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DIGITIZATION AND INNOVATION IN HEALTHCARE SERVICES

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Abstract
Innovation and digital technologies have caused major changes in most fields today, including health services. Thus, access to telemedicine, investigations with modern equipment and online scheduling improved the time spent by patients in receiving the services they needed. In this context, in the last two decades, the interest of academics and specialists in studying the complex relationship between digitization and innovation in the medical field has increased. Therefore, the purpose of this research is to highlight the conceptual links between "healthcare", "innovation" and "digitalization" in order to highlight the current concerns of this sector. Using a bibliometric analysis and the Web of Science database, the paper manages to analyze 650 scientific documents in which these concepts were found. The results of the survey highlight the fact that there was a high interest in research on the relationship between these concepts during the pandemic period. Also, the thematic map created identified specific clusters related to digitization and health. From a theoretical point of view, the research complements academic studies in this field and in particular extends bibliometric theories. From a practical point of view, this study provides valuable information to practitioners and decision-makers in the medical field, and especially to those who are in full development and digitalization process. As an element of originality, the paper identifies thematic groups that provide readers with information on emerging topics in this field.
Keywords: Innovation, Digital, Healthcare, E-Health, Covid-19, Bibliometric.
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1. INTRODUCTION

The challenges facing the medical field are multiple and diverse these days (Gjellebæk et al., 2020). The care system struggles to maintain the quality of services and especially to satisfy patients who need careful and correct care. To provide medical care according to patients' expectations, health systems are forced to use technological innovations and digital technologies to improve access to medical care (Chapman et al., 2004). Also, the greatest contributions, brought by telemedicine and mobile applications that monitor the health status of patients, are felt by people who live in disadvantaged areas or with less developed infrastructure (Ali & Khan, 2023). In addition, during the pandemic with the Covid-19 virus, digital technologies ensured the continuity of medical care for patients with various ailments from a distance, which improved the resilience and the way medical units' function (Behar et al., 2020).

The Covid-19 pandemic has also impacted academic research. Much research has been concerned during the pandemic and after the pandemic to determine relationships, influences and phenomena that affected the activity and the way society functions. Academic studies in the medical sector have also been concerned with identifying new ways to satisfy patients, however there is a gap between studies that include healthcare, digitization and innovation from a bibliometric perspective. Thus, the purpose of this paper is to highlight the conceptual connection between ”health”, ”innovation” and "digital". The research aims to determine this relationship through three research objectives. (O1) Determining how scientific research has evolved over time. (O2) determining the main emerging trends that integrate the three concepts and how they interact with other emerging concepts and (O3) determining how the covid-19 pandemic has influenced the academic environment in the medical field at the intersection with digitization and innovation. The research begins with a review of the scientific literature, to highlight the latest opinions of researchers regarding innovation and digitization in the medical sector, later the study presents methodological elements intended for bibliometric analysis and the data collection method to fulfill the three proposed objectives. The final section of the paper highlights the findings of the analysis along with discussion and practical recommendations for healthcare organizations seeking to integrate digital technology. The research ends with relevant conclusions on the entire study, practical and theoretical contributions are also highlighted, along with the limits that intervened during the research and potential future research directions.

2. REVIEW OF THE SCIENTIFIC LITERATURE

In academic studies, Awad et al. (2021) believes that by integrating digital technologies in the medical field, there is an opportunity to revolutionize the way the medical care system works. Thus, through technologies, care organizations have the opportunity to improve organizational processes such as, the diagnosis of diseases can be performed in a faster way and with greater accuracy, patients have the opportunity to have access to personalized care services and at a distance. The biggest advantage that digital technology brings to the health system is related to the fact that it offers a possibility for patients to identify chronic and critical diseases early. Thus, through the early identification of these diseases, patients are given the opportunity to adopt preventive measures or even to blur the evolution of dangerous diseases (Arden et al., 2021). In this context, there are numerous benefits that digital technology can bring in the medical field, having the role of improving the efficiency, effectiveness, accuracy of the diagnosis and directly the way the patient is treated and cared for. From an organizational perspective, Scheibner et al. (2021) believe that the advances brought by digital

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technology also have the role of minimizing administrative costs and encouraging research and innovation efforts within the industry to overcome emerging dangers.

