International Journal of Hospital Research 2022, 11(3)
http://ijhr.iums.ac.ir
Research Article

A scoping review of eHealth strategies used in the Covid-19 pandemic

Shabnam Iezadi[1], Hamid Pourasghari[1], Rouhangiz Asadi[1], Zhaleh Abdi[1], Faranak Abaszadeh[2], Masoud Etemadian[1*]

[1]Hospital Management Research Center, Health Management Research Institute, Iran University of Medical Sciences, Tehran, Iran.
[2]The Education and Training Organization, Ardabil, Iran.

Abstract

Introduction and objective: Understanding the various eHealth strategies used in the Covid-19 pandemic and its consequences can help to better and more effectively benefit in the future and identify its potential challenges, and more effective and efficient solutions to deal with future epidemics. In this study, we aimed to review the types of eHealth strategies used in the COVID-19 pandemic, the consequences and weaknesses and related challenges.

Methods: In this scoping review we use PRISMA statement to guide or study. Quantitative and qualitative studies that have empirically examined the application of eHealth strategies in Covid-19 pandemic management were included in the review. Inclusion criteria were outlined based on the three characteristics of Population, Concept, and Context (PCC); the population was population of countries affected by the Covid-19 pandemic. The concept was the use of eHealth strategies to control the Covid-19 pandemic and reduce its negative consequences for individuals and community. And the context was Covid-19 pandemic.

Results: Search strategies yielded 3,683 results, and 21 studies were included in the review. Main challenges of adopting eHealth strategies in the COVID-19 era included privacy and data security concerns, resource limitation, need for wireless/internet base systems, need for accuracy and efficiency approval, high cost, and need for linked health information systems. eHealth strategies have been successful in controlling nosocomial infections, reducing the relationship between treatment staff and patients, more accurate and faster diagnosis, providing services to a wide range of patients, and providing quality services.

Conclusion: Evidence suggests that different countries, depending on their infrastructure and available resources, have been able to effectively and efficiently benefit from eHealth strategies in identifying, diagnosing, treating and caring for patients.

Keywords: eHealth; COVID-19; Challenge; Barrier; Health information.

Introduction and objective:

In recent years, there has been a communication revolution in the provision of health care and health promotion by the growth of advanced information technologies. Creating, adopting, and implementing a wide range of new eHealth applications (including online health information websites, interactive electronic health records, decision support programs, health education programs, health care system portals, mobile health communication programs, and applications Advanced telehealth) can lead to increase customers 'and service providers' access to health information, improve the quality of care, reduce health errors, increase collaboration, and encourage health behaviors [1]. The World Health Organization (WHO) defines eHealth as the cost-effective and safe use of information and communication technology in health-related fields, including health services, health surveillance, health literature review, and health education and research [2].

*Corresponding Author: Masoud Etemadian
Email: etemadian@hmrc.ir

There is clear evidence of the growing impact of eHealth on the provision of health services worldwide and how health systems are more efficient and responsive to the needs and expectations of the people. Currently 58% of WHO members have an eHealth strategy, 55% of countries have approved regulations to protect patients' electronic data, and 87% of countries have at least one mHealth initiative[3].

The rate of the use of various e-health applications such as remote care, online consulting, and remote education in strategic plans, reveal the attention of some countries. WHO has emphasizing on the importance of eHealth as one of the essential components of any strategy and the main focus of attention to change the health system in the 21st century[4]. A practical example of the use of health information and communication technology is the fight against tuberculosis. Many countries have implemented pilot projects to learn how to fight tuberculosis by using eHealth and mHealth strategies[5]. Another example is the project that integrates innovative blood pressure monitoring software with a platform to support patient decision-making and records with open mobile access, and has won the Grand Challenges Award, which allows executives to test their projects in middle- and low-income countries. The project, which is technically led by organizations such as UNDP / UNFPA / UNICEF / WHO / World Bank Special Program of Research, Development and Research Training in Human Reproduction (HRP), will enable health care providers to measure blood pressure in pregnant women just by using a camera on their smartphone and provide recommendations for women[6]. Evidence suggests that eHealth could have many applications in a variety of epidemics, COVID-19 as well.

