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AI in Healthcare: A bibliometric and Content Analysis Discourse

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ABSTRACT.

Analyzing prominent authors reveals important figures driving the healthcare sector ahead, whose contributions includes technological advancements, ethical quandaries, and patient-centered methods. Thematic maps illustrate how several themes—including regulatory implications, computerized healthcare systems, and federated learning—are related to one another and are having an impact on how artificial intelligence is applied in the health care sector. Overall, this final assignment shows the revolutionary potential of AI in the delivery of healthcare. If moral values remain intact, openness is preserved, and patient privacy is protected, AI-driven solutions have the potential to change the way healthcare is delivered while enhancing patient outcomes worldwide.

INTRODUCTION.

In recent years, there has been a surge of interest among academics, practitioners, and policymakers worldwide regarding the use of artificial intelligence (AI) in healthcare. AI has the potential to revolutionize various aspects of healthcare delivery, including patient care, diagnosis, and treatment, by mimicking human intelligence and performing tasks that involve cognitive abilities. One significant application of AI in healthcare is medical diagnosis. AI-powered systems can analyze vast amounts of patient data, such as genetic information, clinical notes, and medical images, to aid in accurate patient evaluation and treatment planning. These systems utilize advanced techniques and machine learning algorithms, particularly excelling in detecting neurological disorders, cardiovascular diseases, and cancer, often surpassing human professionals in specific tasks despite its transformative potential, the widespread adoption of AI in healthcare raises numerous ethical concerns and challenges. Issues related to bias, security, privacy, and data transparency must be carefully addressed to ensure the ethical and responsible use of AI technology in clinical settings. Additionally, healthcare personnel require specialized training to effectively utilize AI tools and interpret their results accurately, thereby avoiding overreliance on automated systems and preserving the human-centric nature of healthcare delivery.

RESEARCH METHODOLOGY

The study successfully achieved its goal through content analysis and bibliometric analysis. Bibliometrics, a field within informatics, quantifies the significance and impact of scientific publications using statistical methods to understand how information spreads. On the other hand, content analysis allows researchers to examine the frequency, relevance, and relationships of specific words, themes, or concepts in data.

Database Curation

To tackle these research challenges, we conducted a thorough analysis of scholarly articles spanning from 1997 to 2024 using bibliometrics. We relied on SCOPUS, a comprehensive database renowned for its vast collection of international scholarly literature. SCOPUS stands out due to its meticulous content selection process, ensuring that only top-tier publications are included in its database. Additionally, SCOPUS undergoes regular quality checks to maintain the accuracy and relevance of its data. One of SCOPUS's strengths lies in its robust profiling algorithms and expert curation, which guarantee highly accurate authorship and institutional profiles. This level of precision and reliability enables us to extract valuable insights and trends from the data with confidence.

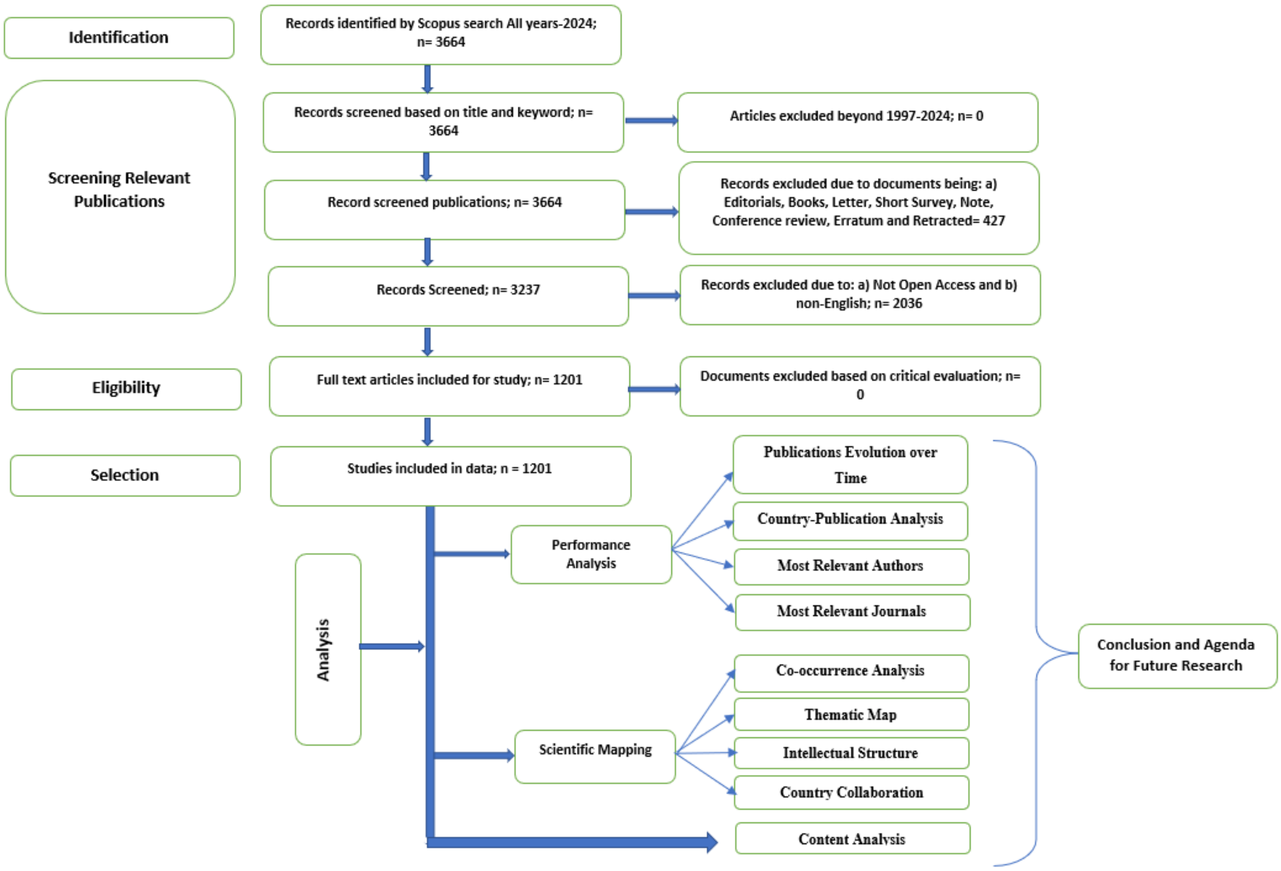
Procurement of articles for bibliometric analysis

Title, abstract, and pertinent keywords A range of carefully chosen keywords have been put into the SCOPUS search function to retrieve 427 papers. To discover pertinent research, three techniques were used: email requests to the corresponding authors of publications found through bibliographic and citation searches, searches in bibliographic databases, and citation searches in other articles. Using the Preferred Reporting Items for the Systematic Review methodology, pertinent papers were selected in this manner. Figure 1

Figure 1.

