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The Perspectives of DM Patients About Barriers to Using Digital Health Technology in Qualitative Study: A Systematic Review

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ABSTRACT

Digital health technology (DHT) has been shown to increase the glycemic control index in Diabetes Mellitus (DM) patients. The application of DHT is associated with several barriers from the perspectives of patients, which must be addressed in further development. This systematic review aimed to identify barriers to using DHT from the perspectives of DM patients. A comprehensive search was carried out across four journal databases: Sage, PubMed, Cochrane, and ScienceDirect, utilising specific keywords covering the period from 2012 to 2022. Selected studies were screened using the PRISMA flowchart by setting inclusion and exclusion criteria, followed by quality assessment through Critical Appraisal Skills Program (CASP) checklist and thematic synthesis. The results showed that 11 studies met the inclusion criteria and were classified in the medium-quality category according to CASP analysis. Data extraction and theme synthesis produced 13 themes correlated with barriers to using DHT in DM patients. The challenges encompassed incomplete physical examinations, restricted patient-provider relationships, insufficient disease awareness, limited technological literacy, limites digital infrastructure, extra costs for access, concerns regarding the security of healthcare data and the privacy of patients, perceived irrelevance of content for some users, time constraints, vision impairments, language barriers, technical problems due to poor app design and system failures, and logistical difficulties. Barriers from the perspectives of DM patients when using DHT were extrinsic factors from digital health infrastructure and intrinsic factors such as cost constraints, limited digital literacy, and low patients knowledge.

Keywords: Diabetes, Barriers, Patients perspective, Qualitative study, Telehealth

INTRODUCTION

Diabetes Mellitus (DM) is a global health problem requiring immediate management. In 2015, around 415 million individuals between the ages of 20 and 79 were affected by diabetes mellitus (DM), with projections indicating that this number could rise to 642 million by the year 2040. (Ogurtsova et al., 2017). Owing to its persistent characteristics, DM causes disease in the long term, associated with complicated and expensive management. Poor glycaemic control among patients may result in unsuccessful treatment, adverse health results, and the occurrence of chronic complications capable of reducing quality of life and causing death (Pamungkas & Chamroonsawasdi, 2019; Wroth & Pathman, 2006). Good glycemic control through decreased hemoglobin A1c (HbA1c) levels is associated with a slower onset and development of microvascular complications (Singh et al., 2013; Stratton et al., 2000). DM self-management is a factor that is considered the most important to achieve good

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control of blood glucose levels (BGL) and prevent diabetes complications (Blondon et al., 2014; El-Gayar et al., 2013). The strategies for self-management include tracking the condition of BGL, using drugs or insulin therapy, and adjusting eating patterns with physical activity (Brzan et al., 2016). Current studies have proven that digital technology is a successful instrument to improve DM self-management (El-Gayar et al., 2013; Franklin et al., 2006; Hou et al., 2016). A recent meta-analysis reported that using DM application as an adjuvant to standard self-management caused significant reductions in HbA1c and prolonged management of glucose levels in the bloodstream (Hou et al., 2016; Wu et al., 2018). Furthermore, the implementation of telemedicine to deliver various aspects of health information covering disease prevention, the monitoring of health conditions, and treatment for patients, has been proposed as a novel approach to enhance healthcare delivery (Lee et al., 2015; Lee et al., 2016; Lee et al., 2017). Earlier research has similarly demonstrated the efficacy of mHealth interventions in managing diabetes self-management (Liang et al., 2011). The application of digital technology has demonstrated significant efficacy in promoting health and facilitating lifestyle changes, especially among patients with diabetes mellitus (Shan et al., 2019).

Digital Health Technology (DHT) is a resource instrument that can be used by individuals with chronic diseases, such as DM to manage and control the condition. This instrument has the capability to alleviate the burdens placed on healthcare inequalities by enhancing access to tailored and affordable medical services. (Muñoz, 2010; Murray et al., 2005). Specifically, mobile health (or mHealth) interventions are proving useful as instrument to address healthcare barriers in both general and special populations. DHT can be application, such as telemedicine, web-based analytics, email, mobile phones, text messaging, wearable devices, and clinics or remote monitoring sensors (Widmer et al., 2015). DHT serves to offer educational resources and care assistance to patients during the intervals between their healthcare visits. Digital health interventions (DHI) can also reduce obstacles to accessing healthcare by eliminating travel expenses, the difficulty of finding childcare during visit, the challenge of taking time off work for medical visits, and the scheduling constraints associated with healthcare professionals' availability.

