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A scope of mobile health solutions in COVID-19 pandemics

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ABSTRACT

Background and aim: COVID-19 has become an international emergency. The use of digital solutions can be effective in managing, preventing, and overcoming the further spread of infectious disease outbreaks. Accordingly, the use of mobile-health (m-health) technologies has the potential to promote public health. This review aimed to study the application of m-health solutions for the management of the COVID-19 outbreak.
Methods: The search strategy was done in Medline (PubMed), Embase, IEEE, and Google Scholar by using related keywords to m-health and COVID-19 on July 6, 2020. English papers that used m-health technologies for the COVID-19 outbreak were included.
Results: Of the 2046 papers identified, 16 were included in this study. M-health had been used for various aims such as early detection, fast screening, patient monitoring, information sharing, education, and treatment in response to the COVID-19 outbreak. M-health solutions were classified into four use case categories: prevention, diagnosis, treatment, and protection. The mobile phone-based app and short text massaging were the most frequently used modalities, followed by wearables, portable screening devices, mobile-telehealth, and continuous telemetry monitor during the pandemics.
Conclusion: It appears that m-health technologies played a positive role during the COVID-19 outbreak. Given the extensive capabilities of m-health solutions, investigation and use of all potential applications of m-health should be considered for combating the current Epidemics and mitigating its negative impacts.

1. Introduction

The COVID-19 epidemic has appeared in Wuhan, China, and then quickly spread in many countries. Now it has become a crisis for communities and governments [1,2]. The severity of COVID-19 disease ranges from mild to severe. It can be asymptomatic or symptomatic as well. COVID-19 can result in uncomplicated illness, moderate pneumonia, severe pneumonia, acute respiratory distress syndrome, sepsis, septic shock, and death [3]. COVID-19 is detected using diagnostic strategies including molecular tests, serology, laboratory examinations, and imaging techniques (Chest X-ray, Chest computed tomography, and Lung ultrasound) techniques. However, there is no standard approach to treat COVID-19 patients, so applying prevention methods to control this infectious disease is crucial [3–6].

Digital solutions can facilitate and improve communities' and health care systems' response to outbreaks of infectious diseases. They can play a role in reducing the outbreak threats [7,8]. Mobile health (m-health) is one of these solutions that offers accessible and cost-effective answers for enhancing public health [9,10]. There are various approaches for m-health like text messaging, patient monitoring, and mobile telemedicine. These approaches can be deployed for health monitoring, health promotion, enhancing awareness, providing support at the point of care, and supporting decision making [11].

Studies have shown applications of m-health in previous infectious disease outbreaks. For instance, a smartphone app had been used for tracking Influenza through a self-administered questionnaire. It had been proved a useful tool for the easy surveillance of influenza activity. Moreover, a mobile-based surveillance app has been previously used for real-time monitoring and detecting the Zika virus [12,13]. A mobile PCR device, based on ultra-rapid and real-time approaches for RT-PCR assay, has already been developed for quick diagnosis (20 min versus 2 h of traditional methods) of the Middle East respiratory syndrome (MERS) [14]. For the COVID-19 pandemic, there are different reports on using m-health technologies for multiple purposes such as preventing, diagnosis, screening, tracking, and contact tracing [15–18].

Mobile-health has the potential to offer different solutions to respond

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to the COVID-19 by providing educational context, contact tracing and tracking, consultation, reducing patient referral, and prevent further spreading of the outbreak [19,20]. Therefore, considering the COVID-19 pandemic as an international emergency, there is a need to collect and report the beneficial approaches to help countries, governments, and communities in management and control of the outbreak. Accordingly, this paper aimed to explore applications of m-health solutions for the management of COVID-19 epidemic.

2. Materials and methods

2.1. Databases and search strategy

The researchers used the Preferred Reporting Items for PRISMA Extension for Scoping Reviews (PRISMA-ScR) guideline for reporting this review. They determined keywords according to the search strategy of various m-health studies for extracting related keywords. The researchers also checked the published reviews of COVID-19 to find the possible synonyms. Additionally, they sought health information technology and medical informatics experts' (n = 2) advice for selecting appropriate keywords. Then they searched MEDLINE (PubMed), Embase, and IEEE using a combination of subject headings (MeSH in PubMed and Emtree in Embase) on July 6, 2020. Additionally, Google Scholar was searched to retrieve the related papers. Finally, the search strategy was confirmed by a librarian expert as follows: (search details in PubMed has been shown).

