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Review article

Artificial intelligence in the management of diabetes mellitus: an integrative literature review

Inteligência artificial no manejo do diabetes mellitus: revisão integrativa da literatura

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Abstract
Objective: to analyze studies addressing the application of artificial intelligence in the management of diabetes mellitus, identifying the main tools employed. **Materials and Methods:** integrative literature review conducted in indexed databases, including articles published between 2020 and 2025. After applying inclusion and exclusion criteria, 14 original studies were selected. The analysis followed the methodological principles of the PICO model and the PRISMA guidelines (Preferred Reporting Items for Systematic reviews and Meta-Analyses). **Results:** the studies demonstrated that machine learning models present high potential for predicting complications, stratifying clinical risk, optimizing glycemic monitoring and supporting clinical decision making. Computational triage systems, predictive algorithms, wearable devices and chatbots demonstrated usefulness in care personalization and in promoting health literacy. **Conclusion:** artificial intelligence may represent a promising strategy for the management of diabetes mellitus by improving diagnostic accuracy, enabling earlier interventions and enhancing clinical follow up, although challenges related to data standardization, scientific validation, professional acceptance and technological integration still require overcoming to consolidate its safe and effective use in healthcare practice.
Keywords: Artificial Intelligence. Diabetes Mellitus. Glycemic control. Health Literacy.

Resumo
Objetivo: analisar as aplicações da inteligência artificial no manejo do diabetes mellitus. **Materiais e Métodos:** revisão integrativa da literatura realizada a partir da análise de artigos publicados entre 2020 e 2025. Após aplicação dos critérios de inclusão e exclusão, foram selecionados 14 artigos originais. A análise considerou os princípios metodológicos do modelo PICO e as diretrizes PRISMA (*Preferred Reporting Items for Systematic reviews and Meta-Analyses*). **Resultados:** os estudos evidenciaram que modelos de aprendizado de máquina apresentaram elevado potencial para predição de complicações, estratificação de risco, otimização do monitoramento glicêmico e apoio à tomada de decisão clínica. Sistemas computacionais de triagem, algoritmos preditivos, dispositivos vestíveis e chatbots demonstraram utilidade na personalização do cuidado e na promoção do letramento em saúde. **Conclusão:** a inteligência artificial pode ser uma estratégia promissora para o manejo do diabetes mellitus ao ampliar a precisão diagnóstica, favorecer intervenções precoces e aprimorar o acompanhamento clínico, embora desafios relacionados à padronização dos dados, validação científica, aceitabilidade profissional e integração tecnológica ainda são observados.
Palavras-chave: Inteligência artificial. Diabetes mellitus. Controle glicêmico. Literacia para a Saúde.

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Introduction

Diabetes mellitus (DM) is a chronic metabolic condition characterized by persistently elevated blood glucose levels. It results from insufficient insulin production by the pancreas or from the body's inability to use insulin efficiently[1]. It is classified into four main categories: type 1 (DM1), type 2 (DM2), gestational diabetes (GDM), and other types of diabetes. The most common form is DM2, accounting for approximately 90% of cases. It occurs when the body does not use insulin effectively, known as insulin resistance, or does not produce a sufficient amount to maintain controlled blood glucose levels[2].

Among men, the age groups 55 to 64 years and 65 to 74 years show the highest prevalence. Among women, a similar pattern is observed, with higher prevalence in the same age ranges. Estimates indicate that by 2045, more than 700 million people may be affected by DM, highlighting the need to implement effective strategies for its prevention and management[3]. Despite advances in healthcare, early detection remains a challenge, as in many cases diagnosis occurs late, when complications are already established. This situation underscores the impact of limited awareness about DM, a factor that contributes to delayed healthcare seeking and the consequent worsening of patients' clinical condition[4].