Studies related to DHI collaborate with human-computer interaction (HCI), including software engineering with health interventions covering biomedical, behavioral, and social sciences. In HCI studies, there is a greater emphasis on proximal (interaction) and distal (effect) outcomes. This shows the need for iterative design and testing until interventions are considered easily accessible and beneficial to users (Blandford et al., 2018; Elwyn et al., 2011). Acceptability and usability are important factors for DHT, because the effectiveness depends on individual acceptance of use, and population impact relies on achieving a high proportion of the target individuals. The use of repeatable methods common to HCI allows DHI optimization to achieve adequate acceptability, ensuring affordability, uptake, and usage to obtain health-side effectiveness and cost-effectiveness (Murray et al., 2016). Therefore, this review aims to identify barriers experienced by patients and health workers who provide services using DHT to manage therapy.

MATERIALS AND METHODS

Search strategy

This review included studies from the PubMed, Sage, Cochrane, and Scient direct journal databases published during 2012-2022. The literature search was conducted from October-November 2022, for Sage using the keywords: (((barriers) AND (digital health)) AND (diabetes)) AND (qualitative). As for the Science Direct database, the keywords used were barriers, telehealth, and diabetes qualitative. Cochrane database was searched using keywords like barriers, digital, health, diabetes, and qualitative. The Pubmed database was searched using the keywords (((digital health) AND (diabetes)) AND (barriers)) AND (qualitative). The criteria for inclusion of studies were English written, available in full text, and use the qualitative method. Additional requirements were studies to be reviewed in the form of reports or results describing DM patients barriers when using digital health.

Eligibility criteria

The inclusion criteria for this review included studies published between January 2012 and December 2022.

Original qualitative studies.

Studies on DHI, which obtained information from DM patients. This included web-based interventions, telecare or telehealth systems, mHealth application, patient portals or individual health records, along with interventions provided

through text messaging services or interactive voice response systems.

The exclusion criteria were

Descriptive case studies and commentary analyses produced without any empirical evidence or direct interaction or observation of the subjects involved.

Screening

AKH independently screened titles and abstracts from the database, followed by a duplication screening using Mendeley. All studies meeting the inclusion criteria were obtained in full-text form for subsequent review and evaluation.

Data extraction

Data extraction was carried out by two reviewers (AKH and NMY) independently using a comprehensive system. This was followed by standardization and plotting of data extraction templates. The extracted information included the author, publication year, country, purpose, type of digital health technology, participants (patients), sample size, methods of data collection, and principal findings. Subsequently, the results obtained were analyzed to determine thematic patterns.

Quality assessment of systematic literature review studies

A quality assessment was carried out for inclusion to ensure the credibility and rigor of the synthesis. This assessment was performed on all included articles that met the requirements using the Critical Appraisal Skills Program (CASP) checklist. CASP is a qualitative systematic review checklist to improve the accuracy of data synthesis by assessing the robustness of studies in line with the parameters of recruitment validity, data collection, analysis, and results based on clear criteria. The checklist comprises 10 questions that evaluate the methodological robustness, credibility, and relevance of qualitative research. The CASP critical score is structured as follows: a) Criterion fully satisfied = 2; b) Criterion partially satisfied = 1; c) Criterion not applicable, not satisfied, or omitted = 0; A total score of 20 indicates high quality; scores between 16 and 19 suggest moderate quality; and scores of 15 or below indicate low quality. A total of two authors (AKH and NMY) conducted CASP assessment independently, with differences of opinion resolved by the third author (SAK). Moreover, studies classified as high and moderate quality were used in this review.

RESULTS AND DISCUSSION

Search Results

This review obtained 776 studies, where 37 were duplicates by Mendeley duplicate checking, remaining 739 (Figure 1). A total of 674 studies were excluded because the title screen and abstract did not meet the criteria keywords such as DM, barriers to digital health, and qualitative study. Furthermore, 37 studies could not be assessed in full text, and 17 did not meet the inclusion and exclusion criteria. A total of 11 studies were available for review that discuss the perspectives of patients about barriers to using digital technology for the management of DM.

