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Digital Transformation in Healthcare Management: A Bibliometric and Systematic Literature Review

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Abstract

Background: Digital transformation has become a strategic priority for healthcare organizations, driven by the growing adoption of digital health technologies, telemedicine, artificial intelligence, and health information systems. Despite increasing scholarly attention, the literature remains fragmented across disciplines, limiting a comprehensive understanding of its intellectual structure, dominant themes, and future directions.
Aims and Scope of the Paper: Therefore, this study systematically examines the development of digital transformation research in healthcare management using a combined bibliometric and systematic literature review approach.
Methods: Data were retrieved from the Scopus database and screened using the PRISMA framework, resulting in 62 publications published between 2016 and 2026. Bibliometric analysis was conducted using VOSviewer to explore publication trends, collaboration networks, citation structures, and thematic relationships, while thematic synthesis was used to identify major research themes and emerging topics.
Result: The findings indicate substantial growth in research on digital transformation in healthcare management, particularly after 2022, accompanied by increasing international collaboration and citation activity. Healthcare management, digital health, and telemedicine emerged as the most prominent themes. Keyword co-occurrence analysis identified five major research clusters: Digital Health Transformation, Telemedicine and Remote Healthcare Services, Health Information Systems and Data Governance, Artificial Intelligence and Healthcare Innovation, and Workforce Development, Leadership, and Organizational Readiness. Overlay visualization further highlighted emerging interests in workforce competency, digital leadership, health information management, and data security.
Conclusion: This study provides a comprehensive mapping of the intellectual structure of digital transformation research in healthcare management and identifies key research gaps related to workforce readiness, artificial intelligence governance, healthcare cyber security, and sustainable digital transformation strategies. The findings offer valuable insights for researchers, healthcare managers, and policymakers seeking to advance healthcare digitalization initiatives.

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INTRODUCTION

The healthcare sector is experiencing an unprecedented wave of digital transformation driven by rapid technological advancements, increasing healthcare demands, and the need for more efficient and patient-centered healthcare services (Abbaszada, 2025; Bogati, 2025). Healthcare organizations worldwide face complex challenges, including rising healthcare expenditures, aging populations, workforce shortages, increasing chronic disease prevalence, and growing expectations

for high-quality healthcare delivery (Addo & Findlay, 2024). In response to these challenges, digital technologies have become essential tools for improving healthcare accessibility, enhancing clinical decision-making, optimizing operational performance, and supporting sustainable healthcare management (De Leeuw et al., 2020; Uslu et al., 2020).

Digital transformation refers to the strategic integration of digital technologies into organizational structures, processes, and service delivery systems to create substantial improvements in performance and value creation (Maqbuli & Al-mahmoudi, 2026). Within healthcare settings, digital transformation extends beyond technological implementation and involves organizational adaptation, workforce development, governance restructuring, and innovation management (Geada et al., 2024; Handrean et al., 2025). Technologies such as digital health platforms, telemedicine systems, electronic health records (EHRs), artificial intelligence (AI), block chain, healthcare analytics, cloud computing, and the Internet of Medical Things (IoMT) have become central components of contemporary healthcare management (He et al., 2026; Hong & Dahnil, 2024; Mansour & Bick, 2024; Nguyen & Voznak, 2024).

The significance of digital transformation became particularly evident during the COVID-19 pandemic. Healthcare providers were required to rapidly deploy digital solutions to maintain continuity of care while reducing physical interactions and minimizing infection risks (Mulukuntla & Pamulaparthyvenkata, 2020). Telemedicine, virtual consultations, remote patient monitoring, and digital communication systems emerged as critical mechanisms for sustaining healthcare operations during periods of disruption (Hassan et al., 2024; Rubbio et al., 2020). The pandemic accelerated technology adoption at an unprecedented rate and demonstrated that digital capabilities are no longer optional innovations but strategic necessities for healthcare organizations seeking resilience and adaptability (Ting et al., 2020).

Existing literature consistently highlights the transformative potential of digital health technologies. Digital health encompasses a broad range of technologies designed to improve healthcare delivery, health management, and patient engagement through digital platforms and data-driven approaches. Recent studies indicate that digital health technologies contribute to improved healthcare accessibility, enhanced patient outcomes, reduced operational costs, and greater healthcare efficiency (Majcherek et al., 2024; Nguyen & Voznak, 2024; Oborn & Barrett, 2016; Vinci et al., 2025). Furthermore, the emergence of health metaverse technologies, smart healthcare ecosystems, and integrated digital platforms suggests that healthcare digitalization is evolving beyond process automation toward the creation of interconnected healthcare environments capable of supporting personalized and data-driven healthcare services.

Among the various manifestations of healthcare digitalization, telemedicine has emerged as one of the most influential innovations. Telemedicine enables healthcare providers to deliver healthcare services remotely through information and communication technologies, thereby overcoming geographical barriers and improving healthcare accessibility (Haleem et al., 2021). Studies have demonstrated that telemedicine contributes to continuity of care, organizational resilience, and healthcare system responsiveness, particularly in geographically dispersed regions and during public health emergencies (Hassan et al., 2024; Liu et al., 2022; Rubbio et al., 2020; Rydgren et al., 2026). The rapid expansion of telemedicine during the pandemic further highlighted its potential to become a permanent component of future healthcare delivery models.

Despite the increasing adoption of digital health technologies, the success of healthcare digital transformation depends heavily on the effectiveness of health information systems and data governance mechanisms (Akindote et al., 2024; Ricciardi et al., 2019). Modern healthcare organizations generate vast amounts of clinical, operational, and administrative data that require secure management, interoperability, and effective utilization (Yusuf et al., 2025). Research has shown that integrated health information systems facilitate evidence-based decision-making, improve care coordination, and support organizational performance (De Leeuw et al., 2020; Uslu et al., 2020; Yoo & Lee, 2022). Electronic health records, health informatics infrastructures, and healthcare analytics systems enable healthcare professionals to access and utilize information more efficiently, thereby improving healthcare quality and patient safety.

However, the growing dependence on digital information infrastructures also introduces significant challenges related to cyber security, privacy protection, interoperability, and data governance. As healthcare organizations become increasingly interconnected, concerns regarding

data breaches, cyber attacks, and information security have gained prominence within both academic and professional discussions (Ghayoomi et al., 2021; Hasan et al., 2022; Hong & Dahnil, 2024). Blockchain technologies and advanced security frameworks have been proposed as potential solutions for improving data integrity, transparency, and trust within digital healthcare ecosystems. Nevertheless, empirical evidence regarding the effectiveness and scalability of these approaches remains limited, indicating the need for further investigation (Deng et al., 2025).

Artificial intelligence represents another transformative force shaping the future of healthcare management. AI technologies have demonstrated considerable potential for supporting predictive analytics, clinical decision-making, diagnostic assistance, patient monitoring, and healthcare resource optimization (Chu et al., 2023; Hasan et al., 2022; Mansour & Bick, 2024). Through the analysis of large and complex datasets, AI systems can identify patterns, generate predictions, and provide decision support that enhances both clinical and managerial performance. Consequently, AI is increasingly viewed as a strategic enabler of healthcare innovation and organizational transformation.

Although AI offers substantial benefits, its implementation also raises important ethical, legal, and governance-related concerns. Issues such as algorithmic transparency, accountability, explain ability, fairness, and regulatory compliance remain insufficiently addressed within the existing literature (Chu et al., 2023; Hasan et al., 2022). The increasing integration of AI into healthcare decision-making processes highlights the need for governance frameworks capable of balancing innovation with ethical responsibility and patient safety.

Beyond technological considerations, recent studies emphasize that healthcare digital transformation is fundamentally a socio-technical process requiring organizational readiness and workforce adaptation. (Brommeyer et al., 2024) argue that organizational readiness is a critical determinant of transformation success because healthcare institutions must align technological investments with organizational capabilities and strategic objectives. Similar conclusions were reported by (Papalia et al., 2023), who highlighted the importance of leadership and management development in supporting organizational transformation. Likewise, (De Leeuw et al., 2020) found that healthcare professionals' digital competencies significantly influence technology adoption and utilization outcomes.

