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Bibliometric analysis of artificial intelligence in healthcare research: Trends and future directions

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ABSTRACT

Objective: The presence of artificial intelligence (AI) in healthcare is a powerful and game-changing force that is completely transforming the industry as a whole. Using sophisticated algorithms and data analytics, AI has unparalleled prospects for improving patient care, streamlining operational efficiency, and fostering innovation across the healthcare ecosystem. This study conducts a comprehensive bibliometric analysis of research on AI in healthcare, utilising the SCOPUS database as the primary data source.
Methods: Preliminary findings from 2013 identified 153 publications on AI and healthcare. Between 2019 and 2023, the number of publications increased exponentially, indicating significant growth and development in the field. The analysis employs various bibliometric indicators to assess research production performance, science mapping techniques, and thematic mapping analysis.
Results: The study reveals insights into research hotspots, thematic focus, and emerging trends in AI and healthcare research. Based on an extensive examination of the Scopus database provides a brief overview and suggests potential avenues for further investigation.
Conclusion: This article provides valuable contributions to understanding the current landscape of AI in healthcare, offering insights for future research directions and informing strategic decision making in the field.

Introduction

Acquiring knowledge enhances our understanding of different subjects and circumstances and enables us to make educated choices in our everyday lives. The copious amount of data at our disposal allows well-informed decision making and enhances the probability of beneficial results.[1] In the present age of technology, nearly every facet of existence has been converted into digital representations.[2–4] Whether at an individual or corporate level, many applications produce significant amounts of data regularly.[5] Prominent data experts predict that data acquisition will continue to rise exponentially shortly.[6] Seagate's Data Age 2025 research predicts that the worldwide data sphere will exceed 175 zettabytes by 2025.[7] In the digital era, data are being produced from almost every aspect of life, and each technological progress adds to the continuously growing collection of information referred to as the data ocean.[8] As a result, technologists and major organisations have been making a deliberate and coordinated effort to create systems that can efficiently handle and derive significant insights from this immense volume of data.[9] The overarching objective is to develop solutions that effectively meet the needs of present and future demands in diverse areas and domains. The healthcare industry is highly reliant on data, particularly electronic health data, which are crucial for comprehending and enhancing healthcare results in modern times.[10,11]

The interrelated technology pillars of big data and AI propel innovation in various industries, including manufacturing, healthcare, finance and retail.[12–15] The AI algorithms have revolutionary potential in healthcare.[16] AI algorithms use big data as their raw material to learn, adapt and make predictions.[17] AI improves extensive data analysis through process automation, insight discovery and real-time, more informed decision making.[18] For instance,

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AI transforms patient monitoring, treatment planning and disease diagnosis in the healthcare industry.[19] AI algorithms may uncover patterns and connections in patient records, genetic data and medical images that may not be visible to human practitioners.[20] The application of AI in healthcare has great potential to enhance patient outcomes, lower deaths and decrease expenses.[21] AI analytics solutions in healthcare utilise large amounts of data to extract significant insights that can improve decision-making processes.[22] As a result, the increasing need for AI has motivated researchers to explore the topic extensively, leading to many new study inquiries.[23] Nevertheless, staying up-to-date with the ever-increasing amount of information on the subject presents difficulties because of the rapid rise of research publications.[24]

The real-life examples and case studies prove that AI transforms the healthcare industry and can enhance patient care and organisational efficiency. An exemplary instance is IBM Watson for Oncology, whereby an AI system remains beneficial in diagnosing and mapping treatment for cancer patients by utilising a vast database of medical literature and patient records.[25,26] The latest study conducted at Memorial Sloan Kettering Cancer Center provides evidence that supports these findings. It was observed that Watson's treatment recommendations aligned with those of human oncologists in most cases, demonstrating that AI can enhance accuracy and decision making in the field of diagnosis.[27] Furthermore, machine learning, a subfield of AI, is being utilised in patient care to create models of adverse occurrences. For instance, the AI system that the University of Chicago Medicine uses can accurately determine the likelihood of patients experiencing a decline in their health problems.[28] This is achieved by continuous analysis of electronic health records (EHRs) and the ability to manage and regulate these situations.[29] Moreover, there is a growing usage of AI in managing medical data. For example, natural language processing (NLP) is used to analyse the text in EHRs and find valuable information.[30] The Mayo Clinic utilises NLP algorithms to make essential choices regarding clinical trials based on patient data.[31] These applications demonstrate that AI is not only a trendy topic, but is already being used to improve the condition of patients and the operation of healthcare organisations in real-world physical facilities.

In the current technological environment, a significant volume of data is generated hourly from many settings, independent of their size. Data are widely acknowledged as a vital asset in all companies and sectors.[32] Access to comprehensive data empowers firms to make well-informed decisions and carry out operations more efficiently.[33] As a result, firms are overwhelmed with large quantities of data from multiple sources.[34] The progress in information and communication technology has contributed significantly to the creation and storage of vast amounts of data, resulting in intricate issues in managing these data. Text mining is used to evaluate collections of documents to locate and uncover significant trends.[35] Bibliometrics is a method that uses quantitative analysis to understand new developments in some regions of study and evaluate the output of research.[36,37] Considering the above, the main goal of the systematic investigation is to assess the research production in the area of AI in healthcare. A thorough performance investigation and a detailed analysis of scientific mapping were undertaken to accomplish the primary objectives. The study examined several important bibliometric indicators, such as the number of scientific articles produced, the authors with the highest productivity, internationally cited documents, relevant affiliations, keywords, and authors in the performance analysis.

Methodology

Bibliometric tools, such as performance analysis and science mapping, offer significant insights into developing specific themes. This study employed a systematic search to collect relevant information for bibliometric analysis. The search adheres to a predetermined sequence of procedures, improving the investigation's scientific validity, transparency and thoroughness. A systematic search strengthens the research's credibility while guaranteeing the removal of irrelevant studies.

