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ORIGINAL

Evolution of the use of artificial intelligence in medicine: empirical bibliometric study

Evolución del uso de la inteligencia artificial en medicina: estudio bibliométrico empírico

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ABSTRACT

This study analyzes the evolution of scientific production on artificial intelligence applied to medicine between 2015 and 2025 using a bibliometric approach. A total of 7040 publications indexed in Scopus were reviewed, including articles, reviews, and conference proceedings. The results show sustained growth in research, with a notable increase from 2020 onwards and a peak in 2025. Production is concentrated in countries with established research systems, led by the United States, India, the United Kingdom, and China, while Latin America contributes 3,66 % of the total, with Brazil as the main regional contributor. Co-occurrence analysis identified six thematic clusters representing the main areas of development: clinical integration of AI, decision support, outcome prediction, personalized medicine, and advanced applications in specialties such as cardiology. The conclusion is that AI is transforming medical practice, although challenges remain in ethical regulation, data representativeness, and professional adoption.

Keywords: Artificial Intelligence; Bibliometric Analysis; Medicine.

RESUMEN

El presente estudio analiza la evolución de la producción científica sobre inteligencia artificial aplicada a la medicina entre 2015 y 2025 mediante un enfoque bibliométrico. Se revisaron 7040 publicaciones indexadas en Scopus, considerando artículos, revisiones y actas de conferencia. Los resultados muestran un crecimiento sostenido de la investigación, con un incremento notable a partir de 2020 y un pico en 2025. La producción se concentra en países con sistemas de investigación consolidados, liderados por Estados Unidos, India, Reino Unido y China, mientras que Latinoamérica aporta el 3,66 % del total, con Brasil como principal contribuyente regional. El análisis de coocurrencia permitió identificar seis clústeres temáticos que representan los principales núcleos de desarrollo: la integración clínica de la IA, el apoyo a decisiones, la predicción de resultados, la medicina personalizada y las aplicaciones avanzadas en especialidades como cardiología. Se concluye que la IA está transformando la práctica médica, aunque persisten desafíos en regulación ética, representatividad de datos y adopción profesional.

Palabras clave: Inteligencia Artificial; Análisis Bibliométrico; Medicina.

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INTRODUCTION

Artificial intelligence (AI) has experienced rapid growth over the past two decades, positioning itself as one of the technological pillars of digital transformation in various sectors, including the healthcare field.[1,2] Its integration into medicine has been driven by the convergence of multiple factors: the expansion of computational capacity, the digitization of healthcare systems, the availability of large volumes of clinical data, and the maturity of advanced algorithms capable of learning and improving their performance on the basis of experience. This scenario has given rise to a new paradigm in medical practice, focused on diagnostic precision, personalized treatments, and the optimization of patient care processes.[3,4]

Conceptually, AI in medicine involves the development and application of computational systems capable of performing tasks traditionally associated with human cognition, such as pattern recognition, image interpretation, prediction of clinical behaviors, and decision-making in complex situations. Techniques such as machine learning, deep learning, and artificial neural networks have demonstrated remarkable performance in diagnostic areas such as radiology, dermatology, digital pathology, and cardiology, contributing, for example, to the early detection of neoplasms, the evaluation of skin lesions, or the automated interpretation of electrocardiograms.[5] Moreover, AI has been integrated into healthcare management through clinical decision support systems, hospital resource management models, and telemedicine monitoring platforms designed for the continuous follow-up of patients with chronic diseases.[6,7]

However, the growing interest in this topic cannot be explained solely by its clinical and administrative potential.[8] AI in medicine is also emerging as a strategic field of multidisciplinary scientific research, where medical informatics, bioengineering, statistics, epidemiology, ethics, and health policy converge.[9,10]

This convergence has generated a significant increase in academic output, evident in the exponential rise in articles, conferences, projects, and international collaborations.[11] However, this expansion has not been uniform: the geographical distribution of knowledge, the predominant theoretical approaches, the areas of greatest development, and the scientific collaboration networks exhibit distinct patterns that require examination to be understood.

In this context, bibliometric analysis emerges as an ideal methodological tool for characterizing the scientific development of artificial intelligence applied to medicine. Bibliometrics allows for quantifying and describing trends in research output, identifying authors and countries with the greatest contributions, visualizing coauthorship networks, detecting high-impact journals, and recognizing emerging thematic niches.[12] Furthermore, it enables the evaluation of research dynamics over time, revealing periods of growth, stabilization, and diversification of scientific lines. These perspectives are fundamental for understanding how knowledge is collectively constructed, what conceptual nuclei define the research agenda, and how academic systems are articulated on a global scale.

