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A Systematic Review of the Adoption of eHealth Cloud-based Technology Applications during COVID-19

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ABSTRACT

Electronic health technology applications are important tools that are utilized to provide health care services. These applications allow healthcare professionals and patients to share, manage and have control over their health information electronically whilst maintaining social distancing. Under hard conditions brought by the coronavirus 2019 disease (COVID-19), eHealth tools can be used to assist with the provision of healthcare services. However, the adoption of these technology applications by users is still questionable. This study presents a systematic literature review of 31 articles that were published on the adoption of eHealth cloud-based technology applications during COVID-19. A systematic literature review was conducted using PRISMA protocol by searching the Scopus databases. The search was conducted for the year 2020 to 2021 since COVID-19 is still new in the research field. From 31 articles that were selected, it was found that most countries are still left behind on this topic. It was only a few researchers in each country who tried to contribute or put effort into the topic. Furthermore, it was indicated that Italy contributed the highest with 5 authors to this topic. Thus, more research still needs to be conducted on this topic. One of the limitations of this study was that, the data was gathered from the Scopus database only. Researchers suggest that for future research, other additional sources need to be searched to find out more about the adoption of eHealth cloud-based technology applications during COVID-19.

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1. Introduction

The deadly pandemic caused by the Corona virus (COVID-19) has altered people's lives world-wide and citizens are battling for survival against this pandemic. From its first outbreak in Wuhan 2019, the coronavirus, a highly transmittable and fast spreading disease, has reached every corner of the globe. So far, the cases of this pandemic have been confirmed in 198 countries [1].

Because of an alarming rise in the number of cases outside China, the World Health Organization (WHO) officially declared the outbreak of this virus in March and implemented new social distancing methods to lower the curve of transmission [2]. Consequently, cities were inaccessible and public gatherings were prohibited, changing people's usual lifestyle. Countries have experienced a variety of healthcare, financial, and social issues as a result of the Covid-19. Moreover, healthcare practitioners are having difficulties in providing systematic health services [3]. To resolve healthcare difficulties brought by the COVID-19 pandemic, technical innovation is one of the possible solutions in present times. In specific terms, eHealth cloud-based services are technically viable and

appropriate for assisting patients, family members, and healthcare providers during this pandemic [4].

According to WHO, eHealth is the use of information and communication technology in support of health and health-related disciplines such as healthcare, health surveillance, health education, knowledge, and research that is both cost-effective and secure [5]. Electronic health technology applications and tools like mobile health, telemedicine, electronic health records and virtual healthcare are assumed to be effective in increasing healthcare services access and enhancing the healthcare service quality during coronavirus [6]. Regardless of the benefits of eHealth resolutions to enhance health care quality, studies denote that their adoption rate is either low or underutilized [7]. According to [7], there is a gap between planning for new technology adoption and its long-term execution to realize strategic or expected benefits.

Understanding the user's perspective on eHealth and associated initiatives is critical [8]. Now the question is, what is the level of the adoption of eHealth cloud-based technology applications during COVID-19? Many reviews were done for the adoption of eHealth cloud-based technology applications. However, only a few reviews focused on the adoption of such technology applications during COVID-19. Thus, this study seeks to present what was done according to the literature to measure the level of the adoption of eHealth cloud-based technology applications during COVID-19 through a systematic review.

2. Materials and Method

The main objective of this research was to find out what was done according to the literature to measure the level of the adoption of eHealth cloud-based technology applications during COVID-19 through a systematic review. The methodology of this study followed the guidelines of the PRISMA group by Moher, et al. [9] to present methods and approaches used to collect and report data.

2.1 Search strategy

In this study, the literature on the adoption of eHealth cloud-based technology applications during COVID-19 was reviewed from the Scopus database. The keywords were searched from the Scopus database and it was found that there were 174 documents that were published from the initial search. The search terms that were utilized by the researchers were “COVID-19”, “Adoption”, “eHealth” and “Cloud-based applications”.

2.2 Selection criteria

The selection criteria for this research study was based on PRISMA framework. The PRISMA framework is a set of guidelines by Moher, et al. [9] which are used for systematic literature reviews, critical literature analyses and meta-analysis. The focus of the search was mapping the eHealth cloud-based technology application and COVID-19 to the computer science field, health sciences and social sciences. The search was then limited to the subject areas of computer science, healthcare professionals, engineering, social science and medicine. All articles before 2020 were excluded so that the focus can be on COVID-19. The search included documents from all countries.

