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MedEst|2026 | Vol.6: e565| ISSN: 2789-7567 |RNPS: 2524| NARRATIVE REVIEW ARTICLE

Diabetes mellitus and blood glucose determinations: historical evolution, current technologies, and future perspectives

La diabetes mellitus y las determinaciones de la glucemia: evolución histórica, tecnologías actuales y perspectivas futuras

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RESUMEN

Introducción: La diabetes mellitus es un trastorno metabólico crónico caracterizado por hiperglucemia, secundaria a defectos en la secreción o acción de la insulina. Afecta a más de 415 millones de adultos en el mundo, con proyecciones que superan los 642 millones para 2040. Comprender los métodos de determinación glucémica resulta fundamental para el diagnóstico y monitoreo adecuados. **Objetivo:** Describir la diabetes mellitus como enfermedad crónica y los medios disponibles para su diagnóstico y monitoreo. **Métodos:** Se realizó una revisión narrativa de la literatura mediante búsqueda en PubMed, SciELO y Scopus, utilizando descriptores DeCS/MeSH. Se priorizaron artículos de los últimos cinco años, aplicando criterios de inclusión y exclusión definidos. **Desarrollo:** La fisiopatología de la DM1 implica destrucción autoinmune de células β, mientras que la DM2 combina insulinorresistencia y falla secretora progresiva. Los métodos de determinación glucémica han evolucionado desde pruebas cualitativas en orina hasta monitores continuos, dispositivos no invasivos y sistemas implantables. La variabilidad glucémica emerge como predictor independiente de complicaciones. La prueba de tolerancia oral a la glucosa sigue siendo relevante diagnósticamente. **Conclusiones:** La diabetes constituye un problema de salud global creciente. Los avances tecnológicos en la determinación de glucemia mejoran la precisión y la calidad de vida. La prevención mediante dieta y ejercicio sigue siendo la estrategia más costo-efectiva. Los datos locales de Cárdenas (11 801 pacientes) refuerzan la necesidad de actualizar conocimientos en profesionales y comunidad.

ABSTRACT

Introduction: Diabetes mellitus is a chronic metabolic disorder characterized by hyperglycemia due to defects in insulin secretion or action. It affects more than 415 million adults worldwide, with projections exceeding 642 million by 2040. Understanding blood glucose determination methods is essential for proper diagnosis and monitoring. **Objective:** To describe diabetes mellitus as a chronic disease and the available means for its diagnosis and monitoring. **Methods:** A narrative literature review was conducted through searches in PubMed, SciELO, and Scopus, using DeCS/MeSH descriptors. Articles from the last five years were prioritized, applying defined inclusion and exclusion criteria. **Development:** The pathophysiology of T1DM involves autoimmune destruction of β-cells, while T2DM combines insulin resistance and progressive secretory failure. Glucose determination methods have evolved from qualitative urine tests to continuous monitors, non-invasive devices, and implantable systems. Glycemic variability emerges as an independent predictor of complications. The oral glucose tolerance test remains diagnostically relevant. **Conclusions:** Diabetes constitutes a growing global health problem. Technological advances in glucose determination improve accuracy and quality of life. Prevention through diet and exercise remains the most cost-effective strategy. Local data from Cárdenas (11,801 patients) reinforce the need to update knowledge among professionals and the community.

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INTRODUCTION

Diabetes mellitus (DM) constitutes a group of metabolic disorders characterized by chronic hyperglycemia, secondary to defects in insulin secretion, its action, or both [1]. This endocrine condition currently affects more than 415 million adults worldwide, and projections estimate that by 2040 the figure will exceed 642 million if the current trend continues [2].

DM is classified into type 1, type 2, gestational, and other specific forms, with type 2 being the most prevalent globally, closely linked to overweight, obesity, and sedentary lifestyles. Sustained hyperglycemia, when not adequately controlled, induces microvascular complications—such as retinopathy, nephropathy, and neuropathy—and macrovascular complications—ischemic heart disease and stroke—which severely impair quality of life and increase mortality [3,4].

