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REVIEW ARTICLE

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Investigating the implementation of telehealth and digital technologies during public health crisis: A qualitative review

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Abstract

Public health crises such as the Coronavirus disease 2019 (COVID-19) pandemic across the world overstrained the health care system. Accordingly, telehealth and digital technologies were implemented. Telehealth and digital technologies refer to the provision of health care at a distance using electronic means for diagnosis, evaluation, treatment, monitoring, and education of patients. This approach, while extremely useful, can be challenging for both patients and physicians, mainly as this is a new mode of health care to health practitioners and patients. Intrinsically, when managing the massive disruption to the routine of patient health care workflow, it is important to understand the important factors associated with an accelerated introduction of telehealth and digital technologies for the effective and safe continuation of healthcare during a public health crisis. Accordingly, this current study performed a qualitative review analysis of 40 scientific sources from 2019 to 2022. Findings present health practitioners that implemented telehealth and digital technologies during the public health emergency. Additionally, findings from this study presents a workflow approach for telehealth visit cycle and also discusses the current telehealth and virtual applications being implemented during public health crisis. This study

provides implications to support health care managers and policymakers of health centres to be virtually informed regarding digital applications being implemented by patients and health practitioners on how to implement an effective telehealth system during public health crises.

KEYWORDS
coronavirus disease 2019 pandemic, digital technologies, healthcare, public health crisis, remote treatment, telehealth

Highlights

- This current study performed a qualitative review analysis of 40 scientific sources from 2019 to 2022.
- Findings present health practitioners that implemented telehealth and digital technologies during the public health emergency.
- This study presents a workflow approach for telehealth visit cycle and discusses the current telehealth and virtual applications being implemented during public health crisis.
- This study provides implications to support health care managers and policymakers of health centres.
- Supports health practitioners on how to implement an effective telehealth system during public health crises.

1 | INTRODUCTION

Recent focus has surfaced detailing the significance of telehealth and digital technologies in during public health crisis and the need for a substantial change in the effort to redesign and manage existing health care models. One of these focuses is due to the coronavirus disease 2019 (COVID-19) pandemic which presented the health sector with a public health emergency. As normal capacity of hospitals was exceeded, and health practitioners struggled to manage this unprecedented medical practitioner's global health crisis.[1] Relying on traditional medical practices, such as patients visiting physician office posed significant health concerns. As a result, health institutions adopted telehealth for continued care of patients while lessening risk of exposure to patients and health practitioners.[1] Therefore, telehealth was recognized as an innovative technology that can help in managing and providing healthcare to patients romotely.[2] Telehealth or telemedicine refers to the use of telecommunication technology to provide medical services and information.[3] Telehealth is the technology of providing health care from a distant location using Information and Communication Technology (ICT).[4] Telehealth was originated from the Greek word tēl or tēle which meaning afar or at a distance.[5]

Therefore, telehealth deploys ICT to support and deliver health-related services as well as provides medical training or education via the internet, wireless communications, video conferencing, streaming multimedia video, and store-and-forward telehealth.[6] According to Nagra et al.[7] telehealth can be in various forms, ranging from use of mobile phone applications (apps) (mHealth) for monitoring patients, using video consultations. The use of telehealth is necessary due to shortage of crucial health care resources, mainly Personal Protective Equipment (PPE),[4,8] ventilators, and available Intensive Care Unit beds.[4] Prior studies have shown that telehealth has been previously used to overcome physical barriers or distance between patients and physicians in rural areas.[9]

Telehealth encompasses synchronous or asynchronous mode of delivery.[2] Synchronous involves real-time patient consultation with the physician.[10] Whereas, asynchronous involves store-and-forward applications that provides care to patients.[10,11] Asynchronous may include health care via online patient messaging portal,[12,13] messaging service

or secure email via cloud-based platform. Asynchronous medium supports health practitioners to review patient health information using charts, lab reports, patient diagnostic images, or recorded videos.[10,14] Besides, asynchronous provide a means for health practitioners in different locations or time zones to collaborate on difficult cases.[10]

Findings from Prasad et al.[15] suggested that the use of telehealth reduces medical cost incurred, minimise visit time, and increased lead to high patient satisfaction in in the long run. Respectively, telehealth has emerged amidst the COVID-19 public health crisis as a viable initiate that can expand access and provide health care to patients remotely.[16] It provides medium for remote screening, diagnosing, treating, and monitoring of patients.[17] Accordingly, to investigate the implementation of telehealth during the COVID-19 public health crisis this study addressed the following research questions as follows:

- **RQ1**: Which are the roles and current state of telehealth and digital technologies for remote treatment of patients during the COVID-19 public health crisis?
- **RQ2**: Which health practitioners implemented telehealth and digital technologies for treatment of patients during the COVID-19 public health crisis?
- **RQ3**: What current telehealth and digital technologies was being implemented for treatment of patients during the COVID-19 public health crisis?
- **RQ4**: What factors influenced telehealth and digital technologies implementation for treatment of patients during the COVID-19 public health crisis?

Therefore, the aim of this study is to provide implications on the implementation of telehealth for treatment of patients during the pandemic in supporting health practitioners to manage the COVID-19 public health crisis. This study provides the factors that impacted the implementation of telehealth and digital technologies and further provides recommendations for better implementation into the current healthcare process. The reminder of the article is structured as follows. The second section is methodology, third section is findings and discussion. Fourth section is recommendations and implications. Then the recommendations are presented. The last section is conclusion.

2 | METHODOLOGY

This study adopts a qualitative review methodology to provide evidence similar to prior studies.[10,17–19] The qualitative review identifies studies relevant to the aforementioned research questions. To identify suitable sources for this study a search was employed. The search was conducted based on the search terms using search strings executed in online electronic databases. A keywords strings with Boolean operators (OR/AND) was utilised in the search. The search keyword strings used comprises of telehealth, telemedicine, COVID-19, coronavirus disease 2019, pandemic, digital health, remote care, public health crisis, public health emergency, digitalised health care, digitalised medical care, virtual health care, virtual medical care. The scientific databases and digital libraries include PubMed, Google scholar, Scopus, Web of science (Clarivate Analytics), ScienceDirect, ProQuest, Emerald, Taylor & Francis, Inderscience, Springer, Sage, ACM, Wiley, and IEEE Xplore. The online search of relevant literature was conducted in May 2020 and then in December 2022 as shown in Figure 1 to improve the literature within the second-round review of this manuscript.

