

CHAPTER 3

Mobile/Web-Based Applications in Healthcare

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Introduction

According to reports, the first mobile health applications were created in the 1960s to track the health of astronauts in space. Wireless devices that monitor an individual's heart rate while they are exercising were created in the years that followed, and with the advent of smartphones, mobile/web-based health applications began to gain popularity (Kopmaz & Arslanoğlu, 2018). The average life expectancy has increased as a result of health advancements, and the prevalence of chronic diseases has increased the workload of healthcare personnel. Healthcare services are rapidly evolving to handle this workload. The most significant aspect of this process of development and change in health is the use of mobile and web-based applications. A growing number of disease areas are using mobile/web-based applications, which the World Health Organization defines as "the provision of many applications in the field of health supported by mobile phones, patient tracking tools, personal digital assistants, and web-based applications" (Keutzer et al., 2020). It can be said that mobile or web-based health applications that adopt strategies such as taking responsibility for one's health after attending to the immediate health needs of the person who applies to the health institution to receive health services when he or she is ill, taking precautions to maintain his or her health and avoid becoming ill, carrying information about his or her health status with him or her, and using treatment protocols appropriate for the patient's genetic make-up and personality structure Teenagers and young adults frequently use smartphones and tablets. A variety of treatments and goals, such as knowledge growth and independent self-management abilities, can be addressed thanks to the multipurpose properties of smartphones and tablets (Virella Pérez et al., 2019). The workload of healthcare professionals diminishes at the same time as patient and healthy individual health awareness rises due to the widespread usage and expanded capability of mobile/web-based applications in health (Ghose et al., 2022).

For the technology used in all areas of life to be used more effectively and efficiently in the field of health, initiatives to increase the awareness of health professionals and society on this issue are gaining importance. Mobile/web-based applications in health continue to be used as supportive or complementary to many traditional applications used to date. Mobile/web-based applications, which continue to be used for different purposes in the field of health, are offered to the use of society and healthcare professionals with both advantages and disadvantages and changing usage types. While evaluation studies on the effectiveness of mobile/web-based applications

in the field of health continue to increase day by day, there are many studies with high levels of evidence demonstrating the effectiveness of these applications (Farooqui et al., 2015; Castensøe-Seidenfaden et al., 2018; Le Marne et al., 2018; Aromatario et al., 2019; Virella Pérez et al., 2019; Lorca-Cabrera et al., 2020; McCloud et al., 2020).

Uses and Purposes of Mobile/Web-based Applications in Health Care

Mobile/Web-based applications are widely used in health promotion, diagnosis, clinical treatment and care, home care and follow-up, patient and staff training, counseling, and coaching. It is noteworthy that the rate of use of mobile/Web-based applications is affected by the development status of countries, and as science and technology progress, the rate and areas of use increase. For developed countries, remote disease management is used for nutrition, exercise activities, and electronic transfer of patient data to maintain health and well-being, while for developing countries it is used for purposes such as informing via mobile phone, raising awareness about diseases and disease prevention (Stach et al., 2020; Tezcan, 2016).

