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## COMPARATIVE ANALYSIS OF MANAGEMENT MODELS FOR DIABETES PROGRAMS IN BRAZIL, THE UNITED STATES AND CANADA

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**Abstract:** Diabetes Mellitus (DM) is a complex metabolic condition caused by different causes, characterized by a deficiency or inability of the body to use insulin properly. This study sought to compare the health systems of Brazil, Canada and the United States of America, focusing on health management, prevention of the disease studied, guidance and care for patients with DM. The study is presented as an integrative literature review, composed of scientific articles in electronic media on the VHL platform that were published between 2018 and 2023, in Portuguese and English, where the purpose is to collect and synthesize research results on a defined topic or question in a systematic and orderly manner that contributes to a better understanding of the subject under study. Data analysis enabled the classification of two (2) thematic categories, as follows: Category A: Telemedicine technology applied in the Unified Health System in the care of people with diabetes mellitus; and Category B: Scarcity of evidence and new technologies in the 3 countries surveyed. This study reinforces the importance of telemedicine as a valuable tool for overcoming access barriers and improving care in the context of diabetes mellitus in the SUS, as well as pointing out the urgent need for investment in research, continuing education and careful implementation of new technologies to improve the quality of life and health management of this population.

**Keywords:** Diabetes Mellitus, Health Management, Health Policies.

## INTRODUCTION

Diabetes Mellitus (DM) is a metabolic syndrome caused by the deficiency or inability of insulin, a hormone produced by the pancreas that is responsible for balancing glucose metabolism (Brazil, 2019).

The World Health Organization (WHO) classifies DM into four clinical categories: type 1 (DM1), type 2 (DM2), gestational (DMG) and other specific types. In addition, there is the condition of pre-diabetes, characterized by fasting glucose between 100 mg/dL and 126 mg/dL, associated with reduced glucose tolerance, indicating an increased risk of developing the disease.

DM1 is an autoimmune and polygenic disease caused by the destruction of pancreatic beta cells, resulting in total insulin deficiency. It accounts for 5% to 10% of DM cases (Brazil, 2019). DM2, which predominates in 90% to 95% of cases, is characterized by dysfunction of the pancreatic beta cells, leading to insulin resistance. Factors such as age, ethnicity, obesity and lifestyle directly influence its occurrence (WHO, 2019).

Adopting healthy habits is essential for reducing the incidence of chronic diseases. The Brazilian Diabetes Society (SBD) recommends educational programs for individuals at risk of developing DM2, with an emphasis on moderate weight loss, physical exercise and healthy eating.

The growing prevalence of DM places Brazil fourth in the world ranking of the disease. Between 2012 and 2016, almost 300,000 deaths were recorded in the country (Marques et al., 2020). In the United States, the prevalence of the disease doubled between 1988 and 2018, reaching 10.1% of the population, while 4.3% can live with the disease undiagnosed (United States, 2019). In Canada, 7.7% of the population aged between 20 and 79 has been diagnosed, making it a public health concern due to obesity and a sedentary lifestyle (Canada, 2020).

Epidemiological analysis of the disease and action by health systems are fundamental to controlling DM. In Brazil, treatment begins with the Family Health Strategy (ESF), prioritizing prevention and health promotion, simi-

lar to the Canadian model. In the USA, however, the approach focuses mainly on treating the disease (Brazil, 2020).

This study compares DM management and prevention strategies in the health systems of Brazil, Canada and the United States, analyzing orientation and care programs for patients, given the increasing rate of cases and deaths among young adults (SBD, 2019). This highlights the importance of public policies aimed at monitoring, treating and training professionals to reduce the impacts of the disease. Health promotion programs are essential to encourage healthy habits and increase patients' quality of life (Bonfim et al., 2012).

The relevance of this work lies in providing up-to-date scientific information for young adults with DM, presenting innovative techniques that improve quality of life and encourage adherence to available programs. It seeks to contribute to the scientific community with current data on the disease, helping to minimize its incidence and mortality and promoting improvements in public health management.

A recent study in six Brazilian state capitals identified a prevalence of 20% among university employees aged 35 to 74, with half of the cases having no previous diagnosis. The 2013 National Health Survey (PNS) estimated that 6.2% of the adult Brazilian population reported a medical diagnosis of DM, with a higher incidence among individuals with less schooling (Brasil, 2019).

DM generates high costs for health systems. In Brazil, in 2017, it represented 1.1% of GDP, and in Canada, the projection for 2022 indicated spending of 15.36 billion dollars (Barros, 2017; Bilandzic and Rosella, 2017). Complications of DM are the leading cause of early death in several countries, accounting for around 4 million deaths in 2015, which is equivalent to one death every eight seconds (Brazil, 2020).

In Canada, 80% of diabetic patients die from complications of the disease, often associated with poor diet and a sedentary lifestyle. In addition, the lack of glycemic control contributes to the high mortality rate, with data indicating that half of patients do not regularly monitor their glucose levels (Canada, 2022).

Given this scenario, this study seeks to identify effective technologies and awareness-raising strategies to reduce the risk of DM2. The question is: **what improvements can health systems in developed countries bring to the SUS, based on an integrative literature review?**

## OBJECTIVES

### GENERAL OBJECTIVE

Analyze the equivalence of management in diabetes programs in Brazil, the United States and Canada.