2.3 Quality assessment

This systematic review was originally based on conference papers as well as journal articles. The exported data were checked for duplications so that the quality of this review can be maintained. To ensure the quality and relevance of the academic literature that was included in the review process, abstracts of articles were deeply analysed and purified. At a later stage, each research paper was carefully evaluated. Moreover, all selected published papers were limited to English language only. Only two studies were excluded from this review because they were not written in English language.

After the overall assessment, only 31 studies were selected aforementioned inclusion and exclusion criteria. Figure 1 shows the literature inclusion and exclusion at all stages.

2.4 Data extraction

Only 31 articles were selected in the data extraction phase with the following extraction characteristics:

- An article must be an original basic, review or applied paper from a journal or conference publication. All published cases and reports were excluded.
- All articles must be limited to the subject area of computer science, healthcare professionals, engineering, social science and medicine. Furthermore, they must all be written in English language.
- Extracted articles were published from 2020 to 2021.
- The extracted papers are were not limited to any country.

Figure 1 presents the summary of methodology utilized in this study in line with PRISMA framework.

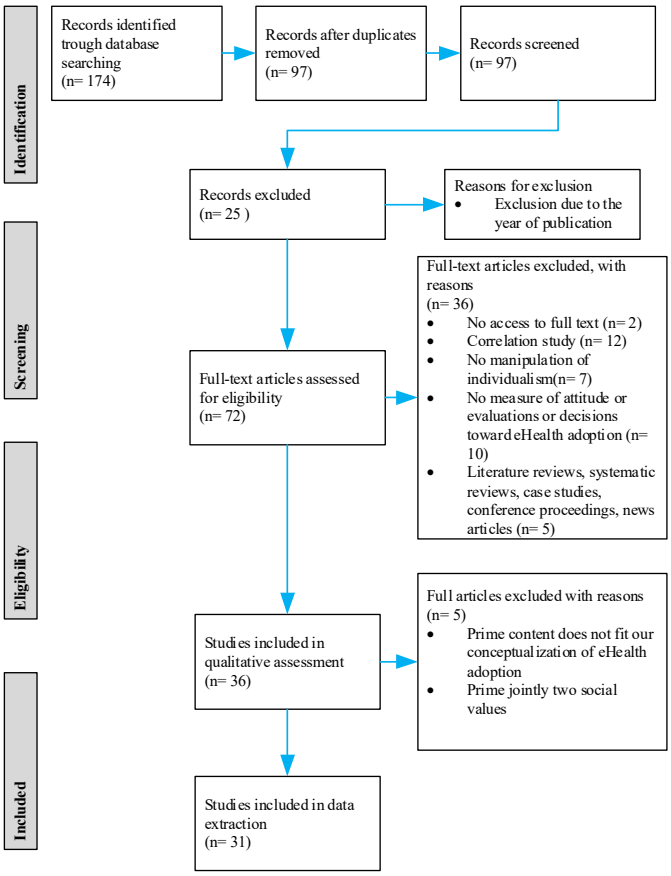

Fig. 1 Summary of methodology adopted from [9]

3. Results and Discussion

3.1 Reporting findings

It is indicated by the results that there are only a few papers that have been published so far, on the adoption of eHealth technology applications during COVID-19 compared to 2020. In the year 2020, 18 documents were published on the Scopus database and this number was five times more than the number (13) in the year 2021. This denotes that up to date, the number of publications on the topic

started to gradually decrease. Since this study focused on the adoption of eHealth cloud-based technology applications during COVID-19, the researchers believes that this pandemic is still new to the research field, hence the number of studies during this pandemic are limited. Table 1 displays the statistics on how papers for the adoption of eHealth cloud-based technology applications during COVID-19 were published each year.

Table 1 Distribution of Papers by Year

Year	Number of papers
2020	18
2021	13

The distributions of papers by source title are shown in Table 2. The findings indicate that Telemedicine and e-Health sourced the majority of papers. This sourced a maximum of 4 articles on eHealth technology applications during COVID-19 from 2020 to 2021. Followed by European Urology, International Journal of Clinical Practice and International Journal of Environmental Research and Public Health respectively, with 2 articles sourced by each source to date. Other remaining sources are doing a very significant contribution by sourcing 1 paper each.