Remote monitoring of patients receiving outpatient or inpatient treatment and care services, monitoring their vital signs, and sharing them with healthcare professionals in a timely and instantaneous manner so that necessary interventions can be made without delay are important for both healthcare professionals and patients (Demir & Arslan, 2017). In a systematic review evaluating mobile applications used for diagnosis and treatment, it was determined that cameras, touch screens, and microphones were the most frequently used internal sensors, and it was reported that the topics addressed by these applications were respiratory, dermatology, neurology and anxiety-related health problems (Baxter et al., 2020). In a study examining the characteristics of mobile applications developed to improve lifestyle for chronic diseases, it was determined that the applications are mostly for the treatment of conditions related to many diagnosed chronic diseases such as diabetes mellitus, hypertension, cardiovascular diseases, asthma, and neoplasms. The main interventions were lifestyle changes, reducing body weight, promoting a healthy diet, and encouraging regular physical exercise. It was also concluded that simple messages and warnings to adhere to treatment facilitate health care (Debon et al., 2019). A clinical monitoring system based on color-coded alarm systems has been developed to monitor an entire unit or a bed in an intensive care unit according to the severity of patients' vital signs (Ventola, 2014). In a systematic review study examining smartphone applications developed for the care of patients with diabetes, it was found that the applications focused on reminder systems to encourage treatment adherence, patient information/education, collective information and gamification, processing of blood glucose data, and nurse coaching system via telephone (Fornengo, 2022). Mobile/web-based applications are useful to overcome problems such as difficulty in diagnosis, patient compliance, and lack of education, which are also problems in tuberculosis treatment (Keutzer et al., 2020). Counseling, sexual therapy, and self-management interventions through mobile applications have been shown to have positive effects on sexual health problems in chronic patients (Karim et al., 2020). In a study examining pediatric health behaviors and related outcomes of digital technology, behavioral issues such as vaccination compliance, HIV prevention, dental hygiene, sun protection, physical activity, smoking, obesity, diabetes, stem cell transplantation, and asthma were addressed as in adults (Virella Pérez et al., 2019). It can be said that mobile/Web-based applications can be applied for behavior change for both adults and children. Mobile/web-based applications are also used in orthopedics and trauma surgery patient groups for education and health information. However, it has been stated that disadvantageous

situations such as the fact that the target audience consists of young people and the elderly cannot benefit from these applications (Reinecke et al. 2021). As a result of the articles analyzed from 19 countries to determine the scope of mobile health applications that help COVID-19 management, 29 mobile applications were identified. Among these, 15 (52%) applications were contact tracing, 7 (24%) applications were quarantine, 7 (24%) applications were symptom monitoring, and 1 (3%) information provision application. More than half (n=20, 69%) were developed by government sources, only 3 (10%) by private organizations, and 3 (10%) by universities. It was stated that these practices can be effective when adopted by the community (John Leon Singh et al., 2020).

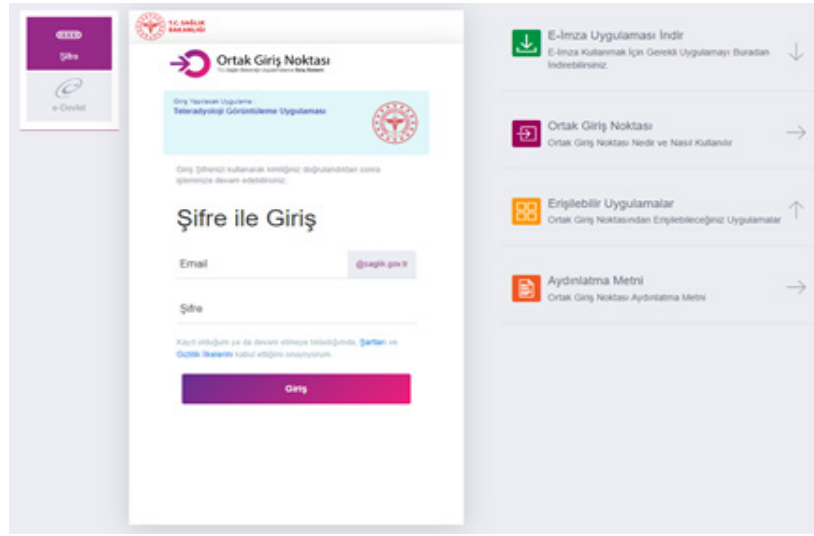
Types of Mobile/Web-based Application Usage in Health Care

In healthcare, there is a wide choice of apps that can help answer clinical practice and other questions at the point of care, such as drug reference guides, calculators, clinical guidelines, and other decision support aids, textbooks and literature search portals, and so on. There are even mobile apps that can perform simple examinations such as surgical simulations, hearing or vision tests (Ventola, 2014). Although there are many different types of use in health, mobile/web-based applications can be listed as telehealth applications, text messaging, smartphone applications, home care technologies, etc. (Tezcan, 2016).

