

RESEARCH

Digital Healthcare Intervention to Improve Self-Management for Patients with Type 2 Diabetes: A Scoping Review

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Nowadays, diabetes is considered to be one of the major health emergencies worldwide. Products and services for diabetes management have been evolving into digital platforms and tools. We conducted a scoping review on intervention research to identify the benefits, barriers and limitations during the intervention. Our research identified 115 studies that were relevant for the study using the keyword research strategy; 25 met our inclusion criteria. These studies focus on the communication between health professionals and their patients; and self-care behavioral changes caused by using digital tools such as mobile-phones, apps, web-portals and Bluetooth devices to keep track of the patient's health data. The benefits of using eHealth systems are: raising awareness among patients, tracking their health data, and acquiring self-care behaviors alongside the health professional and family members. Future research needs to improve the user experience avoiding the identified barriers like *frustration technology*, *lack of face-to-face intervention* and *low health literacy* to prevent patients from abandoning the intervention.

Keywords: healthcare; mHealth; scoping review; type 2 diabetes

Introduction

Nowadays, diabetes is considered to be one of the major health emergencies worldwide. Each year more people develop this condition which can foster complications in their lifetime [14]. The patient suffering from this disease has to change their lifestyle creating habits that contribute to the regulation of their glucose levels [37].

Patients with diabetes usually require to have insulin administered to them (via syringe, pen or pump) and blood glucose monitoring devices. It is important for the patient to keep a record of their health data to make decisions in their self-management routines, this data also helps health professionals to make decisions during the treatment.

Overtime, products and services for diabetes self-care have been evolving. The Industry 4.0 or fourth industrial revolution has influence throughout all industries, including healthcare. In recent years, digital tools have been developed for the self-management of this chronic disease, simplifying the treatment of diabetes with functions such as personalizing treatment for each patient and improving and expediting the communication between the patient and the healthcare professional [7, 13, 27].

There is still a lack of information about the benefits, barriers and limitations that the eHealth products may have during the interventions with patients with T2D, which entails an opportunity to discuss findings and identify insights that will help in future research.

This scoping review of different interventions with *eHealth* and *mHealth* systems on the self-care and self-management of patients with type 2 diabetes focus on the communication between health professionals and their patients and the applications of self-care behavioral changes using digital tools. Understanding the benefits, barriers and limitations of using these *eHealth* applications to complement the treatment for patients with diabetes or the possible of substitute the usual care in clinics.

Literature Review

Diabetes

The World Health Organization (WHO) [40] defines diabetes as a chronic, metabolic disease characterized by elevated levels of blood glucose, which leads over time to serious damage to heart, blood vessels, eyes, kidneys and nerves.

According to the American Diabetes Association (ADA) ([1]: S13–S28) diabetes can be classified into the following categories: Type 1 diabetes (T1D), type 2 diabetes (T2D) and gestational diabetes mellitus (GDM). T2D previously

referred to as “noninsulin-dependent diabetes” accounts for 90–95% of all diabetes. This form encompasses individuals who have relative (rather than absolute) insulin deficiency and have peripheral insulin resistance which means the pancreas can still produce insulin, but the body becomes resistant to it. At least initially the patient may not need insulin treatment. This chronic disease is related to adults but nowadays young people may also suffer from it [1, 14, 21].

When patients are diagnosed with diabetes, they have to change their lifestyle, and in order to accomplish said feat, they have to change their habits. The American Association of Diabetes Educators (AADE), identifies seven diabetes self-care behaviors which patients have to incorporate into their lifestyle during the treatment. These behaviors are the following: physical activity, proper diet, medication intake, monitoring of blood glucose, problem solving especially for blood glucose (high and low levels and sick days), reducing risk of diabetes complications and living with diabetes [25].

