Artificial Intelligence in Healthcare Business Ecosystem: A Bibliometric Study

Albert Feisal Muhd Feisal Ismail[1(✉)], Mohd Fazli Mohd Sam[1],
Kamarudin Abu Bakar[1], Amiruddin Ahamat[1], Sabrinah Adam[2],
Muhammad Imran Qureshi[3]
[1]Faculty of Technology Management and Technopreneurship, Universiti Teknikal Malaysia (UTeM), Melaka, Malaysia
[2]Azman Hashim International Business School, Universiti Teknologi Malaysia (UTM), Johor, Malaysia
[3]Teesside University International Business School, Teesside University, Middlesbrough, United Kingdom
feisal@utem.edu.my

Abstract—The use of artificial intelligence (AI) in healthcare is rapidly increasing. Digital health start-ups are bringing new digital technologies and services to the market, allowing for cost savings and service improvements in the healthcare sector. However, successful integration of AI into the healthcare ecosystem is required to realise its full potential. A digital ecosystem approach can be used to achieve this integration. Using bibliometric analysis, this research seeks to provide a clear overview of artificial intelligence in the digital healthcare ecosystem by analysing the published literature in the field. A systematic literature search was conducted on an article extracted from the Scopus database related to artificial intelligence in the digital healthcare ecosystem. A search technique was devised in order to collect relevant publications and bibliographic data (e.g., country, research area, sources, and author). The VOS viewer was used to visualise the co-authorship networks of countries as well as the co-occurrence of author keywords (Leiden University). This study is unique in a way that it presents a comprehensive picture of global efforts of the use of artificial intelligence in the healthcare business ecosystem. Academic researchers, policymakers, and healthcare practitioners who wish to collaborate in these areas in the future will benefit from the insights and research directions of this study.

Keywords—artificial intelligence, healthcare, business ecosystem, bibliometric analysis

1 Introduction

In recent years, artificial intelligence (AI) has evolved into one of the most powerful technologies in tech history for bringing machines and humans together. Back in the day, AI was confined to theories and science fiction. But, in today's world, AI is no longer limited to research labs and scientific laboratories; rather, it has become a part

of our everyday life [1][2]. There is a wide range of artificial intelligence products and services available on the market, ranging from search engines to call-centre chatbots to AI-enabled humanoid robots, which has not only accelerated the growth in the functional capacities of industries but has also improved our current living conditions. AI is permeating many aspects of human life, from education and health to entertainment and finance. AI is also used in systems to combat climate change, anticipate weather for scientific organizations, and eliminate food waste, world hunger, and poverty.

One of the main reasons for the increased utilization of AI is the Covid-19 [3][4]. As more government and business organizations focus on digital improvements, artificial intelligence applications have emerged as the most important component driving this push forward. As society adjusts to the new developments brought on by the pandemic, citizens around the world expect their governments to prioritize the "digital-first" strategy. AI has allowed businesses to improve their operations. Today, a corporate leader's skill is in foreseeing what competitors will do next. Senior executives have seen the value of using other sophisticated technologies like business analytics and data science as a result of integrating AI into operational processes.

Technological advancements are transforming the structure and organization of the healthcare business ecosystem [5]. Artificial intelligence (AI) has the potential to improve healthcare by modifying clinical practice and streamlining procedures [6][7][8]. To improve customer experiences and decision-making processes, many healthcare organizations are looking into integrating artificial intelligence (AI) into their systems [9]. Because of its potential to unleash the power of big data and obtain insight for supporting evidence-based clinical decision-making and delivering value-based care, artificial intelligence (AI) is quickly expanding in the healthcare sector [10]. It is crucial for healthcare professionals to understand the true potential of AI technologies and how they might be used to improve the efficiency, safety, and accessibility of health services, as well as to promote the digital transformation of the healthcare business ecosystem. As AI's popularity grows, researchers work progressively to integrate different technologies to achieve synergy with robotics, the internet of things, and electronic medical record systems [11] as they transform and improve the service and efficiency of the existing medical systems [12]. Among the various shapes that digital technologies might take, artificial intelligence has the most widespread impact and supports healthcare institutions in value co-creation [13].