The pathophysiology of DM is heterogeneous. In type 1 DM, there is an autoimmune destruction of pancreatic β-cells, with a progressive decline in their mass, which in non-diabetic individuals is three to five times greater than that which persists in the first decades of life of affected patients [5,6]. In type 2 DM, on the other hand, a genetic predisposition to limited secretory reserve converges with acquired factors—sedentary lifestyle, inadequate diet, and obesity—that generate hepatic, muscular, and adipose insulin resistance; this resistance forces the pancreas to increase insulin secretion to maintain normoglycemia, until β-cell exhaustion triggers secretory failure and frank hyperglycemia [1]. Among monogenic forms, MODY (Maturity Onset Diabetes of the Young) accounts for 15 % of cases in the United States and is inherited in an autosomal dominant pattern; it presents with a primary defect in β-cell function, without ketosis, without associated obesity, and with onset generally before 25 years of age [7].

Accurate blood glucose determination is an irreplaceable clinical tool for diagnosis, therapeutic monitoring, and individualized adjustment of hypoglycemic regimens [1]. Reference values for metabolic control in diabetic patients establish fasting blood glucose between 4,4 and 7,2 mmol/L and postprandial blood glucose below 10 mmol/L, with glycosylated hemoglobin (HbA1c) below 7 % [3]. The World Health Organization emphasizes that glycemic self-monitoring, when integrated into a diabetes education program, improves metabolic control and reduces the risk of severe hypoglycemia [2].

Measurement methods have evolved notably: from qualitative urine tests of the 19th century—such as Benedict's reagent (1908) and Clinitest and Clinistix strips (1945–1956)—to the first capillary blood systems, such as Dextrostix (1965) and the Ames Reflectance Meter

(1970), which gave way to portable home-use glucometers [8]. Currently, continuous glucose monitors (CGM) measure glucose in interstitial fluid every few minutes and provide early alerts, while non-invasive devices—based on Raman spectroscopy or dermal biosensors—and long-term implantable systems represent the most promising technological horizon [9].

Beyond glycemic averages, glycemic variability (GV)—the acute fluctuations between peaks and troughs—has emerged as an independent predictor of vascular complications and hypoglycemic episodes; metrics such as the coefficient of variation (CV) and standard deviation (SD), quantifiable via CGM, allow defining stable control when the CV is below 36 %. The oral glucose tolerance test (OGTT) remains valid for diagnosis in subjects at risk or with doubtful results, although its execution requires rigorous conditions: 8–12 hour fasting, prior intake of at least 250 g of daily carbohydrates for three days, discontinuation of interfering drugs, and absence of acute processes or stress, since any deviation can alter the results [10].

The treatment of DM encompasses a spectrum ranging from primary prevention—promotion of healthy weight, systematic exercise, and balanced diet—to measures in secondary and tertiary care, aimed at slowing disease progression, preventing acute and chronic complications, and rehabilitating sequelae [2,7]. In the municipality of Cárdenas, Cuba, 11,801 patients with diabetes are registered, evidencing the local burden of this pathology and the urgency of updating knowledge about its pathophysiological bases and glycemic determination methods among health professionals and the community.

The aim of this narrative review is to describe diabetes mellitus as a chronic disease and the available means for its diagnosis and monitoring, with emphasis on the technological evolution of blood glucose determinations and the rigorous application of diagnostic tests, in order to contribute to better clinical practice from primary care.

METHODS

A narrative review of the scientific literature was conducted with the aim of synthesizing current knowledge about diabetes mellitus and blood glucose determination methods, following the methodological standards proposed for this type of review.

