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Review

The Impact of Use of Electronic Medical Records on The Quality Of Health Services and Patient Safety: Review

Diah Wijayanti Sutha[1*], Christine[2], Lilis Masyfufah[3], Eka Wilda Faida[4], Titin Wahyuni[5], Siti Novianti[6], Agustin Dwi Syalfina[7]

1 STIKES Yayasan RS Dr. Soetomo; diahwsutha@gmail.com*
2 Poltekkes Kemenkes Palu; christinekromoprawiro@gmail.com
3 STIKES Yayasan RS Dr. Soetomo; lilis_masyfufah@stikes-yrsds.ac.id
4 STIKES Yayasan RS Dr. Soetomo; ekawildafaida@gmail.com
5 STIKES Yayasan RS Dr. Soetomo; titinwahyuni@gmail.com
6 Universitas Siliwangi; sitinovianti@unsil.ac.id
7 Sekolah Tinggi Ilmu Kesehatan Majapahit; agustinpipin2@gmail.com

* Correspondence: diahwsutha@gmail.com; Tel.: 085643715203

Abstract: Electronic Medical Records have been introduced to improve the efficiency and quality of healthcare services, as well as patient safety. This study aims to review the impact of the use of Electronic Medical Records on these aspects through a narrative review. The literature review was conducted using three databases, namely PubMed, MEDLINE, and CINAHL, with the addition of Google Scholar for wider coverage. The articles retrieved were limited to publications from January 2013 to October 2023. The implementation of Electronic Medical Records improves the efficiency of healthcare services by accelerating patient data access, reducing administrative costs, and strengthening coordination between healthcare workers. However, although the advantages of Electronic Medical Records are seen in increasing the accuracy and accessibility of medical information, there are risks to patient safety, such as data input errors and the threat of data leakage. Overall, Electronic Medical Records contribute positively to improving the quality of healthcare services, especially in chronic disease management, collaboration between medical professionals, and real-time monitoring of patient conditions, which have an impact on the continuity and effectiveness of care.

Keywords: Information technology; healthcare; digital transformation

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1. Introduction

Electronic medical record systems have changed the way patient information is stored, accessed, and managed in healthcare. With the advancement of information technology, the use of Electronic Medical Record (EMR) or better known as Electronic Health Records (EHR) has become increasingly common in various healthcare facilities, including hospitals, clinics, and physician practices. EMRs provide the potential to improve the efficiency, accessibility, and coordination of healthcare services [1], which should have a positive impact on the quality of care and safety. The use of EMR in healthcare has undergone significant development in the last few decades. EMR is an important tool designed to replace conventional medical records with a digital format that allows for more efficient storage, access, and exchange of patient data. EMR also offers the potential to optimize the quality of healthcare, improve care coordination, reduce medical errors and save administrative costs [2].

However, despite the many potential benefits of electronic medical record, the use of EMR has not always been smooth, and several challenges have emerged along with its implementation. Although EMR systems have proven to be viable and are beginning to be widely used in several countries, the issue of limited resources raises several questions [3]–[5], Does EMR offer major advantages for medical projects? Beyond a few well-funded

test sites, is it feasible to employ this information technology (IT)? Does it improve the management of these healthcare institutions or the quality of patient care? What guidance can we offer other healthcare institutions to assist them choose the most sustainable and efficient EMR system technologies in this setting? The use of electronic medical records has not been optimally implemented in several countries, many countries still use electronic records only to fulfill administrative processes, even though several studies have shown the effectiveness of implementing counseling actions, for example, is quite effective and has a positive impact with data collection support and as an early reminder in several counseling actions [6], but there are also some that are not implemented optimally.

The implementation of the evaluation of the impact of the use of EMR on the quality of service and patient safety is very important. The implementation of EMR also raises various impacts, both positive and negative, which need to be considered. Therefore, this systematic literature study was conducted. This study was conducted with a focus on collecting previous research results related to the impact of EMR implementation on health services and patient safety. One of the urgencies of this study is to see the learning from the experience of previous research results, with a comprehensive literature review study that will later be able to help identify trends, patterns, and consistencies from previous studies related to the impacts caused by the implementation of EMR. This will certainly be able to help decision makers for health services, health administration, and researchers to understand the impacts caused by the implementation and the factors that contribute to positive or negative impacts and take appropriate steps to minimize risks and maximize the benefits of EMR. In addition, it is to update views on technology development, along with the development of technology and user experience in the use of EMR, various changes and improvements have emerged. The latest literature review can help in understanding how these developments affect the impact of EMR implementation on current health services.