Table 2 Distribution of Papers by Source Title

Source title	Papers published	Year
Acta Informatica Medica	1	2021
African Journal of Reproductive Health	1	2020
BMJ Open	1	2020
CMES - Computer Modeling in Engineering and Sciences	1	2020
European Urology	2	2020
Frontiers in Medicine	1	2021
Health and Technology	1	2021
Health Sociology Review	1	2021
IEEE Access	1	2020
IEEE Reviews in Biomedical Engineering	1	2021
Internal Medicine Journal	1	2020
International Journal of Adolescent Medicine and Health	1	2020
International Journal of Clinical Practice	2	2020

International Journal of Environmental Research and Public Health	2	2020&2021
International Journal of Health Planning and Management	1	2021
International Journal of Telemedicine and Applications	1	2020
Internet Interventions	1	2020
Neurological Sciences	1	2020
Obesity Surgery	1	2020
Patient Preference and Adherence	1	2020
Revista de Neurologia	1	2020
Revista espanola de salud publica	1	2020
Semergen	1	2020
Telemedicine and e-Health	4	2020&2021
Wireless Personal Communications	1	2020

The largest number of articles on the adoption of eHealth cloud-based technology applications during COVID-19 were published from Italy and these were five articles. According to the findings, the second largest number of published articles was from China, France and Germany respectively with two articles each. Researchers from other remaining countries are making a very significant contribution to the topic with only one article published. Even if academics around the world tried to put their effort on the topic of the adoption of eHealth cloud-based technology applications during COVID-19, it is still clear that more research is required in this field. Table 3 indicates the number of studies that were published from each country from 2020 to 2021.

Table 3 Distribution of Papers by Country

Studies	**Country**	**Total**
[10]	Bangladesh	1
[11]	Canada	1
[12, 13]	China	2
[14]	Denmark	1
[15, 16]	France	2
[17, 18]	Germany	2
[19]	Honduras	1
[20]	India	1
[21-25]	Italy	5
[26]	Jordan	1

[27]	Kazakhstan	1
[28]	Madrid	1
[29]	Morocco	1
[30]	Nigeria	1
[31]	Norway	1
[32]	Pakistan	1
[33, 34]	Saudi Arabia	2
[35, 36]	Spain	2
[37]	Sweden	1
[38]	United Arab Emirates	1
[39]	United Kingdom	1
[40]	United States	1

According to the findings, research on the adoption of eHealth cloud-based technology applications during COVID-19 is being appreciated and acknowledged by other researchers in their studies. The most cited paper of eHealth technology application during COVID-19 was "The COVID-19 pandemic: The 'black swan' for mental health care and a turning point for e-health" authored by Wind, et al. [37]. The paper citations have reached 190 citations up to date. The second most cited paper was "Telemedicine Online Visits in Urology During the COVID-19 Pandemic-Potential, Risk Factors, and Patients' Perspective" by Boehm, et al. [17] with 56 citations to date, followed by Novara, et al. [24] "Telehealth in Urology: A Systematic Review of the Literature. How Much Can Telemedicine Be Useful During and After" with 44 citations, Pappot, et al. [14] "Telemedicine and e-Health Solutions for COVID-19: Patients' Perspective" with 29 citations and Ndiaye, et al. [16] "IoT in the wake of Covid-19: A survey on contributions, challenges and evolution" with 19 citations. Table 4 shows the distribution of papers by their citations.

Table 4 Distribution of Papers by Citations

Author	Title	Citations
[34]	"The use of digital healthcare platforms during the COVID-19 pandemic: The consumer perspective"	1
[38]	"Telehealth in the time of Corona: 'doctor in the house'"	0
[36]	"Telemedicine and e-Health research solutions in literature for combatting COVID-19: a systematic review"	2
[26]	"The role of e-health in improving control and management of COVID 19 outbreak: Current perspectives"	2

