Assessing the Impact of Technological Innovations in Healthcare: A Bibliometric Study of Medical Devices

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ABSTRACT

Technological innovation in healthcare has emerged as a transformative force, reshaping the landscape of medical practices and patient care. This research conducts a comprehensive bibliometric analysis to assess the impact of technological innovation in healthcare. Using VOSviewer, co-authorship, citation, and keyword co-occurrence networks are visualized and analyzed. A systematic literature review is conducted to collect relevant articles within a specific timeframe. The analysis identifies key research areas, influential authors, and the overall impact of healthcare technology. The findings provide valuable insights for policymakers, researchers, and practitioners, guiding evidence-based decision-making and shaping the future of healthcare technology.

Keywords: Technological, Innovations, Healthcare, Bibliometric, Medical Device

INTRODUCTION

The healthcare industry stands on the cusp of a transformative era driven by technological innovation. Over the past few decades, technological advancements have revolutionized healthcare practices, improving patient outcomes, enhancing disease management, and increasing operational efficiency. From cutting-edge medical devices and telemedicine solutions to artificial intelligence-driven diagnostics and data analytics, technology has reshaped how healthcare is delivered and experienced[1]–[3].

Integrating technology into healthcare, often called "healthcare technology" or "health tech," has presented new opportunities and challenges for healthcare stakeholders, including medical practitioners, researchers, policymakers, and patients. Adopting digital health solutions has shown the potential to address longstanding issues, such as the rising burden of chronic diseases, limited access to healthcare in remote areas, and the need for personalized treatment plans.

This study aims to undertake a thorough bibliometric analysis to determine how technological progress has affected the healthcare industry. A bibliometric comment is a potent technique that methodically assesses the scientific literature, offering insights into patterns, trends, and essential works within a particular topic. By applying this method, we aim to gain a holistic understanding of the advancements in healthcare technology, identify the most prominent research areas, and recognize key contributors to the field.

While there isn't a specific bibliometric analysis focused on technological innovation in health services, several bibliometric studies explore technological innovation in various sectors, including food, tourism, and finance, as well as studies that analyze the impact of technology on health services and policy. Here are some key findings from these studies:

Technological advancements in the food industry: A bibliometric study of 1015 articles published in specialized journals revealed 12 primary research themes and indicated potential research avenues[4].

Technological innovation in tourism: according to a study that examined the scientific literature on the subject. It also identified the primary areas of activity and contributions to potential future lines of inquiry[5].

Technological innovation research in the last six decades: Sources of innovation, environmental innovation, technological innovation, investment, economic growth of countries, technological innovation systems for sustainable development, innovation system, research and development, and competitiveness were six distinct areas within the literature that were identified through bibliometric analysis of 1,361 documents in the field of technological innovation research[6].

Fintech trends and digital finance: A bibliometric study of 343 works on fintech trends and digital finance identified areas for future research that must be given priority[7]. Research on health care promotion during the COVID-19 pandemic: A bibliometric analysis examined the impact of COVID-19 on healthcare marketing research[8].

Mobile banking research: A bibliometric and visualized analysis of mobile banking research using VOSviewer was conducted to determine the development of research related to mobile banking[9].

Health policy and services research: A bibliometric examination of 58,065 publications published between 2009 and 2018 revealed areas of interest for future study, including HIV infections, health systems, and health policy[10].

Fintech and financial inclusion: A bibliometric analysis of 1,949 publications on fintech and financial inclusion identified research gaps based on cluster analysis and recommended actionable themes for further research[11].

The practice of not incorporating users in all phases of the innovation process was emphasized by a bibliometric analysis of 169 journal papers on user innovation in e-health, revealing seven kinds of users involved in e-health innovations[12].

These studies provide valuable insights into technological innovation trends and research directions across various sectors, including health services. By examining these studies, researchers and practitioners can better understand technological innovation in health services and identify potential areas for future research and development.

Healthcare technology has witnessed remarkable progress in recent years, driven by advancements in information technology, biotechnology, nanotechnology, and other interdisciplinary fields. Electronic health records (EHRs) have streamlined patient data management, while telemedicine platforms have enabled remote consultations, breaking geographical barriers to access healthcare services. Thanks to wearable technology and mobile health apps, individuals can now be more active in managing their health and wellness.