Preferred reporting items for systematic review and methodology.

As a result of the activity, 1201 papers were finally selected and reviewed in order to meet the study's stated goals. The final the collection consists of 1201 publications that discuss inclusive education bibliometric analysis. proposed scientific mapping and performance analysis as the two principal techniques for doing the analysis.



Performance Analysis:

In evaluating performance, various indicators are used to analyze the overall direction of the topic, the citations received by papers, the total number of publications, and their organization based on author connections, countries, and journals. Additionally, the m-index was introduced to address the challenge of comparing researchers at different career stages (Vanclay, 2007). This index calculates an author's h-index by dividing the total number of years between their first and most recent publication by their h-index, enabling a comparison of an author's output throughout their career.

Scientific mapping:

Scientific mapping helps us grasp the core patterns within a body of knowledge and how these patterns evolve. In this study, co-occurrence analysis was employed to gather conceptual models related to blockchain-based business applications. Thematic maps, depicted as clusters on a two-dimensional matrix with density and centrality axes, were utilized to explore key themes and identify potential areas for further research.

3. Analysis and discussion of results

In this section, we delve into the performance analysis, covering various aspects such as the evolution of publications over time, analysis of publications by country, examination of key authors, and an overview of journals.

The first notable contributions to artificial intelligence (AI) in healthcare date back to the late 1990s, specifically in the publication titled "TSMI: A CEN/TC251 standard for time-specific challenges in healthcare informatics and telematics" by Ceusters et al. (1997) in the International Journal of Medical Informatics. Subsequent significant works include Rayan (2020) offering an AI perspective on healthcare, Al-Dhaen et al. (2021) advancing understanding of responsible AI in the Internet of Medical Things (IoMT), Yaraziz and Bolhasani (2021) on edge computing applications for IoMT in healthcare, and Jadon and Kumar (2023) exploring generative AI models for synthetic data generation in healthcare. Recent contributions include Silvestri et al. (2024) on cyber threat assessment in healthcare using natural language processing and Tse et al. (2024) developing AI-enhanced predictive models for risk stratification in Hong Kong's healthcare big data context. Additionally, Alsadoon, Al-Naymat, and Jerew (2024) proposed an architectural framework for elderly healthcare monitoring using wearable sensors.

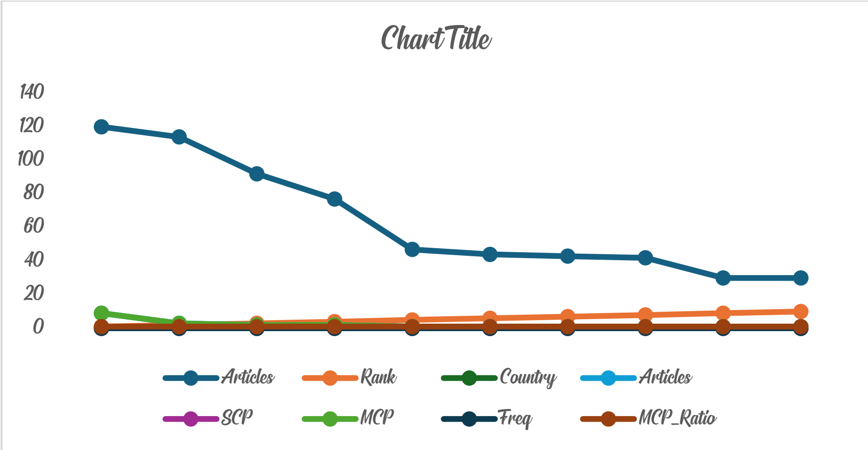


Figure 2.

The distribution of publications over time (2016–2022) in business applications of Blockchain research fields

Authors	Title	Year	Journal	TC	TC/Y
ACAMPORA G;COOK DJ;RASHIDI P;VASILAKOS AV	A SURVEY ON AMBIENT INTELLIGENCE IN HEALTHCARE	2013	PROCEEDINGS OF THE IEEE	500	41.667
BOHR A;MEMARZADEH K	THE RISE OF ARTIFICIAL INTELLIGENCE IN HEALTHCARE APPLICATIONS	2020	ARTIFICIAL INTELLIGENCE IN HEALTHCARE	326	65.2
MAMOSHINA P;OJOMOKO L;YANOVICH Y;OSTROVSKI A;BOTEZATU A;PRIKHODKO P;IZUMCHENKO E;ALIPER A;ROMANTSOV K;ZHEBRAK A;OGU IO;ZHAVORONKOV A	CONVERGING BLOCKCHAIN AND NEXT-GENERATION ARTIFICIAL INTELLIGENCE TECHNOLOGIES TO DECENTRALIZE AND ACCELERATE BIOMEDICAL RESEARCH AND HEALTHCARE	2018	ONCOTARGET	307	43.857
NADARZYNSKI T;MILES O;COWIE A;RIDGE D	ACCEPTABILITY OF ARTIFICIAL INTELLIGENCE (AI)-LED CHATBOT SERVICES IN HEALTHCARE: A MIXED-METHODS STUDY	2019	DIGITAL HEALTH	277	46.167
RONG G;MENDEZ A;BOU ASSI E;ZHAO B;SAWAN M	ARTIFICIAL INTELLIGENCE IN HEALTHCARE: REVIEW AND PREDICTION CASE STUDIES	2020	ENGINEERING	231	46.2
ASAN O;BAYRAK AE;CHOUDHURY A	ARTIFICIAL INTELLIGENCE AND HUMAN TRUST IN HEALTHCARE: FOCUS ON CLINICIANS	2020	JOURNAL OF MEDICAL INTERNET RESEARCH	212	42.4
SECINARO S;CALANDRA D;SECINARO A;MUTHURANGU V;BIANCONE P	THE ROLE OF ARTIFICIAL INTELLIGENCE IN HEALTHCARE: A STRUCTURED LITERATURE REVIEW	2021	BMC MEDICAL INFORMATICS AND DECISION MAKING	205	51.25
VENKATESAN C;KARTHIGAIKUMAR P;PAUL A;SATHEESKUMARAN S;KUMAR R	ECG SIGNAL PREPROCESSING AND SVM CLASSIFIER-BASED ABNORMALITY DETECTION IN REMOTE HEALTHCARE APPLICATIONS	2018	IEEE ACCESS	182	26