### SPECIFIC OBJECTIVES

Learn about new technologies for treating Diabetes Mellitus that are compatible with the SUS.

Carry out a data survey on the management systems built or used for the diabetes program in the United States of America and Canada.

To highlight the factors that facilitate and hinder the prevention and treatment of diabetes.

## THEORETICAL FRAMEWORK

### DIABETES MELLITUS

Diabetes Mellitus (DM) is a metabolic disorder characterized by persistent hyperglycemia due to defects in insulin secretion or action, leading to micro- and macrovascular complications, increased morbidity and mortality and reduced quality of life (Oliveira et

al., 2017). Primary Care Notebook No. 36 and the guidelines of the Brazilian Diabetes Society (2019) classify DM into three main types:

- Type 1 DM (DM1): characterized by the autoimmune or idiopathic destruction of pancreatic beta cells, leading to the need for continuous insulin use to avoid complications such as diabetic ketoacidosis and cardiovascular events. Diagnosis often occurs in childhood, adolescence or early adulthood and is confirmed by tests such as fasting blood glucose  $\geq 126$  mg/dL, glycated hemoglobin (HbA1c)  $\geq 6.5\%$  or post-TOTG blood glucose  $\geq 200$  mg/dL (SBD, 2019).
- Type 2 DM (DM2): corresponds to 90-95% of cases and results from peripheral insulin resistance and progressive beta cell dysfunction, and is often associated with genetic factors, obesity, sedentary lifestyle, dyslipidemia and hypertension (SBD, 2017). The disease can remain asymptomatic for years and is diagnosed late, when there are already complications. Management includes lifestyle changes and pharmacotherapy, with metformin as the first choice (Brazil, 2020).
- Gestational Diabetes Mellitus (GDM): arises due to insulin resistance induced by placental hormones and is diagnosed in the second or third trimester. GDM can be transient or predispose to a greater risk of DM2 in the future. Risk factors include advanced maternal age, obesity, excessive weight gain during pregnancy, gestational hypertension and fetal macrosomia (SBD, 2019; PAHO, 2017).

Diabetes mellitus represents a public health challenge, with a prevalence of 9.2% in the adult Brazilian population and projections of growth until 2030. The increase in incidence reinforces the need for policies to prevent and control the disease and strengthen long-term care (Muzy et al., 2021).

## **PUBLIC POLICIES FOR PEOPLE WITH DIABETES MELLITUS**

Chronic Non-Communicable Diseases (CNCDs), including DM, are responsible for a high burden of morbidity and mortality in Brazil, directly impacting the costs of the health system due to hospitalizations, amputations, cardiovascular complications and neurological sequelae (Rosa, 2021). The Unified Health System (SUS), supported by the 1988 Federal Constitution, guarantees universal care and establishes programs aimed at monitoring, preventing and controlling diabetes (Brasil, 1988).

The creation of the Hypertension and Diabetes Mellitus Care Reorganization Plan (2001) and the National Hypertension and Diabetes Mellitus Program (HIPERDIA) were milestones in structuring care, expanding access to diagnosis and continuous therapy in Primary Health Care (Filho, 2020). The Popular Pharmacy Program (2004) and Federal Law No. 11,347/2006 guaranteed the free or subsidized supply of medicines and supplies for glycemic control (Ministério da Saúde, 2022).

In 2011, the National Policy for Diabetes Prevention and Comprehensive Care for People with Diabetes (Law No. 13,895/2019) was launched, consolidating guidelines for the prevention and management of the disease. The Previne Brasil Program (Ordinance No. 2,979/2019) reformulated the Primary Care financing model, prioritizing quality indicators, including diabetes monitoring (Ministry of Health, 2021).

The implementation of these policies depends on the integration of health services, training of professionals and patient adherence to treatment, and it is essential to strengthen Primary Care in order to minimize complications and reduce the morbidity and mortality associated with DM (Carmo, 2019).

## **STRATEGIC ACTION PLAN TO TACKLE CHRONIC NON-COMMUNICABLE DISEASES (CNTD)**

The Strategic Action Plan for CNCDs was developed in 2011 by the Ministry of Health to reduce the prevalence of chronic diseases and their risk factors (Ministry of Health, 2011). It set national targets, such as reducing obesity, increasing consumption of healthy foods and combating smoking. However, while the smoking rate has been reduced as planned, obesity has risen above the initial projections (Ministry of Health, 2021).

The new Strategic Action Plan for NCDs (2021-2030) maintains the focus on reducing premature mortality (30-69 years) by 1/3 by 2030, in addition to specific targets such as stabilizing obesity in adults, reducing consumption of sweetened beverages and increasing adherence to healthy eating. These indicators are monitored by epidemiological surveys, including VIGITEL (Ministry of Health, 2021).

The Family Health Strategy (ESF) plays a central role in addressing CNCDs, promoting decentralization of care and strengthening preventive actions in Primary Care (Ministry of Health, 2022).

