

## BIBLIOMETRIC ANALYSIS OF COMPLIANCE AND COMPLETENESS IN ELECTRONIC MEDICAL RECORD FILLING: TRENDS AND INSIGHTS FROM HOSPITAL DOCUMENTATION

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### ABSTRACT

The introduction of Electronic Medical Records (EMR) has revolutionized healthcare documentation, emphasizing the importance of compliance and completeness in medical data recording. This study aims to analyze the bibliometric data and visualize the publication trends related to compliance and completeness in EMR using VOSviewer. We employed a bibliometric approach to identify key clusters and relationships among terms in the literature from various journals and countries over recent years. The results highlight three main clusters: documentation and adherence, data completeness and quality, and accuracy and compliance in hospital settings. The analysis shows a significant global interest, with the USA, Germany, and Indonesia being major contributors. The study also reveals a rise in publications from 2018 to 2022, predominantly consisting of research articles. The most cited article, "Tools and Technologies for Registry Interoperability" by V. Ehrenstein et al., underscores the influence of registry interoperability on patient outcomes. Our conclusions indicate that while substantial progress has been made, further research is needed to explore factors affecting compliance and completeness across different healthcare systems, the long-term impact on patient outcomes, the integration of AI technologies, and real-time monitoring tools for data accuracy and compliance.

**Keywords:** Electronic Medical Records, Compliance, Data Completeness, Bibliometric Analysis, Healthcare Documentation

### INTRODUCTION

Medical records are files that contain records and documents of patient identity, examination results, treatment, actions and services that have been provided. Completeness of filling out medical record files can facilitate health workers in providing patient action or treatment and can be used as a useful source of information for hospital management in determining the

evaluation and development of health services (Maimun & Sari, 2022).

The use of electronic medical records (EMR) has become standard in health documentation in modern hospitals. EMRs are designed to improve efficiency and accuracy in recording patient health data. However, adherence to filling standards and data completeness in EMRs remains a major

challenge. Low compliance and incomplete data can affect the quality of care, hinder health data analysis, and trigger regulatory compliance issues.

Health technology transformation is realized through the development and utilization of technology, digitalization, and biotechnology. In Indonesia itself, the health sector has implemented technology and digitization through medical records. Medical records are files of records and documents that contain patient identity, examination, treatment, and actions, medical and other services provided to patients. In order to keep up with the times, medical records were developed into electronic medical records which were later abbreviated as RME. Through Permenkes No. 24 of 2022, every health care facility in Indonesia is required to organize electronic medical records (Bunga Nurfitriya, et al 2022).

The use of technology-based services in hospitals has been proven to help improve service performance because the process is faster than manual systems (Lestari, et al., (2020). People who check their health must have their medical records recorded in a complete, clear, accurate and timely manner in an integrated manner by health workers (Permenkes No. 24 th. 2022 concerning RME). Information from medical records provides important data for monitoring patient care, clinical audits, and assessing patterns of care and service delivery (Garba & Harande, 2016).

However, in practice it is not without obstacles, in the world alone the practice of filling in electronic medical records is always constrained in the

## LITERATURE REVIEW

Hospitals are complex health institutions and require a good information system in carrying out their activities. Medical records are an important necessity for patient data for diagnosis and therapy, but in its development medical records can be used for educational and research

maintenance and development of technological systems. (Liu et al., 2021). In addition to the technological factor, the human factor also needs to be taken into account, training nurses to be able to handle sensitive data is something fundamental, training to use this technology to guarantee its perceivable benefits (Smaradottir, 2018).

Beyond that, the principle of using technology in patient medical records should bring convenience for nurses to record, store, access, analyze, and execute information for the benefit of patients and hospitals in treatment and, improvement of health service delivery, disease control, health management (Balsari et al., 2018).

Although many studies have been conducted to evaluate various aspects of EMRs, systematic analysis of EMR compliance and completeness is lacking. Previous research suggests that technical constraints, lack of training, and non-user-friendly system design may affect compliance and data completeness. However, there are gaps in understanding global trends, publication patterns, and areas that require further attention.

Bibliometric analysis can provide valuable insights into research developments in this area, identify key trends, and highlight existing gaps. By understanding publication patterns and key terms that frequently appear, this study aims to provide guidance for policy and practice improvements in EMR charging. As such, the results of this study are expected to help improve the effectiveness of medical documentation systems and support the quality of care in hospitals.

purposes as well as for legal issues (Nuraini, 2015).