ICTs have become essential in modern civilization for storing, retrieving, and transmitting data, as well as enabling interoperable interaction in digital environments. Meanwhile, the vast amount of heterogeneous data generated on a daily basis, as well as the increasing complexity of software, have made ICT-enabled systems more difficult to develop and maintain. Under these conditions, the concept of "Digital Ecosystems" has evolved and has quickly piqued the interest of the computer science community. Digital Ecosystems are the digital analogues of natural ecosystems, consisting of multiple and autonomous entities such as individuals, companies, services, software, and apps that share one or more missions and are focused on their interactions and inter-relationships [14]. The phrase "Digital Ecosystem" was coined by [15] in a study on "Digital Business Ecosystems," and it refers to a socio-economic development fuelled by information and communication technologies. Business ecosystems, according to practitioners, are characterised by inter-network rather than inter-firm competition and

are primarily driven by technological improvements [16]. In the healthcare domain, the healthcare business ecosystem is defined as "the network of a multitude of agents: care providers (physicians, nurses, pharmacists, and other health professionals), health suppliers, together with their organizations and information systems, care consumers, plus the socio-economic environment and including the health institutional and regulatory framework" [17].

In business ecosystems, a dynamic group of completely independent partners collaborates to deliver integrated products or services. While the healthcare system meets all of the requirements of a business ecosystem, it is rarely managed as one. Scholars are quite interested in this growing issue. By improving coordination and effectively utilising data across partners, healthcare ecosystems could enable new solutions and significant improvements in quality. A business ecosystem is a collection of interconnected resources that work together for value co-creation. Suppliers, customers, trading partners, apps, and third-party data service providers are all components of the business ecosystem. The business ecosystem's success depends on its interoperability.

ICT adoption enables healthcare sectors to innovate or re-engineer themselves in order to improve the economic viability and quality of services [18][19] however there is less evidence in the literature showing its effects on the integration of artificial intelligence in the healthcare business ecosystem. Sectors such as healthcare and education are relatively slow in adopting AI technologies due to challenges such as regulatory concerns [20] even though Artificial intelligence (AI) provides a number of solutions that promise faster diagnosis, broader patient coverage, lower costs, and a better patient experience [21]. Digital health start-ups are bringing new digital technologies and services to the market, allowing for cost savings and service improvements in the healthcare sector [22].

Although digital health is a trending topic [23][24], digital business ecosystems are being discussed in academic literature [25][26][27] the term healthcare business ecosystem is rarely discussed especially relating the artificial intelligence and machine learning. Many [28][29][30][31] scholars have attempted to determine the previous literature trends on artificial intelligence in healthcare. However they were specific to certain areas such as the bibliometric analysis by [32] is specific to the application of artificial intelligence during covid-19 whereas [33][34][35] analyzed the role of artificial intelligence in healthcare by conducting a bibliometric analysis. Very few studies on AI and the healthcare ecosystem have been conducted to identify and recommend practitioners' key insights into the healthcare domain. As a result, we intend to use a bibliometric approach to investigate the dynamics of the interaction between AI and healthcare business ecosystem approaches over time, taking into consideration the AI and healthcare business ecosystem aspects of scientific production.

This study is unique on its own because it aims to determine the past trends in artificial intelligence and its integration into the healthcare business ecosystem. Some of the objectives of this study are:

- To ascertain the publication output of available literature in artificial intelligence and the healthcare business ecosystem.
- To determine the common aspects, include highly prolific journals, institutions, and the most productive countries.

- Identifying the most prolific countries through co-authorship analysis of authors and countries.
- To identify the predominant and emerging keywords in the field by conducting the co-occurrence analysis of authors' keywords.

The rest of the article is structured as follows: Section 2 describes the research methodology and the inclusion and exclusion criteria of the articles from the study. Section 3 provides the descriptive analysis of the articles. The bibliometric analysis is conducted in section 4. The findings are summarized in the conclusion in section 5. Limitations and future directions are mentioned in section 6.

2   Methodology

This study conducts a bibliometric analysis of the past literature on artificial intelligence and the digital health ecosystem. Bibliometrics is a quantitative approach for visualising and synthesising the literature on a specific topic. This study has used VOS viewer software to carry out the bibliometric analysis. The search was carried out in April 2022 using the Scopus database, which was regarded to be the largest among the others [36][37][38] covering a broader range of subjects than other databases. Furthermore, Scopus is user-friendly and allows the retrieval of relevant data for bibliometric analysis, such as authors, title, publishing year, cited references, abstracts, institutions, and countries [39].

