




Identifying data elements and key features of a mobile-based self-care application for patients with COVID-19 in Iran

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Heydari Mohammad

Department of Health Information Technology, Khalkhal University of Medical Sciences, Khalkhal, Iran

Monaghesh Elham

Department of Health Information Technology, School of Management and Medical Informatics, Tabriz University of Medical Sciences, Tabriz, Iran

Esmail Mehraeen

Department of Health Information Technology, Tehran University of Medical Sciences, Khalkhal, Iran

Vahideh Aghamohammadi

Department of Nutrition, Khalkhal University of Medical Sciences, Khalkhal, Iran

Seyedahmad Seyedalinaghi

Iranian Research Center for HIV/AIDS, Iranian Institute for Reduction of High Risk Behaviors, Tehran University of Medical Sciences, Tehran, Iran

Saeed Kalantari

Antimicrobial Resistance Research Center, Iran University of Medical Sciences, Tehran, Iran

Mehrabi Nahid

Assistant Professor of Health information management, Aja University of Medical Sciences (AUMS), Aja, Iran

Khadije Nasiri

Department of Medical- Surgical Nursing, Khalkhal University of Medical Sciences, Khalkhal, Iran

Corresponding author:

Khadije Nasiri, Department of Medical- Surgical Nursing, Khalkhal University of Medical Sciences, Khalkhal 5681955666, Iran
Email: Khadijeh.Nasiri@yahoo.com



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Abstract

Mobile Health applications have shown different usages in the COVID-19 pandemic, which consisted of empowering patient's awareness, promoting patient's self-care, and self-monitor behaviors. The purpose of this study is to identify key features and capabilities of a mobile-based application for self-care and self-management of people with COVID-19 disease. This study was a descriptive-analytical study that was conducted in two main phases in 2020. In the first phase, a literature review study was performed. In the second phase, using the information obtained from the review of similar articles, a questionnaire was designed to validate identified requirements. Based on the results of the first phase, 53 data elements and technical key features for mobile-based self-care application for people with COVID-19 were identified. According to the statistical population, 11 data elements for demographic requirements, 11 data elements for clinical requirements, 15 data elements for self-care specifications, and 16 features for the technical capability of this app were determined. Most of the items were selected by infectious and internal medicine specialists (94%). This study supports that the use of mobile-based applications can play an important role in the management of this disease. Software design and development could help manage and improve patients' health status.

Keywords

Self-care, COVID-19, mobile, application, mobile health

Introduction

COVID-19, an infectious disease emerging from SARS-CoV-2 with human pandemic potential, has created a worldwide health crisis.¹ The disease rapid progression and lack of awareness of its behavioral patterns necessitate an immediate initiative to tackle the health emergency.² To minimize the risk of contracting the coronavirus from person to person during an epidemic, various governments have taken extensive "preventive measures" including "social distancing" and "quarantine" of those at risk.^{3,4} Since a great number of patients do not necessarily need to be hospitalized and it is a must to do self-care and self-monitoring at home, the current initiatives, in this regard, include following the health protocols and abiding by the self-care instructions.^{5,6} Therefore, given the quarantine and public need, the level of public awareness and sensitivity to COVID-19 should be strengthened, and the importance of self-protection should be taught to the people through adequate preventive measures. People's awareness and skills in self-care should be increased.⁷

Self-care is an action in which each person uses the knowledge and proficiency acquired as a source of healthcare independently.⁸ This proceeding can also involve consulting and seeking professional or non-technical assistance from others.⁹ Although self-care is considered as an activity that people take to maintain, and promote their health, sometimes this care applies to children, family, friends, neighbors, and fellow citizens.¹⁰ In doing so, treatment and lifestyle associated with family, community, and health care providers are performed to manage the underlying signs and symptoms.¹¹ Health care organizations have recommended individuals not to leave their houses due to the high rate of spread of the new virus; hence, attention is drawn to the self-care guidelines for better management of the disease.^{5,7}

The World Health Organization (WHO) insisted on improvements in People health and necessary services through electronic technologies.¹² Digital technologies and electronic health for training people, people at risk and those with mild symptoms at this time can be helpful.¹³ It is estimated that there are >5 billion mobile users, and according to the State of Mobile report in 2019,