Electronic medical record (RME) is a system that replaces traditional paper-based medical records with digital versions. The implementation of RME in primary healthcare facilities has become an increasingly popular trend in recent years. The use of RME in primary care provides many benefits, including

efficiency in patient data management, easy access to medical information, and the ability to share data in real-time between health professionals (Collocott et al., 2020; Sudra, 2021).

The use of Electronic Medical Records (RME) produces a system that specifically facilitates various conveniences for users, such as the process of data completeness, alerts, clinical decision support support systems and environmental data with medical knowledge and other tools. The lack of security of electronic medical records is in integrity, which is a form of information that cannot be used without the knowledge of the person concerned. Integrity has a good system but when patients register there is paper and then simasukan to the computer system, the obstacle is when registering at the beginning of a patient who has been treated but says he has never visited so that the writing becomes double and not continuous (Pahlevi et al., 2021).

Medical records are important documents for hospitals, so filling in patient data (registration) must be completed with complete and accurate data (Saleh, 2019). However, although the benefits of medical records have been widely recognized, challenges in their implementation cannot be ignored. One of the main challenges is the completeness of health record filling by health workers. There are several factors that affect the completeness of filling out patient medical records including; busy doctors due to many patients, senior doctors who do not understand technology. In the RMK517 Medical Record Documentation Audit Module Topic 1 Quality Documentation, it states that the factors underlying the implementation (Electronic Health Records/EHR) (Widjaja, 2021).

Completeness of medical records is also influenced by the lack of motivation of medical staff in filling out documents, no sanctions for health workers who do not fill out complete documents, monitoring and evaluation, lack of socialization of SOPs for filling out medical records, medical record

formular arrangements that are less systematic or less simple and integrated, limited financial resources to support evaluation of the completeness of medical record files (Mukarom & Septiawan, 2022). Some mentioned that due to the large number of patients handled, there were documents that were not filled in by the health workers on duty (Halimatusaadah & Hidayati, 2022).

The problem that often arises in filling out medical records is that the filling process is incomplete, the doctor's writing is less specific about the diagnosis, the identification of the examining doctor and the writing that affects readability. This situation will have an impact on internal and external hospitals, because the results of data processing are the basis for making reports related to the preparation of various hospital plans, decision making by the leadership, especially the evaluation of services that have been provided which are expected to result in better evaluation (Wirajaya, 2019).

Incompleteness of medical records is a problem because medical records are data records that can provide information about actions on patients. Medical record files aim to support the achievement of orderly administration in an effort to improve the quality of health services in hospitals, so filling out medical records must be filled in completely so that it can produce accurate information (Swari et al, 2019). Completeness of medical records is very important because it affects the service process carried out by medical staff and affects the quality of service of a hospital. Medical records must be made completely after the patient receives services (Simanjutak M, 2019).

Completeness of filling important reports in inpatient medical record files includes data that is very important in monitoring the progress of the patient's illness. Important report data in medical record files include the main diagnosis, discharge conditions, date of admission to the hospital, type of surgery, operation report, and informed consent. The report will provide information about the actions

taken by doctors and nurses in treating patients, so it is expected to contain accurate, complete, and reliable information (Giyatno and Rizkika, 2020).

The consequences that can result from incomplete filling of medical record files are that officers will have difficulty in identifying patients, officers will have difficulty determining the next treatment or therapy that will be carried out to patients, if there is a medical audit, the medical audit implementation team cannot find out whether the standards and procedures that have been determined have been implemented or not, affect BPJS or insurance claims, if the hospital is involved in a legal case, it will be a problem if the medical record files are not filled in completely and affect the accreditation score obtained by the hospital because it does not fulfill one of the required points for passing accreditation (Wirajaya and Nuraini, 2019).

Filling in medical records is the responsibility of the service provider and all medical personnel involved in providing health services to patients. If the filling of medical records is incomplete, be it the diagnosis of the patient's illness, the name and signature of the doctor, then one day if there is an error in diagnosis, it cannot be accounted for from a legal point of view (Lisnawaty & Andisiri, 2018).

Various factors can affect the completeness of medical records for hospitalized patients. Research conducted by Ulfa identified several main causes of incomplete medical records, including limited time for health workers to fill out medical records, the absence of sanctions for incomplete medical records, lack of socialization of Standard Operating Procedures (SPO), and low discipline of nurses and doctors in filling out medical records thoroughly (Siti Nadya, 2017). On the other hand, research by Anggraini highlighted that the main factors that cause incomplete medical records for inpatients are the limitations of adequate facilities and infrastructure and the

absence of Standard Operating Procedures (SOPs) that regulate the completeness of medical records (Anggraini, 2017).

