



EDUCATIONAL TECHNOLOGIES IN THE PREVENTION AND MANAGEMENT OF CARDIOVASCULAR RISK IN DIABETIC PATIENTS

TECNOLOGIAS EDUCACIONAIS NA PREVENÇÃO E MANEJO DO RISCO CARDIOVASCULAR EM PACIENTES DIABÉTICOS

TECNOLOGÍAS EDUCATIVAS EN LA PREVENCIÓN Y EL MANEJO DEL RIESGO CARDIOVASCULAR EN PACIENTES DIABÉTICOS



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**Adriano Freitas de Santana¹, José Antônio Figueredo Santos², Talina Carla Silva³,
Rafaelle Cavalcante de Lira⁴, Elisangela Vilar de Assis⁵**

ABSTRACT

The chapter entitled “Educational Technologies in the Prevention and Management of Cardiovascular Risk in Diabetic Patients” presents a narrative review that synthesized evidence from articles retrieved from the SciELO, PubMed, and LILACS databases, as well as official documents from the Brazilian Ministry of Health and guidelines from the Brazilian Diabetes Society (SBD), published between 2007 and 2023. The selection prioritized three interconnected thematic axes: primary health care (PHC) and comprehensive care for diabetic patients; cardiovascular complications associated with diabetes mellitus (DM) and risk stratification methods; and the use of educational and digital technologies to support self-care and patient empowerment. Within PHC, DM represents a growing epidemiological challenge, with care pathways within the Brazilian Unified Health System (SUS) emphasizing early diagnosis, glycemic monitoring, and health education through the Family Health Strategy. Quality indicators show advances in access to supplies; however, gaps in treatment adherence persist, highlighting the need for innovative interventions. DM increases cardiovascular risk by up to fourfold. Strict therapeutic targets guide pharmacological treatment combined with secondary prevention strategies, such as lifestyle modifications. Educational technologies emerge as validated tools to promote behavioral change, telemonitoring, and patient empowerment, aligned with the principles of the SUS. Strategies

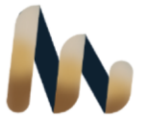
¹ Graduated in Nursing. Universidade Federal de Campina Grande (UFCG).
E-mail: adriano.freitas@estudante.ufcg.edu.br Orcid: <https://orcid.org/0000-0001-6927-9087>
Lattes: <http://lattes.cnpq.br/5966148927709872>

² Medical student. Universidade Federal de Campina Grande (UFCG).
E-mail: joseantonio.figueredo.7@gmail.com Orcid: <https://orcid.org/0009-0003-8439-7278>
Lattes: <http://lattes.cnpq.br/2192473483162987>

³ Dr. in Health Sciences. Secretaria de Educação Especial, 14 Direct. E-mail: talinacarla@hotmail.com
Orcid: <https://orcid.org/0000-0001-8859-1738> Lattes: <http://lattes.cnpq.br/1386411473907330>

⁴ Dr. in Clinical and Experimental Pathophysiology. Universidade Federal de Campina Grande (UFCG).
E-mail: rafaellelira@gmail.com Orcid: <https://orcid.org/0000-0002-0360-1157>
Lattes: <http://lattes.cnpq.br/8587529447235276>

⁵ Dr in Health Sciences. Universidade Federal de Campina Grande (UFCG).
E-mail: elisangela.vilar@professor.ufcg.edu.br Orcid: <https://orcid.org/0000-0002-8223-1878>
Lattes: <http://lattes.cnpq.br/4176556042952208>



aimed at strengthening care for diabetic patients should be further researched and developed in order to minimize the increasing prevalence of the disease, its complications, the loss of patients' quality of life, and financial costs to the public health system.

Keywords: Primary Health Care. Chronic Disease. Technological Innovation. Educational Technology.

