

Review on Artificial Intelligence applied to Cardiovascular Disease Management in Latin America

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Abstract— Cardiovascular diseases (CVDs) are the leading cause of mortality worldwide, with Latin America facing unique challenges due to socioeconomic disparities, limited healthcare resources, and fragmented medical infrastructures. Artificial Intelligence (AI) has emerged as a transformative technology in CVD management, offering potential solutions for early diagnosis, risk stratification, and treatment optimization. However, the adoption of AI in Latin America remains underexplored. This narrative review synthesizes the current state of AI applications in cardiovascular healthcare across the region, analyzing trending research, challenges, and opportunities based on 22 selected studies. The findings highlight a growing interest in AI-driven predictive models, clinical decision support systems, and remote monitoring technologies. Machine learning (ML) techniques have demonstrated promising results in improving CVD diagnosis and prognosis. However, significant barriers such as data scarcity, interoperability challenges, and regulatory limitations hinder widespread clinical implementation. Several studies utilized local datasets, while others relied on international repositories, raising concerns about model generalizability to Latin American populations. Despite these limitations, AI presents an opportunity to bridge healthcare gaps by enabling more efficient and accessible CVD management. This review underscores the need for region-specific AI research, enhanced data-sharing frameworks, and collaborative efforts among healthcare institutions, policymakers, and technology developers. By addressing these challenges, AI has the potential to substantially advance cardiovascular healthcare in Latin America, improving patient outcomes and reducing the burden of CVDs in resource-limited settings.

Clinical Relevance— This review evaluates AI's role in cardiovascular disease management in Latin America, identifying key techniques, ML implementations, challenges and opportunities.

I. INTRODUCTION

Cardiovascular diseases (CVDs) remain the leading cause of mortality worldwide, disproportionately affecting low- and middle-income regions, including Latin America. On a global scale, cardiovascular diseases accounted for approximately one in three deaths, totaling around 20.5 million fatalities. This translates to roughly 56,000 deaths per day or one every 1.5 seconds, highlighting the critical need for urgent interventions to address this major public health concern. In Latin America,

this burden is exacerbated by socio-economic disparities, limited access to advanced healthcare technologies, and fragmented healthcare systems across the region. In 2021, an estimated 48 million individuals in Latin America were living with heart and circulatory diseases [1], underscoring the pressing need for innovative solutions tailored to these challenges [2].

In recent years, Artificial Intelligence (AI) has emerged as a transformative tool in healthcare, offering significant potential for improving CVD prevention, diagnosis, and management. By leveraging AI's capabilities, such as predictive analytics, image processing, and decision support systems, healthcare providers can address critical gaps in cardiovascular care. AI has demonstrated significant potential in various aspects of cardiovascular medicine, ranging from diagnostics to treatment optimization. One of the most promising applications is precision medicine, where AI facilitates personalized healthcare through remote monitoring, medication reminders, real-time disease counseling, and early symptom detection. AI-driven clinical prediction models leverage large datasets, including imaging and laboratory results, to estimate disease progression and patient outcomes with higher accuracy than traditional clinical judgment. For instance, deep learning models have been used to predict five-year survival rates in coronary artery disease patients with superior performance to conventional methods. Cardiac imaging analysis is another crucial area where AI enhances diagnostic accuracy by automating the assessment of echocardiography, coronary angiography, and MRI scans, improving the detection of structural abnormalities and functional impairments. Furthermore, robotic-assisted interventions combined with AI have advanced minimally invasive cardiovascular surgeries, improving precision and reducing procedural risks [3], [4]. AI is also revolutionizing risk assessment and disease stratification, assisting clinicians in classifying cardiovascular conditions and tailoring treatment strategies. As AI continues to evolve, its integration into cardiovascular healthcare holds the promise of improved patient outcomes, reduced clinical workload, and more equitable access to high-quality care, particularly in resource-limited settings such as Latin America.

Despite these global advancements, the integration and impact of AI within Latin America remain underexplored. The unique challenges faced by the region, including data scarcity, infrastructure limitations, and ethical considerations, raise questions about the feasibility and effectiveness of AI

applications in local contexts. At the same time, opportunities abound, such as utilizing regional datasets and addressing healthcare inequities through scalable AI solutions.