The main objective of this study is to conduct a comprehensive analysis of the impact of the use of electronic medical records on the quality of health services and patient safety through a systematic literature review, where previous studies that have been conducted related to the assessment of the impact of the implementation of electronic medical records throughout the world will be collected, which will later be used as a discussion topic with related studies that have been conducted in Indonesia.

Since the Minister of Health Regulation (PMK) number 24 of 2022 concerning Medical Records was issued, Indonesia has started the process of converting patient medical records to an electronic format. Healthcare facilities must put in place an electronic patient medical history recording system in accordance with this policy. The changeover process will be completed no later than December 31, 2023 [7]. However, only 13% of hospitals in Indonesia have implemented EMR optimally [8]. The Indonesian Private Hospital Association (ARSSI) supports the implementation of ESDM in hospital services. The Health Ministry has issued a new regulation that gives health facilities until the end of 2023 to make the transition to an electronic health history recording system [9]. The Minister of Health Regulation in question is a supporting regulatory framework for the implementation of health technology transformation which is part of the 6th pillar of Health Transformation. This policy is present as an update to the previous regulation, namely PMK number 269 of 2008 which was updated to adjust to science and technology, service needs, policies, and laws in the community. As part of the sixth pillar of health transformation, the relevant Minister of Health Regulation provides a supporting regulatory framework for the adoption of health technology transformation. This policy is an update to PMK number 269 of 2008, the previous rule, which was revised to take into account community laws, policies, service demands, and science and technology. The EMR platform is intended to allow the public to access their medical records, so hospitals, clinics, and other health service providers must have an EMR/EHR platform in their facilities [10].

This literature review will answer some of the positive and negative impacts caused by the implementation of electronic medical records throughout the world which will later provide valuable insights into the role and challenges in its implementation in Indonesia in improving or presenting challenges in the health sector, as well as helping to formulate recommendations and best practices that can be improvements and future developments in the use of electronic medical record technology.

This literature review aims to critically examine the positive and negative impacts of electronic medical record (EMR) implementation worldwide. By analyzing studies from diverse healthcare settings—including both developed and developing countries—this review seeks to uncover key patterns, variations, and contextual challenges in EMR adoption. Understanding these variations is essential, as the benefits observed in well-resourced healthcare systems may not always translate directly to settings with limited infrastructure, financial constraints, or workforce challenges.

A comparative analysis will be conducted to explore how EMR systems contribute to efficiency improvements, patient safety, and data management in different healthcare environments. In developed countries, where digital health infrastructure is more advanced, EMR adoption often leads to streamlined workflows, enhanced interoperability, and improved clinical decision-making. In contrast, developing countries may face significant barriers such as high implementation costs, lack of technical expertise, and resistance to change, which could hinder efficiency gains or even introduce new challenges.

By identifying these differences, this review will provide valuable insights into the role of EMRs in Indonesia, where the healthcare landscape presents a unique set of opportunities and constraints. The findings will help assess whether EMRs serve as a tool for improving healthcare quality or if they introduce additional complexities in the Indonesian context. Furthermore, this analysis will contribute to the development of evidence-based recommendations and best practices that can guide future improvements and policy decisions regarding EMR adoption, ensuring that implementation strategies are tailored to the specific needs and capacities of the Indonesian healthcare system.

2. Materials and Methods

The type of research used in this study is the Narrative Literature Review literature review method, which allows for a comprehensive synthesis of existing research findings on electronic medical record (EMR) implementation. The data utilized in this study are secondary data obtained from peer-reviewed journal articles published online. To ensure a broad and inclusive review, we used the terms "Electronic Medical Record" (EMR), "Electronic Health Record" (EHR), and "Online Access" when searching for relevant studies, particularly those examining the relationship between EMR implementation, healthcare service quality, and patient safety.

The focus of this investigation is the impact of electronic medical record implementation on patient service quality and safety, therefore patients and health workers must have access to their respective medical records through patient and health worker portals, studies that report the benefits or impacts of EMR but do not have access will be excluded from the study (exclude study). Studies that do not focus on assessing the quality of health services and patient safety will also be excluded.

In this analysis, only English-language publications were taken into account. Five experts from the fields of health and informatics—one of whom was a physician—four public health experts, and one health informatics researcher contributed to the search strategy's initial identification of pertinent material for this study. A search of the literature was done using CINAHL, MEDLINE, and PubMed. To make sure no pertinent papers were overlooked, Google Scholar was also consulted. The date filter used was January 2013 to October 2023. The keywords used for the search were composed in English, namely electronic health records, electronic medical records, patient portal, patient safety, and quality of health service. The MeSH terms used were electronic health

records, patient portals, patient safety, and health service. To synthesize findings across different studies, we employed a narrative synthesis approach. This method enables us to integrate and interpret diverse findings from various healthcare settings, highlighting both the benefits and challenges of EMR implementation.