The bibliographic search strategy was designed based on Health Sciences Descriptors (DeCS) and MeSH terms: "Diabetes Mellitus," "Blood Glucose," "Glycemic Control," "Hyperglycemia," "Hypoglycemia," "Continuous Glucose Monitoring," and "Oral Glucose

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Tolerance Test." These terms were combined using the Boolean operators AND and OR to maximize the sensitivity and specificity of information retrieval.

Searches were executed in the PubMed, SciELO, and Scopus databases, complemented with the Google Scholar search engine to identify gray literature and relevant non-indexed documents. The search period covered from January 2021 to May 2026, with the purpose of prioritizing evidence published in the last five years; nevertheless, indispensable classical references were included to contextualize the historical and pathophysiological foundations of the disease.

The following criteria were established:

Inclusion criteria: a) original articles, systematic reviews, narrative reviews, clinical practice guidelines, and consensus documents; b) published in Spanish or English; c) addressing the pathophysiology, epidemiology, diagnosis, monitoring, or treatment of diabetes mellitus.

Exclusion criteria: editorials, letters to the editor, isolated case studies, conference abstracts, and documents without full-text access.

The document selection process was structured in two phases: in the first, titles and abstracts were examined to discard those not pertinent to the object of study; in the second, a full-text reading of the preselected works was performed to evaluate their quality, relevance, and level of updating.
Information extraction and synthesis was organized into predefined thematic categories—pathophysiology, diagnostic methods, monitoring technologies, glycemic variability, and treatment—which were refined during the critical reading process to coherently integrate the findings.

Finally, the consistency of bibliographic citations was verified and the ethical principles of scientific publication were applied, explicitly declaring the non-use of generative artificial intelligence in the writing of the manuscript.

RESULTS

Type 1 diabetes mellitus (DM1) is characterized by autoimmune destruction of pancreatic β-cells, leading to an absolute insulin deficiency. In most historical models, a normal β-cell mass that progressively decreases during the autoimmune attack was assumed; however, recent studies have shown that in non-diabetic humans the β-cell mass is three to five times greater than that which likely exists in the first two decades of life of patients who develop DM1 [7]. This

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finding has relevant implications, as it suggests that intrauterine, environmental, or genetic factors during early childhood could condition the initial pancreatic mass, and opens the possibility of intervening on these factors to modify disease risk [8].

Type 2 diabetes (DM2), which represents more than 90 % of cases globally, has a more complex pathophysiology. It begins with a genetic predisposition that limits the pancreas's secretory capacity, to which acquired factors such as sedentary lifestyle and inadequate diet are added, promoting obesity and insulin resistance in the liver, muscle, and adipose tissue [9]. Initially, the β-cell increases its insulin secretion to compensate for peripheral resistance and maintain normoglycemia, a phenomenon that presents with compensatory hyperinsulinemia. Over time, β-cell exhaustion leads to progressive secretory failure, which first manifests as loss of the early insulin peak and postprandial hyperglycemia, and finally as elevated fasting blood glucose, when hepatic glucose production escapes insulin control [9]. The progression of insulin resistance and secretory deterioration determines the frank appearance of DM2.

Among monogenic forms, MODY (Maturity-Onset Diabetes of the Young) constitutes 1–5 % of all diabetes cases in the United States. It is inherited in an autosomal dominant pattern—hence the presence of at least three affected generations in the same family—and is due to a primary defect in β-cell function, with deficient insulin secretion, but without ketosis or ketoacidosis at onset, without usual association with obesity, and with presentation generally before 25 years of age [10]. Unlike DM1, antibodies are not detected, and in contrast to DM2, there is no significant insulin resistance. Except for the MODY 2 variant, the other forms progress progressively toward β-cell failure [10].

