

# Use of educational technologies in the context of diabetes mellitus and the repercussions on self-care: An integrative review

Utilização de tecnologias educacionais no contexto do diabetes mellitus e as repercussões no autocuidado: Revisão integrativa

Uso de tecnologías educativas en el contexto de la diabetes mellitus y las repercusiones en el autocuidado: Una revisión integradora

## RESUMO

Objetivo: identificar na literatura científica tecnologias utilizadas no processo de educação em saúde das pessoas com Diabetes Mellitus e as repercussões no autocuidado. Métodos: trata-se de uma revisão integrativa com coleta de dados de fevereiro a março de 2021, por meio de fontes secundárias: Cumulative Index to Nursing and Allied Health Literature, Medical Literature Analysis and Retrieval System Online, Literatura Latino-Americana e do Caribe em Ciências de Saúde e Scientific Electronic Library Online. Resultados: diversas tecnologias são utilizadas, como: aplicativos de celular, envio de short message service, mensagem de texto, voz ou ligações, criação de web sites, folhetos, cartilhas, vídeos educativos e tecnologias combinadas. As repercussões no autocuidado foram a queda da hemoglobina glicada, controle glicêmico, modificação dos hábitos de vida e adesão à medicação. Conclusão: acredita-se que o estudo possibilitará ampliar o conhecimento dessas tecnologias existentes, com intuito de promover saúde e prevenir agravos dos pacientes com Diabetes Mellitus.

**DESCRIPTORES:** Educação em saúde; Teleeducação; Diabetes Mellitus; Autocuidado

## ABSTRACT

Objective: to identify in the scientific literature technologies used in the health education process of people with Diabetes Mellitus and the repercussions on self-care. Methods: this is an integrative review with data collection from February to March 2021, through secondary sources: Cumulative Index to Nursing and Allied Health Literature, Medical Literature Analysis and Retrieval System Online, Latin American and Caribbean Literature in Health Sciences and Scientific Electronic Library Online. Results: several technologies are used, such as: cell phone applications, sending a short message service, text messaging, voice or calls, creating web sites, brochures, booklets, educational videos and combined technologies. The repercussions on self-care were the drop in glycated hemoglobin, glycemic control, changes in lifestyle and medication adherence. Conclusion: it is believed that the study will make it possible to expand the knowledge of these existing technologies, with the aim of promoting health and preventing injuries in patients with Diabetes Mellitus.

**DESCRIPTORS:** Health education; Educational technology; Diabetes mellitus; Self management.

## RESUMEN

Objetivo: identificar en la literatura científica tecnologías utilizadas en el proceso de educación en salud de las personas con Diabetes Mellitus y las repercusiones en el autocuidado. Métodos: se trata de una revisión integradora con recolección de datos de febrero a marzo de 2021, a través de fuentes secundarias, en el Índice Acumulativo de Literatura en Enfermería y Afines en Salud, Sistema de Análisis y Recuperación de Literatura Médica en Línea, Literatura Latinoamericana y del Caribe en Ciencias de la Salud y Biblioteca electrónica científica en línea. Resultados: Se utilizan varias tecnologías, tales como: aplicaciones de telefonía celular, envío de un servicio de mensajes cortos, mensajería de texto, voz o llamadas, creación de sitios web, folletos, folletos, videos educativos y tecnologías combinadas. Las repercusiones en el autocuidado fueron la caída de la hemoglobina glucosilada, el control glucémico, los cambios en el estilo de vida y la adherencia a la medicación. Conclusión: se cree que este estudio permitirá ampliar el conocimiento de estas tecnologías existentes, con el objetivo de promover la salud y prevenir lesiones en pacientes con Diabetes Mellitus.

**DESCRIPTORES:** Educación para la salud; Teleeducación; Diabetes Mellitus; Autocuidado.

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## INTRODUCTION

**D**iabetes mellitus (DM) is a metabolic disorder characterized by persistent hyperglycemia, resulting from a deficiency in insulin production, in its action or in both mechanisms. It is associated with chronic microvascular complications such as retinopathy and nephropathy, and macrovascular complications such as cardiovascular and cerebrovascular diseases. Peripheral neuropathy is also highlighted, which can cause foot ulcers and lower limb amputation.<sup>1</sup>

In Brazil and in the world, diabetes is considered a public health problem. Currently, more than 463 million adults live with this comorbidity and the number of cases has grown exponentially. This is due to a complex interaction between socioeconomic, demographic, environmental and genetic factors.<sup>1</sup>