Based on the quality analysis, all studies included in this review had a moderate quality category with a CASP analysis total score between 16 and 17 (Table I). The analysis of quality studies in this systematic review used the CASP method, where 13 studies were in the medium quality category with a score range of 16-17. Based on the thematic analysis of 11 studies, there were 13 themes of barriers for DM patients to use DHT. A total of 8 studies put forward the theme of low health knowledge and literacy in DM patients, 5 mentioned difficulties in accessing digital technology infrastructure, 4 stated additional costs that must be incurred by patients, 3 reported time constraints, and 2 identified technical issues related to poor application design and system failure. Additionally, 7 themes each were mentioned by 1 author, namely incomplete physical examination, difficulties in establishing a provider-patients relationship, health care data security and patients privacy, the perceptions of content irrelevant to some users, limitation of vision, insufficient knowledge of individual about the disease, and logistical challenges.

Barriers to using digital health found in each country varied significantly, although individual knowledge and literacy of technology were identified in all studies. This was followed by limited access to digital technology infrastructure that was found in almost all countries except the USA.

Intrinsic barriers (individual)

The individual barriers include attitudes towards technology, or without intrinsic motivation and knowledge (Frederix et al., 2019). Negative attitudes toward new technology can occur from a lack of incentives or patients older age, a perceived low benefit of the technology, and general trust in technology (Frederix et al., 2019; Gagnon et al., 2012).

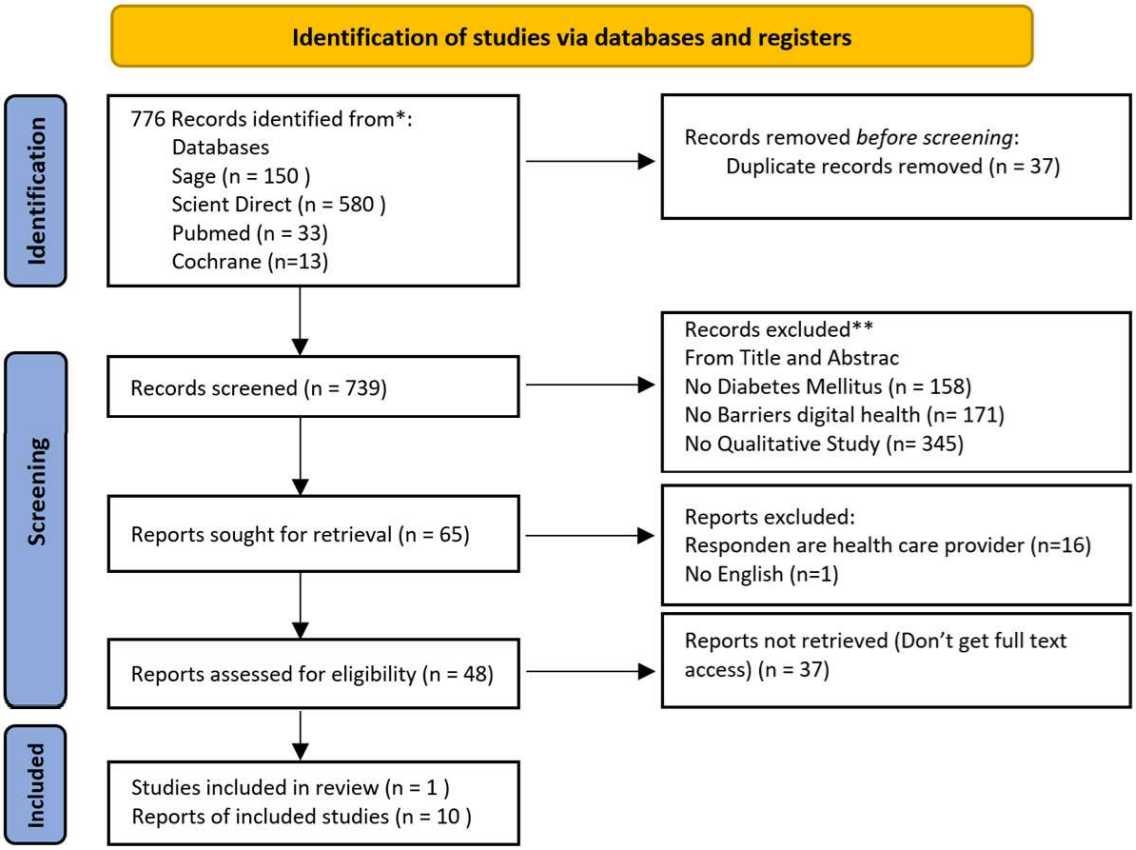


Figure 1. PRISMA flow-chart

Table. I CASP critical appraisal of studies included in this review (n = 10)