Epidemiology and global burden of the disease

It is currently estimated that approximately 415 million adults live with diabetes mellitus worldwide; if the trend continues, 592 million are projected for 2035 and more than 642 million for 2040 [18]. DM1 constitutes approximately 10 % of all forms of diabetes, with a prevalence of 0,5–1 %. Although there is generally no sex distinction, in high-risk populations a slight male predominance is observed, while in low-risk populations the female sex predominates. The age of presentation follows a bimodal distribution, with peaks between 4–6 years and between 10–14 years, although it can debut at any age. Only 10 % of DM1 cases present in families, the rest being sporadic; this form of diabetes has a greater propensity for ketoacidosis, severe hypoglycemia, coma, and death [18].

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DM2 is more frequent in the 40–59 age group, although its prevalence has notably increased at younger ages due to the rise in childhood and adolescent obesity. There is no sex distinction, and it appears predominantly in people residing in urban areas, in relation to sedentary lifestyles and hypercaloric diets [18].

Historical evolution of blood glucose determination methods

The means to measure blood glucose have undergone a radical transformation since their origins. In the 19th century and until 1908, physicians analyzed urine using qualitative copper reduction tests; the best known was Benedict's test, which used a copper sulfate reagent that changed color upon contact with glucose in urine. Its main limitation was the lack of specificity, as it reacted with other reducing substances [11]. In the 1940s and 1950s, the procedure was simplified with the launch of Clinitest, an effervescent tablet with the same reagents, and in 1956 Clinistix arrived, the first dip-and-read test strip for urine, which used the enzyme glucose oxidase and eliminated false positives [11].

The qualitative leap occurred in the 1960s with direct blood measurement. In 1965, Dextrostix appeared, the first reagent strip for capillary blood, which required a large drop and subsequent washing to compare the color with a chart; it was for use in medical offices. In 1970, the Ames Reflectance Meter (ARM) was the first electronic device to read the strip, although it was large, heavy, and had a lead battery. Democratization came in 1980 with the Dextrometer, the first meter designed for home use by patients themselves. From then on, devices became smaller, faster, and more accurate [12].

Current technologies for glucose monitoring

Currently, multiple glycemic measurement systems coexist. Self-monitoring of blood glucose (SMBG) requires a drop of blood obtained by finger prick; although it is the most widespread method, the pain and discomfort associated with pricks can reduce adherence to self-monitoring. A 2023 study noted that accuracy varies by brand, with some being more reliable than others [13].

Continuous glucose monitors (CGM) use a small filament inserted under the skin to measure glucose in interstitial fluid every few minutes, offering alerts for dangerous levels. Their accuracy is high, although a 2025 comparative study showed performance differences between brands, such as Dexcom and Abbott versus Medtronic [14]. Recently, technology has revolutionized self-monitoring, providing metrics such as "time in range" (TIR). The Steno2tech trial demonstrated that the use of CGM in insulin-treated type 2 diabetes

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significantly reduces HbA1c compared to finger pricks [19]. Non-invasive methods represent the great bet for the future; they use light to "see" through the skin, completely eliminating the need for needles. MIT's Raman spectroscopy has shown in 2025 studies accuracy similar to traditional CGM. In September 2025, the FDA approved Biolinq Shine, a biosensor that adheres to the skin and uses a microrarray with nearly imperceptible penetration [14].

Finally, implantable monitors (CBGM) are devices that are completely implanted under the skin, such as Glucotrack; their main advantage is long duration, up to 3 years, eliminating the need for frequent sensor changes [15].

Glycemic variability: a new paradigm

Beyond average levels, glycemic variability (GV) has emerged as an independent predictor of vascular complications and hypoglycemic episodes. GV refers to acute fluctuations in sugar levels, the peaks and valleys, which with continuous monitoring can be quantified by the coefficient of variation (CV) or standard deviation (SD). A CV below 36 % is considered a stable control target [16]. Evidence suggests that high GV is associated with oxidative stress and endothelial damage, with adverse effects independent of HbA1c [17]. This concept has gained clinical relevance, as glycemic stability is emerging as a necessary complement to traditional averages for vascular risk assessment.