From this perspective, the control and prevention of diabetes complications are possible through educational actions carried out by health professionals, being one of the most effective awareness vehicles for these people to perform self-care.<sup>2</sup>

Health education is a care model, fo-

**Studies show that the use of ET by professionals helps people with chronic diseases to have greater adherence to the proposed therapies, actively participating in care planning.**

cused on health promotion and disease prevention, prioritizing the individual's needs and taking into account their lifestyle, sociocultural context, living space and the main health problems. To support the educational actions of health professionals with people with diabetes, different educational technologies are incorporated to facilitate learning and achieve adherence of these individuals, ceasing the existing difficulties in relation to the knowledge that underlies self-care.<sup>3</sup>

For self-care to happen, people need to understand scientific information that surrounds the health-disease process and be able to make healthier choices in everyday life. Health education through active methodologies is essential.<sup>3,5</sup>

Health professionals, including nurses, are in constant search for technological resources to approach and sustain the health education process, enabling and contributing to the autonomy of these people.<sup>4</sup> In this context, Educational Technologies (ET) applied in educational actions aimed at people with DM aim to improve health issues in a reflective and multidimensional way, scientifically validated.<sup>4</sup>

The growing number of people with

DM and the existing fragility in relation to self-care, makes the elaboration of ET essential, so that the responsible professional has the possibility to offer through active methodologies, guidelines on treatment, change of habits and maintenance of metabolic control, influencing the patient to take responsibility and be interested in improving the quality of life.<sup>5</sup>

Studies show that the use of ET by professionals helps people with chronic diseases to have greater adherence to the proposed therapies, actively participating in care planning.<sup>2,5</sup>

When considering the high morbidity and mortality from Diabetes Mellitus and the impact on quality of life as a result of complications, it was questioned which educational technologies can be used by health professionals to improve awareness of the person living with the disease and how the use of these technologies contribute to healthier behaviors. Therefore, it became objective to identify in the scientific literature the technologies used in the health education process of people with Diabetes Mellitus and the repercussions on self-care.

## METHOD

This is an integrative literature review with data collection performed from secondary sources. For its development, the following steps were taken: definition of the objective of the study and the guiding question, establishment of the sample selection criteria (inclusion and exclusion), presentation of the information to be extracted from the articles, analysis of the results,

exposition and discussion of the same and the last step constitutes the conclusion of the findings of the review.<sup>6</sup>

The present study was guided by the following question: what are the Technologies used in the health education process of people with Diabetes Mellitus and the repercussions on self-care? In order to formulate the question correctly and reach the best evidence, the strategy was used, defined as follows: the P for “population” (population with Diabetes Mellitus); the I for “intervention” (not applicable); the C for “comparison” (not applicable, as it is not a comparative study) and O for “outcome” (not applicable).

Data collection was carried out from February to March 2021, through access to the signed content of the Portal of Periodicals of the Coordination for the Improvement of Higher Education Personnel (CAPES), through the institutional login of the Federal University of Juiz de Fora, aiming for a greater number of full-text productions. The following databases were used: Medical Literature Analysis and Retrieval System Online (MEDLINE/PubMed), Cumulative Index to Nursing and Allied Health Literature (CINAHL), Latin American and Caribbean Literature in Health Sciences (LILACS) and Scientific Electronic Library Online (SCIELO).

The descriptors used, according to the Health Sciences Descriptors (DeCS) were: “health education (educação em saúde)”, “Diabetes Mellitus” and “self management (autocuidado)”. The crossing of the descriptors was mediated by the Boolean connector “AND”. In the CINAHL and

MEDLINE/PubMed databases, the terms were used in English and in LILACS and SCIELO, in Portuguese.

In order to select the scientific productions, the inclusion criteria were previously established, namely: studies that address the theme of the review, carried out with individuals from 18 years of age, available in full for free access and in Portuguese, English and Spanish. The time frame established was 10 years (2011-2021) in order to provide the most recent evidence, focusing on the technologies used in the health education process of people with Diabetes Mellitus. Reviews and editorials, review articles, case studies and duplicate productions in the databases were excluded. The selection process of scientific productions that were part of the sample was carried out according to PRISMA recommendations.<sup>7</sup> To determine the strength of the evidence, the study was based on the seven levels (N) of the Agency for Healthcare Research and Quality (AHRQ) classification.<sup>8</sup>

## RESULTS

The publications that make up this review were listed in descending order in the year of publication, for better organization of the results. In table 1 it is possible to access the studies, with the main results found and the respective level of evidence.