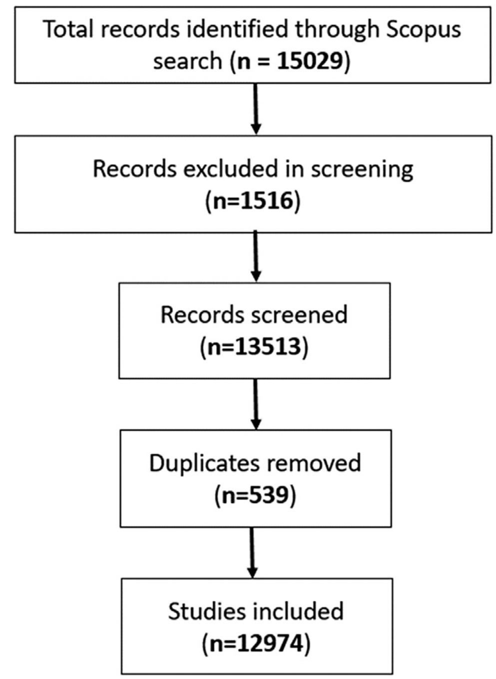

Fig. 1. Systematic search of documents in Scopus database using the keyword 'Artificial intelligence AND healthcare'.

The study aims to examine the research output related to 'artificial intelligence and healthcare'. The Scopus database enabled a comprehensive search for pertinent literature on this subject.[38] Multiple variables played a role in choosing Scopus to retrieve literature. Scopus is the most extensive and continually updated database with flexible data processing capabilities. The search was undertaken with great attention to detail, systematically splitting the procedure into three primary steps. At first, database searches were conducted on the Scopus database. Afterwards, precise search criteria were used to locate pertinent studies for further examination. The study concluded with a bibliometric examination of scholarly publications, with findings shared for scientific mapping and performance evaluations. Fig. 1 depicts the systematic search methodology utilised in this study as a flow diagram.

Systematic search

A methodical strategy was employed throughout the literature search process, incorporating filtering criteria to guarantee relevancy. The web search was performed on 28 March 2024, using the Scopus database, a highly regarded collection of scholarly publications. The search technique was tailored to encompass publications published exclusively in English, guaranteeing the pertinence and dependability of the findings. The search string used to enhance the retrieval of relevant articles consisted of the following combination of pertinent keywords: (health care) AND 'artificial intelligence' OR 'AI' OR 'machine learning' OR 'deep learning' OR 'neural networks' NOT 'cognitive intelligence'. Language and article type filters were utilised in the Scopus database. The Scopus database was utilised to verify the presence of duplicate articles using an additional filter called 'Duplicate articles'. Subsequently, the remaining articles were transferred to a text file to facilitate subsequent analysis. Most studies in the Scopus database utilised the built-in tools, except for thematic mapping and keyword co-occurrence network generation and analysis. Based on Callon's centrality and density rank, the thematic mapping approach displayed the clusters as bubbles in a graph.[39–41] The size of the bubble

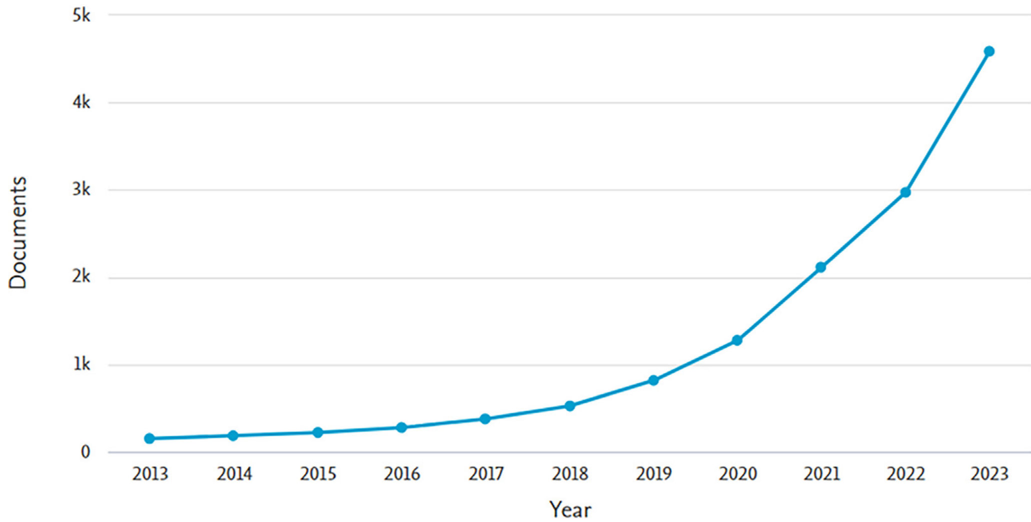

Fig. 2. Annual scientific production of articles dealing with AI in healthcare in the Scopus database.

is determined by the frequency of word occurrences in the cluster. The *X*-axis represents network cluster centrality, which refers to the level of interaction with other graph clusters and quantifies the importance of a study theme. The *Y*-axis depicts a cluster network's density, which measures its internal strength and theme growth.

Study selection

In light of the scope constraints of our investigation, we limited our literature search to articles available in Scopus. To maintain the accuracy and significance of the data, three filtration criteria were implemented: exclusively selecting documents categorised as 'articles', narrowing down the stage to 'published', and explicitly designating the language as 'English'. The purpose of implementing the language filter is to ensure that attention is solely directed towards a specific language. At first, a search using specific keywords on Scopus resulted in 15,029 articles. After applying the filter settings, 1,516 articles were removed from Scopus, resulting in 12,974 (after removing duplicates) remaining for further research. The data were retrieved from Scopus and converted into 'BibTex' format. An extensive investigation was carried out to detect and exclude any duplicate articles from the final dataset to guarantee the exclusivity of the dataset entries.