In this context, artificial intelligence (AI) emerges as a potential tool for analyzing large volumes of clinical data, identifying patterns and correlations that may predict disease development. The application of advanced AI techniques, such as machine learning, has demonstrated strong potential in the prediction and diagnosis of diabetes[5]. It enables systems to learn from data and make predictions without explicit programming. For effective and ethical functioning, three principles are essential: integrity, accuracy, and compliance[6]. Beyond clinical applications, AI also stands out as a health literacy tool, as it can assist patients in managing diabetes in their daily lives[5].

The objective of this study was to analyze the application of artificial intelligence in the management of diabetes mellitus through a literature review.

Materials and Methods

This study is an integrative literature review, which consisted of a systematic search and critical appraisal of published studies. This type of study allows the collection and in-depth analysis of results from original research in order to provide an analytical synthesis on a given topic. A five-year time frame was selected due to the increasing use of AI in healthcare settings during this period, particularly following the release of the "ChatGPT" tool by "OpenAI" in 2022.

The research problem was structured using the PICO model (Patient/Population, Intervention, Control, and Outcome), a widely used methodological strategy for formulating guiding research questions[7] (Table 1). Accordingly, the following guiding question was formulated: How do artificial intelligence application methodologies contribute to the management of diabetes mellitus?

Table 1. Description of the PICO tool (Patient/Population, Intervention, Control, and Outcome).

	Description	**Definition in this Integrative Review**
P	*Population*	Patients diagnosed with Diabetes Mellitus
I	*Intervention*	Using Artificial Intelligence for monitoring, diagnosis and treatment
C	*Control*	Traditional methods of diagnosis, monitoring and treatment
O	*Outcome*	Greater accuracy and effectiveness in early diagnosis, improved glycemic control, reduction of complications, and optimization of insulin administration.

Source: Adapted from Pereira[7].

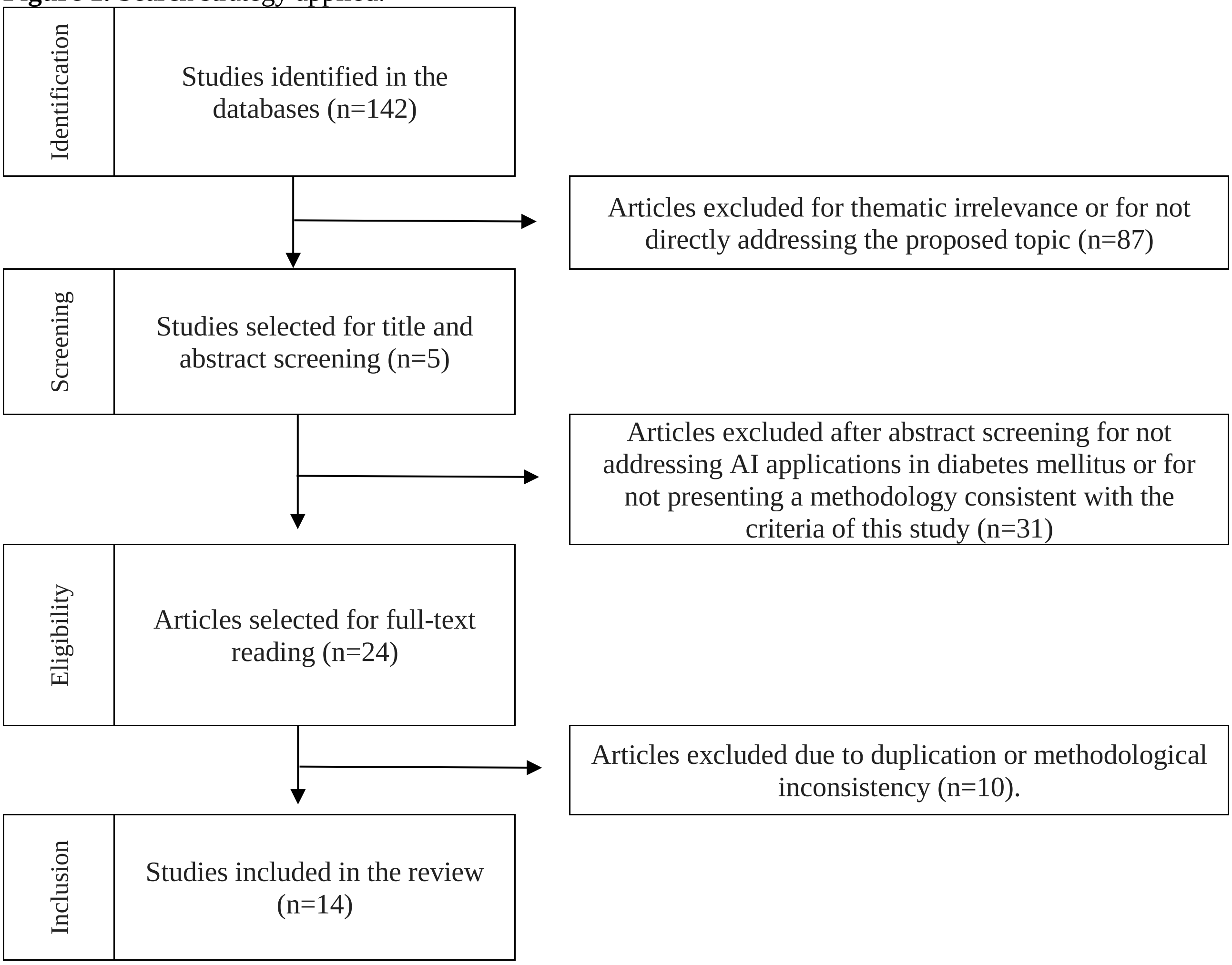
The search was conducted in the Latin American and Caribbean Health Sciences Literature (LILACS), National Library of Medicine (PubMed), and Scientific Electronic Library Online (SciELO) databases, using the following Health Sciences Descriptors (DeCS): a) “diabetes mellitus” AND “artificial intelligence”; b) “diabetes mellitus” AND “machine learning”; c) “diabetes mellitus” AND “artificial intelligence”; d) “diabetes mellitus” AND “machine learning”. Table 2 presents the different filters applied to ensure the selection of original articles across the three databases.