Coronavirus 2019 started in late December 2019 and was declared a public health emergency by the World Health Organization due to its very high speed. The disease has affected more than 108 countries so far. COVID-19 is an infectious disease caused by the new coronavirus, a virus closely related to the SARS coronavirus. Fever, cough, and shortness of breath are common symptoms of this disease. Sore throat, muscle aches, and sputum production are some of the less common symptoms. Although most cases of this disease lead to mild symptoms, some cases lead to pneumonia and multiple sclerosis [7]. Mortality rates are estimated at between 1% and 5%, but vary with age and other health conditions. The disease is mainly transmitted to people through cough drops or sneezes [8].

Due to the rapid spread of the disease and the lack of certain treatment and vaccination for long time, various organizations have adopted various non-clinical strategies to control the epidemic and slow the spread of the disease, including quarantine, social distancing, and delaying non-emergency visits. In the meantime, several countries have benefited from health information technology and eHealth to make the programs more effective. Spain, for example, took a strategic approach to eHealth strategies to shorten waiting lists, provide advice and remote visits for suspected cases, ensure continued care, reduce unnecessary hospital visits and thus reduce the risk of infection transmission[9]. Another study notes the application of Telehealth in mental health care and its potential impact on access to high-quality mental health services in the Covid-19 epidemic[10]. Understanding the various strategies used in the Covid-19 pandemic and its consequences can help to better and more effectively benefit in the future and identify its potential challenges, and more effective and efficient solutions to deal with future epidemics. However, no review study has been conducted in this

field so far. In this study, we intend to conduct a review study of the types of eHealth strategies used in the COVID-19 pandemic, the consequences and weaknesses and related challenges.

Method

In this scoping review we use PRISMA statement to guide or study. Keywords have been selected based on MESH and review of related texts in two main dimensions, including Covid-19 disease and eHealth. The process of review is illustrated in figure1.

Inclusion Criteria

Quantitative and qualitative studies that have empirically examined the application of eHealth strategies in Covid-19 pandemic management were included in the review. Inclusion criteria were outlined based on the three characteristics of Population, Concept, and Context (PCC).
Population: Population of countries affected by the Covid-19 pandemic.
Concept: Use of eHealth strategies to control the Covid-19 pandemic and reduce its negative consequences for individuals and community.
Context: Covid-19 pandemic
English language original studies were eligible in the review and no limitations were applied for time and settings of the studies.

Data source and search strategy

In this study, valid scientific data sources including:

PubMed / Medline, Web of Science, Embase, Cochrane Library, Cochrane Central Registry of Controlled Trials, Scopus. The World Health Organization (WHO) and World Bank websites, as well as references to relevant articles and Google Scholar, were searched. Gray literature (Gray.net) and preprints data sources were also searched.

Before adopting the final search strategies, a pilot search was conducted in PubMed and after careful review of the search results, additional modifications were made in the primary search strategy. Search strategies were employed in each database and an example of a search strategy is presented table 1.

Table 1. Search strategy sample for PubMed

Search strategy PubMed
(((((COVID-19[Title/Abstract]) OR (SARS-CoV-2[Title/Abstract])) OR (2019-nCoV[Title/Abstract])) OR ("2019 novel coronavirus"[Title/Abstract])) OR (2019ncov[Title/Abstract])) AND ((((((((((("ehealth"[Title/Abstract]) OR ("e-health"[Title/Abstract])) OR ("teleconsultation"[Title/Abstract])) OR ("telemedicine"[Title/Abstract])) OR (telehealth[Title/Abstract])) OR ("digital health"[Title/Abstract])) OR ("medical informatics"[Title/Abstract])) OR ("digital application*"[Title/Abstract])) OR ("virtual health"[Title/Abstract])) OR ("tele-pharmacy"[Title/Abstract])) OR (robot*[Title/Abstract])) OR ("tele-icu"[Title/Abstract])) OR ("mobile health"[Title/Abstract]))