Results

Annual scientific production

AI emerged in the 1990s, but its significance surged due to the rapid growth in data accessibility. The convergence of AI with healthcare data has emerged as a central area of interest for researchers worldwide, demonstrating significant annual expansion.[42] In 2013, the number of articles on AI in healthcare exceeded 100, a noteworthy achievement, as depicted in Fig. 2. This pattern consistently increased, reaching 153 articles in the same year. As time passed, there was a significant rise in the number of publications each year. In 2018, the number increased significantly to 527, and then further rose to 819 in 2019 and 1,277 in 2020. From 2021 to 2023, there was significant growth in AI in healthcare, with academics giving more importance to this area. This led to the publication of 2,113, 2,970, and 4,587 research papers each year. It is worth mentioning that a total of 838 research publications were published in January and February, indicating a substantial number of publications anticipated in 2024.

Table 1
List of globally cited documents in Scopus during the period 2013–2023.

S. no	Researchers	Digital object identifier	Cited by
1	Yogesh K. Dwivedi *et al*	10.1016/j.ijinfomgt.2019.08.002	984
2	Muhammad E. H. Chowdhury *et al*	10.1109/ACCESS.2020.3010287	939
3	Aidan Fuller *et al*	10.1109/ACCESS.2020.2998358	892
4	Darshali A. Vyas *et al*	10.1056/NEJMms2004740	880
5	Raju Vaishya *et al*	10.1016/j.dsx.2020.04.012	850
6	Zhouyue Lei *et al*	10.1002/adma.201700321	816
7	Vinay Chamola *et al*	10.1109/ACCESS.2020.2992341	797
8	Min Chen *et al*	10.1109/ACCESS.2017.2694446	768
9	Deng-Ping Fan *et al*	10.1109/TMI.2020.2996645	746
10	Michael D. Abràmoff *et al*	10.1038/s41746-018-0040-6	725

Most globally cited documents

The list of most globally cited documents is pertinent to this study as it comprises influential publications laying the foundation for AI in healthcare. Typically, citations reflect that these documents are groundbreaking works that have contributed significantly to advancing knowledge in the field. They may introduce new techniques, theories or approaches that other authors subsequently use. Recognising the most renowned authors to comprehend the influential figures in this domain is also essential. These authors often produce original works, investigate new research topics, and play a role in shaping policy and practice. By incorporating this information, one can recognise the field's present state while providing a framework for future research and study of the topic for researchers and practitioners in AI and healthcare. In our study, Dwivedi's publication, titled 'Artificial intelligence (AI): multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice, and policy', has received the highest number of citations, totalling 984, according to the bibliometric study conducted on Scopus.[43] This study provides valuable insights into the topic of AI and its ramifications for diverse sectors and society at large. The paper, published in 2021, recognises the significant influence of societal and industrial factors on the speed and trajectory of AI progress. Chowdhury's research, titled 'Can AI aid in screening ciral and COVID-19 pneumonia?', has received significant attention as seen by 939 citations, highlighting its importance in the field.[44] A study conducted by Fuller *et al*[45] brought attention to the extent of digital twin technologies in solving problems and promoting open research.[45] The data in Table 1 demonstrate that works published from 2013 to 2023 have gar-

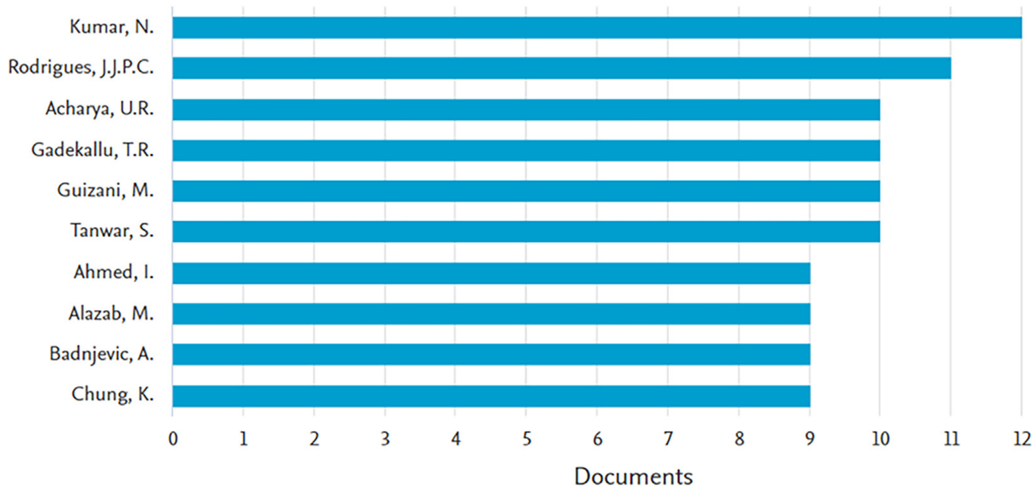

Fig. 3. Authors scientific production dealing AI in healthcare in Scopus database.

nered many citations, suggesting their exceptional quality. Vyas *et al*[46] examine the ongoing controversy regarding including race in clinical algorithms using the latest knowledge in population genetics.[46] Their study is headed 'Hidden in plain sight – reconsidering the use of race correction in clinical algorithms'. Vaishya *et al* emphasise the crucial significance of AI in comprehending and propelling the progress of COVID-19 vaccine development.[47] In addition, Lei *et al* have published a significant study that deals with bioinspired mineral hydrogel to fabricate a novel type of mechanically adaptable ionic skin sensor that has received more than 800 citations.[48] Additional studies on the same subject have garnered considerable interest, with citations varying between 700 and 800.[49–52]

Research production in the field

An examination of bibliometric data from 2013 to 2023 indicates that Kumar has the most author publications, with around 12. Rodrigues closely trails behind, with a publication record of almost 11 papers and a fantastic h-index of 90. Fig. 3 demonstrates the notable contributions of four authors to the field of AI in healthcare, with each author having approximately ten works attributed to their name. These authors, including Acharya, Gadekallu, Guizani and Tanwar, are known for their tremendous productivity. Fig. 3 visually displays the writers' work from 2013 to 2023, showcasing their contributions to the discipline. In addition, notable researchers, including Ahmed, Alazab, Badnjevic and Chung, have made significant contributions to this topic, jointly authoring nine publications since 2013.