194 billion apps have been downloaded worldwide implying that a vast majority of people have easy access to apps.¹⁴ Mobile Applications offer a variety of useful functions ranging from remote tracking by health professionals to infection control and training patients.¹⁵ Apps that deal with health-related issues including prevention, diagnosis, self-care, and disease management help patients improve their health, accordingly.¹²

Needless to say, that information needs assessment and software capabilities are necessary to design a mobile self-care application for patients who do not need to be hospitalized. Due to the lack of similar studies in this case, therefore, the aim of this study was to design a mobile-based application for self-care education as one of the new self-care methods and disease management strategies with patient intervention. This research was conducted to identify features of a mobile-based self-care application for patients with COVID-19 not requiring hospitalization. This COVID-19 mobile app can enjoy functional capabilities such as educational information, special care programs for each user, medication reminders, and monitoring the disease improvement (respiratory status, gastrointestinal symptoms, severe cough and fever, and sense of smell) and daily sleeping and rest habits, as well as following the patient's recovery process for those who have COVID-19 disease.^{16,17}

Methodology

The present descriptive-analytical study that was carried out in two main phases in 2020.

Phase I

The team cooperatively planned and performed a search strategy to identify relevant literature that was specific to mHealth solutions intending COVID-19. In the first phase, a literature search was conducted and the articles were screened based on the inclusion criteria to extract and recognize the data elements and technical features of the COVID-19 self-care application. Then, the keywords searched using online databases of PubMed, IEEE Xplore, CINAHL, Scopus, Science Direct, and Web of Science as well as the WHO website and combined with the underneath search pattern:

- I. "COVID-19" OR "Coronavirus" OR "COVID" OR "SARS- COVID"
- II. "Mobile" OR "Mobile Health" OR "mhealth" OR "Smartphone" OR "Mobile phone" OR "Mobile application" OR "apps"
- III. "Self-care" OR "Self-management" "Self-care Strategies"
- IV. "Data Requirements" OR "Minimum Data Set" OR "Technical Capabilities"
- V. (I) AND (III)
- VI. (II) AND (IV)
- VII. (I) AND (II) AND (III) AND (IV)

The inclusion criteria were review and research articles (full-text access) in the English language. Exclusion criteria were as follows: (1) Letters to the editor (LTE), (2) abstracts, (3) systematic review protocol, (4) short reports, and (5) non-English-language articles. The publication was between 2019 and 2020; applying these criteria, the search for articles carried on until the articles were duplicated. The screening and review process for eligible articles was conducted according to the PRISMA guidelines (Figure 1).