Figure 1 shows the study search phases conducted based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) as employed by prior review studies on COVID-19.[17,19] The search results retrieved 87 articles using the above-mentioned keywords. 9 papers were found as duplicates and were removed. Hence, the total number of remaining papers becomes 78. The remaining papers were assessed against the inclusion and exclusion (studies published in English language that focus of telehealth and COVID-19, published from 2019 till date, and studies that provide possible answers to research questions based on title and abstract content), and quality assessment criteria (selected papers indexed in ISI Web of Science or Scopus database). Therefore, 36 articles were

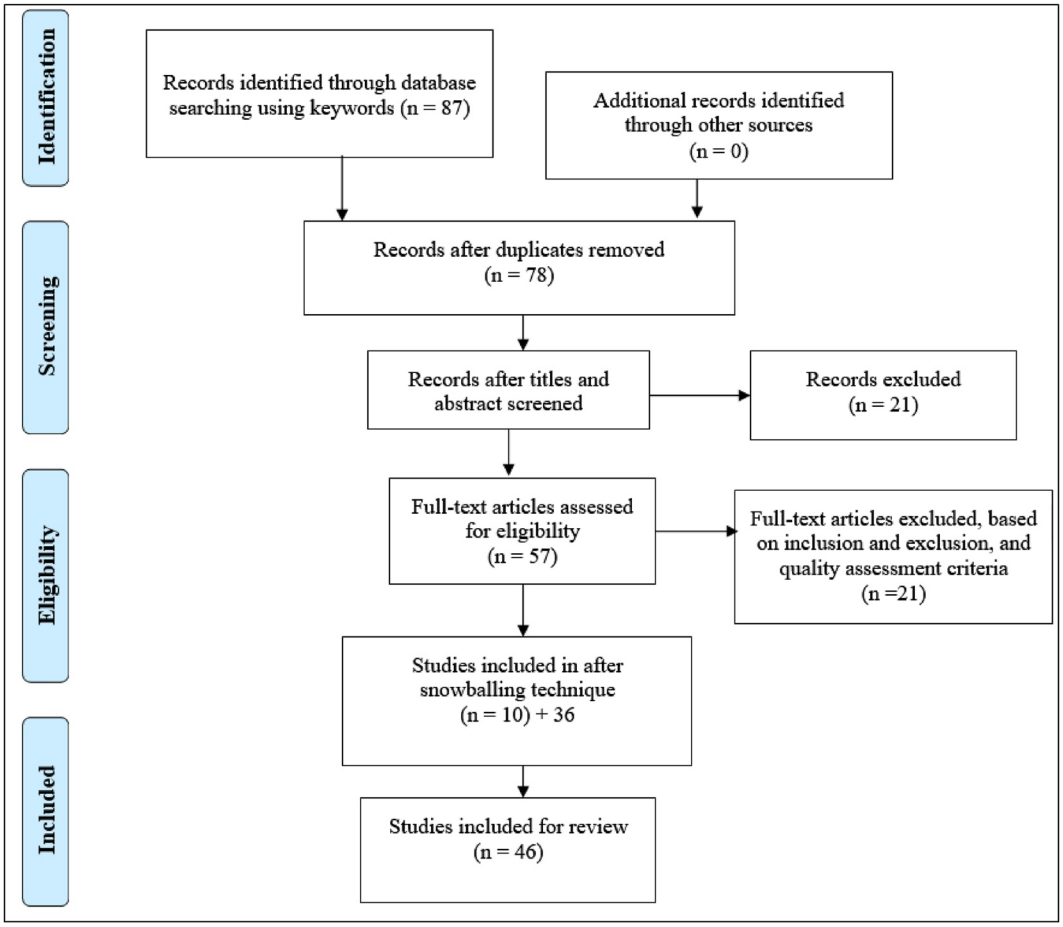

FIGURE 1 PRISMA flowchart for literature search process.

found to meet the criteria. After which 10 papers were added based on snowballing technique from cross referencing and a total of 46 papers were included as seen in the reference section.

3 | FINDINGS AND DISCUSSION

3.1 | Qualitative analysis from secondary data

Inductive thematic analysis is employed in this study since it is well known as one of the best methods for qualitative analysis. Grounded on a systematic review of the study, the selected sources are analysed to conduct an inquiry using inductive thematic analysis.

3.2 | Qualitative analysis of sources

Regarding the selected studies included for this review, the findings for distribution of studies based on publication year is shown in Figure 2. Findings from Figure 2 suggest that (N = 36, 78%) studies are published in 2020, N = 5, 11% for 2021, N = 3, 7% for 2022, and only (N = 2, 4%) was published in 2019.

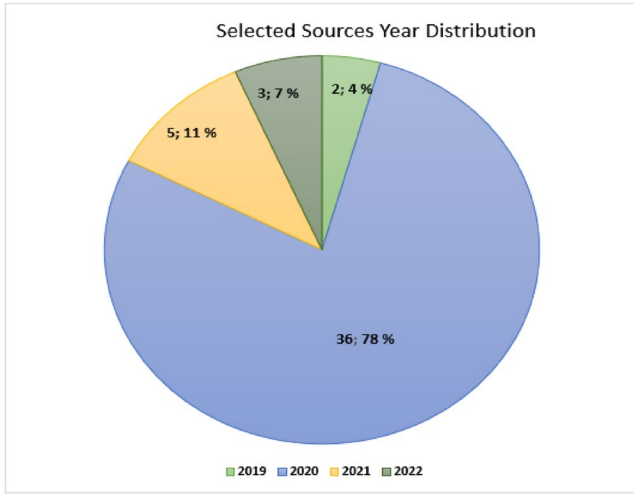

FIGURE 2 Distribution of selected sources in terms of years.

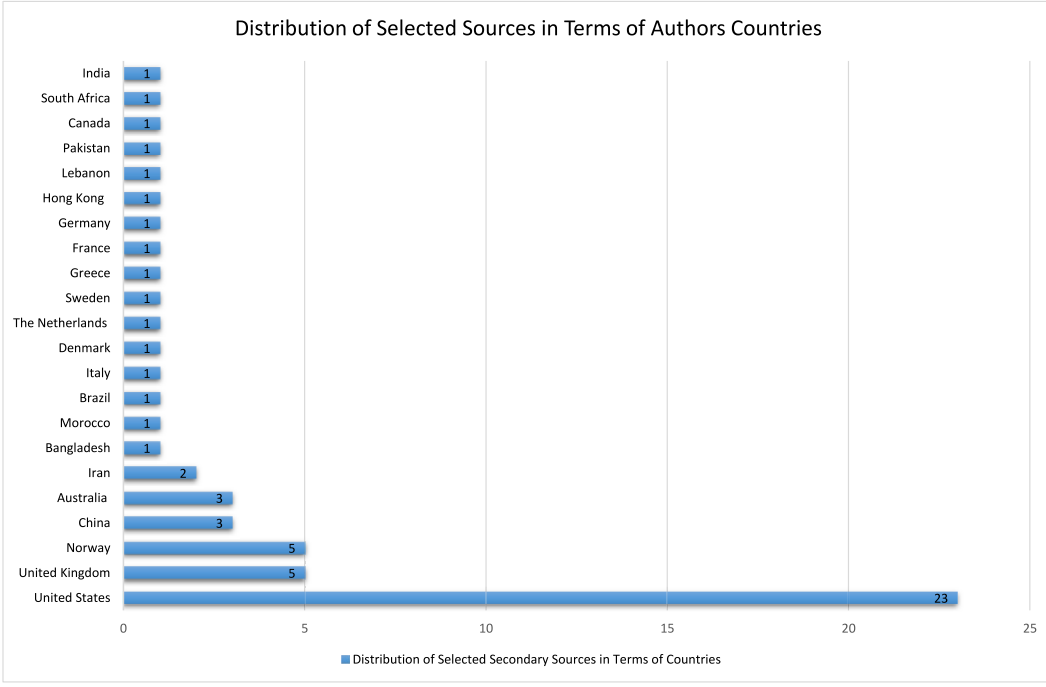

FIGURE 3 Distribution of selected sources in terms of authors countries.