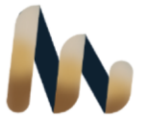
RESUMO

O capítulo intitulado "Tecnologias Educacionais na Prevenção e Manejo do Risco Cardiovascular em Pacientes Diabéticos" apresenta uma revisão narrativa que sintetizou evidências de artigos extraídos das bases SciELO, PubMed e LILACS, além de documentos oficiais do Ministério da Saúde e diretrizes da Sociedade Brasileira de Diabetes (SBD), publicados entre 2007 e 2023. A seleção priorizou três eixos temáticos interconectados: atenção primária à saúde (APS) e cuidado integral ao paciente diabético; complicações cardiovasculares associadas ao diabetes mellitus (DM) e métodos de estratificação de risco; e o emprego de tecnologias educacionais e digitais no suporte ao autocuidado e capacitação. Na APS, o DM representa desafio epidemiológico crescente, com linhas de cuidado do SUS enfatizando diagnóstico precoce, monitoramento glicêmico e educação em saúde via Estratégia Saúde da Família. Indicadores de qualidade revelam avanços em acesso a insumos, mas lacunas na adesão ao tratamento persistem, demandando intervenções inovadoras. O DM eleva o risco cardiovascular em até quatro vezes. Metas terapêuticas rigorosas orientam tratamento medicamento associado a terapias combinadas para prevenção secundária, como mudanças no estilo de vida. As tecnologias educacionais emergem como ferramentas validadas para promover mudanças comportamentais, telemonitoramento e capacitação, alinhadas ao SUS. Estratégias que possam fortalecer o cuidado com pacientes diabéticos devem ser pesquisadas e desenvolvidas a fim de minimizar o aumento da prevalência dessa doença, suas complicações, perda da qualidade de vida dos pacientes e gasto financeiros no sistema público de saúde.

Palavras-chave: Atenção Primária à Saúde. Doença Crônica. Inovação Tecnológica. Tecnologia Educacional.

RESUMEN

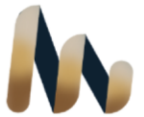
El capítulo titulado "Tecnologías Educativas en la Prevención y el Manejo del Riesgo Cardiovascular en Pacientes Diabéticos" presenta una revisión narrativa que sintetizó evidencias de artículos extraídos de las bases de datos SciELO, PubMed y LILACS, así como de documentos oficiales del Ministerio de Salud de Brasil y de las directrices de la Sociedad Brasileña de Diabetes (SBD), publicados entre 2007 y 2023. La selección priorizó tres ejes temáticos interconectados: la atención primaria de salud (APS) y el cuidado integral del paciente diabético; las complicaciones cardiovasculares asociadas a la diabetes mellitus (DM) y los métodos de estratificación del riesgo; y el uso de tecnologías educativas y digitales para apoyar el autocuidado y la capacitación de los pacientes. En la APS, la DM representa un desafío epidemiológico creciente, con líneas de cuidado del Sistema Único de Salud (SUS) que enfatizan el diagnóstico precoz, el monitoreo glucémico y la educación en salud a través de la Estrategia de Salud de la Familia. Los indicadores de calidad muestran avances en el acceso a insumos; sin embargo, persisten brechas en la adherencia al tratamiento, lo que exige intervenciones innovadoras. La DM incrementa el riesgo cardiovascular hasta cuatro veces. Metas terapéuticas estrictas orientan el tratamiento farmacológico asociado a estrategias de prevención secundaria, como los cambios en el estilo de vida. Las tecnologías educativas surgen como herramientas validadas para promover cambios conductuales, el telemonitoreo y la capacitación, en consonancia con el SUS. Es fundamental investigar y desarrollar estrategias que fortalezcan la atención a los pacientes diabéticos, con el fin de minimizar el aumento de la prevalencia de la enfermedad,



sus complicaciones, la pérdida de calidad de vida de los pacientes y los costos financieros para el sistema público de salud.

Palabras clave: Atención Primaria de Salud. Enfermedad Crónica. Innovación Tecnológica. Tecnología Educativa.





1 INTRODUCTION

Diabetes *Mellitus* (DM) is one of the main global public health problems, due to its high prevalence and associated complications, especially cardiovascular complications. In Brazil, the growing incidence of the disease adds to the structural difficulties of the Unified Health System (SUS), demanding innovative strategies for prevention, monitoring, and self-care (Costa *et al.*, 2017).

Among the main complications of DM, cardiometabolic alterations, which are often associated with metabolic syndrome, stand out. This condition involves factors such as obesity, systemic arterial hypertension, dyslipidemia, kidney disorders, hypertriglyceridemia, and hyperglycemia, which favor the emergence of microvascular complications. Such alterations lead to impairment of tissue perfusion, ischemia and progression of vascular lesions related to lumen obstruction, increased permeability and thickening of the basement membrane, which increases the risk of severe outcomes (Benabou; East; Turatti, 2010; Fatobene; Turatti, 2010).