In the last ten years, Marx & Padmanabhan, (2020) believe that the Covid-19 virus pandemic has exerted the greatest pressure on organizations in the healthcare sector to integrate and use digital technology. As a result of the social distancing measures and the restrictions imposed during the Covid-19 period, patients increasingly used remote medical assistance, carried out through telemedicine, video-audio calls and online consultations, all aimed at contributing to patient well-being (Behar et al., 2020). Although these technologies were developed before the pandemic, according to Omboni et al. (2022) this period of crisis has demonstrated the usefulness of these technologies in the medical field considering that it has overcome geographical barriers to ensure medical assistance for patients in need.

Also, Meskó et al. (2017) highlight the fact that the integration of digital technologies in health can cause patients to be more involved and responsible for medical decisions and consequences considering the fact that in traditional medicine the medical staff had to assume the burden for all processes, infrastructure, information and the decisions adopted. Also, to provide safety to both patients and healthcare professionals, organizations have had to invest in infrastructure, cyber security systems and innovation. Moreover, for the use of these technologies, medical professionals need continuous training to adapt to the new requirements of the organization and patients.

Academic studies (Gjestsen et al., 2017; Lindberg et al., 2017; Gjellebæk et al., 2020; Popa et al., 2022; Banciu et al., 2023) have highlighted that a shift from traditional healthcare to e-health may represent the most challenging stage in today's highly dynamic and ever-changing world. There are numerous factors that are considered obstacles to this transition, currently not exploiting the potential of e-health. Thus, factors such as poorly developed infrastructure, resistance to change, social factors and legislative environment prevent social welfare organizations from utilizing the benefits of emerging technologies. In a study by Labrique et al. (2018) it is mentioned that the lack of adequate infrastructure to support this process is the most encountered challenge even in developed geographical areas. Also, this limit is highlighted by the lack of technological resources, especially the lack of internet connections, the availability of digital devices and the knowledge to use and capitalize on these technologies (Alkureishi et al., 2021; Bunea et al., 2022). Also, reluctance to change can determine the extent to which professionals accept changes in organizational processes and structures, preventing the adoption of e-health solutions (Talwar et al., 2023).

3. RESEARCH METHODOLOGY

The purpose of this paper is to identify the connections between the term's 'healthcare', 'innovation' and 'digital' within specialty literature. In addition, the paper aims to observe whether the COVID-19 pandemic has influenced scientific production. Thus, the methodological approach of the work assumed the realization of a bibliometric analysis, a method well known in the academic world aimed at analyzing quantitative data related to scientific publications (Bunea, 2021; Igreț et al., 2022; Popescu et al., 2023). This includes aspects such as the number of citations, author patterns, trends in research topics, and other factors that contribute to academic discourse and inform actions in various fields of interest. Bibliometric studies can also be important for academics who are interested in the development of this field of research.

The methodological process of the research went through several stages, among which (1) in the first stage, the Web of Science database was queried by searching for the words "healthcare", "innovation" and "digital". In addition, to identify all derivatives of the concepts of interest (such as care, health organizations, e-health) the symbol (*) was used. Also, all concepts were written under ("") to accurately generate the words of interest in the results. Selection filters were also applied to the results. Thus, the data from the year 2024 were excluded from the analysis considering that they do not reflect a complete situation. Also, those early access scientific materials have been removed. Thus, 650 scientific materials suitable for analysis were identified. (2) In the second stage of the analysis, the data was downloaded and processed using the Biblioshiny program. Developed by Aria & Cuccurullo (2017), this program facilitates relevant bibliometric and visual analyzes through an interactive web interface. (3) In the last stage, several analyzes were performed on the data to identify the evolution of research over time, the most productive journals, the strategic map of keywords, factor analysis, and last but not least the evolution of keywords from 2006 to 2023.

4. RESULTS

The first objective of the paper was to observe the evolution over time in research for the group of words "healthcare", "innovation", and "digital", aiming to determine when researchers began to show interest in innovation within the healthcare system and digitization. Figure 1 shows that the first scientific paper was published in 2006. Since then, there has been an upward trend in research on the relationship between the health system, innovation and digital. Later in 2013, there were five scientific publications, and in the following year their number almost tripled, with 12 scientific materials published. The year 2021 however showed a downward trend in academic research with 90 academic papers published.

