

Review Article

Gaps in the Digital Transformation of Public Health in Latin America

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Abstract: This bibliometric study systematically analyzes the evolution of research on digital transformation in public health in Latin America, identifying neglected areas and emerging trends. Based on an analysis of 576 documents retrieved from Scopus, the study examines the geographic distribution of scientific output, the main methodological approaches, and the predominant themes. The results reveal a steady growth in global scientific production, with Europe and Asia leading the field, while Latin America shows limited and uneven participation. Brazil stands out as the country with the highest number of publications, followed distantly by Argentina, Peru, and Mexico. Thematic analysis indicates that concepts such as “digital health” and “digital transformation” are central, whereas areas like “health information interoperability” and “digital health literacy” remain underexplored. The identified gaps highlight the need to strengthen scientific production in the region through collaboration policies, investment in digital infrastructure, and regulatory frameworks that promote equity in the adoption of health technologies. The study concludes that, despite the progress of research on digital transformation in public health, structural challenges persist and must be addressed to achieve effective integration of digitalization into Latin America’s health systems.

Keywords: digital transformation; public health; health disparities; Latin America; digital health; bibliometric

1. Introduction

Digital transformation in the public health sector in Latin America represents a crucial strategy for addressing the deep-rooted inequalities in access, quality, and efficiency of health services. In a region characterized by significant socioeconomic disparities and longstanding structural challenges, the implementation of digital technologies has shown substantial potential, although it remains limited by various barriers.

According to García Alonso et al. (2022), artificial intelligence (AI) is emerging as a key tool for improving accessibility and personalizing treatments in low-income settings. Similarly, De Fátima Marin et al. (2022) highlight that in Brazil—a country with great cultural and economic diversity—national strategies have attempted to include all stakeholders in the health system through tools like the National Health Data Network (RNDS), although challenges related to governance and interoperability persist. However, as emphasized by Capasso et al. (2024), many of these initiatives still lack a sustainable approach that ensures applicability in rural areas and marginalized communities.

The concept of “digital transformation” in public health refers to the integration of digital technologies to optimize processes and improve equity in healthcare delivery

(Tortorella et al., 2023). In Latin America, these technologies range from telemedicine and smart health systems to digital platforms for managing clinical data (Farias et al., 2023). García Alonso et al. (2022) point out that in many countries in the region, AI has begun to be implemented as a tool to address health disparities, although limitations in infrastructure and regulatory frameworks hinder its adoption. These barriers are particularly significant in rural areas, where lack of connectivity and low digital literacy exacerbate inequalities (De La Cruz-Ramirez et al., 2022).

The World Health Organization (WHO) has urged Latin American countries to democratize digital health services to reduce disparities in access to care (Godoy et al., 2020). However, progress across the region has been uneven. For example, Capasso et al. (2024) note that while 96% of healthcare institutions in Peru reported using ICT in maternal care, in other countries like the Dominican Republic, this figure barely reaches 64%, highlighting the disparities in digital technology use across the region.

Portilho and Ribeiro (2024) add that while the COVID-19 pandemic accelerated the adoption of digital technologies in Brazil, significant challenges remain to achieving full connectivity in public health facilities, especially in peripheral areas. Studies addressing digital transformation in public health in Latin America typically adopt technological and contextual approaches. Stein et al. (2021) introduced the concept of “Healthy Healthcare,” which integrates digital systems into public policy frameworks to ensure equitable and sustainable access.

Delgado (2022), for his part, argues that adopting the IPv6 protocol is essential to ensure the sustainability and expansion of technologies such as telemedicine, although much of the region still operates under the IPv4 protocol, limiting digital growth. In this context, Tortorella et al. (2023) suggest using tools such as value stream mapping to identify digital applications that enhance efficiency in public health services.

In Latin America, digital transformation is aligned with the Sustainable Development Goals (SDGs), particularly Goal 3 on health and well-being. However, García Alonso et al. (2022) warn that the implementation of technologies such as AI must be accompanied by clear regulatory frameworks that ensure data privacy and equitable application. In Brazil, De Fátima Marin et al. (2022) describe how the RNDs has sought to decentralize and connect health systems through a federated model, although interoperability and connectivity issues continue to limit its effectiveness.