3   Search strategy

Since there was a lack of studies in the said area the search strategy was kept simple. All articles and conference papers published to date have been considered as part of this analysis. No restriction on the period was imposed. The keywords such as artificial intelligence, business ecosystem, digital health ecosystem, healthcare, and digital ecosystem were used to extract the desired article from the Scopus database. The total number of articles found as a result of the search string query was 131. The resulting articles extracted were 77 after filtering the journal and conference articles published until 2021 and removing the duplicates. Therefore, the total number of articles on which the bibliometric analysis was performed was 77 (Figure 1).
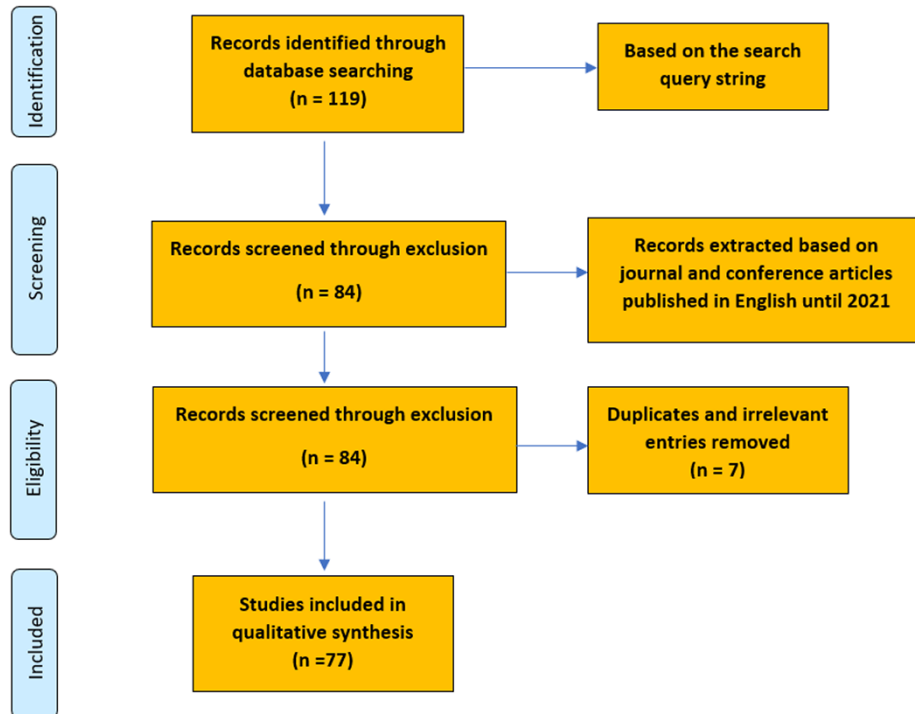
Fig. 1. Search flow chart based on PRISMA

4 Analysis and results

In our initial analysis, we observed the descriptive statistics of the past literature on artificial intelligence and the healthcare business ecosystem. We identified the most influential authors, journals, countries, and institutions.

4.1 Publication output

It can be seen in Figure 2 that the publication trend of artificial intelligence in healthcare rose after 2019 especially during and after 2020, the year when covid 19 occurred. The growth trend in the number of publications can be justified by the growing popularity of artificial intelligence [35]. The use of artificial intelligence in healthcare has grown in recent years, owing in part to COVID-19 [32]. In other words, the potential of AI for the healthcare business ecosystem has piqued the interest of scholars since 2020.
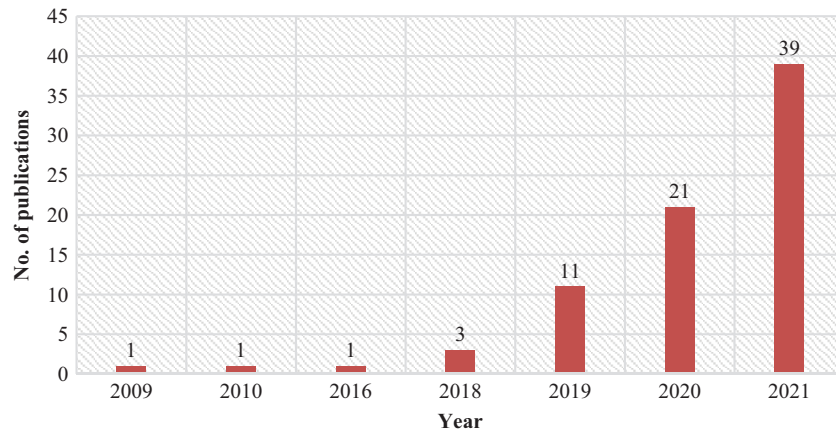
Fig. 2. Publication output

4.2 Top journals

This study has considered both articles and conference papers to conduct bibliometric analysis, but we have also identified the top journals which published most articles on the topic. The top journals have been identified as AI And Society, Mekhatronika Avtomatizatsiyapravlenie, and Sustainability Switzerland with at least two publications in the field.