With telehealth applications; health workers can provide home health services to individuals living in rural areas by communicating remotely with the patient or healthy individual. Telehealth applications enable clinical services to use information technology, video imaging, and telecommunication links to provide remote health services. Remote medical services include telemedicine, defined as the provision of medical services by a physician, as well as the services of professionals such as tele-nursing and tele-pharmacy (El-Sherif et al., 2022). Telehealth applications are mostly used in diabetes, hypertension, depression, heart failure, dementia, COPD/asthma, and kidney failure (Dogan Merih et al., 2021; El-Sherif et al., 2022). Telehealth applications have different clinical application modes such as simultaneous interaction, storing and transmitting data, remote monitoring, and telephone communication (Alvandi, 2017). In Turkey, telehealth applications started with services such as radiological reporting, ECG interpretation, reporting of pathology tissues, and consultation by planning services in the fields of radiology, pathology, and ECG. Today, the Ministry of Health carries out telehealth services with a focus on radiological reporting, teleconsultation, quality control, and e-Nabız integration. In this context, many hospitals have been included in the system. Examinations and evaluations have shown that thanks to the Picture Archiving and Communication Systems (PACS) system, approximately 65% of physicians have given up ordering additional radiology films (Sungur, 2020). For preventive healthcare services for the Syrian refugee population in Turkey, an application called HERA was launched in 2018, offering services in three local languages, namely Arabic, Turkish, and English (Narla et al., 2020). Various applications are offering similar services in many countries. For example, there are applications such as "Amwell, Zocdoc" developed in 2006 and 2007 in the USA, "Ping An Good Doctor" developed in 2015 in China, "MediQuo" developed in 2017 in Spain, "Vezeeta" developed in 2012 in Egypt, "Health Connect" developed in 2018 in Nigeria, "Yandex Health" developed in 2016 in Russia. There are many similar applications in the world (El-Sherif et al., 2022).

Figure 1

A Teleradiology Imaging Application in Turkey (Source: <https://teleradyoloji.saglik.gov.tr/> Access: January 10, 2023)



Short messages (SMS) can be used for appointment reminders, chronic disease management, payment transactions, health alerts (vaccination time alerts, etc.), medication reminders, and transmission of data such as pain level and blood pressure to the health institution.

Figure 2

Short Message (SMS) from the Hospital (Source: <https://www.ntv.com.tr/saglik/devlet-hastanelerinde-sms-donemi-basladi,34tyexpJBWqlJd16SoNpg> Access: 10 Ocak 2023)

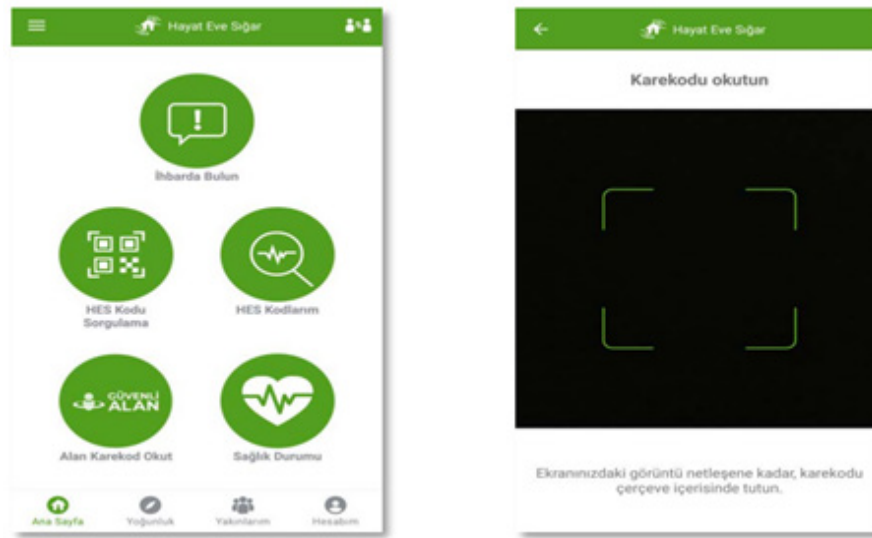


Smartphone applications (mobile apps) enable real-time communication with the patient, enabling diagnosis and treatment. For example, there are smartphone applications that can detect visual impairments with the help of a phone or an external accessory (Ventola, 2014; Majumder et al., 2020; Aruljyothi et al., 2021). In addition, smartphones are used in public health applications, data collection in epidemics, more effective research planning, security of drug supply chains, ensuring drug compliance,

more effective implementation of treatments, and many other innovative solutions (Lamonaca et al., 2015). In addition, interventions such as self-management, physical activity, and exercise programs can be easily done with smartphone applications (Güler & Eby, 2015; Byambasuren et al., 2019). During the COVID-19 pandemic, the Turkish Ministry of Health developed a mobile application called "Hayat Eve Sığar" (Life Fits Home), shown in Figure 5, to ensure the control of individuals in their environments and to monitor their vaccine quarantine and health status.