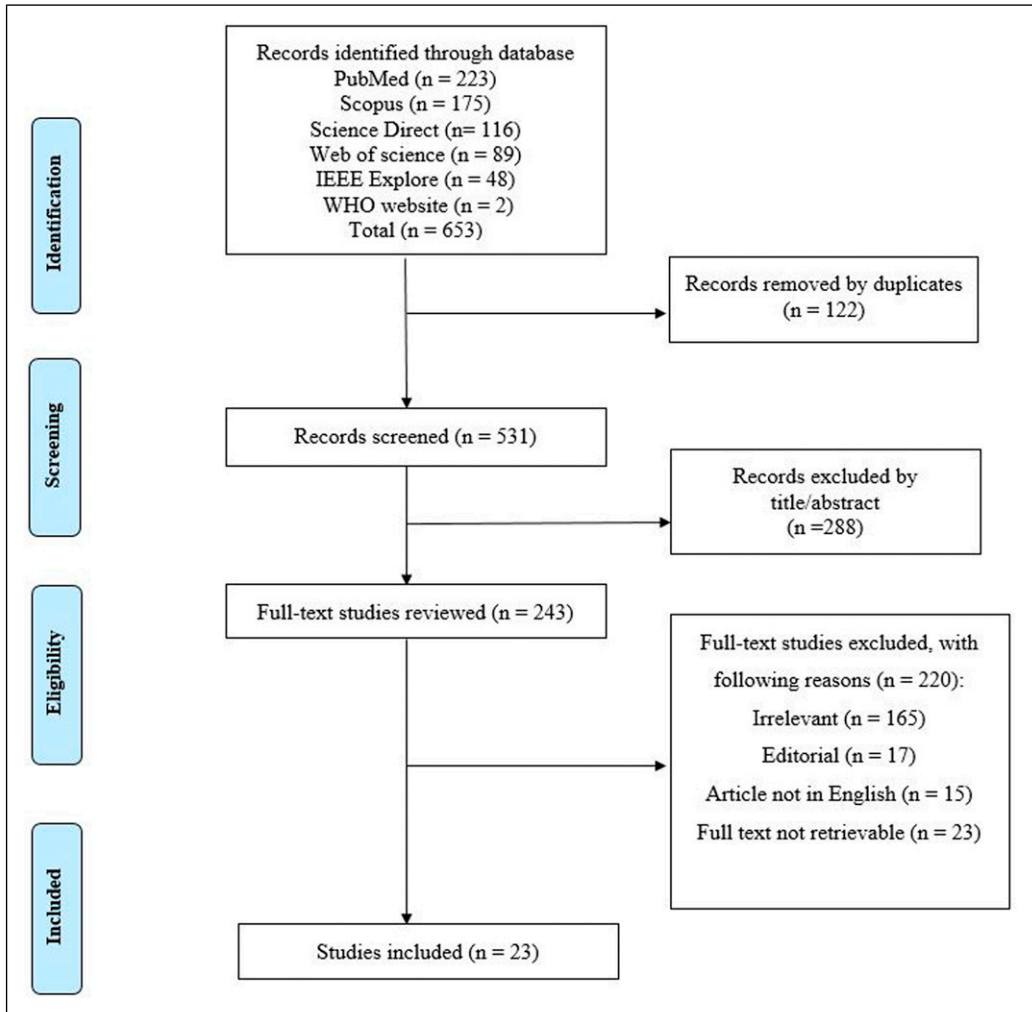


Figure 1. PRISMA diagram of articles included.¹⁸

Phase 2

In the next phase, using the data acquired from the review of studies, a questionnaire was planned to validate identified requirements. The validity of this questionnaire was evaluated and confirmed by 13 infectious and internal medicine specialists working in the corona centers of Khalkhal, Ardabil, and Tehran, who were randomly allocated to the research. The 53 items of the questionnaire contained four parts, an 11 item demographic information, 11 item clinical requirements, self-care education, disease monitoring requirements 15 items, and technical capabilities 16 items on a five-point Likert scale. Scores of each section of the questionnaire was ranged from 1 to 5 (I completely agree = 5, I agree = 4, I have no opinion = 3, I disagree = 2, and I completely disagree = 1).

In this stage, infectious and internal medicine specialists were asked to rank the importance or usefulness of features identified in the literature review. Each of the data elements and identified

features was regarded as necessary items, according to 10 infectious and internal medicine specialists, if that item obtained at least an average of 2.5 and more. The questionnaire has shown acceptable reliability with a Cronbach's alpha of 0.88. Moreover, the validity of the instrument applied was evaluated and confirmed by four specialist physicians. Finally, all statistical analyses were done using IBM SPSS Statistics software (Version 24) (IBM SPSS Statistics, Armonk, USA).

Ethical approval

The study protocol was approved by the Ethics Committee of Khalkhal University of Medical Science (IR.KHALUMS.REC.1399.010). Each participant signed an informed consent form.

Results

Selection and characteristics of source documents

In total, 653 published articles were identified in the database search and of these, 122 articles were duplicated, and 288 articles excluded based on the review of titles and abstracts. Of the 243 remaining, 223 articles excluded through independent review followed by team reviewer consensus and finally leaving a total of 23 articles examined. At this phase, we were looking for evidence to identify the information needs of a mobile-based self-care application for COVID-19 disease (Table 1). Articles in the selection process were demonstrated by the PRISMA diagram (Figure 1).

Data Extracted

Based on the analysis of retrieved articles, 53 items were identified in four categories; (1) demographic data elements, (2) clinical data elements, (3) self-care and disease monitoring data elements, and (4) technical features.

As shown in Table 1, sixteen main features were identified for the COVID-19 mobile-based self-care application based on literature. Patients education ($n = 19$), warning notifications ($n = 14$), self-assessment and self-monitoring features ($n = 13$), alert dialogs ($n = 12$), and share content with others (family and friends) ($n = 11$) were the most frequently identified technical features of COVID-19 self-care mobile application. Figure 2 depicts the most frequent technical features.