With regard to the selected studies country distribution, findings from Figure 3 shows that most studies are conducted in United States (US) (*N* = 23), United Kingdom and Norway (*N* = 5) respectively. With China and Australia (*N* = 3), and Iran with (*N* = 1) studies. Next, (*N* = 1) studies related to implementation of telemedicine or telehealth during the COVID-19 pandemic was carried out in Bangladesh, Morocco, India, Brazil, Italy, Denmark, The Netherlands, Sweden, Greece, France, Germany, Hong Kong, Lebanon, Pakistan, South Africa, and Canada as seen in Figure 3.

Considering the selected secondary studies type distribution, findings from Figure 4 indicate that (*N* = 16) studies employed literature review as a research method. Then, (*N* = 8) studies are research article and (*N* = 6) studies letter

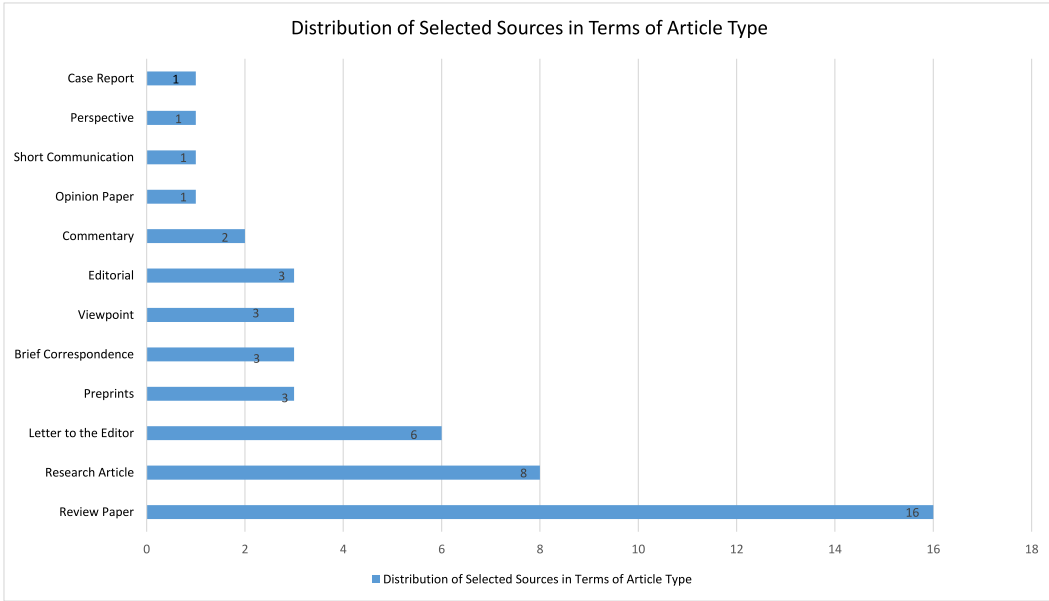

FIGURE 4 Distribution of selected sources in terms of article type.

to the editor. Next, (N = 3) studies were editorial, preprints, brief correspondence, and viewpoint individually. Next, (N = 2) are commentary papers. Lastly, (N = 1) are opinion paper, short communication, perspective, and case report articles respectively.

Additionally, findings from Figure 5 show the distribution of the selected study related to telehealth and telemedicine for treatment during COVID-19 pandemic. The result indicates that (N = 8) studies examined general telemedicine during the COVID-19 pandemic and (N = 4) discussed on general telehealth. Lastly, (N = 1) studies exclusively discussed other areas related to COVID-19 pandemic as seen in Figure 5.

3.3 | Role of telehealth and digital technologies to manage public health crisis

The implementation of telehealth and digital technologies are expected to reduce the overload of the current health care capacity by providing timely care for patients amidst a public health crisis.[20] Telehealth offer care remotely potentially easing constraints currently faced by health practitioners due to public health crisis such as in the COVID-19 pandemic. Similarly, digital technologies can provide apps for remote triage emergency services, patient tracing, etc.[18] Telehealth may also include uses of Artificial Intelligence powered diagnostic platforms, wearable devices, voice interface systems, chatbots, or mobile based sensors such as thermometers, oxygen monitors or smartwatches.[18] Telehealth facilitates the possibility of physicians to reach patients across the world.[21] For example, citizens in Great Britain, China, Israel, and Iran use a government phone application which tracks their location and alerts or notifies individual citizens when a close contact has been infected by the novel coronavirus.[21]

3.4 | Current state of telehealth and digital technologies implementation

Findings from Contreras et al.[21] highlighted that a report sent to the US Congress in 2016, by the US Department of Health and Human Services stated that more than 60% of medical centres in the USA used telehealth. Contreras et al.[21] further mentioned that there was a substantial increase in telehealth use from 2004 to 2017.[21] Also, the use of

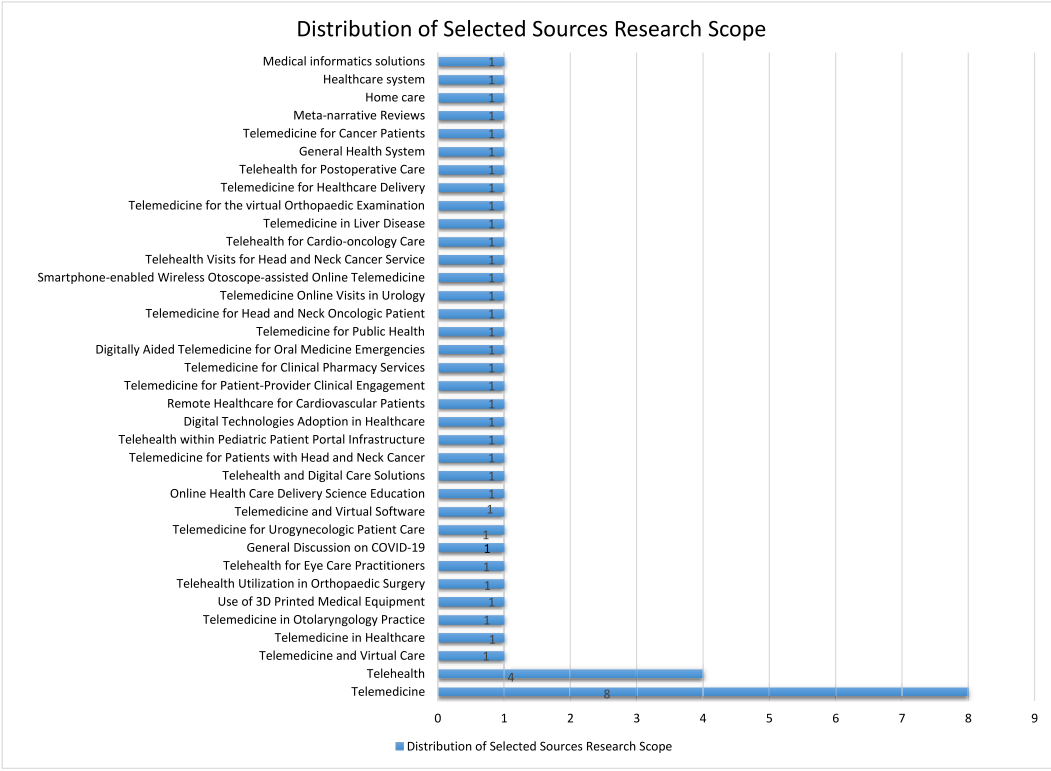

FIGURE 5 Distribution of selected sources research scope.