Oral glucose tolerance test: indications and conditions

The oral glucose tolerance test (OGTT) is very useful in the diagnosis of DM and is indicated in subjects at risk of diabetes and in those with doubtful results. It should not be performed on bedridden patients nor during acute processes—fever, acute myocardial infarction, burns, trauma, surgery, infections—and should be postponed for at least two weeks after complete recovery [20]. Excess of certain hormones—acromegaly, hypercortisolism, hyperaldosteronism, hyperthyroidism, pheochromocytoma—and pregnancy decrease glucose tolerance, so the OGTT should be reassessed after the resolution of such conditions; however, an abnormal OGTT during these situations may have prognostic value for future DM [21].

It is essential to know the routine medications that can interfere with results—insulin sensitizers, salicylates, nicotinic acid, thiazide diuretics, glucocorticoids, diazoxide, protease inhibitors, atypical antipsychotics, hormonal contraceptives, beta-adrenergic agonists, among others—and to discontinue them at least three days before the test; if not possible, this must be recorded in the report [22].

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The procedure requires a prior phase of three days with intake of at least 250 g of daily carbohydrates, 8 to 12 hours fasting, abstention from coffee, tobacco, and unusual physical exercise from 8 hours before, and postponement if any requirement is not met. The first fasting blood glucose sample is drawn between 7:00 and 9:00 a.m., and 75 g of anhydrous glucose dissolved in 250–350 ml of water are administered, to be ingested within 5 minutes. A second sample is taken exactly at 120 minutes. During the test, the patient should not perform physical exertion, smoke, drink coffee or alcohol, or suffer emotional stress. If pallor, nausea, vomiting, sweating, or fainting appear, the test should be suspended and repeated on another occasion [23].

Prevention and treatment strategies

Diabetes treatment is articulated at different levels of care. In primary prevention, aimed at the general population, maintenance of ideal weight, systematic physical exercise, and a balanced diet rich in fiber, vegetables, and fruits, low-sodium, with less than 10 % saturated fats, and low in refined sugars are promoted [24]. In the population at risk of developing DM, measures are added to prevent or correct obesity and avoid drugs that may favor its appearance. In the population with prediabetes, the same promotion measures are applied, modifiable risk factors are addressed, and annual screening is performed or upon symptoms of hyperglycemia [24].

In secondary care, actions are directed at preventing disease progression through active screening of at-risk cases and optimal metabolic control; the objectives are early diagnosis, remission of the syndrome, and delay of its progression, as well as prevention of acute and chronic complications [25]. In tertiary care, interventions focus on early identification of complications, slowing their progression, treating disabilities, and preventing premature mortality, through systematic clinical and laboratory evaluation and a multidisciplinary approach [25].

Specific treatment aims to keep the patient free of symptoms and signs, preserve pancreatic insulin reserve, achieve adequate metabolic control, and avoid or delay acute and chronic complications through the control of risk factors such as arterial hypertension, obesity, hyperlipoproteinemia, hyperinsulinism, alcoholism, and smoking; rehabilitation of cases with sequelae of complications is also sought [25]. In the municipality of Cárdenas, Cuba, 11,801 diabetic patients are registered, reflecting the local burden of the disease and underscoring the need for effective prevention, diagnosis, and treatment strategies integrated into primary care.

DISCUSSION

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This narrative review has addressed diabetes mellitus from its pathophysiological bases to the most advanced technologies for blood glucose determination, with the aim of synthesizing current knowledge and highlighting the evolution of diagnostic and monitoring methods. The compiled findings allow us to affirm that, although diabetes mellitus continues to be an expanding global health challenge, technological advances in glucose measurement have substantially transformed disease management, improving diagnostic accuracy and patients' quality of life.