CORCHADO JM;BAJO J;TAPIA DI;ABRAHAM A	USING HETEROGENEOUS WIRELESS SENSOR NETWORKS IN A TELEMONITORING SYSTEM FOR HEALTHCARE	2010	IEEE TRANSACTIONS ON INFORMATION TECHNOLOGY IN BIOMEDICINE	170	11.333
LOH HW;OOI CP;SEONI S;BARUA PD;MOLINARI F;ACHARYA UR	APPLICATION OF EXPLAINABLE ARTIFICIAL INTELLIGENCE FOR HEALTHCARE: A SYSTEMATIC REVIEW OF THE LAST DECADE (2011–2022)	2022	COMPUTER METHODS AND PROGRAMS IN BIOMEDICINE	149	49.667
Note(s): TC – Total Citations, TC/Y – Total Citations per year					
Source(s): Author's own compilation					

Table 1.

Total number of citations retrieved from the SCOPUS (TC) and the average number of citations received per year (TC/Y)

Country	TP	SCP	MCP	Freq	MCP_Ratio
INDIA	120	0	9	0.007	1
USA	114	0	3	0.002	1
UNITED KINGDOM	92	0	2	0.002	1
CHINA	77	0	2	0.002	1
ITALY	47	0	1	0.001	1
AUSTRALIA	44	0	1	0.001	1
SAUDI ARABIA	43	0	1	0.001	1
KOREA	42	0	1	0.001	1
CANADA	30	0	1	0.001	1
GERMANY	30	0	1	0.001	1

Table 2. Top 15 countries with the highest total publications, single country_publications, Mult-country_publications, and countries with the highest multi-country publication ratio India leads with 120 publications, followed closely by the USA with 114 publications and the UK with 92. China secures fourth place with a respectable 77 publications, followed by Italy with 47 in fifth place. Australia ranks sixth with 44 publications, just after Saudi Arabia in seventh place with 43. Korea contributes 42 publications, placing it in the same league globally. Canada and Germany each have 30 publications, tying for ninth and tenth place, respectively.

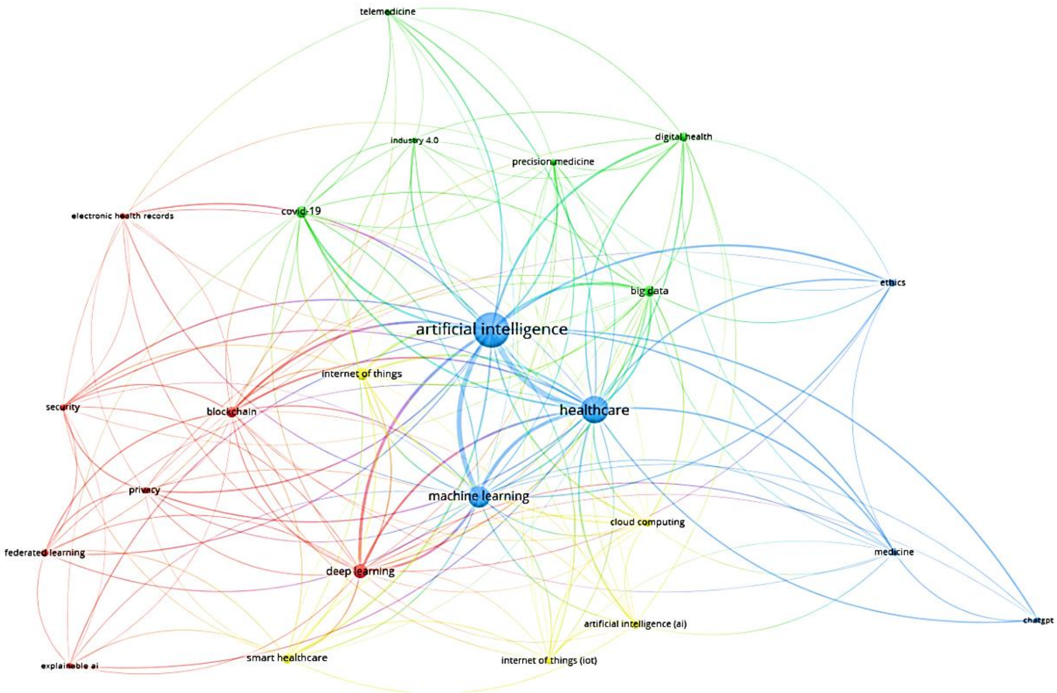


Figure 3.Co-occurrence analysis

Source(s): Authors creation using VOSviewer

Table 4 WANG Y emerged as the most influential author with 3431 citations, focusing on the multifaceted aspects of AI in healthcare, from technology advancements to ethical implications and patient-centered care. LI H follows closely with 1725 citations, highlighting AI's potential in improving diagnostics and patient outcomes while addressing ethical challenges. MA S ranks third with 1706 citations, emphasizing AI's transformative potential in healthcare delivery using machine learning and natural language processing (NLP). JAING Y, at the fourth position with 1684 citations, discusses AI's transformative

Most Impactful Authors

Sr No.	**Element**	**h_index**	**g_index**	**m_index**	**TC**
1	WANG Y	4	8	0.5	3431
2	LI H	3	3	0.375	1725
3	MA S	2	2	0.25	1706
4	JIANG Y	1	2	0.125	1684
5	DONG Q	1	1	0.125	1683
6	DONG Y	1	1	0.125	1683
7	JIANG F	1	1	0.125	1683
8	SHEN H	1	1	0.125	1683
9	ZHI H	1	1	0.125	1683
10	WANG L	4	7	0.5	1652

Table 4.