## DISCUSSION

Information and communication technologies, applied in the area of health education, are a set of tools that aim to promo-

Table 1– Primary studies selected for the integrative review- Juiz de Fora, MG, Brazil, 2021

TITLE	YEAR	MAIN RESULTS	NI
Intervention through Short Messaging System (SMS) and phone call alerts reduced HbA1C levels in 47% type-2 diabetics-results of a pilot study. <sup>9</sup>	2020	Participants received guidance on diabetes self-management through classes and leaflets, in addition to weekly calls and text messages to check adherence, control medication, analyze blood glucose and practice physical activity. The result shows that about 47% of the participants showed a decrease in HbA1c.	N6
The role of text messaging intervention in Inner Mongolia among patients with type 2 diabetes mellitus: a randomized controlled trial. <sup>10</sup>	2020	42 text messages (SMS) were designed based on the themes of health awareness, diet control, physical activities, lifestyle habits and weight control. This method resulted in significant improvements in terms of continuous exercise and weight control of the participants.	N2

The effect of self-management education through weblogs on the quality of life of diabetic patients. <sup>2</sup>	2019	Education sessions for diabetic patients were applied through web blogs, using texts, videos and recorded voice, in addition to exercise and medication administration sessions. This dynamic resulted in the improvement of anthropometric indicators including waist circumference, as well as BMI and FBS.	N6
Effect of simulation education and case management on glycemic control in type 2 diabetes. <sup>11</sup>	2019	Use of simulation education (SE) associated with the traditional DSME method (Diabetes Self Management Education), classes focused on knowledge and skills needed for healthy diet, physical exercise, self-monitoring of blood glucose level and solving problems related to diabetes, in addition to the use of self-explanatory videos. The program was effective in terms of improvements in HbA1c, FBG (fasting blood glucose) and PBG (postprandial glucose) values.	N6
Effectiveness of diabetes self-management education via a smartphone application in insulin treated type 2 diabetes patients – design of a randomised controlled trial ('TRIGGER study'). <sup>12</sup>	2018	The application (TRIGGER) sent unidirectional messages to patients in the intervention group about eating habits, physical activity, prevention of hypoglycemia and glucose variability, providing an improvement in glycemic control compared to the control group.	N2
Diabetes and TelecommunicationS (DATES) study to support self-management for people with type 2 diabetes: a randomized controlled trial. <sup>13</sup>	2018	Motivational messages by m-health (virtual communication media that can favor discrete focused support and enable changes, in addition to the usual clinical care by the professionals in charge. The use of technology provides improvements in the glycemic control of users.	N2
Increased self-care activities and glycemic control rate in relation to health education via Wechat among diabetes patients. <sup>14</sup>	2018	Participants received instant messages via WeChat related to diabetes (self-monitoring of glucose, reasonable diet, exercise prescription, etc.), leading to differences in HbA1c concentration and self-efficacy between the intervention and control groups.	N2
Baseline Characteristics and Technology Training of Underserved Adults With Type 2 Diabetes in the Mobile Diabetes Detective (MoDD) Randomized Controlled Trial <sup>15</sup> .	2017	Participants received HIT DSME intervention, through the MoDD website with educational content about diabetes, in addition to the daily alert of blood glucose collection and its values, via text message. There was improvement in glycemic control similar to face-to-face DSME and increased access, reach and impact.	N2
SMS education for the promotion of diabetes self-management in low & middle income countries: a pilot randomized controlled trial in Egypt. <sup>16</sup>	2017	Patients received educational messages related to diabetes management via SMS and 12 reminders, providing considerable improvements in treatment (decrease in HbA1c, increase in medication adherence, self-efficacy and knowledge scores).	N2
Pilot Feasibility Study of a Digital Storytelling Intervention for Immigrant and Refugee Adults With Diabetes. <sup>17</sup>	2017	In addition to the structural interview, the digital narrative was implemented, where the videos were based on narratives in which the story components are incorporated into the health communication media. This practice resulted in improvements towards psychosocial and glycemic control.	N3
Assessment of a National Diabetes Education Program diabetes management booklet: The GRADE experience. <sup>18</sup>	2017	Application of the 4-step information booklet to improve self-care and self-efficacy knowledge among study participants. The main changes were in A1C frequency, personal role in diabetes management, first step towards daily physical activity, in addition to increased self-efficacy and overall diabetes control.	N6
A Team – Based Online Game Improves Blood Glucose Control in Veterans With Type 2 Diabetes: A randomized Controlled Trial. <sup>19</sup>	2017	An automated system game (DSME) was applied that sent questions regarding comorbidity, in addition, participants received a booklet containing a detailed explanation of the topics. Over the 12 months, game users had significantly greater reductions in average HbA1c than civic game participants, in addition to increasing their awareness..	N2
Development and Evaluation of a Computer-Based, Self-Management Tool for People Recently Diagnosed with Type 2 Diabetes. <sup>20</sup>	2016	Autonomous sections and the LWD program were applied, in order to improve knowledge and encourage self-monitoring of food intake and physical activity, with goal setting. The program was well received by participants and its use provided small but statistically significant improvements in diet-related knowledge.	N2