The most productive countries

Using bibliometric analysis, we examine how publications in the field of AI in healthcare are distributed among nations that have made significant contributions. The study covers the period from 2013 to 2023. The USA has emerged as the foremost contributor, surpassing all other nations with a remarkable 1,107 publications indexed in Scopus. The Indian subcontinent closely follows, ranking second with 822 articles, while China earns third with 610 articles. Saudi Arabia ranks fourth in publishing productivity in this field, with 358 articles. Italy, Australia, Canada, South Korea and Germany have significantly contributed to discussing AI in healthcare. Fig. 4 graphically depicts the extensive involvement of governments in healthcare research and investigations. This demonstrates that countries worldwide are eager to utilise AI to enhance healthcare practices, regardless of their economic level or lifestyle.

Most relevant affiliations

An essential element of bibliometric analysis entails the identification of institutions that exhibit a high level of productivity. Based on the data presented in Fig. 5, King Saud University is identified as the leading university in productivity in AI in healthcare, having produced 72 publications on this topic. Harvard Medical School closely follows in second place, having published 71 publications. The Chinese Academy of Sciences ranks third with 55 published papers. The University of Toronto is ranked sixth, with 54 publications in this discipline. King Abdulaziz University, Prince Sattam Bin Abdulaziz University, Imperial College London, University College London, Vellore Institute of Technology, and the University of Oxford are all renowned institutions that make significant contributions to AI research in the healthcare sector.

Annual source distribution

The study examines the yearly rise in sources, an essential bibliometric measure demonstrating the distribution of publication growth within a specific field depending on their sources. Fig. 6 illustrates the number of publications in the top five notable journals. The study indicates that the papers were distributed among 172 journal sources. *IEEE Access*, *Sensors*, *Applied Sciences*, *Healthcare* and *IEEE Journal of Biomedical and Health Informatics* are the top five publishers of documents indexed in Scopus.

Science mapping analysis

Several disciplines use keyword co-occurrence analysis in their knowledge-mapping efforts.[53] Conducting a comprehensive literature review is crucial to charting the present and future of scientific research in any particular area. However, it is challenging and takes a long time because this activity is manual. Fig. 7 reveals how often specific keywords appear in various publications. The phrase 'big data' appears 793 times, while 'healthcare' follows with 199 occurrences. Cloud computing and the Internet of Things are some of the related terms shown on the graph, with their frequencies shown in descending order. These results show that AI-related healthcare phrases are being used and associated with big data technology at a far higher rate than in the past.

We have created a keyword co-occurrence network (KCN) to investigate further the connection between terms like 'artificial intelligence' and 'healthcare' among others. Nodes in KCN stand for keywords, and edges indicate how often specific keywords appear together in the graph. Every edge's weight is based on the number of occurrences between the matching pair of nodes. The visual representation of edge weight in a

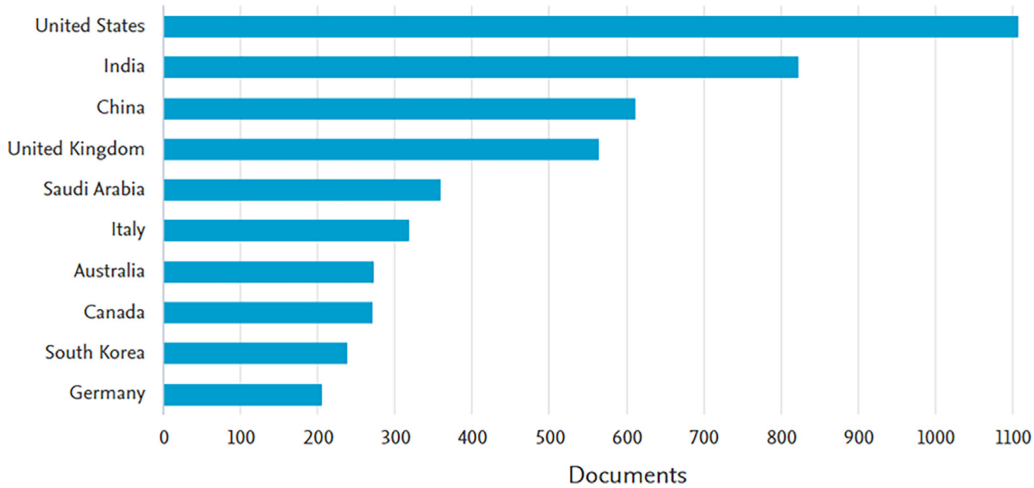

Fig. 4. The most productive countries dealing with AI in healthcare are in the Scopus database.