## **DIABETES MELLITUS STRATEGIC ACTION PLAN IN THE UNITED STATES AND CANADA**

In the US, NCDs affect approximately 50% of the population and are responsible for around 70% of annual deaths, representing a high cost to the health system (Raghupathi and Raghupathi, 2018). Historically, the North American model prioritized the treatment of acute diseases, neglecting preventive approaches. However, recent policies have promoted integrated care strategies, with the active participation of associations such as the American Diabetes Association (ADA) and the American Heart Association (AHA), which develop patient education and support programs (Eyre et al., 2004).



Canada also faces high mortality from NCDs, accounting for 62% of deaths and consuming more than 60% of public health spending. The Canadian system is decentralized, with each province autonomously managing the resources earmarked for the prevention and treatment of NCDs, while the federal government ensures funding and regulation of the area (Marchildon, 2008). Monitoring programs and preventive policies have shown a positive impact on reducing risk factors, reinforcing the need for structured interventions to control DM2 (Liu et al., 2022).

## **METHODOLOGY**

### **TYOLOGY**

This study is characterized as an integrative literature review, with the aim of collecting and synthesizing scientific findings on a specific topic in a systematic and orderly manner, favoring a better understanding of the phenomenon under investigation. This method has been reported in the literature since the 1980s as an effective approach to consolidating existing knowledge (Mendes, Silveira and Galvão, 2008).

The integrative review makes it possible to support decision-making and improve professional practice. It consists of six stages, as described by Mendes, Silveira and Galvão (2008):

1. Identifying the topic and formulating the guiding question;
2. Definition of inclusion and exclusion criteria and systematic literature search;
3. Extraction and categorization of information from the selected studies;
4. Critical and detailed evaluation of the included studies;
5. Interpretation of the results and comparison with the theoretical framework;
6. Presentation of a summary of the knowledge acquired.

### **Identifying the topic or selecting the hypothesis**

The first stage consists of defining the guiding question, which must be relevant to the topic under investigation and aligned with the researcher's practice. This is followed by a search of scientific databases, using strict criteria to select the studies that will make up the review.

In the third stage, information is extracted from the selected studies, using standardized instruments to collect and synthesize essential data.

The fourth stage involves a detailed critical analysis, seeking to understand divergences between the findings of the studies and possible explanations for conflicting results.

The fifth stage is the interpretation and synthesis of the results, establishing comparisons between the evidence analyzed and the theoretical framework.

Finally, in the sixth stage, the results are presented, showing the main findings and providing sufficient information to understand the relevance of the subject under investigation (Mendes, Silveira and Galvão, 2008).

### **Sampling or Literature Search**

The bibliographic search for this study was carried out in electronic databases available in the Virtual Health Library (VHL), including the following sources: Latin American and Caribbean Literature in Health Sciences (LILACS), National Library of Medicine (MEDLINE) and Nursing Database (BDENF). In addition, studies were consulted in the Scientific Electronic Library Online (SciELO), with the aim of gathering, describing and analyzing the available data on the subject.

The sample consisted of scientific articles published between 2018 and 2023, available electronically on the VHL platform, in Portuguese and English. The articles were selected using the descriptors: "Diabetes Mellitus", "Health Management" and "Health Policies", defined using the Descriptors in Health Sciences (DeCS) platform.

The inclusion criteria adopted were:

- Articles published between 2018 and 2023;
- Studies available in full text;
- Articles in Portuguese and English;
- Works that directly address the object of study;
- Original and fully published studies.
- The exclusion criteria were:
- Incomplete or unavailable texts;
- Publications prior to 2018;
- Studies that did not meet the objectives of this work;
- Doctoral theses, dissertations or monographs.

The selection of articles was carried out carefully, based on a search for descriptors in the databases mentioned. The studies obtained went through a screening process, in which they were assessed based on the guiding question and the inclusion and exclusion criteria. After this stage, the articles were critically analysed and the information was organized in such a way as to include the study sample (Mendes, Silveira and Galvão, 2008).

According to the same authors, the selected articles were analyzed in detail and critically, allowing any differences in results between different studies to be identified and explained.

The data extracted was systematized through the construction of tables, summary tables and figures, and then categorized to facilitate the analysis and interpretation of the findings. To organize and interpret the data, the methodological recommendations of Mendes, Silveira and Galvão (2008) were followed.

Interpreting the Results

The articles were searched in the VHL databases, applying the inclusion and exclusion criteria, and both the analysis and synthesis of the data extracted from the articles were carried out descriptively, making it possible to observe, count, describe and classify the data, with the aim of bringing together the knowledge produced on the subject explored in the review. Initially, 4283 articles published in the VHL with the DeCS combined using the *and* particle and indexed in different databases found. Applying the analysis filters based on the first inclusion criteria, full text, resulted in 639,447 articles. Applying the second filter, year of publication between 2018 and 2023, 251,156 articles were found, of which only 242,421 were in English and Portuguese. This can be illustrated in Table 1 below:

Databases	Health Sciences Descriptors (DeCS)	Text Complete	Publications from 2018 to 2023	Language English and Portuguese
BVS (Virtual Health Library)	Diabetes Mellitus	326.671	153.565	148.871
	Health Management	142.421	43.873	42.029
	Health policies	170.355	53.718	51.521
TOTAL	1.133.024	639.447	251.156	242.421

**Table1** - Distribution of selected articles according to Virtual Health Library (VHL), DeCS, full text, year of publication between 2017 and 2022 and English and Portuguese language.