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However, the volume of research remains at a high level. From 2021 to 2023 there has been a growing interest in healthcare and digital and innovation. These interests can be justified by the effects that the Covid-19 pandemic has generated on health services, with between 90 (2021) and 133 (2023) academic materials being published.

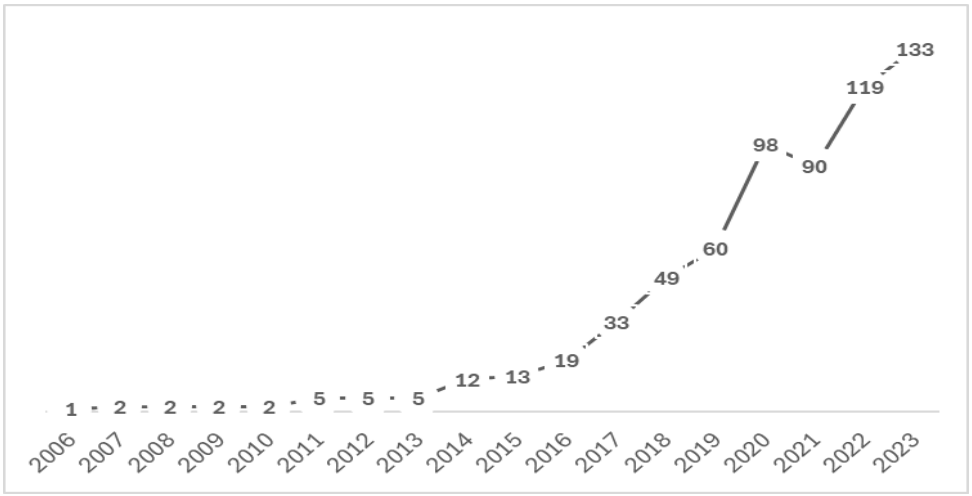

FIGURE 1. THE EVOLUTION OVER TIME OF RESEARCH
Source: Author with data from Web of Science

The following analysis presents the top 10 most productive journals in the process of publishing scientific materials in this field. According to Table no. 1, it is observed that Frontiers in Public Health demonstrate higher productivity within this domain. As a specialized journal, it has effectively published 20 scientific papers on digitalization and innovation in the medical system during the analyzed period.

Second is Sustainability journal, which stands out as one of the most productive journals, recording more than 18 publications on this topic during the analyzed period. Frontiers in Digital Health ranks 3rd together with the International Journal of Environmental and Public Health Research, with 16 scientific articles published, representing 2% of a total of 650 academic materials. In this top, we also find the journals Healthcare, BMC Health Services Research, Circular, And Digital Health, each with 11 articles. The Cureus Journal of Medical Science and IEEE Access complete the ranking of the ten most productive sources, with nine and eight articles published on this topic, respectively.

In the next stage, an analysis called thematic map was carried out. This analysis has the role of presenting different clusters, but especially within them which are the emerging or future fields of research in this field (Agbo et al., 2021). According to researchers Agbo et al. (2021) thematic word map makes a grouping of concepts used in studies and evaluates connections between concepts in order to highlight thematic categories. These thematic categories/clusters have different characteristics and

properties, such as density and centrality, and this differs according to their position within the map. If the density is represented by their vertical position, the centrality is represented by the horizontal position of the clusters. Centrality denotes the degree of correlation among various topics, while density assesses the cohesion among nodes (Esfahani et al., 2019). Thus, according to Figure 2 four quadrants have been identified as follows: The first quadrant (Q1) named "Niche Themes" refers to those specific topics or areas of interest in a field that may not be as widely studied or recognized as the more popular topics. Niche topics often address a narrower audience or address specific specialist research questions or concerns. Quadrant Two (Q2) called "Motor Themes" refers to the driving themes, while quadrant three (Q3) called "Emerging Themes" refers to patterns, newly identified, or emerging topics. The last quadrant (Q4) called the "Basic Themes" represents key principles, theories, or concepts that are central to the field of study.