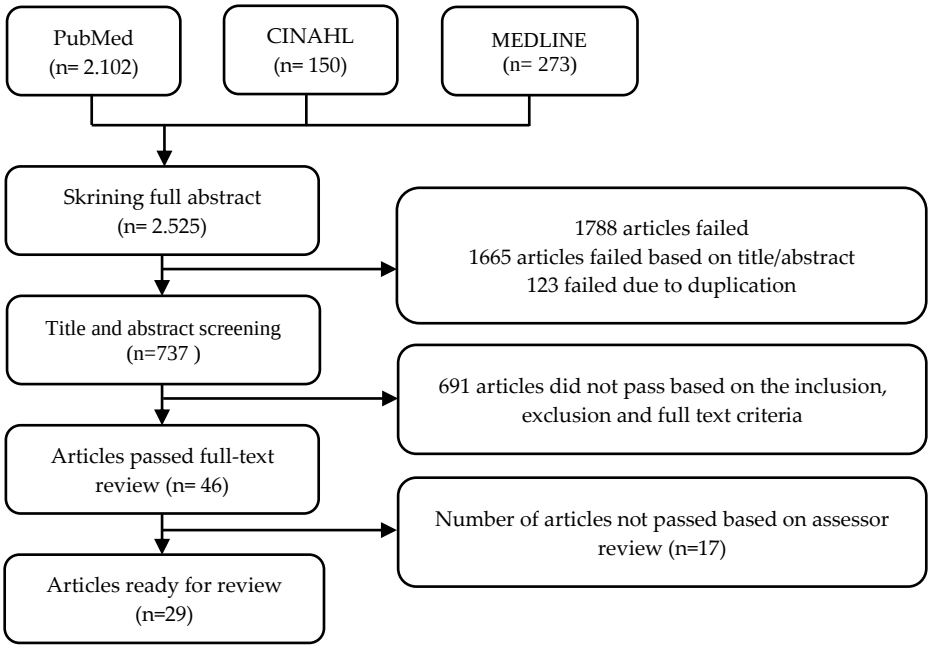

Figure 1. Flow diagram in manuscript screening

The initial search netted more than 2000 manuscripts ready for consideration. The initial manuscript assessment was carried out based on the title, abstract, and duplication. Then the assessment was continued with full text assessment which also considered the inclusion and exclusion criteria that had been previously determined. To ensure the rigor of our literature review, we followed PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines for study selection and reporting. However, to further strengthen the quality assessment, we also applied additional critical appraisal tools, including critical appraisal, to evaluate study credibility based on research design, validity, and relevance, also to assess methodological quality across qualitative, quantitative, and mixed-methods studies. The steps of manuscript screening and selection are shown in the PRISMA diagram (Figure 1). Exclusion criteria: The system is only accessed by health professionals; The system is only accessed by patients; Does not explain the impact on the quality of health services; Does not explain the impact on patient safety.

After the reviewer has carried out an assessment, the final manuscript that is taken will be the manuscript used to answer the objectives of this research and will be the main topic in the discussion chapter.

For this evaluation, manuscripts that discuss the advantages and disadvantages of EMR adoption for patient safety and care quality are taken into consideration. There must be enough details in the manuscript as well. Both the abstract and full-text reviews use quality evaluation. The search criteria, inclusion criteria, and exclusion criteria are used initially by the authors and review committee in the approach. The JBI instrument and the PRISMA checklist are used to conduct an assessment in order to make the final selection of research [11], [12], and any disagreements or issues with the evaluation are settled by dialogue between the three impartial reviewers who carried it out. The

Mendeley Library and the authors' cooperation group are the platforms utilized for data exchange.

Every paper that was reviewed for this study underwent narrative synthesis. To create a summary, studies with similar outcomes in terms of advantages or issues were gathered. The findings are displayed by combining the findings of several studies based on how similar they are, including the proportion of studies that show each result, and then utilizing this information to make inferences. Because the researchers did not require the selected publications to be in the form of RCTs, meta-analysis was inappropriate for this study. The full-text selection screening procedure was examined by four impartial reviewers. Discussions with two additional reviewers were used to settle any disputes.