4.3 Subject areas

Figure 3 shows the distribution of the published literature on artificial intelligence and the digital health ecosystem across the various discipline. Figure 3 shows that 24.7% of the articles belong to the field of computer science while 14.3% are relevant to the field of medicine. 13% of the total publications are published in Engineering while 9.7% of the total publications are in the area of social sciences. Only 5.8% of the articles belong to the field of business and management. The distribution of the published according to their subject areas is shown in Figure 3.
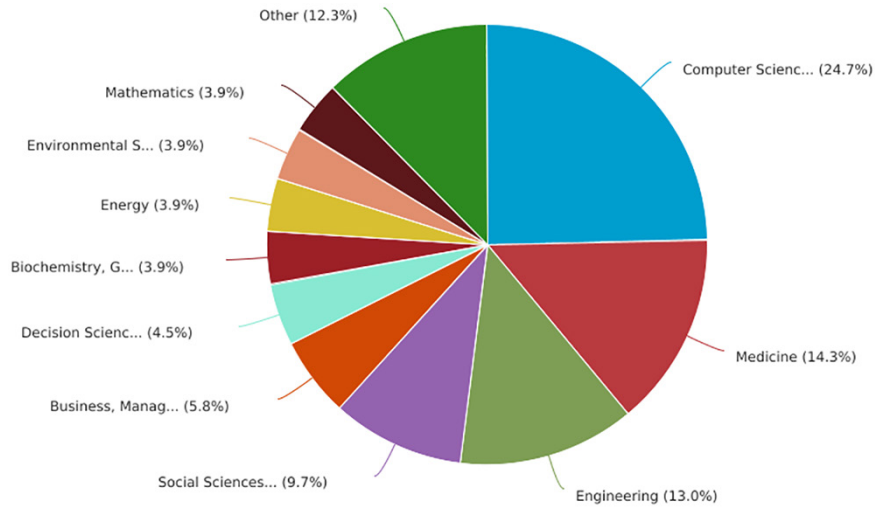
Fig. 3. Subject-wise distribution of published articles

4.4 Prominent countries and institutions

Figure 4 highlights the leading countries based on the number of publications in the field. The top three countries are the United States, Spain, and Italy with 14, 13 and 11 publications respectively. The other leading countries that have contributed to a number of publications in the artificial intelligence and digital health ecosystem field are India, the UK, Australia, China, Ireland, Netherlands and Canada.
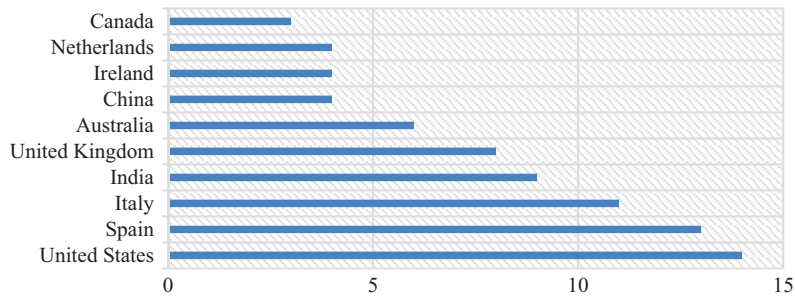

Fig. 4. Leading countries

We have also identified the top 10 institutions that have contributed to the field of AI in the healthcare ecosystem. The University of Oxford seems to be at the top with 3 publications. The rest of the top 10 institutions and their respective countries are shown in Table 1. It can be seen in Table 1 that two of the top three institutions are from the United Kingdom. Also, three Spanish and 2 American institutions made it to the top ten list.

Table 1. Top 10 institutions with most publications

Affiliation	Country	Documents
University of Oxford	UK	3
Universitat Politècnica de València	Spain	2
University of Nottingham	UK	2
Luiss University	Italy	2
Universidad de Salamanca	Spain	2
University of California, San Diego	US	2
Swinburne University of Technology	Australia	2
Institutul Național de Cercetare-Dezvoltare in Informatica	Romania	2
Universidad Antonio de Nebrija	Spain	2
Texas Fertility Center	US	1

4.5 Bibliometric maps

We used VOS viewer to map the literature in the search area. A total of 77 documents were included in this study. We created co-authorship maps and visualizations for collaborating countries, as well as author keyword co-occurrence analysis to determine the emerging and well-established keywords in the literature.

Co-authorship (countries). The minimum number of countries for the co-authorship of countries analysis, which shows collaboration between authors from various geographic locations, was set to two (meaning a minimum of 2 published documents per country). As a result, 24 countries out of 54 were able to meet the threshold. In the diagram (Figure 5), the close proximity of the two countries denotes their strong affiliation with each other.

We discovered that the United Kingdom has the most affiliations with other countries, with 16 links and a total link strength of 22, as well as 8 published articles and 265 citations, based on the co-authorship analysis. It is followed by the United States (14 links, 20 TLS, 14 documents, and 500 citations) and Spain (links: 10, TLS: 17, documents: 13 and citations: 120). Table 2 contains a list of all 24 countries, along with their total link strength, number of documents, and total citations, and Figure 5 depicts a screenshot from the VOS viewer of how the countries are affiliated. The image from the VOS viewer can also be viewed online. The URL is mentioned in the caption of the figure.