This narrative review aims to provide a comprehensive analysis of the state of AI in managing cardiovascular diseases in Latin America. Specifically, it addresses several critical research questions: What types of AI implementations exist, and what CVDs are being targeted? Are AI and Machine Learning (ML) technologies being adopted in clinical settings? What algorithms and datasets are predominantly used, and how do they perform? Finally, what advantages, challenges, and opportunities does the Latin American context present for AI adoption in cardiovascular healthcare?

By synthesizing existing literature and identifying key trends and gaps, this review seeks to inform future research, policy, and clinical practices, ultimately contributing to the equitable advancement of cardiovascular care in the region.

II. METHODS

This narrative review aims to synthesize the current state of Artificial Intelligence (AI) applications in cardiovascular disease (CVD) management within Latin America. Due to the limited number of indexed studies specifically addressing this topic and their heterogeneous nature regarding methodology, populations, and outcomes—a structured systematic review according to PRISMA guidelines was deemed impractical. Therefore, an alternative targeted search and selection strategy was employed to identify relevant publications from a broader range of sources.

A. Search Strategy

The search for relevant publications was conducted using multiple sources, including academic databases (PubMed, IEEE Xplore, Scopus etc.), general web search, institutional repositories and regional journals from Latin America. Initial keyword-based searches in standardized databases (for example: (({artificial intelligence} [Title/Abstract]) {AND} ({cardiovascular} [Title/Abstract])) {AND} ({South America} [Title/Abstract]) yielded limited results. Possible reasons for this include language barriers (as many Latin American studies are published in Spanish or Portuguese), lack of indexing in major databases, and different terminology used in the region. To mitigate this limitation, a broader search was performed using flexible keyword variations, direct website searches, and manual screening of reference lists in identified papers.

B. Inclusion and exclusion criteria

To ensure relevance and alignment with the research objectives, the following selection criteria were applied:

Inclusion Criteria: Studies published in peer-reviewed journals, conference proceedings, or institutional repositories, that discuss AI applications in cardiovascular diseases and focus on Latin American populations, and provide information on AI algorithms, datasets, clinical adoption, or performance metrics.

Exclusion Criteria: Studies that do not focus on both AI and cardiovascular diseases, those unrelated to Latin American context, and those lacking accessible full-text versions.

C. Synthesis Approach

The collected studies were analyzed thematically to explore emerging trends, challenges, and opportunities in AI adoption for cardiovascular disease management in Latin America. Findings were categorized based on AI methodologies, clinical implementation, dataset characteristics, and regional constraints. Given the limited number of studies available on this topic, the synthesis does not aim to provide exhaustive or statistically representative conclusions. Rather, it seeks to offer an informed overview of the current landscape and to identify key trends and unmet research needs that may inform future investigations and guide regional priorities. These findings are further examined in the discussion, which highlights methodological challenges, knowledge gaps, and directions for future research.

III. THEMATIC ANALYSIS

A. Overview of selected studies

Based on the bibliographic search applying the inclusion and exclusion criteria, 22 studies were shortlisted. The domains of the reviewed studies span multiple Latin American countries, highlighting AI's growing role in cardiovascular disease (CVD) research and management in the region. The distribution of research efforts reflects an increasing interest in leveraging AI for improving cardiovascular healthcare outcomes in the region. Argentina, Brazil, Mexico, and Colombia appear prominently in AI-driven CVD research, with several studies originating from these countries. A considerable portion of the selected works employs retrospective analyses leveraging patient data, while others focus on developing predictive models or implementing AI-driven clinical decision support systems.