The reviewed studies employ a range of methodologies, from systematic reviews (Borges do Nascimento et al., 2023; Farias et al., 2023) to empirical analyses based on surveys (De La Cruz-Ramirez et al., 2022) and case studies (Tortorella et al., 2023). For example, Rocha et al. (2023) applied a cluster analysis to develop personalized digital interventions on social networks, demonstrating the potential of these platforms to promote healthy behaviors, although their use in Latin America lacks standardization.

Despite these advances, clear research gaps emerge. One of the most evident is the lack of evidence regarding the effectiveness of digital technologies in improving the quality of care and efficiency of health systems in Latin America (Stein et al., 2021). Moreover, disparities in the adoption of these technologies—particularly in rural communities—underscore the need for specific policies to address these inequalities (Capasso et al., 2024; Godoy et al., 2020).

Another significant gap is the limited digital literacy among healthcare workers. De La Cruz-Ramírez et al. (2022) found that in Peru, most midwives lacked adequate training to use digital tools, reducing the effectiveness of such interventions. Likewise, García Alonso et al. (2022) note that the lack of consistent governance and regulatory frameworks in Latin America prevents the full adoption of data-driven technologies. Finally, while social media has proven to be a promising tool for public health interventions, its use in the region remains limited and lacks an equity-focused approach (Rocha et al., 2023). These

platforms have the potential to reach large segments of the population, but digital divides limit their reach in rural and marginalized communities.

In this context, it is essential to answer the following research question: What are the main research gaps regarding digital transformation in public health in Latin America, and how have thematic trends in this field evolved? Based on this question, the present study aims to systematically explore these gaps, identifying under-researched areas and analyzing emerging trends that can guide future research and support the development of more inclusive and effective policies. To that end, this study justifies the need for a bibliometric analysis to examine the evolution of scientific output in the region, its geographical distribution, the predominant approaches in literature, and the thematic areas that have been little explored.

To facilitate understanding, the manuscript is organized into five main sections. The *Materials and Methods* section describes the bibliometric design adopted, the data sources used, and the analytical techniques implemented. The *Results* section presents key findings on scientific production, prevailing themes, and the identified gaps in the digital transformation of public health in Latin America.

Next, the *Discussion* section contextualizes these results considering the existing literature, highlighting the theoretical and practical implications of the study. The *Limitations* section addresses methodological challenges and constraints that may influence the interpretation of the results. Finally, the *Conclusions* section synthesizes the main contributions of the study and offers recommendations for future research and the design of more effective public policies.

2. Materials and Methods

This study adopts a bibliometric design with a quantitative approach to explore research gaps in digital transformation in public health in Latin America. Its objective is to identify neglected areas and analyze emerging trends that can guide future research and inform more inclusive and effective policies. The approach follows methodological guidelines established in previous bibliometric analysis studies (Donthu et al., 2021; Mukherjee et al., 2022; Zupic & Čater, 2015).

Data were retrieved from Scopus, a database recognized for its curated coverage and high quality (Baas et al., 2020; Kulkanjanapiban & Silwattananusarn, 2022; Pranckutė, 2021). The initial search in the "Article Title" field included the terms "digital transformation" OR "digitalization" OR "digital health" OR "healthcare digitization" AND "public health" OR "health system" OR "healthcare" OR "health services", yielding 843 documents. This was then refined within abstracts using the terms "telemedicine" OR "telehealth" OR "interoperability" OR "big data" OR "artificial intelligence" OR "AI" OR "digital public policy" OR "digital inclusion" OR "cybersecurity", reducing the number to 626 documents for the period 2009–2025. Subsequently, the range was limited to 2009–2024, resulting in 620 documents.

To improve analysis quality, the following document types were excluded: Editorial (n = 18), Note (n = 12), Book (n = 7), Letter (n = 3), Conference Review (n = 2), Retracted (n = 1), and Erratum (n = 1), leaving a total of 576 documents. No country or subject area was excluded, ensuring a comprehensive analysis of the research landscape. The bibliometric analysis was conducted using RStudio version 2024.04.2+764, a widely used software for advanced analysis and visualization of scientific trends (Aria & Cuccurullo, 2017). The study analyzed the evolution of scientific output, the number of documents per year, and their distribution by countries and continents (see Figure 1).

