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Challenges of using telemedicine for patients with diabetes during the COVID-19 pandemic: A scoping review

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ABSTRACT

Background: Telemedicine has aided patients with diabetes during the COVID-19 pandemic in receiving better healthcare services. However, despite its numerous benefits, the use of this technology has faced several challenges. This study aimed to identify the challenges of using telemedicine for patients with diabetes during the COVID-19 pandemic.

Methods: This scoping review was conducted in 2024. Relevant articles published between 2020 and 2023 were searched in databases including PubMed, Scopus, Web of Science, ProQuest, and the Cochrane Library. Initially, 822 articles were retrieved, and after screening 21 articles were selected.

Results: The challenges of using telemedicine for patients with diabetes during the COVID-19 pandemic were categorized into the clinical, individual, organizational, and technical challenges. The clinical challenges included the lack of physical examinations and unavailability of patients' medical history. The individual challenges contained difficulties in using smart phones by patients and their low level of literacy. The organizational challenges were related to insufficient laws about obtaining patient consent and limited reimbursement for telemedicine services, and the technical challenges included limited access to the high-speed Internet services and inadequate technical infrastructure for telemedicine services. Most studies highlighted the role of individual and organizational challenges in using this technology.

Conclusions: Considering the numerous challenges experienced in using telemedicine for patients with diabetes during the COVID-19 pandemic, it seems that more attention should be paid to address each of these challenges to improve the actual usage, service quality, and user acceptance of telemedicine technology. This, in turn, can lead to saving costs and improving the health status and quality of life of patients with diabetes.

Introduction

Diabetes is a metabolic disorder caused by insulin deficiency or insulin resistance and characterized by an increase in blood glucose level, polyphagia, polydipsia, and polyuria. [1] Patients with diabetes are generally susceptible to infections, including respiratory infections, due to the nature of their disease. With the prevalence of the COVID-19 pandemic, individuals with diabetes were at a higher risk of contracting this infection. [1–3] It is estimated that 463 million adults worldwide have diabetes, and approximately 20 to 50 percent of the COVID-19 cases coincide with diabetes. [1] However, providing treatment for patients with diabetes, who suffer from COVID-19 at the same time, is

challenging because their blood glucose levels may increase, and the virus thrives under these conditions. [1,4,5].

To help patients with diabetes, the use of telemedicine technology was suggested. [3] Although the use of this technology for different groups of patients including patients with diabetes has been started many years ago [6], it has become more prominent during the COVID-19 pandemic, as the quarantine measures, social distancing, and the lack of access to healthcare professionals and treatment centers affected the routine procedures for controlling patients' blood glucose and their quality of life. [2,6] Telemedicine refers to the use of information and communication technologies that provide remote medical services, and can be used where healthcare professionals are not available, or in rural

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areas with a noticeable lack of healthcare services. [4] Telemedicine not only aids in blood glucose control, but also helps to reduce the number of in-person visits. [6] The results of a study conducted in India showed that by using telemedicine in the less privileged areas of Delhi, it was possible to screen and manage patients with diabetes during COVID-19. [1] During the COVID pandemic, the virtual clinics and telemedicine interventions were increasingly used to provide appropriate care to patients, including those with diabetes. This, in turn, helped to protect patients from being exposed to COVID-19. The findings of Boscari et al.'s study demonstrated that telemedicine improved glucose control in individuals with diabetes during the COVID-19 pandemic, and can be effective in managing diabetes and precise medication adjustments. [7] In addition, blood glucose control enhances the immune system of patients with diabetes, and reduces the complications associated with COVID-19. [8] Overall, it has been revealed that telemedicine is a powerful tool that allows continuity of care while minimizing the spread of COVID-19 virus. [9].

However, despite all the benefits, the use of telemedicine for patients with diabetes, especially during the COVID-19 pandemic, had some challenges including the lack of familiarity with smart healthcare technologies such as mobile health and telemedicine, technology security concerns, difficulties in decision-making by both patients and physicians, and an increased workload for the healthcare providers. [3] In addition, due to the lack of patient examination and relying on the individual self-reports, in some cases, there is a possibility of making wrong clinical decisions, and many patients feel dissatisfied due to the lack of face-to-face contact with their physicians. [10] Therefore, the aim of this study was to identify the challenges of using telemedicine technology for patients with diabetes during the COVID-19 pandemic via conducting a scoping review. It is expected that the findings of this study facilitate the implementation of future telemedicine services and contribute to improving the health status of patients with diabetes.

Material and methods

This was a scoping review conducted in 2024. The research was conducted using the Arksey and O'Malley methodology. [11] Prior to conducting the study, ethical approval was obtained from the ethics Committee of Iran University of Medical Sciences (IR.IUMS.REC.1400.727).

Research stages

Stage 1: Identifying the research question

The identification of the research question is the starting point for developing search strategies. In the present study, the research question was as follows:

What are the challenges in using telemedicine for patients with diabetes during the COVID-19 pandemic?