Workforce development and leadership have therefore emerged as increasingly important dimensions of healthcare transformation. Healthcare professionals are expected to acquire new digital competencies while adapting to continuously evolving technological environments. Simultaneously, healthcare leaders are required to manage organizational change, facilitate innovation, and promote technology acceptance across healthcare institutions (Abou Hashish et al., 2025; Laukka et al., 2022; Yoo & Lee, 2022). Recent evidence suggests that digital leadership capabilities may be as important as technological infrastructure in determining the long-term success of transformation initiatives.

Despite the growing body of literature, research on digital transformation in healthcare management remains fragmented across multiple disciplines, including healthcare management, nursing management, health informatics, public health, and information systems (Regan, 2022). Existing studies often focus on specific technologies, organizational contexts, or implementation challenges rather than providing an integrated understanding of the broader transformation process. Consequently, the intellectual structure, thematic evolution, and future directions of healthcare digital transformation research remain insufficiently synthesized.

The findings of the preliminary evidence synthesis conducted in this study reveal several important gaps within the existing literature. First, while digital health and telemedicine dominate scholarly discussions, comparatively limited attention has been devoted to workforce readiness, digital leadership, and organizational transformation capabilities. Second, governance-related issues, including cyber security, data governance, and artificial intelligence accountability, remain underexplored despite their growing strategic importance. Third, existing research remains concentrated within specific geographical and institutional contexts, limiting the generalizability of findings across diverse healthcare systems.

To address these limitations, this study employs a bibliometric and systematic literature review approach to comprehensively examine the development of digital transformation research in healthcare management. By integrating bibliometric mapping techniques with thematic

synthesis and evidence-based analysis, this study seeks to identify publication trends, influential studies, dominant research themes, intellectual structures, and future research opportunities. The findings are expected to contribute to both academic scholarship and healthcare practice by providing a comprehensive understanding of how digital transformation is reshaping healthcare management and by identifying strategic directions for future research and implementation.

Accordingly, this study addresses the following research questions:

RQ1: How has research on digital transformation in healthcare management evolved over time?

RQ2: What are the dominant research themes, intellectual structures, and collaboration patterns in digital transformation within healthcare management?

RQ3: What emerging topics and future research directions can be identified in the field of digital transformation in healthcare management?

METHOD

Research Design

This study employed a bibliometric and systematic literature review (SLR) approach to examine the development of digital transformation research in healthcare management. Bibliometric analysis was used to explore publication trends, collaboration networks, citation structures, and thematic relationships within the literature, while systematic literature review techniques were applied to synthesize research themes and identify future research opportunities.

Data Source and Search Strategy

This study employed the Scopus database as the primary source of bibliographic data due to its extensive coverage of peer-reviewed literature and its suitability for bibliometric analysis. Data collection was conducted using a predefined search query focusing on digital transformation and healthcare management. The search query used in this study was: ("digital transformation" OR "digital health") AND ("healthcare management" OR "nursing management"). The search strategy was developed to identify relevant publications related to digital transformation in healthcare management. Table 1 presents the search query used to retrieve documents from the Scopus database.

Table 1. Search Strategy

Database	Search Query	Initial Records
Scopus	("digital transformation" OR "digital health") AND ("healthcare management" OR "nursing management")	160

The search initially retrieved 160 records from the Scopus database. The records were subsequently screened following the PRISMA framework. After applying inclusion and exclusion criteria, removing irrelevant publications, and assessing article eligibility, a total of 62 publications published between 2016 and 2026 were included in the final analysis.

The selected publications were exported in CSV format and analyzed using VOSviewer to examine publication trends, citation structures, country contributions, collaboration networks, keyword co-occurrence patterns, and thematic relationships. Furthermore, evidence synthesis was conducted to identify major research themes, research gaps, and future research directions in digital transformation within healthcare management. The search process was performed in May 2026.

Inclusion and Exclusion Criteria

To ensure the relevance, consistency, and quality of the dataset, inclusion and exclusion criteria were established prior to the screening process. Table 2 summarizes the criteria applied for selecting publications included in the final bibliometric analysis.

Table 2. Inclusion and Exclusion Criteria

Criteria	Inclusion Criteria	Exclusion Criteria
Database	Publications indexed in Scopus	Publications from databases other than Scopus

Criteria	Inclusion Criteria	Exclusion Criteria
Publication Year	Publications published between 2016 and 2026	Publications outside the selected time period
Document Type	Research Articles	Review Articles, Conference Papers, Editorials, Notes, Book Chapters, Letters, and Errata
Language	English	Non-English publications
Subject Areas	Medicine, Nursing, Health Professions, Computer Science, Business, Management and Accounting	Subject areas unrelated to healthcare management and digital transformation
Research Focus	Studies addressing digital transformation, digital health, healthcare management, healthcare innovation, telemedicine, health information systems, healthcare leadership, and related topics	Studies not directly related to healthcare management or digital transformation
Screening Process	Publications relevant to the study objectives after title, abstract, and keyword screening	Publications excluded due to irrelevance to the study objectives after screening

Table 2 presents the inclusion and exclusion criteria applied during the screening process. To ensure consistency and relevance, only English-language research articles indexed in the Scopus database and published between 2016 and 2026 were considered. The screening process focused on studies addressing digital transformation, digital health, healthcare management, healthcare innovation, telemedicine, health information systems, and related topics. Publications categorized as review articles, conference papers, editorials, notes, book chapters, letters, and errata were excluded. Following the application of these criteria and relevance screening based on titles, abstracts, and keywords, a final dataset of 62 articles was retained for bibliometric analysis and thematic synthesis.

Study Selection Process

The study selection procedure followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. The identification stage yielded 160 records from the Scopus database. Subsequently, filtering based on publication year, document type, language, and subject area reduced the dataset to 62 eligible records. All selected records were included in the bibliometric and thematic analyses.

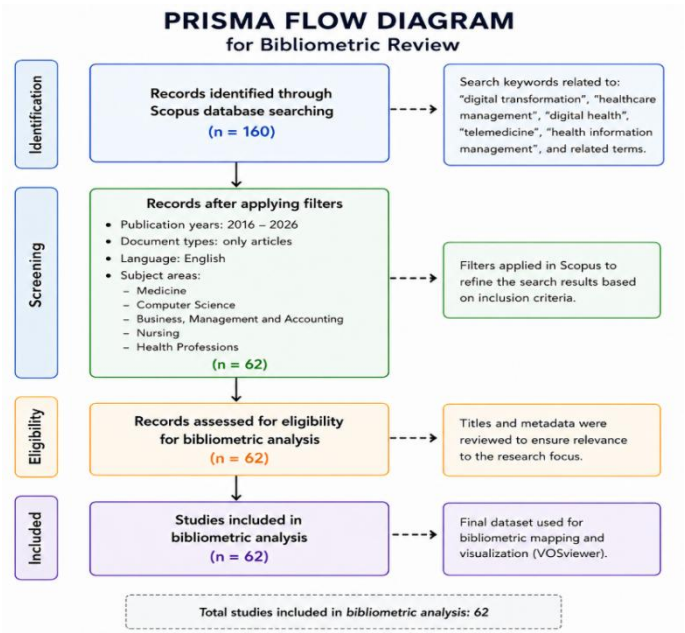

Figure 1. presents the PRISMA flow diagram used in the study selection process

Data Analysis

Bibliometric analysis was conducted using VOSviewer version 1.6.19. Several analytical techniques were employed, including publication trend analysis, source analysis, author analysis, country analysis, citation analysis, co-occurrence analysis, overlay visualization, and density visualization.

Co-occurrence analysis was used to identify dominant research themes and conceptual relationships among keywords. Overlay visualization was utilized to examine the temporal evolution of research topics, while density visualization identified highly investigated research areas. Citation analysis was performed to determine influential publications, and country collaboration analysis was conducted to reveal international research networks.