telehealth and virtual services in the US healthcare sector has increased since the deployment of Electronic Medical Record (EMR) systems.[13] Although, Loeb et al.[13]; Prasad et al.[15] argued that telehealth solutions have not been readily used. This is because as of 2017, only 6.6% telehealth consultations were recorded per year in relation to 1000 health practitioners in the US. But due to COVID-19 the use of telehealth has increased in 2020 and base on the US Centres for Disease Control and Prevention (CDC) recommendations to postponement or cancelation non-important physical consultation and use of digital technologies.[13] As telehealth helps conserve medical resources such as PPE and maintain social distancing to minimise virus spread.[13] Health practitioners are now adopting telehealth for treatment of their patients.

3.5 | Health practitioners that implement telehealth and digital technologies

Findings from Elson et al.[22] reveals that health practitioners such as pharmacists are remotely working under a rotating schedule. These re-deployments comprise of about 14 pharmacists working remotely to provide consistent medical services and additional telehealth support. Likewise, findings from Contreras et al.[21] confirmed the use of telehealth at a single academic institution in response to COVID-19 pandemic. Contreras et al.[21] highlighted that implementation of telehealth increased from less than 100 visits daily to about 2200 over a period of 24 days. Similarly, telehealth is being deployed to monitor oral medicine emergencies in addressing distance barriers to specific healthcare.[23]

Findings from Georgakopoulou[23] revealed that 16 patients were treated using telehealth from 16 March 2020 to 11 April 2020 were satisfied with telehealth service. Although, the authors reported that they faced some issues such as scanning through several low quality number of photos, which prompted the need for follow-ups phone call and

General Data Protection Regulation approvals for online information processing. Also, Maret et al.[24] use teledentistry a type of telehealth as an alternative to face-to-face consultation for dental check. This digital approach was used as a complement to normal oral diseases management. Chou et al.[9] implemented telehealth due to limited availability of PPE and N95 masks to provide appropriate protection of staffs (physicians and nurses). They utilised portable iPad or phone installed with Microsoft Teams for telecommunication between the physician and patient to conduct visual examination via videoconference or intercom.

Triantafillou and Rajasekaran[25] employed telehealth during the COVID-19 pandemic to provide treatment to oncologic patients seeking second opinions, awaiting appointment, in the midst of treatment, and patients undergoing continued oncologic monitoring. Also, limited phone call was opted for patients with less acute conditions. Boehm et al.[26] adopted telehealth for virtual visits in urology during the COVID-19 pandemic. Findings from their study indicates that 54.1% of their patients are willing to use telemedical appointment if they were booked during the COVID-19 pandemic. Meng et al.[27] used a smartphone-enabled wireless otoscope-based telehealth system to respond to patients' questions for online outpatient services. In using the smartphone-enabled wireless otoscope-based telehealth system patients only need to download a dedicated application in their smartphone from the app store based on the phone operating system. Patient can then send images or video taken via their smartphone or through WeChat group to physicians in Hubei Province, China. After which the attending otolaryngologists examines the images data to made diagnosis and provide real-time feedback.[27]

Lee et al.[28] implemented telehealth using Zoom in their hospital during the pandemic since February 2020. Loeb et al.[13] utilized synchronous (real-time) virtual video technology for patient treatment in rthopaedic division. Telehealth helped qualified medical practitioner or physician to review photos or video information uploaded by the patient to assess if physical visit is required. Li and Jalali[29] reported the integration of telehealth at the West China Hospital of Sichuan University (WCH). A mobile application was developed to provide medical guidelines to health practitioners and free online consultation to patients with physician from WCH.[29] Additionally, the application provides free 24/7 psychological health consultation to support individuals with anxiety from the lockdown. The application helped subordinate hospitals to treat local confirmed cases effectively and quickly. Also, the application helped severely ill patients to schedule follow-up visits via a virtual chat room to assess their condition with WCH physicians. When needed, online prescriptions were sent to pharmacies, and the prescribed medications were sent to patients by priority mail services. As of 1 April 2020, 32,676 patients completed follow-up visits and received 10,981 online prescriptions through the application.[29]

Another study by Parikh et al.[30] employed cardiooncology telehealth between 23 March 2020 and 3 April 2020. Over the initial 2.5-week period a total of 11 patients with different cancer case and complaints were attended to through telehealth visits. Serper et al.[31] implemented telehepatology which is telehealth for advanced liver disease. Findings from Serper et al.[31] suggested that from March 2018 to December 2019, 67 patients were referred to the telehepatology treatment, where 7% (5) had online consultations. Patel et al.[16] deployed a child and adolescent patient registration for telehealth visits during the COVID-19 pandemic to facilitate high-volume and urgent virtual registration. This service helped as a response to social distancing and to decrease in-person physical visits, virtual patient portal enrolment of paediatric patients through phone calls and electronic enrolment. Additionally, researchers such as Loeb et al.[13]; Tanaka et al.[32] mentioned the use of video consultations for orthopaedic consultations in a randomized controlled trial based in Norway. The author employed telehealth for postoperative patients, patients undergoing follow-up for orthopaedic disorders in outpatient clinic. Findings from Tanaka et al.[32] reported that the use of telehealth for orthopaedic treatment in Norway was shown to be cost-effective.