Stage 2: Identifying relevant studies

To identify relevant studies, PubMed, Proquest, Scopus, Web of Science, the Cochrane Library, SID, Magiran, IranDoc databases and Google Scholar were searched, and English/Persian articles published between 2020 and 2023 were included in the study. Since the COVID-19 pandemic was declared by the World Health Organization in early 2020, studies were searched from 1st January 2020 to 31st December 2023. To obtain the related articles, a comprehensive search strategy was developed, which included a set of keywords combined using the "OR" and "AND" operators. The keywords and phrases were selected based on the MeSh Terms, suggested entry terms by PubMed, as well as the relevant keywords used in the published articles. The databases, concepts, and keywords are presented in Table 1.

Stage 3: Study selection

All studies, including quantitative, qualitative, and mixed-methods research methodologies, related to the challenges of using telemedicine for patients with diabetes during the COVID-19 pandemic were

Table 1
Databases and concepts.

Databases	PubMed, Proquest, Scopus, Web of Science, the Cochrane Library, SID, Magiran, IranDoc, Google Scholar
Concepts	Telemedicine, diabetes, COVID-19, challenges
Keywords for Telemedicine	"mHealth" OR "Telemonitoring" OR "Telehealth" OR "Mobile Health" OR "Telemedicine"
Keywords for diabetes	"Diabetes" OR "Diabetes Mellitus" OR "Diabetes Insipidus" OR "Gestational diabetes" OR "Type 1 diabetes" OR "Type 2 Diabetes" OR "Type I Diabetes" OR "Type II Diabetes"
Keywords for Covid-19	"Covid-19" OR "Coronavirus" OR "SARS Coronavirus" OR "SARS-COV-2"
Keywords for challenge	"challenge" OR "perception"

included in the present study.

However, articles that were not relevant to the use of telemedicine for patients with diabetes during the COVID-19 pandemic, were published before the pandemic, or were editorials, commentaries, unpublished articles, reports, organizational publications, and guidelines were excluded from the study. In addition, if the full texts of the articles were not available, they were excluded, and only articles published in English or Persian were selected.

Stage 4: Charting the data

After searching databases, retrieved articles were imported into EndNote and duplicates were removed. All articles were screened with respect to their title, abstract, and full text. To extract the data, a data extraction form was designed. The form included the name of the country, publication year, authors' names, research objectives, research methodology, and challenges of using telemedicine for patients with diabetes during the COVID-19 pandemic.

Stage 5: Collecting, summarizing, and reporting of results

The extracted data were presented in a table. Then, the results were summarized and reported descriptively.

Results

A total of 822 articles were identified after searching databases. After removing duplicate articles, 435 remained. The remaining ones were examined in terms of the relevance of their title and abstract to the research topic. Then, full texts of the articles were sought, and 37 articles were removed as there was no access to their full texts. The remaining articles (n = 59) were fully reviewed and assessed for eligibility. Finally, 21 articles were selected and entered for the review study, as they met the inclusion criteria. The process was undertaken according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) [12] (Fig. 1).

Characteristics of the selected studies

The results showed that studies were conducted in Hungary [6], India [14,15], the United States [16–24], Iran [25], Kuwait [26], Brazil [27], Jordan [28], Italy [29,30], the United Kingdom [31,32], and Greece [33]. These studies were published between 2020 and 2023, and a summary of them is provided in Table 2.

Based on the research findings, the challenges of using telemedicine for patients with diabetes during the COVID-19 pandemic can be divided into four categories: clinical, individual, organizational and technical challenges. According to the results, the clinical challenges [6,14,16,17,19–24,26,27,29–33] and the individual challenges [6,14,15,18,20–27,29,30–33] were highlighted in 17 articles. The organizational challenges were addressed in 16 articles [6,14,16,17,20–22,24–32], and the technical challenges were mentioned in 13 articles. [6,14,17,21–24,26–29,31,32].