TABLE 1. TOP 10 MOST PRODUCTIVE ACADEMIC JOURNALS

No.	Sources	Articles	Percentage of 650
1	FRONTIERS IN PUBLIC HEALTH	20	3%
2	SUSTAINABILITY	18	3%
3	FRONTIERS IN DIGITAL HEALTH	16	2%
4	INTERNATIONAL JOURNAL OF ENVIRONMENTAL RESEARCH AND PUBLIC HEALTH	16	2%
5	HEALTHCARE	13	2%
6	BMC HEALTH SERVICES RESEARCH	11	2%
7	CIRCULATION	11	2%
8	DIGITAL HEALTH	11	2%
9	CUREUS JOURNAL OF MEDICAL SCIENCE	9	1%
10	IEEE ACCESS	8	1%

Source: Author with data from Web of Science

Thus, analyzing Figure 2 different clusters can be identified in each of the quadrants mentioned above. Q1 and Q4 are related mostly to the keyword's 'healthcare', 'innovation', and "digital". In Q1 we identify the groups "pressure control blood ", "doctor consensus italian", "controlled trial app", "biomedical evolution process" and "environmental quality drug". Considering the fact that this quadrant presents specific topics that may not be as widely studied or recognized as the more popular topics, the quadrant also presents high density but low centrality. Therefore, researchers have examined all these concepts in greater detail and all these studies are linked to innovation in the digitization process.

In Q2, there are important themes for the general research area. Therefore, in Figure 2, there are two clusters: "data adoption digitalization," located on the border with niche themes, and "artificial medical

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intelligence," located on the border with Q4, representing the basic themes. Thus, these clusters are characterized by a high centrality and density, presenting the collective interest in scientific development and innovation in the medical field.

