Research on Electronic Medical Record Information Sharing: A Bibliometric Analysis

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Abstract. Objective :This study aimed to conduct a bibliometric analysis of information sharing in electronic medical records. Use bibliometric methods to discover the research directions in this field, the spatiotemporal distribution of research results, and the temporal trends of research hotspots. Methods: This article uses bibliometric analysis methods to analyze relevant research on electronic medical record information sharing. The Web of Science (WOS) database was used to extract the publications. Through keyword searches and limiting literature sources to core journals, 1779 articles were ultimately included in the analysis. Citespace6.2.4 was used for bibliometric analysis. Results: The number of related studies shows a stable upward trend. The application and technological optimizations were the subjects analyzed in most studies. Based on the primary geographic distribution of published articles, the United States was the country that published the most articles. Conclusion: We found that research on laws, regulations, and information ethics is insufficient. These research directions are worth further exploration. In addition, the advancement of information technology is also a solution to the problems in electronic medical record information sharing.

Keywords: Electronic medical records EMR; Information sharing; Bibliometric analysis.

1. Introduction

Electronic medical records have been proposed since 2007 and are the core content of hospital information construction (Chi, 2017). Electronic medical record (EMR) adoption has transformed medical practice from a paper-based craft to an integrated healthcare delivery system (Carter, 2015). It is an electronic copy of a single care provider's paper records (Elevance Health, 2023) which contains the patient's home page, medical course records, nursing records, doctor's order information, and patient's surgical records (MEI et al., 2016). Information sharing refers to electronically exchanging and sharing patient medical record information among relevant medical institutions (Zhejiang et al.'s Government, 2022).

Electronic medical record information sharing helps to integrate data information, improve the utilization of information resources, and provide doctors with clear patient history and medication records. In developed medical countries such as the United States, Canada, and the United Kingdom, EMR sharing, remote diagnosis, disease monitoring, and epidemiological research are realized by building a regional shared cloud platform (Wang, 2022). In China, the data interconnection and sharing platform built in pilot cities such as Beijing and Hangzhou has been implemented (Wang, 2022). From 2016 to 2020, China will complete the construction of a national health platform, and the regional health system will gradually improve. China has established over 1,700 Internet hospitals, and over 7,000 public hospitals have established regional electronic health platforms. As many as 260 cities have realized the sharing of personal medical card information within the region (National Health Commission, 2022).

Electronic medical record information sharing is also valuable in the economic realm. From 2000 to 2023, the EMR market exceeded from virtually non-existent to $17.6 billion with an annual growth rate of 6.2% (Future et al. Ltd., 2023). Globally, adopting EMRs has been considered an essential step in the electronic transformation of healthcare. and information sharing of EMR is crucial to improve health system efficiency. Information sharing has extensive research potential in healthcare (Nguyen et al., 2022). In China's electronic health record market is expected to be US$2.27 billion in 2022, with a compound annual growth rate of 5.5% (Insights10, 2023). Due to the outstanding potential of EMR information sharing, governments in various countries have generally increased

their efforts to provide incentives and subsidies to promote the adoption of EMR information sharing (Atasoy et al., 2017), thus attracting the attention of investors. Therefore, EMR information sharing is also of great research value in the economic field.

The development of information sharing conforms to the needs of social development. For example, the epidemic and the aging social phenomenon have increased the demand for digital hospitals (Nautiyal et al., 2023), telemedicine, e-medicine, and information sharing, accelerating the development of digital healthcare (Negreiro, 2021). The construction of the electronic medical information-sharing platform is to provide high-performance services for relevant personnel in the medical industry. At the same time, the advent of informatization has made people pay more attention to protecting the security and privacy of personal health data, promoting the development of information sharing. EMR information sharing needs to ensure data privacy and security to improve people's trust in EMR information sharing. In order to protect the legitimate rights and interests of protecting medical data, the government should strengthen the formulation and implementation of relevant laws and regulations.

Collaborative, efficient, cutting-edge information sharing is still in its infancy in healthcare and is integral to the future growth of provider organizations, management organizations, and other healthcare-related organizations. The current research results can help scholars and related practitioners address current technologies and challenges and predict future developments. This article uses bibliometric analysis to extract research keywords and analyze the distribution of the top ten institutions, countries, and research fields with the most published papers. By explaining the results of bibliometric analysis, This article identifies the most relevant areas of interest and discusses future research directions.