**Source:** own elaboration, (2023).

When the analysis filters were applied in the VHL and indexed in the LILACS, MEDLINE, BDENF and SCIELO databases, 50 articles were selected. After reading the abstracts, 35 articles were excluded. It should also be noted that after exhaustive reading of the other works by two reviewers, only 15 articles met the study's objectives, as described in Table 2.

Databases	Health Sciences Descriptors (DeCS)	Selected articles	Excluded articles	Articles included
BVS (Virtual Health Library)	Diabetes Mellitus	20	15	5
	Health Management	15	09	6
	Health policies	15	11	4
TOTAL		50	35	15

**Table2** - Distribution of selected articles, excluded articles and included articles.

**Source:** own elaboration, (2023).

The selected articles were then distributed according to the separately indexed databases, as shown in Table 3.

Databases	Total
LILACS	03
BDENF	05
MEDLINE	07
Total	15

**Table3** - Distribution of selected articles according to indexed databases.

**Source:** Own elaboration, (2023).

With regard to the years of publication of the articles, between 2018 and 2023, the data collected is described in Table 4 below.

Year of Publication	Total
2018	03
2019	01
2020	02
2021	01
2022	01
2023	07

**Table4** - Distribution of selected articles by year of publication.

**Source:** Own elaboration, (2023).

### Data analysis

The data was analyzed and arranged systematically, using summary tables and figures and then categorized. The recommendations of Mendes, Silveira and Galvão (2008) were used to analyze the data.

The articles selected to make up the sample were identified with codes to summarize the results. The codes are represented by the letter “N” followed by the cardinal number, for example: N1, N2 to N15. As for the methodological design, the articles were distributed/ classified by: code, author/year and journal, as shown in Chart 1.

Code	Author/Year	Journal
N1	LIMA, E.K.S. <i>et al.</i> , 2022	Arquivos de Ciências da Saúde da UNIPAR
N2	GRUNBERGER, G. <i>et al.</i> , 2021	Endocrine Practice
N3	CECILIO, L.C.O. <i>et al.</i> , 2018	CadernoS de Saúde Pública
N4	ARAÚJO, R.C.S. <i>.et al.</i> , 2023	Escola Anna Nery
N5	ALSHANNAQ, H. <i>et al.</i> , 2023	Journal of Comparative Effectiveness Research
N6	VELLOSO, I.S.C. <i>et al.</i> , 2020	Revista Mineira de Enfermagem
N7	HALPERIN, I.J. <i>et al.</i> , 2023	Canadian Journal of Diabetes
N8	CAMPOS, K.F.C. <i>et al.</i> , 2018	Escola Anna Nery
N9	FOURNIE, M. <i>et al.</i> , 2023	BMC Health Services Research
N10	SILVA, H.P. <i>et al.</i> , 2019	Cadernos de Saúde Pública
N11	SALCI, M.A. <i>et al.</i> , 2020	Ciência, Cuidado e Saúde
N12	URBANO, F. <i>et al.</i> , 2023	International Journal of Molecular Sciences
N13	ALMEIDA, E.R. <i>et al.</i> , 2018	Pan American Journal of Public Health
N14	BREVIDELLI, M.M. <i>et al.</i> , 2023	Escola Anna Nery
N15	GREGG, E.W <i>et al.</i> , 2023	Diabetes Care

**Table1** - Table 1 Distribution of articles on The improvement the health system of first world countries can bring to the SUS health program, according to coding, author/year and journal.

**Source:** Own elaboration, (2023).

The articles were then classified by code (n=15), full title and categorized by level of evidence: evidence I (n=4), evidence II (n=0), evidence III (n=0), evidence IV (n=3) and evidence V (n=8). To do this, we coded the articles



from N1 to N15, as shown in Chart 2. The articles in our sample were differentiated according to Evidence-Based Medicine (EBM).

EBM is a way that health professionals and researchers have developed to make decisions and develop methods more efficiently and safely, in order to answer questions more accurately. The clinical research carried out must be of good methodological quality, so that professionals can make decisions without conflict and be used in the scientific community for innovation and the creation of new ideas (El dib *et al.*, 2014).

EBM has four principles: 1. The formulation of the appropriate question, which helps the researcher to maximize their search, avoiding errors in the topic being researched and wasting time unnecessarily; 2. Critical evaluation of the methodological quality of clinical trials, where articles and research are analyzed in order to determine the correct intervention for the case being investigated; 3. Searching for articles and studies with the aim of gathering evidence that will lead to an answer to the proposed question; these studies must be found in reliable sources, avoiding inaccuracies in the data analyzed later; 4. Critical analysis of the evidence, verifying its usefulness in the clinical analysis studied (El dib *et al.*, 2014), 2014).

The same articles were then distributed by place of study, sample characteristics and study design, as shown in Chart 3.

In addition, Table 4 compiles the distribution of articles according to coding and study objective.

The main results found in the selected articles can be identified in descending order by year of publication, as shown in Chart 5.