3.6 | Telehealth and digital technologies being implemented to manage the COVID-19

Figure 6 shows a typical workflow diagram for telehealth visit cycle in a hospital during COVID-19 lockdown based on findings from the literature.[21,22]

Also, Figure 6 depicts a typical workflow diagram for telehealth visit cycle, where telehealth can be either implemented using phone call or video that adhere to Health Insurance Portability and Accountability Act (HIPAA)

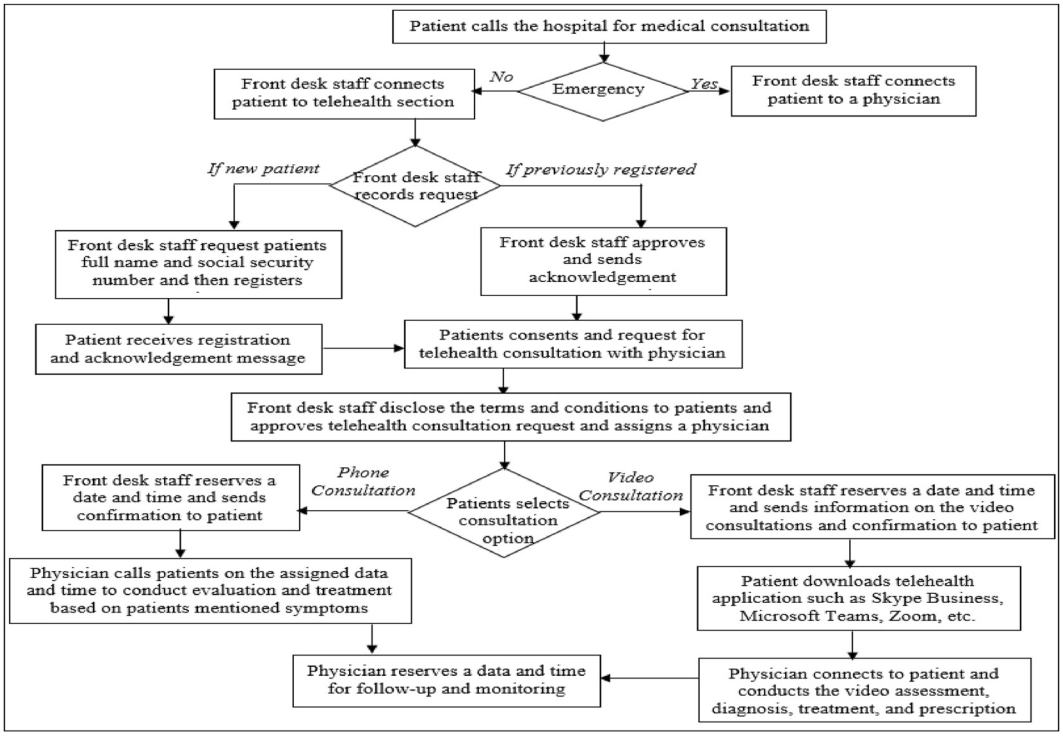

FIGURE 6 A workflow diagram for telehealth visit cycle.

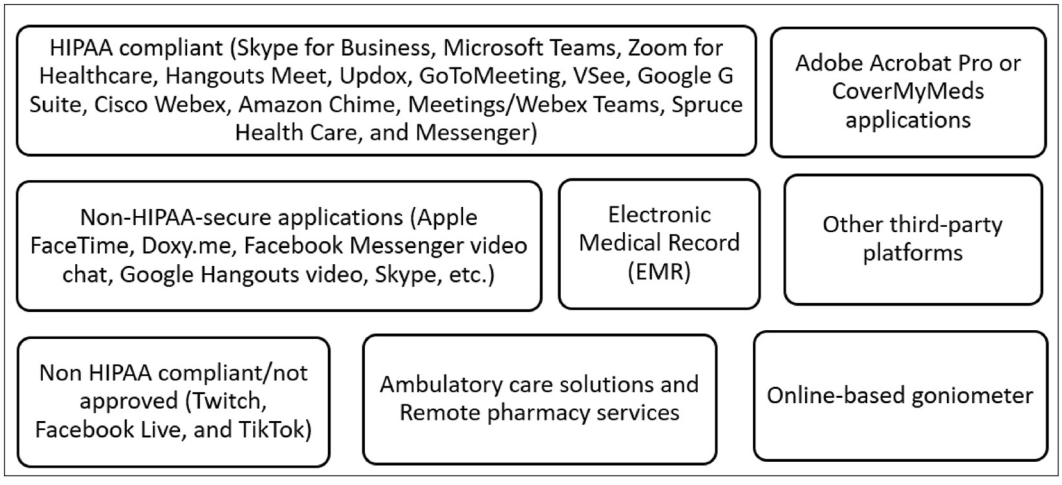

FIGURE 7 Telehealth and digital technologies being implemented to manage COVID-19 public health crisis.

compliant. Figure 6 shows how a patient calls the hospital for medical consultation and how the hospital registers and book telehealth consultations for the patient for treatment of his/her symptoms either via phone or video consultation with the attending physician. Similarly, Figure 7 depicts telehealth and digital technologies being implemented to manage COVID-19 in delivering health care for treatment of patients during the COVID-19 public health crisis.

Additionally, previous telehealth platforms which are HIPAA compliant includes Skype for Business, Microsoft Teams, Zoom for Healthcare, Hangouts Meet, Updox, GoToMeeting, VSee, Google G Suite, Cisco Webex, Amazon

Chime, Meetings/Webex Teams, Spruce Health Care, and Messenger.[21] Currently allowed non-HIPAA-secure applications for video chats, including Apple FaceTime, Doxy.me, Facebook Messenger video chat, Google Hangouts video, Skype, etc. Virtual applications which are not HIPAA compliant and are not allowed to be used for telehealth include Twitch, Facebook Live, and TikTok.[3,6,21] Findings from Elson et al.[22] indicated that remote pharmacy services are being used through various platforms such as Microsoft Teams to manage daily monitoring of patients.

Also, EMR is being used to assess and review patient's information via a secure remote access. Also, some EMR platforms offer telehealth components accessible for rapid usage, while other EMR systems requires patients and health practitioners to deploy other third-party platforms for usage.[21] Moreover, telephone and Microsoft Teams are used to provide patient counselling and education.[22] Using ambulatory care solutions completion of consent and authorisations are documented using Adobe Acrobat Pro or CoverMyMeds applications for assessment of medication treatment monitoring data, replying health-related questions from physicians and patients.[22] According to Perrin et al.[33] more inclusive videos and online training programs exist for health practitioners. These helps to provide exposure to telehealth methods as employed by Texas A&M University and the University of Redlands which provide training about topics like Telehealth 101, laws and ethics of telehealth, and multicultural aspects of rural health.[32] Furthermore, Tanaka et al.[33] collected measurements from patients using online-based goniometer deployed via a browser extension (Protractor by BenBurlingham) that is compatible with several applications (such as Doxy.me, Zoom, and InTouch Health) when launched via Chrome browser.

3.7 | Factors that impact telehealth implementation in a resource-limited settings

Telehealth and digital technologies have been admirably implemented successfully to support health practitioners and patients from 2020 till date 2022 mostly due to the global health crises. Telehealth, which is defined as the delivery of health care remotely via ICT, began since in the 20th century.[34] Regardless of its early establishment and potential to improve healthcare provided to patients, financial and technological barriers associated with the transmission of audio, images, and video via emerging telecommunications infrastructure inevitably limited its pervasive implementation.

Telehealth can considerably improve health care delivery for patients with inadequate access to health services.[2] In fact, even with restricted resources, telehealth-based applications can improve organizational and operational efficiencies of current systems, assisting to decrease health care related costs and enhancing health outcomes. Telehealth offers a potential solution to rein in costs while efficiently achieving vital public health functions.[11] Telehealth applications not only improve health care systems but also set up an interconnected and resilience global health network responsive to global health crises.