2. Method

The bibliometric approach to analyzing scientific output onEMR information sharing was motivated by the need to assess scientific production (Ellegaard & Wallin, 2015). The results of bibliometrics are presented in a summary form, which is convenient for studying new research directions in the future (Martínez-López et al., 2018). CiteSpace is used to visualize and analyze trends and patterns in the scientific literature (Chen, 2004). CiteSpace supports structural and temporal analysis of various networks derived from scientific publications, including keyword clustering, associated word structure analysis, and collaborative networks.

The database used to extract information is Web of Science (WOS). The database allows access to authoritative publications in all areas of knowledge with high-quality indexing (Ellegaard & Wallin, 2015; Shah et al., 2019). The database allows targeted, well-structured searches (Chavarro et al., 2018).

This study focuses on searching English articles published between 1993 and 2023, and the research object is EMR *information sharing.* The following retrieval formula was used, which included any publication on EMRs and information sharing: the search terms were ("EMR"), ("EMR information sharing"), ("electronic medical records") or ("medical information exchange") or ("electronic medical record information sharing").a total of 4,628 results across all databases. WOS allows filtering the results according to the article search database, editor, publication year, and language, adding keyword information sharing, removing 596 irrelevant articles, and keeping 4032 articles. By Restricting the data to the Web of Science Core Collection, searching and filtering on keywords yielded 1958 publications Exported to an Excel worksheet to continue the filtering process. The authors deleted articles not meeting the inclusion criteria through full-text reading and analysis and finally retained 1779 publications (Fig. 1).

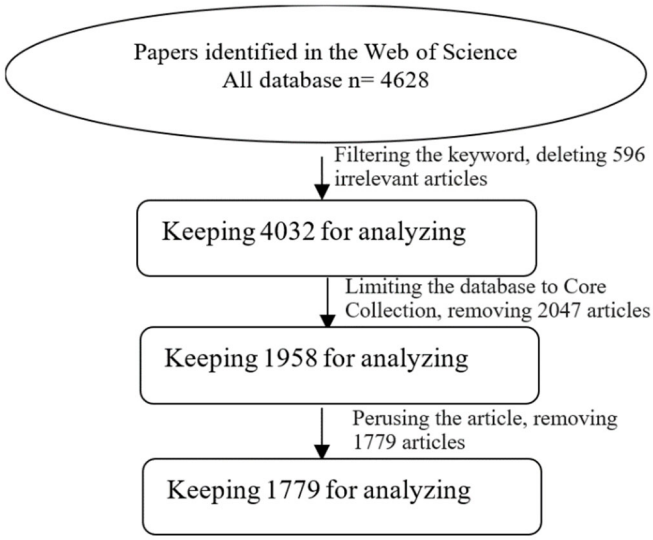

Figure1: Implementation process, screening, and identification n=number

3. Results

Analyzing the number of articles published on EMR information sharing, using a bar chart to show the number of related papers published in the past two decades, showing a slowly rising trend from 1993 to 2020. In 2020, 235 articles were published, reaching a peak, and there were no apparent fluctuations after 2021, maintaining a stable state. The upward trend shows that researchers continue to be interested in this field. It is necessary to analyze further the research direction and distribution of research results on EMR information sharing.

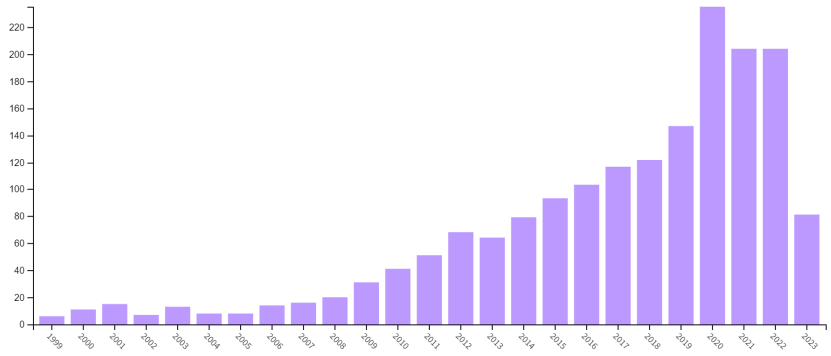

Figure2: The amount of EMR information sharing per year(souring from Web of Science)

Agencies ranking. The 1,779 articles on EMR information sharing were published in more than 500 agencies in different research fields. Two agencies (34.516% of 1779) with more than 100 articles and three (12.724% of 1779) with less than 100 and more than 50 articles. The United States Department of Health Human Services has 342 articles (19.085% of 1779), ranking first. The top eight articles with the largest number of publications are shown in Table 1. All are listed in the Quality Index, and eight are in the healthcare industry. The top eight institutions with the most published articles are all government institutions. Most of them are from US government institutions, except for NSFC, and UKRI is from China and the United Kingdom. The data shows that the government attaches great importance to electronic medical information-sharing research.