1st Author (year of study)	CASP criteria										
	1	2	3	4	5	6	7	8	9	10	Total score
Jeffrey (2019)	2	2	2	2	2	0	1	2	2	2	17
Torbjornsen (2019)	2	2	2	2	2	0	0	2	2	2	16
Rogers (2019)	2	2	2	2	2	0	0	2	2	2	16
Lee (2019)	2	2	2	2	2	0	0	2	2	2	16
Liu (2019)	2	2	2	2	2	0	0	2	2	2	16
Steinman (2020)	2	2	2	2	2	0	0	2	2	2	16
Gordon (2020)	2	2	2	2	2	0	0	2	2	2	16
Mellergard (2021)	2	2	2	2	2	0	0	2	2	2	16
Turnbull (2021)	2	2	2	2	2	0	0	2	2	2	16
Moody (2022)	2	2	2	2	2	0	1	2	2	2	17
Poduval (2022)	2	2	2	2	2	0	1	2	2	2	17

[a]CASP criterion: 1. Was there a clear statement of the aims of the study? 2. Is a qualitative methodology appropriate? 3. Was the design appropriate to address the aims of the study? 4. Was the recruitment strategy appropriate? 5. Was the data collected in a way that addressed the study issue? 6. Has the relationship between the author and participants been adequately considered? 7. Have ethical issues been taken into consideration? 8. Was the data analysis sufficiently rigorous? 9. Is there a clear statement of findings? 10. How valuable is the study? [b]CASP critical score: a) Criterion fully satisfied = 2; b) criterion partially satisfied = 1; c) criterion not relevant, unmet, or not specified = 0; Total score of 20 indicates high quality; scores of 16–19 reflect moderate quality; and scores of 15 or below indicate low quality.

Limited knowledge of individual about the disease

Liu (2019) stated that majority of patients had limited knowledge and understanding of DM retinopathy screening through teleophthalmology. Therefore, the majority became aware of the purpose and application of screening when recommended by healthcare providers. This was in line with the literature showing that patients report healthcare provider recommendations as the strongest motivator to use health technology (George et al., 2016).

Limited individual knowledge and literacy of technology

Digital health literacy (DHL) refers to the capability to locate, retrieve, comprehend, and evaluate health information digital platforms and utilise the acquired knowledge to tackle or mitigate health issues (World health organization (WHO), 2017). Factors that can influence DHL levels include age, health status, education level, digital literacy skills, and motivation to seek information through digital media (Norman & Skinner, 2006; World health organization (WHO), 2017). Another technical problem with the use of DHL is the lack of technology literacy and skills, which is more common among the elderly. Generally, elderly individuals have reported facing significant challenges when navigating and interacting with digital management applications (Scheibe et al., 2015), compared to younger age groups with better experience (Hou et al., 2016).

Wildenbos et al. (2018) study identified four barriers for elderly people in accepting technology. These included cognitive impairment (decreased memory and dementia), alongside poor movement, sensory function, particularly hearing or vision impairment, and lack of motivation due to less perceived benefits or difficulty using new technology. DHL can be useful in reducing these barriers and promoting older adults to accept and use DHT (Choukou et al., 2022). Another barrier reported by DM disease management application users is problem with glucose units presented in the application in mg/dL units. This is less understandable to users who are accustomed to mmol/L units, the standard in Australia. To overcome the barriers, the conversion of glucose and nutrient intake is recommended according to the guidelines used by health professionals in each country to simplify and facilitate application use (Jeffrey et al., 2019).

Language Restrictions

Patients experience difficulty in using digital health because the application does not support colloquial language. Therefore, digital health application must use the same colloquial language of patients (Rogers et al., 2019).