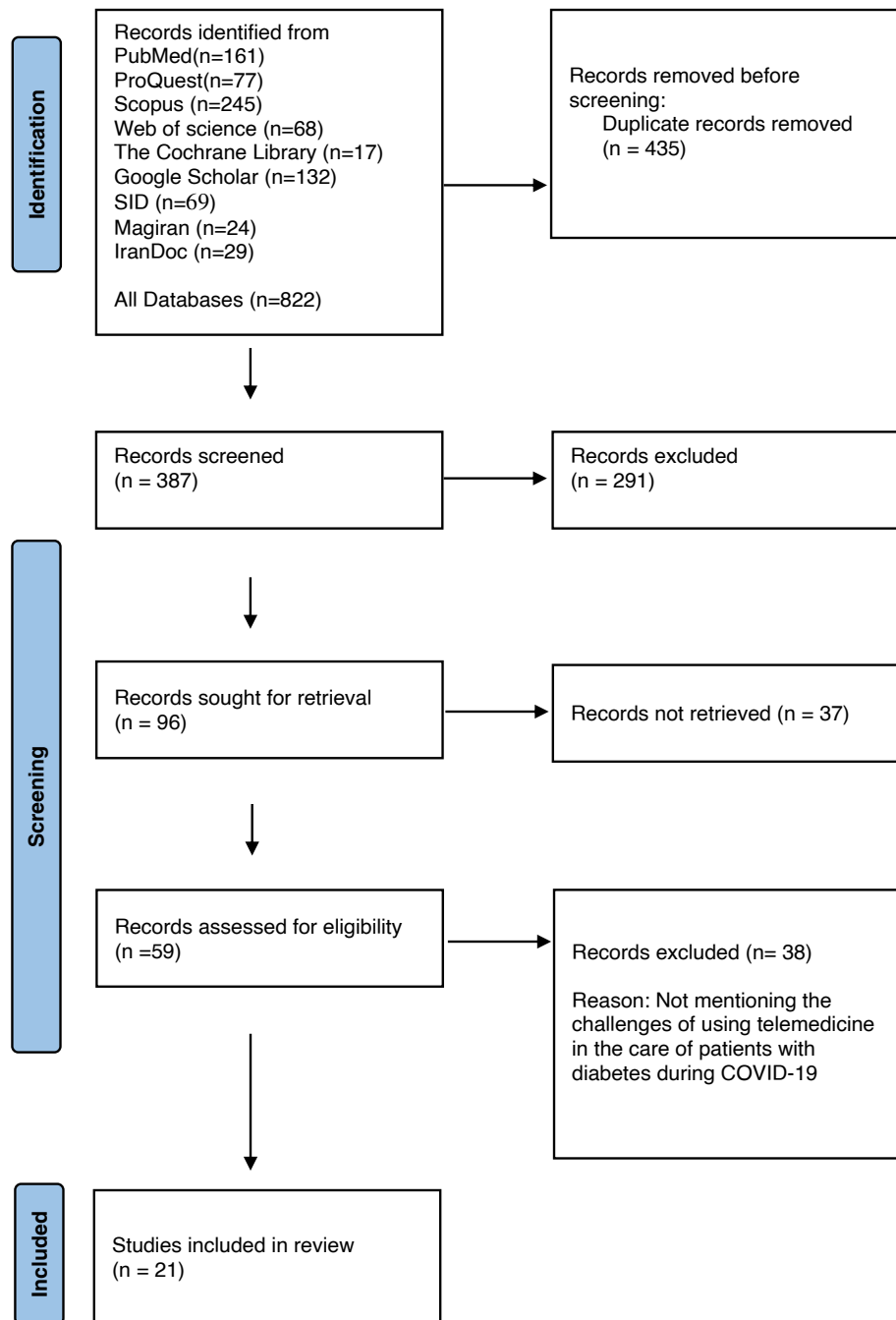


Fig. 1. Process of selecting articles [13].

Clinical challenges

Clinical challenges in using telemedicine for patients with diabetes during the COVID-19 pandemic were addressed in various studies. These studies were conducted in Hungary [6], India [14], the United States [16,17,19,21–24], Kuwait [26], Brazil [27], Italy [29,30], the United Kingdom [31,32], and Greece [33].

Among clinical challenges, the impossibility of physical examinations via telemedicine services was mentioned in most studies. [6,14,16,17,19,21,23,24,26,30,31,33] Other challenges included difficulty in communication between patients and healthcare providers, insufficient patient education [27], and a lack of adherence to the treatment protocols by patients [32]. The findings of two studies indicated that the lack of access to the patient medical history was also a

clinical barrier for using telemedicine for patients with diabetes during the COVID-19 pandemic. [14,24,26,31] Banerjee et al.’s findings showed that sometimes, there was no final diagnosis for patients, but medications were prescribed and, in some cases, the prescribed drugs were among the banned medications. [14] Other challenges included reducing time spent on visiting a patient compared to the in-person visits [17] and the lack of standardized forms for documenting patient medical records. [29].

Individual challenges

Individual challenges were mentioned in most studies. These studies were conducted in Hungary [6], India [14,15], the United States [18,20–24], Kuwait [26], Brazil [27], Italy [29,30], Iran [25], United

Table 2
Challenges of using telemedicine for patients with diabetes during the Covid-19 pandemic.