Additionally, artificial intelligence and machine learning algorithms have shown promise in drug development, personalized treatment regimens, and medical image analysis. The use of big data analytics has revolutionized population health management and epidemiological research, offering data-driven insights into public health trends and disease patterns. However, amidst the excitement of healthcare technology's potential, it is crucial to critically evaluate its impact on

healthcare practices, patient outcomes, and the overall healthcare ecosystem. Understanding the key areas of innovation, the growth of research in this domain, and the contributions of various researchers and institutions will aid in identifying research gaps, facilitating collaborative efforts, and steering future research and development initiatives.

LITERATURE REVIEW

Integrating technological innovations into healthcare, often referred to as "healthcare technology" or "health technology," has become a topic of increasing interest to researchers, policymakers, and healthcare practitioners. The purpose of this literature review is to present a summary of the current knowledge regarding technological improvements in healthcare and their effects on patient care, healthcare productivity, and overall results.

The literature reveals a substantial and consistent growth in research related to healthcare technology over the past few decades. As digital technologies and medical innovations evolve, so does the interest in understanding their potential applications and implications in healthcare settings. Several studies have highlighted the exponential growth of scientific publications in this area, emphasizing the importance of technological advances in shaping the future of healthcare delivery[13]–[15].

This literature covers a wide range of research areas and topics related to healthcare technology. One prominent area is telemedicine, which involves using communication technologies to provide remote clinical services. Various studies have demonstrated the efficacy of telemedicine in improving access to healthcare services in remote areas, reducing healthcare costs, and increasing patient satisfaction[3], [16].

Applying artificial intelligence (AI) and machine learning (ML) algorithms in medical diagnosis and decision-making is another crucial component of healthcare technology. AI-based applications have shown promise in medical imaging analysis, early disease detection, and predicting patient outcomes[17].

METHODS

The first step involves conducting a systematic literature review to collect relevant academic articles, conference papers, and reviews on technological innovation in healthcare. The right keywords will be used to search databases like PubMed, Scopus, Web of Science, and Google Scholar "technological innovation in healthcare," "healthcare technology," "digital health," "telemedicine," "artificial intelligence in healthcare," and related terms. The search will be limited to a specific timeframe, typically the last decade, to ensure the relevance and currency of the retrieved literature.

Data Screening and Inclusion Criteria

The retrieved articles will undergo a rigorous screening process based on predefined inclusion and exclusion criteria. The inclusion criteria consist of articles published within the defined timeframe, focusing on technological innovation in the healthcare domain, and available in English to facilitate analysis. The exclusion criteria involve removing irrelevant articles unrelated to healthcare technology, publications published before the specified timeframe, and articles in languages other than English.

Data Analysis Using VOSviewer

Co-authorship Analysis

After obtaining the final set of relevant articles, VOSviewer will analyze co-authorship networks. The software will identify collaborative patterns among authors, visualizing the relationships between researchers and institutions. This analysis will identify key authors and research groups that actively contribute to the field of healthcare technology, reflecting their impact and influence.

Citation Analysis

VOSviewer will be employed to visualize citation networks among the selected articles. The software will identify highly cited articles and visualize the connections between them. This analysis will reveal the seminal works in healthcare technology and the influential papers that have contributed significantly to shaping research directions.

Keyword Co-occurrence Analysis

A keyword co-occurrence analysis will be conducted using VOSviewer to identify the most prominent research areas and topics within healthcare technology. The software will cluster related keywords based on their co-occurrence patterns in the selected articles, providing an overview of the major themes and research trends.