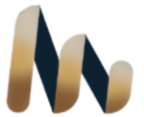
Another relevant aspect concerns cardiovascular risk factors. It is essential to carry out an accurate characterization of these factors in specific population groups, in order to guide educational campaigns and intervention protocols that maximize the efficiency of available resources. In Brazil, there is a regional variation in the prevalence of risk factors, with an inverse relationship between socioeconomic status and cardiovascular mortality. However, there are still few comparative studies that analyze the distribution of these factors from the perspective of social inequalities (Cassani *et al.*, 2009).

In this scenario, educational technologies emerge as promising tools to expand access to health information, favor therapeutic adherence and reduce complications. By integrating self-care and monitoring strategies, these technologies strengthen the role of health education as a central axis in the prevention and management of diabetes and its cardiovascular repercussions.

2 METHODOLOGY

This chapter was elaborated from a narrative literature review, with the purpose of gathering and discussing the available evidence about educational technologies applied to the prevention and management of cardiovascular risk in patients with Diabetes Mellitus.

National and international publications available in scientific databases, such as SciELO, PubMed, and LILACS, as well as official documents from the Ministry of Health and guidelines from the Brazilian Diabetes Society, were consulted. The search included articles,



manuals, books, and chapters published between 2007 and 2023, selected according to three main thematic axes:

1. Primary health care and care for diabetic patients;
2. Cardiovascular complications associated with diabetes and risk stratification methods;
3. Use of educational and digital technologies in diabetic patient care.

The selection of bibliographic material sought to contemplate classic and recent references, ensuring a comprehensive view of the theme. The analysis was conducted in an interpretative manner, emphasizing the most relevant aspects for collective health practice and nursing, with a focus on the prevention of complications and the promotion of self-care.

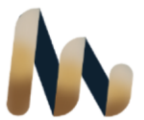
3 PRIMARY HEALTH CARE AND CARE FOR DIABETIC PATIENTS

The care provided to patients with chronic diseases, such as diabetes *mellitus*, represents a crucial example for the analysis of access to and continuity of care in public health services, as this condition can be prevented and diagnosed. In addition, due to potential complications over time, users demand access to specialized exams and services, without disregarding the clinical follow-up offered by Primary Health Care teams (Santos *et al.*, 2020).

An aspect identified in a study by Salci, Meirelles and Silva (2017), during the care of diabetic patients, was the lack of integration of professionals with the families of people with diabetes, as well as with their social context. It is relevant to highlight that, with the exception of Community Health Agents (CHA), no other professional indicated the existence of this engagement and direction in their actions and practices in the process of care and assistance to people with diabetes in Primary Health Care.

Care for people with diabetes, for the most part, is provided collectively, seeking to facilitate access to care for a greater number of users registered in the Hypertensive and Diabetic Registration and Monitoring System. This service, called "group", was scheduled quarterly, aiming to optimize the professionals' schedule to serve a greater number of people with the same condition on predetermined days and times. The approach adopted for the groups is centered on medical consultation, with emphasis on drug prescription, with the main activity being the delivery of prescriptions and, occasionally and non-systematically, the request for laboratory tests (Salci; Meirelles; Silva, 2017).

Lopes *et al.* (2021) reinforce the existence of social representations of the diabetic foot, as a common sense that permeates these people, so that it is extremely important that health professionals create opportunities in care environments, both in primary and specialized care, to promote attentive and qualified listening, solving doubts and guiding them



in their therapeutic dimension. This listening should explore people's beliefs and perceptions about their experience with vascular involvement, allowing interventions to be targeted in order to sensitize them. Additionally, it is essential to challenge them to reflect on possible mistaken beliefs and encourage them to reassess their condition, which can have a positive impact on their self-care and influence their behavioral choices to improve their health.

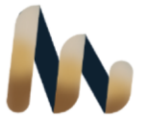
3.1 DIABETES *MELLITUS* AND CARDIOVASCULAR COMPLICATIONS

Type 1 diabetes *mellitus* is characterized as an autoimmune condition that results in an inflammation of the pancreatic beta cells responsible for insulin production. This leads to insulinopenia, i.e., the reduction or complete loss of insulin secretion. Type 2 diabetes mellitus usually manifests after the age of 40, but it can occur in younger individuals, especially those with pre-existing risk factors, often associated with obesity. The mechanisms that lead to hyperglycemia in this type of diabetes include peripheral resistance to insulin action, deficiencies in insulin secretion, increased glucose production by the liver (hepatic gluconeogenesis), and incretin deficiency (Song; Yamashita; Glezer, 2010).