["Mobile Applications" [MeSH Terms] OR "Mobile Health Units" [MeSH Terms] OR "Telemedicine" [MeSH Terms] OR "Cell Phone" [MeSH Terms] OR "Cell Phone Use" [MeSH Terms] OR "Text Messaging" [MeSH Terms] OR "Smartphone" [MeSH Terms] OR "Wearable Electronic Devices" [MeSH Terms] OR "computers, handheld" [MeSH Terms] OR "Remote Sensing Technology" [MeSH Terms] OR "mobile health application" [Title/Abstract] OR "mobile health" [Title/Abstract] OR "mobile health technology" [Title/Abstract] OR "telehealth" [Title/Abstract] OR "mobile phone" [Title/Abstract] OR "text message" [Title/Abstract] OR "short message service" [Title/Abstract] OR "wearable sensor" [Title/Abstract] OR "wearable device" [Title/Abstract] OR "personal digital assistant" [Title/Abstract] OR "telemonitoring" [Title/Abstract] OR "remote sensing" [Title/Abstract] OR "tablet computer" [Title/Abstract] OR "laptop" [Title/Abstract] OR "laptop computer" [Title/Abstract] OR "mobile app" [Title/Abstract] OR "mhealth" [Title/Abstract] OR "m health" [Title/Abstract] OR "ehealth" [Title/Abstract] OR "e health" [Title/Abstract] OR "mobile medicine" [Title/Abstract] OR "mobile" [Title/Abstract] OR "vodcast" [Title/Abstract] OR "wearable" [Title/Abstract] OR "PDA" [Title/Abstract] OR "phone app" [Title/Abstract] OR "smart phone" [Title/Abstract] OR "cellular phone" [Title/Abstract] OR "palmtop" [Title/Abstract]**] AND [**"covid 19" [Title/Abstract] OR "2019 ncov" [Title/Abstract] OR "2019 cov" [Title/Abstract] OR "coronavirus" [Title/Abstract] OR "novel coronavirus" [Title/Abstract] OR "coronavirus 2019" [Title/Abstract] OR "sars cov 2" [Title/Abstract] OR "coronavirus disease 2019" [Title/Abstract] OR "Severe acute respiratory syndrome coronavirus 2" [Title/Abstract] OR "COVID-19" [Supplementary Concept]].

2.2. Study selection and data extraction

Papers were imported into the EndNote X6 library and duplicates were removed using the 'duplicate' function. Articles were screened according to inclusion and exclusion criteria (see Table 1) in three steps 1) Title, 2) abstract, and 3) full-text screening by two authors. Any disagreement on items was discussed and resolved in the online group. Then final papers were included.

Data were extracted from all included papers which met the eligibility criteria for our study. The following data were extracted: first author, country, m-health type, and applications of them in management of COVID-19. Finally, the achieved results were classified into sub-themes based on m-health applications.

Table 1
Screening papers based on the inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
English paper	Letter to Editors, Opinion
Studies that used m-health technologies	Protocols
Studies that used m-health for response to COVID-19	Reviews
Studies that aimed to manage, control, and reduce the COVID-19 pandemic	Telemedicine and Telehealth without the use of m-health approaches
Peer-reviewed studies	Preprints

3. Results

The initial search yielded 2046 papers from different databases and Google scholar. A total number of 1600 studies were remained after removing duplicates. Through the screening process based on title, 1236 papers were excluded. The reviewers excluded 291 articles after screening abstracts. Finally, a total number of 73 papers were eligible to be included in the full-text review, of which, 56 papers did not meet the inclusion criteria, and one paper has two versions (conference paper and journal article). Finally, 16 studies were included in the final review (See Fig. 1 for details).

Table 2 presents the main characteristics and findings of the included studies.

3.1. Applications of m-health in COVID-19

As our finding presents, applications of m-health for COVID-19 can be classified into four categories: 1) prevention, 2) diagnosis, 2) treatment, and 4) protection. Fig. 2 illustrates these categories, approaches of m-health solutions in the management of COVID -19, and their use cases in detail. The remaining of the paper is organized as follows: first mobile phone-based apps and their usage for COVID-19 is presented, followed by use cases of automated text messaging, wearable device/portable health screening device, mobile telehealth system (MTS), and finally portable biosensor for COVID-19.