The behaviors mentioned before are related to the principles of the comprehensive type 2 diabetes management algorithm from the American Association of Clinical Endocrinologist (AACE) and American College of Endocrinology (ACE). Garber et al. [11] mention that it was developed to provide clinicians with a practical guide that considers the patient, their spectrum of risk and complication and evidence-based approaches to treatment which are:

1. Lifestyle modification underlies all therapy (e.g., weight control, physical activity, sleep, etc.).
2. Avoid hypoglycemia.
3. Avoid weight gain.
4. Individualize all glycemic targets (hemoglobin A1C, fasting plasma glucose FPG).
5. Optimal A1C is $\leq 6.5\%$, or as close to normal as is safe and achievable.
6. Therapy choices are patient centric based on A1C at presentation and shared decision-making.
7. Choice of therapy reflects ASCVD, CHF, and renal status.
8. Comorbidities must be managed for comprehensive care.
9. Get to goal as soon as possible—adjust at ≤ 3 months until at goal.
10. Choice of therapy includes ease of use and affordability.
11. Continuous glucose monitoring (CGM) is highly recommended, as available, to assist patients in reaching goals safely.

The self-care behavior of the principals of AACE/ACE are related on a lifestyle modification based on the patient's data. There are different devices (e.g. CGM, insulin delivery) that help the patient to understand and achieve their goals using diabetes technology for an appropriate follow-up that helps the health professional to decide on the treatment.

Diabetes technology

ADA ([2]: S71–S80) defines *diabetes technology* as a term to describe the hardware, devices and software that people with diabetes use to help manage blood glucose levels, stave off diabetes complications, reduce the burden of living with diabetes, and improve quality life. The *diabetes technology* has been divided by two main categories: insulin administered (syringe, pen or pump) and blood glucose monitoring but technology has been evolving using Internet of Things (IoT) for the management and diabetes self-care using.

Vermesan and Friess [38] define IoT as a concept and a paradigm that considers pervasive presence in the environment of a variety of things/objects that through wireless and wired connections and unique addressing schemes are able to interact with each other and cooperate with other things/objects to create new applications/services and reach a common goal. In the medical field there are two important concepts related to IoT: eHealth and mHealth.

Authors Oh et al. [31] defined eHealth as an emerging field focused on medical information and health care services delivered or enhanced through advanced Internet or related technologies, which enables patients to easily obtain medical related services online from health care providers, while mHealth is a component of eHealth. Global Observatory for eHealth (GOe) defined mHealth or mobile health as medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices [6].

In the current market, the development of products and/or services for diabetes care has been evolving, since 2013 the tendency is using digital tools like devices, apps and platforms for the management of the disease, which have influence in the treatment, personalizing it depending on the needs of each patient and introducing many communication tools for both health professionals and patients [13, 27].

Kulzer et al. [17], estimate that within five years there will be an increase in the use of digital tools for diabetes care like glucose management, apps for diabetes treatment, platforms for digital education of the disease and telemedicine.

Material and Method

This paper is focused on articles related to intervention of digital tools that help in the T2D self-management. For this review we follow the framework described by Guirao, Omedo and Ferrer [12], with some modifications to present a review article.

Define the purpose

We searched for eHealth and mHealth interventions studies related to self-care behavior and self-management for patients with T2D.

The next research questions were formulated:

1. What are the features and/or methods which help patients engage with and/or keep motivated with the eHealth system?
2. What are the benefits for patients, health professionals and clinics obtained by implementing an eHealth system instead of usual care (UC)?
3. What are the barriers and limitations that the patient experiences during the intervention and which need to be improved in future studies conducted?

Bibliographic search tool

This research used different electronic databases like JMIR Data and Google Scholar from 2015 thought April 2020. We reviewed only English-language original studies, and researched articles containing the keywords “type 2 diabetes” and requiring the title or the abstract to contain “mHealth”, “eHealth” and “digital health”.