Thematic Analysis

To complement the bibliometric findings, thematic analysis was conducted on the selected publications. Titles, abstracts, and author keywords were reviewed and categorized into thematic groups. The analysis resulted in five major themes: (1) Digital Health Transformation, (2) Telemedicine and Remote Healthcare Services, (3) Health Information Systems and Data Governance, (4) Artificial Intelligence and Healthcare Innovation, and (5) Workforce Development, Leadership, and Organizational Readiness. The thematic analysis enabled a deeper understanding of the intellectual structure of the field and supported the identification of research gaps and future research directions.

RESULTS AND DISCUSSION

Results

Publication Trend Analysis

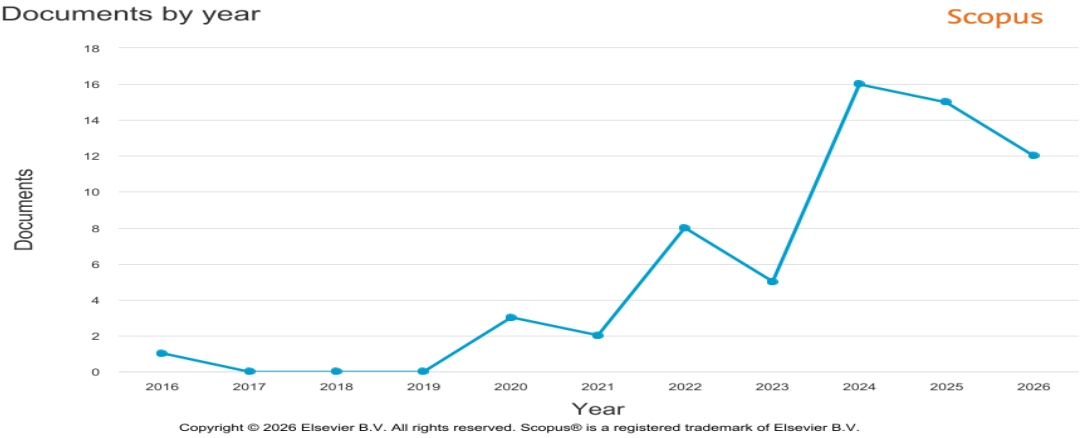

Figure 2. Annual Publication Trend in Digital Transformation and Healthcare Management Research (2016–2026)

Figure 2 presents the annual publication trend of studies related to digital transformation in healthcare management between 2016 and 2026. The results indicate a substantial increase in research output during the last five years. Only one publication was identified in 2016, while no eligible publications were recorded between 2017 and 2019. Research activity began to increase in 2020 with three publications and continued to grow in subsequent years.

A notable increase occurred in 2022, when the number of publications reached eight documents. Although a slight decline was observed in 2023 with five publications, the field experienced rapid growth in 2024, reaching sixteen publications, the highest number during the study period. The trend remained strong in 2025 and 2026 with fifteen and twelve publications, respectively.

Overall, publications produced between 2024 and 2026 accounted for approximately 69.4% of the total dataset, indicating that digital transformation in healthcare management has become an increasingly important research area.

Source Title Analysis

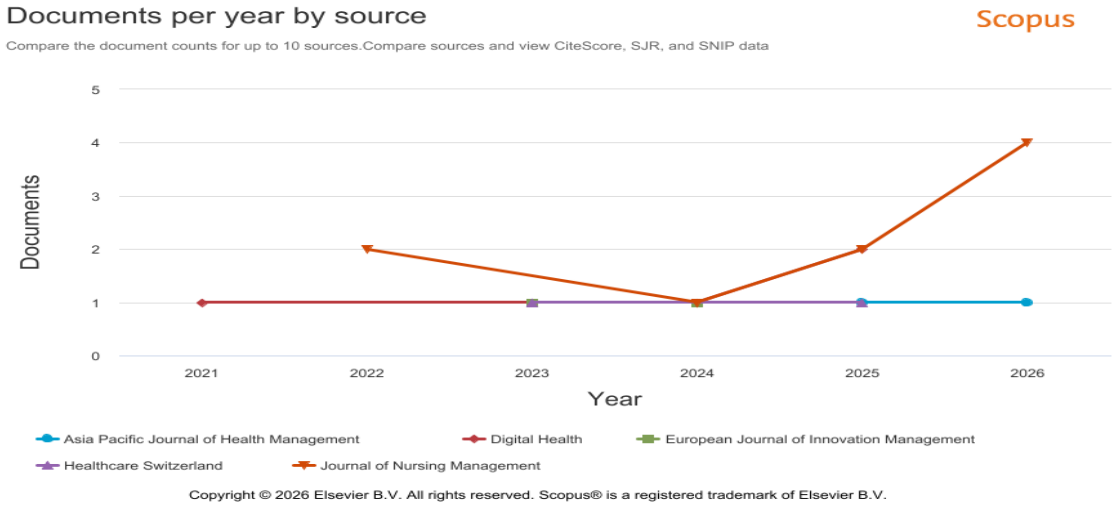

Figure 3. Source Analysis of Publications by Journal

Figure 3 illustrates the distribution of publications across academic journals. The analysis revealed that the Journal of Nursing Management was the most productive publication source, contributing nine articles. Digital Health ranked second with four publications. Other active publication outlets included the Asia Pacific Journal of Health Management, European Journal of Innovation Management, and Healthcare, each contributing two publications. To provide a clearer overview of the leading publication outlets, Table 3 presents the ten most productive sources identified in the dataset.

Table 3. Most Productive Sources in Digital Transformation and Healthcare Management Research

Rank	Source Title	Number of Documents
1	Journal of Nursing Management	9
2	Digital Health	4
3	Asia Pacific Journal of Health Management	2
4	European Journal of Innovation Management	2
5	Healthcare (Switzerland)	2
6	Administrative Sciences	1
7	Anaesthesia, Pain and Intensive Care	1
8	Applied Clinical Informatics	1
9	BMC Health Services Research	1
10	Frontiers in Public Health	1

Table 3 further confirms the dominance of several core publication outlets within the field of digital transformation in healthcare management. The Journal of Nursing Management emerged as the most productive source with nine publications, followed by Digital Health with four publications. Other sources contributed smaller numbers of publications, indicating that research in this field is distributed across multiple journals specializing in healthcare management, digital health, healthcare innovation, and health informatics. The concentration of publications within a limited number of journals suggests the presence of specialized publication channels that significantly influence the development of knowledge related to healthcare digitalization and organizational transformation.

The diversity of publication sources demonstrates the multidisciplinary nature of digital transformation research in healthcare management. The field attracts contributions from healthcare management, nursing, health informatics, information systems, and innovation management disciplines.