From the critical and detailed analysis of the articles, the following categories emerged: Category A: Telemedicine technology applied in the Unified Health System in the care of people with diabetes mellitus and Category B: Scarcity of evidence and new technologies in the 3 countries surveyed, described in Chart 6:

## DISCUSSION OF DATA

Data analysis enabled the classification of two (2) thematic categories, as follows: Category A: Telemedicine technology applied in the Unified Health System in the care of people with diabetes mellitus; and Category B: Scarcity of evidence and new technologies in the 3 countries surveyed.

### TELEMEDICINE TECHNOLOGY APPLIED TO THE SINGLE HEALTH SYSTEM IN THE CARE OF PEOPLE WITH DIABETES MELLITUS.

Telemedicine has proven to be an innovative tool for improving Diabetes Mellitus (DM) care, expanding access to medical care for individuals who face difficulties in attending appointments in person, either due to geographical or logistical limitations. This technology enables remote monitoring, facilitating access to diabetes management, health education and adherence to support programs, such as specialized training and online support groups (Grunberger *et al.*, 2021).

In Brazil, the Unified Health System (SUS) offers free treatment for DM, but faces challenges related to funding and access. In the United States, medical care is predominantly private, varying significantly according to the patient's socioeconomic profile. In Canada, the public system guarantees universal coverage, similar to the SUS, but faces difficulties in terms of waiting times and accessibility (Almeida *et al.*, 2018; Urbano *et al.*, 2023; Fournie, Sibbald and Harris, 2023).

In the USA, the integration of telemedicine into MD care was accelerated in 2020 due to the SARS-CoV-2 (COVID-19) pandemic. Initially implemented to reduce the risks of contagion, telemedicine has consolidated itself as an essential resource for treating the disease, allowing remote consultations, continuous monitoring and remote prescription of medication (Grunberger *et al.*, 2021).

Code	Title	Level of evidence
N1	Adherence to diabetes mellitus treatment in primary health care patients.	V
N2	American Association of Clinical Endocrinology Clinical Practice Guideline: The Use of Advanced Technology in the Management of Persons With Diabetes Mellitus.	I
N3	Notes on the (still) current challenges of primary health care.	V
N4	Knowledge and use of the right to health by users with diabetes: a mixed-methods study	V
N5	Cost-utility of real-time continuous glucose monitoring versus self-monitoring of blood glucose in people with insulin-treated type 2 diabetes in canada	IV
N6	Nursing's challenges in promoting health equity practices: a dialog between nursing in Brazil and Canada.	V
N7	Do-It-Yourself Automated Insulin Delivery: A Position Statement	I
N8	Continuing education: discourses of professionals in a basic health unit.	V
N9	Exploring quality improvement for diabetes care in First Nations communities in Canada: a multiple case study.	IV
N10	Incorporation of technologies in the health systems of Canada and Brazil: perspectives for advances in evaluation processes.	V
N11	Insufficiencies in the applicability of policies aimed at diabetes mellitus and humanization in primary care.	V
N12	Pediatric Type 1 Diabetes: Mechanisms and Impact of Technologies on Comorbidities and Life Expectancy.	IV
N13	National Primary Care Policy in Brazil: an analysis of the revision process (2015-2017).	V
N14	D-Day Program: a propositional trial of an educational intervention for self-management in type 2 diabetes.	I
N15	Use of Real-World Data in Population Science to Improve the Prevention and Care of Diabetes-Related Outcomes.	I

**Chart2** - Distribution of articles on How the health system of first-world countries can improve the SUS health program, according to coding, full title and level of evidence.

**Source:** Own elaboration, (2023).

Code	Location	Sample characteristics	Study design
N1	Brazil	Thirty people took part in the study, including patients of both sexes, aged 18 or over, diagnosed with DM more than six months previously and who were being regularly monitored at the unit.	Descriptive, with a qualitative approach.
N2	United States of America	The American Association for Clinical Endocrinology (AACE) conducted literature searches for relevant articles published from 2012 to 2021. A task force of medical experts developed evidence-based guideline recommendations based on a review of clinical evidence, experience and informal consensus, accordingly.	Qualitative
N3	Brazil	In recent decades, Brazil has consolidated the proposal to create an extensive primary care network health as the main gateway to a universal public health system. Recognizing the consistent progress made in this direction, this article presents four points on some of the challenges to consolidating this project.	Article essay
N4	Brazil/ Canada	The research population consisted of users of the Family Health Strategy in the urban area of the municipality where the study was carried out. The number of people with type 1 and type 2 DM was determined by consulting the individual registration report for primary health care, obtained through e-SUS and e-SUS PEC (Electronic Citizen's Record), which showed a total of 439 users being monitored at the UBSF in the urban area of the city.	Mixed study with quantitative and qualitative data
N5	Canada	The clinical data came from a real-world study in which rt-CGM reduced A1C by 0.56% versus continued SMBG. The analysis was performed using IQVIA's Diabetes Core Model, from the perspective of a Canadian payer over a lifetime horizon for a 65-year-old cohort with an A1C of 8.3% at the start of the study.	Prognostic study
N6	Brazil	A reflective dialog about equity in health was developed, drawing a parallel between the challenges of nursing practice with equity in Brazil and Canada.	Article - Reflective dialog