METHOD

A bibliometric, descriptive, and cross-sectional study was conducted to analyze trends in scientific output on artificial intelligence applied to medicine during the 2015–2025 period, using the methodology proposed by Castillo-González et al..[13] The Scopus database was consulted. The search used the search term "Artificial Intelligence AND Medical Care"; a filter was applied to document types (article, review, and conference paper), yielding a total of 7040 academic articles. All the documents were included regardless of language. All the articles were exported, and a dataset was created for analysis using Microsoft Excel (latest version available in September 2021; Microsoft Corporation, Redmond, WA, USA). The co-occurrence network was generated using the VOSviewer tool, version 1.6.19.

RESULTS AND DISCUSSION

AI has ceased to be an abstract promise and has become a technological and epistemological tool that is reshaping contemporary medicine. The convergence of machine learning algorithms, deep neural networks, large-scale foundational models, computer vision, and natural language processing—along with the growing availability of clinical data and biomedical images—is transforming the cycles of prevention, diagnosis, prognosis, treatment, and follow-up. This process occurs within an ecosystem where healthcare institutions, universities, technology companies, public–private laboratories, regulators, and patients converge, making AI in medicine an intrinsically interdisciplinary and socially dense field.[14]

The bibliometric analysis included a total of 7040 articles published over the past ten years. The global output showed a trend of sustained growth, peaking in 2025, the year in which 2136 articles were recorded, representing the highest level of the analyzed period. This trend reveals a progressive expansion of the field, possibly associated with increased editorial visibility and the consolidation of scientific collaboration networks.[15,16]

In the case of Latin America, 258 articles were identified as published during the same period, which is equivalent to 3,66 % of the global volume. Like the global trend, the region also reached its peak in 2025, with 88 articles, indicating a recent acceleration in regional participation within the field.

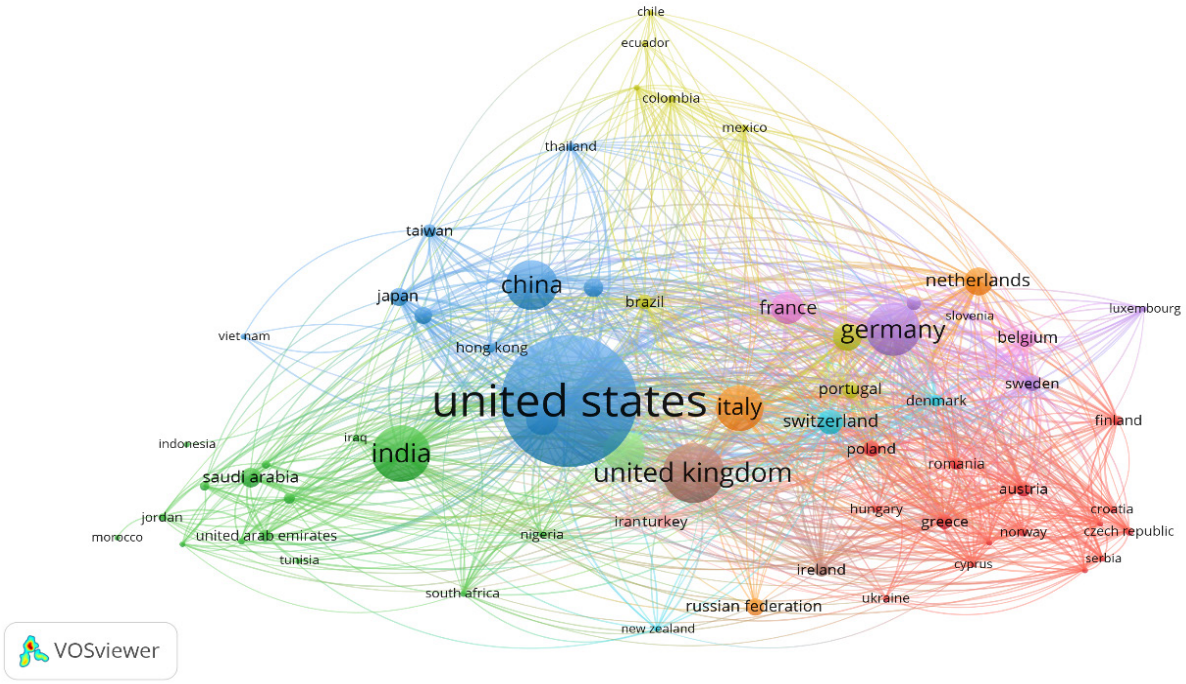
With respect to geographic distribution, an analysis of the countries with the highest scientific output reveals a high concentration of institutions in high-income countries. The United States leads by a wide margin in global output, followed by India, the United Kingdom, Italy, Canada, France, Australia, Spain, Germany, and China.