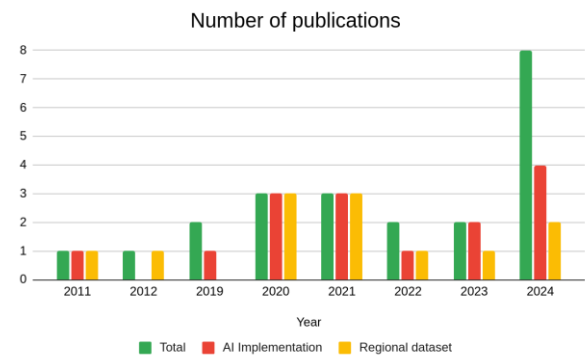


Figure 1. Number of studies related to AI in cardiovascular diseases in Latin American context

The regional research trends suggest a growing inclination (Figure 1) towards predictive analytics, AI-based diagnostics, and remote monitoring technologies in the domain of CVD. Some studies focus on risk prediction models, evaluating various AI techniques such as neural networks, decision trees,

and random forests for CVD diagnosis and prognosis [5], [6]. Others explore AI-driven clinical decision support systems (CDSS) for enhancing diagnostic accuracy and treatment recommendations [7], [8], [9]. The studies also highlight the use of wearable and mobile health technologies, demonstrating AI's potential in continuous cardiovascular monitoring and early warning systems [10].

B. AI applications in cardiovascular disease

The implementation of AI in CVD management through applied technologies are also gaining traction across Latin America, with various initiatives leveraging advanced algorithms for early diagnosis and remote monitoring. One such development is the *Telemonitoramento Remoto Assistido de Arritmia* (TRAdA) platform [11], a collaboration between Lenovo and the Instituto do Coração (InCor) in Brazil that integrates artificial intelligence with wearable IoT technology to enable continuous cardiac monitoring and early detection of arrhythmias. Cardiac arrhythmias affect over 20 million individuals in Brazil, contributing to approximately 320,000 sudden deaths annually. The TRAdA system employs AI-driven analysis of electrocardiographic signals, generating alerts for healthcare professionals in real time.

AI methodologies applied to CVD in Latin America vary widely. Studies such as [7], [12] employed supervised learning techniques for risk prediction, while others leveraged unsupervised models for clustering patient profiles [13] or integrate hybrid models, combining ML with traditional statistical approaches to enhance predictive accuracy and interpretability.

The reviewed studies (Table I) primarily focus on early diagnosis, risk stratification, imaging analysis and treatment planning. Among the wide spectrum of cardiovascular risks, areas defined in the studies include acute myocardial infarction, atrial fibrillation, acute coronary syndrome, cardiac operative risk, preoperative risk-of-death prediction in congenital heart defects, CVD in women, ischemic heart disease, postoperative care, acute coronary syndrome, and heart failure. Several studies employ ML models to detect atrial fibrillation and heart failure from electrocardiograms (ECGs) [12], [14]. Others utilize AI to analyze echocardiography and computed tomography (CT) scans, assisting in identifying structural heart diseases. For instance, [15] demonstrated that convolutional neural networks (CNNs) could quantify cardiac biventricular function, improving diagnostic efficiency. Additionally, predictive analytics has been used for identifying high-risk patients, particularly in heart failure management.

TABLE I. SUMMARY OF THE STUDIES BASED ON AI IN CARDIOVASCULAR DISEASES IN LATIN AMERICAN CONTEXT

Ref	Country	CVD	AI	Performance
[5]	BR	All CVD	No	-
[6]	CO	CVD Risk	ANN, RF, DT	DT (81%), RF (85%) y MLP (89%) F1-score
[7] [†]	CO	Acute myocardial infarction	LR, RF	PPV, TPR, TNR and ACC of LR (92.8%, 83.7%, 94.5%, 89.6%), RF (92.8%, 76.5%, 95.6%, 87.5%)