Author Productivity Analysis

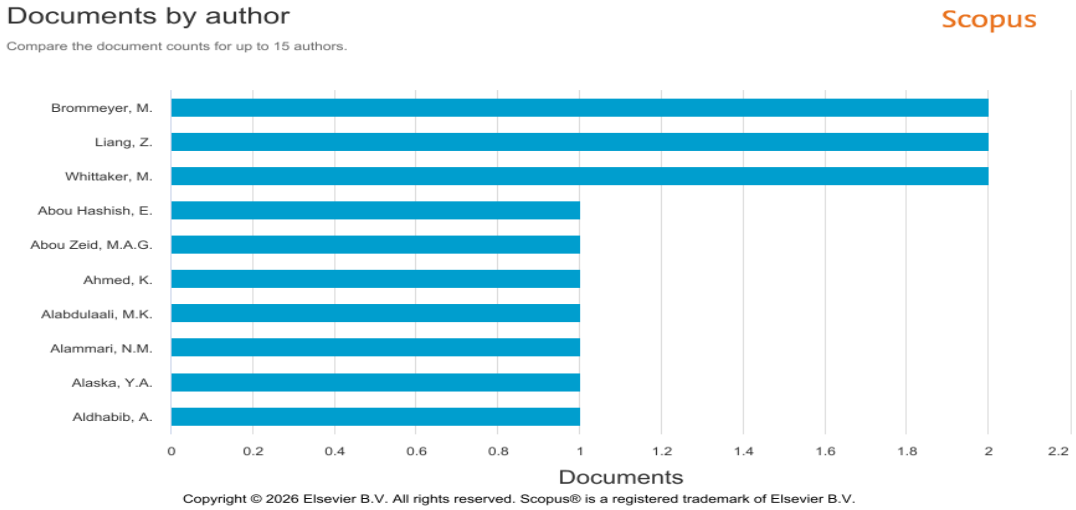

Figure 4. Source Analysis of Publications by author

The distribution of publications by author demonstrates a relatively dispersed authorship structure. No single author dominated the research field. Brommeyer M., Liang Z., and Whittaker M. were the most productive contributors, each publishing two documents within the dataset. Most other authors contributed one publication. The absence of highly dominant authors suggests that digital transformation in healthcare management remains an emerging and multidisciplinary research area involving scholars from diverse academic backgrounds.

Furthermore, the dispersed authorship pattern indicates that the field has not yet developed a concentrated group of highly influential scholars who consistently dominate research production. Instead, contributions are distributed across researchers from various disciplines, including healthcare management, nursing, health informatics, information systems, and organizational studies. This pattern reflects the interdisciplinary nature of digital transformation research and suggests that knowledge development in the field is driven by diverse perspectives and collaborative efforts rather than by a single dominant research community.

Country Distribution Analysis

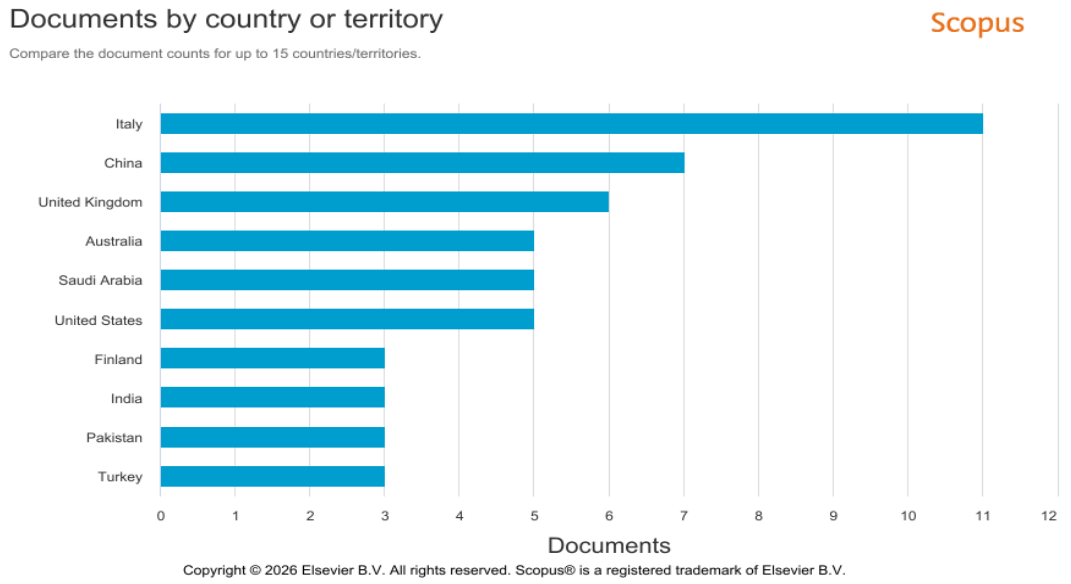

Figure 5. Country Distribution of Publications in Digital Transformation and Healthcare Management Research

Figure 5 presents the geographical distribution of publications. Italy emerged as the leading contributor with eleven publications, followed by China with seven publications and the United Kingdom with six publications. Australia, Saudi Arabia, and the United States each contributed five publications. To provide a clearer overview of international collaboration patterns, Table 4 summarizes the research collaboration clusters identified through country co-authorship analysis.

Table 4. International Research Collaboration Clusters in Digital Transformation and Healthcare Management Research

Cluster	Countries Involved	Number of Countries	Interpretation
Cluster 1	Italy, France, Germany	3	Represents a strong European collaboration network focusing on healthcare digital transformation, healthcare innovation, and organizational digitalization. Italy emerged as the leading contributor within this cluster.
Cluster 2	United Kingdom, Australia	2	Demonstrates cross-regional collaboration emphasizing healthcare management, digital health implementation, and healthcare service innovation.
Cluster 3	Finland, Norway	2	Reflects Nordic collaboration with research interests in healthcare technology adoption, digital services, and healthcare system development.

Note: Collaboration clusters were identified using country co-authorship analysis in VOSviewer based on the final dataset of 62 publications.

Table 4 presents the international research collaboration clusters identified through country co-authorship analysis. Three major collaboration networks were observed. The first cluster consisted of Italy, France, and Germany, indicating a strong European research partnership in healthcare digital transformation. The second cluster linked the United Kingdom and Australia, reflecting collaboration in healthcare management and digital health implementation. The third cluster connected Finland and Norway, highlighting Nordic cooperation in healthcare technology and digital service innovation.

These findings suggest that European countries play a central role in fostering international collaboration within the field. Although countries such as the United States, China, and Saudi Arabia demonstrated substantial publication outputs, their collaboration links were relatively limited within the analyzed network. Overall, international collaboration appears to be an important mechanism for accelerating knowledge exchange, technological innovation, and the development of digital healthcare management practices.

The results indicate that research on digital transformation in healthcare management is globally distributed, with significant contributions originating from Europe, Asia, and North America. The concentration of publications in developed healthcare systems suggests that technological infrastructure and healthcare innovation policies play important roles in stimulating research productivity.

Keyword Co-occurrence Analysis

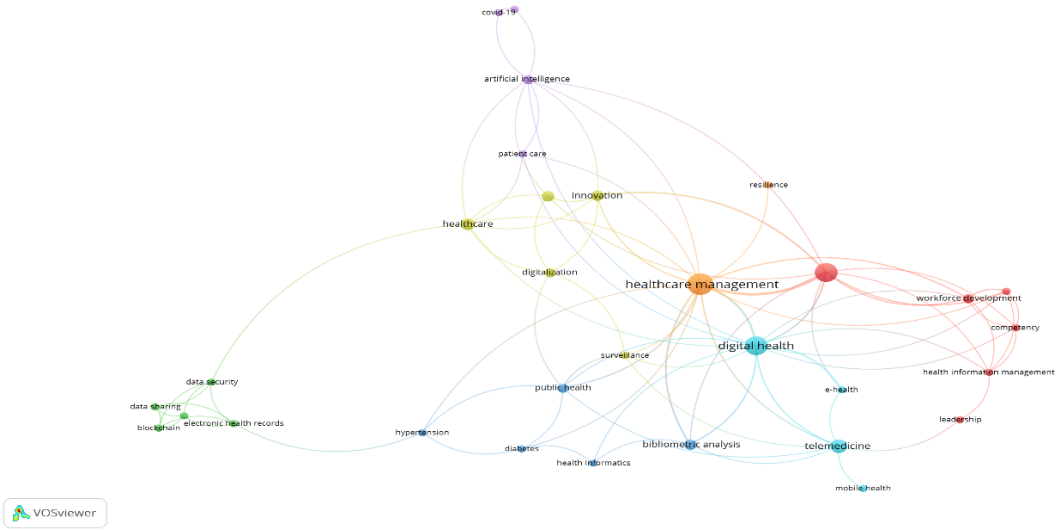

Figure 6. Keyword Co-occurrence Network Visualization

Keyword co-occurrence analysis was conducted using VOSviewer to identify dominant research themes and conceptual relationships within the literature. The analysis generated a network consisting of 31 interconnected keywords organized into five thematic clusters. The first cluster focused on workforce development, competency, leadership, health information management, and healthcare management. The second cluster centered on digital health services, including digital health, telemedicine, e-health, and mobile health. The third cluster highlighted health information systems and data governance through keywords such as electronic health records, blockchain, data sharing, and data security. The fourth cluster represented digital transformation and innovation, emphasizing healthcare digitalization and organizational innovation. The fifth cluster focused on artificial intelligence and patient care, reflecting the increasing integration of AI technologies into healthcare service delivery and decision-making processes.Among all keywords, healthcare management (17 occurrences), digital health (13 occurrences), and digital transformation (13 occurrences) emerged as the most frequently occurring concepts, indicating their central role within the literature.