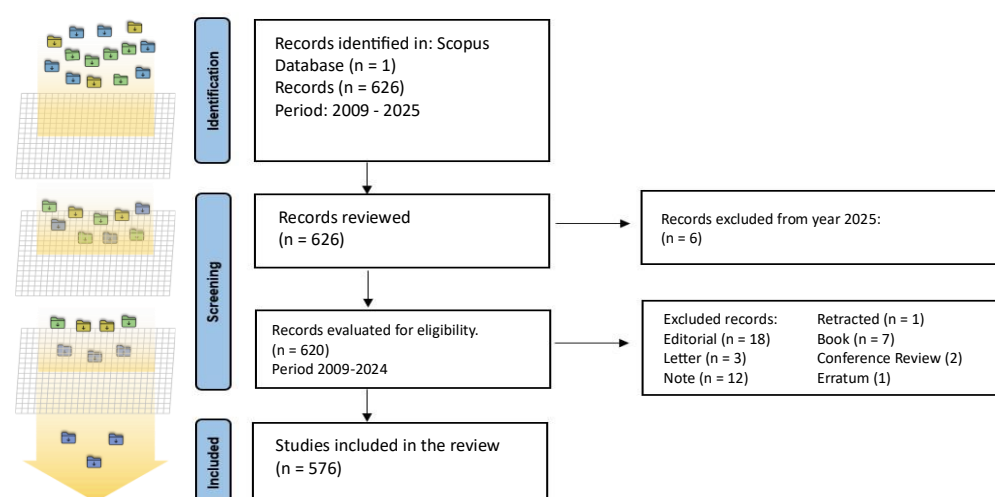


Figure 1. Document selection flowchart in Scopus

To identify conceptual structures, co-word analysis was used—a bibliometric technique that examines keywords as units of study (McAllister et al., 2022; Todeschini & Bacchini, 2016). Thematic mapping was applied, classifying topics into basic, motor, niche, and emerging or declining themes. Parameters included 250 keywords, a minimum cluster frequency of 5 per thousand documents, and the Walktrap algorithm. Visualization was carried out using RStudio version 2024.04.2+764 and Excel 365 version 2408 (Meyer & Avery, 2009; Neyeloff et al., 2012). A Thematic Map was generated to illustrate the distribution and relationship of topics in digital transformation in public health. Bar charts were created to represent scientific production by year, continent, and Latin American countries. A document selection flowchart and a table of cluster centrality and density were also developed to interpret the relevance and interconnection of key topics.

This methodological approach, based on bibliometric techniques and data visualization tools, enables a thorough analysis of the research landscape, identifying knowledge gaps and the evolution of research lines. It provides key insights for future studies and evidence-based policymaking (Derviş, 2020; Meyer & Avery, 2009; Neyeloff et al., 2012).

3. Results

3.1. Inequalities in Scientific Production on Digital Transformation in Public Health

The data in Figure 2 reveal significant growth in global scientific output related to digital transformation in public health. From just 2 publications in 2009 to 167 documents in 2024, there has been a steady increase reflecting growing interest in the topic. This growth may be linked to advances in digital technologies and the need to address global challenges, such as those exposed during the COVID-19 pandemic, which accelerated the adoption of digital solutions in healthcare systems.

In terms of geographical distribution, the data show that Europe leads scientific production, with contributions from 31 countries, followed by Asia with 29 countries, and Africa with 19 countries. The Americas, with only 11 contributing countries, lag these regions. This difference highlights a significant gap in the participation of American countries in research on digital transformation in public health.