[21]	"Health communication in covid-19 era: Experiences from the italian vaccinarsì network websites"	1
[13]	"End-to-End AI-Based Point-of-Care Diagnosis System for Classifying Respiratory Illnesses and Early Detection of COVID-19: A Theoretical"	3
[17]	"Telemedicine Online Visits in Urology During the COVID-19" "Pandemic-Potential, Risk Factors, and Patients' Perspective"	56
[39]	"Characteristics of online medical care consultation for pregnant women during the COVID-19 outbreak: Cross-sectional study"	2
[10]	"Telemedicine is an important aspect of healthcare services amid COVID-19 outbreak: Its barriers in Bangladesh and stra	4
[20]	Wireless COVID-19 Telehealth: Leukocytes Encryption Guided by Amino Acid Matrix"	0
[29]	"A Systematic Literature Review on e-Mental Health Solutions to Assist Health Care Workers during COVID-19"	5
[35]	"Remote consultation: information for Primary Care physicians"	5
[22]	"e-Health vs COVID-19: home patient telemonitoring to maintain TIA continuum of care"	5
[15]	"Validating the correct wearing of protection mask by taking a selfie: Design of a mobile application "CheckYourMask" to li"	2
[11]	"A Wearable Tele-Health System towards Monitoring COVID-19 and Chronic Diseases"	1
[28]	"Role of the information systems and e-health in the COVID-19 pandemic. A call to action"	0
[40]	"COVID-19 Brings about Rapid Changes in the Telehealth Landscape"	1
[32]	"Implementation of a telemedicine service during COVID-19 pandemic in Pakistan"	0

[16]	"IoT in the wake of Covid-19: A survey on contributions, challenges and evolution"	19
[24]	"Telehealth in Urology: A Systematic Review of the Literature. How Much Can Telemedicine Be Useful During and After"	44
[30]	"Coronavirus (COVID-19) pandemic in Nigeria: Preventive and control challenges within the first two months of outbreak"	1
[14]	"Telemedicine and e-Health Solutions for COVID-19: Patients' Perspective"	29
[25]	"Telemedicine Implementation on a Bariatric Outpatient Clinic During COVID-19 Pandemic in Italy: an Unexpected Hill-Star"	1
[19]	"E-health tools to overcome the gap in epilepsy care before, during and after COVID-19 pandemics"	9
[27]	"The recent progress and applications of digital technologies in healthcare: A review"	5
[23]	"Telemedicine and the 2019 coronavirus (SARS-CoV-2)"	3
[33]	"Optimizing the communication with cancer patients during the COVID-19 pandemic: Patient perspectives"	4
[31]	"Applications of e-Health to Support Person-Centered Health Care at the Time of COVID-19 Pandemic"	3
[12]	"The use of E-health during the COVID-19 pandemic: a case study in China's Hubei province"	0
[18]	"Restrictercise! preferences regarding digital home training programs during confinements associated with the covid-19 pandemic"	4
[37]	"The COVID-19 pandemic: The 'black swan' for mental health care and a turning point for e-health"	190

3.2 Discussions of selected studies

This study was undertaken to find out what was done according to the literature, to measure the level of the adoption of eHealth cloud-based technology applications during COVID-19. A few articles that were reviewed in this study utilized the extended Technology Acceptance Model (TAM) to describe an individual's attitude and behavioural intention toward the adoption of eHealth cloud-based technology applications during COVI9-19. These studies revealed that eHealth technology applications are important tools that can be used to solve individual issues that are health related whilst maintaining a social distancing during COVID-19. It was further indicated that experience and IT knowledge, beliefs, attitudes as well as health professionals' desires have an impact on their willingness to utilize eHealth technology applications. A strong relationship amongst perceived usefulness, perceived ease of use and individuals' utilization of eHealth tools and applications was also discovered by previous studies. Moreover, it was found by previous studies that a lack of technical experience, lack of motivation as well as poor policies and support from the top management are some of the factors that contributes towards the adoption of eHealth cloud-based technology applications during COVID-19. Poor awareness of eHealth advantage, lack of technical infrastructure, lack of digital literacy and healthcare professionals' resistance were identified as barriers to eHealth adoption by related studies.

4. Conclusion, Limitations and Future Work

This study reviewed 31 research articles on the adoption of eHealth cloud-based technology applications during COVID-19, from 2020 to 2021 since coronavirus is still new in the research field. Different countries with different researchers tried to put effort in this topic. However, the results indicate that more research is still needed. It is indicated in the findings that many countries are still left far behind on this topic. Research on the adoption of eHealth cloud-based technology applications during COVID-19, was analysed according to the publication year, source title, country and author as well as distribution of papers by citations. One of the limitations of this study was that, the data was gathered from the Scopus database only. Researchers suggest that for future research, other additional sources need to be searched to find out more about the adoption of eHealth cloud-based technology applications during COVID-19. Secondly, the topic of this study was limited to cloud-based technology applications only. It is suggested that in future research, the topic could be extended to include modern technical innovations such as 5G and IoT. It is suggested that future research could focus on collecting data from other countries and parts of the world.