There is also diabetic nephropathy that can occur in type I and II diabetes *mellitus*, as hyperglycemia leads to glomerular and renal vascular lesions, in addition to predisposing to events such as pyelonephritis, a type of infection of the upper urinary tract. Exposure to high concentrations of glucose is characterized by thickening of the basement membrane with an increase in mesangial volume, resulting in reduced glomerular filtration. Diabetic retinopathy is among the biggest causes of acquired vision loss worldwide, because hyperglycemia, with the thickening of the basement membrane of the retinal vessels, has destructive effects on the lens and iris, which leads to cataracts or glaucoma, but the retina is the one that is most damaged. In addition, diabetic neuropathy is present in almost half of individuals with diabetes and the risk of amputations is almost 15%. Chronic axonal neuropathy is the most predominant finding, characterized by thickening of *the vasa nervorum* (Aguar; Villela; Bouskela, 2007; Benabou; East; Turatti, 2010).

Very commonly associated with diabetes Mellitus, there is also Systemic Arterial Hypertension (SAH), which is characterized by an increase in Blood Pressure (BP), above the values established by the *American Heart Association* (AHA). In patients with these associated disorders, the cause of death due to cardiovascular consequences is seven times higher. SAH collaborates with the development of micro and macrovascular complications, especially with renal damage (Garcia *et al.*, 2021).

Among the macrovascular complications, diabetic macroangiopathies can also be highlighted, which manifest in the great vessels and can obstruct them. It is common to



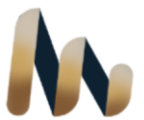
observe three manifestations caused by these obstructions, Coronary Artery Disease (CAD), Cerebrovascular Diseases and Peripheral Vascular Disease (PVD). There are studies that prove the importance of preventing macrovascular diseases, as it comprises an important morbidity and mortality rate of diabetic patients, an example of which is the increased risk of ischemic events, such as Acute Myocardial Infarction (AMI), due to CAD, and the higher risk of Cerebrovascular Accident (CVA), as a result of Cerebrovascular Diseases (Fávero; Amália; Baraldi, 2021).

In an attempt to reduce the effects and the appearance of macrovascular pathologies resulting from diabetes *mellitus*, it is necessary to have continuous glycemic control and this can be obtained through glycated hemoglobin, an exam capable of revealing the average values of serum glucose in a period of approximately 90 days, in order to predict exposure to glucose, which is vital, since the increase in this substance is associated with such complications. Thus, it is possible to perceive the variations in micro and macrovascular complications that affect diabetic patients, even without a diagnosis, with deficits in strict blood glucose control or other basic care, so that they risk developing cardiovascular diseases (Benabou; East; Turatti, 2010).

Society often associates cardiovascular risk factors directly with cardiovascular disease itself, which can hinder the implementation of effective interventions in prevention and health promotion. Therefore, the importance of the concept of cardiovascular risk is highlighted, as it provides a deeper understanding of the components involved, facilitating the delivery of nursing and health care in an effective and holistic way. In nursing practice, the conceptual analysis of cardiovascular risk helps to recognize the problems and responses of people with this risk, which professionals deal with on a daily basis (Félix *et al.*, 2022).

Cardiovascular risk calculators are widely used to identify at-risk populations in need of promotion, prevention, and treatment measures. Although the protocols may vary according to the consensus of the experts, they all recommend healthy eating measures, such as the consumption of fruits and vegetables, the reduction of salt, fat and sugar, smoking cessation, moderation in alcohol consumption and the practice of physical activity. It is essential to monitor and set therapeutic goals, as well as to track the evolution of treatment over time (Malta *et al.*, 2021).

The Ministry of Health proposes the use of stratification to define the prognosis and management in the approach of hypertensive patients in primary care, recommending the adoption of the Framingham Score (EF). This score has been successfully tested in several populations and seeks to estimate the risk of a cardiovascular event for the patient, based on some variables. Considering that the risk factors used in this stratification are frequent in



Brazil, its use has the potential to improve the control of patients with systemic arterial hypertension (SAH) in the country and reduce the occurrence of severe outcomes for patients (Pimenta; Caldeira, 2014).