## RESEARCH METHODS

This study used a bibliometric approach to evaluate trends and patterns in electronic medical record (EMR) compliance and completion based on published literature from 2018 to 2024. The process began with data collection using the Publish or Perish app, which accessed the Google Scholar database to identify relevant publications. The keywords used in the search included "Compliance," "Completeness," "Electronic Medical Record Filling," "Electronic Medical Records Documentation," "EMR Documentation," and "Hospital." From these search results, the 50 highest ranked journals were selected for analysis. The selection of journals based on this ranking aims to ensure that the data used comes from the most relevant and high-quality sources.

After data collection, the next step was to classify the information based on several key criteria. Classification was done based on year of publication to identify temporal trends in publications, journal type to group publications into different categories or types, number of citations to assess the impact and influence of each publication, and country of research to understand the geographical distribution of related research. This classified data was then analyzed using VOSviewer, a bibliometric analysis tool that enables in-depth data visualization and mapping.

In the analysis using VOSviewer, the important parameters applied include occurrence and term. The occurrence value was set at 4, which sets a minimum threshold for keyword frequency to ensure that only the most frequently occurring terms were analyzed. Up to 20 major key terms were identified to reveal the dominant

themes in the literature. The resulting visualizations include networking maps, which depict the relationship between key terms and publications to identify patterns of interconnectedness; overlay maps, which show how key terms evolve over time and provide an overview of changing research trends; and visual density maps, which show the concentration and intensity of research in different topic areas.

Interpretation of the results of this analysis was undertaken to provide in-depth insight into the interrelationships between various terms and publications, as well as to identify areas of high research interest and gaps that still need to be explored. By understanding existing trends and under-explored areas in the literature, this study aims to provide guidance for researchers and policy makers in improving EMR documentation practices and directing future research efforts.

### Research Gaps

However, several research gaps need further exploration. First, more in-depth studies on factors affecting compliance and data completeness across different healthcare systems and cultures are needed. Second, longitudinal studies examining the long-term impact of improved data completeness and quality on patient outcomes are essential. Third, further exploration is required on integrating new technologies such as artificial intelligence and machine learning to enhance the quality and completeness of EMRs. Finally, there is a need for developing more effective tools and methods to measure and monitor data compliance and completeness in real-time in clinical settings. Research in these areas will help strengthen EMR systems and improve overall healthcare quality.

## RESULTS AND DISCUSSION

This section presents the results of a bibliometric analysis conducted to evaluate trends and patterns in the literature related to electronic medical record (EMR) compliance and completion from 2018 to 2024. The main purpose of this analysis was to provide a comprehensive insight into how this topic has been addressed in the academic literature and to identify areas that require further attention in research.

The results of the analysis will be discussed based on data classification that includes the distribution of publications by year, journal type, number of citations, and researcher country. Visualizations generated through the VOSviewer application, including networking maps, overlays, and visual density, will be used to illustrate the interrelationships between key terms, the evolution of topics over time, and the intensity of research in different areas. The interpretation of these results aims to reveal key trends, identify gaps in existing research, and provide recommendations for future studies.

By understanding the publication patterns and linkages in the literature, this section will discuss how EMR adherence and completeness have been the focus of research, as well as provide guidance for researchers, practitioners, and policymakers to improve EMR documentation practices and pursue the gaps that exist in current knowledge.

### Publication Trends by Year

Analysis of publication trends by year of publication showed significant fluctuations in the number of articles addressing electronic medical record (EMR) compliance and completeness from 2018 to 2024. In 2018 and 2019, there were 5 publications each,

signaling an initial period of steady but still limited interest. However, from 2020, there was a sharp spike with 11 publications, possibly triggered by the increasing adoption of EMRs and the urgent need to evaluate and improve medical documentation practices. This surge continued, peaking in 2022 with

13 publications, indicating a period of intense interest and focus on EMR-related issues. This increase can be attributed to the development of new policies, increased awareness of medical data quality, and technological innovations that support EMR systems.

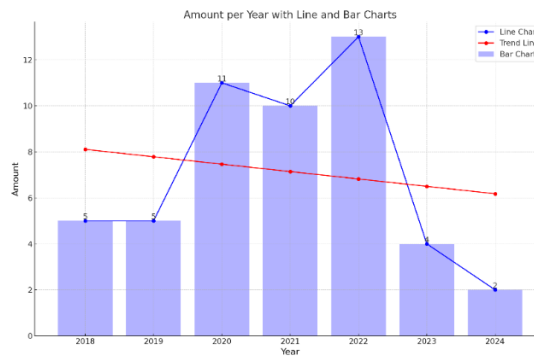


Figure 1. Related Publication Trends From Google Schollar Databases Using Pop Application

However, this trend shows a drastic change in 2023 and 2024, with the number of publications decreasing to 4 and 2, respectively. This decrease may reflect a shift in research focus to other areas or the impact of external factors such as the COVID-19 pandemic that may have affected research priorities and resource allocation. In addition, this decline could indicate that EMR-related research has entered a routine monitoring and evaluation stage, reducing the need for in-depth new research.