Top 10 Most

Impactful authors

Table 5 KUMAR S stands out as the most prolific author with 10 publications, delving into a wide array of topics related to technology integration in healthcare, particularly focusing on AI-based disease detection, mental health care, innovative solutions, deep learning techniques, COVID-19 response, and more. WANG Y follows closely with 8 publications, exploring AI applications in healthcare, including explainable AI, patient monitoring, and integration with technologies like drones and continuous glucose monitoring systems (CGMS). WANG L ranks third with 7 publications, also focusing on AI's application in healthcare and associated challenges.

Muhammad G, Kumar A, Khan S, Liu H, and Carter Sm are equally productive authors, ranking fourth to eighth, with 6 publications each. Their work centers around smart healthcare, IoT/IoMT, AI, edge/cloud computing, security, medical signals fusion, COVID-19 detection, deep learning, and blockchain.

LIU X and QADIR J round off the top ten productive authors with 5 publications each, emphasizing healthcare data privacy, blockchain, AI applications, wearable sensors, gait analysis, and smart healthcare systems.

Most Productive Authors					
Sr No.	Element	h_index	g_index	m_index	NP
1	KUMAR S	6	10	1.2	10
2	WANG Y	4	8	0.5	8
3	WANG L	4	7	0.5	7
4	MUHAMMAD G	6	6	0.857	6
5	KUMAR A	5	6	1	6
6	KHAN S	5	6	1.25	6
7	LIU H	3	6	0.5	6
8	CARTER SM	3	5	0.75	6
9	LIU X	4	5	0.667	5
10	QADIR J	3	5	0.375	5

Table 5.

Top 10 Most

Productive authors

3.1.4 Most relevant journals. Research on the commercial applications of blockchain has been published across various journals, showcasing continuous progress in this field over time. The impact of these journals can be understood through metrics like total citations, h-index, g-index (which emphasizes highly cited articles), and m-index (which considers the age of journals). Here are the top 10 journals, as indicated by their influence and relevance in this area, reflecting the diverse landscape of blockchain research.

Top 10 most impactful journals

Rank	**Journals**	**h_index**	**g_index**	**m_index**	**TC**
1	IEEE ACCESS	23	49	2.3	2444
2	STROKE AND VASCULAR NEUROLOGY	1	1	0.125	1683
3	NPJ DIGITAL MEDICINE	11	15	1.833	983
4	BMC MEDICAL INFORMATICS AND DECISION MAKING	6	8	1.2	818
5	JOURNAL OF THE AMERICAN MEDICAL INFORMATICS ASSOCIATION	5	6	0.714	670
6	HEALTHCARE (SWITZERLAND)	9	22	2.25	632
7	INTERNATIONAL JOURNAL OF ENVIRONMENTAL RESEARCH AND PUBLIC HEALTH	12	24	1.333	603
8	ARTIFICIAL INTELLIGENCE IN HEALTHCARE	2	2	0.4	601
9	PROCEEDINGS OF THE IEEE	2	2	0.167	578
10	PROCEDIA COMPUTER SCIENCE	11	22	0.786	571

Top 10 most productive journals

Rank	**Element**	**h_index**	**g_index**	**m_index**	**NP**
1	IEEE ACCESS	23	49	2.3	55
2	SENSORS	13	23	1	28

3	INTERNATIONAL JOURNAL OF ENVIRONMENTAL RESEARCH AND PUBLIC HEALTH	12	24	1.333	24
4	HEALTHCARE (SWITZERLAND)	9	22	2.25	22
5	PROCEDIA COMPUTER SCIENCE	11	22	0.786	22
6	STUDIES IN HEALTH TECHNOLOGY AND INFORMATICS	3	4	0.75	21
7	APPLIED SCIENCES (SWITZERLAND)	9	15	1.286	20
8	DIGITAL HEALTH	9	16	1.5	16
9	NPJ DIGITAL MEDICINE	11	15	1.833	15
10	IEEE JOURNAL OF BIOMEDICAL AND HEALTH INFORMATICS	8	13	1.6	13

Table 6.

Top 10 Most Relevant journals

The analysis based on the m-index revealed that IEEE journals are highly productive and relevant for publishing research on artificial intelligence (AI) in healthcare. Specifically, IEEE ACCESS stands out with 2433 citations for its AI-related papers in healthcare, indicating a significant amount of high-quality research in this field. Other notable journals include Studies in Health Technology and Informatics, Healthcare (Switzerland), International Journal of Environmental Research and Public Health, and Sensors. Stroke and Vascular Neurology also gained prominence, ranking second in terms of citations (1683), showcasing its impact in areas like interventional neurology, vascular health, and AI applications in healthcare. These journals have contributed substantially to advancing knowledge and research prospects in AI within the healthcare industry.

3.2 Scientific mapping

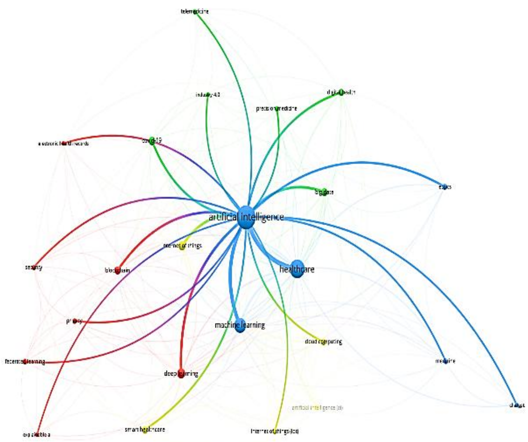
The research delved into the intricate world of blockchain technology's applications in business, revealing key insights through scientific mapping. By analyzing co-occurrences within the dataset and SCOPUS-assigned keywords, the study utilized the Louvain cluster approach and expert assessments to identify 26 highly developed keywords (Gerke, 2020), as depicted in Figure 3.

In the vast realm of healthcare innovation, the fusion of artificial intelligence (AI) with advanced technologies like deep learning, blockchain, and the Internet of Things (IoT) ushers in a new era of transformative possibilities. Navigating through this AI-driven healthcare landscape unveils thematic clusters and emerging trends that shape the digital health terrain.