N7	Canada	A diverse group of diabetes technology experts was convened by the Diabetes Canada Clinical Practice Guidelines (CPG) Steering Committee to determine the scope and purpose of the position statement.	Clinical practice guide
N8	Brazil	The setting for the study was a basic health unit located in the city of Belo Horizonte. The reality was initially captured through peripheral participant observation. In-depth interviews were conducted with 25 professionals from the unit who had worked in primary care and the Family Health Strategy for over a year, regardless of their professional category	Qualitative study
N9	Canada	Multiple sources of qualitative data were analyzed to understand: (1) how knowledge and information were used to inform the teams' QM process; (2) how the process was influenced by the context of primary care services in communities; and (3) the factors that supported or hindered their QM process.	Qualitative and participatory community-based case study.
N10	Brazil	The characterization of the HTA systems in Brazil and Canada was carried out by searching the Google Scholar database in April 2018, using the following search terms in Portuguese and English: "health technologies", "assessment", "incorporation", "management", "Brazil".	Exploratory
N11	Brazil	There were 29 participants from five ESFs, including five nurses, five doctors, four nursing assistants and 15 community health agents (ACS). Only two doctors were male. Their ages ranged from 24 to 59	Qualitative
N12	United States of America	We reviewed the mechanisms of currently available technologies for pediatric DM1 and explored their effect on short- and long-term diabetes-related comorbidities, quality of life and life expectancy.	Clinical practice guide
N13	Brazil	This is an account of the experience of a group of participants in the federal management of primary care in the process of revising the PNAB, which took place between 2015 and 2017. Documents and other personal records of meetings, meetings and workshops about the PNAB review, as well as management reports and official technical and normative documents, were used as sources of information.	Experience report
N14	Brazil	Based on two behavioral models: The ADCES7 Self-Care Behaviors™ (Association of Diabetes Care and Education Specialists); and the Behaviour Change Wheel (BCW).	Proposing a complex intervention
N15	United States of America	They analyzed the current landscape and applications of real-world data in clinical effectiveness and population health research for diabetes and summarized opportunities and best practices in conducting, reporting and disseminating RWD to optimize its value and limit its drawbacks.	Bibliographic review

**Table3** - Distribution of articles on Improving the health system in first world countries, according to coding, location, sample characteristics and study design.

**Source:** Own elaboration, (2023).

Code	Objective of the study
N1	Reporting on adherence to Diabetes Mellitus treatment in Primary Health Care.
N2	To provide evidence-based recommendations for healthcare professionals on the safe and effective use of diabetes technologies.
N3	To present four notes on some of the challenges facing the consolidation of the National Primary Care Policy (PNAB) and thus contribute to the advancement of primary care.
N4	To verify the factors related to the level of utilization of health rights of users with type 1 and type 2 diabetes mellitus and to understand the knowledge and utilization of health rights of these users.
N5	To examine the long-term health and economic outcomes associated with the use of rt-CGM compared to SMBG in insulin-treated people with type 2 diabetes living in Canada, based on clinical data.
N6	To develop a reflective dialog about equity in health, drawing a parallel between the challenges of nursing practice with equity in Brazil and Canada.
N7	Provide guidance to Canadian health professionals to support individuals who use unregulated technologies.
N8	To analyze the discourses of health professionals about continuing education in the daily life of a basic health unit.
N9	Demonstrate how knowledge and information were used to inform the quality process improvement teams.
N10	Examine how HTA systems are organized in Brazil and Canada, and discuss their implications for planning the incorporation of technologies in Brazil, considering the challenges posed by the process of regionalization and the establishment of health care networks.

N11	To assess how professionals from family health teams apply public policies aimed at diabetes mellitus care and humanization to people who use insulin.
N12	We review the mechanisms of currently available technologies for pediatric-age DM1 and explore their effect on short- and long-term diabetes-related comorbidities, quality of life and life expectancy.
N13	To present and discuss events related to the process of reviewing the National Primary Care Policy (PNAB) in Brazil, in order to highlight narratives that can contribute to future analysis of the formulation, implementation and evaluation of this policy.
N14	Presenting the Diabetes Day Program (Dia-D): an educational intervention for self-management of type 2 diabetes focused on promoting healthy eating, regular physical activity and correct use of medication among adults with type 2 diabetes.
N15	Analyze the current scenario and applications of RWD in effective clinics and population health research for diabetes and summarize the opportunities and best practices in the conduct of care.

**Table4** - Distribution of articles on Improving the health system in first world countries, according to code and study objective.