Overall, these data indicate a cyclical nature in research interest in EMRs, with periods of significant increases followed by decreases, reflecting changes in research priorities and health policy. These findings provide insight into the dynamics of attention to EMR documentation and highlight the need for ongoing adjustments in research strategies to meet the evolving needs and challenges in electronic medical records management.

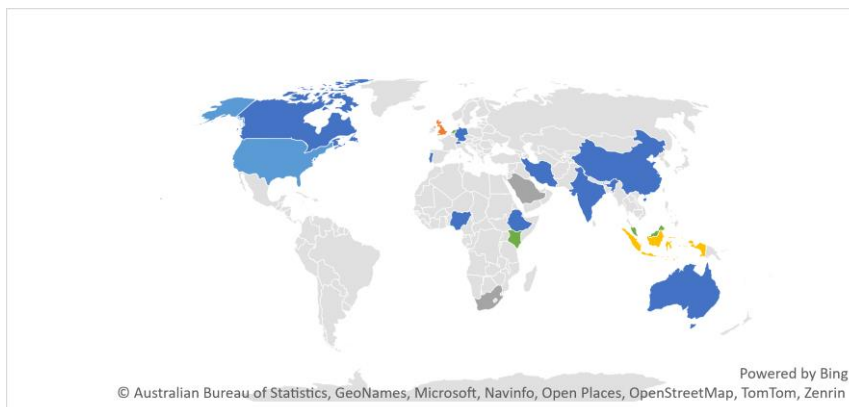


Figure 2. Publications By Country Of Publication

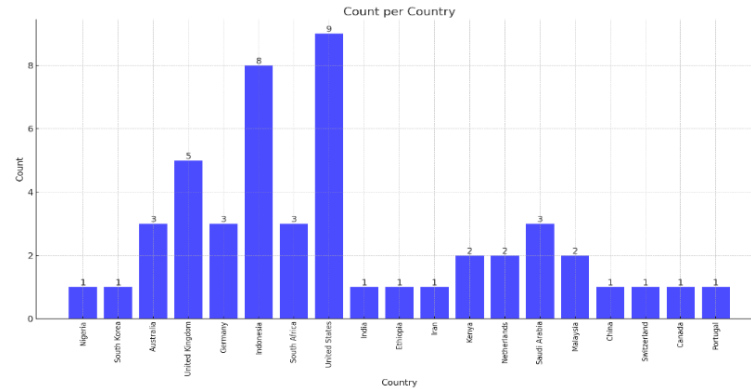


Figure 3. List of Journal Publishers By Country

**Discussion of Publication Trends by Journal/Article Type**

Analysis of publication types related to electronic medical record (EMR) compliance and completeness revealed a clear distribution between different types of journals and articles from 2018 to 2024. Most of the publications obtained in this study were research articles, with a total of 46 out of 50 articles analyzed, reflecting the

primary focus on presenting empirical research results and in-depth analysis of EMR-related issues. This predominance of research articles indicates that the topic is gaining significant attention in the context of practical studies and direct applications, as well as reflections of evidence-based data on compliance and completeness in EMR documentation.

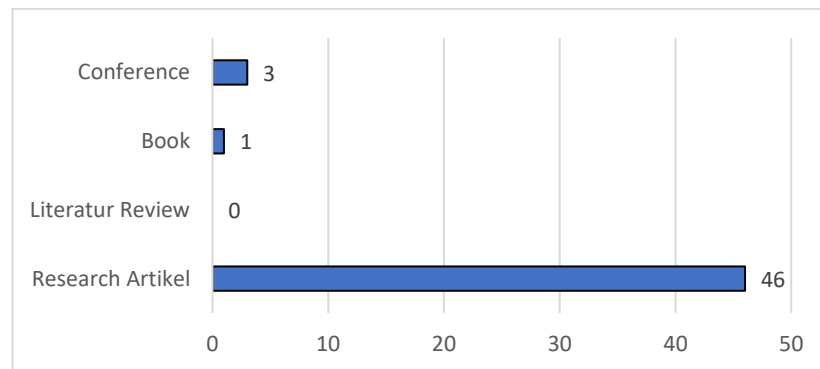


Figure 4. Distribution Of Countries That Publish Related Research

In contrast, no publications in the form of literature reviews were found during the period of this study. This may indicate that while there is a lot of empirical research being conducted, the lack of literature reviews may indicate the need for a summary and critical analysis of the existing literature to understand the trends, gaps and key findings in this field more holistically.