Table 2. Search filters applied for article selection.

	Latin American and Caribbean Health Sciences Literature	**National Library of Medicine (PubMed)**	**Scientific Electronic Library Online**
Description of filters	Diagnostic studies, observational studies, prevalence studies, risk factor studies, screening studies, and etiological studies.	Adaptive clinical trials, clinical studies, clinical trials, observational studies, comparative studies, randomized clinical trials, validation studies, and evaluation studies.	Articles; Experimental studies; Medicine; Research.

Original studies addressing applications of AI and machine learning in the management of DM were included, as well as articles with methodologies aligned with the objectives of the present study and conducted with scientific rigor, containing relevant quantitative or qualitative data on the topic. Publications from 2020 to 2025 available in Portuguese, English, or Spanish were also included. Review articles, meta-analyses, clinical guidelines, studies without a defined methodology, and duplicate records were excluded.

Figure 1. Search strategy applied.



Disagreements between the researchers were resolved through a consensus technique, following the principles of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework[8], which establishes guidelines for the transparent and rigorous conduct of systematic and integrative reviews.

A data extraction form was used for the critical analysis of the studies, consisting of the following information: title; authors; year; study setting; sample; objective; study design; and main results. The adopted methodology allowed the consolidation of relevant information on the applications and challenges of AI in the management of DM, providing a solid basis for the analysis of the results.

Results

Fourteen studies published between 2021 and 2024 were included. A predominance of retrospective[10,14,17,19,20] and observational designs[9,15,20] was observed, along with one clinical trial[11] and other study types[5,12,16,18,22]. The investigations encompassed studies conducted across different continents, showing methodological diversity in sample size, algorithms used, and outcomes analyzed (Table 3).

The applications of artificial intelligence in the management of DM were grouped into four main axes: (a) glycemic prediction and metabolic monitoring; (b) risk and complication prediction; (c) diabetic retinopathy screening; and (d) comparison of diagnostic methods and algorithms.