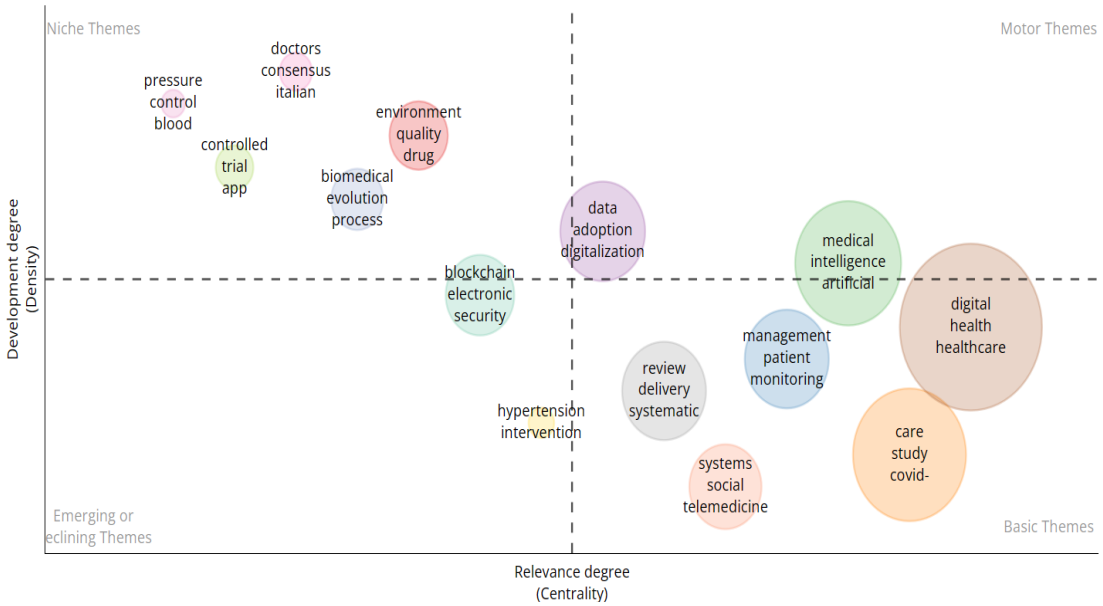

FIGURE 2. THEMATIC MAP OF THE KEYWORDS PLUS
Source: Author with Biblioshiny

In the Q3 quadrant, the emerging themes of this topic are presented, and the studies included concepts such as "blockchain electronic security" and "hypertension intervention". These themes are very important for researchers at the present time and also for future research. Blockchains in the medical field offer certain benefits for the organization and patients Shahnaz et al. (2019) mention that this technology provides security, anonymity and integrity of patient data without the intervention of a party. Moreover, the security of medical data must be treated as a top priority for healthcare organizations. Within Q4, there are the most clusters and the most conceptual links between the concepts within them. Q4 also presents the main "core" themes that have been tackled by academics over time. The most used keywords plus such were "systematic review", "management patient monitoring", "systems social telemedicine", "social", "digital healthcare", "care study covid". All these concepts indicate that people's concern about science in general has been about improving the quality, accessibility, efficiency and effectiveness of medical services. Systematic reviews in the medical field are both important and necessary, considering that through them, medical specialists and academics can identify medical solutions to specific problems of patients, regardless of their nature. Also, patient monitoring and their management must be updated and improved with the new expectations of patients. Thus, personalized

treatments, specific to individual needs, are essential for the current medical care system, in addition to the management of health needs expertise and up-to-date knowledge to face the challenges encountered in this field.

The factor analysis represented in Figure 3 delineates the complexities of the conceptual structure delimited into two dimensions with positive and negative values. In dimension one (D1) the key concepts found in the area with positive values represent the frequency of studies associated with the analyzed key concepts (Begimbetova et al., 2023). The most used keywords are "patient privacy", "challenges", "technologies", "transformation", "innovation", "system", "opportunities", "performance", "organizations", "governance", "networks", and "strategy." While the area with lower positive values is characterized by lower productivity from a scientific point of view, the words "people" and "adaptation" being identified.

The plus keywords identified in dimension two (D2) show different characteristics depending on their strategic positioning. In the positive area, concepts that are identified in scientific materials or articles with a high impact are highlighted, such as "telemedicine", "care", "quality", "experiences", "big data", "artificial intelligence", "internet", and "things.". While the key concepts identified in areas with negative values are characterized by low quality, and these are: "risk", "health", "barriers" and "outcomes".

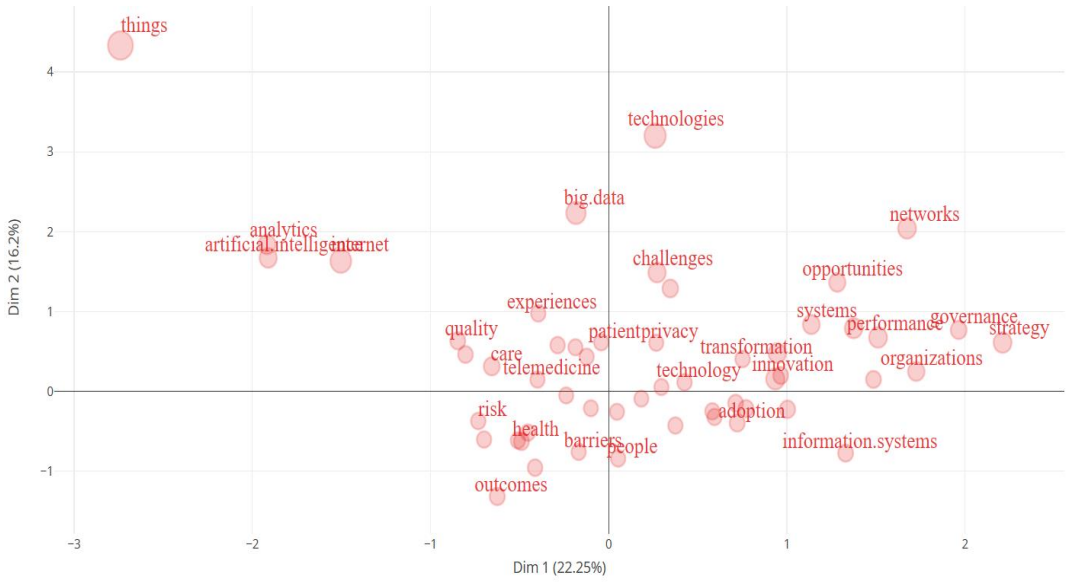

FIGURE 3. FACTORIAL ANALYSES OF THE KEYWORDS PLUS
Source: Author with Biblioshiny

The last analysis of the research was to identify the evolution of key concepts through keywords plus over time. Thus, Figure 4 shows two distinct time periods and the evolution of key concepts used in scientific research in the period 2006-2018 (left side) and until 2019-2023 (right side). The results

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indicate that from 2006 to 2018 there were used concepts in academic studies such as "mobile health", "digital technologies" and innovation. A special emphasis was also placed on the integration of big data in the digitization and innovation of health systems.