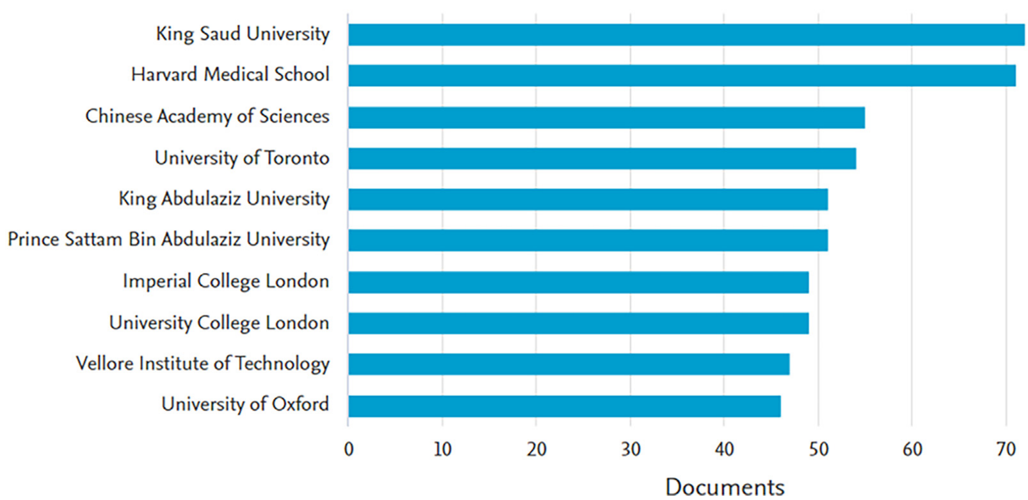

Fig. 5. Most productive affiliations dealing with AI in healthcare are in the Scopus database.

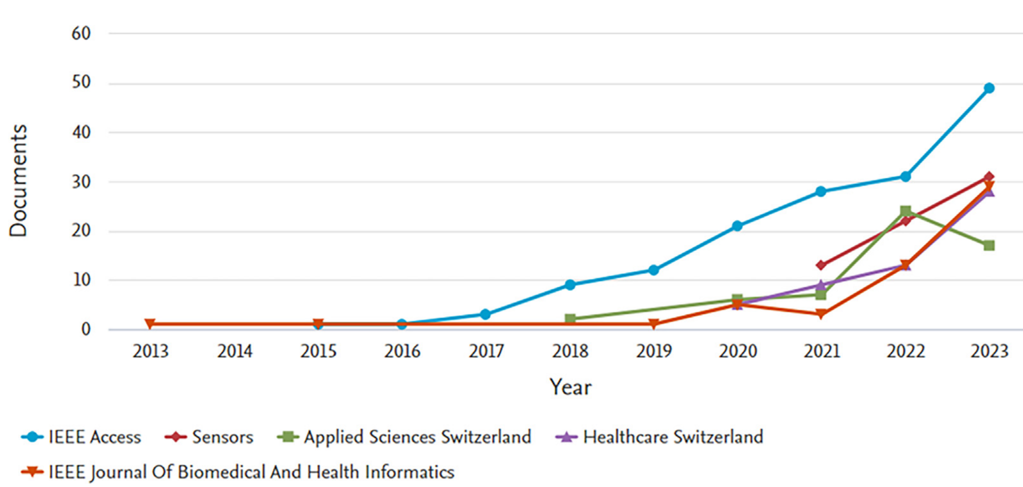

Fig. 6. The annual source distribution deals with AI in healthcare in the Scopus database.

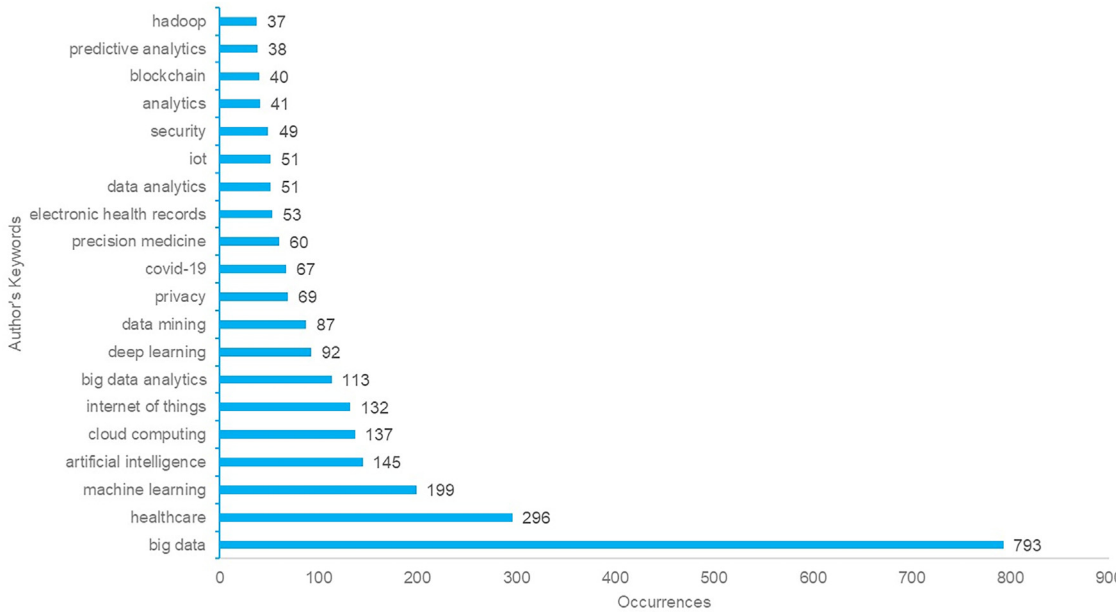

Fig. 7. The most frequently occurring keywords in documents related to AI and healthcare from 2013 to 2023.

KCN is its thickness. Fig. 8 shows the KCN divided into three distinct clusters, distinguished by their respective hues: Cluster 1, Cluster 2 and Cluster 3. More prominent nodes in the KCN indicate more frequent word occurrences, which is proportional to word frequency. Cluster 1 extensively uses the terms ‘artificial intelligence’ and ‘healthcare’, the edge that connects these two phrases has more weight than any other edge, indicating that they occur together more frequently.