[9] ^{†*}	AR	Heart failure	MLP, ANN (FBR)	AUC, NPV, PPV for MLP for 30-day (0.82, 93.2%, 66.7%), 6-month (0.87, 89.1%, 78.6%) and 1-year (0.85, 85.6%, 78.9%) mortality.
[10] ^{†*}	AR	Heart failure	No	Paired mean difference was 2 ± 6 mmHg for SBP, -0.14 ± 4.6 mmHg for DBP, and 0.23 ± 4 bpm for HR.
[11] [*]	BR	Arrhythmias	Yes	-
[12] [*]	BR	CVD Risk	No	-
[13] [†]	BR	Atrial fibrillation	K-means, kNN, SA	AF risk in all individuals ACC: 0.95, AUC: 0.80, TPR: 0.99, TNR: 0.63.
[14] [†]	BR	Acute coronary syndrome	No	93.8% TPR and 83.3% TNR
[15] [†]	AR	NA, biventricular function	CNN	Pearson's coefficient 0.98, 0.92, 0.96 and 0.8 for volumes and biventricular EF
[16] [†]	BR	Preop. risk in congenital heart defects	MLP, RF, ET, SGB, ABC, BDT	Top performing was RF (AUC: 0.902)
[17] [†]	CO	Cardiac Operative Risk	NB, GBM, LR, MLP, RF, SVM	GBM (ROC: 0.755; PR: 0.292) higher than EuroSCORE-II (ROC: 0.716, PR: 0.179)
[18] [†]	BR	Acute coronary syndrome	LR, GBM	GBM was superior to LR (AUC: 0.891)
[19]	MX	All CVD in women	RF, LR, SVM	ACC of 86% (SVM) and 100%, 70%, 86%, 100% (LR) for each dataset.
[20] [†]	CU	CVD Risk	DT, MLP	Best performance with MLP (recall: 95.2%, AUC: 0.987).
[21]	CO	Valvular heart disease	CNN, kNN, SVM, MLP, RF	Euclidian distance to ideal classifier in best complex (0.26127) and real (0.36022) model.
[22] ^{†*}	BR	Ischemic heart disease	kNN, BN, PLS, PCA, RF, XGBoost, Bagged Cart, SVM	Best predictor was SVM with RMSE: 0.789
[23] [†]	BR	Postop. care	BN	ROC curve

[†] Latin American Dataset
*Hospital implementation

The implementation of AI in actual clinical settings within Latin America is still limited. Some studies, such as [22], [18], [20], [23] tested AI models using hospital datasets from Latin America, demonstrating their feasibility in real-world clinical scenarios in regional context. Others relied on publicly available datasets or international repositories for model training and validation [6], [19], [21]. Although several studies showed improvements in patient stratification both in retrospective and prospective studies, widespread adoption of AI in routine clinical practice remains a challenge.

C. Datasets, algorithms, and performance

Among the reviewed studies, machine learning models such as random forests, support vector machines, and gradient boosting are frequently used for structured data analysis. Deep learning techniques, including CNNs for medical imaging and recurrent neural networks (RNNs) for sequential data, have also been explored [9], [18].

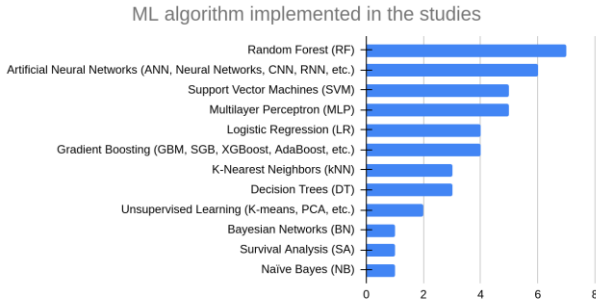


Figure 2. Number of studies implementing each ML algorithm.

Performance evaluation varies across studies, with common metrics including accuracy, area under the curve (AUC), sensitivity (TPR), and specificity (TNR). The most observed metric across the studies has been AUC, followed by accuracy (ACC), specificity and sensitivity. Some studies also use other metrics like F1 score, Kappa score, and RMSE, depending on the type of ML problem. In [17], gradient boosting classifier achieved an AUC of 0.76 for predicting mortality related to cardiac operative risk using electronic health record data. Several studies reported considerably acceptable performance metrics in terms of accuracy, AUC-ROC, specificity and sensitivity. For example, [16] evaluated machine learning models on an unbalanced dataset from InCor, using AUC and Average Precision (AP) as performance metrics. Bagged Decision Trees (BGT), Random Forest (RF), and Stochastic Gradient Boosting (SGB) achieved the highest AUC-ROC scores (92.6%, 90.2%, and 88.5%, respectively) and AP scores (0.81, 0.73, and 0.70, respectively). Sensitivity (Recall) was particularly high for RF (92.2%), making it the best for identifying mortality risk. BGT excelled in predicting survival, achieving 90.8% specificity while maintaining a sensitivity of 70.6%. Both BGT and RF were highlighted as the most suitable models for pre-surgical mortality risk prediction. However, despite promising model performance in different studies, performance variations arise due to differences in dataset size, feature selection, and preprocessing methodologies.