Selection criteria

The inclusion criteria for the systematic review were the following: (1) interventions using eHealth or mHealth, (2) communication with professional health and patient (3) usual care vs eHealth intervention, (4) self-care behaviors changes, (5) studies published between 2015 and April 2020 and (6) English language. The exclusion criteria were interventions not involving patients; like reviews, protocols, study cases, thesis, abstract or empirical studies. We also excluded interventions which did not report results of the described study or studies which are not involved with T2D. Books, oral presentation and posters were also excluded.

Assessing the quality of studies

Using the aforementioned keyword research strategy, 115 studies were found. Following that, duplicated studies were removed, leaving 105 articles left. Then, the exclusion criteria were applied, reducing the spectrum to 51 articles. The full-text version of the studies was read by the three authors of this review, and they were selected if said studies were focused on interventions regarding eHealth and/or mHealth with patients suffering from T2D and if they explained the results they found, reducing the scope of the review to 25 articles. The studies were categorized in the different types of intervention and topics they focused on: health professional and patient communication, behavior changes, UC (Usual Care) vs eHealth and the barriers and limitations of the interventions.

Results

Search results

Using the *Search Strategy*, we found 68 articles in Google Scholar and 47 articles in JMIR Data. The primary search resulted in 115 articles, after removing the duplicated articles, there were only 105 articles left (**Figure 1**).

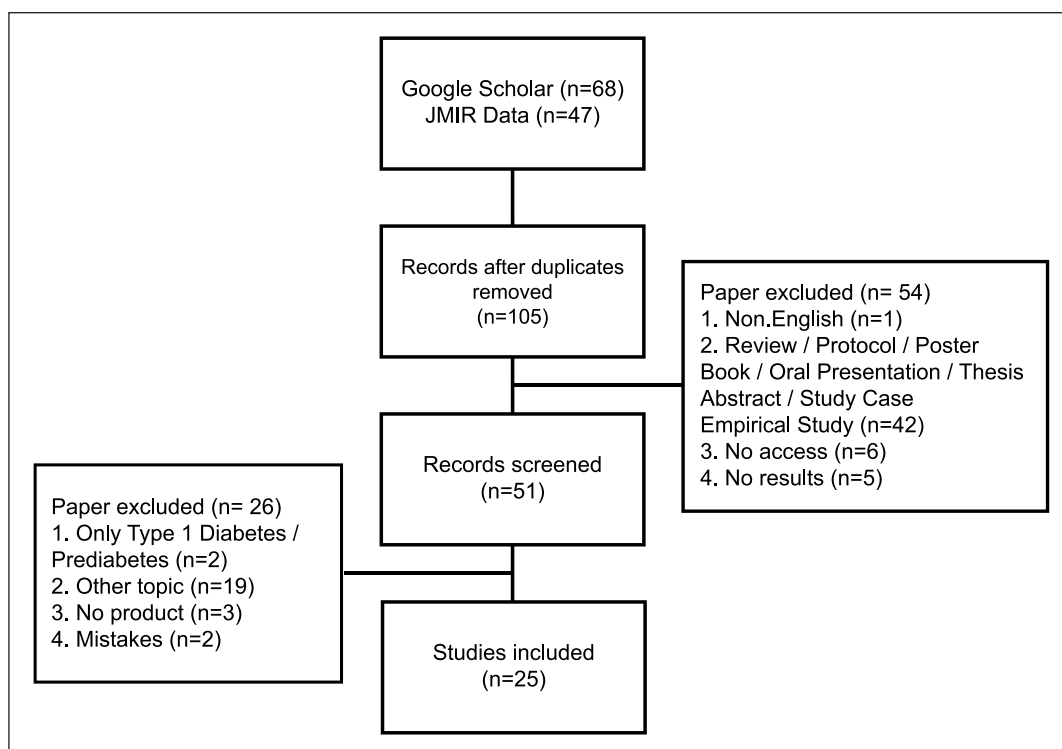


Figure 1: Study selection process.