Thematic mapping

Thematic mapping is a theoretical framework used in bibliometrics to depict the conceptual framework of studied keywords. This method uses visual representation to describe the arrangement of topics in a thematic map, partitioning it into four quadrants, each symbolising a distinct subject. The themes are classified according to two characteristics: density and centrality. The density of keywords, which represents the strength of association between them, is displayed by the vertical axis. Centrality, a measure of the degree to which the phrases are related, is shown on the horizontal axis. The thematic map depicted in Fig. 9 examines the field of AI and its utilisation in healthcare, with subjects organised into four quadrants. In the figure, two or three themes have been grouped and represented by one circle. This is because themes exhibit close correlation or substantial overlap. Combining these themes might offer a comprehensive perspective on an area of interest. For instance, precision medicine, personalised medicine, and data science subjects may be combined due to their frequent interdependence. The primary motif is positioned in the lower right corner, while the emerging or diminishing motif is depicted in the bottom left quadrant. Prominent subjects such as healthcare, cloud computing, big data and machine learning are highlighted.[54,55]

The placement of deep learning in the core topic quadrant is particularly significant since it indicates its critical role in developing the subject matter.[56,57] The thematic map highlights key areas with strong linkages among themes such as healthcare records, public health, data analytics and predictive analytics.[58] Thematic analysis also demonstrates that specific sectors, such as data analytics and predictive analysis, strongly connect to AI and healthcare. Fig. 9 shows that none of the recognised themes are in the motor theme quadrant, representing highly developed and central topics. Despite extensive study and exploration, this highlights the absence of any particular domain within AI and healthcare that can confidently assert its complete maturity. This remark indicates that there are many potential areas for future research in all of the previously mentioned subfields. This demonstrates that this topic involves multiple disciplines and is constantly evolving.

Significantly, the examination also reveals that none are categorised as emerging/declining, which often denotes either advancing or becoming obsolete. This implies that leaders and knowledgeable individuals in AI in the medical domain prioritise topics with ample and up-to-date research while showing less interest in inactive or less significant domains compared to current areas of interest. The absence of rising or falling clusters could be linked to the dynamic evolution of the subject field, where fresh research issues are swiftly integrated into the conversation.

Several interesting findings are presented, particularly the placement of data analytics and predictive analysis in the niche quadrant. This quadrant is well developed but isolated. Given that these subjects were presented in the context of the relationship between AI and healthcare, their classification as niche topics suggests that although they are related to the main issues, they are likely to be studied more restricted. This revelation encourages further exploration of the connections between other disciplines within the field and highlights the importance of integrating these themes with other research priorities. Researchers in this subject are encouraged to employ these approaches to progress in their study area. Notably, the thematic map’s four quadrants all include the ideas of data science, personalised medicine, precision medicine and healthcare, demonstrating their significance across disciplines.

Discussion

The current study provides a thorough bibliometric analysis that reveals the ever-changing research landscape at the interface of AI and healthcare. Using a systematic search on the Scopus database, it thoroughly examines the scholarly output of the past 10 years, providing significant insights into many facets of this growing subject. An essential discovery of the study is the rapid and significant increase in research on AI in healthcare, especially in recent times. The yearly examination of scientific production demonstrates a notable increase in publications, demonstrating a rising interest and acknowledgement of the importance of AI applications in healthcare. This trend highlights the changing nature of research objectives and the growing acknowledgement of AI’s capacity to transform healthcare delivery and outcomes. Furthermore,

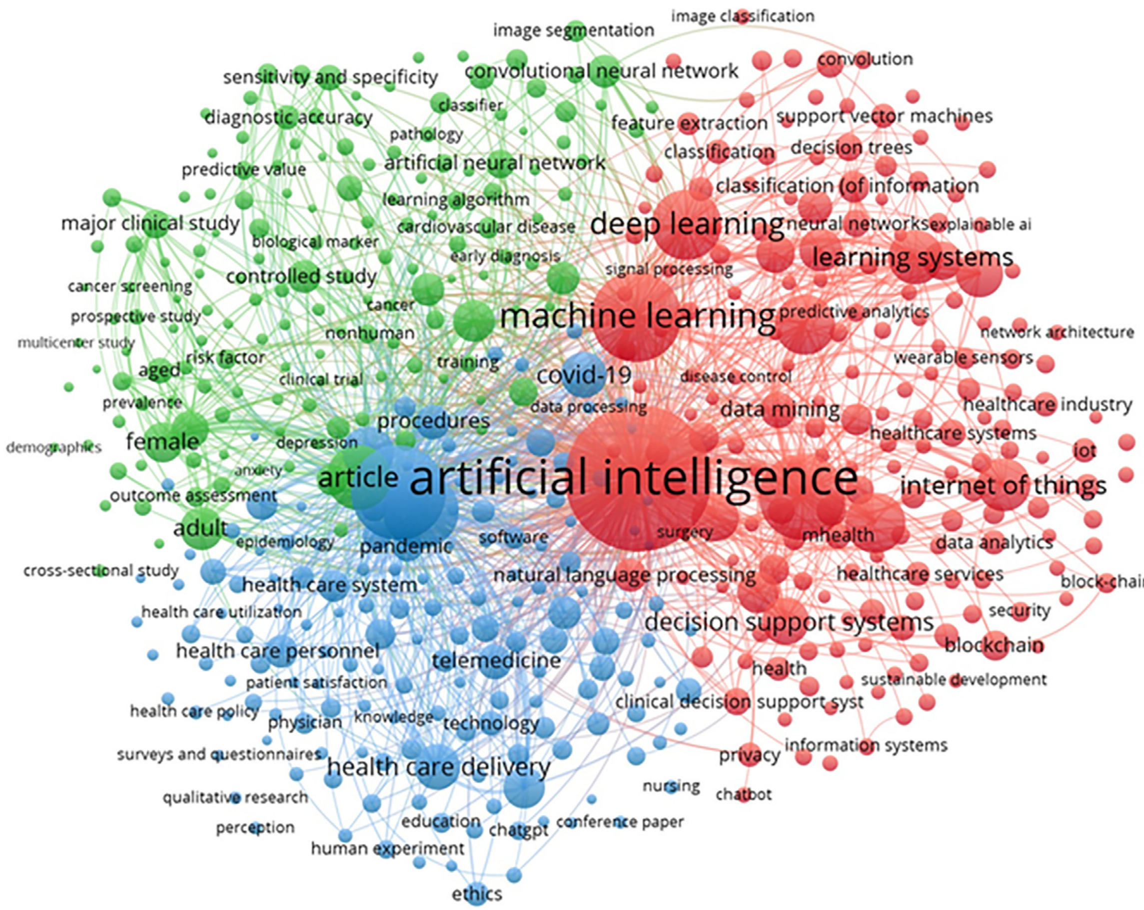

Fig. 8. Keyword co-occurrence network of the documents related to artificial intelligence and healthcare.