Figure 8 depicts factors that impact telehealth implementation in a resource-limited settings. Telehealth can be employed as a feasible response to the need for a unified network of secured health data sharing as well as financing for global health crises.[14] Despite the promise of telehealth, it still faces many setbacks that impacts its wide-scale implementation in a resource-limited settings. Certainly, issues related to lack of funding, low resource settings, inadequate technical resources, and limited infrastructure still hinder the widespread deployment of telehealth during global health crisis like the COVID-19 pandemic. Thus, most of the patients have little or no less access to internet connection. Thus, effective telehealth requires a good infrastructure for health consultation.[34] It is thus not unexpected that telehealth was not primarily envisioned as an innovation for confronting public health challenges that afflicted areas with limited infrastructure and inadequate technological resources.[17]

Issues such as the lack of policy changes, lack of international regulatory standards, biases against technology-based medicine, and interoperability between initiatives, and inertia.[34] Moreover, security and privacy are still an ongoing issue linked to patients' data and may be linked to the reason why patients are unwilling or not fully committed to use telehealth. This is because most patients may not want to connect over video which reveals their living space to the physician. In contrast, physicians need to understand how to improve health literacy and build trust to patients.[35]

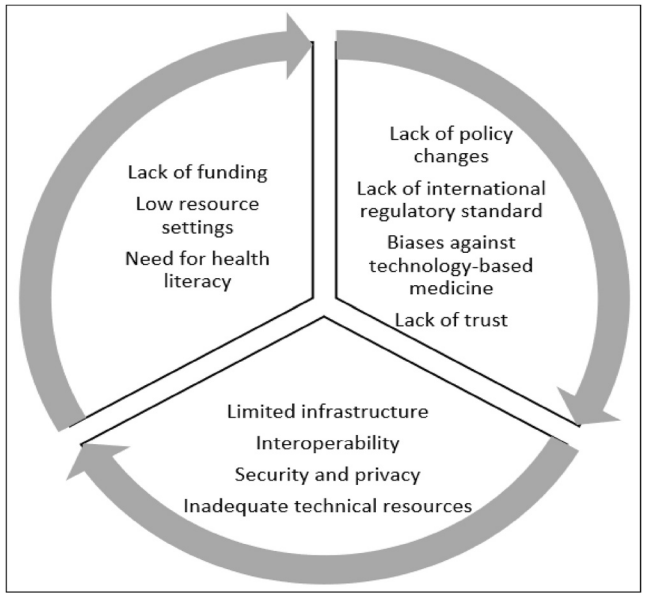

FIGURE 8 Factors that impact telehealth implementation in a resource-limited settings.

Nevertheless, over the years, there have been considerable advancement of digital technologies, decrease in related costs, and increasing prevalence of technical resources even in resource-poor environments. In fact, disbursement of health funding to developing countries has gradually increased.

Furthermore, physical infrastructures needed for successful implementation of telehealth initiatives have constantly been improved across the world as reported in the literature.[34] in addition, the access to internet and physical devices such as mobile phone has increased. Issues related to patient education and engagement regarding educational support for digital treatment of disease, and patient self-care management, for informing the populations about their health conditions is still in development. It is also important to provide educational training to health practitioners in using telehealth is made a priority. Evidently, this also involves the integration of this telehealth training into the teaching programs of health practitioners. The efficacy of telehealth implementation further depends on the question of the benefit of this effort, as well as government-based reimbursement models, which requires a restructuring of the entire health system.[34]

4 | DISCUSSION AND IMPLICATIONS OF THE STUDY

Due to COVID-19 public health crisis, telehealth provides implications to minimise exposure of patients and physicians from infections by facilitating initial triage, health counselling, and monitoring of patients.[36,37] As healthcare provider and policymakers are relying on telehealth as an immediate solution to help manage the threats and challenges imposed by the COVID-19 pandemic.[38] Findings from the literature confirmed that the use of telehealth and digital technologies can help reduce the demands for PPE usage which demand is high throughout the world.[9,39] PPE mostly consists of gloves, eye protection, medical masks, gowns, and respirator N95 or FFP2 standard by face shield or goggles.[37,40]

Nevertheless, as a digital tool for public health sector, some factors should be considered during the implementing of telehealth and digital technologies to achieve an effective solution for the public health sector. This is because despite the adoption of digital technologies in healthcare, telehealth has not been readily implemented. During the COVID-19 pandemic public health crisis, healthcare systems have commenced crisis management planning. To properly assign resources and prevent further infection while providing efficient patient care, most health centres rapidly

introduced a robust telehealth programme. Even though, the implementation of the telehealth necessitated attention to education of providers and patients, technological resources, patient triage, credentialling, regulatory considerations, and scheduling.[41] This current article reviews prior studies and provides recommendations based on current evidence on the potential of telehealth and digital technologies for treatment of patients during the pandemic and beyond. This article provides implementation instruction based on experience from the literature for health practitioners who wish to implement telehealth during public health crisis.

Amidst public health crisis the implementation of telehealth allows health providers to maintain sustainability and continuity of patient healthcare while triaging patients in planning for a likely case backlog after crisis reduction. To properly allocate both human and medical resources and avoid virus exposure whilst providing safe, effective, and efficient patient health care, medical centres urgently established a robust telehealth programme.[41] Additionally, telehealth helped physician to carryout follow-up on patients, remotely discuss results, and evaluate patient's response to treatment. It minimises the need for patients to travel to consult physician, leading to a less use of PPE.[29,37] Besides, telehealth eliminates long hours of waiting in hospital by patients who may be exposed to infection. Another advantage is that telehealth helps physicians to easily and frequently monitor patients remotely, by sending them forms or checklists to fill regularly.[40,42]

In addition, patients can easily update their physician with new symptoms, fears, or questions. It also facilitates communication between health specialists.[37,43] Respectively, findings from this review suggest that the health practitioners are embracing telehealth technologies to provide health care to patients during the current pandemic.[21,44] Moreover, findings from this review provide important implications for use of telehealth and digital technologies services to help patients and medical practitioners. While telehealth can and ought to serve important roles in managing global health crisis, it is not a universal remedy. Certainly, telehealth cannot and is not expected to replace the patient physician relationship which forms the foundation of good medicine. Though, it should fill the existing gaps in improving the management of health care and addressing other profound challenges that impact the overall health care system as a respond to global and national health emergencies.[34]

5 | RECOMMENDATIONS

During the COVID-19 public health crisis, many health centres found telehealth appointments to have low adoption. However, findings from the literature suggested better patient satisfaction in the implementation of telehealth. Though, it is essential to specify clear guidelines. There is need to provide adequate bandwidth to support an effective video visit to improve internet access to optimise telehealth usage. There is need to bridge the digital divide of technology access, skills, and knowledge to use digital technologies effectively.[45] As a major element of the digital divide is digital health literacy to improve patients' educational ability to efficiently use devices, such as a smartphone or computer, poses a setback for patients who may not be familiar with technologies and have low health literacy.