NO	Author, year	Country	Research objective	Research methodology	Challenges of using telemedicine for patients with diabetes during the Covid-19 pandemic	
1	Banerjee et al., 2020 [14]	India	To describe the role of teleconsultation in caring for people with diabetes mellitus (DM)	Qualitative (Literature review)	Clinical challenges Individual challenges Organizational challenges Technical challenges	Unavailability of patient medical history Impossibility of physical examinations Prescribing medication despite lack of final diagnosis Prescribing drugs prohibited by the government Difficulty in using smartphones by patients Low level of user acceptance (patient, patient's family and service providers) Insufficient rules about obtaining patient consent Lack of access to the high-speed internet services Impossibility of physical examination.
2	Garg et al., 2020 [16]	USA	To present two cases of type 1 diabetes management through telemedicine and discussing the potential of these services in the time of COVID-19	Qualitative (Case report)	Clinical challenges Individual challenges Organizational challenges	Not reported Inadequate rules for financial supports via insurance companies Limited reimbursement for telemedicine services Not reported
3	Ghosh et al., 2020 [15]	India	To explore data on telemedicine for patients with diabetes in times of restricted mobility due to COVID-19 pandemic	Qualitative (Literature review)	Technical challenges Clinical challenges Individual challenges	Not reported Concerns about patient privacy and information confidentiality Difficulty in communicating with elderly patients Low level of patient literacy Inadequacy of users' technical skills Not reported
4	Nouhjah and Jahanfar, 2020 [25]	Iran	To highlight challenges in the management of patients with diabetes during the COVID-19 outbreak in developing countries	Qualitative) Literature review)	Organizational challenges Technical challenges Clinical challenges Individual challenges	Not reported Inadequate experience of patients in making video calls Low level of patient literacy Low level of patient's family literacy Inadequacy of users' technical skills Limited provision of telemedicine services Limited engagement of health service providers in the production of digital health tools Lack of an integrated national registry system to identify patients with diabetes Not reported
5	Odeh et al., 2020 [28]	Jordan	to evaluate the effect of measures on pediatrics patients with type 1 diabetes in terms of acute metabolic complications and shortages in insulin and glucose measuring supplies and to evaluates the caregivers' perceptions of the use of telemedicine during the lockdown	Quantitative (Survey)	Technical challenges Clinical challenges Individual challenges Organizational challenges Technical challenges	Not reported Not reported Limited reimbursement for telemedicine services Inadequacy of the technical infrastructure for telemedicine services
6	Sarteau et al., 2021 [17]	USA	To explore providers' perceptions of care delivery adaptations and challenges for providers and patients across nine international pediatric diabetes clinics	Quantitative (Survey)	Clinical challenges Individual challenges Organizational challenges Technical challenges	Impossibility of physical examinations Reducing communication time with the patient compared to the face-to-face visits Not reported Inadequacy of training for users (patient, patient's family and service providers) Internet connection instability Barriers associated with sharing electronic health data such as blood glucose Lack of access to the electronic devices Inadequate technology support for teleconference platforms Difficulty in retrieving information from

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Table 2 (continued)

NO	Author, year	Country	Research objective	Research methodology	Challenges of using telemedicine for patients with diabetes during the Covid-19 pandemic	
						different databases
7	Giani et al., 2021 [29]	Italy	To describe healthcare professionals' (HCPs) experience on telemedicine use in diabetes care and investigate the changes and challenges associated with its implementation	Quantitative (Survey)	Clinical challenges Individual challenges	Lack of standard forms for documenting patient medical records Lack of access to multilingual resources for users Lack of clear and understandable instructions/guidelines on how to use the technology
					Organizational challenges	Inadequacy of training for users Inability to share experiences of using telemedicine with other health service providers Lack of an electronic health records system in hospitals to integrate patient data Insufficient rules about obtaining patient consent
					Technical challenges	Lack of a single tool to download data from all devices. Lack of an integrated tool for documenting data (including self-assessment data, screening questionnaires and sharing the results of blood tests). Inability to download data automatically without the patient intervention Lack of available technical support for users (patient, patient's family and service provider). Lack of access to high-speed internet services
8	Choudhary et al, 2021 [32]	UK	To evaluate the role and challenges of telemedicine, particularly in the context of remote monitoring and glucose-sensing technologies, in diabetes care, with a focus on the COVID-19 pandemic's impact	Mixed-method Study	Clinical challenges Individual challenges	Lack of adherence to the treatment protocols Inadequacy of users' technical skills Concerns about patient privacy and information confidentiality
					Organizational challenges	Limited reimbursement for telemedicine services Lack of integration with workflows
					Technical challenges	Lack of system integration Inadequacy of the technical infrastructure for telemedicine services
9	James et al., 2021 [31]	UK	(1) To review and synthesize reported opportunities, challenges, and lessons learned in the scale-up, spread, and sustainability of video consultations (2) To identify transferable insights that can inform policy and practice	Qualitative (Systematic review)	Clinical challenges Individual challenges Organizational challenges	Unavailability of patient medical history Impossibility of physical examinations Low level of patient literacy Inadequacy of users' technical skills Lack of a long-term strategic plan Resistance of health service providers to change Intensive work processes in health care centers Financial constraints
					Technical challenges	Inadequacy of training for users (patient, patient's family and service provider). Not reported
10	Shawar et al., 2021 [18]	USA	To introduce a newly diagnosed child with type 1 diabetes and concurrent covid-19 admitted to a special isolation ward and training through telehealth to limit the risk of virus transmission to staff	Qualitative (Case report)	Clinical challenges Individual challenges	Not reported Inadequacy of users' technical skills Lack of access to, or limited access of patients or their families to technology (smartphone, computer or high-bandwidth internet) Lack of access to multilingual resources for users
					Organizational challenges	Not reported
					Technical challenges	Not reported
11	Ahmed et al., 2022 [19]	USA	To evaluate the perspectives of patients with cystic fibrosis and telemedicine providers and to determine its association with barriers in the management of cystic fibrosis-related diabetes	Quantitative (Survey)	Clinical challenges Individual challenges Organizational challenges	Impossibility of physical examinations Not reported Not reported