There is only one publication in book form and three publications from

conferences. Book publications, while limited, can provide an in-depth and comprehensive perspective that is not always captured in regular research articles. Conference publications, while fewer, demonstrate the contribution of an academic forum that is often the place to introduce preliminary findings or new ideas before they are published in peer-reviewed journals. Conferences are often an important arena for discussion and exchange of ideas on

current topics, including EMR-related issues.

Overall, these publication trends indicate that although research articles are dominant in the literature on EMR, there are opportunities to expand and enrich the field through more literature reviews, more in-depth book publications, and contributions from conferences. A more diverse approach in publications can help create a more holistic and in-depth understanding of the challenges and developments in EMR documentation.

#### Publication Based on publisher

Publications related to Electronic Medical Records (EMR) are distributed across various publishers and platforms, indicating significant global interest in this topic. Several publishers, each with one publication, include jmblsr, Journal of Social Research, Dspace, core.ac, Wiley Online Library, Frontiers, Jurnal

Manajemen dan Pemasaran Jasa, ncbi, Taylor and Francis, African Journal Online, Health Sains, Scielo, Turkish Journal of Computer and Mathematics Education, OPUS, JMMR Publications, BMJ Open Quality, EYE, ICPH, JAMIA, AIS Library, Informa PubsOnline, Lippincot, ResearchGate, IJSR, M Library, and ASCO. Google has two publications, Elsevier has four publications, and Atlantis Press Springer has two publications. Springer Link is the largest contributor with seven publications, followed by Sage Journal with six publications. Additionally, Thieme and JMIR Publications each have two publications. This distribution shows that research on EMR is widely disseminated across various journals and major publishers, highlighting the importance of diverse perspectives in developing best practices for electronic medical records management (Olawumi, 2022).

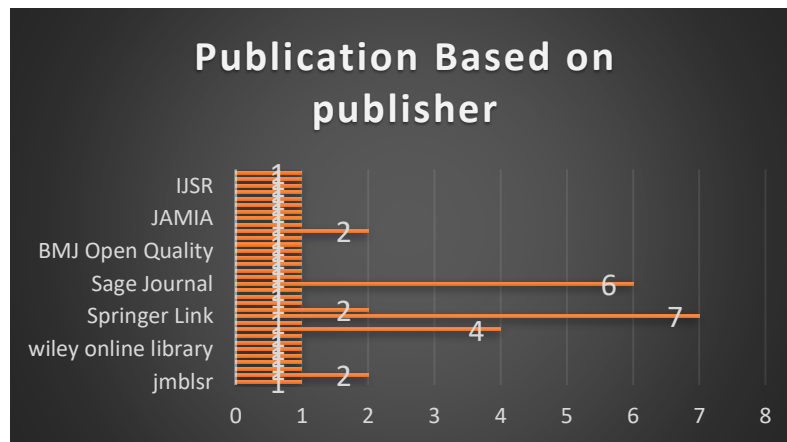


Figure 5. Distribution Of Publishers That Publish Related Research

#### Discussion of Publication Trends by Citation

Analysis of publication trends by citation provides insight into the impact and influence of articles addressing electronic medical record (EMR)

compliance and completeness. In the data obtained, there was significant variation in the number of citations received by different publications, reflecting differences in influence and relevance in this area.



Table 1. Publication Trends by Citation

No.	Author	Title	Citation	Type	Year	Country
1	V Ehrenstein, H Kharrazi, H Lehman	Tools and Technologies for Registry Interoperability, Registries for Evaluating Patient Outcomes: A User's Guide, 3rd Edition, Addendum 2 [Internet].	110	Research Article	2019	Denmark
2	V Alonso, JV Santos, M Pinto	Health records as the basis of clinical coding: Is the quality adequate? A qualitative study of medical coders' perceptions	82	Research Article	2019	Portugal
3	E Li, J Clarke, H Ashrafian, Darzi, AL Neves	The Impact of Electronic Health Record Interoperability on Safety and Quality of Care in High-Income Countries: A Systematic Review	48	Research Article	2022	UK
4	RM Wali, RM Alqahtani, SK Alharazi, SA Bukhari	Patient satisfaction with the implementation of electronic medical records in the Western Region, Saudi Arabia, 2018	48	Research Article	2020	Saudi Arabia
5	ECH Wang, A Wright	Characterizing outpatient problem list completeness and duplications in the electronic health record	36	Research Article	2020	USA
6	KH Pine, C Bossen	Good organizational	35	Research Article	2020	USA