Data management and screening studies

The results of the search in valid scientific databases were pulled into the EndNote program and duplicate results were removed. In the first stage of screening, the title / abstract of the studies was reviewed separately by two researchers based on inclusion criteria. In the second stage, the full-text of the studies was reviewed by both researchers and the eligible studies were elected. At each stage of screening, any disagreements were resolved by discussing them with the third researcher.

Data extraction

A data extraction form was developed based on the research question. Information including article information (title, author, year of publication, journal), type of study (target population, setting, sample size, data collection method, eHealth strategy (type of technology, purpose of use), application challenges (limitations, barriers and Negative Results / Risks), its benefits and positive consequences were extracted and entered into the data collection form. The form was piloted by extracting data from three articles by two investigators.

Data synthesis

The results were finally interpreted and presented in narrative and tabular format.

Results

Employing search strategies in relevant data bases yielded 3,683 results after removing duplicate results. We identified 71 articles for further review of the full text after screening for title/abstract. Finally, 21 studies were included in the review[11-31]. The design of the majority of the studies were case study[11, 12, 14, 16, 17, 19-28, 30, 31]. Most of the studies were from the US[11, 14, 17, 18, 20, 22, 25] and China[13, 16, 19, 27, 28, 29, 30, 31]. Figure 1 shows the process of screening and selecting articles.