Short – Term Trajectories of Use of a Caloric Monitoring Mobile Phone App Among Patients With Type 2 Diabetes Mellitus in a Primary Care Settings. <sup>21</sup>	2015	Patients received the usual counseling model and instructions for using the iDAT application to help with self-care. The univariate analysis showed that there were improvements in food and motivation to exercise, which are associated with frequent users of the application.	N4
Improvements in illness self-management and psychological distress associated with telemonitoring support for adults with diabetes. <sup>22.</sup>	2015	Participants received incentives for self-care through IVR (interactive voice response) weekly, leading to improved blood glucose levels and foot inspection. In addition, after the intervention, they showed improvement in medication adherence, physical functioning, depressive symptoms and diabetes-specific suffering.	N4
Effectiveness of a web-based physical activity intervention for adults with Type 2 diabetes- a randomised controlled trial. <sup>23.</sup>	2014	Access to the Diabetes in Check website and receipt of weekly notices about the importance of participation, in addition to encouraging the development of skills to initiate or sustain behavior changes. Substantial changes in physical activity practice were identified.	N2
Diabetes self-management smartphone application for adults with type 1 diabetes: randomized controlled trial. <sup>24.</sup>	2013	Application of a self-management application (Glucose Buddy), where participants entered their glucose level, insulin dosages, medications, diet and physical activity. In addition, they received text messages with reminders and a means of removing doubts. The intervention group had a significant decrease in HbA1c and both showed improvement in self-care and nutrition.	N2
Randomised controlled trial of an automated, interactive telephone intervention (TLC Diabetes) to improve type 2 diabetes management: baseline findings and six-month outcomes. <sup>25.</sup>	2012	In addition to the quarterly bulletin, participants received access to the Telephone-Linked Care (TLC) telephone system, aiming to improve self-management through blood glucose control, nutrition, physical activity and medication intake. TLC had a statistically significant impact on participants' HbA1c, causing the geometric mean of HbA1c to decrease.	N2
Evaluation of educational actions to promote self-management of care in type 2 diabetes mellitus. (Avaliação das ações educativas na promoção do autogerenciamento dos cuidados em diabetes mellitus tipo 2.) <sup>5.</sup>	2011	During the study, playful and interactive group dynamics (games and booklets) were used, in addition to individual assistance through dialogic education. There was no statistically significant change in glycated hemoglobin analyzed together, but separately.	N6
Using technology to deliver healthcare education to rural patients. <sup>26.</sup>	2011	My Health Education & Resources Online (MyHERO) makes it easy to find reliable, evidence-based health information, in addition, patients received guidance from nurses regarding self-care during individual consultations, both increased knowledge related to DM and blood glucose control/monitoring.	N6
Cluster-randomized trial of a mobile phone personalized behavioral intervention for blood glucose control. <sup>27.</sup>	2011	The study addresses the web-based software (Mobile Diabetes Intervention Study) that encourages diabetes self-management and training for these patients, along with educational and motivational text messages, responsible for causing an average decline in participants' glycated hemoglobin.	N2
Feasibility and usability of a text message-based program for diabetes self-management in an urban African-American population. <sup>28.</sup>	2011	The study uses SMS-DMCare, a health information technology that encourages participants to adhere to self-care through daily medication reminders, routine foot care, and medication administration. As a result, they achieved improvements in the treatment and self-management of diabetes mellitus. As for the level of HbA1c, further studies would be necessary.	N6

Source: prepared by the authors

te the best care for the individual, deviating from traditional methods that often do not efficiently achieve the desired goals.<sup>29</sup> To Tibes and collaborators<sup>30</sup>, Technologies are on the rise, due to the widespread use of smartphones and tablets, interconnected with applications.