3.1.1. Mobile phone-based apps

HeadToToe is a mobile platform for providing organized knowledge dissemination solutions to medical students and healthcare providers. The healthcare staff of Children's Hospital of Geneva used this app as a communication tool to share and reach local procedures, treatment plans, and general information about the COVID-19 to healthcare providers, especially physicians in their institutions. A survey answered by 125 healthcare professionals has shown that this app facilitated information retrieval (N (%) = 83.3%). On a 10-point Likert based questionnaire, the mentioned app was rated for being time-saving capabilities by 8.5 (SD = 2.1), reassurance concerning the care of COVID-19 patients in daily practice by 7.6 (SD = 2.1), and the need to seek information from other sources by 5.9 (SD = 3.3) [18].

A mobile app, called ETZ Treatment Guide, is a suitable app to provide timely information (such as information on knee replacement surgery, breast cancer, and cataract) for supporting patients during the therapeutic period. This app was customized for providing COVID-19 content for patient education and monitoring patients through the functionality of symptom monitoring and self-assessment at the non-academic teaching hospital"Elisabeth Twee Steden" (ETZ) in Tilburg, Netherlands. The app is available at Google Play and the App Store. During the 20 days, 6169 peoples had used this app to check their health status. Data captured by this app was used to depict an interactive map [16].

In the USA, a mobile app was developed for contact tracing (a process for identifying potential transmission ways to diminish further spreading of infectious disease outbreak) and determining the risk. This