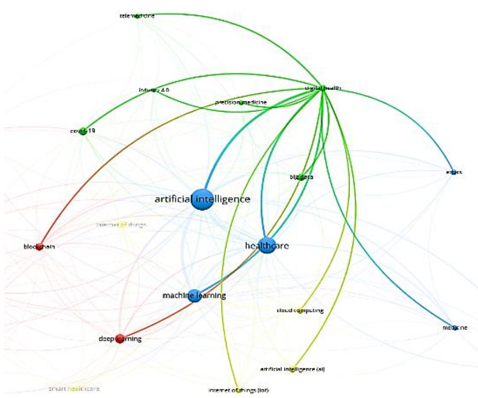
Cluster-I highlights AI's impact on revolutionizing healthcare, enhancing diagnostic capabilities, and tailoring patient care, particularly in areas like robotic surgery and predictive analytics. This investigation, led by Kumar, K. P., Baskaran, P., and Thulasisingh, A. (2022), underscores innovation and patient-centric care as AI paves the way for a healthcare system transformation.

Cluster-II dives deep into how AI drives the hospital of the future, leveraging big data for precise patient diagnosis and treatment. The integration of IoT devices allows remote patient monitoring, while explainable AI ensures transparency in decision-making, and blockchain secures sensitive medical information. This technological synergy promises a future where healthcare is personalized and preventive, tackling illnesses at their roots.

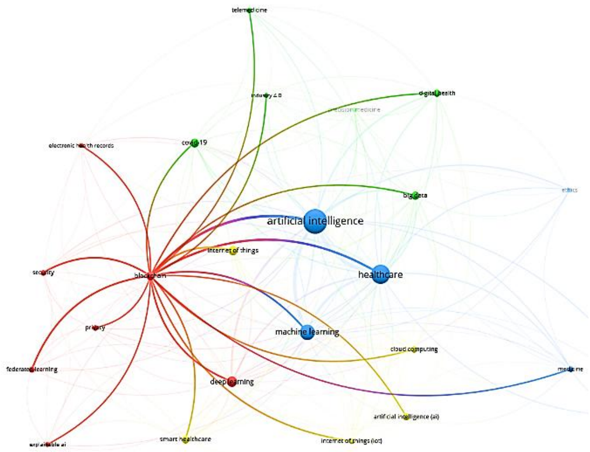
Overall, this cluster analysis encapsulates the multifaceted role of AI in healthcare, unveiling interconnected themes and novel developments that promise to revolutionize clinical practices, foster innovation, and reshape healthcare delivery paradigms.



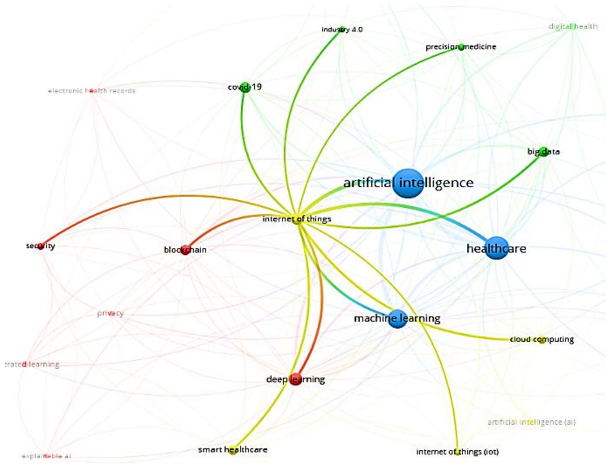
CLUSTER 1 (Blue)



CLUSTER 2 (Green)



CLUSTER 3 (Red)



CLUSTER 4 (Yellow)

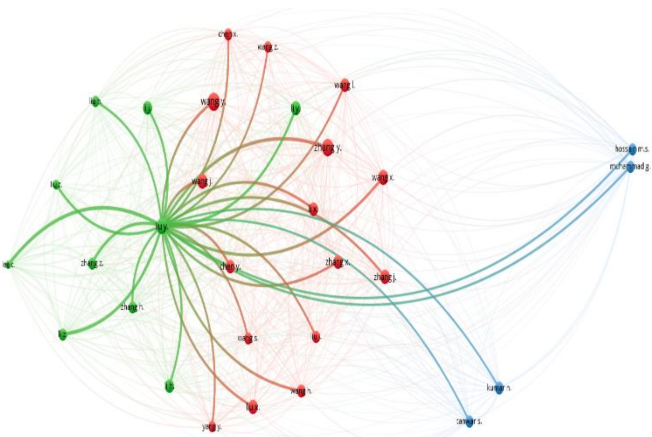
Figure 4.

Cluster wise cooccurrence analysis

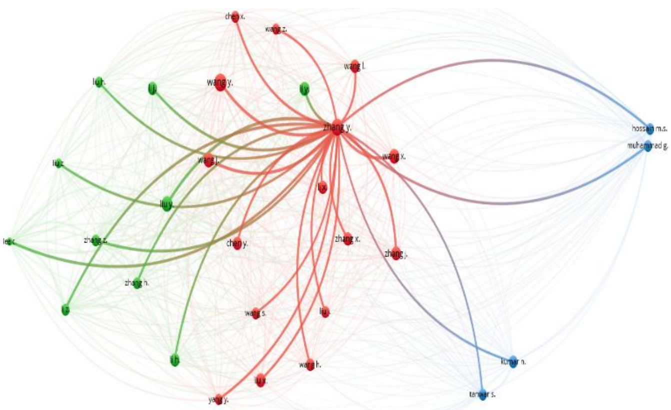
Cluster III delves into the profound impact of artificial intelligence (AI) and its allies on healthcare. This transformative force is driven by the Internet of Things (IoT), a network of devices that tirelessly monitor patient health. The data generated, in conjunction with electronic health records (EHRs), forms a vast pool of information. Blockchain technology plays a crucial role in safeguarding this sensitive data. However, in the realm of powerful technologies, Explainable AI (XAI) becomes indispensable. XAI ensures ethical decision-making and instills confidence by enabling practitioners to comprehend the rationale behind AI's decisions.

In Cluster IV, the focus shifts to the effects of artificial intelligence on healthcare. AI, powered by advanced technologies like machine learning and deep learning, stands at the forefront of this transformation. The Internet of Things (IoT) further enriches this landscape by enabling continuous remote monitoring of patients' health through devices.