However, when it comes to the use of technologies for the management of DM, there is a scarcity, as the resources available by health services such as websites, educational software and the application of booklets for self-care guidance are little publicized in the scientific literature, in ad-

dition, they show flaws in the application as they often do not reach the awareness of the target audience.<sup>31</sup>

The technologies used in diabetes control help in the acquisition of new skills and enhance existing ones, establishing a relationship between the learning process and

the application to practice, such as glucose control, insulin administration and physical activity. Therefore, the individual is empowered and acquires knowledge about himself and his pathology.<sup>32</sup>

Most of the studies that make up the present review<sup>12,13,14,20,21,24,25,26,27</sup> used apps and one-way messages to establish a balanced diet<sup>20,21,24,25,26</sup>, a routine regarding physical activity<sup>20,21,24,25</sup>, in addition to self-monitoring of glucose, achieving, through the establishment of goals, improved glycemic control.<sup>12,13,14,27</sup>

Studies that associated “apps” with SMS (text messages) are also noteworthy.<sup>24,27</sup> The Glucose Buddy<sup>24</sup>, an application in which participants entered data such as glucose level, insulin dosages, medications, diet and physical activity, received SMS with reminders to carry out the program’s demands.

The contact of professionals via SMS messages, calls and voice messages<sup>9,10,2,15,16,22,27,28</sup>, is characterized as a basic and easily accessible resource. In this sense, Owolabi et al.<sup>33</sup> points to the use of this tool, as a reminder, in order to increase medication adherence<sup>16</sup>, routine foot care<sup>28</sup>, reduced hemoglobin level<sup>13,16,24,27,28</sup>, improved eating habits and increased physical activity practices.<sup>10,22,23,24</sup>

The websites and weblogs<sup>2,15,23</sup> they are important facilitators of learning, as they offer the possibility of interaction between individuals and the sharing of knowledge. The approximation between the health professional and the patient expands the knowledge about the disease and enables

the individual to self-management.

To Souza et al.<sup>34</sup>, combining playful and cognitive aspects, through active methodologies, becomes a fundamental strategy for the teaching-learning process. The exchange of experiences through classes, games and videos are important for participants to be involved in an interactive field and for this it is essential that there is acceptance and listening.<sup>9,11,17,5</sup>

The use of printed media, such as brochures<sup>9,18,19</sup> and booklets<sup>5</sup>, for guidance on diabetes, has not been used as often. It is believed that some factors may contribute to this, such as the high cost of printing and people’s lack of interest in reading and carrying these materials.<sup>16</sup> According to Oliveira<sup>35</sup> the use of printed materials is significant for the educational process, especially when it comes to chronic diseases, because through these, there is the development of skills and improvement of self-care, thus contributing to disease control and treatment adherence. Thus, booklets and leaflets still represent an important support material<sup>36</sup>, being viable in the instruction of the individual in relation to the health-disease process, giving conditions to the same for self-management and change of life habits<sup>4</sup>, allowing the fall of HbA1c<sup>9,11,19,5</sup>, psychosocial improvements<sup>17</sup>, raising awareness<sup>19</sup> and glycemic control.<sup>17,18</sup>

To Araújo and collaborators<sup>32</sup> the nurse plays a crucial role in the process, as the role of health educator is inherent to the professional. The use of different educational technologies can promote the awareness of

diabetics for the correct management of the disease and thus empower them in self-care. It is up to the nurse to assess how these resources contribute to the health of patients with DM and whether they have a positive effect by providing the information necessary for the person to empower themselves with self-care and make choices that improve their quality of life.

## CONCLUSION

The studies that make up this review show several technological resources available for health education of patients with Diabetes Mellitus, especially applications, text message, voice and call, in addition to web sites, games, leaflets, booklets and educational videos. It is noteworthy that these resources have had a positive impact on the control of the disease, affecting the awareness of individuals and improving their self-management. A limitation is the lack of national studies, considering that most portrayed the reality of other countries.

It is believed that the present study will make it possible to expand the knowledge of health professionals regarding educational technologies applied in the context of health promotion and prevention of diseases resulting from Diabetes Mellitus, and thus provide subsidies to develop teaching strategies that include viable technologies for the reality of each scenario, contributing to the empowerment of the sick person in their self-management.

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