An additional cost must be incurred for access

Another aspect was the costs included compared to conventional treatments, where participants stated that telemonitoring would only favor wealthy patients (Lee et al., 2019). The costs included in using DHT, such as Freestyle Libre, were high for some participants. Another low-income participant stated that Fitbits became less affordable due to rising prices (Turnbull et al., 2021). Consequently, the use of mHealth application can cause problems due to the consistent requirement for running device (Bucci et al., 2019) and a data plan with some costs included (Son et al., 2020; Sun et al., 2017). A previous study stated that patients were concerned about the potential need for additional costs for using the application (Beer et al., 2020). There are concerns about the lack of opportunity to test and evaluate digital health before purchasing, showing concerns for financial disadvantage when digital health is not useful (Minen et al., 2021).

Limitation of vision

Steinman (2020) showed that one of barriers to using digital health in the form of written messages in Cambodia was the limited viewing ability of participants due to the age factor and the small screen of the smartphone. Similarly, a study in India found that 89% preferred to receive voice reminders for their medication over text messages (DeSouza et al., 2014). Despite the provision for voicemail, more targeted and focused dissemination efforts would be required to reach older and poorer individuals with less cell phone access and less technological literacy.

Extrinsic barriers

Incomplete physical examination

Patients express concerns about the physical examination constraints, which can be incomplete as the geographical distance and the service provider influence care quality. The difference in physical examination during a CVT compared to an in-person consultation causes an incomplete visit (Gordon et al., 2020).

Table II. Characteristics and Outcome of Included Studies

First Author & year	Country	Number of participants; Age	Methodology	Interventions	Objective of study	Details of technology	Barriers
Jeffrey (2019)	Australia	16; 30-79 years old	Qualitative, semi-structured interviews	Application	This research primarily aims to assess the experiences, obstacles, and enablers associated with the utilisation of the application among patients with diabetes mellitus (DM). The secondary aim is to identify suggestions for enhancing the application's usage among DM patients.	This application provides information about health education, monitoring, tracking, food nutrition, drugs, and text messages.	Barriers to the use of DM management application are: • The lack of knowledge and awareness of DM patients about application as healthcare aids, • The lack of knowledge of disease severity, • The lack of technology and health literacy • Limited internet connectivity in rural areas.
Torbjornsen (2019)	Norway	24; N/A	Qualitative, semi-structured interview	Mobile phone-based diabetes diary application	Investigate a comprehensive understanding of user acceptance regarding mobile applications for diabetes self-management, and examine their role in the communication between patients and healthcare providers.	The Few Touch application is used in conjunction with OneTouch® Ultra Easy® LifeScan Inc., Milpitas, CA, USA, to transfer blood glucose measurements to the application through Bluetooth. The application also has a diary containing the content of personal objectives, manually planning daily activities, and eating patterns.	• Takes more time and effort to perform routines in the app. • The smartphone's usability issues and the constraints of applications, such as the transfer of blood glucose levels, do not consistently function as intended. • The size of the smartphone is small with small buttons • features that sometimes don't work for all as they should. • Additional cost with data usage
Rogers (2019)	New York, USA	36; N/A	Qualitative, in-depth interviews	Mobile Insulin Titration Intervention (MITI)	Identify and evaluate barriers and facilitators to the integration of the MITI program into patients care.	MITI is an automated text message system that will be received once a week by uncontrolled DM patients who require adjustment of their basal insulin by entering their FBG data. Patients enter FBG data in MITI and will be monitored by nurses. The nurse calls once a week to advise on titrating the insulin dose. Furthermore, MITI helps patients find the right insulin dose to achieve an FBG level of 80 to 130 mg/dL.	• Limited adaptability to digital programs • Limited time, where Call Titration is Only Available on Thursday • Language Restrictions