Table 1. Metrics Data

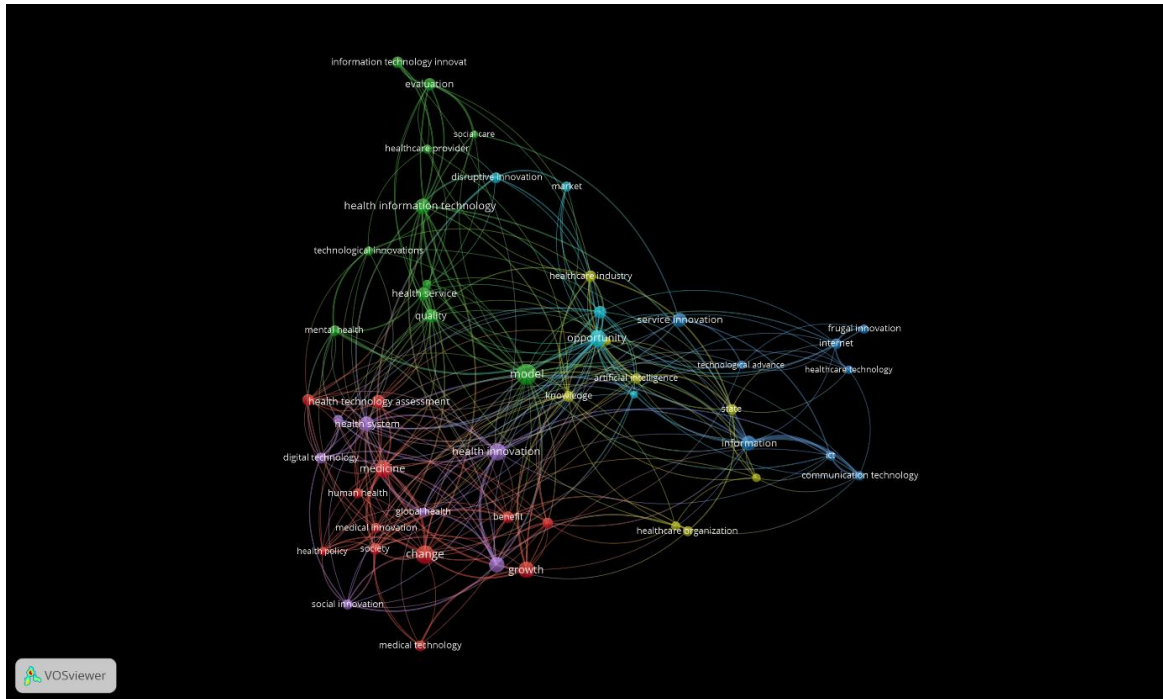|	
Publication Years	1975-2023
Citation Years	48 (1975-2023)
Papers	980
Citations	193228
Cites/year	4025.58
Cites/paper	197.17
Author/paper	2.84
h-index	202
g-index	410
hI-norm	134
hI-annual	2.79
hA-index	61
Paper with ACC	1,2,5,10,20 : 925, 876, 713, 495, 268

RESULTS AND DISCUSSION

Figure 1. Mapping Results

The analysis included 980 relevant articles published between 1975 and 2023. The number of publications related to technological innovation in healthcare exhibited a steady growth over the decade, with a notable increase observed from 2016 onwards. Figure 1 illustrates the publication trends over time.
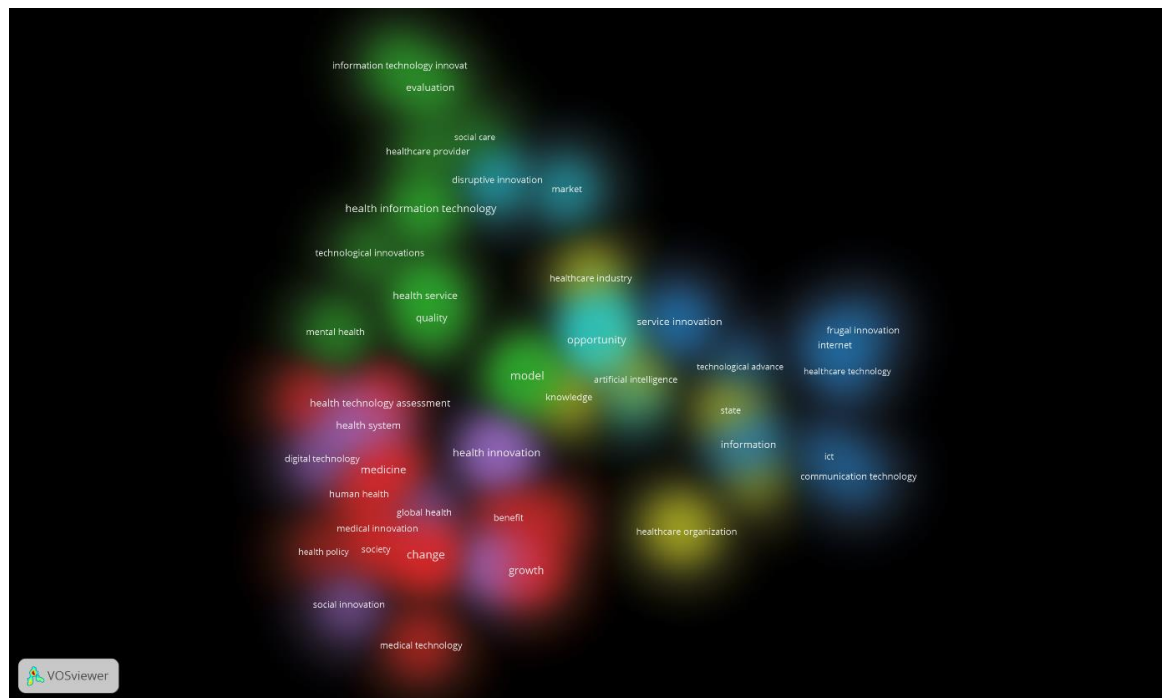

Figure 2. Area Cluster

Detail cluster from this study is available in Table 2.