In digital interventions applied to metabolic monitoring[9,10,20], a reduction in glycated hemoglobin and a higher proportion of patients achieving glycemic targets were observed. In studies focused on risk and complication prediction[11,13,15,17,19,21], machine learning models showed high performance, with strong discriminative ability and good accuracy in identifying clinical outcomes.

In diabetic retinopathy screening[14,16,18,22] AI-based systems demonstrated sensitivity between 90.48% and 98.52% and specificity above 85%, indicating good diagnostic accuracy. In studies comparing diagnostic methods and algorithms[5,12], a strong correlation was found between AI-based methods and traditional laboratory tests, although with slight variations in estimated values, as well as superior performance of certain algorithms in terms of accuracy and predictive precision.

The findings indicate that AI has the potential to improve DM control by enhancing prevention, diagnosis, and treatment. Its application may contribute to personalized care, early risk prediction, and optimization of therapeutic strategies.

Table 3. Characteristics of the selected studies (n=14).

Author, year	Country and year of the study	Objective	Methodology	Main results
Doorn *et al.*, 2021[9]	Netherlands, 2016–2018	To predict glycemic levels using artificial intelligence, based on continuous glucose monitoring data and physical activity.	Observational study with 851 individuals. A Long Short-Term Memory model was used. Validation was performed using a type 1 diabetes mellitus database.	Root Mean Square Error ranging from 0.37 to 0.59 mmol/L. Predictions were considered safe in more than 98% of cases.
Oliveira; Barcelos; Siqueira, 2022[12]	Brazil, 2021	To correlate glucose measurements obtained by glucometer, laboratory analysis, and an artificial intelligence–based system.	Cross-sectional study with 20 volunteers, conducted through simultaneous sample collection.	Strong correlation between the methods (r>0.75). The artificial intelligence–based system overestimated glycemic values by approximately 40%.
Du *et al.*, 2022[11]	China, 2018–2020	To evaluate functional magnetic resonance imaging associated with	Clinical trial with 64 patients.	Effectiveness of 96.9%, with improved coverage and satisfaction.

		artificial intelligence, using the Fuzzy C-Means algorithm in home care for diabetic nephropathy.		
Kim *et al.*, 2022[10]	South Korea, 2019	To analyze lifestyle patterns using artificial intelligence associated with wearable body trackers.	Prospective study with 24 adults, using Fitbit devices, SHAP (SHapley Additive exPlanations) technique, and data clustering methods.	A 0.3% reduction in glycated hemoglobin (HbA1c) levels associated with sleep regularity.
Lee *et al.*, 2022[13]	South Korea, 2015–2020	To predict gestational diabetes mellitus using artificial intelligence and variables associated with non-alcoholic fatty liver disease.	Cohort study with 1,443 pregnant women, using machine learning models including logistic regression, Random Forest, Support Vector Machine, and Deep Neural Network.	Area Under the Curve up to 0.819 in the Support Vector Machine model. The inclusion of variables related to non-alcoholic fatty liver disease improved the predictive performance of the models.
Acharyya *et al.*, 2023[14]	India, 2019–2020	To evaluate the Adven-i artificial intelligence system for screening diabetic retinopathy and other retinal diseases.	Retrospective study analyzing 2,261 images.	Sensitivity of 95.12% and specificity above 85%.
Kwiendacz *et al.*, 2023[15]	Poland, 2021–2022	To predict cardiovascular risk in patients with diabetes mellitus using artificial intelligence.	Observational study with 238 patients.	Area Under the Curve of 0.86. The main predictors identified were age, use of β-blockers, angiotensin-converting enzyme inhibitors (ACE inhibitors), and presence of ulcers.
Lupidi *et al.*, 2023[16]	Italy, 2022	To validate the Selena+ artificial intelligence system for diabetic retinopathy screening.	Cross-sectional study with 251 patients.	Sensitivity and specificity of 96.8%.
Wang *et al.*, 2023[17]	United States, 2007–2018	To predict heart failure in patients with diabetes mellitus and prediabetes using artificial intelligence models.	Retrospective study with 3,527 individuals, using five machine learning algorithms.	The Random Forest algorithm showed an Area Under the Curve of 0.978. The main predictive variables were age, presence of pain, and use of antidiabetic medications.
Zhang *et al.*, 2024[19]	China, 2019–2023	To detect diabetes mellitus and prediabetes in normoglycemic	Retrospective study with 59,259 individuals, using seven	The CatBoost model showed an Area Under the Receiver Operating Characteristic curve (auROC) of 0.806 in