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Table 2 (continued)

NO	Author, year	Country	Research objective	Research methodology	Challenges of using telemedicine for patients with diabetes during the Covid-19 pandemic	
12	Crossen et al., 2022 [20]	USA	To examine new opportunities and ongoing challenges for using telemedicine within diabetes management, based on data and experiences from the pre-pandemic and pandemic time frames	Qualitative (Literature review)	Technical challenges Clinical challenges Individual challenges	Not reported Not reported Limited use of telemedicine by the ethnic minorities Limited use of telemedicine by the elderly patients Limited use of telemedicine by non-native speakers Low level of patient literacy Inadequacy of users' technical skills Concern about patient privacy and information confidentiality Lack of equity in the use of telemedicine for diabetes care Inadequacy of providing patient-centered healthcare services Lack of engagement in the provision of services by non-physician team members such as nurses, certified diabetes care nurses, diabetes specialists, nutritionists and social workers Not reported
13	de Kreutzenberg SV, 2022 [30]	Italy	To review results obtained by telemedicine application in type 1 and type 2 diabetes during Covid-19, and discuss future perspectives for telemedicine use to manage diabetes	Qualitative (Literature review)	Clinical challenges Individual challenges	Impossibility of physical examinations Preference of patients to receive face-to-face services Inadequacy of users' technical skills Cultural barriers Emotional barriers Lack of access to, or limited access of patients or their families to technology Concerns about patient privacy and information confidentiality Inadequacy of training for users (patient, patient's family and service provider) Unequal coverage of telemedicine services Not reported
14	C. Li 2022 [21]	USA	To discuss the evolution of telehealth in diabetes management and cites a case study to examine the gaps and identify nursing strategies for implementation	Qualitative (Case study)	Technical challenges Clinical challenges Individual challenges	Impossibility of physical examinations Cost of equipment (e.g., digital blood pressure devices) Concerns about patient privacy and information confidentiality Financial limitations related to the maintenance of equipment and physical spaces to create a telemedicine site Lack of financial incentive for health service providers in the private sector Inadequacy of training for users
15	Papazafropoulou 2022 [33]	Greece	To summarize the existing evidence of the impact of TM on the follow-up of patients with diabetes during the pandemic as well as its place in the future in the management of patients with diabetes.	Qualitative (Literature review)	Technical challenges Clinical challenges Individual challenges	The need to standardize technical infrastructure Impossibility of physical examinations Difficulty in communicating with the elderly patients Concerns about patient privacy and information confidentiality Not reported
16	Alessi et al, 2022 [27]	Brazil	To assess the feasibility and efficacy of a telehealth intervention in enhancing mental health parameters and addressing emotional, diabetes-related, eating, and sleep disorders in type 1 diabetes patients during the COVID-19 pandemic's social distancing period	Quantitative Study	Technical challenges Clinical challenges	The complexity and non-uniformity of digital platforms Challenges in communication between patients and healthcare providers Challenges in delivering comprehensive patient education Low level of user acceptance Preference of patients to receive face-to-face services

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Table 2 (continued)