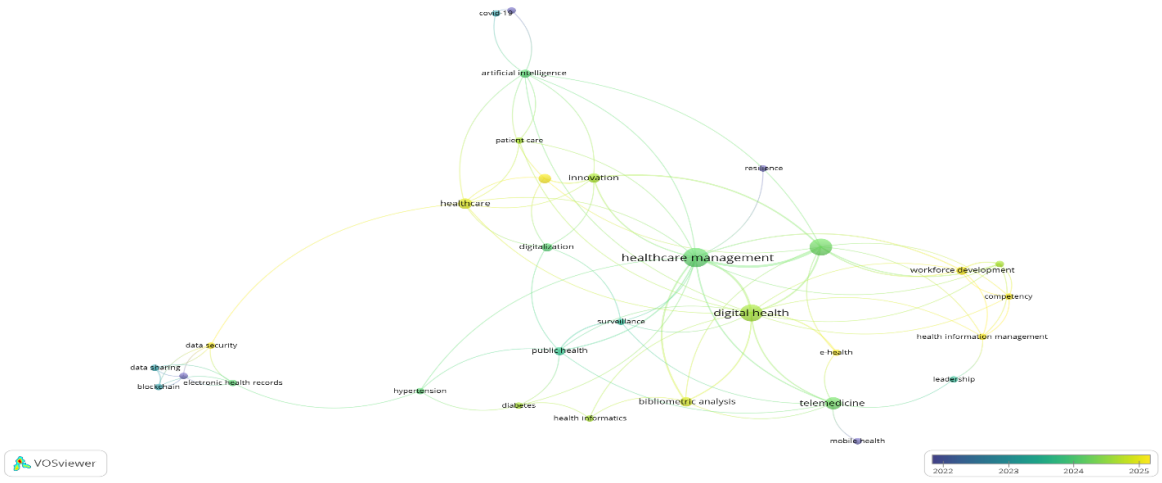

Figure 7. Overlay Visualization of Research Themes

Overlay visualization was performed to identify the temporal evolution of research topics. The results revealed a clear progression of themes over time. Earlier studies were primarily associated with COVID-19, blockchain technologies, mobile health, and data-sharing mechanisms.

Subsequent research increasingly focused on telemedicine, digital health, artificial intelligence, and healthcare innovation.

More recent publications concentrated on workforce development, competency enhancement, health information management, and data security. These findings indicate a gradual shift from technology adoption studies toward organizational readiness, workforce capability development, and governance-related concerns.

Density Visualization Analysis

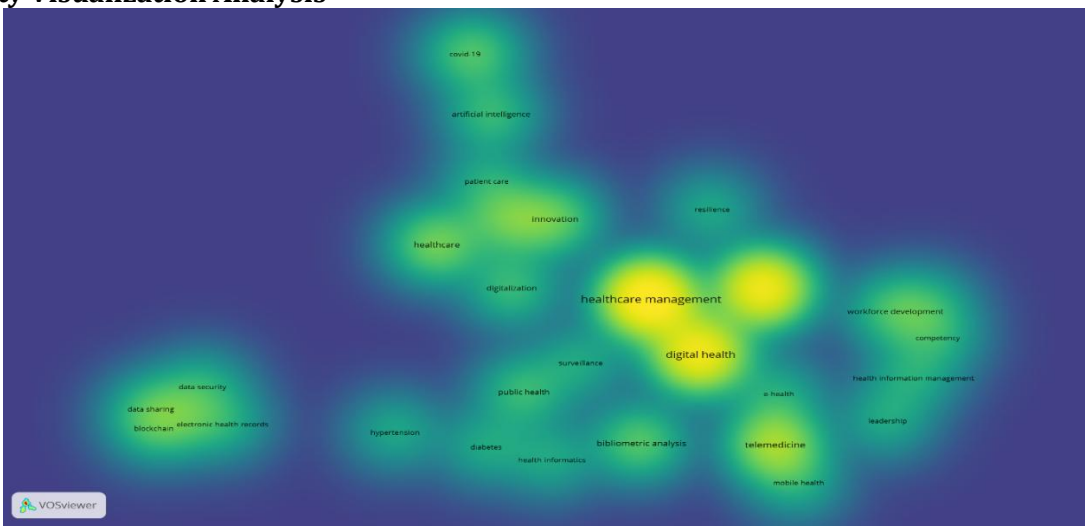

Figure 8. Density Visualization of Research Themes

Density visualization was employed to identify research hotspots within the field. The analysis demonstrated that healthcare management and digital health represent the most intensively investigated topics. Telemedicine, innovation, and healthcare digitalization also exhibited relatively high density levels, indicating their prominence within the literature. In contrast, workforce development, leadership, competency, data security, blockchain, and health information management displayed lower density levels, suggesting that these topics remain less extensively explored.

The density map highlights the concentration of existing research around healthcare service digitalization while simultaneously revealing opportunities for future studies in organizational and governance dimensions of healthcare transformation.

Citation Analysis

Figure 9. Citation Analysis of Documents

Citation analysis was conducted to identify influential publications shaping the development of digital transformation research in healthcare management. The most influential study within the dataset was authored by Uslu, Okay, and Dursun (2020), receiving 159 citations. This was followed by De Leeuw, Woltjer, and Koo (2020) with 123 citations and Rubio, Bruccoleri, and Piet (2020) with 80 citations. Other highly cited publications included studies by Hasan et al., Chu et al., Majcherek and Hegerty, and Laukka et al.

The concentration of highly cited publications around 2020 suggests that the COVID-19 pandemic period accelerated scholarly interest in digital health technologies, telemedicine implementation, healthcare information systems, and healthcare management innovation.
These highly cited studies constitute the intellectual foundation of contemporary research on digital transformation in healthcare management. To identify the intellectual foundations of the field, Table 5 presents the ten most cited documents within the analyzed dataset.

Table 5. Top 10 Most Cited Documents in Digital Transformation and Healthcare Management Research

Rank	Authors	Year	Title	Citations
1	Uslu, B.Ç.; Okay, E.; Dursun, E.	2020	Analysis of Factors Affecting IoT-Based Smart Hospital Design	159
2	De Leeuw, J.A.; Woltjer, H.; Kool, R.B.	2020	Identification of Factors Influencing the Adoption of Health Information Technology by Nurses Who Are Digitally Lagging: In-Depth Interview Study	123
3	Rubbio, I.; Bruccoleri, M.; Pietrosi, A.; Ragonese, B.	2020	Digital Health Technology Enhances Resilient Behaviour: Evidence from the Ward	80
4	Hasan, K.; Chowdhury, M.J.M.; Biswas, K.; Ahmed, K.; Islam, M.S.; Usman, M.	2022	A Blockchain-Based Secure Data-Sharing Framework for Software Defined Wireless Body Area Networks	64
5	Chu, Y.; Tang, K.; Hsu, Y.-C.; Huang, T.; Wang, D.; Li, W.; Savitz, S.I.; Jiang, X.; Shams, S.	2023	Non-Invasive Arterial Blood Pressure Measurement and SpO2 Estimation Using PPG Signal: A Deep Learning Framework	59
6	Majcherek, D.; Hegerty, S.W.; Kowalski, A.M.; Lewandowska, M.S.; Dikova, D.	2024	Opportunities for Healthcare Digitalization in Europe: Comparative Analysis of Inequalities in Access to Medical Services	51
7	Laukka, E.; Pölkki, T.; Kanste, O.	2022	Leadership in the Context of Digital Health Services: A Concept Analysis	49
8	Ecer, F.; Haseli, G.; Krishankumar, R.; Hajiaghaei-Keshteli, M.	2024	Evaluation of Sustainable Cold Chain Suppliers Using a Combined Multi-Criteria Group Decision-Making Framework Under Fuzzy ZE-Numbers	42
9	Nguyen, H.-S.; Voznak, M.	2024	A Bibliometric Analysis of Technology in Digital Health: Exploring Health Metaverse and Visualizing Emerging Healthcare Management Trends	37
10	Ghayoomi, H.; Laskey, K.; Miller-Hooks, E.; Hooks, C.; Tariverdi, M.	2021	Assessing Resilience of Hospitals to Cyberattack	32