We found 25 intervention studies which met the inclusion criteria. The main objective of the review is selecting the intervention studies to analyze the features that have an impact in the engagement and/or motivation of the patient improving their self-care and self-management, as well as the benefits, barriers and limitations found by the studies.

Different types of interventions were identified, including those focused on the communication between health professionals and patients, self-care behavior changes and UC vs mHealth intervention.

The self-care behavior-change interventions were focused mostly in the blood glucose monitoring, diet, and physical activity.

Publication data

The 25 included studies were published between January 2015 and April 2020. In 2016 we can observe an increment of studies focused on eHealth or mHealth interventions with patients with T2D comparing them with 2015. Also, in 2020 we can observe four articles between January and April, therefore we can make an assumption that this number will increase in this year (**Figure 2**).

The majority of the intervention studies were performed in USA (n = 11). About 32% were completed in Europe (n = 8), specifically in Norway, United Kingdom, Belgium and Poland; 12% in Asia (n = 3), performed in China and Japan; 8% in Oceania (n = 2), specifically in Australia and 4% in South America (n = 1), with a study performed in Peru (**Table 1**).

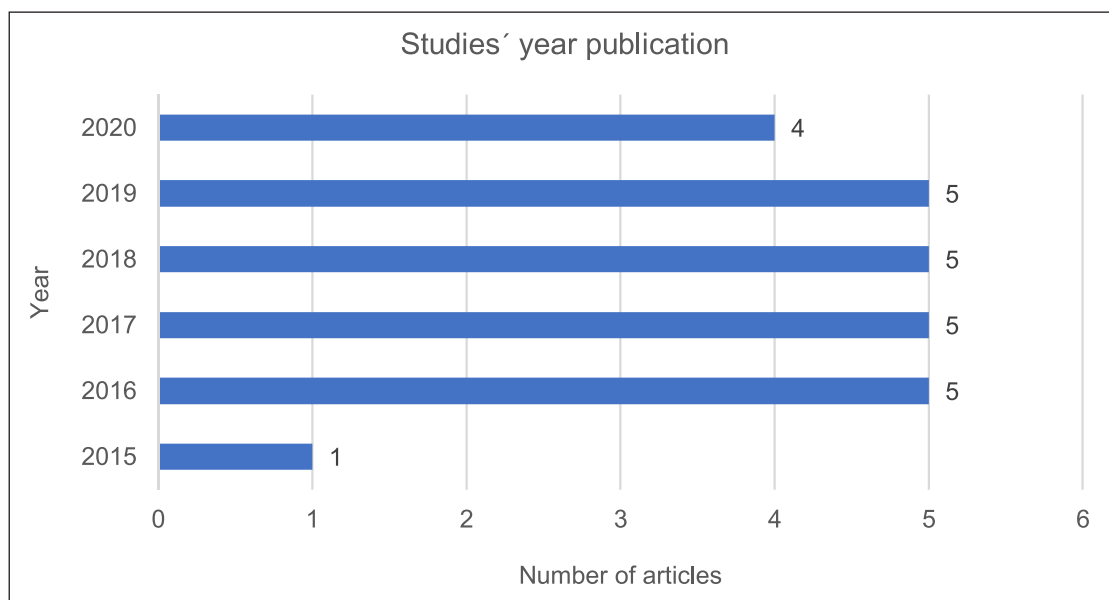


Figure 2: Number of studies published per year between 2015 and April 2020.

Table 1: Number of studies per country.

Country	Number of studies
USA	11
Norway	3
UK	3
Australia	2
China	2
Belgium	1
Peru	1
Poland	1
Japan	1
Total of studies	25

Table 2: Types of intervention and topics.