Table 2 shows that the top ten countries in terms of citations are the United States (n=500), the United Kingdom (n=265), India (n=239), the Netherlands (n=188), Nigeria (n=186), China (n=176), Spain (n=120), Saudi Arabia (n=111), Portugal (n=110), and Japan (n=70), indicating that the top country with the most publications may not necessarily be the top country with the most citations. Similarly, while the United States (n=14) has more publications than the United Kingdom (n=8), the United

Kingdom has the highest total link strength (TLS), indicating that it has collaborated more with authors from around the world to contribute to the field rather than publishing independently.
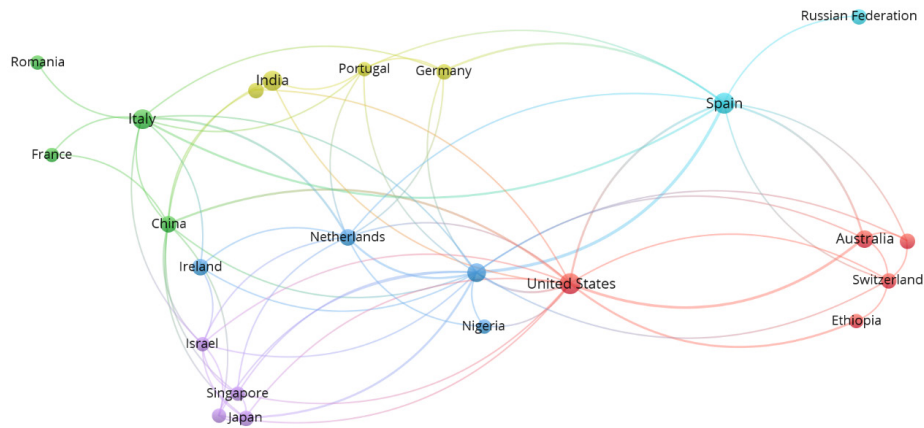

Fig. 5. A bibliometric map showing co-authorship analysis of countries in network visualisation mode; URL: https://bit.ly/370qHkE

Table 2. Top collaborating countries based on their TLS

Country	Documents	Citations	TLS	Country	Documents	Citations	Tls
United Kingdom	8	265	22	South Korea	2	65	6
United States	14	500	20	Switzerland	3	24	6
Spain	13	120	17	India	9	239	5
Italy	11	33	12	Ireland	4	4	4
Netherlands	4	188	12	Norway	3	21	4
China	4	176	11	Saudi Arabia	3	111	4
Israel	2	58	9	Ethiopia	2	9	3
Australia	6	63	8	Nigeria	2	186	3
Japan	3	70	7	France	2	11	2
Singapore	2	57	7	Romania	2	1	1
Germany	3	3	6	Russian Federation	3	41	1
Portugal	2	110	6	Canada	3	33	0

Co-occurrence (author keywords). We conducted a co-occurrence analysis to know the keywords authors have used in their studies so far. Our results after running a co-occurrence analysis of author keywords revealed 300 keywords used in the papers related to artificial intelligence and the healthcare ecosystem. The minimum number of keyword occurrences was set at 2 to be included in the analysis. As a result, 36 keywords were found to meet the criteria. We got 33 keywords by combining similar

keywords (like the internet of things and IOT, and artificial intelligence and AI) into a single keyword. The most prominent keywords occurred were Artificial Intelligence, Internet of Things, Blockchain, Big Data, Smart Cities, Deep Learning, Healthcare, Information and Communication Technology, Sustainability, and Covid-19 with 34, 12, 8, 9, 5, 4, 6, 4, 3 and 4 occurrences (Table 3). The overlay visualization of data is shown in Figure 6 and the keywords along with their occurrences and total link strength (TLS) are shown in Table 3.
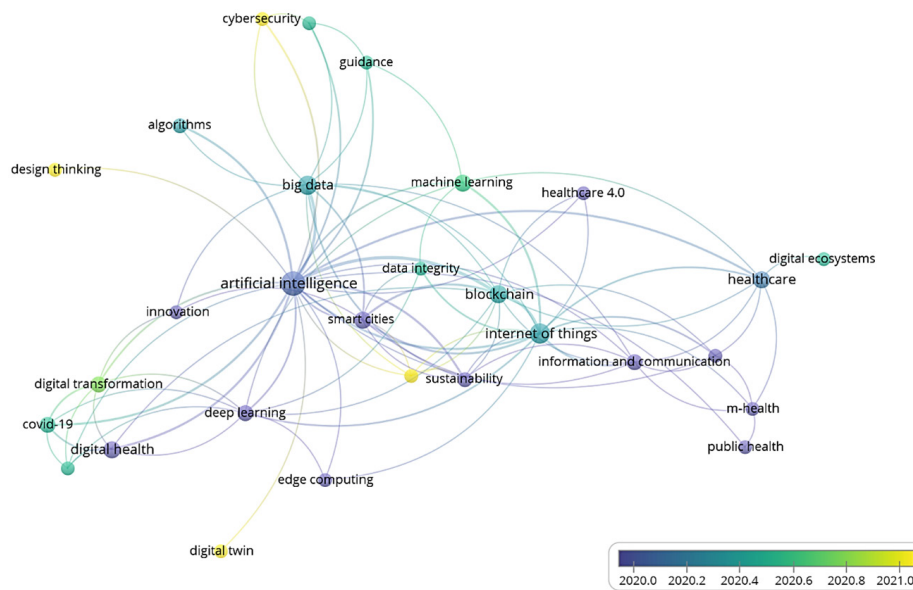