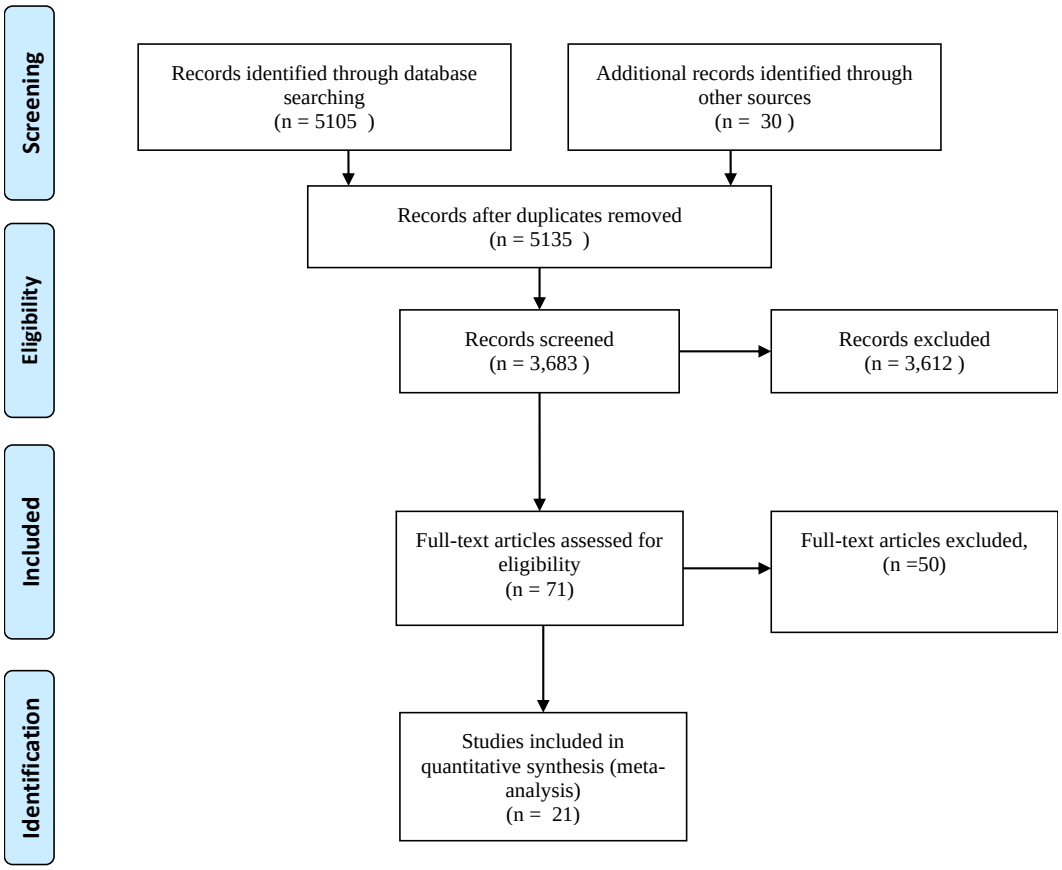

Figure 1. PRISMA figure for study selection results

Applications of eHealth Strategies in COVID-19 pandemic

We categorized the findings based on the type of eHealth strategy and its application,

and a summary of the results is provided in Tables 2 and 3.

Although the studies were from both developing and developed countries, most of the studies were from China (eight studies) and the United States (seven studies). These studies focus on a variety of eHealth strategies, including electronic health record templates, robotic clinical care, virtual intensive care unit, cloud-based system for effective monitoring and control Cloud-Based System for Effective Surveillance and Control, Mobile-based decision support system, Web-based COVID-19 self-assessment tool, ICU surveillance technology, contact tracking, Internet hospitals, identification, screening and diagnosis of patients with COVID-19, and spatial and temporal reporting via network and GPS. Most studies were case studies or technology descriptions.

Challenges of applying eHealth strategies in COVID-19 pandemic

Like any fast-paced program, there are challenges to applying the strategies the COVID-19 pandemic, such as the challenges encountered when building an aircraft while flying. Items that can be improved include the ability to patients' awareness, additional tools to measure patients entering and leaving the program, and a simpler patient registration process. Examples of challenges are provided below.

Privacy and data security concerns

Strategies such as mobile data tracing and positioning require an epidemiologist or their representative to examine the call. Although these strategies may seem very promising, data privacy concerns remain a major obstacle. Finding a balance between using technology and maintaining data security and patient privacy is essential. Existing rules on patient privacy are being tested. While mobile positioning data can be used in current regulations, data holder guidelines should include measures to reduce misuse and unauthorized access. Future research should design and implement models for tracking mobile location calls.

Resource limitation

Resources are also challenging to implement the new system, especially when connected to hospital information systems, and further data analysis requires coordination and collaboration between local and external sources. Lack of internal or external validation of the system has been created due to the conditions that occurred during the epidemics, the problem of ethics and limited resources.

Need for wireless/internet base systems

Strategies such as symptom control now require Internet access to enter data using the web interface. The presence of this system in smartphones and mobile devices using downloadable applications increases accessibility and improves performance and flexibility. On the other hand, the complete clinical situation should be considered during the establishment of a dynamic risk assessment model, including the severity of symptoms and history of chronic underlying diseases, but retrospective data are not available in many current clinics, including fever clinics. Further aggregation of relevant clinical data can lead to earlier evaluation and triage support methods, and we can also discuss the effect of dynamic changes in patients' clinical information on their COVID-19 risk classification.

Tele-ICU seems to be a promising way in the present age, but its approval requires a huge investment that prevents its

implementation. Its use should be moderated with a focus on data privacy and cyber security.

Need for accuracy and efficiency approval

There are also challenges to the artificial intelligence approach to assessing the risk of COVID-19 infection in virtual visits. Predicting positive results based on clinical notes is challenging. In an effort to improve the performance of computer algorithms used in the screening of the 2019 Corona Virus Test (COVID-19), researchers have used natural language processing and artificial intelligence-based methods with unstructured patient data collected through telehealth visits. The problem is that clinical notes can contain significant amounts of ambient noise, resulting in irrelevant data in both patterned text and patient input based on the SARS-CoV PCR test. At the University of South Carolina, during the study period, despite the use of computer algorithms, only 5.6% of those tested were positive. The full clinical picture should be considered in test decisions, including the severity of symptoms and a history of chronic underlying disease.