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References

[1] S. S. Iriani and A. L. Andjarwati, "Analysis of perceived usefulness, perceived ease of use, and perceived risk toward online shopping in the era of Covid-19 pandemic," (in English), *Syst. Rev. Pharm.,* Article vol. 11, no. 12, pp. 313-320, 2020, doi: 10.31838/srp.2020.12.50.

[2] C. Vermeiren *et al.*, "Comparison of copan ESwab and FLOQSwab for COVID-19 diagnosis: working around a supply shortage," (in English), *J. Clin. Microbiol.,* Short Survey vol. 58, no. 6, 2020, Art no. e00669-20, doi: 10.1128/JCM.00669-20.

[3] J. Shigemura, R. J. Ursano, J. C. Morganstein, M. Kurosawa, and D. M. Benedek, "Public responses to the novel 2019 coronavirus (2019-nCoV) in Japan: Mental health consequences and target populations," (in English), *Psychiatry Clin. Neurosci.,* Letter vol. 74, no. 4, pp. 281-282, 2020, doi: 10.1111/pcn.12988.

[4] A. S. Albahri *et al.*, "Role of biological Data Mining and Machine Learning Techniques in Detecting and Diagnosing the Novel Coronavirus (COVID-19): A Systematic Review," (in English), *J. Med. Syst.,* Review vol. 44, no. 7, 2020, Art no. 122, doi: 10.1007/s10916-020-01582-x.

[5] M. R. Hoque, Y. Bao, and G. Sorwar, "Investigating factors influencing the adoption of e-Health in developing countries: A patient's perspective," (in English), *Informatics Health Soc. Care,* Article vol. 42, no. 1, pp. 1-17, 2017, doi: 10.3109/17538157.2015.1075541.

[6] F. M. Al-Anezi, "Factors influencing decision making for implementing e-health in light of the COVID-19 outbreak in Gulf Cooperation Council countries," (in eng), *Int Health,* Feb 24 2021, doi: 10.1093/inthealth/ihab003.

[7] M. A. Zayyad and M. Toycan, "Factors affecting sustainable adoption of e-health technology in developing countries: An exploratory survey of Nigerian hospitals from the perspective of healthcare professionals," (in English), *PeerJ,* Article vol. 2018, no. 3, 2018, Art no. e4436, doi: 10.7717/peerj.4436.

[8] D. Golinelli, E. Boetto, G. Carullo, A. G. Nuzzolese, M. P. Landini, and M. P. Fantini, "Adoption of Digital Technologies in Health Care During the COVID-19 Pandemic: Systematic Review of Early Scientific Literature," (in eng), *J. Med. Internet Res.,* vol. 22, no. 11, pp. e22280-e22280, 2020, doi: 10.2196/22280.

[9] D. Moher, A. Liberati, J. Tetzlaff, and D. G. Altman, "Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement," (in eng), *PLoS Med,* vol. 6, no. 7, p. e1000097, Jul 21 2009, doi: 10.1371/journal.pmed.1000097.

[10] S. R. Chowdhury, T. C. Sunna, and S. Ahmed, "Telemedicine is an important aspect of healthcare services amid COVID-19 outbreak: Its barriers in Bangladesh and strategies to overcome," *Int. J. Health Plann. Manage.,* Article vol. 36, no. 1, pp. 4-12, 2021, doi: 10.1002/hpm.3064.

[11] W. Jiang *et al.*, "A Wearable Tele-Health System towards Monitoring COVID-19 and Chronic Diseases," (in eng), *IEEE Rev Biomed Eng,* vol. Pp, Mar 30 2021, doi: 10.1109/rbme.2021.3069815.

[12] W. Wang, L. Sun, T. Liu, and T. Lai, "The use of E-health during the COVID-19 pandemic: a case study in China's Hubei province," (in eng), *Health Sociol Rev,* pp. 1-17, Jun 23 2021, doi: 10.1080/14461242.2021.1941184.

[13] A. N. Belkacem, S. Ouhbi, A. Lakas, E. Benkhelifa, and C. Chen, "End-to-End AI-Based Point-of-Care Diagnosis System for Classifying Respiratory Illnesses and Early Detection of COVID-19," ed: arXiv, 2020.