Continue of Table II. Characteristics and Outcome of Included Studies

First Author & year	Country	Number of participants; Age	Methodology	Interventions	Objective of study	Details of technology	Barriers
Lee (2019)	Malaysia	48; 29-69 years old	Qualitative, In-depth, and focus group interviews	Telemedicine	Investigating the experiences and viewpoints of diabetes mellitus patients employing telemedicine for the management of their condition.	Participants in the telemedicine cohort will measure their fasting blood glucose levels a minimum of twice weekly, or more frequently as advised by their physician. This blood glucose data will be sent via Bluetooth technology to the participant's mobile device and a secure remote server. Participants and their doctors can access the results of blood glucose levels recorded on the server. Telemedicine provides advice regarding lifestyle modifications, changes in medication, and how to contact their healthcare provider during the study. The participants results are also checked weekly to initiate interventions when needed, such as a change of medication and counseling, with consent from the treating doctor.	Patients stated that barriers faced when using the telemedicine system included : • Difficulties in internet connectivity • Difficulties in understanding the interface of the telemedicine system • The costs included in using telemedicine.
Liu (2019)	Wisconsin, USA	29; 46-86 years old	Qualitative, open-ended, individual interviews	Teleophthalmology	Identification of barriers and facilitators experienced by patients and primary care providers (PCP) in using Teleophthalmology, and strategies for improvement.	Teleophthalmology is a diabetic eye screening intervention to reduce blindness due to DM. Retina camera is used to take eye pictures at the location of a health care provider, such as a primary care clinic (where more than 90% of patients with diabetes get their treatment). The image obtained is transmitted electronically to and evaluated by a specialist at a remote location, within the same day up to 1 week.	Barriers to DM patients using teleophthalmology were : • Lack of familiarity with teleophthalmology. • Misunderstandings Regarding Diabetic Eye Examinations • Logistical challenges.

Continue of Table II. Characteristics and Outcome of Included Studies

First Author & year	Country	Number of participants; Age	Methodology	Interventions	Objective of study	Details of technology	Barriers
Steinman (2020)	Cambodia	59; 45-65 years old	Qualitative, semistructured interviews and focus groups	MoPoTsyo (mHealth)	Identify facilitators and barriers experienced by DM or hypertensive patients in using m-health, which includes acceptance, suitability, and feasibility of mHealth to support chronic disease management and improve community clinical relationships with existing services.	MoPoTsyo provides a centralized database that tracks demographic data, health check results, laboratory results, doctor visits, and information about drugs.	Limitations in : • Literacy • Vision • Cell phone facilities
Gordon (2020)	Eastern Colorado, USA	27; 67-70 years old	Qualitative, semi-structured telephone interviews	Clinical video telehealth (CVT) technology	Exploration of DM patients' opinions of CVT technology, related to technical, social, and personal barriers, and the benefits of communicating with their healthcare providers.	CVT is a communication technology to assess patients conditions using real-time audio and video, where patients and providers are in different locations.	• Patients have difficulty completing the physical examination • There is perception that the service provider is not paying attention. • Patients report feeling less during visits, having difficulty finding opportunities to talk, and are often rushed by the provider. • There is limited ability to speak and ask questions, alongside difficulties in establishing a provider-patients relationship.
Mellergard (2021)	Sweden	22; 35-75 years old	Qualitative, Semi-structured interviews	Digital lifestyle intervention	An investigation into the experiences of patients regarding self-management of diabetes and their perspectives on digital interventions for lifestyle modification.	Digital lifestyle intervention is a digital intervention that focuses on self-affirmation that can influence self-affirmation in the context of diabetes management.	Respondents experience difficulty in finding accessible, reliable, and relevant information about DM management.

Continue of Table II. Characteristics and Outcome of Included Studies

First Author & year	Country	Number of participants; Age	Methodology	Interventions	Objective of study	Details of technology	Barriers
Turnbull (2021)	UK	21; 29–74 years old	Qualitative, Semi-structured interviews	Digital Health Technology (DHT)	This study aims to gain knowledge about how and why DM patients access and use DHT, alongside variation in the experience between individuals and social groups.	Various web/internet-based sites or application that assist DM patients in managing their diabetes condition have been downloaded and installed onto a smartphone or tablet.	Reported barriers to accessing DHT: • Extra costs that need to be incurred for access • Limited individual knowledge of technology • Lack of technical skills using technology
Moody (2022)	N/A	11 Reviews	Systematic Qualitative Review study	Self-management technology	Identification of supporting factors and barriers for the elderly in using digital technology for self-management of dementia, diabetes, and chronic kidney disease.	Self-monitoring for DM and reminder prompts for people with dementia.	• Limitations of digital and literacy skills • Insufficient acces of digital technology infrastructure • The cost is less affordable than the impact of poverty • Lack of diversity
Poduval (2022)	United Kingdom	N/A	Qualitative, focus group logistics, and telephone interviews	HeLP-Diabetes website	Get an overview of the initial web design, optimization of web usability, and constraints experienced for further improvement.	The HeLP-Diabetes platform features components such as establishing objectives, planning actions, self-assessment, performance feedback, and information on nutritious eating, weight management, physical activity, smoking, alcohol use, and medication management.	• Insufficient time to initiate or finish the programme. • Concerns that the duration of completing the programme may be excessively lengthy • Ambivalence about starting • The felling that the content may not be pertinent to certain users.