The citation analysis revealed that several publications have played a foundational role in shaping the intellectual structure of digital transformation research in healthcare management. As presented in Table 2, the study by Uslu, Okay, and Dursun (2020) emerged as the most influential

publication with 159 citations, followed by De Leeuw, Woltjer, and Kool (2020) with 123 citations. Highly cited studies primarily focused on smart hospitals, digital health technology adoption, healthcare resilience, blockchain-based health data management, artificial intelligence applications, and digital leadership in healthcare settings.

The dominance of these publications suggests that the current literature is strongly influenced by research examining healthcare digitalization, technological innovation, organizational readiness, cybersecurity, health information systems, and leadership capabilities. These studies collectively provide the theoretical and practical foundations for understanding how healthcare organizations adopt and leverage digital technologies to improve service quality, operational efficiency, patient outcomes, and organizational resilience.

Overall, the findings indicate that research on digital transformation in healthcare management has experienced substantial growth during the last decade, particularly after 2022. The publication trend demonstrates an increasing academic interest in the integration of digital technologies within healthcare organizations, with publication output reaching its highest level in 2024. This trend reflects the growing importance of digital transformation as healthcare systems worldwide continue to adopt innovative technologies to improve efficiency, service quality, and patient outcomes.

The bibliometric analysis revealed that healthcare management, digital health, telemedicine, healthcare innovation, workforce development, leadership, health information management, and data security constitute the dominant research themes within the field. Keyword co-occurrence and thematic mapping further showed that healthcare management and digital health function as the central conceptual nodes connecting emerging topics such as artificial intelligence, health informatics, workforce competency, and digital leadership. Overlay visualization demonstrated a recent shift toward research focusing on healthcare innovation, competency development, and organizational readiness, indicating the evolving priorities of healthcare digitalization.

Country and collaboration analyses highlighted the prominent role of European countries, particularly Italy and the United Kingdom, in shaping the global research landscape. Although China, the United States, Australia, and Saudi Arabia also contributed significantly to publication output, international collaboration networks remained concentrated within a limited number of research clusters. Citation analysis identified several highly influential publications that continue to provide the intellectual foundation for contemporary discussions on digital transformation in healthcare management. Furthermore, keyword co-occurrence, citation analysis, and thematic synthesis revealed strong conceptual relationships among studies addressing digital health implementation, healthcare technology adoption, organizational transformation, and healthcare service innovation.

Taken together, these findings suggest that the field has evolved from a technology-centered perspective toward a more integrated organizational and managerial approach. Future research is therefore expected to focus not only on technological advancement but also on leadership capabilities, workforce preparedness, digital governance, cybersecurity, interoperability, and the long-term sustainability of digital transformation initiatives in healthcare systems.

Discussion

The findings of this study reveal that digital transformation in healthcare management has evolved into a multidimensional phenomenon that extends far beyond the adoption of digital technologies. While earlier research primarily emphasized technological implementation, recent studies increasingly recognize that sustainable healthcare transformation requires the integration of technological capabilities, organizational readiness, workforce competencies, leadership support, and governance mechanisms. The bibliometric and thematic analyses demonstrate that the field has progressively shifted from a technology-centered perspective toward a more comprehensive understanding of digital transformation as a socio-technical and organizational process.

Digital Transformation Beyond Technology Adoption

One of the most significant findings emerging from this review is the recognition that digital transformation in healthcare should not be understood merely as the implementation of digital tools. Instead, it represents a fundamental transformation of organizational structures, processes,

and service delivery models. This finding is consistent with the arguments presented by (Uslu et al., 2020), who emphasize that healthcare digitalization requires the alignment of technological infrastructure, organizational processes, and managerial capabilities. Similarly, (Brommeyer et al., 2024) highlight the importance of organizational readiness as a prerequisite for successful transformation outcomes. These observations are further supported by (Papalia et al., 2023), who argue that leadership and management development are critical enablers of organizational transformation within increasingly digital healthcare environments.

The increasing prominence of digital transformation within healthcare reflects broader shifts occurring across contemporary organizations. Digital technologies no longer function solely as operational support systems but have become strategic assets capable of reshaping organizational value creation. Healthcare organizations are increasingly expected to integrate digital solutions into clinical workflows, managerial processes, patient engagement strategies, and organizational decision-making mechanisms. Consequently, digital transformation has become closely associated with organizational innovation, strategic adaptation, and long-term competitiveness.

The publication trend analysis supports this interpretation. The sharp increase in publications after 2022 suggests that researchers have begun to examine digital transformation from broader organizational perspectives rather than focusing exclusively on technology implementation. This shift may reflect growing recognition that technological investments alone do not guarantee transformation success. Instead, healthcare organizations must develop complementary organizational capabilities that enable effective technology utilization and sustainable innovation.

These findings contribute to the growing body of literature suggesting that healthcare digital transformation should be conceptualized as a socio-technical transformation process. Such a perspective recognizes the interdependence of technology, people, organizational structures, and institutional environments. Consequently, future research and practice should move beyond technology adoption metrics and consider broader organizational transformation outcomes.

Digital Health and Telemedicine as Drivers of Service Innovation

The results further indicate that digital health and telemedicine represent the most influential and visible manifestations of healthcare digital transformation. The dominance of these themes within the keyword network and density visualization suggests that healthcare researchers and practitioners view digital service delivery as a central component of transformation efforts.

The emergence of telemedicine as a dominant research theme reflects the profound impact of the COVID-19 pandemic on healthcare delivery systems. Rubio et al. (2020) demonstrate that telemedicine contributed significantly to organizational resilience by enabling healthcare providers to maintain continuity of care during periods of disruption. Similarly, (Hassan et al., 2024) emphasize the role of telehealth technologies in expanding healthcare accessibility and supporting patient-centered service delivery.

However, the significance of telemedicine extends beyond pandemic-related responses. The evidence synthesis suggests that telemedicine has become an important mechanism for addressing persistent healthcare challenges, including geographical disparities, workforce shortages, and increasing healthcare demands. By enabling remote consultations and digital monitoring, telemedicine supports more flexible and accessible healthcare delivery models.

The evolution of telemedicine also reflects broader changes in healthcare service innovation. Traditional healthcare systems have historically relied on physical interactions between patients and providers. Digital health technologies challenge this model by facilitating virtual care pathways, continuous monitoring, and personalized healthcare experiences. As a result, healthcare organizations increasingly operate within hybrid service environments that combine physical and digital interactions.

Recent studies further suggest that digital health services contribute not only to service continuity but also to reducing inequalities in healthcare access and improving patient engagement across diverse healthcare settings. (Majcherek et al., 2024) highlight the role of digital health innovations in strengthening healthcare accessibility, while (Yoo & Lee, 2022) emphasize the importance of integrating digital technologies into healthcare practice to support more responsive and patient-centered service delivery. These findings reinforce the view that digital health

technologies have evolved into strategic instruments for healthcare innovation rather than merely technological alternatives to conventional care.