Scoring

Fifteen infectious and internal specialists working at Covid-19 referral centers were asked to score the identified data elements and technical capabilities of the questionnaire. Finally, the identified data elements and features were scored by 13 infectious and internal medicine specialists (response rate 87%). Physicians' expertise in infectious diseases and their prioritizing of the common mobile app elements will help develop a mobile app. All data elements of the demographic category, clinical requirements, self-care, and disease monitoring requirements were selected by statistical population. Moreover, according to the scoring of the statistical population, three technical features, including "Communicate with physicians," "Notebook for patients," and "Share content with others," in the technical feature category, had the lowest mean and were left out (2.3, 2.4, and 2.4, respectively) (Table 2).

In addition to healthcare, useful interventions promoting healthy behavior such as self-care instructions are crucial requirements of COVID management. Identification of data elements and

Table 1. Identified technical features of COVID-19 mobile-based self-care application on the review of literature.

First ID author	Year	Type of study	Technical features										Other features					
			User profile	Warning and alerts notification	Medication reminders	Nutritional features	Monitor adherence to medication	Receive feedback from users (contact us)	Educational text and images	Motivational messages	Fewer and cough monitor	Help		Communicate	Notebook for patient	Self-monitoring	Share content with others	Links to more information
1 Edwar Meinert ¹⁹	2020	Case study	N	Y	N	N	N	N	Y	Y	N	Y	N	Y	Y	N	N	Symptom tracking A voice control assistant
2 Piper Liping Liu ²⁰	2020	Original articles	N	Y	N	Y	N	N	N	N	N	Y	N	Y	N	N	N	—
3 Inobong Ekong ²¹	2020	Original articles	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Contact tracking Telecommunications Storage.
4 Mengchun Gong ²²	2020	Original articles	Y	Y	N	Y	Y	N	N	N	N	Y	N	N	N	N	N	management, and analysis of the integrated COVID-19 data
5 Muhammad Nazrul Islam ²³	2020	Review	N	Y	Y	N	N	Y	N	N	N	N	N	N	Y	Y	Y	Video consultation
6 Jane deLima Thomas ²⁴	2020	Original articles	Y	Y	N	Y	Y	N	N	N	Y	Y	N	N	Y	Y	Y	—
7 Becky Inlester ²⁵	2020	Viewpoint	N	Y	N	N	N	N	N	N	N	Y	N	N	Y	N	N	—
8 Miskyn Zhang ²⁶	2020	Review	N	Y	N	Y	N	N	N	N	Y	Y	N	N	Y	N	N	—
9 Keiichi Yamamoto ²⁶	2020	Original article	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	Y	Y	Y	Y	Symptom tracking
10 Sufang Huang ²⁷	2020	Case report	N	N	N	N	N	Y	Y	Y	N	N	N	N	Y	Y	Y	Online quarantine observation form
11 Ciro Catturo ²⁸	2020	—	N	N	Y	Y	Y	Y	N	N	Y	Y	N	Y	Y	Y	Y	emergency contact
12 Ravi Prataap Singh ²⁹	2020	Review	N	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Contact tracing
13 Yamamoto, K. ³⁰	2020	Original article	Y	Y	Y	N	N	Y	Y	Y	N	Y	N	Y	N	N	N	Capture the real-time data and other necessary information of the infected patient
14 Roberto Collado-Borrrell, ³¹	2020	Review	Y	N	Y	Y	Y	N	N	N	N	N	Y	Y	N	N	N	Health data monitoring in remote location and Virtual management
15 Doreen MachereraMukona ³²	2020	Review	N	N	Y	N	N	Y	Y	N	N	N	Y	Y	N	N	N	Recording of symptoms and contact tracing
16 Wirrb, F. N. ³³	2020	Scoping review	N	Y	Y	N	N	N	N	N	Y	N	Y	Y	Y	Y	Y	Recording of symptoms

(continued)

Table I. (continued)