High cost

One of the biggest concerns about the tracking system for controlling the prevalence of COVID-19 is privacy - various studies have suggested ways to keep people anonymous. The architecture of a patient tracking system is costly, and it may be argued that the price is too high for an internet-of-things (IoT) device to be distributed to the highest possible segment of the population. However, such costs are available in the electronics market when purchasing each product individually. Mass production of the device in the final design can significantly reduce the price of components. In addition to device costs, development costs for the final mobile application and backed up data as well as hosting, maintenance and memory space costs should be considered.

Need for linked health information systems

Many effective strategies require the integration of patient information from different sources. Therefore, some regulations prevent the sharing of information between institutions. Legal and regulatory measures are needed to be taken by the authorities to make it possible to share clinical data between different institutions while maintaining privacy, safety and confidentiality.

Results of applying eHealth strategies in COVID-19 Pandemic

The application of eHealth strategies has had promising results in controlling the epidemic and providing effective services while maintaining the safety of the patients and the clinicians. Table 3 summarizes the results of applying different strategies.

Table 2. Characteristics of the eHealth Strategies used in COVID-19 pandemic

Area of use	Aim of the strategy	Type of the strategy	Country
Case identification	•Self-assessment and identification of suspected cases •Timely diagnosis of infected people • Early identification of suspected cases •For initial detection of COVID-19 virus	•Web-based COVID-19 self-assessment tool •Remote monitoring strategy using wearable biosensors •Infection risk scoring systems •Symptom tracking system •Humanoid robot	China United States of America India
diagnosis	•Detection and evaluation of COVID-19 remotely with greater protection of the treatment staff •Sensitive and specific detection of SARS-CoV-2 antibodies •Assist physicians in providing dynamic risk assessments for patients suspected of having COVID-19 during an epidemic.	•Robotic ultrasound based on 5G technology •Robotic clinical care (including CT scan of lungs based on artificial intelligence and remote control robot to collect throat swabs for testing) •Liquid control robotic system •Mobile based decision support system for COVID-19 •Robotic remote ultrasound system	China United States of America
Care/treatment	•Strengthening the intensive care services provided in its ICUs. •Immunizing the care of the worst patients •Early discharge and direct referral of patients from the emergency department and primary care. •Reduce inaccessibility and inequality of health services during the outbreak •Patient remote education and monitoring •Facilitate the clinical management of patients with COVID-19	•ICU monitoring technology •Virtual Intensive Care Unit •Internet Hospitals •Patient Remote Education and Monitoring Platform (RPM) •IT-based management in clinically healthy patients with COVID-19	China India United States of America United Kingdom South Korea
Control of the pandemic	•Contact tracing •To complement traditional public and social health approaches to reducing and suppressing COVID-19 •Collection, integration, standardization and analysis of COVID-19 data from various sources	•Spatial and temporal reporting via network and GPS •Mobile Tracking Data Positioning Mobile •Cloud-based system for effective monitoring and control of COVID-19 •BubbleBox	China United States of America Nigeria Italy