Figure 3

Hayat Eve Sığar Mobile Application (Source: <https://hayatevesigar.saglik.gov.tr/HES.pdf> Access: January 10, 2023).



With home care technologies; home care applications can be easily provided especially for patient groups over the age of 65, with diabetes, high blood pressure, heart failure, chronic lung diseases, and disabilities. Home healthcare services are provided through technological approaches such as artificial intelligence applications, telehealth, wearable technology, communication with medical devices, reliable home technologies, and care robots, virtual reality applications (Doğan Merih et al., 2021). Mobile/Web-based health applications enable patients who need home care to communicate with their doctors via video communication and to send their data regularly. Especially in cases where face-to-face home visits to individuals living in rural areas are prevented due to time, distance, and weather obstacles, transportation can be provided with home care technologies (Olver, 2005; Read Paul et al., 2019). In one study, mobile web-based video conferencing, which is a home care technology, was used to support elderly palliative care patients living in rural areas, and it was stated that this service, which is more effective than phone calls, has limitations such as low visual and audio quality compared to face-to-face visits (Read Paul et al., 2019). For examples of home care support systems in Turkey, <https://apps.apple.com/us/app/aile-destek/id1606165366> and <https://sesanltd.com.tr/saglik-bakanligi-evde-saglik-hizmetlerine-nasil-basvurulur/> links can be examined.

Advantages of Mobile/Web-based Applications in Health Care

Although there are many possibilities and opportunities for mobile and web-based health applications, one of the most crucial things to keep in mind is that applications and solutions do not always rely solely on technology. Mobile and web-based health applications are comparable in complexity to other health applications, it can be argued. Their advantages, however, are that they can be accessed remotely and make extensive use of communication and information technologies. Another benefit is that they give patients or healthy people the opportunity to control the process by taking an active role in their care. They allow for remote monitoring and reporting of people's health state in addition to serving as a communication tool for healthcare providers (Ardahan & Akdeniz, 2018). Applications for smartphones and the web can help remind users to take their medication on time and motivate them to exercise (Güler & Eby, 2015). The ability to communicate information and messages in real-time, provide remote monitoring, enable video conferencing between the patient and the healthcare provider providing care, and serve as a friend and reminder for the user regarding exercise, nutrition, and medication use are just a few benefits of mobile/web-based health applications (Güler & Eby, 2015). Additionally, according to Aromatario et al. (2019), using mobile or web-based applications can help to lessen health disparities. In the field of healthcare, mobile/web-based applications can assist with financial and administrative transactions, public health surveillance, professional training, and biomedical research, streamlining administrative costs and improving the health of the nation's population while also saving time in the education of healthcare professionals and both sick and healthy people (National Research Council et al., 2000).

Being responsible for a dependent person is often cited as a significant source of stress that can affect caregivers' health and quality of life. Mobile/Web-based applications can help empower caregivers of people with chronic diseases and develop solutions to reduce physical and psychological problems caused by caregiving (Lorca-Cabrera et al., 2020). Ploeg et al. (2017). (2017) reported that web-based interventions reduced depressive symptoms, anxiety, stress, and distress among caregivers of adults with chronic diseases (Ploeg et al., 2017). Sherifali et al. (2018) also reported that internet-based interventions improved the mental health of caregivers responsible for adults dealing with chronic illness, particularly depressive symptoms, stress, distress, and anxiety (Sherifali et al., 2018).