		reasons for better medical records: The data work of clinical documentation integrity specialists				
7	M Beckmann, K Dittmer, J Jaschke, U Karbach	Electronic patient records and its effects on social aspects of interprofessional collaboration and clinical workflows in hospitals (eCoCo): a mixed methods study protocol	21	Study protocol	2021	Germany
8	CHK Wu, SMH Luk, RL Holder, Z Rodrigues	How do paper and electronic records compare for completeness? A three center study	20	Research Article	2018	UK
9	Na Mohd Nor, NA Taib, M Saad, HS Zaini, Z Ahmad	Development of electronic medical records for clinical and research purposes: the breast cancer module using an implementation framework in a middle income country- Malaysia	19	Research Article	2019	Malaysia
10	N Makeleni, L Ciliers	Critical success factors to improve data quality of electronic medical records in public healthcare institutions	17	Research Article	2021	South Africa

The most cited article was V Ehrenstein, H Kharrazi, and H Lehman's "Tools and Technologies for Registry Interoperability," with a total of 110 citations. This publication, published in "Registries for Evaluating Patient Outcomes: A User's Guide" third edition, showed great influence in understanding registry interoperability, an important aspect of EMR management. The success of this article in attracting significant attention may be due to its relevance and wide applicability across different contexts and countries.

Furthermore, the article by V Alonso, JV Santos, and M Pinto on health record quality as a basis for clinical coding, published in the Sage Journal, has 82 citations. This study focused on medical coders' perceptions of record quality, making it an important resource for studies assessing coding accuracy and effectiveness in EMR systems.

The article by E Li, J Clarke, and H Ashrafian, published in JMIR Publications, recorded 48 citations. This article discusses the impact of electronic health record interoperability on safety and quality of care in high-income countries, providing an invaluable systematic review for researchers and practitioners studying EMR quality in developed countries.

Other publications, such as the one written by RM Wali and colleagues on patient satisfaction with EMR implementation in Saudi Arabia, also received 48 citations. This article offers insights into patient perceptions of EMRs, which may influence system implementation and improvement in developing countries.

Some articles with lower citations, such as the study by ECH Wang and A

Wright on the completeness of outpatient problem lists, with 36 citations, or by KH Pine and C Bossen on specialist work data integrity of clinical documentation with 35 citations, still make important contributions albeit on a smaller scale. These articles suggest a focus on specific aspects of EMR documentation, such as completeness and integrity, which are important for documentation quality improvement.

Finally, publications with lower citations, such as the protocol study by M Beckmann and colleagues or the study by Na Mohd Nor and team on the development of EMR for clinical and research purposes in Malaysia, indicate areas that may still be in the developmental stage or have a more limited impact in the existing literature.

Overall, this distribution of citations indicates that articles that have significant impact and broad relevance in the context of EMR receive more attention and recognition within the academic community. The findings also highlight the importance of publishing research that not only contributes to theoretical understanding but also has significant practical implications in EMR management.

#### **Related Vos Viewer Network Visualization Publication Overview**

VOSviewer is a useful tool for analyzing and visualizing scientific publication networks. In this analysis, we see how terms related to compliance and completeness in electronic medical record (EMR) completion are organized and interrelated in the scientific literature. Clustering in Network Visualization

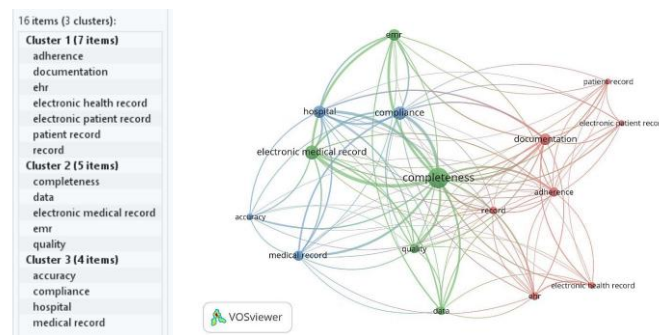


Figure 6. Network Visualization Overview Publications

**a. Cluster 1: Documentation and Compliance (Red)**

**Key Terms:** adherence, documentation, ehr, electronic health record, electronic patient record, patient record, record.