Topics	Number of studies
Health professional and patient communication	5
Behavior changes	
Monitoring	4
Physical activity and diet	7
Medication intake	1
Support intervention	1
UC vs mHealth intervention	15
Barriers and Limitation	8

The articles were divided in different topics, with some of them exploring more than one of the relevant topics (Table 2). Most of the articles are focused on the comparison of the usual care vs mHealth intervention (n = 15), which means they want to prove if there are benefits in changing the traditional care. Some of the studies are focused on behavior changes (n = 13) to improve self-care management like: monitoring (n = 4), physical activity (n = 7), medication intake (n = 1) and support intervention (n = 1). Some articles discuss the barriers and limitations regarding the eHealth intervention with the patients (n = 8) and the intervention focused on communication between health professionals and patients (n = 5).

Types of interventions

Health professional and patient communication

Diabetes self-management is an important skill for patients to develop during their treatment and it includes the actions and decisions which they must take to improve their quality of life and reduce the risk of developing complications in the future. Nevertheless, these changes of habits are difficult for patients to achieve on their own. Constant communication between health professionals and patients is essential during the treatment of diabetes. Usually the eHealth system is compound with a smartphone/mobile, data services, wireless devices and/or a portal web where health professionals can monitor their patients and decide the call-to-action required in the treatment of each patient.

Most of the eHealth interventions studies help patients bolster diabetes self-management by empowering self-determined goals-settings and competence-building where they can communicate with their health professional via web-portal or basic mobile phone technology while setting self-care goals and improving the patient’s ability and their adherence to self-care behaviors. On that note, patients can express their experiences and difficulties with their diabetes self-management in daily life; the health professional then aids them by providing feedback in order to help them reflect and improve communication which enable autonomous problem-solving, goal setting, and action planning depending on the answers provided by the patient, improving self-care [4, 18, 22].

Communication between health professionals and patients is not limited to improving motivation, it also implies tracing the patient’s data which the health provider can monitor and make an action depending on the obtained information, by reducing complications of T2D (e.g. cardiovascular, depression, hypertension). The artificial intelligence can analyze and help both clinics and health professionals with an alarm system if there is an anomaly, allowing them to take a rapid decision action [16, 30].

The reviewed researches showed the importance of communication between health professionals and patients, nonetheless, they also stated the importance of a family member getting involved. The patient’s adherence most of the time is impacted by family actions and can affect control of the disease. In this type of intervention, the patient receives text message support and can choose to invite a support person, which most of the time is a family member, to receive text messages which allow them to understand and know more about their treatment [22].

Behavior changes

The patients must adopt different self-care behaviors when they are diagnosed with diabetes. There are many strategies to motivate behavior changes in the patient using tailored messages as motivation, reminders and goal settings combined with their track data utilizing digital tools like using a mobile phone, app, web-portal and Bluetooth devices helps the patient monitor their data easily.

Monitoring

As part of the treatment, the patient with TD2 needs to have a written registry of their glucose level and other data like blood pressure, BMI, weight, and others. This data is useful for the health professional to evaluate the treatment and, if necessary, it allows them to change it.

Burford et al. [5] demonstrate the usage of a portable device like tablets or smartphones can improve the engagement of the patient using an mHealth app related to self-care behaviors complementing that with community support and by providing relevant information, visualizing the data easily and allowing the possibility to share said information with their health professional. With these features, patients can understand more about their disease through acquiring this information and realizing the importance of keeping daily records of each behavior, thus improving the patient's health and well-being by setting goals [36, 41, 42].

Physical activity and diet

The patient with T2D has to acquire healthy eating habits and perform physical activity to regulate their blood glucose levels, also helping the patient to prevent obesity and complications derived by the disease. In order to understand how to create a habit, the researchers observed behavior change theories like the Fogg behavior model (FMB) in the mHealth systems [34].

Giving the patient relevant information and facilitating knowledge about the benefits of the different self-care behaviors like physical activity, diet and self-management, can raise awareness of the disease, which is enhanced by using different features to reinforce the provided information (eg. tips, quizzes) action plan, self-techniques goal-settings, providing feedback regarding their progress and identifying and reaching a solution for potential barriers of the patient during the intervention [26, 32, 34].