Smartphones and tablets provide easy access and use at the point of care with a single device, as they can be stored in a pocket with both computing and communication features. In addition to providing voice and text information, newer models offer more advanced features such as web search, global positioning systems (GPS), high-quality cameras, and voice recorders (Ventola, 2014). Cloud-based storage and file-sharing services, which can be accessed using a mobile device, are useful in information management as they allow users to store, update and share documents or photos with others without the need to use a flash drive or CD. Cloud-based information storage allows instant access to information from multiple devices, thus enabling people working together in healthcare to share materials quickly (Nguyen et al., 2019; Fellah et al., 2020). In summary, it can be said that the use of mobile/web-based applications in the field of health will lead to better diagnosis and treatment, individuals who can manage their health, increased preventive health practices, chronic disease follow-up, continuity of the health system, time savings for healthcare professionals and patients, and cost reduction by reducing hospitalization. Mobile/web-based applications, which

offer unlimited possibilities and opportunities, should be used carefully and attentively in health service delivery, which is an important and risky area (Ardahan & Akdeniz, 2018; Tezcan, 2016).

Disadvantages of Mobile/Web-Based Applications in Health Care

Despite the fact that technology has gotten more affordable, one of its biggest limitations is cost due to the complicated question of who should pay for mobile and web-based health apps. For instance, many cloud-based storage systems used in mobile and web-based apps, which are useful for storing data, offer users several gigabytes of memory for free; however, users are frequently prompted to pay an annual fee for extra space (Xu et al., 2021). For many users, this can be a drawback. Because healthcare organizations use various applications that are incompatible with one another, patients are unable to access their medical information (Tezcan, 2016). For the information to be effective, it is crucial that social inequality be addressed as well as the user's degree of health and technological literacy. Individuals with low health literacy may not be able to use these technologies (Öney Doğanyigit, 2015; Aromatario et al., 2019). Since personal data can be accessed by mobile/web-based health applications, strict security and privacy precautions must be taken to protect the confidentiality of data; otherwise, grave issues with personal data may occur. Users' lack of awareness of the fact that mobile/web-based health applications can only be helpful with consistent use and the danger of internet and phone use to the point of addiction is a drawback (Tezcan, 2016; Silva et al., 2018; Kayyali et al., 2017). The misuse of various diet and exercise programs provided by mobile and web-based health applications, particularly by those with chronic illnesses, can lead to a variety of health issues. Due to this, specialists in the field must create the content of such mobile/web-based health applications while adhering to the guidelines (Kopmaz & Arslanoglu, 2018). All age groups can use programs that are mobile or web-based. However, it can be said that usage rates decline as people get older. This may be considered a drawback, particularly for senior populations where the prevalence of chronic diseases is considerable (Reinecke et al. 2021).

Evaluation of the Efficiency/Effectiveness of Mobile/Web-Based Applications in Healthcare

The development of technology affects and determines how practices are carried out. Accordingly, healthcare professionals need to evaluate the impact of developing technology on health practices. There are short-term results related to mobile/web-based health applications and there are no long-term outputs, and time is required for the formation of sufficient outputs that prove efficiency/effectiveness (Ardahan & Akdeniz, 2018).

In a study that comprehensively evaluated the effect of mobile health applications on physical activity and eating behaviors on behavior change, it was stated that even when the applications were related to eating behaviors, the evaluations were tool-oriented rather than intervention-oriented (Aromatario et al., 2019). Mobile/web-based application studies with pediatric patients were examined and 78% of the participants found the "Young with Diabetes" application useful and 85% reported that they would recommend it to others (Castensøe-Seidenfaden et al., 2018), the participants of the "EpApp" application reported the information content and reminder themes of the application as the most useful feature (Le Marne et al, 2018), participants of the "Asthmahero" application used the application as a medication reminder, it provided

patients' confidence and motivation in achieving asthma control, and 95% of the participants reported satisfaction with the application (Farooqui et al., 2015). In a study conducted in the United States, a storytelling intervention was conducted on a mobile/web-based platform to encourage HPV vaccination in women, and positive improvements were found in women's knowledge and attitudes toward HPV vaccination (Kim et al., 2020). Significant improvements in women's self-efficacy and quality of life were reported with a mobile/web-based self-management application for women with breast cancer experiencing chemotherapy-induced amenorrhea (Park et al., 2021). A mobile/web-based training program for pregnant women was conducted and it was concluded that the participants were generally satisfied with the training, but they reported that there should be more training content on dealing with emergencies that may occur in infants and newborn care (Kim & Kang, 2019). With an application called "ScreenMen" developed to encourage health screening in men, it was reported that men's desire for health screening was increased and that the application was useful and users' satisfaction levels were high (Teo et al., 2019).