Fig. 6. Snapshot of a bibliometric map showing co-occurrence of keywords analysis overlay visualisation mode; URL: https://bit.ly/3MLDC9z

Keywords such as M-Health, Ontology, Telemedicine, Algorithms, Cybersecurity, Edge Computing, Healthcare 4.0, Innovation, Public Health, Design Thinking, Digital Ecosystems, Digital Twin with total link strength of 5 or less (Table 3) show that these topics are still emerging, and more work is required in these fields. They may be of interest to future researchers and may serve as influential hot topics for future research in the said field.

Table 3. Top keywords based on TLS

Keyword	Occurrences	TLS	Keyword	Occurrences	TLS
Artificial Intelligence	34	52	Older Adults	2	6
Internet Of Things	12	31	Patient-Centred Ecosystem	2	6
Blockchain	8	24	Personalised Assistive Care	2	6
Big Data	9	18	Guidance	2	5
Smart Cities	5	15	M-Health	2	5
Deep Learning	4	12	Ontology	2	5
Healthcare	6	11	Telemedicine	2	5
Information And Communication Technology	4	11	Algorithms	3	4
Sustainability	3	10	Cybersecurity	2	4
Covid-19	4	9	Edge Computing	2	3
Digital Health	6	9	Healthcare 4.0	2	3
Machine Learning	5	9	Innovation	2	3
Digital Transformation	4	8	Public Health	2	2
E-Health	2	7	Design Thinking	2	1
Adaptive Technologies	2	6	Digital Ecosystems	2	1
Cloud Computing	2	6	Digital Twin	2	1
Data Integrity	2	6			

5   Conclusion

This paper examined the progress and various trends of AI in the healthcare business ecosystem from 2009 to 2021. We aimed to provide a bird's-eye view of the entirety of artificial intelligence relating to the healthcare business ecosystem. This analysis provides a comprehensive overview of the AI-related research conducted in the field of healthcare. With multiple searching and screening rounds, a bibliometric analysis is conducted on the 77 selected articles relating to artificial intelligence in the healthcare ecosystem. This research depicted the publication growth trend of AI and healthcare ecosystem research published from 2009 to 2021. This research has also identified the top journals, institutions and countries. It was found that AI And Society is the top journal whereas the University of Oxford is the top institution with the most publications in the field. A country-wise analysis was done which depicted that the top country with most publications is the United States with 14 published documents however the country that received the most citations in the United Kingdom. Through co-authorship

of country analysis, we determine that the top three countries involved in collaborative research with the rest of the world are the United Kingdom, the United States and Spain. The interest of developed countries such as the United Kingdom, the United States, China, and some European countries has led to the development and significant growth of AI-related research in healthcare. We have also determined the well-established and the merging hot topics in the field through co-occurrence of keywords analysis using Vos Viewer software. These hot topics are intriguing areas for future research to provide recommendations to future researchers so that they can focus their efforts in these areas and fill research gaps. The findings and research directions of this study will benefit academic researchers, policymakers, and healthcare practitioners who wish to collaborate in these areas in the future.

5.1 Limitations

The limitations of our work must be acknowledged. First, we only included studies published in English. As a result, we may have overlooked significant studies published in various languages. Future research can widen the scope of the search to include more relevant research to enrich the literature. Secondly, due to the limited research in the field, we have selected journal articles as well as conference articles which may not be fully peer-reviewed. Third, we only extracted and analysed data from Scopus; although Scopus is a large database that offers a wide variety of research there is a chance that we missed some potential articles. Future research could use different databases to compare the results.

6 Acknowledgements

7 References

[1] A. Elliott, The culture of AI: everyday life and the digital revolution. 2019. https://doi.org/10.4324/9781315387185

[2] Indrasen Poola, "How artificial intelligence in impacting real life every day," International Journal of Advance Research and Development. 2017.