**Explanation:** This cluster deals with the documentation and adherence process in electronic medical record systems. "Adherence" refers to adherence to procedures and standards to ensure accurate EHR documentation.

**b. Cluster 2: Data Completeness and Quality (Green)**

**Key Terms:** completeness, data, electronic medical record, emr, quality.

**Explanation:** This cluster focuses on the completeness and quality of data in the EMR. "Completeness" and "quality" indicate attention to how complete and quality the data recorded in the EMR system is.

**c. Cluster 3: Accuracy and Compliance in Hospitals (Blue)**

**Key Terms:** accuracy, compliance, hospital, medical record.

**Explanation:** This cluster relates to data accuracy and compliance in the context of hospitals. "Accuracy" and "compliance" highlight the importance of ensuring data in medical records is accurate and complies with standards.

The network visualization shows a close relationship between these terms, with completeness as an important center connected to many other terms,

signifying how important data completeness is in EMR and EHR completion. The strong relationship between electronic health record, electronic medical record, and patient record shows that these terms are often used together in research on EMRs. Terms such as compliance and accuracy also show a close relationship with hospital and medical records, highlighting the criticality of compliance and data accuracy in the hospital context.

This bibliometric analysis reveals that the main themes in scientific publications on electronic medical record filling are compliance, completeness, and data quality. This visualization helps us understand the relationship of these various concepts and how they take center stage in research on EMRs and EHRs, so that researchers and practitioners can develop best practices in electronic medical record filling.

**VOSviewer Overlay Visualization Publication Overview**

In this overlay visualization, we see how the various terms related to compliance and completeness in electronic medical record (EMR) completion are organized and interrelated based on the scientific literature. This overlay visualization uses a color scheme to show the temporal progression of the terms, with darker colors representing older terms and lighter colors representing newer terms.

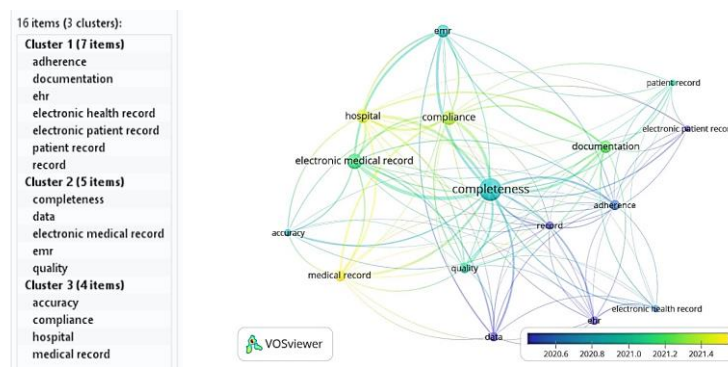


Figure 7. Overlay Visualization Overview Publications

### Clustering in Network Visualization

a. **Cluster 1:** Documentation and Compliance (Red)

**Key Terms:** *adherence, documentation, ehr, electronic health record, electronic patient record, patient record, record.*

**Explanation:** This cluster deals with the documentation and adherence process in electronic medical record systems. "Adherence" refers to adherence to procedures and standards to ensure documentation in the EHR is accurate. This term tends to appear earlier in the period indicated by the darker color.

b. **Cluster 2:** Data Completeness and Quality (Green)

**Key Terms:** *completeness, data, electronic medical record, emr, quality.*

**Explanation:** This cluster focuses on the completeness and quality of data in the EMR. "Completeness" and "quality" indicate a primary concern for how complete and quality the data recorded in the EMR system is. The term "completeness" has become very important and appears frequently in various periods, indicated by the large node size and varying colors.

c. **Cluster 3:** Accuracy and Compliance in Hospitals (Blue)

**Key Terms:** *accuracy, compliance, hospital, medical record.*

**Explanation:** This cluster includes terms related to data accuracy and compliance in the context of hospitals and medical records. "Accuracy" and "compliance" highlight the importance of ensuring data in medical records is accurate and compliant with standards. The lighter color indicates that these terms continue to be relevant and used in more recent research.

In this network visualization, the lines connecting terms indicate the relationship or *co-occurrence* between the keywords in the scientific literature. The thicker the line, the stronger the relationship between the terms. The term "completeness" emerges as an important center in this network, indicating that data completeness is a theme that is strongly connected to many other terms. This reflects how important data completeness is in the context of EMR and EHR completion. The strong relationships between "electronic health record", "electronic medical record", and "patient record" indicate that these terms are often used together in research on EMRs.