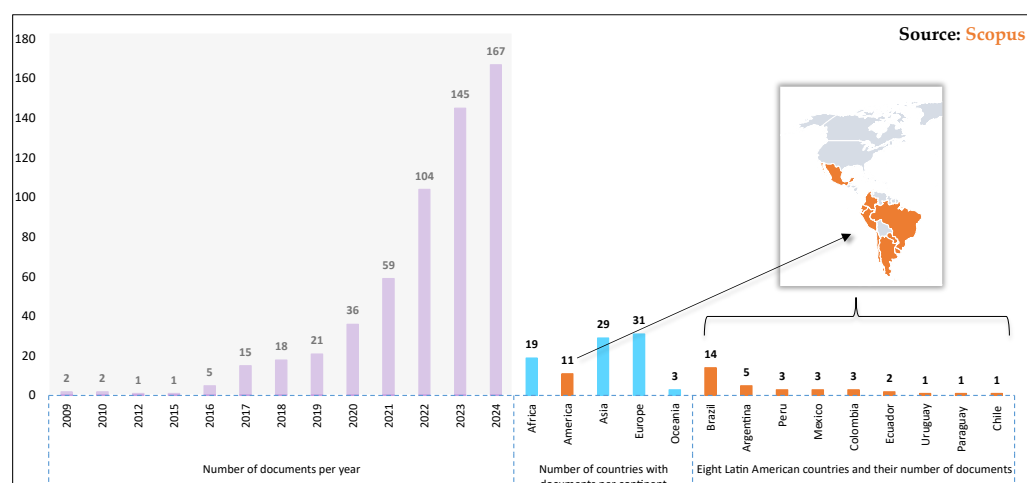


Figure 2. Documents by year, by continent, and by Latin American countries during 2009–2024.

A closer look at Latin American countries reveals a notable disparity among them. Of the 11 countries from the Americas contributing to this topic, 8 are from Latin America, but the distribution is uneven. Brazil stands out as the main contributor in the region, with 14 published documents—more than double the output of Argentina, which has 5. Countries such as Peru, Mexico, and Colombia each have 3 documents, showing similar levels of participation, while Ecuador has 2, and Uruguay, Paraguay, and Chile each have just 1 publication, indicating marginal presence in this research area. These differences reflect significant gaps in scientific production within Latin America.

3.2. Analysis of the Conceptual Structure

For this analysis, we used RStudio, applying the "co-word" bibliometric technique with author keywords as the unit of analysis and the statistical method of "Thematic Mapping." The goal is to identify research gaps and analyze emerging trends (Figure 3).

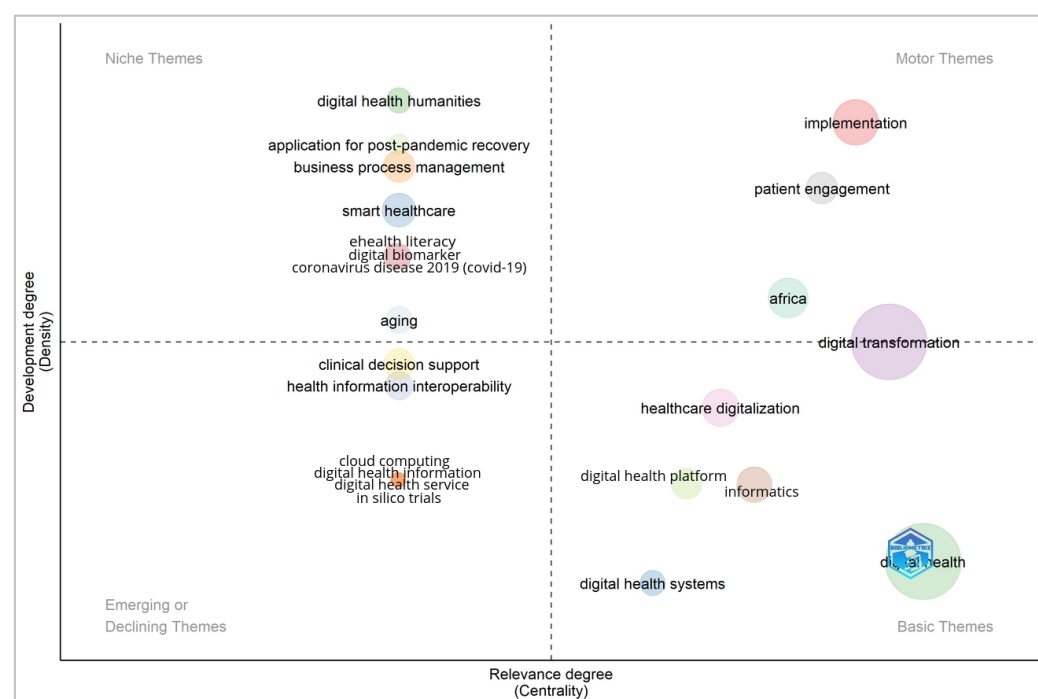


Figure 3. Thematic Map generated by RStudio for the period 2009–2024.