First ID author	Year	Type of study	Technical features										Other features					
			User profile	Warning and alerts notification	Medication reminders	Nutritional features	Monitor adherence to medication	Receive feedback from users (contact us)	Educational text and images	Motivational messages	Fever and cough monitor	Help		Communicate	Notebook for patient	Self-monitoring	Share content with others	Links to more information
17 Thomas Timmers ³⁴	2020	Original article	Y	Y	Y	Y	N	N	Y	Y	N	Y	Y	N	Y	N	N	Symptoms track and monitoring and Follow-Up
18 Lucinda Lai ³⁵	2020	Original article	N	N	N	N	N	N	Y	Y	N	Y	N	N	Y	Y	N	Video Simulations of difficult conversations
19 Meshari F. Alweshmi ³⁶	2020	Communication	N	Y	N	N	N	N	N	N	N	Y	N	Y	N	N	N	Online surveillance-mapping tools
20 Sohini Sarbadhikari ³⁷	2020	Review	N	Y	Y	N	N	Y	N	Y	N	Y	N	Y	N	N	N	Deep learning and contact tracing
21 Haider, Ahmad S ³⁸	2020	Original article	N	N	N	N	N	N	Y	Y	Y	Y	Y	N	N	Y	N	Data visualization
22 Jaxaid, M ³⁹	2020	Review	N	Y	Y	N	N	Y	N	N	N	Y	Y	Y	N	N	N	Technologies to control and management of COVID-19
23 Yap, K. Y ⁴⁰	2020	Original article	Y	N	Y	N	N	Y	N	N	Y	N	N	Y	N	Y	N	—

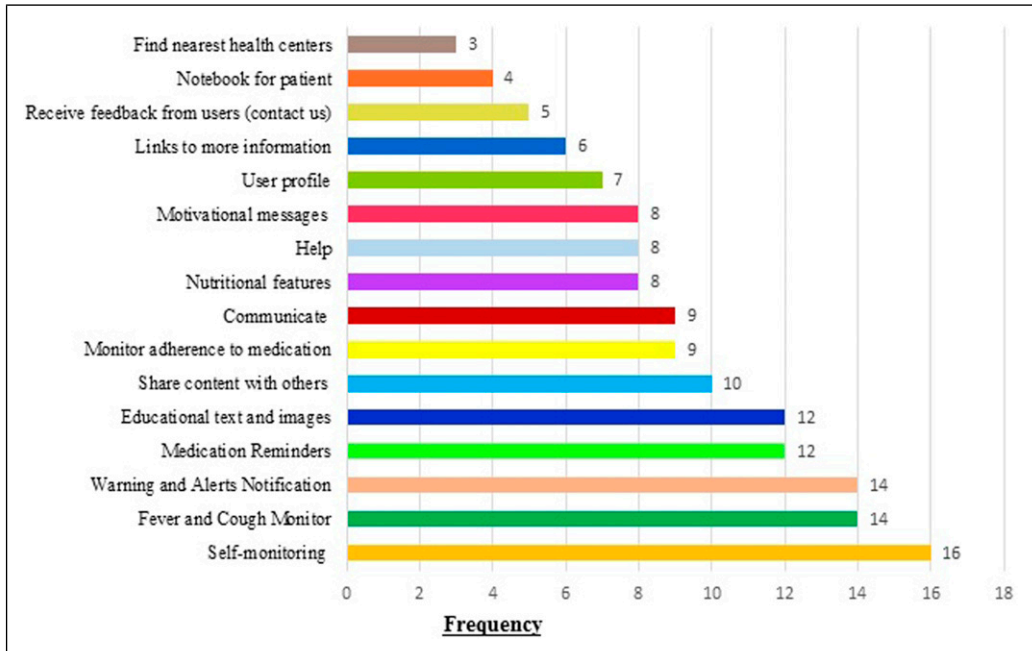


Figure 2. Frequency of identified technical features of COVID-19 Mobile-base Self-care Application on the review of literature.

technical features for mobile-based self-care applications for people with COVID-19, were selected. Physicians by answering the questions of the Likert scale questionnaire prioritized and determined common elements based on their expertise as well as their experiences of what a patient with Covid-19 needs for self-care; the elements that had the highest score are given priority. A Practical self-care mobile application with features such as reminders, warning notifications, symptom monitor, and manage the disease could improve the situation of patients.

Discussion

Self-care can be one of the main and practical approaches in the management and prevention of infectious illnesses⁴¹ which promote general health and wellbeing.⁴² Due to the prevalence of COVID-19 disease as a contagious infectious disease and the significance of self-care in the prevention of this disease, the participation of patients with this disease in self-care instruction is important for disease management.⁴³ Therefore, it seems the development of a mobile-based application is useful for infectious diseases.⁴⁴

In the present study, 53 technical features and data elements for mobile-based self-care application for individuals with COVID-19 were recognized, and according to the statistical population, 11 elements for demographic requirements, 11 elements for clinical requirements, 15 elements for self-care specifications, and 16 elements for technical specifications were detected. Three technical features, including “Communicate with physicians,” “Notebook for patients,” and “Share content with others,” in the technical feature category, had the lowest mean and were left out. Finally, 50 elements were approved for this app.