Table 1: Top 8 most published agencies

Agencies	Record Count	% of 1,779
United States Department Of Health Human Services	342	19.085

National Institutes Of Health (NIH) USA	277	15.458
National Natural Science Foundation Of China (NSFC)	93	5.19
Agency For Healthcare Research Quality (AHRQ	78	4.353
National Library Of Medicine (NLM)	57	3.181
Uk Research Innovation (UKRI)	45	2.511
National Science Foundation (NSF)	40	2.232
National Center For Advancing Translational Sciences (NCATS)	38	2.121

Geographical distribution. The analysis found that only a few electronic medical information-sharing publications had no attribution, totaling 0.843% of 1779. We found that the country with the most case studies is the United States, with 917 articles (51.546% of 1779) showing a cliff-like lead. Second, 184 and 176 publications came from China and the UK . (Fig.3)

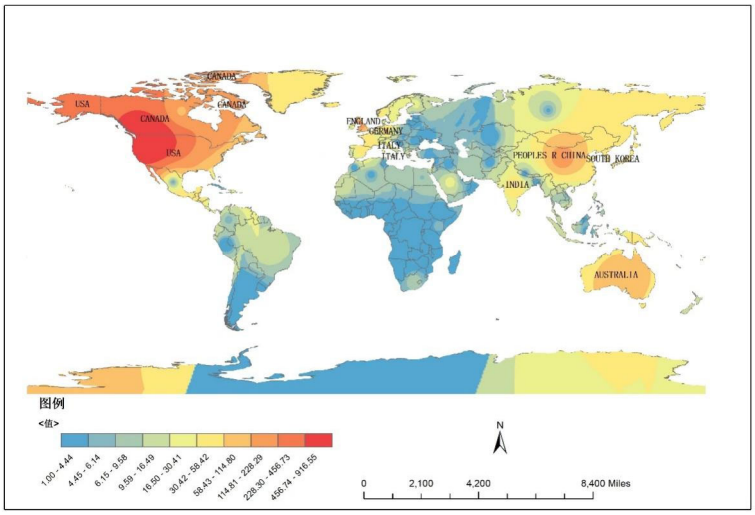

Figure 3: Geographic distribution heat map on EMR information sharing

The content of the 1779 selected publications was analyzed to provide information on the most studied topics, keywords, countries with the highest number of articles in the case studies, etc.

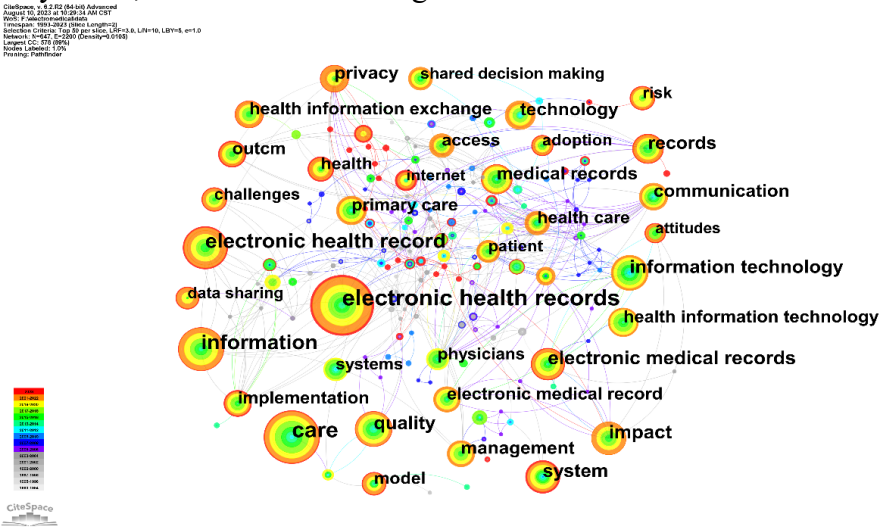

Figure 4: Keyword co-occurrence in EMR information-sharing publications

Keyword analysis. This part of the research analyzes the most relevant keywords to highlight hot issues and find possible future research topics by keyword co-occurrence analysis. Applying at least one occurrence of each word as a filter found 647 words grouped into 20 clusters. With the parameter of 40 as the filter, select the ranking 0-10 group in the clustering group and map these keywords as shown in Figure 4 and Figure 5, where the most frequently used word is "electronic health records" 281 times, "care"239 times," information"165 times," electronic health record"165 times, “electronic medical records”107 times. Analysis of these groups allowed us to identify specific research themes. The prominent themes in group 0, represented green in the picture, link EMRs and information science technologies. In group 1 (orange), research on patient portals, risk, and technical intent more potentially emerged. Cluster 2 then showcases topics, including information on electronic health records, implementation, primary care, and healthcare delivery. Cluster 3, yellow, analyzes the quality of general practice. Group 4, bright yellow, consensus protocol; concurrent computing and achievements. Group 5 (green) focuses on medical records systems and online access to records. (Fig.5)