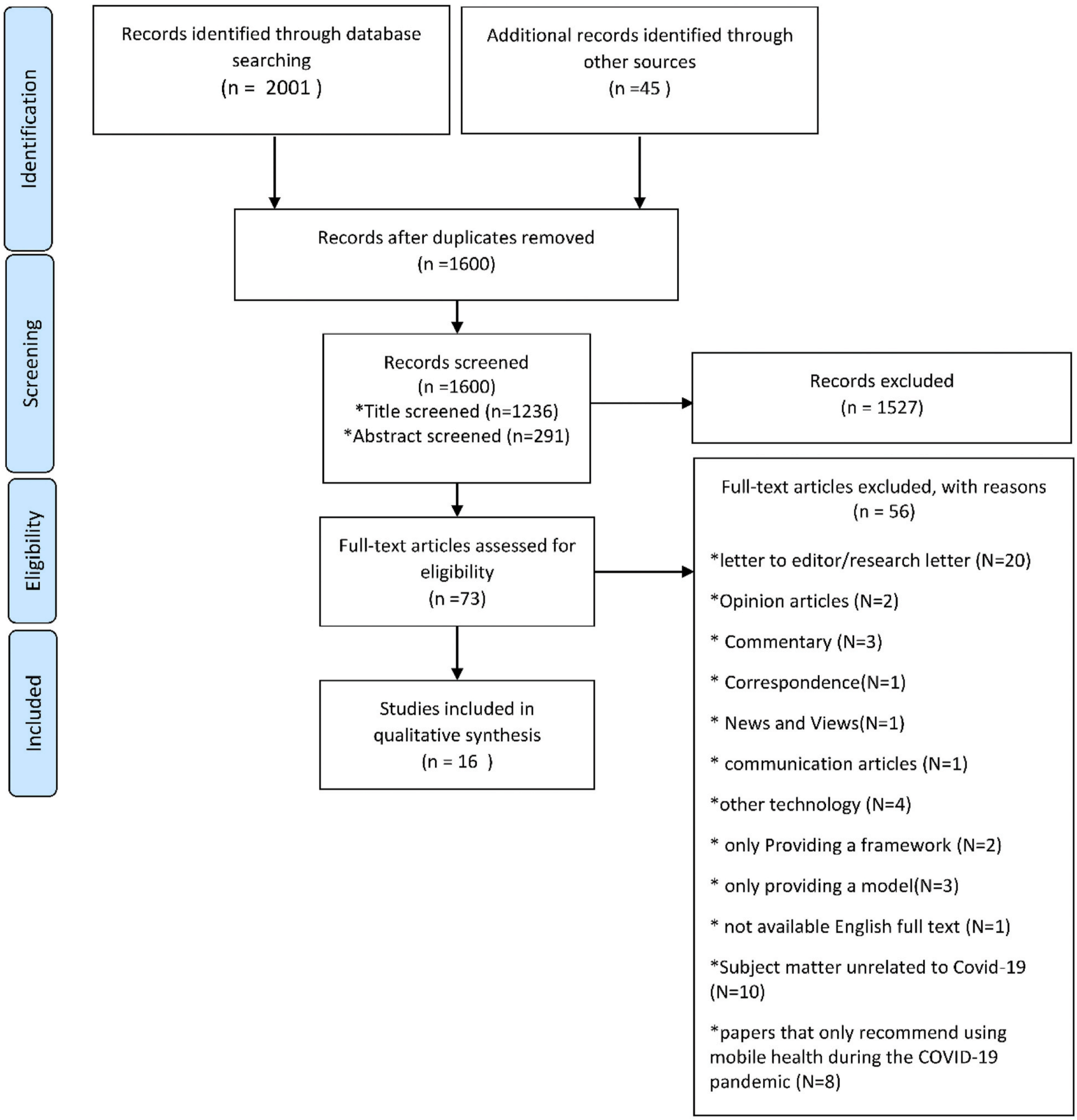

Fig. 1. Flowchart for the selection process of the included studies.

app performs through analyzing the data structure of the transmission graph [17]. The COVID-19 Caregiver Cockpit (C19CC) is based on the electronic health record system named CANKADO. It is a web/mobile app developed in Germany. The purpose of this app is to help physicians by assessing and identifying COVID-19 patients. This app has covered various scenarios ranging from people screening to visit preparation, remote monitoring, and using in the hospital ward [21].

The COVID Symptom Study mobile app was developed by Drew et al. for self-reporting data related to COVID-19 disease. Data include clinical information such as risk factors and demographic information such as age, and location across the United Kingdom and the United States. This app facilitates the report of epidemiological data on various symptoms of COVID-19 and determines emerging hotspot areas [22].

The symptom tracker for COVID-19 is another free mobile-based application launched in the United Kingdom and the United States between 24 March and April 21, 2020. During this period, 2,618,862 asymptomatic and symptomatic cases (2,450,569 in the United Kingdom and 168,293 in the US) have used this mobile phone app to capture self-reported data of COVID-19 symptoms. These data have been utilized to provide a predictive model to identify probable positive cases that had not conducted the COVID-19 test [22]. The Pallicovid Care Toolkit was developed by a workgroup of interdisciplinary palliative care clinicians to provide educational resources of palliative care for non-palliative care staff for the COVID-19 Pandemic. This program containing 1) a mobile and desktop Web application, 2) a comprehensive chapter in a COVID-19 online resource, 3) one-page summaries for managing dyspnea, pain, delirium, constipation, and goals of care conversations, 4) pocket cards consist of concise guidelines from one-page summaries, 5) communication skills training videos, 6) COVID nurse resource line for nursing advice and 7) Palliative care office hours. This app is available at pallicovid. app and covidprotocols.org [23]. In Georgia, Rao and Vazquez developed an online survey through the

Table 2
Applications of mobile health technologies in COVID-19 outbreak.