This core group is characterized by robust science and technology systems, greater funding availability, and well-established doctoral training and research structures (figure 1).

Table 1. Number of articles published globally and comparisons with Latin America

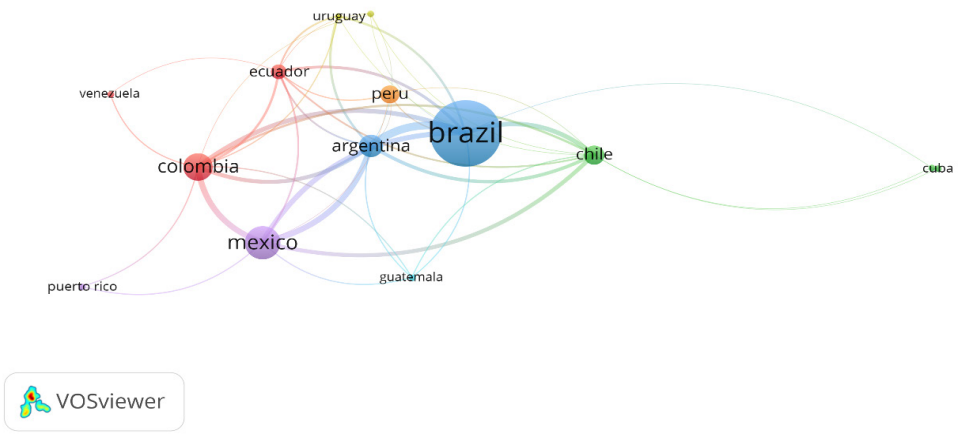
Year	Number of articles	
	Global	Latin America
2016	45	3
2017	76	2
2018	125	5
2019	282	9
2020	440	16
2021	595	19
2022	630	16
2023	1014	32
2024	1697	68
2025	2136	88
Total	7040	258

Source: Scopus (2015–2025)



Source: Scopus (2015–2025)

Figure 1. International collaboration in scientific output on artificial intelligence and healthcare



Source: Scopus (2015–2025)

Figure 2. Latin America contributes to scientific output on artificial intelligence and healthcare

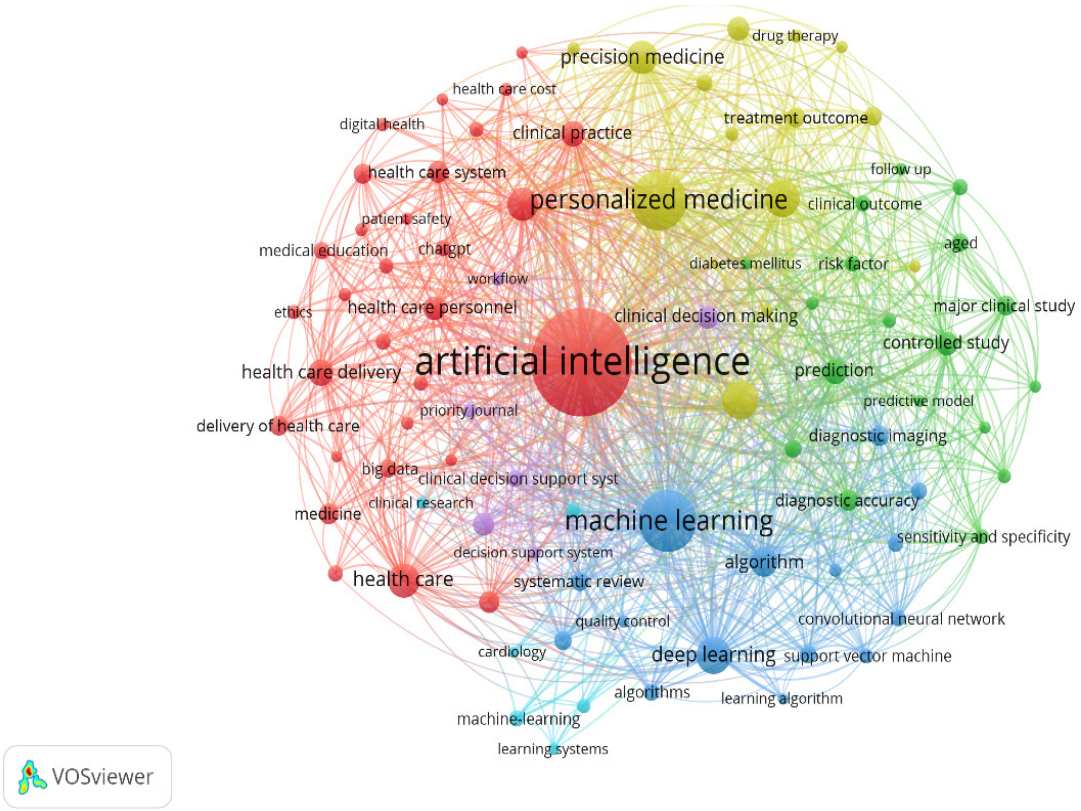
In Latin America, Brazil leads the way, with the highest number of articles in the region, followed by Mexico, Colombia, Chile, and Argentina.[17] These five countries account for the majority of Latin American output, while nations such as Ecuador, Peru, Cuba, Uruguay, and Bolivia make smaller but consistent contributions (figure 2).