Dataset availability remains a significant challenge in Latin America. Many studies rely on small patient cohorts like 30 patients [10], whereas studies such as [18] used data from 600 patients. Implemented systems like TRAdA in Brazil reported clinical validation at InCor involving 253 patients, demonstrating the system's efficacy in detecting arrhythmias in both hospital and home settings. In post-surgical patients, AI-assisted monitoring facilitated timely interventions, including the identification of atrial fibrillation and associated

complications such as pulmonary thromboembolism [11]. In contrast, several studies have reported working on bigger patient cohorts as well. For example, [13] leveraged a dataset of over 20,000 patients collected over 9 years, and [16] used over 2000 patient-data for preoperative risk-of-death prediction in surgery congenital heart defects. The use of international datasets such as the Framingham Heart Study or Cleveland Heart Disease dataset is also observed in some studies [6], [19], though their applicability to Latin American populations is debatable due to demographic and genetic differences.

D. Regional challenges and opportunities

Several key barriers hinder improved CVD outcomes in Latin America. These include a lack of public awareness and insufficient communication from healthcare providers regarding the severity of untreated CVD and atherosclerotic cardiovascular disease (ASCVD), as well as their associated risk factors such as diabetes, hypertension, obesity, and smoking. Additionally, limited emphasis on managing high-risk LDL levels and other contributing factors further exacerbates the issue. Financial constraints and the inconvenience of preventive health check-ups also contribute to delayed diagnoses and treatment. Furthermore, disparities in access to effective care following a CVD diagnosis remain a significant challenge. Another critical gap is the limited research on CVD in women, particularly regarding its impact on pregnancy and the heightened risk for both mothers and infants. This concern extends across different age groups, with awareness gaps leading to inadequate prevention and treatment, as observed in countries like Chile [1].

Beyond awareness and accessibility challenges, data-related issues significantly impact the advancement of AI-driven solutions for CVD in Latin America. One of the primary concerns is the lack of health data interoperability. While some countries, such as Uruguay, have made strides in integrating health records at a national level through their nationwide platforms, many others struggle with fragmented systems that hinder efficient data exchange. Achieving interoperability across healthcare institutions is essential for improving patient outcomes, facilitating large-scale AI applications, and supporting local research tailored to the region's specific population needs.

A clear example of these challenges is seen in Brazil, where the lack of integration between hospitals, healthcare providers, and public health institutions limits coordinated care and data-driven decision-making. The public health system also faces significant disparities in service accessibility, particularly for low-income and remote populations. To address these gaps, initiatives such as Open Health have emerged, promoting digital transformation in healthcare. The goal is to create interoperable systems where patient data can be securely shared between institutions, leveraging technologies like AI and blockchain for improved healthcare management and research. However, achieving this vision requires strong governance, regulatory frameworks, and collaboration between stakeholders to ensure data privacy, security, and ethical AI deployment.

The primary challenges in AI adoption for CVD management in Latin America include:

Data Scarcity: Limited access to large-scale, high-quality datasets hinders model training and generalization. Several studies noted this limitation of smaller cohort data, even compared to other predictive ML models like EuroSCORE-II [17]. In [18], although this limitation was mitigated through statistical procedures such as cross-validation and extensive sensitivity analyses as a part of standardized techniques of ML pipeline, the variations and significant differences between cohort participants in terms of socioeconomic status and prior clinical characteristics were considered advantageous for enhancing the model's external validity despite being trained on a smaller cohort.

Infrastructure Limitations: Many hospitals lack the computational resources or data frameworks needed to deploy AI-driven solutions in real-time clinical settings [20]. Especially with the evident need of high quality and diverse data for preparation of robust ML models, infrastructure is one of the reasons that limits the implementation in day-to-day clinical pipeline.

Regulatory and Ethical Concerns: The absence of standardized AI governance frameworks raises concerns regarding data privacy, algorithmic bias, and clinical accountability. However, with the advancement of telemedicine in Latin America, several countries have implemented regulatory frameworks for the same. These frameworks, despite not being specifically for AI-adoption, marks the first steps in that direction. For example, Chile enacted Law 21541 in 2013, mandating healthcare providers to offer telemedicine services while ensuring patient privacy and data protection. Future applications, such as remote monitoring and medication management, could improve AI-based CVD care, but challenges persist, including inadequate digital infrastructure and the need for comprehensive regulations. Additionally, technological advancements in medical devices and hospital infrastructure are necessary, particularly to enhance interoperability. Despite efforts, progress in integrating healthcare systems has been slow, though legislation introduced in May 2024 seeks to improve clinical record interoperability and streamline healthcare services [1].