Clustering analysis is performed on keywords in smart medical information sharing. The 647 keywords and 2200 links form 20 large clusters, Q=0.833, S=0.9431. The S-value is a measure of homogeneity within a cluster. The larger the S value, the higher the cluster members’ similarity; Q>0.3 indicates that the cluster structure is obvious; the reliability is high (Chen, 2004), so the cluster diagram has strong credibility. Research hotspots obtained through cluster analysis include "electronic medical records,” "patient portals,” "electronic health records,” "consensus protocols,” "medical records,” "artificial intelligence,” "medical services,” "health information exchange,” Several clusters such as "distributed system” (Fig. 5).

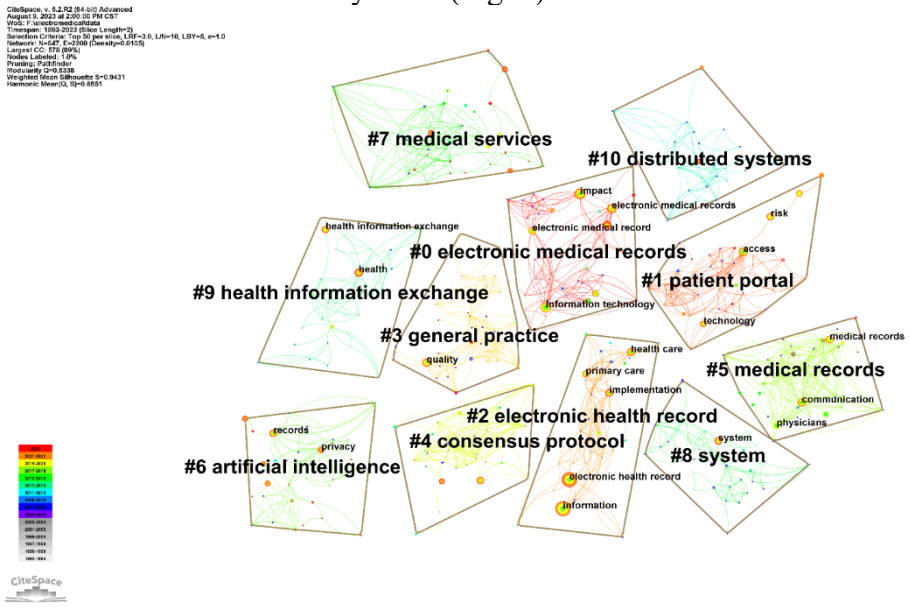

Figure 5: The clusters of the keywords in EMR information sharing publications

Keyword clustering timeline analysis extracts hot keywords in different periods according to the frequency and frequency increase time. Studying the change and alternation of hot words and the changes of hot words is possible. According to the appearance of keywords on the time axis, the frontier changes and development trends in the research field can be inferred (XU et al., 2022). Around 2000, with the development of information technology, a large number of research results emerged. After 2000, more research began to focus on patient portals, medical services, and artificial intelligence. (Fig.6)