Table 2. Geographic distribution. Top 10 countries worldwide and in Latin America

Global Top 10		**Top 10 in Latin America**	
Countries	**Number of articles**	**Countries**	**Number of articles**
USA	2324	Brazil	123
India	816	Mexico	43
Great Britain	747	Colombia	40
China	744	Chile	26
Germany	624	Argentina	23
Italy	556	Ecuador	16
Canada	435	Peru	12
France	315	Cuba	8
Australia	286	Uruguay	6
Spain	263	Bolivia	4

Source: Scopus (2015–2025).

The publication output was concentrated in a core group of journals that together accounted for 626 articles (8,89 % of the ten-year total). The top ten were the Journal of Medical internet Research (124 articles), the Journal of Biomedical Informatics (94 articles), Scientific Reports (74 articles), PLOS ONE (64 articles), IEEE Access (57 articles), Frontiers in Public Health (54 articles), Sensors (52 articles), BMC Medical Informatics and Decision Making (50 articles), Frontiers in Medicine (42 articles), and Computers in Biology and Medicine (39 articles). This configuration represents a mix of generalist megajournals (e.g., Scientific Reports, PLOS ONE), biomedical informatics/digital health titles (JMIR, JBI, BMC Medical Informatics), and high-volume, open-access platforms (IEEE Access, Frontiers), consistent with the expansion of cross-cutting fields (e-health, data science, applied AI). This concentration is justified since some of these journals are megajournals where academic output tends to be concentrated.[18]



Scopus: (2015–2025)

Figure 3. Keyword network of scientific output on artificial intelligence and healthcare

The co-occurrence analysis identified six thematic clusters that synthesized the conceptual and methodological core of the field. These clusters not only group the most frequent keywords but also reflect how scientific discourse is organized, which problems are prioritized, and which methodological approaches predominate (figure 3).

Cluster 1, artificial intelligence applied to healthcare and health services, includes groups of terms that articulate the integration of artificial intelligence into healthcare systems, highlighting topics such as telemedicine, quality of care, medical education, and clinical practice, especially during and after the COVID-19 pandemic. The presence of concepts such as data privacy and ethics indicates a concern for ethical and regulatory implications, whereas terms such as the large language model and ChatGPT signal the recent entry of generative models into the field. This cluster represents the direct use of AI in clinical and organizational interactions, as well as in the transformation of care models.

Cluster 2, clinical evaluation, prediction, and outcome studies, involves research focused on evaluating health outcomes, identifying risk factors, and measuring diagnostic or prognostic performance. It relates to the use of AI as a predictive tool, applied to clinical cohorts, with approaches such as retrospective studies and follow-up analyses. It reflects the evaluative dimension, where artificial intelligence does not replace clinical decisions but supports prediction and risk stratification.

Cluster 3, AI computational technologies and models for automated analysis, groups the computational methods used to process data. The co-occurrence of terms such as convolutional neural network, diagnostic imaging, and image analysis indicates a strong presence of AI applied to medical image analysis, whereas natural language processing is linked to the extraction of information from clinical records or literature. This cluster highlights the technical/algorithmic layer underpinning the advances observed in the previous clusters.

Cluster 4, personalized medicine, therapies, and molecular biology, focuses on the intersection between AI and precision medicine, particularly in oncology. The combination of genomics, drug therapy, and treatment outcome indicates the use of predictive models for therapeutic selection, prognosis, and the design of personalized interventions. It represents the biomedical deepening of AI toward the molecular level and personalized decision-making.