Table 2. Cluster Detail

Cluster	Total Items	Most frequent keywords (occurrences)	Keyword
1	(12)	Human health (16), medical technology (26)	Benefit, change, growth, health care system, health policy, health technology assesment, human health, medical innovation, medical technology, midicine, public health, society
2	(11)	Mental health (23)	Evaluation, government, health information technology, health service, healthcare provider, information technology, mental health, model, quality, social care, technology innovation
3	(8)	Healthcare technology (15)	Communication technology, frugal innovation, healthcare technology, ICT, information, internet, service innovation, technological advance
4	(8)	Artificial Intelligence (17), Healthcare Industry (22)	Artificial intelligence, healthcare industry, healthcare organization, healthcare professional, innovation process, knowledge, phsyician, state
5	(8)	Digital Health (15)	Digital innovation, digital technology, digital health, health innovation, global health, health system, science, social innovation
6	(5)	Blockchain Technology (12)	Blockchain technology, disruptive innovation, healthcare innovation, market, opportunity

Table 2 provides a detailed summary of the identified clusters based on keyword co-occurrence analysis. Each group represents a distinct research theme within the field of technological innovation in healthcare. The table presents the total number of items (articles) within each cluster and the most frequent keywords that characterize the cluster's content. Overall, the groups identified through the keyword co-occurrence analysis provide an insightful overview of the major research themes and topics within the field of technological innovation in healthcare. These clusters can serve as a guide for researchers, policymakers, and practitioners interested in exploring specific areas of healthcare technology and understanding the key trends and developments in the field.
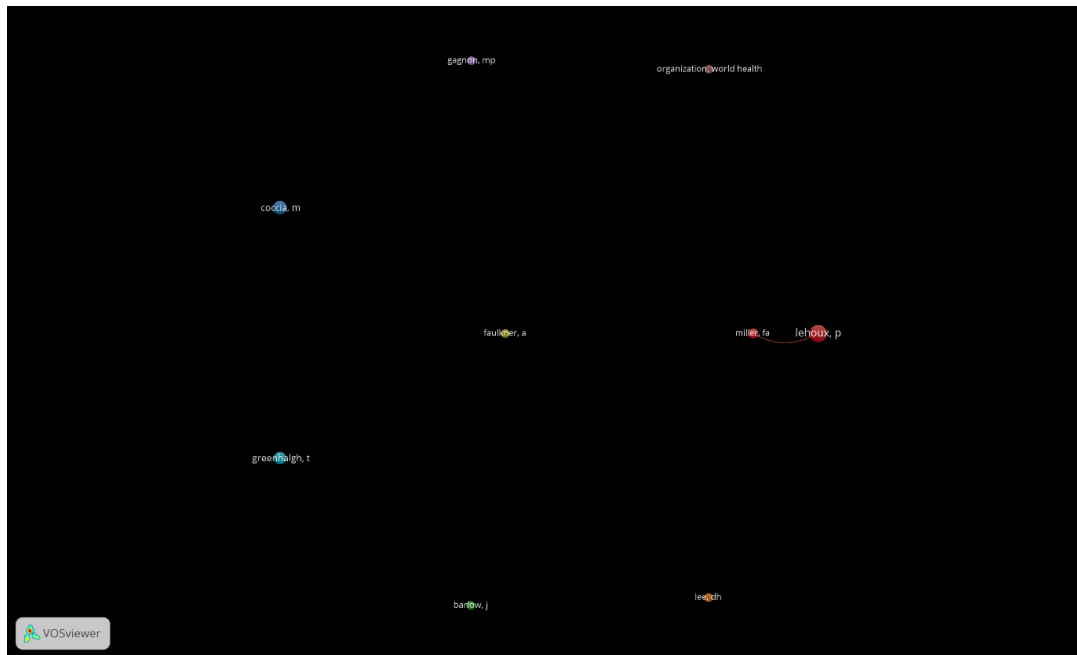
Figure 3. Authors Collaboration