The thematic structure of research on digital transformation in public health is categorized based on centrality and density (Table 1). The most relevant basic themes include "digital health" and "digital transformation," with Callon centrality values of 8.734 and 5.286, respectively. These values indicate strong connections with other topics in the field. Both themes also show high cluster frequencies, with 599 and 575 mentions, reinforcing their central role in the knowledge network.

Table 1. Centrality and density of thematic clusters during 2009-2024.

Cluster	Centrality of Callon	Callon Density	Centrality of rank	Range Density	Cluster Frequency
digital health	8.734	48.323	23	2	599
digital transformation	5.286	57.147	22	12	575
implementation	0.894	76.574	21	22	38
patient engagement	0.583	70.000	20	19	11
africa	0.556	61.420	19	14	23
informatics	0.542	50.000	18	5,5	15
healthcare digitalization	0.438	51.111	17	9	18
digital health platform	0.167	50.000	16	5,5	5
digital health systems	0.063	43.750	15	1	6
smart healthcare	0.000	66.667	7.5	18	13
business process management	0.000	73.333	7.5	20	11
ehealth literacy	0.000	62.500	7.5	16	4
digital biomarker	0.000	62.500	7.5	16	4
health information interoperability	0.000	51.852	7.5	10	8
clinical decision support	0.000	56.944	7.5	11	10
coronavirus disease 2019 (covid-19)	0.000	62.500	7.5	16	4
aging	0.000	58.333	7.5	13	7
application for post-pandemic recovery	0.000	75.000	7.5	21	4
digital health humanities	0.000	100.000	7.5	23	6
cloud computing	0.000	50.000	7.5	5.5	2
digital health information	0.000	50.000	7.5	5.5	2
digital health service	0.000	50.000	7.5	5.5	2
in silico trials	0.000	50.000	7.5	5.5	2

Among the motor themes—those with both high centrality and density—are "implementation" with a density of 76.574 and "patient engagement" with 70.000. These themes exhibit strong internal development, suggesting significant advancement in recent literature. Also included in this category is "africa," with a density of 61.420, indicating that research on digital transformation in public health in that continent has gained relevance.

Niche themes show lower centrality but high specialization. These include "smart healthcare" (66.667), "business process management" (73.333), and "digital biomarker" (62.500), which are developing areas with strong internal cohesion but weaker links to the rest of the field. "Digital health humanities" stand out with the highest density (100.000), indicating absolute specialization in this area.

In contrast, emerging or declining themes include "health information interoperability" (51.852), "clinical decision support" (56.944), and "coronavirus disease 2019 (COVID-19)" (62.500), suggesting that although these topics were relevant in recent years, they may be losing prominence in the current literature. Additionally, terms such as "cloud computing," "digital health service," and "in silico trials," each with a density of 50.000, appear in this category, indicating that their impact on research may be in a consolidation or decline phase.

4. Discussion

The findings of this study confirm the sustained growth of scientific output on digital transformation in public health at a global level, aligning with trends reported in previous studies such as those by Tortorella et al. (2023) and Farias et al. (2023). From 2009 to 2024, the increase in the number of publications reflects the growing relevance of the topic, driven by advances in digital technologies and their integration into healthcare systems—a phenomenon also noted by Garcia Alonso et al. (2022). However, when comparing these findings with the literature review, a significant gap in scientific production from Latin America becomes evident, suggesting the existence of structural barriers that hinder knowledge generation in this field (Capasso et al., 2024; De Fatima Marin et al., 2022). The dominance of Europe and Asia in publication output supports what was indicated by Stein et al. (2021), who identified higher investment in digital infrastructure in these continents compared to Latin America, where only a few countries, such as Brazil and Argentina, have achieved more significant participation (Garcia Alonso et al., 2022; Godoy et al., 2020).