Table III. Thematic analysis

Thematic	Jeffrey, 2019	Torbjornsen, 2019	Rogers, 2019	Lee, 2019	Liu, 2019	Steinman, 2020	Gordon, 2020	Mellergard, 2021	Moody, 2022	Turnbull, 2021	Poduval, 2022
In completing the physical examination							v				
Difficulties in establishing a provider-patients relationship.							v				
Limited knowledge of the individual about the disease					v						
Lack of personal understanding and literacy in technology	v		v	v	v	v		v	v	v	
Limited access to digital technology infrastructure	v	v		v		v			v		
Additional charges for DHT access		v		v					v	v	
Healthcare data security and patients privacy				v							
The feeling that content may not be pertinent to certain users.											v
Lack of time		v	v								v
Limitation of vision						v					
Language limitation			v								
Technical challenges associated with inadequate application design and system malfunctions	v	v									
Logistical limitation					v						

Table IV. Thematic barriers for DM patients in various countries in using e-health

Thematic	Australia	Europe (UK, Sweden, Norway)	USA	Asia (Malaysia, Cambodia)
In completing the physical examination			v	
Difficulties in establishing a provider-patients relationship.			v	
Limited knowledge of the individual about the disease			v	
Lack of personal understanding and literacy in technology	v	v	v	v
Limited access to digital technology infrastructure	v	v		v
Additional charges for DHT access		v		v
Healthcare data security and patients privacy				v
The feeling that content may not be pertinent to certain users.		v		
Lack of time		v	v	
Limitation of vision				v
Language limitation			v	
Technical challenges associated with inadequate application design and system malfunctions	v	v		
Logistical limitation			v	

Generally, physical examination is an essential prerequisite for an effective doctor-patients relationship (Kumar et al., 2021; Mathew et al., 2021; Raheja et al., 2021; Ullas et al., 2021). There is also dissatisfaction with doctors relationship after consultations without face-to-face contact (Garg et al., 2021). The study conducted by D'Souza et al. (2021) reported that the elderly preferred face-to-face consultations. Moreover, barriers arising from the absence of direct physical examination in digital health can be addressed by making referrals to the nearest health center whenever symptoms or reports show the need for an in-person assessment (Kumar et al., 2021).

Limitations of the Service Provider-Patients Relationship

There is difficulty speaking and asking questions, alongside the establishment of a provider-patients relationship. There is also a perception that service providers pay less attention during visits using CVT. Feeling less inclusion in healthcare is reported during visits, and difficulty in finding opportunities to talk. These barriers to building patients-healthcare provider relationships can be overcome with the knowledge and skills to communicate effectively (Gordon et al., 2020).

Lack of access to digital technology infrastructure

Barriers to using DHT due to lack of infrastructure are predominantly found in low-income to middle-income countries, particularly rural areas (Jeffrey et al., 2019; Lee et al., 2019; Moody et al., 2022). Technical barriers found in rural areas is internet connectivity difficulties. DHT users report problems using some of the features in the application when outside the internet signal range. According to Lee (2019), participants emphasized the importance of user-friendly DHT, with the majority reporting minor technical difficulties in various areas. These include the connectivity and availability of the internet in rural areas, which hinder making effective use of telemonitoring devices. Another technical barrier in using digital health is the lack of stability of their internet connection at home (Lee et al., 2019). Therefore, future application development needs to have "offline" features to ensure coverage in the rural populations (Jeffrey et al., 2019). The technical problem causes difficulties in using application, leading to loss of motivation by DM patients (Desveaux et al., 2018; Lie et al., 2017). Low internet network coverage and information technology infrastructure are described as the main barriers to the adoption of digital use in the health sector. A lack of basic technical

infrastructure, such as the availability of smartphones, is a potential barrier to digital health adoption (Banerjee et al., 2021; Desingh & Baskaran, 2022; Kumar et al., 2021; Menon et al., 2021; Raheja et al., 2021; Sampathkumar et al., 2022; Sandhu et al., 2021; Ullas et al., 2021).