Application (section)	Authors (Year)	Country	m-health types	Applications in management of COVID-19
Mobile phone-based App (3.1.1)	Zamberg et al. [18]	Switzerland	Mobile-phone-based app (name: "HeadToToe")	• Dissemination solution for presenting medical content to healthcare providers • screening and containment procedures in hospital • Presenting common questions with their answers for parents • Providing consultation channels to increase the reach of valid information to health professionals, reduce misinformation, and efficiently implement the recommended measures. • tool for information seeking • used as a communication channel
	Timmers et al. [16]	Netherlands	Mobile phone-based app (name: "ETZ Behandelwijzer")	• Self-assessment • Education through videos for showing how preventing the COVID-19 outbreak • Obtaining the latest information about COVID by linking to RIVM's (Rijksinstituut voor Volksgezondheid, Welzijn en Sport) website
	Yasaka et al. [17]	United States	Mobile-phone-based app	• Contact tracing
	Schinköthe et al. [21]	Germany	Mobile phone-based app (name: CANKADO)	• Patient assessment • To help healthcare providers in screening and monitoring the patients
	Drew et al. [22]	The United Kingdom and the United States	Mobile phone-based app	• Identifying extremely prevalent symptoms • Testing broad hypotheses. • Identifying infected areas
	Menni et al. [22]	UK	Mobile phone-based app	• Self-assessment through reporting COVID-19 symptoms • Provide a predictive model for the detection of infected cases
	deLima Thomas et al. [23]	USA	Mobile phone-based app (multi-platform)	• Educating about palliative care for non-palliative care healthcare provider to apply in COVID-19 patients in the hospital
	Srinivasa Rao and Vazquez [15]	Georgia	Mobile phone	• Collecting signs and symptoms through an online survey • assisting to early diagnosis and screening
Automated Text Messaging (3.1.2)	Barrett et al. [24]	Ireland	automated text messaging	• Early detection of infected individuals by asking relevant questions
	Agyapong et al. [25]	Canada	SMS text messaging)name: Text4Hope)	• Managing mental health of subscribers
	Saleem et al. [26]	USA	Automated Text Messaging (name: Annie)	• Informing Coronavirus Precautions Protocol (CPP) to Veterans • Assisting in the management of the infected patients
Wearable device/Portable health screening device (3.1.3)	Chung et al. [27]	Taiwan	Wearable device (name: HEARThermo)	• Helping in early diagnosis through body temperature monitoring
	Jiang et al. [28]	China	Remote and portable respiratory infectious screening devices	• Screening of people wearing masks by measuring body temperature and respiration rate information
Mobile telehealth system (MTS) (3.1.4)	Gabriels et al. [29]	New York	Mobile continuous telemetry	• Monitoring cardiac arrhythmias among inpatients with COVID-19
	Ren et al. [30]	China	Mobile Telehealth	• Getting access to patient information any time and any place (mobile ward round at any time) • Supporting case information discussion, consultation, and tracking among healthcare providers using a mobile phone, without harming the security of medical information • Help to increase the efficiency of treatment
Biosensor (3.1.5)	Mavrikou et al. [31]	Greece	Portable biosensor	• Detecting COVID-19 spike protein (SARS-CoV-2 S1)

mobile phone for risk assessment of people to identify infected cases by using artificial intelligence (AI) algorithm [15].

3.1.2. Automated text messaging

Text Messaging was used for fast detection of infected cases by sending related questions about COVID-19 symptoms to asymptomatic persons (being in contact with the infected people) identified by the department of public health (DPH) in Ireland. These contacts answer questions with yes or no, then individuals with COVID-19 symptoms receiving teleconsulting or referred to clinicians for directly COVID-19 testing. The result of this study was indicative of the impact of the program on enhancement in the detection of positive cases (response percent to questions: 82.9%) [24].

The text message program named Text4Hope has aimed to monitor mental health (depression, anxiety, and stress) as a negative impact of the COVID-19 outbreak through a baseline questionnaire. After developing this system, many participants had subscribed for using it. However, there was no report on user satisfaction despite its evaluation one or two weeks after its usage [25].

The US Department of Veterans Affairs (VA) used an automated short message service (SMS) application called "Annie" to support the management of patients during the COVID-19 outbreak. Two protocols were used to develop this program as follows:

1. Coronavirus Precautions Protocol (CPP) that was supported through providing educational content about COVID-19 precautions by sending wellness questions and educational tips
2) Isolation/Quarantine that consisted of 9 questions about geographic distribution, responses to the Annie messages, clinical status (self-report), and activities that had taken or not taken according to the received messages [26].

3.1.3. Wearable device/portable health screening devices

The "HEARThermo" was a device for the early detection of infected patients by measuring body temperature and heart rate. Fever is a common symptom in COVID-19 patients. Therefore monitoring body temperature can help to an early screening of infected individuals [27].

Moreover, in China, a mobile device was developed for the remote screening of infected cases by monitoring the body temperature and respiration rate of individuals who wear masks.