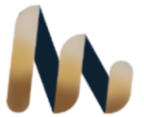
The Framingham score is used to this day, reliable, simple and quickly applied, as well as low cost for the identification of outpatients at higher risk of Cardiovascular Diseases. It enables the inclusion of rigorous screening and more aggressive and efficient therapies to prevent future heart disease. However, although it is considered one of the best methods available for screening Cardiovascular Risk in diabetic patients, in both sexes and in any age group, it is already known that the accuracy of recognizing CVR in diabetic patients is lower than that of non-diabetic patients (Oliveira *et al.*, 2007).

This can be attributed, in part, to the fact that in the Framingham Study the prevalence of diabetes was relatively low, being 7% in males and 5% in females, and triglyceride levels were not included in its score. As a result, the Framingham equation for estimating 10-year cardiovascular risk in patients with diabetes may underestimate their actual risk, especially due to the higher incidence of acute cardiovascular events in diabetics than expected, compared to the estimate for the non-diabetic population. This underestimation may also occur when HDL-cholesterol is considered separately as a predictor of cardiovascular risk in diabetic patients (Oliveira *et al.*, 2007).

4 EDUCATIONAL TECHNOLOGIES AS A PREVENTION AND MANAGEMENT STRATEGY

The Ministry of Health brings us that individuals with diabetes *mellitus* require a comprehensive and regular evaluation, aiming to identify early any changes that may increase the risk of developing ulcers and other complications associated with the vascular system. There are flowcharts of care in both primary and specialized care, which consider risk stratification. This enables a more efficient and effective use of the time and resources of health teams (Brasil, 2016).

The use of digital tools in the care of diabetic patients has transformed clinical practice, promoting a more individualized and effective follow-up. The guideline "Digital Tools in Diabetes", from the Brazilian Diabetes Society, emphasizes the relevance of these technologies in monitoring blood glucose, adherence to treatment, and preventing complications. Devices such as continuous glucose monitors and health apps enable real-time tracking, enabling immediate adjustments to insulin dosage. This constant monitoring offers valuable insights into blood glucose fluctuations throughout the day, facilitating more accurate interventions (Damaceno *et al.*, 2023).



Diabetes control apps have been shown to be effective in promoting patient self-management, offering reminders for administering medications and performing exams, in addition to making it possible to record information about diet and physical activities. With functionalities that facilitate data sharing with health professionals, these apps improve communication between patients and medical teams, allowing therapeutic adjustments based on up-to-date information (Damaceno *et al.*, 2023; Malfatti; Assunção, 2011).

Innovations, such as artificial intelligence algorithms, also contribute to analyzing large volumes of data and identifying risk patterns, further personalizing treatment plans. This digital approach to diabetes management fosters greater engagement in self-care, facilitating clinical decision-making and aligning with the Brazilian Diabetes Society's goals of improving glycemic control and reducing long-term complications (Damaceno *et al.*, 2023; Malfatti; Assunção, 2011).

Digital technologies make it possible to offer educational content in a dynamic, interactive and personalized way, overcoming geographical barriers and facilitating access for women, regardless of their location and socioeconomic condition. This is particularly relevant in regions with less availability of specialized services, contributing to the reduction of health inequalities, a fundamental principle of the SUS.

5 CONCLUSION

Diabetes *mellitus* is a multifactorial disease present at all levels of care and with several clinical repercussions, and its management and treatment are important focuses, especially in PHC, due to its various complications. It is seen that the care process of the person with DM goes through several spheres, with the need for comprehensive and contextualized care, covering a psychosocial and behavioral space beyond the traditional clinical approach, with interventions and care guided by attentive and qualified listening in which points such as self-care and lifestyle are highlighted.

Understanding cardiovascular risk is essential in the care process of people with DM, so that it allows the understanding of the vulnerabilities and needs of this population. However, there is still a limitation in the understanding of this risk, being the most appropriate tool for calculating the Framingham Score (FE), which is prone to underestimate the real cardiovascular threat in a diabetic patient, which reverberates the need to seek a more accurate means of understanding this risk.

In this context, educational technologies emerge as tools capable of transforming the self-care process, playing an even more significant role in the context of nursing care, so that



constant monitoring and greater engagement within the treatment are possible. The ease and practicality that these tools bring is extremely important within the construction of care.

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