Table 2. The Mean and Std.deviation of given scores and selected data elements/technical features.

Category	No	Data element/technical features	Mean	SD	√/x
Demographic	1	Gender	4.7	0.37	✓
	2	Weight and height	4.3	0.5	✓
	3	Date of birth (age)	4.3	0.75	✓
	4	Place of birth (country, province, city)	4.0	0.7	✓
	5	Education level	3.7	0.72	✓
	6	Marital status (single/married/deceased spouse/divorced)	3.7	0.72	✓
	7	Patient name and surname	3.5	1.19	✓
	8	Occupation	3.5	0.77	✓
	9	Patient's address and phone/mobile number	3.3	0.85	✓
	10	National identity number	3.0	0.91	✓
	11	Race	2.6	1.1	✓
	Clinical	12	Type of underlying disease (diabetes mellitus, heart failure, asthma, chronic obstructive pulmonary disease, etc.)	4.8	0.37
13		Used medication	4.8	0.37	✓
14		History of underlying disease	4.7	0.43	✓
15		Daily fever	4.6	0.5	✓
16		Clinical symptoms (shortness of breath, chest pain, and fatigue.)	4.6	0.48	✓
17		Cough, fever, chills, sore throat, diarrhea and vomiting	4.5	0.51	✓
18		Commuting with a patient with COVID-19 (two choices)	4.4	0.52	✓
19		History of coronavirus in entourage	4.4	0.51	✓
20		Body Mass Index (BMI)	4.2	0.83	✓
21		Blood oxygen level	3.9	0.89	✓
22	Laboratory and chest CT imaging (Name of test, Laboratory test results...)	3.7	1.21	✓	

(continued)

Table 2. (continued)

Category	No	Data element/technical features	Mean	SD	√/x	
Self-care education and disease monitoring	23	Medication reminders and monitor adherence	4.6	0.51	√	
	24	Record daily fever and monitor fever	4.6	0.51	√	
	25	Educating the signs and symptoms of COVID-19	4.5	0.51	√	
	26	Educate self-isolation	4.4	0.51	√	
	27	Behavior management training to reduce outbreak	4.4	0.65	√	
	28	Medication recommendations and adherence to taking the drug	4.3	0.63	√	
	29	Dietary recommendations	4.3	0.63	√	
	30	How to use of shared devices in the house	4.3	0.63	√	
	31	Record blood oxygen and monitor	4.1	0.96	√	
	32	Motivational messages to the patient to reduce the psychological burden and stress caused by the disease	3.8	0.89	√	
	Technical features	33	Frequently asked questions about COVID-19 disease	3.8	0.68	√
		34	Training virus prevention and transmission strategies	3.8	0.55	√
35		Stress management and reduce patient anxiety	3.8	0.55	√	
36		Record and monitor the patient's daily sleep	3.7	0.63	√	
37		Daily warnings cessation smoking	3.5	0.87	√	
38		Medication reminders	4.4	0.66	√	
39		Self-assessment and self-monitoring (chart)	4.3	0.5	√	
40		Links to more educational information	4.2	0.63	√	
41		Nutritional features	4.0	0.64	√	
42		Fever and cough monitor	4.0	0.57	√	
43		Warning and alert notification	3.9	0.49	√	
44		Help	3.9	0.76	√	
45		User profile	3.6	0.5	√	
46		Motivational messages	3.5	0.51	√	
47		Educational text and images	3.4	0.76	√	
48		Monitor adherence to medication (chart)	3.3	0.63	√	
49		Receive feedback from the users (contact us)	3.2	0.59	√	
50		Introducing nearest COVID-19 specialized health centers	3.0	0.7	√	
51		Notebook for patient	2.4	0.66	x	
52		Share content with others (family and friends)	2.4	0.76	x	
53		Communicate with physicians	2.3	0.75	x	

x = Removed item, √ = Selected item.