The device consisted of two modules: 1) image collection module including smartphone and the thermal camera (name: FLIR one), 2)

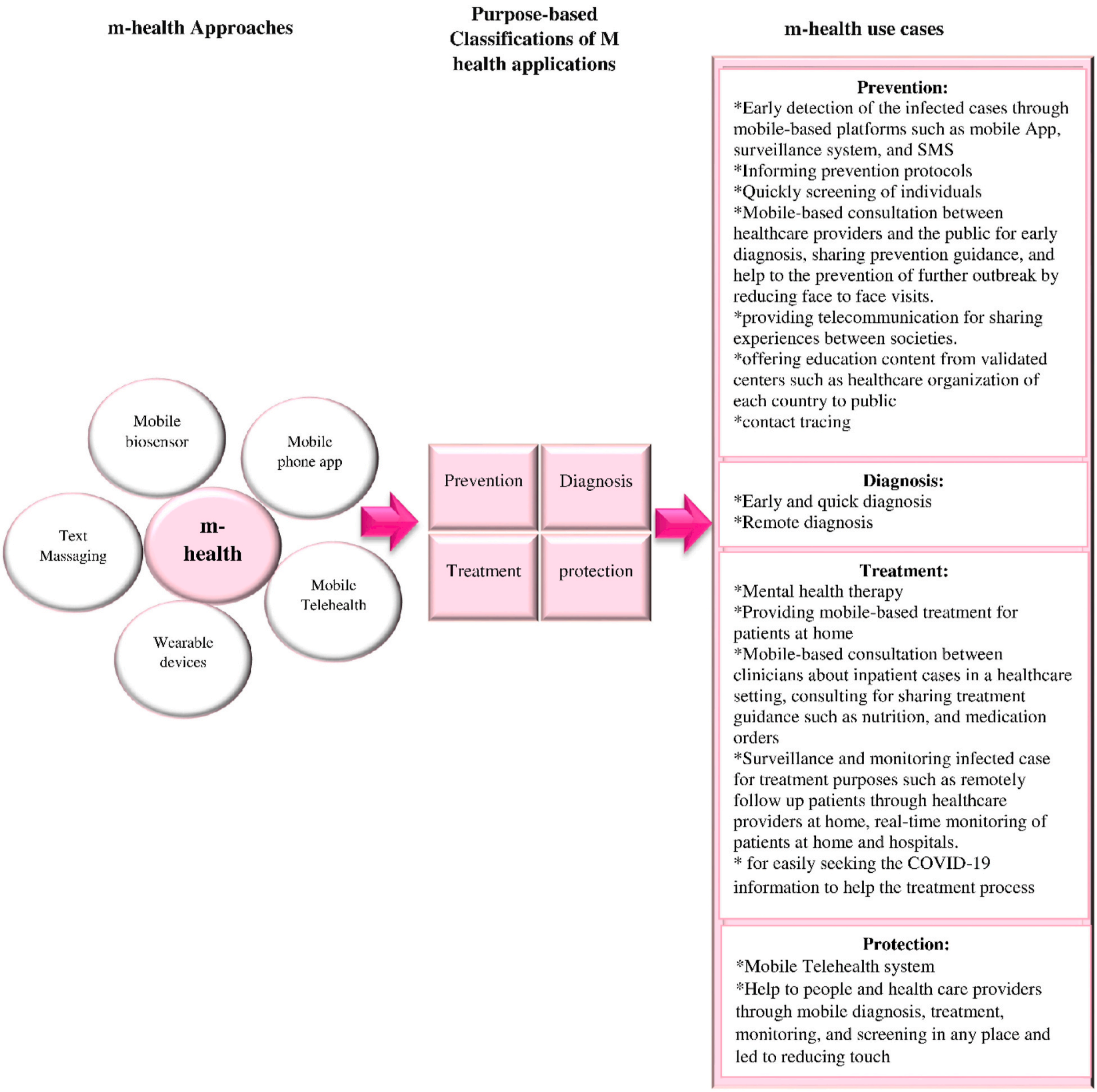

Fig. 2. Overview of m-health applications for the management of the COVID-19 outbreak.

health indicator measurement module for capturing body temperature and respiration rate. For this aim, the thermal camera linked to an android based mobile phone was used to detect nostrils in the thermal image through face recognition algorithms (region of interest (ROI) selection) and captured data. Finally, any abnormal condition could be reported and alerted by using 3)the health assessment module. This system obtained the accuracy, sensitivity, and specificity of 83.69%, 90.23%, and 90.23% [28].