The current health legislative regarding reimbursement from medical aids involving billing and claims procedures had changed during the COVID-19 pandemic, resulting to cumbersome claims process for patients and health-care providers. Typically, the COVID-19 global health crisis provided the health sector with an opportunity to exploit the use of digital technologies to support the existing health-care services. The implementation of telehealth is likely to be viable for patients, health practitioners, and health-care service providers with resources such as skills, financial support, access to enabling infrastructure and resources.[45]

6 | CONCLUSIONS, LIMITATIONS, AND FUTURE WORKS

Telehealth and digital technologies offer a medium to maintain connectivity and provide accessible health care during a public health crisis.[8] This reduces risk of COVID-19 transmission and ensure that finite health care is provided.[8] In public health emergency, telehealth provides a way to triage and provide timely health care. Telehealth and digital technologies can maintain continuity of care for patients, support colleagues on the front line, and reduce infectious

transmission of infection.[8] Telehealth and digital technologies can provide support for digitalisation of workflow using real-time data exchange.[1] As telehealth and digital technologies becomes more widely adopted as a tool for delivering healthcare services, during the COVID-19 pandemic global health crisis on addressing the health needs of health practitioners and patients.

It is important to explore the factors that impacts telehealth implementation to meet health practitioners and patients' treatment expectations, addressing their specific health treatment needs, thereby providing accessible and useable heath care for patients.[46] The implementation of telehealth is favourable in environment where patients and health practitioners have access to facilitating resources can be valuable. So, telehealth is necessary in developing health-care services in an accessible way. Consequently, telehealth plays an important role in various settings where the remote digital service can save lives. Accordingly, this article discusses the implementation of telehealth and digital technologies for treatment of patients during public health emergencies.[45]

Findings from this study reveal that health practitioners are adopted telehealth and digital technologies to manage the spread of COVID-19. The findings also present the current telehealth and digital technologies being implemented to manage COVID-19. As with any research this review has a few limitations. First, this review was carried out within a short period of time, and the literature has been growing daily. Thus, a few studies may be missed during the search of literature. Secondly, this study did not employ primary data from survey, interview, etc. only secondary data from the literature was employed. Further studies will predominantly focus on getting more relevant sources to conceptualise a model to help in improving healthcare management with telehealth and digital technologies. In addition, data will be collected using survey to help improve the implementation of telehealth and digital technologies in health care sector.

AUTHOR CONTRIBUTIONS

Bokolo Anthony Jnr. contributes to conducting the review and writing of the manuscript.

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CONFLICT OF INTEREST STATEMENT

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in the study.

ETHICS STATEMENT

Not applicable.

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REFERENCES

1. Zhai Y, Wang Y, Zhang M, et al. From isolation to coordination: how can telemedicine help combat the COVID-19 outbreak? *medRxiv*; 2020.
2. Jnr BA. Use of telemedicine and virtual care for remote treatment in response to COVID-19 pandemic. *J Med Syst*. 2020;44(7):1-9.
3. Pollock K, Setzen M, Svider PF. Embracing telemedicine into your otolaryngology practice amid the COVID-19 crisis: an invited commentary. *Am J Otolaryngol*. 2020;41(3):102490. https://doi.org/10.1016/j.amjoto.2020.102490

4. Kadir MA. Role of telemedicine in healthcare during COVID-19 pandemic in developing countries. *Telehealth Med Today*. 2020. https://doi.org/10.30953/tmt.v5.187
5. Belhouideg S. Impact of 3D printed medical equipment on the management of the Covid19 pandemic. *Int J Health Plan Manag*. 2020;35(5):1014-1022. https://doi.org/10.1002/hpm.3009
6. Parisien RL, Shin M, Constant M, et al. Telehealth utilization in response to the novel coronavirus (COVID-19) pandemic in orthopaedic surgery. *J Am Acad Orthop Surg*. 2020;28(11):e487-e492. https://doi.org/10.5435/jaaos-d-20-00339
7. Nagra M, Vianya-Estopa M, Wolffsohn JS. Could telehealth help eye care practitioners adapt contact lens services during the COVID-19 pandemic? *Contact Lens Anterior Eye*. 2020;43(3):204-207. https://doi.org/10.1016/j.clae.2020.04.002
8. Lee I, Kovarik C, Tejasvi T, Pizarro M, Lipoff JB. Telehealth: helping your patients and practice survive and thrive during the COVID-19 crisis with rapid quality implementation. *J Am Acad Dermatol*. 2020;82(5):1213-1214. https://doi.org/10.1016/j.jaad.2020.03.052
9. Paton C. Insouciance and inexperience: a deadly combination when dealing with COVID-19. *Int J Health Plan Manag*. 2020;35(5):983-987. https://doi.org/10.1002/hpm.2991
10. Grimes CL, Balk EM, Crisp CC, et al. A guide for urogynecologic patient care utilizing telemedicine during the COVID-19 pandemic: review of existing evidence. *International Urogynecology Journal*. 2020;1(6):1063-1089. https://doi.org/10.1007/s00192-020-04314-4
11. Bokolo AJ. Exploring the adoption of telemedicine and virtual software for care of outpatients during and after COVID-19 pandemic. *Ir J Med Sci*. 2021;190(1):1-10. https://doi.org/10.1007/s11845-020-02299-z
12. Faerber A, Andrews A, Lobb A, et al. A new model of online health care delivery science education for mid-career health care professionals. *Healthcare*. 2019;7(4). https://doi.org/10.1016/j.hjdsi.2018.12.002
13. Loeb AE, Rao SS, Ficke JR, Morris CD, Riley LH, III, Levin AS. Departmental experience and lessons learned with accelerated introduction of telemedicine during the COVID-19 crisis. *J Am Acad Orthop Surg*. 2020;28(11):e469-e476. https://doi.org/10.5435/jaaos-d-20-00380
14. Anthony Jnr B. Implications of telehealth and digital care solutions during COVID-19 pandemic: a qualitative literature review. *Inf Health Soc Care*. 2021;46(1):68-83. https://doi.org/10.1080/17538157.2020.1839467
15. Prasad A, Brewster R, Newman JG, Rajasekaran K. Optimizing your telemedicine visit during the COVID-19 pandemic: practice guidelines for patients with head and neck cancer. *Head & Neck*. 2020;42(6):1317-1321. https://doi.org/10.1002/hed.26197
16. Patel PD, Cobb J, Wright D, et al. Rapid development of telehealth capabilities within pediatric patient portal infrastructure for COVID-19 care: barriers, solutions, results. *J Am Med Inf Assoc*. 2020;27(7):1116-1120. https://doi.org/10.1093/jamia/ocaa065
17. dos Santos Puga, ME, de Assis Reis, FS, Milby, KM, et al (2020). Telehealth interventions in the context of the COVID-19 pandemic: protocol for a scoping review.
18. Golinelli D, Boetto E, Carullo G, Landini MP, Fantini MP. How the COVID-19 pandemic is favoring the adoption of digital technologies in healthcare: a rapid literature review. *medRxiv*. 2020.
19. Neubeck L, Hansen T, Jaarsma T, Klompstra L, Gallagher R. Delivering healthcare remotely to cardiovascular patients during COVID-19: a rapid review of the evidence. *Eur J Cardiovasc Nurs*. 2020;19(6):1474515120924530. https://doi.org/10.1177/1474515120924530
20. Hong YR, Lawrence J, Williams D, Jr, Mainous A, Iii. Population-level interest and telehealth capacity of US hospitals in response to COVID-19: cross-sectional analysis of Google search and National Hospital Survey Data. *JMIR Public Health Surveillance*. 2020;6(2):e18961. https://doi.org/10.2196/18961
21. Contreras CM, Metzger GA, Beane JD, Dedhia PH, Ejaz A, Pawlik TM. Telemedicine: patient-provider clinical engagement during the COVID-19 pandemic and beyond. *J Gastrointest Surg*. 2020;1(7):1692-1697. https://doi.org/10.1007/s11605-020-04623-5
22. Elson EC, Oermann C, Duehlmeyer S, Bledsoe S. Use of telemedicine to provide clinical pharmacy services during the SARS-CoV-2 pandemic. *Am J Health Syst Pharm*. 2020;77(13):1005-1006. https://doi.org/10.1093/ajhp/zxaa112
23. Georgakopoulou EA. Digitally aided telemedicine during the SARS-CoV-2 pandemic to screen oral medicine emergencies. *Oral Dis*. 2020;27(S3):754-756. https://doi.org/10.1111/odi.13383
24. Maret D, Peters OA, Vaysse F, Vigarios E. Integration of telemedicine into the public health response to COVID-19 must include dentists. *Int Endod J*. 2020;53(6):880-881. https://doi.org/10.1111/iej.13312
25. Triantafillou V, Rajasekaran K. A commentary on the challenges of telemedicine for head and neck oncologic patients during COVID-19. *Otolaryngology–Head Neck Surg*. 2020;163(1):0194599820923622. https://doi.org/10.1177/0194599820923622
26. Boehm K, Ziewers S, Brandt MP, et al. Telemedicine online visits in urology during the COVID-19 pandemic—potential, risk factors, and patients' perspective. *Eur Urol*. 2020;78(1):16-20. https://doi.org/10.1016/j.eururo.2020.04.055
27. Meng X, Dai Z, Hang C, Wang Y. Smartphone-enabled wireless otoscope-assisted online telemedicine during the COVID-19 outbreak. *Am J Otolaryngol*. 2020;41(3):102476. https://doi.org/10.1016/j.amjoto.2020.102476