Demographic requirements

The findings of the study show that 11 data elements are essential for the demographic part of the application. Demographic information is regarded as necessary data for identifying, calling, and following patients.⁴⁵ Sharpe and Niakan in their studies emphasized the identifying of demographic information to promote management of people living with HIV.^{43,46} In a study by Saeedinia et al.,⁴⁷ according to the statistical population, 13 data elements were identified for demographic information of a smartphone's self-care system to prevent COVID-19. Authors indicated that the completeness of identifying information can ameliorate self-care skills to prevent coronavirus, symptoms management, motivate and decrease stress, and enhance personal hygiene and communication with health care workers.⁴⁷ In the current study, "gender, height and weight, and age" had the highest mean score among the demographic characteristics that were in line with the results of studies by Sharp et al.,⁴³ Niakan et al.,⁴⁶ and Saeedinia.⁴⁷

Clinical requirements

According to the results, the "used medication" and "history of underlying disease and type of underlying disease" had the highest frequency among other clinical elements for the self-care application of COVID-19.

Previous studies have shown an increased susceptibility of COVID-19 infection and high mortality in patients with underlying diseases, including diabetes mellitus, hypertension, respiratory system disease, and cardiovascular disease.^{48,49} Also, Lippi et al.,⁵⁰ demonstrated chronic obstructive pulmonary disease (COPD) is related to a significant, over five-fold raised risk of severe COVID-19 infection. Guan et al.⁵¹ showed that the presence of any co-existing disease was more common among patients with severe disease in contrast to non-severe patients. Attention to medications used in the treatment of comorbidities might save countless lives by COVID-19 disease.⁵² Medicines such as statins, angiotensin-converting enzyme inhibitors (ACEIs), and angiotensin receptor blockers (ARBs) may raise the vulnerability of COVID-19 infection and the odds of lung injury secondary to augmented angiotensin-converting enzyme 2 (ACE2) expression.^{53,54}

Self-care education and disease monitoring requirements

The "medication reminders and monitor adherence," "training the signs and symptoms of COVID-19," and "record daily fever and monitor fever" had the highest mean among the self-care education and disease monitoring requirements. The typical manifestations of COVID-19 disease are fever, cough, fatigue, and gastrointestinal symptoms.^{46,54,55} Personal health records (PHRs) are appropriate for the daily management of physical status versus the highly infectious diseases.²⁶

As mentioned above, "medication reminders and monitor adherence" also had the highest score. Self-care refers to proceeding that patients undertake to maintain and enhance health, such as approaches to reach and maintain high levels of medication adherence.⁵⁷ Narasimhan et al.,⁵⁸ indicated that a voice call reminder system may ameliorate medication adherence and in turn enhance treatment outcomes among patients with Tuberculosis. The results of studies on HIV patients showed that smartphone applications such as text message reminders may have the potential to improve adherence to antiretroviral therapy.^{43,59} The usability and acceptability of a smartphone application have been evaluated to assist oral chemotherapy adherence and symptom management in people suffering from cancer.⁶⁰ People with chronic conditions such as diabetes can

enhance their adherence to treatment and manage their disease by using self-care app features such as medication reminders, blood sugar monitoring, and diet and exercise recommendations.⁴³

Technical capability

“Links to more educational information” had the highest score in the data elements for the technical capability of the COVID-19 self-care application. Saeidnia et al.⁴⁷ showed that the data elements of communication with health and medical units, educational messages, communication with the physician, and receiving news from reputable sources had the highest score in the technical capability of COVID-19 self-care application. In addition, in another study, the element of educational information was reported to be the highest score among the technical features of the diabetes self-care application⁴⁵. Monitoring adherence to medication use is another feature confirmed in the present research that is consistent with the findings of other studies such as Swendeman et al.,⁶¹ Narasimhan et al.⁵⁸, and Perera et al.⁵⁹

Conclusion

The requirements and technical capabilities of a mobile-based self-care application for patients with COVID-19 were recognized in four categories of demographic, clinical, self-care education and disease monitoring, and technical features. The symptoms of COVID-19, record daily fever, and monitor the fever and medication reminders, and monitor adherence were the most highlighted technical features of the COVID-19 self-care application. Due to the infectious nature of COVID-19 disease and the need for self-isolation of patients, the use of mobile-based applications can play an important role in the management of this disease. Also, Researchers can use these findings as a foundation for designing and creating new COVID-related mobile-based applications.

Limitations

The present study had some limitations. At the first phase, there was a limitation of studies in this issue. Moreover, to collect the data, researchers had to visit specialists in person.

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ORCID iDs

Esmael Mehraeen  <https://orcid.org/0000-0003-4108-2973>

Khadijeh Nasiri  <https://orcid.org/0000-0001-6404-5257>

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