**Source:** Own elaboration, (2023).

Code	Results found
N1	It was observed that adherence to diabetes treatment involves numerous challenges, mainly related to the user and health systems/professionals. The biggest challenges encountered were in relation to the overvaluation of drug treatment over the adoption of healthy habits and actions to promote self-care.
N2	This guideline includes 37 evidence-based clinical practice recommendations for advanced diabetes technology and contains 357 citations that inform the evidence base.
N3	This would mean that for primary health care to reach another level of functioning and insertion into the health system, three important transformations would be needed that would work synergistically with each other: the production of a new worker; the experimentation of a new management paradigm for the Ministry of Health; and another design for the articulation of primary health care with the service network, guaranteeing it a new kind of protagonism.
N4	There was a relationship between the score of the level of use of health rights with monthly family income and self-reported skin color; and it was found that the more economically vulnerable a population, the more they seek rights, in addition to the disparity related to ethnic groups and access to health rights being evident
N5	The projected average total lifetime costs were CAD 207,466 for rt-CGM versus CAD 189,863 for SMBG (difference: CAD 17.602) and the mean projected quality-adjusted life expectancy was 9.97 quality-adjusted life years (QALYs) for rt-CGM versus 9.02 QALYs for SMBG (difference: 0.95 QALYs), resulting in an incremental cost-utility ratio (ICUR) of CAD 18,523 per QALY gained for rt-CGM versus SMBG.
N6	Proposing health equity practices from a nursing perspective presupposes overcoming complex challenges that can be analyzed from five dimensions: care, management, training/ongoing education, political engagement and research.
N7	Essential skills in diabetes management, use of insulin pump therapy and use of MCG provide a basis for success with DIY systems.
N8	Recycling, updating, institutional responsibility, continuous learning, disaccommodation and transformation, revealed by the vocabulary, interdiscourse, temporality, modality, evaluation and institutional social practice. They hold the institution responsible, but value continuing education for transforming work processes and user care.
N9	The findings of this study demonstrate how teams drew on multiple sources of knowledge and information to inform their QM work, the importance of strengthening relationships and building rapport with the community, the influence of organizational support and capacity, and the key factors that facilitated QM efforts.
N10	Both systems have weaknesses, but the Brazilian case has a number of factors (insufficient resources, the impact of court decisions, heavy dependence on technologies from abroad, and incipient regional processes and planning in the field of HTA) that make the scenario more complex.
N11	Two categories emerged: "Insufficiencies in health care for people who use insulin" presents the limitations of care related especially to health education; and "Humanization of people who use insulin in daily practice" is representative of the absences of health professionals related to the humanization of care in this context.
N12	Diabetes technologies have greatly improved the management and care of people with DM1 and the prevention of DM1-related complications.

N13	The process of revising the PNAB, which took place between 2015 and 2017, was strongly marked by technical-political disputes between the Ministry of Health and the representative bodies of municipal and state health secretariats. The main changes introduced by the new version of the PNAB are the possibility of financing other models of primary care organization besides the Family Health Strategy; the expansion of the duties of community health agents; the construction of the national offer of essential and expanded primary care services and actions; and the inclusion of the primary care manager in the teams.
N14	The BCW's "Capability, Opportunity, Motivation-Behavior (COM-B)" conceptual framework made it possible to define the determinants of the target behaviors. Based on these, training, capacity building, education, environmental restructuring, persuasion, service provision, guidelines and communication interventions were proposed. Behavior change techniques (demonstration and self-monitoring of behavior, information on health consequences, among others) underpinned the content of the intervention.
N15	Clinical trials demonstrate evidence of efficacy; however, they are usually expensive, take a long time to conduct and RWE can help provide additional evidence of efficacy and safety.

**Table5** - Distribution of articles on improving the health system in first world countries, according to coding, and the main results found in the studies.

**Source:** Own elaboration, (2023).

Categories	Articles with Codes	Authors/year
<b>Category A:</b> Telemedicine technology applied to the Unified Health System in the care of people with diabetes mellitus and Category	N1, N2, N6, N9, N11, N12, N13.	LIMA, E.K.S. <i>et al.</i> / 2022; GRUNBERGER, G. <i>et al.</i> / 2021; VELLOSO, I.S.C. <i>et al.</i> / 2020; FOURNIE, M. <i>et al.</i> / 2023; SALCI, M.A. <i>et al.</i> / 2020; URBANO, F. <i>et al.</i> / 2023; ALMEIDA, E.R. <i>et al.</i> / 2018.
<b>Category B:</b> Scarcity of evidence and new technologies in the 3 countries surveyed	N3, N4, N5, N7, N8, N10, N14, N15.	CECILIO, L.C.O. <i>et al.</i> / 2018; ARAÚJO, R.C.S. <i>et al.</i> / 2023; ALSHANNAQ, H. <i>al.</i> / 2023; HALPERIN, I.J. <i>et al.</i> / 2023; CAMPOS, K.F.C. <i>et al.</i> / 2018; SILVA, H.P. <i>et al.</i> / 2019; BREVIDELLI, M.M. <i>et al.</i> / 2023; GREGG, E.W <i>et al.</i> / 2023.

**Chart6** - Categorization of the articles selected for content analysis.

**Source:** Own elaboration, (2023).

Studies indicate that telemedicine enables clinical results that are comparable or superior to face-to-face consultations, as well as allowing more frequent monitoring, which is essential for glycemic control and adjusting therapies (Grunberger et al., 2021).

In Brazil, a quantitative study carried out in the city of Guaiúba-CE revealed that the difficulty of accessing face-to-face consultations significantly interferes with adherence to DM treatment in Primary Health Care (PHC), demonstrating the need to implement telemedicine in the SUS to increase access to care (Lima and Lima, 2022).

Research carried out in the state of Paraná reinforced the lack of a structured health education program, highlighting the absence of effective communication between professionals and patients, as well as the lack of research into the correct administration of insulin. In this

context, telemedicine has emerged as a viable alternative to fill these gaps (Salci et al., 2020).