Measuring the levels of their negative self-behaviors -like the lack of physical activity and sedentary behavior- using a website, was useful to raise awareness of said negative behavior and a wakeup call to change their habits [32].

A support program can motivate patients to be more physically active: like applying trigger text-messaging and complementing that with a digital device like a pedometer, all of them actions which can make the patient's monitoring easier [24, 34].

The primary features identified in the interventions which promoted a change in behavior were (1) a daily food logging (2) setting goals of losing weight and body mass index (BMI), (3) tracking their behavior (e.g. steps, food/calories, blood pressure, blood glucose and weight) and/or using tracking devices (e.g. Fitbit), (4) coaching program and (5) group support using social media (e.g. Facebook).

Using this type of features in the mHealth system demonstrates a potential efficacy in reducing the risk of developing diabetes in overweight patients. The studies also showed that improving engagement with the mHealth system and group interaction had a direct impact on self-monitoring through food logging, resulting in higher weight loss [3, 23, 41].

Medication intake

The health professional prescribes the patient with oral medication and/or insulin during the treatment. The medication intake is an important self-care behavior to adopt during the treatment but patients usually disregard this easily. For improving medication adherence, the interventions used tailored messages and a system for daily reminders, motivation and confirmation of the medication intake while also complementing the intervention feedback with direct phone calls from the health professional [28].

Support intervention

The messages and goal-settings remind the patients to register their data regarding each self-care behavior, which can change habits, but also their state of mind. The psychological intervention can support people with chronic conditions. Patients using their mobile phone can reach the therapist supporting their self-monitoring and awareness of health behavior, thoughts, feelings and applied self-management strategies. With this information the health professional can create personalized feedback [29].

UC vs mHealth intervention

The research of eHealth systems is performed to improve and eventually substitute some tools and/or strategies used in the standard medical care or UC.

During these interventions, researchers compared eHealth systems to the UC system, emphasizing the benefits and barriers of each system.

The mHealth apps demonstrated during the intervention studies that they can improve the quality of clinical care. People with diabetes require access to systematic, ongoing, and organized care delivered by a multidisciplinary team of skilled health care providers conformed sometimes by doctors, nurses, health educators, dietitians and other health professionals. Using an mHealth system with advice regarding behavioral and motivational messages, a tracking health app, a Bluetooth device (eg. glucometer) and a web-platform can improve the management and education in their own home [19, 26, 33, 35, 43]. The benefits of digital intervention can reduce the frequency of failed contact with patients, and they also have the potential to enhance work practice patterns and health service delivery for clinicians and patients in diabetes management [4].

Health professionals prefer digital systems (e.g. app, web-portal) and telephone consultation rather than the UC (e.g. written patient's records) because they can extract the patient's real-time data from the mHealth system, providing a better option for health professionals in order for them to appreciate if the treatment is working or not, also to

personalize the topics the patient needs to improve or learn and making quick decisions based on the data [4, 8, 19, 33, 35].

On the studied interventions we can observe an improvement of the self-care data like glycemic control at the 6^o-month milestone or further. During the intervention, the UC group demonstrated interest in using the online resources and used the wearable device for tracking physical activity [10, 18, 35, 43].

We identified other benefits that can have the implementation of eHealth in the treatment of diabetes.

Most of the patients with T2D are elderly people, and as such, they are expected to have less experience with computers and the use of mobile solutions, however, despite their age during the study, their assessment of using eHealth system was remarkably positive. Adults with T2D are suitable for eHealth intervention and are also interested in implementing self-regulation techniques. The beneficial impact of this type of intervention helps the senior patient to improve their diet, exercise patterns, medication intake, smoking and blood glucose measurement, while also reducing expenses on endocrinology clinic visits and on endocrinology medications, by creating awareness in the importance of following the treatment [16, 28, 44].