3.1.4. Mobile telehealth system (MTS)

A "mobile continuous telemetry monitor" (MCOT) is a telehealth approach used for the COVID-19 cases being treated with hydroxychloroquine and azithromycin in inpatient settings. These medicines have the risk of ECG QT prolongation. Healthcare providers need to monitor "the QT interval" for patients taking these medicines. This work increases the contact of healthcare providers with the COVID-19 patients. Therefore, an alternative approach can reduce clinicians' exposure to infected cases and can contribute to their safety protection. Therefore, in the case report conducted by Gabriels et al., to decrease the exposure, MCOT was used for real-time monitoring of arrhythmias and QT interval of 72-year- old female inpatient to address this challenge [29].

A mobile telehealth system (MTS) is an m-health platform to decrease patient visits in a healthcare setting and providing healthcare services out of the hospital. For this purpose, there is a need to access patient information for reaching the efficiency of the therapeutic process. The MTS could address this challenge by presenting clinicians with patient information (inpatient and outpatient information) via five modules including medical record, condition abstract, medical advice, laboratory test, and radiology images. Real-time interaction and request/response modules were also developed and used for communication. This system led to reducing the person-to-person contact in the healthcare setting [30]. The C19CC application, previously described in the mobile phone section (3-1-1), can also be considered as a mobile telehealth tool [21].

3.1.5. Portable biosensor

A novel biosensor was developed for ultra-rapid (3 min) and ultra-sensitive detection of the SARS-CoV-2 S1 (the surface skip protein expressed on the surface of the COVID-19 virus). It is a ready-to-use platform such as a portable read-out device managed via mobile phone or tablet. The use of this bio-sensor was feasible for the mass screening of COVID-19 cases. Using this biosensor can facilitate the direct monitoring of viral infection without prior sample processing (e.g. RNA extraction from the patient samples, the creation of ribonucleo-protein (RNP) complexes) [31].

4. Discussion

We may call covid-19 pandemics a milestone in the history of m-health and telehealth worldwide, including developing countries. M-health capabilities have been applied quickly during the COVID-19 outbreaks. This work presented the applications of m-health for the COVID epidemic and then classified their purposes into four categories of prevention, diagnosis, treatment, and social (physical) distancing & protection.

The results of this review revealed that 50% (8/16) of m-health solutions were multi-purpose mobile phone-based apps [15–18,21,22,24]. This finding is in line with a study conducted by Iyengar et al. They articulated the purposes of using mobile applications during the COVID-19 as follows: monitoring, remote teleconsultation, group consulting, training, supporting mental health, and radiodiagnosis [20]. Mohanty et al. have referred to various mobile-phone apps targetting surveillance of epidemics such as Ebola, Zika, influenza, Dengue, Malaria, and H1N1. However, most of them have been released for the Influenza outbreak [32].

A short text message was another m-health application for the response to the COVID-19 pandemic. This use case had been reported in Barrett et al., Agyapong et al., and Saleem et al. studies [24–26]. The short message services have been previously referred to as an effective tool during disease outbreaks which significantly had led to enhancing notification of disease outbreaks in Kenya [33]. Concerning various types of m-health devices, smartphones are common for use among people and healthcare providers. Therefore, m-health solutions are more prevalent in the form of a smartphone-based app and short text message for offering educational content, prevention recommendations, quick screening, and early diagnosis of people. However, overuse and misuse of smartphone technology may pose users with some side effects. Accordingly, pain in the neck, elbow, wrist, and hand, Cubital Tunnel syndrome (Cell phone elbow), Carpal Tunnel Syndrome, De Quervain's Tenosynovitis, Extensor Pollicis Longus tendinitis/rupture, Extensor tendinitis, Myofascial syndrome of Adductor Pollicis, first interosseous, Extensor Digitorum Communis muscle, Weakness of grip, pinch and Low backache are commonly associated conditions with repeated overuse of smartphones [20,34,35]. The correct use with due care can avoid these side effects.

Smartphones can collect personal information (for example locations, and phone call logs of users). Therefore, it appears inevitable to address issues of privacy and data ownership. This aim can be achieved by using appropriate technical solutions for personal metadata management [36].