		individuals using artificial intelligence models.	machine learning algorithms.	internal validation and 0.794 in external validation.
Shamanna *et al.*, 2024[20]	Índia, 2022–2023	To evaluate a digital twin intervention in type 2 diabetes mellitus.	Retrospective observational study with 1,853 patients.	Reduction in glycated hemoglobin (HbA1c) from 8.1% to 6.3%, with 89% of patients achieving glycemic targets. An average weight loss of 4.8 kg and a reduction in medication use were also observed.
Fregoso-Aparicio *et al.*, 2021[5]	Mexico, 2021	To compare machine learning and deep learning models for the prediction of type 2 diabetes mellitus and to identify techniques associated with the best predictive performance.	Systematic literature review conducted according to PRISMA recommendations, with a comparative analysis of machine learning and deep learning models applied to the prediction of type 2 diabetes mellitus.	Tree-based algorithms showed the best predictive performance for type 2 diabetes mellitus. Data balancing and feature selection techniques increased model efficiency, whereas deep neural networks demonstrated lower-than-expected performance. Models trained on well-structured datasets achieved near-perfect results.
Cleland *et al.*, 2024[22]	Tanzania, 2023–2024	To evaluate the impact of artificial intelligence on adherence to ophthalmologic follow-up after diabetic retinopathy screening.	Trial with 2,364 patients using the Selena+ artificial intelligence system.	Ongoing study evaluating adherence to follow-up care and the cost-effectiveness of the intervention.
Doğan *et al.*, 2024[18]	Turkey, 2023	To compare the performance of non-mydriatic cameras associated with the EyeCheckup artificial intelligence system.	Clinical study with 865 patients, based on image analysis.	Sensitivity ranging from 90.48% to 98.52% and specificity ranging from 95.93% to 98.95%.

Discussion

The use of predictive models based on machine learning constitutes one of the main frontiers of innovation in AI applications for the diagnosis and treatment of DM. Studies have demonstrated the potential of these models to predict glycemic levels with high accuracy[9,10]. Evidence indicates that algorithms based on recurrent neural networks were able to predict blood glucose levels with a high degree of accuracy using continuous glucose monitoring data, representing a promising tool for automated insulin delivery systems[10].

The use of wearable devices combined with machine learning algorithms enabled the identification of healthier lifestyle patterns in individuals with DM2, with a direct impact on reducing glycated hemoglobin levels[10]. These findings reinforce the potential of AI for personalized care and optimization of glycemic control, especially through the integration of continuous and behavioral data into clinical decision-making.

In a study focused on the follow-up of patients with diabetic nephropathy, computer vision algorithms were employed for the analysis of functional magnetic resonance imaging, and the combination of AI with the Plan-Do-Check-Act (PDCA) care model resulted in improved quality of life and greater clinical effectiveness[11]. In the diagnostic context, a strong correlation was observed among three glucose measurement methods (glucometer, laboratory analysis, and AI-based point-of-care equipment), although the values obtained by the AI system were on average 40% higher, which may impact the clinical interpretation of test results[12]. This finding highlights that, despite the high correlation among methods, limitations related to the standardization and calibration of AI-based systems still exist, which is an essential aspect for their safe incorporation into clinical practice.