Despite these challenges, opportunities for AI in Latin American CVD management are emerging. The 2024 Latin American Artificial Intelligence Index (ILIA) assessed AI readiness across 19 countries in the region. Chile (73.07), Brazil (69.30), and Uruguay (64.98) ranked highest, indicating strong institutional and technological foundations for AI adoption. Other countries, including Argentina (55.77), Colombia (52.64), and Mexico (51.40), were categorized as “adopters,” reflecting moderate progress in AI integration [24]. These findings highlight disparities in AI development across Latin America, presenting opportunities to strengthen regional collaboration and expand AI-driven applications in healthcare, particularly for cardiovascular disease management.

There has been an increment in aspiring AI-adoption in healthcare in Latin America. The first steps include facilitating the background like interoperable data or telemedicine regulations and incorporation in the healthcare systems. [25] reports the national strategies of several countries of the region like Argentina, Brazil, Chile, Colombia, Costa Rica, Peru,

Mexico and Uruguay, along with the Montevideo Declaration of March 2023, where several stakeholders adhered to taking advantage of and channel the potential of AI from a regional perspective. Several countries of the region have also implemented national-level EHR networks for better interoperability, but the incorporation of specific AI-led predictive modeling for CVD in clinical settings within this network is not a reality yet.

Several studies highlight the potential of AI-driven telemedicine solutions, particularly for remote and underserved populations. Furthermore, initiatives fostering local AI talent and research collaborations between hospitals and universities indicate a positive trend toward sustainable AI development. The growing availability of regional datasets also presents an opportunity for more contextually relevant AI applications.

IV. CONCLUSION

The integration of artificial intelligence (AI) into cardiovascular disease (CVD) research and clinical practice in Latin America presents a promising yet underexplored avenue. This narrative review highlights the current landscape, identifying key trends, challenges, and opportunities in leveraging AI for improved CVD diagnosis, risk stratification, and treatment. While AI applications have shown significant potential in automating diagnostics, enhancing decision support systems, and predicting patient outcomes, their adoption in clinical settings remains limited due to infrastructural, regulatory, and data accessibility challenges.

Our analysis indicates that the majority of AI research in Latin America on CVDs remains in the experimental or proof-of-concept stage, with few implementations in real-world hospital settings. Machine learning algorithms such as support vector machines, neural networks, and deep learning models are frequently explored, yet their clinical validation and large-scale deployment are insufficient. Furthermore, the scarcity of high-quality, Latin America-specific datasets limits the generalizability of AI models, underscoring the need for improved data-sharing initiatives and standardized data collection protocols.

A significant barrier to AI adoption in Latin America is the lack of integration between research institutions, healthcare providers, and policymakers. Regulatory frameworks for AI-driven medical technologies are still evolving, leading to concerns about data privacy, algorithmic bias, and ethical considerations in AI deployment. Addressing these issues requires multi-stakeholder collaboration to establish clear guidelines for AI implementation, validation, and monitoring in CVD management.

Despite these challenges, the region presents unique opportunities for AI-driven healthcare advancements. Expanding telemedicine capabilities, increasing investments in digital health infrastructure, and fostering international research collaborations could accelerate AI adoption. Additionally, the adaptation of AI models to the diverse genetic and socio-economic characteristics of Latin American populations is crucial for ensuring equity in healthcare outcomes.

In conclusion, while AI holds immense potential to transform CVD care in Latin America, its full integration into clinical workflows demands concerted efforts in research, policymaking, and technology development. Future research should prioritize the validation of AI models in real-world settings, the creation of robust datasets, and the development of ethical AI frameworks tailored to regional healthcare systems. By addressing these gaps, AI can become a transformative tool in combating the burden of CVDs across Latin America, ultimately improving patient outcomes and healthcare efficiency.

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