Despite these benefits, several challenges remain unresolved. Infrastructure limitations, digital literacy disparities, reimbursement policies, and regulatory barriers continue to affect telemedicine implementation. Furthermore, the effectiveness of telemedicine varies across healthcare contexts and patient populations. These observations suggest that future studies should focus not only on adoption rates but also on long-term sustainability, quality outcomes, and equitable access to digital healthcare services.

Health Information Systems and Data Governance as Strategic Foundations

Another important finding concerns the strategic role of health information systems (HIS) and data governance within healthcare transformation. The bibliometric mapping identified health information management, interoperability, data sharing, and cybersecurity as increasingly important themes. These findings indicate that information infrastructures constitute the foundation upon which digital transformation initiatives are built.

(De Leeuw et al., 2020) argue that successful healthcare transformation depends heavily on the integration and interoperability of health information systems. Similarly, (Uslu et al., 2020) emphasize that smart healthcare environments require seamless information exchange among digital platforms, clinical systems, and organizational processes. Without effective information infrastructures, healthcare organizations face significant difficulties in realizing the benefits of digital technologies.

The growing importance of data governance reflects the increasing reliance on healthcare data as a strategic organizational resource. Digital transformation generates substantial volumes of clinical and operational data that support decision-making, performance management, and healthcare innovation. Consequently, healthcare organizations must establish governance mechanisms capable of ensuring data quality, accessibility, security, and ethical utilization.

Recent evidence also highlights the growing importance of electronic health records and digital monitoring systems as strategic organizational resources. (Hong & Dahnil, 2024) argue that integrated digital information systems can enhance healthcare decision-making, improve patient management, and support organizational performance. This observation further strengthens the argument that information infrastructures are becoming indispensable foundations for sustainable healthcare transformation.

The emergence of cybersecurity and blockchain-related studies further illustrates the evolving complexity of healthcare information management. (Ghayoomi et al., 2021) highlight the vulnerability of healthcare institutions to cyber threats, while (Hasan et al., 2022) propose blockchain-based approaches for enhancing data security and interoperability. These studies collectively suggest that future healthcare transformation efforts must balance innovation objectives with security and privacy requirements.

From a managerial perspective, data governance should no longer be viewed as a technical responsibility delegated exclusively to information technology departments. Instead, it should be recognized as a strategic management issue requiring organizational leadership, regulatory compliance, and cross-functional collaboration.

Artificial Intelligence as a Catalyst for Healthcare Innovation

The findings also reveal the increasing importance of artificial intelligence as a catalyst for healthcare innovation. AI-related keywords appeared prominently within recent publications, indicating growing scholarly interest in data-driven healthcare solutions.

The evidence synthesis demonstrates that AI technologies are increasingly applied to predictive analytics, diagnostic support, patient monitoring, resource management, and healthcare planning. (Chu et al., 2023) show that AI-based monitoring systems improve healthcare decision-making through real-time data analysis, while (Hasan et al., 2022) emphasize the role of advanced digital technologies in supporting healthcare innovation.

Recent studies have also highlighted the increasing integration of AI-enabled applications within broader digital health ecosystems. (Mansour & Bick, 2024) emphasize the transformative potential of intelligent technologies for supporting healthcare innovation and organizational

decision-making, while (Nguyen & Voznak, 2024) demonstrate how emerging digital health ecosystems increasingly rely on data-driven technologies to deliver predictive and personalized healthcare services. These developments indicate that AI is becoming a strategic component of future healthcare management and innovation agendas.

The growing prominence of AI reflects a broader transition from digitalization toward intelligent healthcare systems. Earlier transformation initiatives focused primarily on converting manual processes into digital formats. Contemporary innovations increasingly emphasize the use of advanced analytics and intelligent algorithms to generate insights, predictions, and automated decision support. This evolution suggests that healthcare organizations are moving toward more proactive and data-driven management approaches.

Nevertheless, the literature reveals an important imbalance. While substantial attention has been devoted to AI implementation and performance outcomes, relatively limited research addresses governance-related concerns. Questions regarding transparency, explainability, algorithmic bias, accountability, and ethical responsibility remain insufficiently explored. As AI becomes increasingly integrated into clinical and managerial decision-making, these issues are likely to become more significant.

Consequently, future research should extend beyond technological effectiveness and examine the institutional, ethical, and governance dimensions of AI adoption. Such efforts will be essential for ensuring that healthcare innovation remains aligned with principles of patient safety, fairness, and accountability.

Workforce Readiness and Digital Leadership as Emerging Priorities

Perhaps the most significant emerging theme identified through the overlay visualization concerns workforce development, competency enhancement, and digital leadership. Unlike digital health and telemedicine, which dominate existing literature, workforce-related topics appear to represent newer areas of scholarly attention.

Recent studies further indicate that managerial, informatics, and digital competencies among healthcare professionals are becoming increasingly important determinants of transformation success. (Abou Hashish et al., 2025) emphasize the importance of informatics competencies among nurse managers, while (Gao et al., 2025) highlight the growing need for competency development frameworks capable of supporting workforce adaptation within technology-driven healthcare environments. These findings suggest that healthcare organizations must invest not only in technological infrastructure but also in continuous workforce development initiatives.

The evidence synthesis suggests that workforce readiness constitutes a critical determinant of transformation success. (De Leeuw et al., 2020) demonstrate that healthcare professionals' digital competencies influence technology adoption outcomes, while (Yoo & Lee, 2022) highlight the growing importance of digital skills within healthcare practice. These findings reinforce the argument that technological infrastructure alone cannot guarantee successful transformation.

Similarly, (Laukka et al., 2022) emphasize the strategic role of digital leadership in facilitating organizational change. Healthcare leaders are increasingly required to manage complex transformation initiatives, support workforce adaptation, and foster cultures of innovation. Effective leadership therefore becomes a crucial mechanism for translating technological investments into meaningful organizational outcomes.

The emergence of workforce development as a recent research trend suggests that healthcare digital transformation is entering a new phase of maturity. Earlier research focused primarily on technological feasibility and implementation challenges. Contemporary discussions increasingly recognize that sustainable transformation depends on human capabilities, organizational learning, and adaptive leadership.

This finding has important implications for both research and practice. Healthcare organizations should invest not only in technological infrastructure but also in workforce development programs, digital competency training, and leadership capacity building. Likewise, researchers should investigate how human and organizational factors interact with technological innovation to influence transformation outcomes.

Theoretical and Practical Implications

Collectively, the findings of this study suggest that digital transformation in healthcare management should be understood as an integrated process involving technological innovation, organizational adaptation, information governance, workforce development, and leadership transformation. The field has evolved from technology-centric discussions toward more comprehensive perspectives that recognize the importance of socio-technical interactions.

From a theoretical perspective, the study contributes to the literature by integrating fragmented research streams into a coherent framework that links digital health, telemedicine, health information systems, artificial intelligence, workforce development, and organizational readiness. From a practical perspective, the findings highlight the need for healthcare managers and policymakers to adopt holistic transformation strategies that simultaneously address technological, organizational, and human dimensions.

Ultimately, sustainable healthcare transformation requires more than technological advancement. It requires leadership, governance, organizational learning, workforce preparedness, and a strategic commitment to continuous innovation. These factors collectively determine whether digital technologies become isolated innovations or catalysts for meaningful healthcare transformation.

Research Gaps and Future Research Agenda

Research Gaps

The bibliometric and thematic analyses revealed several important research gaps within the literature on digital transformation in healthcare management. A key gap identified in the literature is that, although digital health, telemedicine, and healthcare information systems have emerged as dominant research themes, much of the existing literature remains focused on technology adoption and implementation. Comparatively limited attention has been devoted to understanding how healthcare organizations sustain digital transformation over time through organizational restructuring, strategic adaptation, and long-term transformation management (Gao et al., 2025; Vinci et al., 2025).