Table3 Results of applying eHealth strategies in COVID-19 pandemic

Area of using eHealth strategies	Results
Patient care	• These programs provide a safe and satisfying experience for patients while minimizing exposure to COVID-19 and face-to-face healthcare. • These strategies make it possible to provide timely services to a very large number of COVID-19 patients by using appropriate response protocols. • The biggest success of these strategies was the reporting of patient feedback, which provided a sense of security and a way to quickly access COVID-19 intensive care. • In assessing patient satisfaction responses, many patients expressed feelings of being cared for and protected during the program. • In the situation that diagnostic and treatment services were not available, these strategies have provided more support and supervision to patients than ever before so that they could feel safe at home and have access to care when needed. • Future work should include a stronger analysis of patient experience as well as the factors that influence patients' decisions about participating in the eHealth programs. With the use of virtual wards, patients with non-severe covid-19 can be safely managed in the community instead of being hospitalized. The virtual section provides a safety net for this group of patients.
Patient identification and diagnosis	• The thermal scanner is the best choice to detect each person's fever remotely to prevent infection to other people. In this strategy, the researchers developed an independent humanoid robotic control system. Using a heat scanner, it scans the person's forehead to measure temperature. The recorded temperature is analyzed. Relevant instructions and warnings are provided by the robotic system. The implemented system works properly and is useful for healthy people to identify health status. • Improving patient experience, improving the efficiency of medical staff, and improving patient care have been among the achievements of strategies for identifying and isolating suspicious individuals. • The robotic remote ultrasound system can not only reduce the risk of infection in specialists but also track the progression of the disease dynamically. In addition, important data can be obtained in conjunction with data from other diagnostic methods to provide timely and accurate guidance for setting diagnosis and treatment. The robotic system could also be a potential tool for telemedicine professionals dealing with difficult situations such as infectious diseases, natural disasters and medical care in war zones and remote areas. • Infection risk scoring systems facilitate the restoration of order in life. The use of different health codes has overcome the fragmentation of traditional data collection and greatly enhanced government precision measures in preventing and controlling epidemics and the resumption of work and production on a regular basis.
Contact tracing	• Spatial-temporal reporting networks and GPS are potentially powerful strategies for preventing and controlling epidemics by large-scale social network-based data collection programs, collecting large data from multiple Source, and real-time data analysis. These strategies enable advanced and accurate tracing of contacts at high speed and accuracy with the aim of controlling the epidemic.

Discussion

The aim of this study was to identify the experiences of different countries in the application of different eHealth strategies in Pandemi Quaid-19. The results show that different countries with modern methods and effectively have been able to use eHealth strategies in various dimensions of the concept from them tracking to prevention and diagnosis and patient care.

The eHealth strategies have had several positive implications for controlling the COVID-19 pandemic. For example, these strategies have made it possible to provide timely services to a large number of

COVID -19 patients. Taking advantages of remote care and diagnostic services, for example vICUs, by providing safe conditions for medical staff and patient companions, has made it possible to provide services to a wide range of people suspected of having the disease and patients[14]. The use of robotic and automatic technologies has also enabled advanced detection with minimal human contacts[18, 24, 27, 31]. Effective use of patient and contact tracing technologies is another success of eHealth in COVID -19[15, 23, 28].

However, the application of various eHealth strategies in COVID-19 pandemic has not been without challenges and, like any other emergency situation, has faced obstacles such as structural and process challenges. Many systems used to feed patients' medical records are web-based. This alone reveals fundamental challenges in legislating, patient privacy, and shortcomings in medical information systems to provide effective information [15,21,23,25]. On the other hand, such systems require large capital at start-up. And it is obvious that not all countries have the adequate infrastructure and financial resources and skilled manpower to benefit from such systems [16, 22]. On the other hand, using some eHealth systems, such as mobile contact tracing needs specialists in various fields, including field epidemiologists [15]. The required expertise is not readily available in many areas, including developing countries.

Facilitators were identified in the face of the challenges facing the countries' health systems. One of the most important facilitators was the participation of multiple stakeholders in convincing the community to benefit from eHealth strategies [16]. The cooperation of local governments, local relief forces and citizens is one of the most important keys to the success of eHealth strategies in controlling the pandemic. Because the government needs access to personal and medical information of members of society to succeed in this serious matter, and the cooperation of citizens in accessing this information is the main support for this success[16].

Study Limitations

We just included English language papers in the review.