One investigation developed predictive models for gestational diabetes based on clinical variables associated with non-alcoholic fatty liver disease, using different AI algorithms, including Support Vector Machine. The inclusion of these variables increased predictive accuracy, especially in models based on Support Vector Machine and artificial neural networks[13]. Another study evaluated an AI system (Adven-i) for diabetic retinopathy screening and other retinal diseases, showing sensitivity above 91% and specificity above 85%, demonstrating potential for large-scale applications[14]. In the same context, regression and clustering techniques were used to predict cardiovascular risk in individuals living with diabetes, with an Area Under the Curve (AUC) of 0.86 and identification of key predictors such as age, β-blocker use, and presence of foot ulcers[15]. These findings demonstrate the ability of AI models to recognize complex patterns and clinical variables associated with the occurrence of complications.

The Selena+ AI algorithm for diabetic retinopathy screening using non-mydriatic cameras was validated and showed sensitivity and specificity of 96.8%, in addition to high agreement with specialists (kappa = 0.935)[16]. Predictive models were also applied to detect the risk of heart failure in patients with prediabetes and DM, and the Random Forest algorithm achieved an AUC of 0.978, outperforming traditional approaches[17]. In a study comparing the performance of three non-mydriatic ophthalmologic cameras associated with the EyeCheckup system, sensitivity values ranged from 90.48% to 98.52%, with specificity above 95%, highlighting the importance of image standardization to ensure the diagnostic accuracy of AI systems[18]. These findings suggest that image quality and appropriate algorithm selection may influence the diagnostic performance of intelligent systems.

In a comparative analysis of different machine learning algorithms applied to the Pima Indigenous women database, the Random Forest model showed the highest accuracy for DM prediction, suggesting diagnostic feasibility in specific populations[5]. In a study based on a large Chinese database, algorithms capable of identifying prediabetes and DM cases in individuals with normal glycemia were trained, and the CatBoost model demonstrated superior performance, with an Area Under the Receiver Operating Characteristic curve (auROC) of up to 0.806, reinforcing the role of AI in the early detection of the disease[19]. In an investigation focused on personalized care in DM2, AI was shown to identify behavioral patterns and promote better treatment adherence[20]. Complementarily, non-laboratory predictive algorithms for DM screening were developed and externally validated, demonstrating good sensitivity and specificity[21]. Collectively, these studies indicate that AI can expand diagnostic capacity and support more individualized preventive approaches.

The application of AI in ophthalmologic screening for diabetic retinopathy may increase patient adherence to specialized care[22]. The integration of these systems into electronic health records and clinical practice requires robust regulatory guidelines, professional training, and technological infrastructure. Despite challenges related to clinical data variability and patients' digital literacy, the studies included in this review[5,9-22] indicate a positive impact of AI on improving DM care, ranging from early screening to therapeutic personalization.

As limitations of this integrative review, the restricted time frame of the included studies and the methodological heterogeneity regarding sample size, algorithms employed, and performance metrics used should be highlighted, as these factors may hinder direct comparability among results.

Conclusion

Artificial intelligence can contribute to the treatment of DM through machine learning for complication prediction, chatbots for health education, and continuous glucose monitoring. The analyzed studies demonstrated the growing application of AI in the management of this condition, including early detection, treatment personalization, and clinical decision support.

Authors' Contributions

Concept and study design: Daniella Antunes Pereira Rocha, Aline Teixeira, Ana Clara Lacerda Freitas. Data analysis, interpretation, and manuscript writing: Daniella Antunes Pereira Rocha, Aline Teixeira, Ana Clara Lacerda Freitas. Resource management: Daniella Antunes Pereira Rocha, Aline Teixeira, Ana Clara Lacerda Freitas. Critical review of the manuscript for intellectual content and final presentation: Isis Gabriella Antunes Lopes Veloso, Árlen Almeida Duarte de Sousa, Andréa Maria Eleutério de Barros Lima Martin. The authors approved the final version of the manuscript and declared themselves responsible for all aspects of the work, including ensuring its accuracy and integrity.

Conflict of Interest

The authors declared no conflicts of interest.

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