To evaluate the application developed in our training study given with a mobile application to improve the supportive care needs and quality of life of women with breast cancer, the patient evaluation form, the supportive care needs scale (Aksuoğlu & Şenturan, 2016) and the World Health Organization quality of life scale (Eser et al., 1999) and the questionnaires for evaluating the application created by the authors were used. "The Effect Of Training Performed Using Mobile Application On Supportive Care Requirements And Quality Of Life In Women With Breast Cancer: Randomized Controlled Study", a mobile application was developed. Mobile applications developed in preparation for the study were examined. The educational content to be placed in the application was prepared, and factors such as whether the application serves the purpose, whether it is related to the care needs of the target group, the comprehensibility of the language, font, contrast, easy-to-use, simple and plain design, and the comprehensibility of the menu and icons were taken into consideration. Expert opinion on the content of the training and the application was obtained before the implementation of the study. Patients were included in the group that received opinions. It was determined that there was a consensus among the experts regarding the appropriateness of the scope of the mobile application and that the expert opinions were compatible with each other. After it was determined that Kendall's Wa coefficient of concordance was $W=0.180$ ($p<0.05$, $\chi^2=44.340$), the application was offered to the users (Balci & Faydali, 2023).

The application, which we call **My Breast Health**, is in Turkish. It consists of seven interfaces: "Edit Password and Information", "How I Feel Today", "Daily Tips", "Training", "Forms and Scales", "About Us", "Resources". User login and interfaces were controlled through the "Admin Panel". Users registered to the application with a username and password that they set themselves. After the user registration was approved by the Admin Panel, the use of the application became active. Users' access to the mobile application and completion of the training content could be monitored throughout the study. **My Breast Health** mobile application admin panel and mobile application interfaces are given below as pictures. Images can be used regarding the chapter (Balci & Faydali, 2023).

Figure 4

My Breast Health Mobile Application Admin Panel

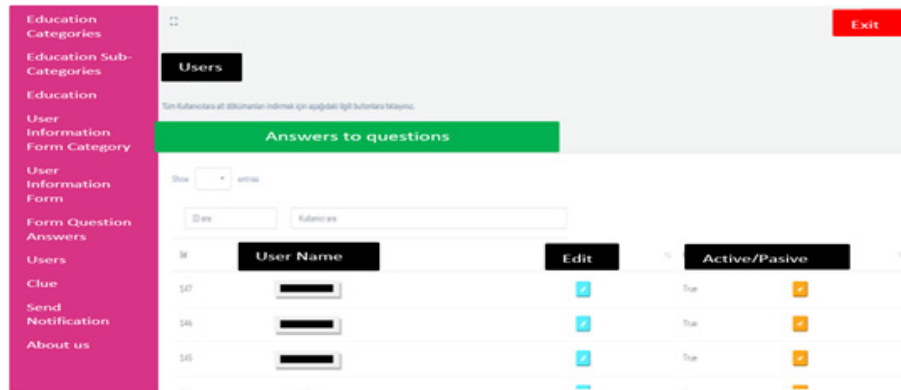


Figure 5

Interfaces of the mobile application



Interface 1; Edit Password and Information. This is an interface for women to edit their passwords and information.

Interface 2; How am I feeling today? Women were asked to indicate whether they had any problems or care needs daily.

Interface 3; Daily Tip. When a patient logged in to the application (to better manage symptoms), a daily tip was sent by the researcher about the solution suggestions for the most common problems mentioned in the training content and the subject that the patient marked as needing care.

Interface 4; Training. This interface included training topics shaped in line with expert opinions.

Interface 5; Forms and Scales. The scales and forms to be filled in by the patients were presented through the mobile application.

Interface 6; About Us. This interface explains the purpose and content of this application. It also provides information about the researcher (Balci & Faydali, 2023).