[3] D. S. W. Ting, L. Carin, V. Dzau, and T. Y. Wong, "Digital technology and COVID-19," Nature Medicine. 2020. https://doi.org/10.1038/s41591-020-0824-5

[4] The Lancet Digital Health, "Artificial intelligence for COVID-19: saviour or saboteur?" The Lancet Digital Health. 2021. https://doi.org/10.1016/S2589-7500(20)30295-8

[5] S. Marcos-Pablos, J. A. Juanes Méndez, and M. L. Walters, "State-of-the-art technologies at the service of medical training and practice to foster Digital Health Ecosystems," 2020. https://doi.org/10.1145/3434780.3436700

[6] S. Ibeneme et al., "Data revolution, health status transformation and the role of artificial intelligence for health and pandemic preparedness in the African context," BMC Proceedings. 2021. https://doi.org/10.1186/s12919-021-00228-1

[7] S. Reddy, "Use of artificial intelligence in healthcare delivery," in eHealth – Making Health Care Smarter. 2018. https://doi.org/10.5772/intechopen.74714

[8] A. Arora, "Conceptualising artificial intelligence as a digital healthcare innovation: an introductory review," Medical Devices: Evidence and Research. 2020. https://doi.org/10.2147/MDER.S262590

[9] D. Wiljer et al., "Accelerating the appropriate adoption of artificial intelligence in health care: protocol for a multistepped approach," JMIR Research Protocols. 2021. https://doi.org/10.2196/30940

[10] M. Chen and M. Decary, "Artificial intelligence in healthcare: an essential guide for health leaders," Healthcare Management Forum. 2020. https://doi.org/10.1177/0840470419873123

[11] A. Arora, "Conceptualising artificial intelligence as a digital healthcare innovation: an introductory review," Medical Devices: Evidence and Research. 2020. https://doi.org/10.2147/MDER.S262590

[12] L. Omrcen, H. Leventic, K. Romic, and I. Galic, "Integration of blockchain and AI in EHR sharing: a survey," 2021. https://doi.org/10.1109/ELMAR52657.2021.9550953

[13] D. Leone, F. Schiavone, F. P. Appio, and B. Chiao, "How does artificial intelligence enable and enhance value co-creation in industrial markets? An exploratory case study in the healthcare ecosystem," Journal of Business Research. 2021. https://doi.org/10.1016/j.jbusres.2020.11.008

[14] W. Li, Y. Badr, and F. Biennier, "Digital ecosystems: challenges and prospects," 2012. https://doi.org/10.1145/2457276.2457297

[15] F. Nachira, "Towards a network of digital business ecosystems fostering the local development," Ecosystems. 2002.

[16] F. T. C. Tan, J. Ondrus, B. Tan, and J. Oh, "Digital transformation of business ecosystems: evidence from the Korean pop industry," Information Systems Journal. 2020. https://doi.org/10.1111/isj.12285

[17] L. D. Serbanati, F. L. Ricci, G. Mercurio, and A. Vasilateanu, "Steps towards a digital health ecosystem," Journal of Biomedical Informatics, 2011. https://doi.org/10.1016/j.jbi.2011.02.011

[18] L. D. Serbanati, F. L. Ricci, G. Mercurio, and A. Vasilateanu, "Steps towards a digital health ecosystem," Journal of Biomedical Informatics, 2011. https://doi.org/10.1016/j.jbi.2011.02.011

[19] I. Mustapha, N. Khan, M. I. Qureshi, A. A. Harasis, and N. T. Van, "Impact of industry 4.0 on healthcare: a systematic literature review (SLR) from the last decade," International Journal of Interactive Mobile Technologies. 2021. https://doi.org/10.3991/ijim.v15i18.25531

[20] J. Bughin et al., "Artificial intelligence the next digital frontier," McKinsey & Company. 2017. https://doi.org/10.1016/S1353-4858(17)30039-9

[21] M. Jain, A. Goel, S. Sinha, and S. Dhir, "Employability implications of artificial intelligence in healthcare ecosystem: responding with readiness," Foresight. 2021. https://doi.org/10.1108/FS-04-2020-0038

[22] A. K. Witte, "A review on digital healthcare ecosystem structure: identifying elements and characteristics," 2020.

[23] P. Mellodge and C. Vendetti, "Remotely monitoring a patient's mobility: a digital health application," IEEE Potentials. 2011. https://doi.org/10.1109/MPOT.2010.939453

[24] H. Sikandar, Y. Vaicondam, S. Parveen, N. Khan, and M. I. Qureshi, "Bibliometric analysis of telemedicine and e-health literature," International Journal of Online and Biomedical Engineering, vol. 17, no. 12, pp. 52–69, 2021. https://doi.org/10.3991/ijoe.v17i12.25483

[25] E. Chang and M. West, "Digital ecosystems a next generation of the collaborative environment," the Eight International Conference on Information …, 2006.