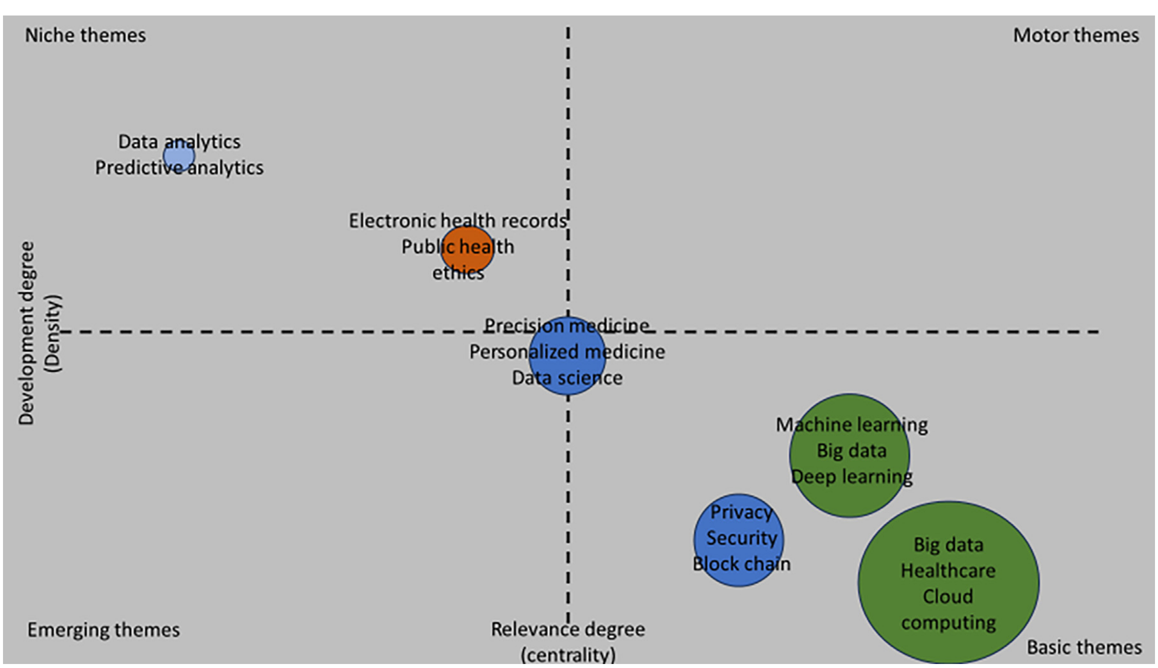

Fig. 9. Thematic mapping of the keywords on the documents related to AI in healthcare concepts.

identifying the most widely cited documents offers valuable insights into significant contributions and influential works shaping the discussion on AI in healthcare. Publications like Dwivedi's comprehensive analysis of emerging challenges and opportunities and Chowdhury's investigation into the role of AI in screening viral and COVID-19 pneumonia have received considerable attention. However, there are several drawbacks to relying on more than absolute citation counts to judge the quality of research. A more equitable and balanced assessment of the influence of research can be achieved via normalisation methods such as percentile rankings, h-index and its variations, and altmetrics.

Examining author productivity and institutional affiliations reveals the primary individuals and organisations responsible for pushing progress in this field of research. Authors like Kumar and Rodrigues are recognised for their extensive contributions, while organisations such as King Saud University and Harvard Medical School exhibit exceptional research production. These critical insights help establish collaborative networks and promote interdisciplinary partnerships to further research in AI-driven healthcare innovation. Moreover, the survey highlights the widespread dispersion of research endeavours, with countries such as the USA, India and China becoming significant donors. This highlights the widespread acknowledgement of AI's ability to bring about significant changes in tackling healthcare issues and emphasises the significance of global cooperation in progressing the subject.

Using theme mapping and science mapping analysis provides a more profound comprehension of the fundamental concepts and patterns influencing research in AI and healthcare. By identifying thematic clusters and patterns of term co-occurrence, these analyses emphasise important areas of investigation, including big data analytics, predictive modelling, and personalised medicine. However, we are aware of some analysis limitations. Because thematic clustering accuracy depends on data quality and granularity, it should be bias-free and gap-free. Clustering can also simplify complex relationships. As study regions change, clusters may too, rendering our findings outdated. Despite these limitations, our method provides valuable insights and a foundation for future research. These insights offer researchers vital direction in investigating new subjects and directing future research efforts. The suggested science mapping aims to identify and categorise the mapping methodologies used in the current study. We have found two main categories: keyword correlation networks and thematic mapping. However, investigating other connections, such as author co-citation, funding organisations and institutional collaboration, could provide a deeper insight into the top achievers and the power dynamics within the sector. These analyses would provide insight into the changing dynamics of academics' responsibilities, the influence of funding sources on the direction of research efforts, and the patterns of collaboration that contribute to the development of AI and healthcare developments. Using these components in future investigations will provide a holistic perspective of the research setting, thereby enhancing the quality and depth of the research.