NO	Author, year	Country	Research objective	Research methodology	Challenges of using telemedicine for patients with diabetes during the Covid-19 pandemic	
17	Bullock et al, 2023 [22]	USA	To explore the challenges and opportunities associated with the rapid transition to telehealth delivery of National Diabetes Prevention Program (DPP) and Diabetes Self-Management Education and Support (DSMES) programs during the COVID-19 pandemic, across various levels of the Social-Ecological Model (SEM)	Qualitative Study	Organizational challenges Technical challenges Clinical challenges Individual challenges Organizational challenges Technical challenges	Lack of access to, or limited access of patients or their families to technology Lack of patient engagement in telemedicine programs Lack of access to high-speed internet services Internet connection instability Lack of standard forms for documenting patient medical records Inadequacy of users' technical skills Lack of access to, or limited access of patients or their families to technology Increasing the workload of healthcare providers Lack of contingency plans for technical issues Lack of access to high-speed Internet services Internet connection instability Impossibility of physical examinations
18	Thomas et al, 2023 [23]	USA	To examine the perceptions and experiences of youth of color, caregivers, and healthcare providers regarding telehealth for pediatric type 1 diabetes care during the COVID-19 pandemic	Qualitative Study	Clinical challenges Individual challenges Organizational challenges Technical challenges	Inadequacy of users' technical skills Low level of user acceptance Cultural/language barriers Not reported Lack of access to high-speed Internet services Internet connection instability Lack of system integration Impossibility of physical examinations
19	Rosta et al, 2023 [6]	Hungary	To explore the utilization, implementation, and impact of telemedicine in diabetes care across various countries, considering pre- and post- Covid pandemic scenarios, technological advancements, and healthcare system adaptations	Qualitative Study	Clinical challenges Individual challenges Organizational challenges Technical challenges	Unavailability of patient medical history Lack of access to, or limited access of patients or their families to technology Preference of patients to receive face-to-face services Inadequacy of users' technical skills Concerns about patient privacy and information confidentiality Insufficient rules to support telemedicine services Lack of access to high-speed Internet services
20	Chun-An et al, 2023 [24]	USA	To explore the perspectives of patients with type 2 diabetes (T2D) and healthcare providers on the benefits, challenges, and impact of telehealth visits in diabetes care	Qualitative Study	Clinical challenges Individual challenges Organizational challenges Technical challenges	Unavailability of patient medical history Impossibility of physical examinations Lack of access to, or limited access of patients or their families to technology Inadequacy of users' technical skills Lack of patient engagement in telemedicine programs Lack of system integration Lack of access to high-speed internet services
21	Altabtabaei et al, 2023 [26]	Kuwait	To explore the challenges and opportunities associated with the adoption of telemedicine for diabetes care and management from the perspectives of both patients with diabetes and healthcare providers	Qualitative Study	Clinical challenges Individual challenges Organizational challenges Technical challenges	Unavailability of patient medical history Impossibility of physical examinations Prescribing medication despite lack of final diagnosis Preference of patients to receive face-to-face services Inadequacy of users' technical skills Lack of access to, or limited access of patients or their families to technology (smartphone, computer, or high-bandwidth internet) Increasing the workload of healthcare providers Lack of system integration Lack of access to high-speed internet services

Kingdom [31,32], and Greece. [33]. The findings of two studies demonstrated that despite the benefits of telemedicine, a lack of access to multilingual resources for users, including patients, their families, and service providers, was an individual barrier to use this technology. [18,29] In addition, concerns over respecting patient privacy and information confidentiality were mentioned in different studies. [15–18,22,23,30,33] In several studies, low level of patients' and their families' literacy, as well as their inadequate technical skills were identified as other individual challenges. [15,18,20,22–26,30–32] In the study conducted by Banerjee et al., several issues about difficulty in using smartphones by patients and low level of user acceptance were identified as individual challenges. [14] Other challenges included difficulty in communicating with the elderly patients [15,33], insufficient patient experience with making video calls [25,27], and lack of clear and understandable instructions/guidelines on using the technology. [29] In other studies, lack of access or limited access to technology (devices, smartphones, computers, or high-speed internet) [6,18,22,24,26,27,30], limited use of telemedicine by the ethnic minorities, elderly patients, and non-native speakers [20,23], and patient preference for receiving in-person services [30] were reported. Other challenges included cultural barriers, emotional barriers [30], and cost of equipment (such as digital blood pressure devices). [21].

Organizational challenges

Organizational challenges were addressed in several studies. These studies were conducted in Hungary [6] India [14], the United States [16,17,20–22,24], Kuwait [26], Brazil [27], Iran [25], Jordan [28], Italy [29,30], the United Kingdom [31,32], and Greece [33]. A lack of integration with clinical workflows [32], and lack of patient engagement in developing telemedicine programs [24,27] were noted as challenges to effective use of telemedicine technology. Insufficient rules about obtaining patient consent were identified as another organizational challenge. [14,29] The limited reimbursement for telemedicine services [16,28] and inadequacy of training for users were other organizational challenges. [17,21,29–31].

In some studies, inadequate rules for financial supports via insurance companies [16], limited availability of telemedicine services, and insufficient involvement of health service providers in the development of digital health tools were reported. [25] A lack of an integrated national registry system to identify patients with diabetes [25], inability to share experiences of using telemedicine with other healthcare providers, a lack of electronic health records systems in hospitals to integrate patient data [29] can also hinder using telemedicine technology. These were coupled with increasing the workload of healthcare providers and the lack of contingency plans for technical issues [22], a lack of a long-term strategic plan, resistance of health service providers to change, intensive work processes in healthcare centers, and financial constraints. [31] Crossen et al. mentioned other challenges which included a lack of equity in the use of telemedicine for diabetes care, inadequacy of providing patient-centered healthcare services, a lack of involvement in the provision of services by non-physician team members such as nurses, certified diabetes care nurses, diabetes specialists, nutritionists, and social workers. [20] Apart from these, some researchers discussed factors influencing equal coverage of telemedicine services [30], financial constraints related to the maintenance of equipment and physical spaces to create a telemedicine site, and a lack of financial incentives for health service providers in the private sector to use the technology. [21].

Technical challenges

Technical challenges in using telemedicine for patients with diabetes during the COVID-19 pandemic were addressed in some studies, which were conducted in Hungary [6], United States [17,20–24], Kuwait [26], Brazil [27], India [14], Jordan [28], Italy [29], UK [32], and Greece [33]. A recurring issue across multiple studies was the lack of access to

high-speed internet services, which can lead to disrupted consultations and compromised care quality. [6,14,22–24,26,27,29].