This bibliometric analysis reveals that in the context of scientific publications on electronic medical record filling, the main themes that emerge are compliance, completeness, and data quality. This visualization helps us understand how these various concepts are interconnected and how

they have taken center stage in research on EMRs and EHRs. The colors in the overlay visualization provide additional information about the temporal progression of this research, showing the evolution of the research focus over time. With this understanding, researchers and practitioners can better develop best practices and ensure that electronic medical record filling is done in a way that meets compliance standards and

ensures data completeness and accuracy.

### VOSviewer Density Visualization Publication Overview

This density visualization illustrates the density and frequency of occurrence of terms related to compliance and completeness in electronic medical record (EMR) completion. Hotter colors (yellow and red) indicate higher density, while cooler colors (blue) indicate lower density.

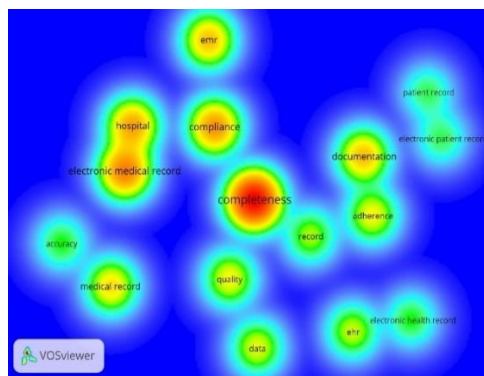


Figure 8. Density Visualization Overview Publications

### Clustering in Density Visualization

#### a. Documentation and Compliance Cluster

**Key Terms:** *adherence, documentation, ehr, electronic health record, electronic patient record, patient record, record.*

**Explanation:** This cluster focuses on documentation and adherence processes in electronic medical record systems. Terms such as *adherence* and *documentation* appear with significant density, indicating a strong focus on ensuring adherence to documentation standards in EHRs.

#### b. Data Completeness and Quality Cluster

**Key Terms:** *completeness, data, electronic medical record, emr, quality.*

**Explanation:** This cluster shows the attention to data completeness and quality in

EMRs. *Completeness* is at the center with the highest density, indicating that data completeness is a central theme in electronic medical record completion.

#### c. Accuracy and Compliance Cluster in Hospitals

**Key Terms:** *accuracy, compliance, hospital, medical record.*

**Explanation:** This cluster focuses on data accuracy and compliance in a hospital environment. Terms such as *compliance* and *hospital* have a high density, indicating the importance of ensuring that data in hospital medical records is accurate and compliant with applicable regulations.

This density visualization shows the relationships and focus of the research more clearly. The term *completeness* emerges as the highest density center, indicating the

importance of data completeness in the context of EMR. The strong relationship between the terms electronic health record, electronic medical record, and patient record indicates that these terms are often used together in research. Terms such as *compliance* and *accuracy* also have high density near the terms hospital and medical record, highlighting the criticality of data compliance and accuracy in the hospital context.

This density visualization analysis reveals that the main themes in scientific publications on electronic medical record filling are compliance, completeness, and data quality. The colors in the visualization indicate the density and focus of the research, helping us understand the priorities and relationships between terms in the context of EMRs and EHRs. With this understanding, researchers and practitioners can develop best practices to ensure accurate, complete and compliant electronic medical record filling.

## CONCLUSIONS

Through a series of analyses using VOSviewer, we have visualized and identified relationships and the density of terms related to compliance and completeness in Electronic Medical Record (EMR) filling. The main clusters identified include compliance and documentation, data completeness and quality, and accuracy and compliance in hospital settings. The first cluster highlights the importance of adherence and documentation, indicating that accurate and standardized documentation is crucial in EHR and EMR systems. The second cluster focuses on completeness and quality, emphasizing that data completeness is a critical aspect of EMR filling. The third cluster shows that accuracy and compliance are vital in hospital contexts.

Publications on this topic are spread across various journals and platforms such as Springer Link, Elsevier, and Sage Journal, with countries like the USA, Germany, and Indonesia having high publication counts, indicating the global nature of EMR research. Temporal analysis shows an increase in publications from 2018 to 2022, peaking in 2022. Most publications are research articles, indicating the dominance of empirical research in the EMR literature. The article "Tools and Technologies for Registry Interoperability" by V Ehrenstein et al. is the most cited, highlighting its significant influence in the field.

Overall, this analysis reveals that completeness and compliance in EMR filling are vital research areas with significant attention to data quality and accuracy. The VOSviewer visualization helps understand the relationships between key terms and shows the evolution of research focus over time, enabling researchers and practitioners to continually develop best practices for ensuring accurate, complete, and standard-compliant EMR filling worldwide.

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