infrastructure requirements. Synchronous telemedicine involves virtual meetings that happen in a timely manner, usually involving two-way interaction using audio and video to avoid the need for an in-person visit. Synchronous meetings should be used when conversation is necessary, such as during new patient consultations, preoperative visits, postoperative assessments, and follow-up visits. This session can be conducted for both new and established patients as well as consults. Asynchronous telemedicine involves the collecting, brief, storing, and exchanging of data for a patient or, more often, another provider to review at a later time.[18,50,69]

Some studies have been focused on the application of interaction modalities for providing remotely or virtual care during the COVID-19 pandemic. Mann *et al*. in their study stated that virtual visits in real-time sessions for VUC cases require an effective open interaction than nonemergency cases (NUC).[39] Shokri and Lighthall, in their study demonstrated that store-and-forward services are appropriate when applied in NUC scenarios or in the routine delivery of patient care.[28] Contreras *et al*., in their study showed that open two-way interactive is one of the most important factors in the success of these systems in managing COVID-19. Their study also revealed that using real-time interactive methods is more effective and efficient than nonreal-time types.[7] Wosik *et al*. stated that although real-time video-conferencing is preferable for patients during COVID-19, it is complex, expensive, and requires access to a high-bandwidth internet connection.[74] Mouchtouris *et al*. stated that rapid adoption of virtual care is depending on a robust telemedicine infrastructure. They also stated the accessibility of high-bandwidth internet connection and complex telecommunication requirements are necessary to facilitate online video-based visits.[76]

Similarly, in the current study, our findings demonstrate that the accessibility to real-time infrastructures for timely transmission video calls and video conference data is most required to meet the needs of patient population according to "stay-at-home" restrictions. It is suggested that during this crisis, customized smartphone apps must be designed in the form of real-time tele-COVID services. In addition, the high capabilities of the mass/social media (such as TV, Facebook, and Telegram) in remote management of these situations should not be overlooked. On the other hand, some basic technologies such as E-mail, online chat, short message service, and telephone calls, despite being simpler and more available, violate effective interaction between patient and provider, particularly in emergency situations. However, due to the importance of maintaining social isolation and the use of tele-COVID for remote disease management, most studies stressed on real-time, live (synchronous), and reciprocal interaction modes.[37,39,41,44,45,47,56,61] Adoption of tele-COVID services with regard to its virtual care modes, purposes, interaction approaches, and scheduling attributes, plays a significant role in preventing latency in information exchanges and network outages.

This study opens opportunities for introducing the available technological and telecommunicational capacities to provide tele-COVID services and maintaining social distances by reducing the need for face-to-face visits. In addition, it will pave the way for health-care industries in designing customized tele-COVID modalities for remote patient management.

However, the results will need further investigation from the patients', providers', and IT experts' perspectives.

While telemedicine precludes the physical examination of a patient, this can be overwhelmed by through using video-enabled conferencing for visits. Furthermore, it allows collection of a range of information prior to a patient's admission, and may therefore be used in preoperative assessment. The standardization of virtual examinations and the privacy concerns related to virtual visits are the next steps in improving the utility of telemedicine during this pandemic. Our systematic review holds three restrictions. Initially, it is likely that some pertinent studies were not taken into account because they have been published in languages other than English (e.g., Chinese). Second, we did not have access to some other databases such as CINAHL and PsycINFO. Finally, due to our search inclusion/exclusion criteria (tele-COVID studies conducted in 2020), we have missed some valuable studies in this field.

Conclusion

The COVID-19 outbreak is converting the telemedicine landscape with rapid transition. In the current crisis, active and consistent patient engagement through robust, applicable, and affordable telemedicine services can help health-care system to successfully manage this contagious. To our knowledge, tele-COVID has the potential to solve many problems in this crisis, but its potential has not yet well described and taken into more consideration from patients' perspective and literature review. Video calls in the form of social medias or special apps, real-time video-conference platforms, and personal webcam represent a valuable strategy for enabling effective and real-time patient communication and render health-care services, while limitations exist, specifically with technical difficulties and low bandwidths. Finally, designing special communication software (e.g., Zoom, Dogpile, and Epic) or customizing the current messenger apps (e.g., WhatsApp, Telegram, and WeChat) in the context of universal smart phones, is one of the popular and convenience options to provide tele-COVID services.

In conclusion, it is noted that the results of the present study can be used for other possible future pandemics and natural disasters. The future researches should focus on novel telecommunication and telematics approaches especially in the field of new generation and high-bandwidth networks. These innovations could be applied to diminish the destructive effects of probable future pandemics.

Acknowledgments

This article is extracted from a research project supported by Abadan University of Medical Sciences with ethical code IR.ABADANUMS.REC.1399.074. We also thank the Research Deputy of Abadan University of Medical Sciences for financially supporting this project.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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