[14] N. Pappot, G. A. Taarnhøj, and H. Pappot, "Telemedicine and e-Health Solutions for COVID-19: Patients' Perspective," *Telemedicine. e-Health,* Review vol. 26, no. 7, pp. 847-849, 2020, doi: 10.1089/tmj.2020.0099.

[15] K. Hammoudi, A. Cabani, H. Benhabiles, and M. Melkemi, "Validating the Correct Wearing of Protection Mask by Taking a Selfie: Design of a Mobile Application "CheckYourMask" to Limit the Spread of COVID-19," *Computer Modeling in Engineering \& Sciences,* vol. 124, no. 3, pp. 1049--1059, 2020. [Online]. Available: http://www.techscience.com/CMES/v124n3/39927.

[16] M. Ndiaye, S. S. Oyewobi, A. M. Abu-Mahfouz, G. P. Hancke, A. M. Kurien, and K. Djouani, "IoT in the Wake of COVID-19: A Survey on Contributions, Challenges and Evolution," *IEEE Access,* vol. 8, pp. 186821-186839, 2020, doi: 10.1109/ACCESS.2020.3030090.

[17] K. Boehm *et al.*, "Telemedicine Online Visits in Urology During the COVID-19 Pandemic-Potential, Risk Factors, and Patients' Perspective," (in eng), *Eur Urol,* vol. 78, no. 1, pp. 16-20, Jul 2020, doi: 10.1016/j.eururo.2020.04.055.

[18] J. Wilke *et al.*, "Restrictercise! Preferences Regarding Digital Home Training Programs during Confinements Associated with the COVID-19 Pandemic," (in eng), *Int J Environ Res Public Health,* vol. 17, no. 18, Sep 7 2020, doi: 10.3390/ijerph17186515.

[19] A. Santos-Peyret *et al.*, "E-health tools to overcome the gap in epilepsy care before, during and after COVID-19 pandemics," *Rev. Neurol.,* Review vol. 70, no. 9, pp. 323-328, 2020, doi: 10.33588/RN.7009.2020173.

[20] J. Dey and S. Mukherjee, "Wireless COVID-19 Telehealth: Leukocytes Encryption Guided by Amino Acid Matrix," *Wireless Personal Communications,* 2021/04/26 2021, doi: 10.1007/s11277-021-08534-9.

[21] A. Arghittu *et al.*, "Health Communication in COVID-19 Era: Experiences from the Italian VaccinarSì Network Websites," (in eng), *Int J Environ Res Public Health,* vol. 18, no. 11, May 25 2021, doi: 10.3390/ijerph18115642.

[22] G. Furlanis *et al.*, "e-Health vs COVID-19: home patient telemonitoring to maintain TIA continuum of care," (in eng), *Neurol Sci,* vol. 41, no. 8, pp. 2023-2024, Aug 2020, doi: 10.1007/s10072-020-04524-0.

[23] P. Sossai, S. Uguccioni, and S. Casagrande, "Telemedicine and the 2019 coronavirus (SARS-CoV-2)," (in eng), *Int J Clin Pract,* vol. 74, no. 10, p. e13592, Oct 2020, doi: 10.1111/ijcp.13592.

[24] G. Novara *et al.*, "Telehealth in Urology: A Systematic Review of the Literature. How Much Can Telemedicine Be Useful During and After the COVID-19 Pandemic?," (in eng), *Eur Urol,* vol. 78, no. 6, pp. 786-811, Dec 2020, doi: 10.1016/j.eururo.2020.06.025.

[25] M. Runfola, G. Fantola, S. Pintus, M. Iafrancesco, and R. Moroni, "Telemedicine Implementation on a Bariatric Outpatient Clinic During COVID-19 Pandemic in Italy: an Unexpected Hill-Start," (in eng), *Obes Surg,* vol. 30, no. 12, pp. 5145-5149, Dec 2020, doi: 10.1007/s11695-020-05007-z.

[26] M. A. Al-Ruzzieh, O. Ayaad, and B. Qaddumi, "The role of e-health in improving control and management of COVID 19 outbreak: current perspectives," *International Journal of Adolescent Medicine and Health,* no. 20200072, 2020, doi: doi:10.1515/ijamh-2020-0072.