[26] I. Pranata, G. Skinner, and R. Athauda, "A distributed mechanism for secure collaboration in Digital Ecosystems," 2011. https://doi.org/10.1145/2077489.2077495

[27] G. E. Iyawa, M. Herselman, and A. Botha, "Digital health innovation ecosystems: from systematic literature review to conceptual framework," 2016. https://doi.org/10.1016/j.procs.2016.09.149

[28] S. Fosso Wamba and M. M. Queiroz, "Responsible artificial intelligence as a secret ingredient for digital health: bibliometric analysis, insights, and research directions," Information Systems Frontiers. 2021. https://doi.org/10.1007/s10796-021-10142-8

[29] M. M. Islam et al., "Application of artificial intelligence in covid-19 pandemic: bibliometric analysis," Healthcare (Switzerland). 2021. https://doi.org/10.3390/healthcare9040441

[30] Y. Guo, Z. Hao, S. Zhao, J. Gong, and F. Yang, "Artificial intelligence in health care: bibliometric analysis," Journal of Medical Internet Research. 2020. https://doi.org/10.2196/18228

[31] B. X. Tran et al., "Global evolution of research in artificial intelligence in health and medicine: a bibliometric study," Journal of Clinical Medicine. 2019. https://doi.org/10.3390/jcm8030360

[32] M. M. Islam et al., "Application of artificial intelligence in covid-19 pandemic: bibliometric analysis," Healthcare (Switzerland). 2021. https://doi.org/10.3390/healthcare9040441

[33] Y. Guo, Z. Hao, S. Zhao, J. Gong, and F. Yang, "Artificial intelligence in health care: bibliometric analysis," Journal of Medical Internet Research. 2020. https://doi.org/10.2196/18228

[34] B. X. Tran et al., "Global evolution of research in artificial intelligence in health and medicine: a bibliometric study," Journal of Clinical Medicine. 2019. https://doi.org/10.3390/jcm8030360

[35] S. Fosso Wamba and M. M. Queiroz, "Responsible artificial intelligence as a secret ingredient for digital health: bibliometric analysis, insights, and research directions," Information Systems Frontiers. 2021. https://doi.org/10.1007/s10796-021-10142-8

[36] R. Pranckutė, "Web of science (WoS) and scopus: the titans of bibliographic information in today's academic world," Publications. 2021. https://doi.org/10.3390/publications9010012

[37] H. Sikandar, Y. Vaicondam, N. Khan, M. I. Qureshi, and A. Ullah, "Scientific mapping of industry 4.0 research: a bibliometric analysis," International Journal of Interactive Mobile Technologies (iJIM), vol. 15, no. 18, p. 129, 2021. https://doi.org/10.3991/ijim.v15i18.25535

[38] H. Sikandar and U. H. Abdul Kohar, "A systematic literature review of open innovation in small and medium enterprises in the past decade," Foresight. 2021. https://doi.org/10.1108/FS-01-2021-0030

[39] H. Sikandar, Umar Haiyat Abdul Kohar, and Sidra Salam, "The evolution of social innovation and its global research trends: a bibliometric analysis," Systematic Literature Review and Meta-Analysis Journal, vol. 1, no. 2, pp. 117–133, 2021. https://doi.org/10.54480/slrm.v1i2.9

8   Authors

Albert Feisal Muhd Feisal Ismail, Faculty of Technology Management and Technopreneurship, Universiti Teknikal Malaysia (UTeM), Melaka, Malaysia.

Mohd Fazli Mohd Sam, Faculty of Technology Management and Technopreneurship, Universiti Teknikal Malaysia (UTeM), Melaka, Malaysia. E-mail: mohd.fazli@utem.edu.my

Kamarudin Abu Bakar, Faculty of Technology Management and Technopreneurship, Universiti Teknikal Malaysia (UTeM), Melaka, Malaysia. E-mail: kamarudin@utem.edu.my

Amiruddin Ahamat, Faculty of Technology Management and Technopreneurship, Universiti Teknikal Malaysia (UTeM), Melaka, Malaysia. E-mail: amiruddin@utem.edu.my

Sabrinah Adam, Azman Hashim International Business School, Universiti Teknologi Malaysia (UTM), Malaysia. E-mail: sabrinah@utm.edu.my

Muhammad Imran Qureshi, Teesside University International Business School, Clarendon Building, Teesside University, Middlesbrough, Tees Valley, TS1 3BX, United Kingdom. E-mail: m.qureshi@tees.ac.uk