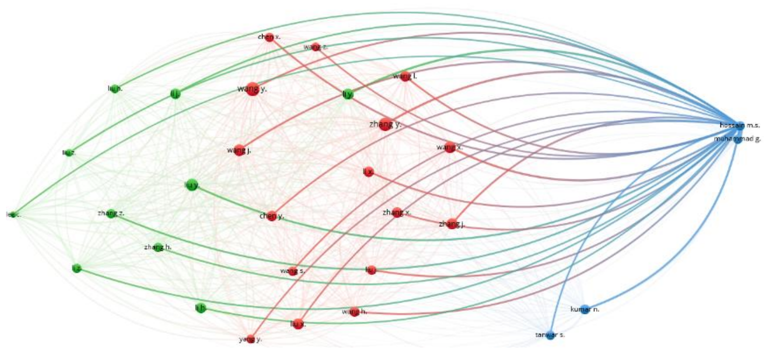
Co-citation:



Green (I)



Red (II)



Blue (III)

Figure 5.

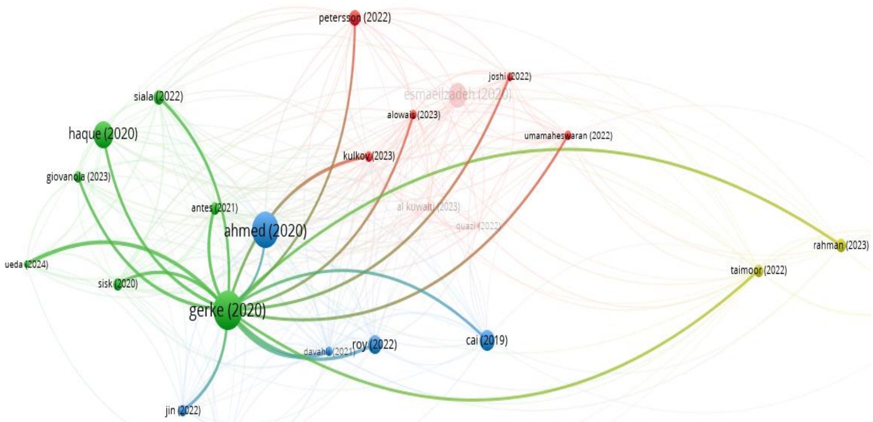
Cluster wise co-citation analysis

Cluster I showcases the transformative journey of healthcare, led by esteemed researchers like Zhang Y., Zhang Z., and Wang. Their focus on artificial intelligence (AI) unveils its potential to revolutionize medicine. Hossain, Muhammad, and Chen delve into machine learning's role in diagnosis and therapy, while Zhang J., Hang, and Muhammad explore deep learning's power to uncover intricate medical patterns. Hossain and Wang also delve into blockchain's use for securing health data, reflecting a keen awareness of ethical considerations surrounding AI.

Cluster II depicts a pioneering shift in healthcare, championed by researchers like Professor Wang, Zhang Y., Hossain, and Muhammad. They delve into how AI, especially machine learning, can revolutionize medical diagnosis and treatment. Professor Zhang Y.'s expertise in the Internet of Things (IoT) aids in gathering real-time patient data for AI algorithms.

Cluster III reveals an international collaboration of leading experts aiming to harness AI for healthcare transformation. Professor Zhang Zhar's groundbreaking work in big data and machine learning sets the stage for AI's medical applications. Drs. Kumar Navaneethan and Muhammad Gandhi contribute expertise in machine learning, focusing on its medical diagnosis and therapy applications.

Bibliography Coupling:



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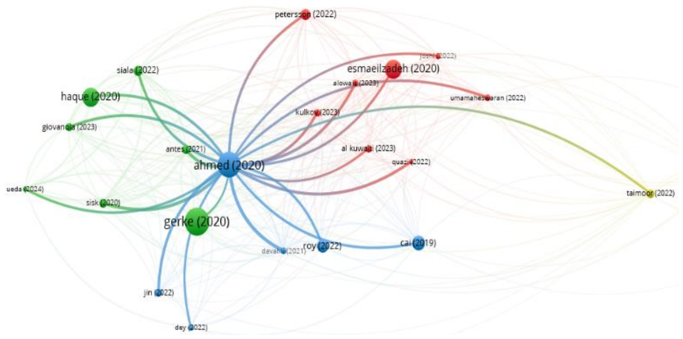

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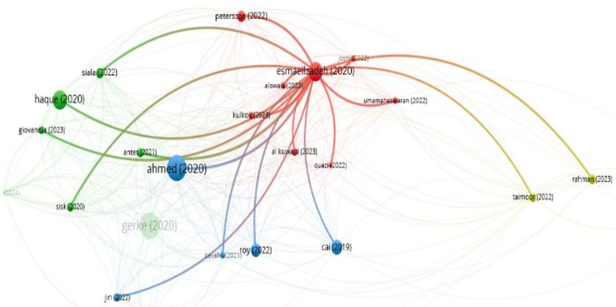
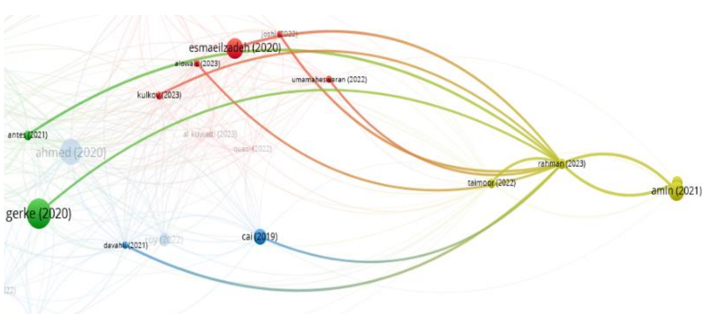




Red (III) **Yellow (IV)**

Figure 6.

Cluster wise bibliography coupling analysis

Cluster I focuses on bridging the gap between artificial intelligence (AI) and practical medical applications. Professor Petersson's groundbreaking work in AI and machine learning forms the foundation for applying these technologies in therapy. Ueda and Kulkarni's expertise in managing vast data volumes ensures AI algorithms can effectively process and utilize data, aided by Drs. Sisk and Gerke's experience with electronic health records (EHRs). Cai and Jin contribute to IoT research, vital for integrating real-time data into AI systems.

Cluster II marks a pivotal moment in healthcare history, with researchers aiming to transform medical care using AI. Professor Ueda's big data research sets the stage for AI advancements. Siala and Davan's cloud computing expertise supports efficient data management, while Dr. Al-Kuwaiti et al. explore blockchain for data security.