Technical challenges included the inadequacy of the technical infrastructure for telemedicine services [28,32], the Internet connection instability [22,23,27], and difficulty in retrieving information from different databases. [17] A lack of a single tool to download data from all devices, a lack of an integrated tool for documenting data (including self-assessment data, screening questionnaires and sharing the results of blood tests), and inability to download data automatically without the patient intervention were other technical challenges addressed by Giani et al. [29] In other studies, a lack of available technical support for users [29], the need to standardize technical infrastructure [21], a lack of system integration [24,26,32], and the complexity and non-uniformity of digital platforms were highlighted. [33].

Synthesis

In this study, a number of clinical, individual, organizational, and technical challenges in using telemedicine for patient with diabetes during the COVID-19 pandemic were identified. The geographical distribution of the studies showed that these challenges were mainly reported by the developed/ developing countries. In addition, the results indicated that although the use of telemedicine has been established in these countries even before the COVID-19 pandemic, the individual and organizational issues still need further attentions compared to the clinical and technical challenges.

Discussion

Despite the several potential benefits of telemedicine to provide healthcare services at the point of need, the use of this technology for patients with diabetes during the COVID-19 pandemic has faced with some challenges. The aim of this study was to identify the challenges of using telemedicine for patients with diabetes during the COVID-19 pandemic. The results indicated that these challenges could be categorized into the clinical, individual, organizational, and technical ones.

The clinical challenges included the limitations of performing physical examinations, prescribing medications despite the lack of a final diagnosis, prescribing drugs that might be banned by the government, and reducing the time spent on communicating with patients compared to the in-person visits. As noted by Restrepo et al., the physical examination is a crucial component of a diagnostic process and its role in telemedicine services requires further exploration. [39] In fact, the inability to conduct a comprehensive physical examination remotely can hinder the diagnostic process and may result in missed or delayed diagnoses. Healthcare providers must rely on patient-reported symptoms and visual assessments, which may not always provide a complete picture of the patient's health status. This also may cause prescribing medications without a confirmed diagnosis which can lead to ineffective or inappropriate treatment, potentially compromising patient safety. Limited time for patient interaction in telemedicine consultations may also lead to misunderstandings, incomplete information exchange, and reduced patient satisfaction. According to Pogorzelska et al., in order to increase patient satisfaction, aspects such as physician engagement and showing empathy should be taken into account during a telemedicine visit. Providing an explanation for the treatment process and respecting patient's preferences can help to achieve more success in communication with patients. [38].

According to the results, the individual challenges contained more personal issues such as difficulties in using smartphones by patients, concerns about patient privacy and confidentiality of information, low level of patient literacy, lack of clear and comprehensive instruction on how to use the technology, limited access of patients or their families to technology (such as smartphones, computers, or high-speed internet), etc. Most of these challenges have been highlighted by other researchers, too. [34–36] Difficulties in using smartphones by patients, especially

older adults, or individuals with low level of literacy or limited technology literacy can lead to frustration and prevent accessing care at the point of need. Therefore, providing simple and easy to use technology as well as technical support can help patients feel more comfortable and confident in using telemedicine tools. As suggested by Abdulwahab and Zedan, developing telemedicine technology that does not depend heavily on the internet connections or can be operated offline can be useful to increase accessibility for patients who do not have stable internet service. [37].

Patient data security is also a critical issue in telemedicine. Ensuring robust data encryption, secure communication channels, and adherence to privacy regulations is essential to address these concerns. The patient should be reassured about the nature of telemedicine visits and the conversation, which should be secure and confidential. [40] Moreover, addressing digital inequities through initiatives like technology subsidies, community resources, and telemedicine outreach programs is crucial to ensure equitable access to care. [41].

The research findings showed that organizational challenges included insufficient rules about obtaining patient consent, insufficient training for users, limited reimbursement for telemedicine services, lack of equity in the use of telemedicine for diabetes management, financial constraints, resistance to change, lack of financial incentives for health service providers in the private sector, etc. It seems that clear guidelines and protocols must be generated to ensure that patient consent is obtained and respected in telemedicine interactions. In fact, a valid consent is essential for a teleconsultation, and an explicit patient consent is required for a telemedicine visit. [40] Moreover, proper training is essential for healthcare providers and staff to effectively use telemedicine tools and platforms. [40] Inadequate training can result in errors, inefficiencies, and suboptimal patient care. Reimbursement policies play a significant role in the adoption of telemedicine. Without adequate reimbursement, healthcare providers may be hesitant to invest in telemedicine infrastructure and services. Similarly, financial incentives can motivate healthcare providers to adopt telemedicine practices. Developing reimbursement models and incentives for healthcare providers can encourage greater engagement in telemedicine services. [42].

Disparities in access to telemedicine services can exacerbate existing healthcare inequalities. Efforts should be made to ensure that telemedicine services are accessible to all patients, regardless of socioeconomic status or geographic location. Policymakers and healthcare organizations need to carefully consider the challenges of using telemedicine among underprivileged groups and ensure that adequate funding and training are provided for them. [41].