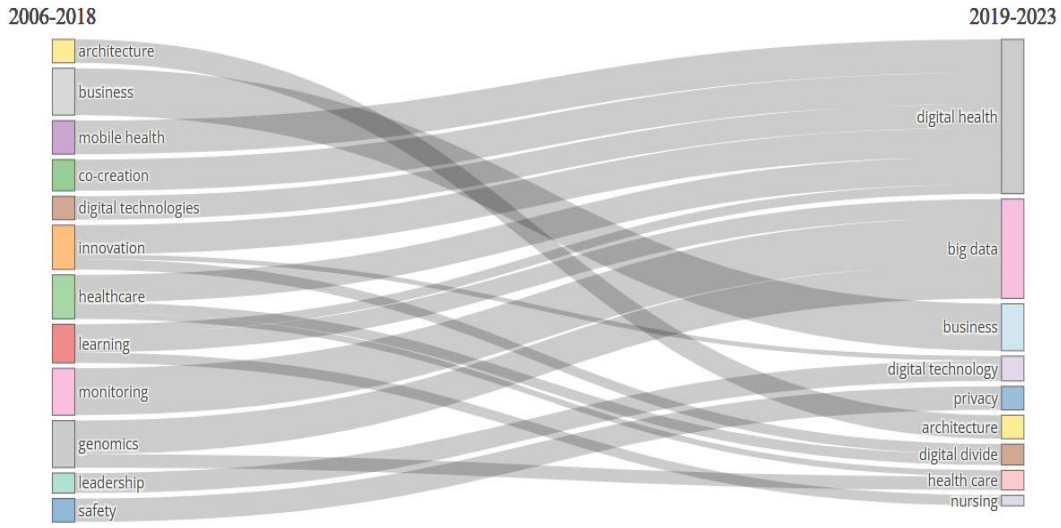

FIGURE 4. THE EVOLUTION OF THE KEYWORDS PLUS
Source: Author with Biblioshiny

The research results highlighted information about the scientific evolution of research, the top of the most productive scientific journals that are focused on the health system, digitalization and innovation, the strategic conceptual map and the evolution of concepts over time.

5. DISCUSSION

Digitalization and innovation in the medical field are two distinct topics that are often associated with the same role: to improve healthcare. The results of this study align with the results of other studies in this field. The study developed by Cobelli & Blasi (2024) presented a scientific growth on the topic of digital health in 2018. Also, the authors confirm that most of the studies that were published in 2020, resulted from efforts to innovate health systems in response to measures of social distancing. imposed by local authorities. Also, other studies in the field of e-health, such as that of Thakur et al. (2012) analyzed through a qualitative approach the innovation capacity of medical units, stating that there are problems of perception and understanding of innovation when strategic objectives are assigned hierarchically to lower-level managers. Therefore, the authors highlight the fact that the existence of a complete and transparent database would allow decision-makers within the organization to understand individual and

organizational objectives and follow the same trajectory that would allow an organizational change towards digitalization. It will also increase consumer awareness of health care through online health and other public systems. Maste et al. (2020) argue that healthcare is a highly private and data-sensitive field of activity. Likewise, patient data is important both for organizations that provide medical care and for companies concerned with the development and research of pharmaceutical products, in order to innovate new products and treatments. In addition, sensitive patient data and information can contribute to new medical inventions through research, however, data security, privacy and integrity is a priority for providers. Considering the fact that in the thematic map of keywords, the concepts of "blockchain", "security" were identified in the quadrant that presented emerging themes or those that will capture the interest of researchers in the future, and in the driving themes "artificial intelligence" a series of benefits or information that can help medical professionals in making the decision to integrate digital technology, but more so to ensure the security and privacy of patient data will be presented.