Conclusion

Evidence suggests that different countries, depending on their infrastructure and available resources, have been able to effectively and efficiently benefit from eHealth strategies in identifying, diagnosing, treating and caring for patients. Such strategies have been successful in controlling nosocomial infections, reducing the relationship between treatment staff and patients, more accurate and faster diagnosis, providing services to a wide range of patients, and providing quality services. However, taking advantage of such strategies in the COVID-19 pandemic has faced challenges such as resource constraints, legal barriers, and privacy. Collaborating with governments and local health forces with the public can greatly facilitate the benefit of eHealth strategies in a pandemic.

Funding

The study was funded by Hospital Management Research Center, Iran University of Medical Sciences, Tehran, Iran (Grant Number: 95-02-141-29015). The study funder had no role in study design, data collection, writing of the manuscript, and submission.

Conflict of interests

None.

Authors' contributions

The authors are the same

References

1. Kreps GL, Neuhauser L (2010) New directions in eHealth communication: opportunities and challenges. Patient education and counseling 78: 329-336.

2. Abedi V, Olulana O, Avula V, Chaudhary D, Khan A, et al. (2020) Racial, Economic, and Health Inequality and COVID-19 Infection in the United States. J Racial Ethn Health Disparities: 1-11.

3. Abuelezam NN (2020) Health Equity During COVID-19: the Case of Arab Americans. Am J Prev Med 59: 455-457.

4. Amir Ashkan Nasiripour, Reza Radfar, Reza Najafbeigi, Rahmani. H (2011) Investigating the Factors Affecting the Establishment of e-Health System in Iran. Hospital 10: 54-62.

5. Adegunsoye A, Ventura IB, Liarski VM (2020) Association of Black Race with Outcomes in COVID-19 Disease: A Retrospective Cohort Study. Annals of the American Thoracic Society 17: 1336-1339.

6. Adhikari S, Pantaleo NP, Feldman JM, Ogedegbe O, Thorpe L, et al. (2020) Assessment of Community-Level Disparities in Coronavirus Disease 2019 (COVID-19) Infections and Deaths in Large US Metropolitan Areas. JAMA Network Open 3: e2016938-e2016938.

7. Hui DS, I Azhar E, Madani TA, Ntoumi F, Kock R, et al. (2020) The continuing 2019-nCoV epidemic threat of novel coronaviruses to global health—The latest 2019 novel coronavirus outbreak in Wuhan, China. International Journal of Infectious Diseases 91: 264-266.

8. World Health Organization (2020) Coronavirus disease (COVID-19) outbreak.

9. Sust PP, Solans O, Fajardo JC, Peralta MM, Rodenas P, et al. (2020) Turning the crisis into an opportunity: digital health strategies deployed during the COVID-19 outbreak. JMIR Public Health and Surveillance 6: e19106.

10. Torous J, Myrick KJ, Rauseo-Ricupero N, Firth J (2020) Digital mental health and COVID-19: using technology today to accelerate the curve on access and quality tomorrow. JMIR mental health 7: e18848.

11. Annis T, Pleasants S, Hultman G, Lindemann E, Thompson JA, et al. (2020) Rapid implementation of a COVID-19 remote patient monitoring program. J Am Med Inform Assoc 27: 1326-1330.

12. Bae YS, Kim KH, Choi SW, Ko T, Jeong CW, et al. (2020) Information Technology-Based Management of Clinically Healthy COVID-19 Patients: Lessons From a Living and Treatment Support Center Operated by Seoul National University Hospital. Journal of medical Internet research 22: e19938.

13. Chen B, Marvin S, While A (2020) Containing COVID-19 in China: AI and the robotic restructuring of future cities. Dialogues in Human Geography 10: 238-241.

14. Dhala A (2020) Rapid Implementation and Innovative Applications of a Virtual Intensive Care Unit During the COVID-19 Pandemic: Case Study. Psychooncology 22: e20143.

15. Ekong I, Chukwu E, Chukwu M (2020) COVID-19 mobile positioning data contact tracing and patient privacy regulations: Exploratory search of global response strategies and the use of digital tools in Nigeria. JMIR mHealth and uHealth 8.