Healthcare data security and patients privacy

Lee (2019) identified DTH barrier from a user perspective, namely the conflict between operational usability against healthcare data security and privacy. The absence of health service data security and patients privacy can reduce the potential of telemedicine to help monitor health. Consequently, DHT developers need to consider aspects of information security and privacy. Collaboration with the field of cybersecurity, particularly experts in network security and cryptography, is important in the development of DHT.

Data security and patients privacy are considered significant barriers to digital health adoption. The majority of users reported the risk of data being leaked, stolen, or tracked by malicious users (Perez et al., 2022). This suggests susceptibility to data security and privacy risks compared to face-to-face consultations. Data protection is an important concern because of threats due to leaks of confidential information and data in digital information systems, with third-party application (Biswas et al., 2020; Menon et al., 2021). Concerns about data security and confidentiality are a major challenge, as highly sensitive data is secured (Desingh & Baskaran, 2022; Powell et al., 2017; Prakash & Das, 2022; Thenral M & Annamalai, 2021; Ullas et al., 2021).

The feeling of content not being relevant to some users

Poduval (2022) conducted usability test and stated that there was content irrelevant to the conditions of the participants. Evaluation results from users are applied to modify content in a persuasive, appropriate, and relevant pattern.

Lack of time

Limited time is one of the barriers to using digital health. Participants perceived that the starting and completion process is long when accessing digital health (Poduval et al., 2022). This shows the need to increase the speed of access and data processing in application.

Patients mention that using DHT is a waste of time, particularly during the documentation process (Perez et al., 2022). The amount of time required to prepare and use digital health tools is identified as a factor reducing the quality (Browne et al., 2020; Pratap et al., 2018; Thies et al., 2017; Woods et al., 2019). The perceptions occur from repetitive, long, complicated, and boring content, leading to less time spent on mHealth application (Bentley et al., 2020; Bucci et al., 2019; Hatcher et al., 2018; Kowatsch et al., 2021; Luna-Perejon et al., 2019; Okorodudu et al., 2015).

Technical issues related to poor application design and System failure

Technical problems related to digital health hardware include lack of free storage space on smartphones, short battery life (Browne et al., 2020), and small screens (Woods et al., 2019). Some patients still do not use smartphones, limiting the wide coverage of installing the application (Chung et al., 2020). Other problems are related to software, such as functionality (Minen et al., 2021; Thirumalai et al., 2018), update challenges, and technical issues with the operating system (Woods et al., 2019). There are occurrences of bugs, glitches, or screen freezes in digital health application (Argent et al., 2018; Woods et al., 2019).

According to the Technology Acceptance Model (TAM) and Health Information Technology Acceptance Model (HITAM), application that fails to function properly is not user-friendly. The difficult navigation can reduce intention to use application (Holden & Karsh, 2010; Kim & Park, 2012). This barrier can be overcome through face-to-face training (Brzan et.al., 2016). Technical constraints in the use of application and smartphones are ethical issues, which serve as an additional burden for DM self-management. However, the experience of failure in using the application can cause clinical distress for patients (Torbjørnsen et al., 2019).

Functional barriers related to DHT design and interface for older users include a small screen, text, and icons, alongside complex functionality, as well as a lack of color contrast between text and background. Inefficient applications, which encompass issues with logging in, navigating, and malfunctioning IT systems, pose significant obstacles to their usage. To mitigate these challenges, future enhancements should incorporate beneficial features tailored for older adults, such as an excellent visual interface and auditory feedback (Nymberg et al., 2019; Perez et al., 2022; Pywell et al., 2020).

Logistical limitation

DM patients who use digital health aids often experience problems related to time, distribution trips, or the cost of providing logistics. This barrier can be overcome by logistics provision on the same day, which is scheduled directly at a convenient location to minimize independent costs by maximizing health insurance coverage (Liu et al., 2019).

Limitations of the review

All studies that meet the criteria in the methodology only have moderate quality. Although the keywords used in this review are unique, some studies are excluded when not indexed by search procedures and identified through the database.

CONCLUSION

In conclusion, this systematic review explores 11 studies and identifies 2 main barriers from the perspectives of DM patients when using digital health for management. The barriers include extrinsic factors from digital health infrastructure and intrinsic factors from individual patients, such as limited DHL.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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