The thematic analysis reinforces the hierarchical structure of the topics studied, in line with trends identified in the literature. Concepts such as "digital health" and "digital transformation" are consolidated as core themes with high centrality and density, reflecting their importance in the field's evolution (Farias et al., 2023; Tortorella et al., 2023). These findings are consistent with those of Garcia Alonso et al. (2022), who highlighted that health digitalization and digital transformation are priority areas of research. However, motor themes such as "implementation" and "patient engagement," despite showing significant development, exhibit lower centrality in the knowledge network, indicating that their impact on academic debate is not yet predominant (Stein et al., 2021). In line with this finding, previous studies have pointed out that the effective implementation of digital technologies continues to face regulatory and infrastructure barriers, which limit their adoption in public health settings (De La Cruz-Ramirez et al., 2022; Delgado, 2022).

Niche themes such as "business process management" and "digital biomarkers" show greater specialization within the field, suggesting that they have begun to establish themselves as areas of study with strong internal cohesion (Rocha et al., 2023). The high density of these topics aligns with the findings of Borges do Nascimento et al. (2023), who emphasized that digitalization in public health has driven specialized research on digital biomarkers and the use of intelligent systems in clinical decision-making. However, emerging or declining themes such as "health information interoperability" and "cloud computing" show signs of stagnation in terms of academic relevance (Tortorella et al., 2023). This is consistent with the observations of Karunaratne and Monteiro (2023), who argue that data interoperability remains a critical challenge in the region due to the lack of standardization in digital health systems.

4.1. Limitations

Despite the insights obtained, the reviewed evidence presents certain limitations that must be considered. First, the lack of comparative studies across regions hinders a deeper analysis of the factors explaining differences in scientific production (De Fatima Marin et

al., 2022). Moreover, the literature indicates that most studies tend to focus on technological aspects without thoroughly addressing the social and regulatory implications of digitalization, leaving gaps in the comprehensive understanding of the phenomenon (Capasso et al., 2024; Garcia Alonso et al., 2022). The scarcity of longitudinal studies also limits the ability to assess the real impact of digital transformation in public health over time (De La Cruz-Ramirez et al., 2022).

The bibliometric review process used in this study also presents some limitations. While it enables the identification of patterns and trends in scientific output, its reliance on specific databases may have excluded relevant studies published in non-indexed journals (Borges do Nascimento et al., 2023). Furthermore, although cluster and thematic map analysis is useful for structuring knowledge, it does not always capture the complexity of the conceptual evolution of the topics studied (Rocha et al., 2023). Therefore, future research could complement this approach with qualitative methodologies that allow for a deeper interpretation of the factors driving the adoption of digital technologies in public health systems in Latin America (Stein et al., 2021).

4.2. Implications

The implications of these findings are significant for practice, policymaking, and the future research agenda. From a practical standpoint, the results highlight the need to strengthen scientific production in Latin America by promoting regional collaboration initiatives that generate knowledge applicable to digital transformation in public health (Garcia Alonso et al., 2022). In terms of public policy, it is essential to develop regulatory frameworks that facilitate the adoption of digital tools in health systems while ensuring data protection and equity in implementation (Capasso et al., 2024; De Fatima Marin et al., 2022). Finally, in the academic sphere, it is crucial to encourage research that addresses the identified gaps, particularly regarding accessibility, data interoperability, and the training of healthcare personnel in the use of emerging technologies (De La Cruz-Ramirez et al., 2022).

5. Conclusions

In summary, this study has identified significant disparities in scientific production on digital transformation in public health across Latin America, highlighting both advances and areas requiring further attention. The comparison with existing literature confirms that while interest in the topic has grown, structural challenges continue to limit its development in the region. The limitations in the evidence and review process underscore the need to expand the knowledge base through more detailed studies and complementary methodologies. Based on these findings, there is an urgent call to strengthen research and collaboration in this field to produce knowledge that contributes to the formulation of more inclusive and effective policies for digital transformation in public health in Latin America.

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