As financial constraints can hinder the implementation and expansion of telemedicine programs, securing funding and resources is suggested for the sustainability of telemedicine initiatives. [43] Apart from financial issues, to overcome healthcare providers' or patients' resistance to change, providing them with adequate training and effective communication strategies are essential to address their concerns and promote acceptance of telemedicine solutions. [44].

Another part of the findings was related to the technical challenges which included the lack of access to the high-speed internet services, insufficient technical infrastructure for telemedicine services, Internet connection instability, barriers associated with sharing electronic health data, etc. Indeed, reliable high-speed internet is essential for conducting seamless telemedicine consultations. Patients in rural or underserved areas may face challenges accessing high-speed internet, leading to connectivity issues, poor audio/video quality, and disruptions during their virtual visits. Not only the high-speed internet, but also robust technical infrastructure is necessary to support telemedicine platforms effectively. Inadequate hardware, software, or IT support can hinder the implementation of telemedicine programs and limit the scalability of virtual care initiatives. Secure electronic health data exchange can also be useful for seamless communication and coordination of care in telemedicine. [43,44].

Upgrading technical infrastructure within healthcare facilities to

support telemedicine platforms, enhancing connectivity for teleconsultations, and adopting secure and interoperable health IT solutions to facilitate seamless data exchange and integration across different care settings can help to provide patients and healthcare providers with better telemedicine services. [45–47].

Overall, it seems that overcoming these challenges needs allocating adequate resources to improve different aspect of service delivery. More investment in technological advancements, paying attention to the non-technical issues, and adherence to best practices in digital health can help to overcome these challenges and drive the widespread adoption of telemedicine as a vital component of modern healthcare delivery.

Research limitations

This study examined various challenges encountered when using telemedicine for patients with diabetes during the COVID-19 pandemic. However, this study had certain limitations. Although major databases were searched, there might be other databases that were not searched. In addition, non-English/Persian articles along with the full texts of some articles which were not freely available even after contacting the authors were excluded from the study. Therefore, a number of existing relevant papers might not be reviewed in the current study due to the resources constraints. Moreover, in this study, an overview of using telemedicine technology for patients with different types of diabetes was provided, and we did not distinguish between diabetes management in the primary and secondary care settings. Furthermore, different types of diabetes may need various levels of care, and patients at different age groups may experience various challenges. It seems that these issues can be investigated in future studies with more details.

Research implications

The results of the current study highlighted that although many efforts have been made to establish telemedicine services successfully and there is a large amount of literature regarding the use of telemedicine for patients with diabetes, there are still a number of opportunities which need further investigations.

In this study, some clinical challenges were identified; however, researchers can focus on evaluating the effectiveness of telemedicine in managing diabetes during the pandemic. Studies can investigate the outcomes of using telemedicine services to determine the efficacy of services such as telemonitoring and teleconsultations. To overcome individual challenges, investigating strategies to enhance patient engagement and adherence to telemedicine interventions is crucial. Researchers can explore factors influencing patient motivation, satisfaction, and compliance with telemedicine services. As a challenge of using telemedicine was limited access to technology, addressing disparities in access to telemedicine services is essential, too. Researchers can examine how socioeconomic factors and geographical locations impact the ability of patients with diabetes to benefit from telemedicine services during the pandemic. Paying more attention to the security and privacy concerns associated with telemedicine platforms and ensuring compliance with data protection regulations are other critical areas for investigation.

As an organizational aspect, assessing the preparedness of patients, clinicians, nurses, and other healthcare professionals to use telemedicine platforms effectively is essential for optimizing patient outcomes. Moreover, investigating the integration of telemedicine into the existing healthcare systems for diabetes management can provide insights into the organizational challenges, workflow optimization, and reimbursement models. The sustainability of using telemedicine solutions is partly depending up on the technical issues. Therefore, developing more secure simple technologies along with improving the technical infrastructures can help improving patient access to the healthcare services and the quality of care.

Conclusion

This study highlighted the challenges of using telemedicine in providing care for patients with diabetes during the COVID-19 pandemic. The results indicated that these challenges can be categorized into four domains: clinical, individual, organizational, and technical challenges. It seems that paying more attentions to these challenges and investigating solutions to overcome them can help patients and healthcare providers to use the technology more effectively. This, in turn, can lead to saving costs, improving patient's health status, and reducing long-term diabetes complications. Furthermore, considering these challenges will increase the likelihood of success in telemedicine projects, and prevent wasting resources. However, the impact of addressing these challenges on the actual use of the technology and clinical outcomes needs to be investigated in the future studies.

CRedit authorship contribution statement

Fatemeh Mirasghari: Writing – original draft, Methodology, Formal analysis, Data curation. **Haleh Ayatollahi:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Farnia Velayati:** Writing – review & editing, Validation. **Arezo Abasi:** Writing – review & editing.

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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