Thus, for the protection and security of digital data, which are often a real challenge for healthcare providers, recommendations can be considered such as: (1) Introduction of blockchain applications, which provide decentralization of the dataset, protection of user identity and data transparency so that when a date or information is changed in the network, it is visible to everyone (Akram et al., 2020). (2) The gradual integration of artificial intelligence in the medical field, in the first stage they can be considered useful where organizations want to optimize their flow of data and information, by controlling disinformation, and where the infrastructure of the healthcare provider allows, artificial intelligence can improve healthcare through risk prediction, disease forecasting and personalized treatments (Olawade et al., 2023). (3) The development of clear policies and protocols, especially policies and strategies for employees to follow in the process of integrating digital technologies and their use to maintain the privacy and security of patient data (Su et al., 2011). (4) Health professional education should nowadays also include information about the use of new technologies, artificial intelligence, given that there is a transition from traditional care to medical care assisted by artificial intelligence. The continuous training of medical specialists are important criteria to support the quality of medical services in the current context as well (Kyaw et al., 2019).

Further, Kelly & Young (2017) also analyzed the promotion of innovation in the field of health services and found that it is a sum of intervention, adoption, and last but not least diffusion factors. Therefore, he believes that the innovation necessary in this field must have three main objectives in mind (1) innovation to produce a higher quality of medical services, (2) the innovation process to be safe for each patient and how much for specialists, and (3) innovation must bring efficiency in terms of work style, patient waiting time, and so on.

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6. CONCLUSIONS

Research within the health sector has underscored the need to incorporate digital not only in patient care, but also in disease treatment and prediagnosis, facilitating remote monitoring and prevention efforts. In addition, the dependence on technology determines a need for organizations to integrate modern digital technologies that respond to the needs of patients and stakeholders involved in the medical care process. Given that the purpose of the research was to highlight conceptual links between the keyword's "health", "innovation" and "digital", the following conclusions can be summarized:

- The conceptual links between the analyzed words represent emerging themes in the specialized literature. Also, in the last four years, there has been an upsurge in scientific research on digitization and innovation in the health system. The impact of the pandemic on research has also been recognized by other scientific studies (Behar et al., 2020; Omboni et al., 2022; Ali and Khan, 2023). The authors highlighted that the covid-19 virus exerted pressure on the digitization of medical services.
- In terms of the most productive journals, they were "Frontiers in Public Health", "Sustainability", "Frontiers in Digital Health" and "International Journal of Environmental Research and Public Health".
- In the last decade attention has begun to increase on the exploitation of various digital technologies in the health system, such as telemedicine, ehealth and others. These technologies began to be exploited with the need for innovative solutions in the medical field to overcome a possible health crisis, such as the Covid-19 virus.
- Also, there are obstacles that often prevent the digitalization of the medical system. The most encountered obstacles relate to issues of ensuring data confidentiality and data security, regulatory and legislative issues, limited organizational resources and resistance to change. To overcome these often-encountered challenges efforts are required from all stakeholders, and likewise the greatest effort must be supported by the organization providing medical services.

6.1. Practical and theoretical implications

This research aims to provide a perspective on the topic of healthcare, digital and innovation. Additionally, this understanding informs practitioners of technology adoption, organizational change, and health policy development in today's healthcare context.

The practical implications of the study shed light on the recent surge in academic research at the intersection of healthcare, innovation, and digitalization, providing practitioners with information on

emerging trends. Additionally, the identification of journals that are highly productive in publishing materials on these topics provides practitioners with reliable sources to stay abreast of the latest advancements and best practices in digital healthcare. Additionally, bibliographic studies offer a perspective on the amount of research in this field, helping healthcare organizations devise strategies to navigate regulatory complexities and enhance data interoperability.

6.2. Limits and future agenda

The limitations of the study are specific to bibliometric analysis. Therefore, the quality of the paper must be considered within the context of its methodological constraints. Although bibliometric analysis provides valuable insight into publication trends and research productivity, it has inherent limitations that may impact the study's findings and interpretations. Bibliometric analysis is based solely on quantitative data extracted from scholarly publications, which can overlook qualitative aspects of research quality, such as the rigor of methodology or the significance of the findings. Thus, future research can include more analysis on the quality and impact of this research.

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