At the end of the study, women who experienced the My Breast Health mobile application were asked about their opinions with positive and negative statements about the training content and the application. The evaluation results of the patients after the study are given in Table 1. It was determined that the majority of women who evaluated

the mobile application were satisfied with the mobile application and found it useful. As a result of the study, the supportive care needs of patients using the mobile application decreased positively and their quality of life increased significantly ($p<0.05$) (Balci & Faydali, 2023).

Table 1

Evaluation of Mobile Application and Education (n=41)

Opinions on the content of the training	Yes	Unde- cided	No
	n (%)	n (%)	n (%)
Was the language of the training clear?	41 (100)	0 (0)	0 (0)
Was the content of the training adequate?	40 (97,6)	1 (2,4)	0 (0)
Did the training cover your care needs?	40 (97,6)	1 (2,4)	0 (0)
Did the mobile application meet your information needs?	40 (97,6)	0 (0)	1 (2,4)
Were the topics provided with the mobile application understand- able?	40 (97,6)	1 (2,4)	0 (0)
Were the visuals of the training explanatory?	38 (92,7)	2 (4,9)	1 (2,4)
Opinions on the mobile application			
Did the mobile app serve its purpose?	40 (97,6)	1 (2,4)	0 (0)
Was the typeface of the mobile app appropriate?	40 (97,6)	1 (2,4)	0 (0)
Was the contrast of the mobile application sufficient?	40 (97,6)	0 (0)	1 (2,4)
Was it easy to switch between application interfaces/screens and/ or easy to use?	40 (97,6)	1 (2,4)	0 (0)
Were the main menu icons of the mobile application understand- able/easy to use?	40 (97,6)	0 (0)	1 (2,4)
Did you find the mobile application reliable?	40 (97,6)	0 (0)	1 (2,4)
Were you satisfied with the communication through the mobile app?	40 (97,6)	1 (2,4)	0 (0)
Were you satisfied with the reminders?	40 (97,6)	0 (0)	1 (2,4)
Was the mobile app content readable?	39 (95,1)	0 (0)	2 (4,9)
Were you satisfied with the mobile interaction?	39 (95,1)	2 (4,9)	0 (0)
Was the design of the app simple and straightforward?	39 (95,1)	1 (2,4)	1 (2,4)
Were you able to concentrate while using the mobile app?	38 (92,7)	3 (7,3)	0 (0)
Was the mobile application advantageous?	38 (92,7)	3 (7,3)	0 (0)
Were the topics given with the mobile application memorable?	38 (92,7)	2 (4,9)	1 (2,4)
Are you satisfied with using the mobile application?	37 (90,2)	2 (4,9)	2 (4,9)
Was the performance of the mobile application adequate?	33 (80,5)	2 (4,9)	6 (14,6)
Was it visually big enough?	27 (65,9)	0 (0)	14 (34,1)
Was the mobile application easy to install?	26 (63,4)	2 (4,9)	13 (31,7)
Would you prefer face-to-face training to mobile application?	23 (56,1)	9 (22)	9 (22)
Would you like the training to continue with the mobile applica- tion?	19 (46,3)	3 (7,3)	19 (46,3)
Did you need support in using the mobile application?	13 (31,7)	2 (4,9)	26 (63,4)
Were there any disadvantages of the mobile application?	8 (19,5)	5 (12,2)	28 (68,3)
Did you think that your privacy was violated in the mobile appli- cation?	5 (12,2)	0 (0)	36 (87,8)
Did you have any problems with the mobile application?	5 (12,2)	1 (2,4)	35 (85,4)
Was the mobile application complicated?	2 (4,9)	1 (2,4)	38 (92,7)

Conclusion

Notably, both patients and medical professionals' benefit from the use of mobile and web-based applications in healthcare. In order to reduce effort and time, mobile and web-based applications should be made available to healthcare professionals as well as patients. Within the purview of governments and health ministries, applications can be created for both small-scale and large-scale studies. It is believed that once the service is made available to vast numbers of people, the cost will drop and the ongoing usage of applications may be secured. It is advised that attempts to develop new technologies in this area as well as evidence-based research assessing mobile/web-based applications be extended.

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