The pathophysiology of type 1 and type 2 diabetes mellitus presents as a heterogeneous continuum in which genetic, environmental, and metabolic factors converge. The works of Lakhtakia [7] and Mazur [8] have shown that the β-cell mass in non-diabetic individuals is notably greater than that which persists in DM1 patients during the first decades of life, suggesting that the functional reserve of the pancreas could be conditioned by early events, possibly intrauterine or during early childhood. This observation opens a window of opportunity for primary prevention, by raising the possibility of intervening on modifiable factors that determine the development of pancreatic mass. In DM2, the pathophysiological model described by the American Diabetes Association [1] and by the IDF [9] underscores the interaction between genetic predisposition and lifestyle habits; insulin resistance and progressive secretory exhaustion constitute the basis of disease progression. This knowledge reinforces the importance of lifestyle interventions from early ages, especially in populations with high prevalence of obesity and sedentary lifestyle.

One of the most relevant findings of this review is the technological evolution in blood glucose determination. From the qualitative urine tests of the 19th century to current continuous monitors and non-invasive systems, there has been a qualitative leap in accuracy, comfort, and patient self-management capacity [11,12]. Portable glucometers, although widely used, have limitations related to adherence due to the pain and discomfort of repeated pricks [13].

In this context, continuous glucose monitors (CGM) have proven to be superior in detecting glycemic patterns and reducing hypoglycemic episodes, especially in patients with type 1 diabetes and in those with type 2 diabetes on intensive insulin therapy [14,19]. The Steno2tech trial, cited by Grunberger et al. [18], constitutes solid evidence that CGM use significantly reduces HbA1c compared to conventional capillary self-monitoring. However, variability in accuracy between different brands, noted in recent comparative studies [14], warns of the need for critical and standardized evaluation of these devices before their widespread adoption.

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Non-invasive technologies, such as Raman spectroscopy and the Biolinq Shine biosensor approved by the FDA in 2025, represent the most promising horizon [14]. These innovations could completely eliminate the need for blood extractions, dramatically improving adherence and quality of life. Nevertheless, technical challenges persist related to the correlation between optical measurements and actual blood glucose, as well as sensor stability and durability. Long-term implantable systems, such as Glucotrack, offer an alternative for patients requiring continuous monitoring without the burden of frequent sensor changes [15]. Together, these technologies are redefining the standard of care, although their implementation in resource-limited settings, such as the municipality of Cárdenas, faces economic and infrastructure barriers that must be considered.

Glycemic variability (GV) has emerged as a central concept in the evaluation of metabolic control. Traditionally, glycosylated hemoglobin (HbA1c) has been the reference marker for long-term glycemic control; however, GV offers complementary information about acute glucose fluctuations, which have been independently associated with oxidative stress, endothelial dysfunction, and vascular complications [16,17].

The coefficient of variation (CV) below 36 % has been established as a stable control target, and its measurement via CGM provides a valuable tool for therapeutic decision-making [16]. This integrative approach, combining HbA1c, time in range (TIR), and GV, represents an advance in personalizing diabetes management, although its applicability in primary care requires additional training and resources.

The oral glucose tolerance test (OGTT) remains a diagnostic pillar, especially in subjects with risk factors or doubtful results. However, its usefulness depends strictly on compliance with rigorous conditions: fasting, prior carbohydrate intake, discontinuation of interfering drugs, and absence of acute illness or stress [20,21,22,23]. Any deviation from these requirements can alter results and lead to misdiagnoses. The reviewed literature agrees that the OGTT should be performed under strict standardized protocols, and that primary care physicians must be trained to identify and correct possible interferences. The complexity of the procedure, combined with patient discomfort, has motivated the search for diagnostic alternatives, such as glycosylated hemoglobin, although the OGTT maintains its indication in specific cases, especially in the diagnosis of gestational diabetes and prediabetes screening.

In the area of treatment, the review confirms that prevention remains the most cost-effective strategy. Health promotion measures—balanced diet, physical exercise, and weight control—constitute the first line of action at all levels of care, from the general population to

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high-risk groups and prediabetic patients [24]. In secondary and tertiary care, rigorous metabolic control and a multidisciplinary approach to cardiovascular risk factors are fundamental to delaying disease progression and preventing complications [25]. However, the available evidence shows that, despite recommendations, adherence to preventive and therapeutic measures remains suboptimal in many populations, reflected in high complication rates and the growing burden of the disease.