Using tailored messages has the potential to achieve a significant public health benefit in diabetes, by providing a simple, low-cost mHealth system for patients with a low-income [8, 10, 18, 22, 28], also, a self-monitoring app can help promote T2DM self-management in rural areas where there are not nearby clinics by providing a constant checkup method for their health [9].

The papers focusing on physical activity and diet demonstrate changes in some parameters of the patients, mostly on weight. Yamaguchi et al. [41] mentioned that within a month of using GlucoNote app, the participants improved their weight loss in -0.5 kg (SD 1.2), meaning a decreasing rate of 0.6% (SD 1.6). Bender et al. [3], mention that weight loss of 5% to 7% during 6 months is associated to prevent T2D and reduce cardiovascular risk, and is also related to significant clinical improvements (eg. blood pressure, glucose), the PilAm Go4Health study was a short 3-months intervention where the participant may not have sufficient time to achieve the 5% weight loss goal.

Li et al. [19] demonstrate the control rates of HbA1c, FBG, and P2BG were higher in the mHealth than usual care groups: 45.75% vs 47.00% ($P = .57$), 38.03% vs 32.76% ($P = .07$), and 47.32% vs 47.89% ($P = .83$), respectively.

To improve self-care data log of the patient (e.g. blood glucose, blood pressure, BMI), the interventions need to be a long-term study, of more than 6 months [10, 19, 23]. Sometimes, there are difficulties to perform a long-term study because the patient may quit during the intervention, therefore it is important to analyze the barriers and limitations of the study itself to prevent this.

Barriers and Limitation

There are many barriers and limitations on implementing eHealth interventions. The lack of motivation and lack of engagement are two clearly identified barriers hindering acceptance of a digital treatment intervention. The aforementioned barriers are related to *frustration technology*, which is defined as the lack of understanding or basic health literacy and missing the face-to-face interaction with the health professional, as well as the patient's lack of knowledge regarding health literacy.

Frustration technology

The difficulty to adapt to new technology does not lay only on the age factor, but also on the usability of the product, which means the ease to understand or adapt to a digital platform and/or device. If the digital solution has too many errors, technical issues during the intervention or if it requires too many steps to produce an action in the web-portal/app, it will be too time-consuming for the patient, which can provoke weariness and the loss of interest on the product, which reflects on less engagement [20, 28]. The frustration of the participant during the interventions is sometimes related to the performance of the software and the frequent updates which reduces enthusiasm due to technical difficulties [8]. The monotony of the intervention may become an issue if the patient feels like they are only filling out questionnaires [32]. It is necessary to measure the technological skills of the patients in order to avoid the need to provide technical support during the intervention [36].

Another barrier to uptake were the multiple reporting requirements and electronic record systems, which led to the perception that the app was redundant, despite dissimilarities to existing systems in most cases [8].

Another issue reported by the patients, related to frustration technology, was the fear of breaking the devices provided by the investigators to check their physical activity, which led the patients to reduce the intensity of their activity during the trial. Patients stated that being able to use the provided devices for free was comfortable but they mentioned that if they had to buy them, for example the FreeStyle FMG, it would be too expensive for them. Language is also an important factor to take into consideration and researchers must adjust it depending on the population where the test is conducted [39, 42].

Lack of face-to-face interaction

Another issue found in the reviewed studies was the impersonal nature of some of the eHealth systems, meaning the lack of face-to-face interaction with the health professional. This emphasized human communication as a motivating trigger to achieve previously set goals. When patients do not have a set appointment with a health professional, they

tend to neglect the recommendations provided by the eHealth systems [20]. Another identified barrier is the fact that impersonal messages tend to lose motivation and interest from the participant [24], at times, patients have reported these type of messages to be bothersome [39].