[27] M. Senbekov *et al.*, "The Recent Progress and Applications of Digital Technologies in Healthcare: A Review," (in eng), *Int J Telemed Appl,* vol. 2020, p. 8830200, 2020, doi: 10.1155/2020/8830200.

[28] A. Martín Fernández, "Role of the information systems and e-health in the COVID-19 pandemic. A call to action," *Rev Esp Salud Publica,* Article vol. 95, 2021. [Online]. Available: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85100229779&partnerID=40&md5=84136fa62fe55741421eeaa60131f8b2.

[29] N. Drissi, S. Ouhbi, G. Marques, I. de la Torre Díez, M. Ghogho, and M. A. Janati Idrissi, "A Systematic Literature Review on e-Mental Health Solutions to Assist Health Care Workers During COVID-19," (in eng), *Telemed J E Health,* vol. 27, no. 6, pp. 594-602, Jun 2021, doi: 10.1089/tmj.2020.0287.

[30] L. N. Omaka-Amari, C. O. Aleke, N. E. Obande-Ogbuinya, P. C. Ngwakwe, O. Nwankwo, and E. N. Afoke, "Coronavirus (COVID-19) Pandemic in Nigeria: Preventive and Control Challenges within the First Two Months of Outbreak," (in eng), *Afr J Reprod Health,* vol. 24, no. s1, pp. 87-97, Jun 2020, doi: 10.29063/ajrh2020/v24i2s.13.

[31] T. H. Tebeje and J. Klein, "Applications of e-Health to Support Person-Centered Health Care at the Time of COVID-19 Pandemic," (in eng), *Telemed J E Health,* vol. 27, no. 2, pp. 150-158, Feb 2021, doi: 10.1089/tmj.2020.0201.

[32] M. H. Nagra, S. Ehsan, U. Ahmad, M. Ali, H. A. Hussain, and A. Bakar, "Implementation of a telemedicine service during COVID-19 pandemic in Pakistan," *Int J Clin Pract,* Article vol. 75, no. 8, 2021, Art no. e14310, doi: 10.1111/ijcp.14310.

[33] E. Tashkandi *et al.*, "Optimizing the Communication with Cancer Patients During the COVID-19 Pandemic: Patient Perspectives," (in eng), *Patient Prefer Adherence,* vol. 14, pp. 1205-1212, 2020, doi: 10.2147/ppa.S263022.

[34] F. Alharbi, "The Use of Digital Healthcare Platforms During the COVID-19 Pandemic: the Consumer Perspective," (in eng), *Acta Inform Med,* vol. 29, no. 1, pp. 51-58, 2021, doi: 10.5455/aim.2021.29.51-58.

[35] H. Eguia, F. Vinciarelli, R. L. Villoslada Muñiz, and F. J. Sanz García, "Consulta no presencial en tiempos de coronavirus: información para médicos de Atención Primaria," *Medicina de Familia. SEMERGEN,* vol. 46, no. 8, pp. 560-565, 2020/11/01/ 2020, doi: https://doi.org/10.1016/j.semerg.2020.08.005.

[36] S. G. Alonso *et al.*, "Telemedicine and e-Health research solutions in literature for combatting COVID-19: a systematic review," (in eng), *Health Technol (Berl),* pp. 1-10, 2021, doi: 10.1007/s12553-021-00529-7.

[37] T. R. Wind, M. Rijkeboer, G. Andersson, and H. Riper, "The COVID-19 pandemic: The 'black swan' for mental health care and a turning point for e-health," (in eng), *Internet Interv,* vol. 20, p. 100317, Apr 2020, doi: 10.1016/j.invent.2020.100317.

[38] Y. Z. Almallah and D. J. Doyle, "Telehealth in the time of Corona: 'doctor in the house'," (in eng), *Intern Med J,* vol. 50, no. 12, pp. 1578-1583, Dec 2020, doi: 10.1111/imj.15108.

[39] M. Chen *et al.*, "Characteristics of online medical care consultation for pregnant women during the COVID-19 outbreak: cross-sectional study," (in eng), *BMJ Open,* vol. 10, no. 11, p. e043461, Nov 17 2020, doi: 10.1136/bmjopen-2020-043461.

[40] M. A. Moore and D. D. Munroe, "COVID-19 Brings About Rapid Changes in the Telehealth Landscape," (in eng), *Telemed J E Health,* vol. 27, no. 4, pp. 382-384, Apr 2021, doi: 10.1089/tmj.2020.0228.