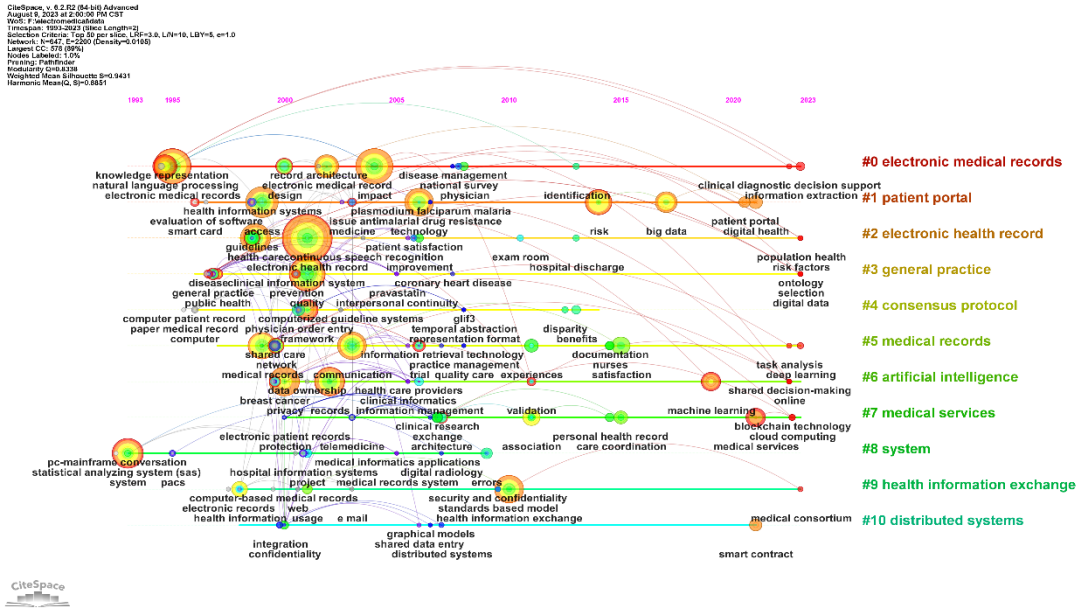

Figure 6: Time map of keyword clustering in electronic medical information sharing research from 1993 to 2023

4. Discussion

In China, with the development of smart cities, smart medical care, and academics, scholars are paying more and more attention to EMRs and discussing how to build a health platform and achieve regional information sharing among institutions (Li, 2022). With the rapid development of technological innovation, big data, cloud computing, 5G network technology, and artificial intelligence, smart medical care has become one of the distinctive features of the times (FANG et al., 2023). EMRs and information sharing are significant signs of the integration of technology in the medical field. In 2020, the number of research papers on smart healthcare will peak in the past two decades. The accumulation and upgrading of Internet technology support the development of electronic medical information sharing.

A large number of demands and technical support have promoted the rapid development of EMR information sharing. In order to improve the flexibility of medical information systems, XML is used as a description language to eliminate information islands through the HL7 standard and interface engine (XIAO et al., 2017). Establish consistency in regional medical information sharing and exchange to ensure the integrity of EMR information (XIAO et al., 2017). SOA (Service Oriented Architecture) provides a reusable approach to system design, development, deployment and management principles. Support the reuse and sharing of various patient records within different departments or across organizational boundaries and improve the synchronization and interoperability of information and data between heterogeneous systems (Li, 2017). By training machine learning algorithms, artificial intelligence can help medical staff quickly identify specified information from shared information, provide personalized diagnosis and treatment plans, and monitor and predict patient condition trends (Rahman et al., 2022). Electronic medical information is patient privacy, and information sharing can improve medical efficiency and diagnostic accuracy. Therefore, privacy protection issues are a necessary part of the electronic medical information-sharing process. Blockchain can store and distribute information to ensure data security for information sharing and avoid third-party manipulation during transmission. (Chen et al., 2022).

Although the enthusiasm for research on EMR information sharing in 2021-2023 has declined slightly, the research results are still much higher than before 2019. With the intensification of a global aging society and the uncertainty of the prevalence of infectious diseases, the elderly group has greater demand and higher requirements for medical and health resources. (World Health Organization (WHO, 2023). Put forward more serious questions about the rationality of social

medical resource allocation and use efficiency. In the future, smart medical care for older people and even society will continue to be a social research topic. In the research of electronic medical information sharing, the research of developed countries is more concentrated than that of developing countries, and the number of articles published is more. The developed countries have rich, advanced technology and more professional researchers, which are important in leading the research direction. The study found that national regulations focused on protecting the privacy and security of users' EMR data (ZENG et al., 2022), still cannot eliminate users' concerns about information security sharing. EMR information sharing is a project involving the participation of the whole people. It is necessary to understand the degree of understanding and agreement of institutions, doctors, and patients on all aspects of EMR information sharing (ZENG et al., 2022).

5. Conclusion

Undoubtedly, electronic medical record (EMR) information sharing still has a long way to go. Through keyword clustering analysis, we have identified that the research hotspots of articles on EMR information sharing primarily revolve around practical needs, technological advancements, relevant public evaluation, security standards, institutional mechanisms, human privacy and security, and other related aspects. However, further research is required on the regulatory and ethical dimensions of EMR information sharing.

Despite the extensive research conducted in this field, it is imperative to make progress in information technology to overcome the challenges posed by barriers to EMR information sharing, particularly regarding privacy and security. In this study, we aim to provide valuable insights by integrating research findings from different organizations and regions, which can serve as a reference for promoting the level of EMR information sharing and enhancing the service efficiency of the healthcare industry.

Nevertheless, it is important to acknowledge the limitations of this paper. To further enhance the comprehensiveness of our analysis, future studies should consider improving the database used, exploring articles published in various languages worldwide, and summarizing data characteristics specific to each region.

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