Cluster 5, clinical decision support systems and electronic health records, reflects the development of digital infrastructure within healthcare settings, where decision support systems are integrated into electronic health records to guide recommendations and automate workflows. It represents the organizational dimension of AI: how it is implemented, integrated, and modified in everyday clinical practice. In cluster 6, AI is applied to cardiovascular diseases and specific clinical subfields, indicating that there are clinical areas where the use of AI is more established, with cardiology being among the pioneers. The terms indicate applications in the prediction, diagnosis, and monitoring of cardiovascular diseases, where large volumes of data and well-established markers exist, facilitating the training of robust models.

Table 3. Interpretive synthesis of keyword co-occurrence clusters

Cluster	Main Thematic Axis	Concepts included	Reason for grouping/co-occurrence logic	Interpretation of the role in the field
Cluster 1 AI in healthcare services and clinical practice	Digital transformation of healthcare	AI, big data, telemedicine, digital health, clinical practice, medical education, quality of care, COVID-19, ethics, and privacy	Groups together works that use AI to improve care processes, medical education, healthcare management, and remote care modalities during and after the pandemic.	Represents the practical implementation of AI in healthcare and its ethical, organizational, and professional adoption challenges.
Cluster 2 Clinical Outcome Assessment and Prediction	Risk prediction and diagnostic performance	Prognosis, risk factors, sensitivity/specificity, retrospective studies, prediction, outcome assessment	Studies link AI to risk stratification, clinical follow-up, and model validation in real-world populations.	It demonstrates the evaluative dimension of AI and its use as a support for evidence-based clinical decision-making.
Cluster 3 Computational AI methods and models	Algorithms and machine learning	Neural networks, CNN, deep learning, NLP, image analysis, SVM, systematic review	Brings together the technical and methodological developments that enable the processing of large volumes of clinical, textual, and imaging data.	It constitutes the technological foundation enabling the advances observed in diagnostics, prediction, and automation.
Cluster 4 Precision Medicine and Molecular Biology	Therapeutic personalization and genomics	Genetics, pathology, biomarkers, oncology, therapy, and treatment outcomes	AI is used to interpret molecular data and select treatments tailored to individual biological profiles.	It represents the biomedical advancement of AI in personalized medicine, especially in cancer.
Cluster 5 Clinical Decision Support Systems	Integration of AI into clinical systems	Clinical decision support, electronic health records, workflow, recommendation systems	This cluster brings together research that integrates AI into hospital infrastructure, digitization, and clinical practice guidelines.	It highlights the institutional dimension of AI: how it reorganizes workflows and professional practice.
Cluster 6 AI Applied to Clinical Specialties	Disease-focused applications	Cardiology, cardiovascular diseases, clinical research, machine learning	It is centered on one of the specialties where AI is most advanced due to the availability of data and protocols.	It exemplifies the applied maturation of AI in specific clinical areas with robust evidence.

Source: Scopus (2015–2025). This is derived from the interpretation of clusters identified by the VOSviewer software when the keyword network is constructed.

CONCLUSIONS

Bibliometric analysis revealed that artificial intelligence in medicine experienced sustained growth during the period from 2015–2025, establishing itself as an expanding interdisciplinary field. Scientific output is concentrated mainly in countries with robust research systems, while Latin America, although with a smaller share, has shown an upward trend, especially in recent years. The six identified thematic clusters reflect the field's progressive maturity, from the digital transformation of healthcare services and algorithm-supported clinical assessment to the development of advanced computational models, personalized medicine, and established applications in cardiology and other specialties. However, key challenges remain regarding data quality and representativeness, ethical regulation, the reduction of algorithmic biases, and the professional training necessary for the safe integration of these tools. AI is reshaping contemporary medical practice, but its full and equitable adoption will depend on strengthening scientific cooperation, technological infrastructure, and ethical governance to ensure that its benefits are accessible and socially responsible.

FINANCING

None.

CONFLICT OF INTEREST

None.

AUTHORSHIP CONTRIBUTION

Conceptualization: Cristiane de Carvalho Gico, William Castillo-González.
Data curation: Cristiane de Carvalho Gico, William Castillo-González.
Formal analysis: Cristiane de Carvalho Gico, William Castillo-González.
Drafting - original draft: Cristiane de Carvalho Gico, William Castillo-González.
Writing - proofreading and editing: Cristiane de Carvalho Gico, William Castillo-González.

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