Cluster III highlights the foundational role of Professor Haque in machine learning for healthcare, aiding drug development and medical diagnostics. Deep learning specialists like Quazi, Joshi Rose, and Ahmed enhance AI's ability to interpret complex medical images swiftly and accurately.

Cluster IV portrays researchers orchestrating a medical revolution. Professor Amin's AI research leads the way, supported by experts like Sisk and Antes in EHRs for quality data access. Aloweis explores telemedicine's role in remote patient monitoring, while Dr. Al-Kuwaiti et al. emphasize blockchain for secure data management, ensuring harmony and security in healthcare innovation

3.2.2 Thematic map. To aid readers in comprehending the scope and complexity of the topics the writers have addressed over the years, a thematic map of the area is also provided (Figure 7). It is noteworthy that the co-occurrence keywords + parameter were used in this study to create theme maps.

3.2.2.1 Motor Themes: The keywords "federated learning", "medical services", "digital healthcare", and "internet of things" have high centrality and density, as can be seen in this map. This indicates that the most significant and related themes in the area of AI in healthcare are these ones. Federated learning allows AI models to be trained on data from multiple sources without compromising patient privacy.

3.2.2.2 Niche Themes. Although they seem to be discussed regularly, the specialty subjects in your thematic map—healthcare systems, health policy, and information technology—seem to have little bearing on the main issue of AI in healthcare. This implies that rather than broader healthcare system or policy problems, the focus should be more on the technical breakthroughs (federated learning, medical services, etc.) driving this subject.

3.2.2.3 Emerging or Declining Themes. The map shows a focus on the technology components of incorporating AI into healthcare procedures, as evidenced by the prioritization of terms such as internet of things, federated learning, medical services, and digital healthcare. Don't completely ignore these seemingly unimportant themes, though. They could act as a helping hand: Qualitative research aids in understanding user needs and experiences, which is crucial for designing effective AI applications in healthcare.

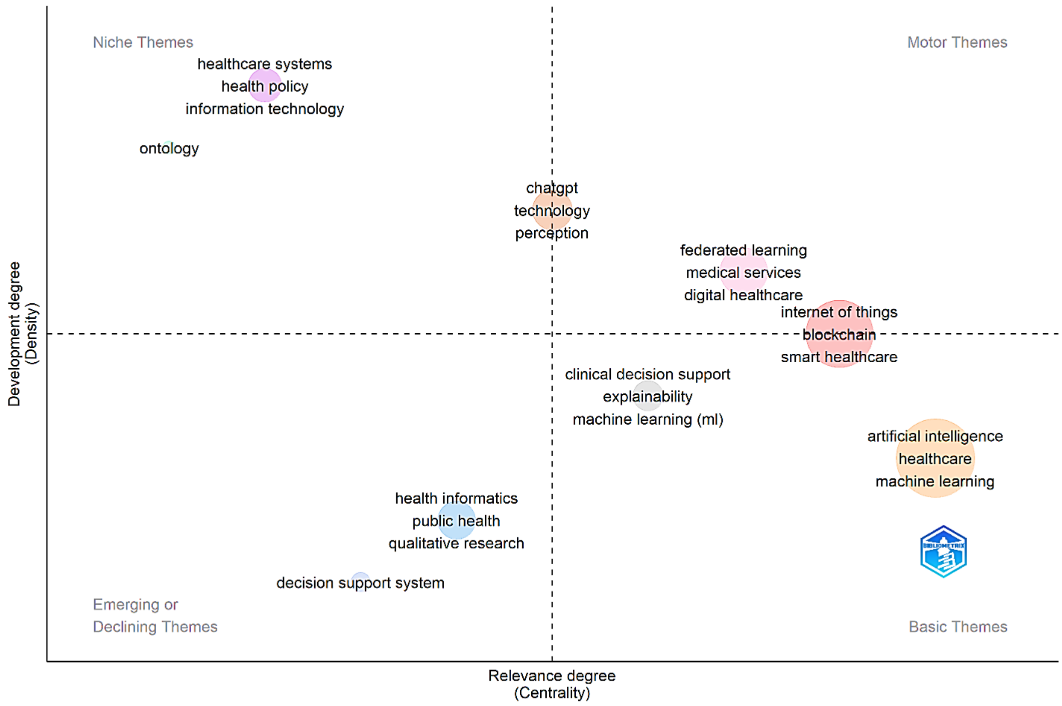


Figure 7. Sources(s): Author's Creation using Bibliometrix R-Package

Thematic map

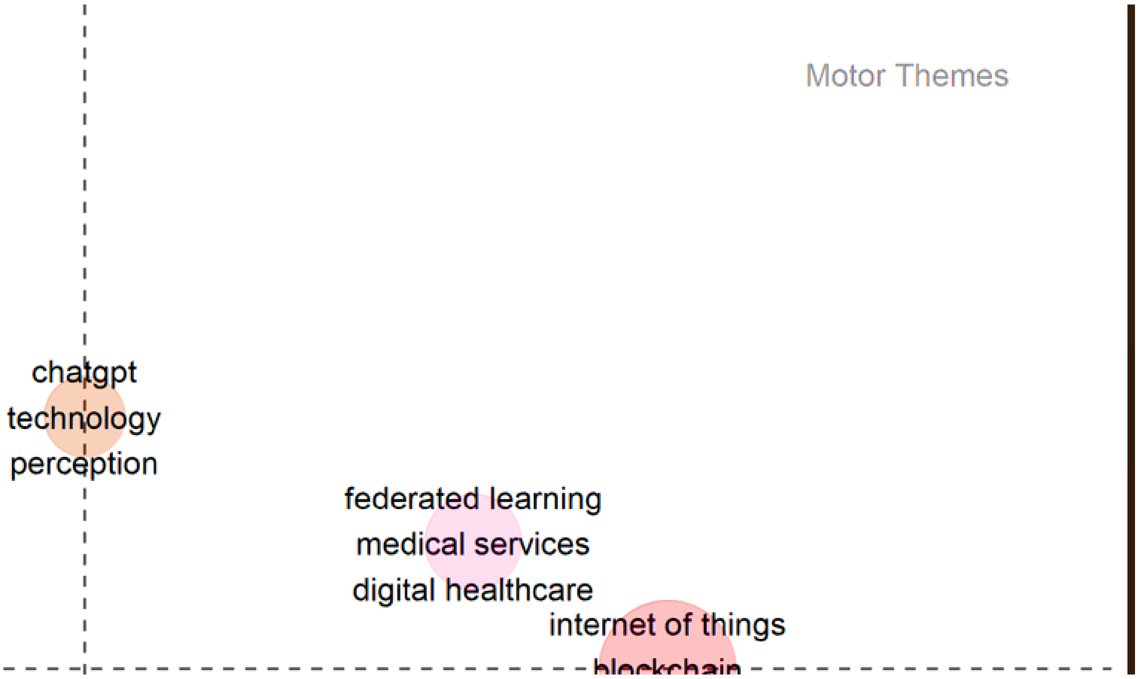


Figure 8.