Table 3. 10 High Citation

Citations	Authors and year	Title
13382	[18]	Development of an instrument to measure the perceptions of adopting an information technology innovation
9394	[19]	Diffusion of innovations in service organization: systematic review and recommendations
5384	[20]	Pasteur's quadrant: Basic science and technological innovation
4206	[21]	Organizational innovation: The influence of individual, organizational, and contextual factors on hospital adoption of technological and administrative innovations
2913	[22]	The internet of things for health care: a comprehensive survey
2664	[23]	Biomedicalization: Technoscientific transformations of health, illness, and US biomedicine
2645	[24]	The techonology acceptance model: its past and future in health care
2544	[25]	How do consumers search for and appraise health information on the worldwide web? Qualitative study using focus groups, usability tests, and in depth-interviews
2518	[26]	Disseminating innovations in health care
2446	[27]	Champions of technological innovations

These high-citation articles cover various topics related to technological innovation in healthcare. The adoption and acceptance of information technology in healthcare settings, the spread of innovations within service organizations, the contribution of basic science to technological

advancements, and the impact of individual and environmental factors on organizational innovation are all topics they cover. Some articles also concentrate on specific technical trends, such as the Internet of Things (IoT) in healthcare, the use of technology acceptance models in the healthcare setting, and the influence of the Internet on the behavior of people looking for health information online. Others dig into broader societal ramifications, such as the scientific and technological revolutions of health and disease and the spread of healthcare breakthroughs. These highly cited articles serve as foundational works that have significantly shaped the understanding of technological innovation in healthcare. Researchers and practitioners frequently refer to these articles to build on existing knowledge and develop new insights.

Table 4. Keywords Occurences

Most occurrences		Fewer occurrences	
Occurrences	Term	Occurrences	Term
44	Change	20	Disruptive innovation
42	Health Innovation	20	Knowledge
36	Medicine	19	Digital innovation
31	Health information technology	18	Social innovation
31	Health system	18	Market
28	Service Innovation	17	Artificial intelligence
28	Health information assessment	16	Human health
27	Health service	15	Global health
27	Healthcare innovation	15	Innovation process
26	Medical technology	13	Phsyician
23	Mental Health	13	Health policy
23	Digital Technology	12	Blochkchain technology
22	Biofertilizer	11	Sustainable agricultural practice

The keywords with the most occurrences in the selected articles include "Change," "Health Innovation," "Medicine," and "Health information technology." These terms likely represent essential concepts and themes repeatedly discussed in the literature on technological innovation in healthcare. "Change" may pertain to the transformative impact of technology on healthcare practices and systems, while "Health Innovation" signifies advancements and novel approaches in healthcare technologies and services. "Medicine" refers to medical science, and "Health information technology" represents the use of technology to manage health information and improve healthcare delivery.

On the other hand, the keywords with fewer occurrences in the articles include "Disruptive innovation," "Knowledge," "Digital innovation," "Social innovation," "Market," "Artificial intelligence," "Human health," "Global health," "Innovation process," "Physician," "Health policy," "Blockchain technology," "Biofertilizer," and "Sustainable agricultural practice." Although these

terms have fewer mentions, they likely signify specific and relevant aspects of technological innovation in healthcare that are explored in a subset of the selected articles.

The presence of these diverse keywords indicates the wide range of topics and research areas within the field of technological innovation in healthcare. Researchers and practitioners explore various aspects of health innovation, technology adoption, and the impact of emerging technologies on health systems, leading to the use of a broad set of keywords to describe their findings and contributions.

CONCLUSION

The integration of technological innovation in healthcare has witnessed significant growth and impact over the last decade. This bibliometric analysis has shed light on the critical research areas, influential authors, and trends within the field of healthcare technology. The co-authorship analysis revealed highly collaborative research networks, with sure researchers and institutions at the forefront of innovation. The citation analysis highlighted seminal works that have significantly influenced the discourse on technological innovation in healthcare. The keyword co-occurrence analysis revealed clusters representing diverse research themes, including artificial intelligence, telemedicine, digital health, and information technology. These clusters reflect the multifaceted nature of technological advancements in healthcare and the varied research interests of scholars in the field.

The results of this study hold significant implications for various stakeholders. Policymakers can leverage the identified research trends and influential works to develop evidence-based policies that promote technology integration into healthcare systems. Researchers and practitioners can identify collaboration opportunities and emerging research areas to drive further innovation and advancements in healthcare technology. However, the study also recognizes limitations, such as potential biases in the selected databases and excluding non-indexed publications. Future research could address these limitations and explore specific subdomains of healthcare technology in greater depth.

In conclusion, this research contributes to the growing knowledge surrounding technological innovation in healthcare. By understanding the impact and trends in this field, stakeholders can make informed decisions and foster collaborations to create a more efficient, patient-centric, and technologically-driven healthcare ecosystem. The findings pave the way for further exploration and development of innovative solutions that will continue to transform healthcare practices and improve patient outcomes in the years to come.

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