In the present study, research potentials and trends were examined thoroughly. Extensive research is underway on AI applications in radiology.[59] Current models focus on utilising machine learning algorithms to aid in image processing, reduce diagnostic errors, and improve the efficiency of working with radiological imaging.[60] For example, a study published in *Nature* demonstrated that an AI model developed by Google Health outperformed human radiologists in accurately identifying breast cancer from mammograms.[61] This finding highlights the significant potential of AI in the field of diagnostic imaging.[62] Pharmacogenomics is another important field of research where AI provides personalised medicinal approaches based on the patient's genetic makeup, environment and behaviour. AI-empowered systems, such as the AI tools that forecast patients' responses to various cancer therapies, are utilising advancements in disciplines like pharmacogenomics to develop reliable anticipatory models of treatment possibilities.[63] Telehealth has been a significant trend, particularly during the COVID-19 pandemic, where AI enhances remote patient monitoring (RPM), specifically virtual care.[19] One instance of this is the utilisation of chatbots and virtual assistants in services like Babylon Health.[22] These tools provide consumers with initial diagnosis and health advice, hence increasing the accessibility of healthcare for the population. These topics are regarded as promising because they have the potential to address some of the healthcare challenges, such as the growing burden on healthcare systems, the need to improve the quality of services, and the demand for personalised treatment. The implications for future research are extensive, as these themes emphasise patient-centred, data-driven healthcare facilitated by AI. There will likely be increased focus on advancing these technologies, addressing their ethical concerns, and integrating them into various healthcare delivery systems.

AI healthcare articles have increased due to growing interest in the subject and advancements in other related domains of AI between 2013 and 2023. Upon closer examination of the publications, it becomes evident that a significant portion of the research and innovation has been focused on utilising machine learning (ML), particularly in fields such as predictive analysis, diagnosis and treatment, and medical imaging.[64] These fields have gained more attention due to advancements in algorithmic approaches, large datasets, and the processing power needed to work with them. The progress of natural language processing has been driven by the need to effectively handle and extract insights from unstructured clinical data, such as electronic health records (EHRs) and medical literature.[65] Moreover, the field of healthcare robotics, namely surgical assistant robots and other medical aid robots, has gained attention because of the potential to improve the AI-enabled functionality of robots.[66] Introducing new technology, such as deep learning and data storage, in healthcare systems has made it easier to solve increasingly complicated challenges.[67] Moreover, using big data analytics and cloud computing has facilitated handling and examining vast quantities of healthcare data. The COVID-19 pandemic has also increased the demand for digital health solutions, leading to a rise in research on creative technological solutions for healthcare. These factors have increased the number of published materials related to AI in healthcare and broadened the scope and viewpoints of research in this rapidly advancing field.

One limitation of our study is that the analysis is conducted solely on a single database. While this approach ensures data consistency and simplifies data management, it gives researchers a narrow perspective of the research landscape. The categorisation and indexing of journals and articles in multiple database systems vary, leading to inequalities. It would be beneficial to include sources such as Web of Science, PubMed, or Google Scholar to obtain a more comprehensive understanding of the topic. Future research studies should use a search strategy that searches numerous databases to include a broader range of results and to verify the findings using different indexing services.

We further outline several potential limitations associated with using AI in healthcare, emphasising that these are just a few factors that need to be considered when using this technology. One concern is biased algorithms, where AI systems are trained using datasets that lack diversity. This might result in reproducing and reinforcing existing inequalities in healthcare provision. These ethical justice and equity concerns should be prioritised while developing and implementing emerging AI advances. Furthermore, there are apprehensions regarding the confidentiality of patient data when it is integrated into AI models. It demonstrates the necessity of implementing a secure method for safeguarding the data collected in healthcare facilities. Future research should address the following challenges: enhancing the AI model's interpretability, ensuring the AI model's training with different datasets, and integrating ethical considerations into generating AI models. Furthermore, it is possible to effectively address any privacy concerns that have been exploited by incorporating stringent data security protocols, such as employing advanced encryption algorithms and embracing privacy-conscious AI techniques like federated learning. The healthcare community must address these limitations to overcome them. This will enable the development of more efficient, effective, ethical, and socially acceptable AI systems.

Conclusion

This paper provides a concise overview of the bibliometric study that uncovers the growth and diversification of AI research in the healthcare field over the past 10 years. The recent publishing surge indicates the growing recognition of AI's role in enhancing the health sector's efficiency and effectiveness. This analysis's specific consequences include identifying highly cited publications and authors. This information is valuable for establishing the most influential documents in a specific field of study and identifying the leading experts in that area of research. Additionally, it emphasises a multisectoral approach and involves international cooperation from countries such as the USA, India and China. However, the study has certain limitations, such as its reliance on a citation-based approach and the need to include a more diverse spectrum of research outputs, which should be considered using a more extensive variety of databases.

This study has future consequences, and the following action plan is proposed: Future research in AI development should prioritise building AI systems that possess transparency, interpretability and ethical standards. To eradicate such biases, the researchers must guarantee that their AI models are trained to utilise a wide range of datasets. Moreover, future research must investigate the implementation of AI in other extensive healthcare systems and its subdomains, such as predictive analytics, personalised medication, telehealth, and other pertinent advanced areas of study that address the rights of patients and employers. This is necessary due to the increasing technological concerns associated with these fields. Expanding the data sources for bibliometric analysis to include databases and metrics beyond just citations would enhance our comprehension of the dynamics within the subject. Therefore, by adhering to these research guidelines, the academic community may contribute to advancing AI's constructive and advantageous application in healthcare.

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CRediT authorship contribution statement

Renganathan Senthil: Formal analysis, Data curation. **Thirunavukarasou Anand:** Formal analysis, Data curation. **Chaitanya Sree Somala:** Data curation. **Konda Mani Saravanan:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

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