Motor themes

Sources(s): Author's Creation using Bibliometrix R-Package

Public health considerations are critical for ensuring equitable access to AI-powered healthcare solutions. Health informatics provides the data infrastructure for AI algorithms. AI-generated insights can be integrated into decision support systems to assist medical personnel in making clinical decisions.

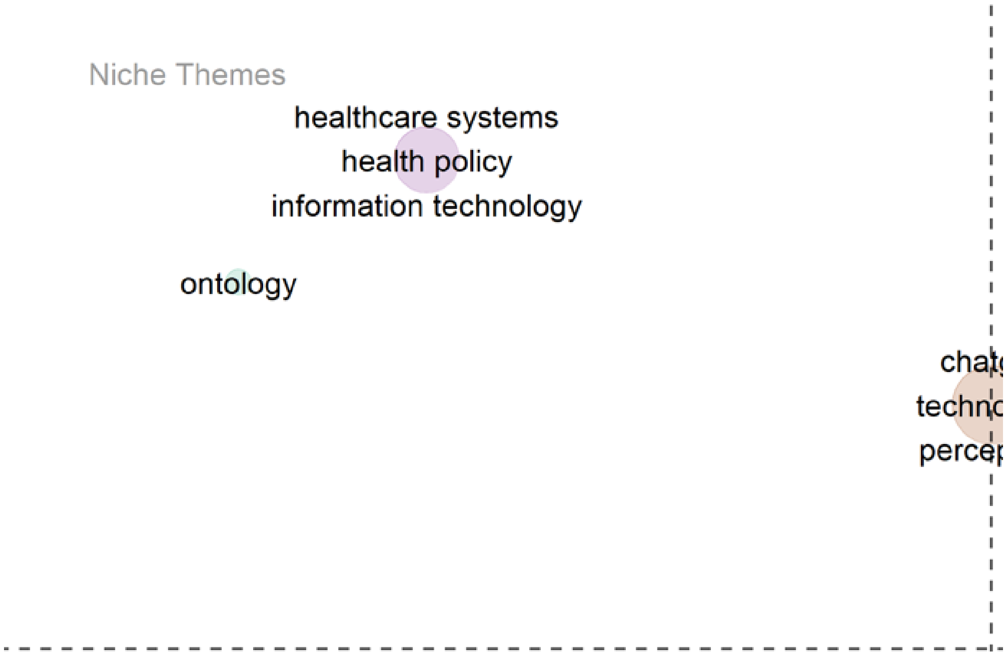


Figure 9.

Niche themes

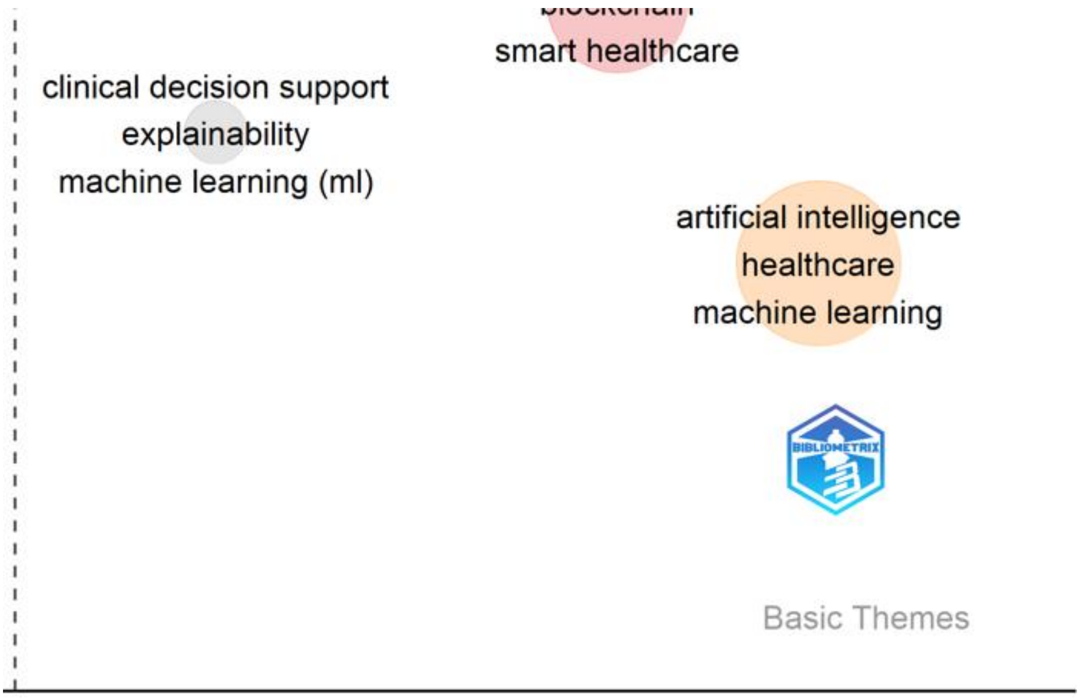
Sources(s): Author's Creation using Bibliometrix R-Package

Figure 10.

Emerging or declining

Sources(s): Author's Creation using Bibliometrix R-Package

3.2.2.4 Basic Themes. With terms like "machine learning," "artificial intelligence," "clinical decision support," and "explainability" holding prominent positions, thematic map revolves on the main theme of artificial intelligence (AI) in healthcare. This shows that these topics are essential to understanding AI in healthcare analysis.



4. Conclusion:

Research on artificial intelligence (AI) in healthcare has unveiled a world brimming with innovation, collaboration, and promising opportunities. This capstone project, through thorough examination of various performance indicators, author impact, country-publication dynamics, and theme mapping, sheds light on the current state and evolution of AI integration in healthcare.

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