28. Lee AK, Cho RH, Lau EH, et al. Mitigation of head and neck cancer service disruption during COVID-19 in Hong Kong through telehealth and multi-institutional collaboration. *Head & Neck*. 2020;42(7):1454-1459. https://doi.org/10.1002/hed.26226
29. Li, W, & Jalali, MS (2020). How telemedicine integrated into China's anti-COVID-19 strategies: case from a national referral center.
30. Parikh A, Kumar AA, Jahangir E. Cardio-oncology care in the time of COVID-19 and the role of telehealth. *Jacc. Cardio-oncology*. 2020;2(2):356-358. https://doi.org/10.1016/j.jaccao.2020.04.003
31. Serper M, Cubell AW, Deleener ME, et al. Telemedicine in liver disease and beyond: can the COVID-19 crisis lead to action? *Hepatology*. 2020;72(2):723-728. https://doi.org/10.1002/hep.31276
32. Galavi Z, Montazeri M, Ahmadian L. Barriers and challenges of using health information technology in home care: a systematic review. *Int J Health Plan Manag*. 2022;37(5):2542-2568. https://doi.org/10.1002/hpm.3492
33. Tanaka MJ, Oh LS, Martin SD, Berkson EM. Telemedicine in the era of COVID-19: the virtual orthopaedic examination. *J Bone Jt Surg*. 2020;102(12):e57. https://doi.org/10.2106/jbjs.20.00609
34. Loeb AE, Rao SS, Ficke JR, Morris CD, Riley LH, III, Levin AS. Departmental experience and lessons learned with accelerated introduction of telemedicine during the COVID-19 crisis. *J Am Acad Orthop Surg*. 2020;28(11):e469-e476. https://doi.org/10.5435/jaaos-d-20-00380
35. Lew SQ, Sikka N. Telehealth and kidney disease care: role after the public health emergency? *Clin J Am Soc Nephrol*. 2021;16(12):1784-1786. ¨. https://doi.org/10.2215/cjn.13651021
36. Perrin PB, Pierce BS, Elliott TR. COVID-19 and telemedicine: a revolution in healthcare delivery is at hand. *Health Science Reports*. 2020;3(2):e166. https://doi.org/10.1002/hsr2.166
37. Keri VC, Brunda RL, Jorwal P, Sethi P, Wig N. Decentralizing COVID-19 care—moving towards a COVID-19-capable healthcare system (CCHS). *Int J Health Plan Manag*. 2021;36(4):1355-1361. https://doi.org/10.1002/hpm.3158
38. Qualliotine JR, Orosco RK. Self-removing passive drain to facilitate postoperative care via telehealth during the COVID-19 pandemic. *Head & Neck*. 2020;42(6):1305-1307. https://doi.org/10.1002/hed.26203
39. Gholamzadeh M, Abtahi H, Safdari R. Suggesting a framework for preparedness against the pandemic outbreak based on medical informatics solutions: a thematic analysis. *Int J health Plan Manag*. 2021;36(3):754-783. https://doi.org/10.1002/hpm.3106
40. Elkaddoum, R, Haddad, FG, Eid, R, & Kourie, HR (2020). Telemedicine for cancer patients during COVID-19 pandemic: between threats and opportunities.
41. Kim T, Zuckerman JE. Realizing the potential of telemedicine in global health. *Journal of Global Health*. 2019;9(2):1-4. https://doi.org/10.7189/jogh.09.020307
42. Shaikh BT, Ali N. COVID-19 and fiscal space for health system in Pakistan: it is time for a policy decision. *Int J Health Plan Manag*. 2020;35(4):813-817. https://doi.org/10.1002/hpm.2986
43. Anthony Jnr B. Integrating telemedicine to support digital health care for the management of COVID-19 pandemic. *Int J Healthc Manag*. 2021;14(1):280-289. https://doi.org/10.1080/20479700.2020.1870354
44. Bokolo AJ. Application of telemedicine and eHealth technology for clinical services in response to COVID-19 pandemic. *Health Technol*. 2021;11(2):359-366. https://doi.org/10.1007/s12553-020-00516-4
45. Maleka NH, Matli W. A review of telehealth during the COVID-19 emergency situation in the public health sector: challenges and opportunities. *Journal of Science and Technology Policy Management*. 2022. https://doi.org/10.1108/jstpm-08-2021-0126
46. Kulchar RJ, Chen K, Moon C, Srinivas S, Gupta A. Telemedicine, safe medication stewardship, and COVID-19: digital transformation during a global pandemic. *Journal of Interprofessional Education & Practice*. 2022;29:100524. https://doi.org/10.1016/j.xjep.2022.100524

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