Health literacy

Basic health literacy is important for the patient to understand their disease and its treatment. Although this may be an overarching problem for healthcare in general, it is of paramount importance in eHealth interventions because while in Usual Care patients are able to directly ask their health professionals any doubts and questions which may arise during their treatment, that is not always the case with eHealth interventions, where patients mostly interact with a device which does not always have technical support to solve medical questions. Furthermore, when the patient does not know the basic information about diabetes, they tend to reject the eHealth interventions because they do not understand the benefits. Nonetheless, if the information or feedback provided is too vast or if it is shown with technical words or long texts, the patient may lose interest on reading about the topic, and on the other hand, they might find the information irrelevant if it is not new for them because they are well-informed by their health professional. Another common problem described in these articles is the fact that if the patient does not familiarize themselves with these issues described in the interventions, they will not be able to empathize with the case or medical information provided, therefore it is advised to avoid stating extreme cases as a way to dissuade negative habits [20, 32].

Discussion

Principal findings

Our scoping review demonstrates that using mobile phones has a significant high engagement and long-term changing self-care habits like weight loss, medication intake and increasing physical activity. Using tailored messages was found to be useful for the patient as reminders to their goal-settings and feedback, motivating the user to change their behavior also is a potential benefit for public health in the treatment of diabetes, as a low-cost system for patients with a low-income or living in rural areas.

The communication between the health professional and the patient is important to increase awareness, as well as the social support provided by family members getting involved during the treatment. Support groups are also important in order for the patient to get motivated, whether they use social media groups or community groups. The follow-on support motivates the participants to be physically active, increasing awareness on their own. Also, participants found telephone calls as a useful tool which allowed them to overcome any technical barriers.

There is potential of implementing digital tools in clinics for the treatment of diabetes, however, the reviewed articles mention the need for more studies and trials [8]. Apps have the potential to enhance work practice patterns and health service delivery for clinicians and patients in diabetes management [4]. Both clinics and patients display a great acceptance of using an eHealth system and also identifying the benefits of communicating and tracking the data of the patient in real-time, therefore, it is a great opportunity to change from the UC to a digital care.

Researchers often assume that elder patients have less experience with technology or are not interested in learning; nevertheless, adults are suitable for eHealth interventions, which help them understand and learn to self-manage their treatment more easily. It is important that technical support is provided before and during the intervention, to ensure the solution to any problem that the eHealth system may present, thus avoiding losing the interest of the patient.

User experience

User-centered design helps researchers understand the needs, values, and abilities of users, as well as iteratively assessing the design to improve users' perceptions and interactions with the technology and content [22]. It can influence in the motivation and awareness of the patient about their disease, and as such, it is an important aspect to be considered during the development of the eHealth system.

Providing a clear benefit to the patient's health using mHealth technology can increase their motivation in order to ensure long-term engagement with apps and media platforms, therefore, the lack of face-to-face interaction and the monotony of answering questionnaires and not having a real interaction with a health professional, entails an issue that must be addressed by researchers, since the impossibility that patients have to solve doubts and express their feelings about the treatment and the disease, is the main motive patients manifest as the reason for losing interest in the mHealth system. Identifying the barriers and limitations which lead to patients dropping out from the eHealth interventions, allows researchers to focus on solving these particular issues, thus maintaining the interest from the patient [15, 20, 28].

The lack of usability may influence the engagement of the patient. Before the trial, it is important to measure the technological illiteracy of the participants, sometimes they have different levels of technical experience with digital tools and can somehow affect the trial and the engagement of the intervention. This is an important variable to be considered in the selection criteria. Also, it is important to consider providing technical support during the trial [36, 44].

Conclusion

The eHealth system contributes in the awareness, change of habits and motivation of the patient to follow the treatment alongside the health professional and the patient's family member. The actual tendency for the treatment and management of diabetes is to implement digital care while also maintaining physical consulting, because the patient needs the interaction with the health professional.

Future researches have to focus on the *user experience* during the development of the product in order to prevent participants from dropping out during the intervention, while also implementing technical support to resolve any technical issues that may arise.

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