16. Gong M, Liu L, Sun X, Yang Y, Wang S, et al. (2020) Cloud-Based System for Effective Surveillance and Control of COVID-19: Useful Experiences from Hubei, China. Journal of Medical Internet Research 22.

17. Handel A, Kassaye SG (2020) Rapid Deployment of a Free, Privacy-Assured COVID-19 Symptom Tracker for Public Safety During Reopening: System Development and Feasibility Study. Disaster Med Public Health Prep 6: e19399.

18. Karp DG, Cuda D, Tandel D, Danh K, Robinson PV, et al. (2020) Sensitive and Specific Detection of SARS-CoV-2 Antibodies Using a High-Throughput, Fully

Automated Liquid-Handling Robotic System. SLAS Technology.

19. Liu Y, Wang Z, Ren J, Tian Y, Zhou M, et al. (2020) A COVID-19 risk assessment decision support system for general practitioners: Design and development study. Journal of Medical Internet Research 22.

20. Mehring WM, Poksay A, Kriege J, Prasannappa R, Wang MD, et al. (2020) Initial Experience with a COVID-19 Web-Based Patient Self-assessment Tool. Journal of General Internal Medicine 35: 2821-2822.

21. Naik BN, Gupta R, Singh A, Soni SL, Puri GD (2020) Real-Time Smart Patient Monitoring and Assessment Amid COVID-19 Pandemic - an Alternative Approach to Remote Monitoring. Journal of Medical Systems 44.

22. Obeid JS, Davis M, Turner M, Meystre SM, Heider PM, et al. (2020) An artificial intelligence approach to COVID-19 infection risk assessment in virtual visits: A case report. J Am Med Inform Assoc 27: 1321-1325.

23. Polenta A, Rignanese P, Sernani P, Falcionelli N, Mekuria DN, et al. (2020) An internet of things approach to contact tracing-the bubblebox system. Information (Switzerland) 11.

24. Rane KP (2020) Design and development of low cost humanoid robot with thermal temperature scanner for COVID-19 virus preliminary identification. International Journal of Advanced Trends in Computer Science and Engineering 9: 3485-3493.

25. Salway RJ, Silvestri D, Wei EK, Bouton M (2020) Using Information Technology To Improve COVID-19 Care At New York City Health + Hospitals. Health Aff (Millwood) 39: 1601-1604.

26. Thornton J (2020) The "virtual wards" supporting patients with covid-19 in the community. The BMJ 369.

27. Wang J, Peng C, Zhao Y, Ye R, Hong J, et al. (2020) Application of a Robotic Tele-Echography System for COVID-19 Pneumonia. Journal of Ultrasound in Medicine.

28. Wang S, Ding S, Xiong L (2020) A new system for surveillance and digital contact tracing for COVID-19: Spatiotemporal reporting over network and GPS. JMIR mHealth and uHealth 8.

29. Wong CK, Ho DTY, Tam AR, Zhou M, Lau YM, et al. (2020) Artificial intelligence mobile health platform for early detection of COVID-19 in quarantine subjects using a wearable biosensor: Protocol for a randomised controlled trial. BMJ Open 10.

30. Wu J, Xie X, Yang L, Xu X, Cai Y, et al. (2020) Mobile health technology combats COVID-19 in China. Journal of Infection.

31. Yu RZ, Li YQ, Peng CZ, Ye RZ, He Q (2020) Role of 5G-powered remote robotic ultrasound during the COVID-19 outbreak: Insights from two cases. European Review for Medical and Pharmacological Sciences 24: 7796-7800.

Please cite this article as:

Shabnam Iezadi, Masoud Etemadian, Rouhangiz Asadi, Zhaleh Abdi,Faranak Abaszadeh, Omid Barati, Hamid Pourasghari . A scoping review of eHealth strategies used in the Covid-19 pandemic. Int J Hosp Res. 2022; 11 (3).