During the COVID-19 pandemic, mobile telehealth, as a beneficial approach, has been utilized for various aims (for example, facilitating access to patient information outside hospitals and assessing and identifying COVID-19 cases) [21,30]. In the past, the mobile-phone-based system had been developed for serological detection of Marburg and Ebola filoviruses. This antibody detection system aimed to tele-monitor infections caused by Ebola and Marburg filoviruses at the point of use. This system uses a flow cell assay cartridge that captures specific antibodies with microarrayed recombinant antigens, and a smartphone fluorescent reader for high-performance interpretation of test results [37]. Similarly, during the COVID-19 outbreak, the mobile telehealth system was applied to reduces face-to-face communication to prevent further spreading [30]. Therefore, the use of mobile telehealth capabilities can be applied as a beneficial tool during the infectious disease outbreak in particular for isolated or quarantined patients, as well as overcoming limitations such as patients' information unavailability, inaccessibility of healthcare providers when they are outside the hospital or health care center. However, there are some challenges for m-health applications in monitoring systems, as follows: 1) user-related challenges (e.g. literacy, technology acceptance, weak communication between health care providers and patients), 2) infrastructure challenges (e.g. data connection, standard, and regulations), 3) process challenge (e.g. security, confidentiality, and ethical concerns), 4) management challenges in quality control and legislation, 5) resource-related challenges such as hardware, software, cost, and developer, and 6) Training related challenges [38]. Therefore, despite the benefits of mobile services, appropriate solutions should be created to address the challenges of using these services in each country.

Reducing the outbreak impacts requires the quick diagnosis and screening of suspected COVID-19 cases. M-health approaches have contributed to this aim. They can facilitate the COVID-19 diagnosis and speed up the screening process. M-health solutions can improve healthcare provider safety (through reducing their direct exposure to infected cases) and promote social distancing via portable biosensors, mobile continuous telemetry monitor, and portable screening platforms. They can provide critical medical recommendations and alarm about COVID-19 [27–29,31,39].

Several papers have previously presented use cases of mobile devices for detecting infectious diseases [40–42]. For example, a portable magnetoresistive sensitive lab device was developed for diagnosing Influenza A virus for using outside hospitals [42]. Moreover, an affordable mobile-based device was built to diagnose Malaria by identifying Plasmodium parasites through artificial intelligence and image processing techniques [41]. Overall mobile devices have facilitated the detection and diagnosis of infected patients outside healthcare settings. They have managed to reduce face-to-face communication and increase the safety protection of health care providers and the public during the epidemic.

4.1. Limitations

Inadequate information about technical aspects of the included m-health solutions was one of the main limitations of this review.

5. Conclusion

It appears that m-health technologies played a positive role during the COVID-19 outbreak. Mobile-health has targeted the prevention, early detection, screening, education, and treatment of infected patients. Interestingly, smartphone-based apps were the most dominant solution in comparison to other mobile health technology types. The use of m-health technologies appears as an appropriate method to control and manage the COVID-19 outbreak because of its ubiquity. Therefore, planning for the realization of m-health potential should be considered by governments, software developers, healthcare providers, members of the public, and societies.

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Consent

Studies on patients or volunteers require ethics committee approval and fully informed written consent which should be documented in the paper. Authors must obtain written and signed consent to publish the case report from the patient (or, where applicable, the patient's guardian or next of kin) prior to submission. We ask Authors to confirm as part of the submission process that such consent has been obtained, and the manuscript must include a statement to this effect in a consent section at the end of the manuscript, as follows: "Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request". Patients have a right to privacy. Patients' and volunteers' names, initials, or hospital numbers should not be used. Images of patients or volunteers should not be used unless the information is essential for scientific purposes and explicit permission has been given as part of the consent. If such consent is made subject to any conditions, the Editor in Chief must be made aware of all such conditions. Even where consent has been given, identifying details should be omitted if they are not essential. If identifying characteristics are altered to protect anonymity, such as in genetic pedigrees, authors should provide assurance that alterations do not distort scientific meaning and editors should so note. Not applicable.

Author contribution

Please specify the contribution of each author to the paper, e.g. study design, data collections, data analysis, writing, others, who have contributed in other ways should be listed as contributors.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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