In addition, a Brazilian study highlighted that the Canadian Nursing Association has promoted the expansion of Primary Health Care (PHC) services as a strategy for more equitable and inclusive access. Similarly, the use of telemedicine in Brazil could be a way of ensuring greater equity in care for DM patients (Velloso et al., 2020).

The benefits of telemedicine for patients with DM1, DM2 and Gestational DM (GDM) are remarkable. Studies show that its application reduces complications, improves adherence to treatment and strengthens self-management of the disease, especially among young people with DM1 and women with GDM, preventing, for example, excessive weight gain during pregnancy (Grunberger et al., 2021).



## SCARCITY OF EVIDENCE AND NEW TECHNOLOGIES IN THE 3 COUNTRIES SURVEYED

Faced with the growth of Chronic Non-Communicable Diseases (CNCDs), it is essential to improve educational strategies aimed at patients, encompassing not only the individual, but also their family and social context. To this end, the development and implementation of new technologies is fundamental for this population (Brevidei, Bergerot and Domenico, 2023).

However, studies indicate that there are still significant gaps in the production of scientific evidence to support public policies for the prevention and management of DM. Policy and population interventions often lack solid scientific backing, especially with regard to screening and early detection of diabetes and pre-diabetes, which are still a matter of controversy. The lack of robust clinical trials makes it difficult to formulate more effective guidelines, highlighting the need for financial incentives for research that brings long-term benefits (Gregg et al., 2023).

In Canada, although the Health Technology Assessment (HTA) system is consolidated and comprehensive, it still has structural weaknesses. The main deficiencies include:

- Lax criteria in the selection of technologies to be evaluated;
- Lack of transparency in the creation and use of HTAs for non-pharmacological technologies;
- Low participation of doctors and patients in HTA processes;
- Inconsistent regulatory criteria for the introduction of new technologies;
- Lack of studies on the impact of HTA on public policies (Silva and Elias, 2019).

In addition, a Canadian study pointed out the scarcity of comparative data between different automatic insulin delivery devices, making it impossible to draw conclusions

about the superiority of one method over another. Restricted access to continuous real-time glucose monitoring was also identified for patients with DM2 in various regions of the country, which reinforces the need for innovation and expanding access to new technologies (Halperin et al., 2023; Alshannaq et al., 2023).

In Brazil, the rapid expansion of Health Technology Assessment (HTA) has brought with it several limitations, including methodologically incomplete processes, insufficient scope and misalignment between the technologies assessed and the real needs of the population. HTAs often prioritize technologies without considering their epidemiological relevance, ignoring criteria such as prevalence, morbidity and impact on mortality (Silva and Elias, 2019).

One study also pointed out that the rapid technological evolution in healthcare requires constant updating of professionals, with continuous training in new protocols, procedures and digital tools. However, the lack of adequate qualifications to deal with innovations still represents a significant challenge in the SUS (Campos, Marques and Silva, 2018).

Another study reinforces this issue, highlighting that continuing education in health is still an underdeveloped proposal in Brazil. The lack of professionals trained to train teams on new guidelines and technologies directly impacts the implementation of public policies (Cecílio and Reis, 2018).

In addition, it was observed that the lack of knowledge about rights of access to health care is a significant obstacle for people with DM. Even with advances in public policies, misinformation prevents many people from taking advantage of the services available. This highlights the need for new technologies aimed at both computerizing the health system and communicating with patients, facilitating clinical intervention and access to services (Araújo et al., 2023).

## CONCLUSION

The implementation of telemedicine technology in the context of diabetes mellitus care in the SUS is a promising strategy for overcoming access challenges and improving the quality and efficiency of the services offered. This study shows that telemedicine makes it possible to extend the reach of clinical care, facilitate access to educational programs, and promote greater adherence to treatment, especially in geographically restricted regions or for individuals who have difficulty attending face-to-face consultations.

The comparative analysis between countries such as the United States, Canada and Brazil highlights different healthcare systems and their respective approaches to diabetes mellitus management. While the SUS in Brazil faces financial and access challenges, private and public health systems in other countries also face issues of variability in access to health care, waiting times and shortcomings in the implementation of structured health education programs.

The paucity of evidence and the need for new technologies for diabetes management are evident in this study. The lack of solid studies on both policy interventions and health technologies highlights the importance of encoura-

ging clinical trials and research to evaluate the effectiveness of educational programs, monitoring and treatment technologies.

The challenges presented include the lack of uniform criteria in health technology assessment processes, poor selection of technologies to be assessed and the need for better participation by doctors and patients in assessment processes. In addition, the implementation and updating of new technologies requires a continuing education approach for health professionals to enable them to incorporate and manage these innovations in health services.

Furthermore, the lack of understanding of health-related rights among users highlights the need for interventions that address not only the technology itself, but also education and adequate information to improve adherence and health care outcomes for individuals with diabetes.

Therefore, this study reinforces the importance of telemedicine as a valuable tool for overcoming access barriers and improving care in the context of diabetes mellitus in the SUS, as well as pointing out the urgent need for investment in research, continuing education and careful implementation of new technologies to improve the quality of life and health management of this population.

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