Data from the municipality of Cárdenas, with 11,801 diabetic patients registered, illustrate the magnitude of the problem at the local level and underscore the need to strengthen prevention and control strategies in primary care. This figure, although not contextualized with the total population, evidences that diabetes is not a distant problem but a reality that directly affects the community. Continuing education for health professionals and diabetes education for patients and their families are indispensable pillars for improving metabolic control indicators and reducing the incidence of complications.

Limitations of the review

This narrative review presents limitations that must be acknowledged. First, as a narrative and not a systematic review, an exhaustive search protocol nor a quantitative analysis of the evidence has been applied, which could introduce selection biases in article inclusion. Second, the selection of sources has focused on indexed databases and easily accessible documents, which could exclude gray literature or studies published in other languages. Third, the variability in the methodological quality of the included studies has not been assessed using standardized tools, so the conclusions should be interpreted with caution. Finally, the updating of references, although prioritizing the last five years, includes some classical sources that, while essential for contextualizing pathophysiology, may not reflect the most recent advances in specific areas such as pharmacology or genetics.

Implications for clinical practice and future research

The findings of this review have direct implications for clinical practice in primary care. It is recommended that health professionals systematically integrate the use of continuous glucose monitors in patients with type 1 diabetes and in those with type 2 diabetes on insulin therapy, whenever resources allow. Likewise, it is suggested to incorporate glycemic variability assessment as a complement to HbA1c in therapeutic decision-making. In the diagnostic field, it is essential to reinforce OGTT execution protocols to minimize errors and ensure reliable results.

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For future research, several areas of interest are identified: a) studies evaluating the effectiveness and cost-effectiveness of CGM in primary care settings in low- and middle-income countries; b) investigations into the determining factors of β-cell mass and its potential modification through early interventions; c) clinical trials comparing new non-invasive technologies with conventional methods in terms of accuracy, adherence, and long-term clinical outcomes; d) analysis of glycemic variability as a therapeutic target and its impact on reducing macrovascular and microvascular complications.

In conclusion, diabetes mellitus continues to be a global epidemic that demands an integrated and multidisciplinary response. Technological advances in blood glucose determination have provided powerful tools for diagnosis and monitoring, but their effectiveness depends on proper implementation, professional training, and patient education. The combination of prevention, early diagnosis, rigorous metabolic control, and rational use of new technologies constitutes the most promising path to reduce the burden of this disease and improve the quality of life of those who suffer from it.

CONCLUSIONS

Diabetes mellitus constitutes a growing global health problem, with more than 415 million adults affected and a projection exceeding 642 million by 2040, which justifies the need to deepen knowledge about it from primary care levels. The pathophysiological heterogeneity—from autoimmune destruction of β-cells in DM1 to insulin resistance and secretory deficit in DM2—demands a personalized diagnostic and therapeutic approach. Blood glucose determination methods have evolved significantly, from qualitative urine tests to continuous monitors and non-invasive devices, improving accuracy, adherence, and quality of life. The oral glucose tolerance test remains relevant, although it requires rigorous conditions to avoid interference. Prevention, based on diet, exercise, and weight control, constitutes the most cost-effective strategy. Glycemic variability emerges as an independent predictor of complications, complementary to HbA1c. Local data from the municipality of Cárdenas (11,801 patients) reinforce the importance of updating knowledge about diabetes among professionals and the community

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MARC: Conceptualization, formal analysis, methodology, project management, drafting, revision, and editing.

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YPP: Conceptualization, methodology, supervision, revision, and editing.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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USE OF ARTIFICIAL INTELLIGENCE

The authors declare that no artificial intelligence was used in the writing of this manuscript.