Another important gap relates to workforce readiness and digital competency development remain emerging but insufficiently explored research areas. While recent studies emphasize the importance of digital competencies among healthcare professionals, evidence regarding comprehensive workforce transformation, digital literacy development, and long-term capability building remains limited across healthcare settings (Abou Hashish et al., 2025; Gao et al., 2025).

A further research gap relates to leadership and governance dimensions continue to receive relatively limited scholarly attention. Existing studies suggest that successful digital transformation requires leadership competencies, organizational vision, and effective change management; however, empirical investigations examining digital leadership and governance mechanisms remain comparatively scarce (Laukka et al., 2022; Papalia et al., 2023).

Beyond these issues, artificial intelligence has become one of the fastest-growing topics in healthcare digitalization. Nevertheless, current research predominantly focuses on technology adoption and operational applications, while issues related to accountability, transparency, explainability, and ethical governance remain insufficiently addressed (Mansour & Bick, 2024; Nguyen & Voznak, 2024).

Another emerging research gap healthcare data governance and cybersecurity continue to represent underdeveloped research domains. Although digital health systems increasingly rely on data-intensive infrastructures, challenges related to interoperability, privacy protection, information security, and secure data exchange remain inadequately explored (Hasan et al., 2022; Hong & Dahnil, 2024).

Lastly, the geographical distribution of research demonstrates a strong concentration within developed countries and technologically advanced healthcare systems. As a result, evidence regarding digital transformation implementation in developing countries remains limited, restricting the generalizability of existing findings across diverse healthcare contexts (Alharbi et al., 2025; Majcherek et al., 2024).

Future Research Agenda

Based on the identified gaps, several future research directions are proposed.

Future Research Agenda 1: Digital Leadership and Organizational Transformation

Future studies should investigate leadership competencies, governance structures, and organizational capabilities required to support sustainable digital transformation. Particular attention should be directed toward understanding how healthcare leaders facilitate organizational change, promote innovation, and build digitally mature healthcare organizations.

Future Research Agenda 2: Workforce Readiness and Digital Competency Development

Future research should focus on developing comprehensive frameworks for assessing workforce readiness and digital competencies. Longitudinal studies examining professional adaptation, digital literacy enhancement, and competency development across healthcare professions would contribute to a deeper understanding of the human dimensions of healthcare digitalization.

Future Research Agenda 3: Artificial Intelligence Governance in Healthcare

Future investigations should move beyond technology adoption and examine governance-related issues, including accountability, transparency, explainability, ethical oversight, and regulatory compliance. Such studies will be critical for ensuring responsible and trustworthy implementation of AI technologies in healthcare settings.

Future Research Agenda 4: Healthcare Data Governance and Cybersecurity

The increasing digitalization of healthcare services necessitates stronger attention to data governance and cybersecurity. Future studies should explore interoperability frameworks, privacy-preserving technologies, secure information exchange mechanisms, and cybersecurity resilience strategies capable of supporting integrated healthcare ecosystems.

Future Research Agenda 5: Sustainable Telemedicine and Digital Health Models

Although telemedicine and digital health services have expanded rapidly, questions remain regarding their long-term sustainability and integration into routine healthcare delivery. Future research should evaluate hybrid care models, organizational impacts, healthcare accessibility, patient outcomes, and cost-effectiveness to identify sustainable pathways for digital healthcare implementation.

Future Research Agenda 6: Digital Transformation in Developing Countries

Future studies should broaden the geographical scope of research by examining digital transformation initiatives in developing and emerging economies. Comparative investigations across healthcare systems with different levels of technological maturity may provide valuable insights into contextual barriers, implementation strategies, and mechanisms for reducing global digital disparities.

Conceptual Implications for Future Research

The findings of this study suggest that future research should adopt a more integrated perspective that simultaneously considers technological, organizational, and human dimensions of healthcare digital transformation. Digital technologies such as telemedicine, artificial intelligence, digital health platforms, and health information systems should be examined alongside organizational enablers, including leadership, governance, innovation capability, and strategic management. At the same time, workforce readiness, digital competency development, professional training, and change management should be recognized as essential human factors influencing transformation outcomes.

Such an integrated perspective may provide a more comprehensive understanding of how healthcare organizations can achieve sustainable digital transformation while improving service quality, operational efficiency, organizational resilience, and patient-centered care.

Limitations

Despite its contributions, this study has several limitations. First, the analysis was restricted to publications indexed in the Scopus database, which may have excluded relevant studies available in other academic databases. Second, only English-language articles were included, potentially limiting the representation of research published in other languages. Third, the findings are influenced by the selected search strategy, inclusion criteria, and bibliometric parameters applied

during the analysis process. Nevertheless, the use of a systematic screening procedure based on the PRISMA framework and the integration of bibliometric and thematic analyses helped ensure the rigor and reliability of the findings. Future studies may expand the scope of analysis by incorporating multiple databases, broader search terms, and comparative analyses across different healthcare contexts to provide a more comprehensive understanding of digital transformation in healthcare management.

CONCLUSION

This study systematically examined the development of research on digital transformation in healthcare management through a combined bibliometric and systematic literature review approach. Using 62 articles retrieved from the Scopus database and published between 2016 and 2026, the study mapped the evolution of the field, identified dominant research themes, explored intellectual and geographical research patterns, and proposed future research directions.

The findings reveal a substantial increase in scholarly interest in digital transformation in healthcare management, particularly after 2022, with publication output reaching its highest level during the most recent years of analysis. This trend reflects the growing recognition of digital technologies as strategic enablers of healthcare innovation, organizational effectiveness, and patient-centered service delivery. The analysis also identified the Journal of Nursing Management and Digital Health as the most productive publication outlets, while Italy, China, the United Kingdom, Australia, Saudi Arabia, and the United States emerged as the leading contributors to the global research landscape.

The bibliometric mapping highlighted healthcare management, digital health, telemedicine, healthcare innovation, workforce development, leadership, health information management, and data security as the dominant themes shaping the field. Furthermore, overlay visualization revealed several emerging research areas, including digital leadership, workforce competency development, artificial intelligence, healthcare data governance, cybersecurity, and organizational readiness. These findings suggest that research on healthcare digitalization is evolving from a technology-oriented perspective toward a more integrated organizational and managerial perspective that emphasizes leadership capabilities, governance mechanisms, workforce preparedness, and sustainable transformation strategies.

The study further identified several important research gaps. Although existing literature has extensively explored technology adoption and implementation, limited attention has been devoted to digital leadership, workforce competency development, artificial intelligence governance, healthcare data governance, cybersecurity resilience, sustainable telemedicine models, and digital transformation initiatives in developing countries. These gaps highlight the need for future investigations that move beyond technological implementation and focus on the organizational, managerial, ethical, and human dimensions of healthcare transformation.

Based on these findings, this study proposes a future research agenda emphasizing six strategic areas: digital leadership and organizational transformation, workforce readiness and competency development, artificial intelligence governance, healthcare data governance and cybersecurity, sustainable telemedicine and digital health models, and digital transformation in developing countries. Collectively, these areas provide a roadmap for advancing both theoretical understanding and practical implementation of healthcare digitalization.

This study contributes to the literature by providing a comprehensive overview of the intellectual structure, thematic evolution, and future directions of digital transformation research in healthcare management. From a theoretical perspective, the findings support the development of an integrated conceptual perspective that combines technological, organizational, and human dimensions as key determinants of successful healthcare transformation. From a practical perspective, the results offer valuable insights for healthcare managers, policymakers, and practitioners seeking to design and implement sustainable digital transformation strategies. Such an approach may help healthcare organizations enhance service quality, operational efficiency, organizational resilience, and patient-centered care in an increasingly digital healthcare environment.

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AUTHOR CONTRIBUTION STATEMENT

A.R. contributed to the conceptualization, methodology, data collection, formal analysis, visualization, and preparation of the original manuscript draft. M.Q.R. contributed to validation, supervision, manuscript review and editing, interpretation of results, and final approval of the manuscript. All authors have read and approved the final version of the manuscript.

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