In the data quality analysis, the researcher did it at the critical appraisal stage, namely on 46 manuscripts. This study used tools from JBI and PRISMA [11], [12]. The JBI tool was chosen by researchers because it provides all types of studies in a study, and the PRISMA tool was chosen to complement the assessment results of the JBI instrument. Data synthesis here is a process to summarize key information and characteristics in each selected article. The components in this data synthesis are in accordance with the research objectives that the researcher has compiled. This stage is the critical appraisal stage, as an effort to assess bias in order to measure the level of trust, value, and relevance to the topic in the literature used in this study. The assessment of the quality of literature in this study uses a tool from JBI which can be accessed on the jbi.global. The use of critical appraisal tools will be used according to the type of study in the literature to be reviewed.

The final manuscripts that were collected after going through the final assessment process (Critical Appraisal) were 29 manuscripts. The 29 manuscripts became the main manuscripts in answering the objectives of this study, namely evaluating the impact of the use of EMR on the efficiency and productivity of health services, including reducing time in searching for medical information, reducing administrative costs, and improving care coordination, assessing the impact of the use of EMR on patient safety with a focus on potential risks such as input errors, data leaks, and cybersecurity challenges, and identifying changes in the quality of health services that may occur as a result of the implementation of EMR, such as improving disease management, patient monitoring, and medical team coordination.

3. Results and Discussion

Data synthesis on 29 studies is described in accordance with the objectives of this literature review, in addition, it is also described based on the research methods used and the results of studies that are relevant to the objectives of the literature review. The results of the data synthesis are presented in Table 1.

Table 1. Data synthesis results

Research purposes	Methods and Results
The study aims to evaluate the impact of the use of electronic medical records (EMR) on the efficiency and productivity of health services. The focus of this study is to measure the reduction in time in searching for medical information, reduction in administrative costs, and improvement in coordination of care between medical personnel.	The research conducted included using a quantitative approach by collecting several hospitals that have implemented EMR. The results of the study showed that the use of EMR significantly reduced the time needed to access medical information, reduced administrative costs, and improved nurse coordination [13]–[21].
These studies aim, among other things, to assess and describe the impact of EMR use on patient safety, with a focus	The study used an anticipatory, quasi-experimental, qualitative, and mixed method approach with data collection through surveys and in-depth interviews with health workers

Research purposes	Methods and Results
on potential risks such as data input errors, medical information leaks, and cybersecurity challenges	and analysis of reported incidents related to EMR. The results of the study showed that although EMR has the potential to improve patient safety, there are several risks that need to be managed, including data input errors, patient data leaks, and vulnerability to cyber-attacks [15], [17], [26]–[32], [18]–[25].
These studies focus on improving disease management, patient monitoring, and medical team coordination	The study used an anticipatory, quasi-experimental, qualitative, and mixed method approach with data collection through surveys and in-depth interviews with medical personnel and medical document analysis in several hospitals that have implemented EMR. The results of the study showed that the implementation of EMR had a significant positive impact on the quality of health services, including improved chronic disease management, better patient monitoring and more efficient medical team coordinators [15], [17], [36]–[39], [20]–[22], [27], [30], [33]–[35].

Table 1 presents the results of data synthesis from 29 reviewed manuscripts. Studies were conducted in at least 17 countries, both developed and developing countries, including America, Australia, Malaysia, Sudan, and Africa. Medical records have been implemented in the study for at least a year and at most more than 10 years. Developed countries have implemented EMR for a long time so that studies conducted in developed countries can on average answer all the objectives set in this literature review, namely the impact of EMR use on the efficiency and productivity of health services, including reducing time in searching for medical information, reducing administrative costs and improving care coordination, assessing the impact of EMR use on patient safety with a focus on potential risks such as input errors, data leaks, and cybersecurity challenges, and identifying changes in the quality of health services that may occur as a result of EMR implementation, such as improving disease management, patient monitoring, and medical team coordination.

Electronic medical records are digital systems used to store, manage, and access patient medical information electronically. The implementation of EMR is expected to improve operational efficiency in hospitals, reduce administrative costs, and improve coordination of care between medical personnel. However, the effectiveness of EMR use needs to be evaluated to ensure that these goals are achieved.

The use of EMR has a significant positive impact on the efficiency and productivity of healthcare services. EMR allows for quick access to patient medical information compared to manual, paper-based systems [20]. In addition, administrative costs related to managing medical records decreased significantly after the implementation of EMR. This decrease was due to the elimination of the need for paper, physical storage space, and efficiency in the documentation process.

The reduction in medical information search time and administrative costs indicates that EMR contributes to resource savings and increased hospital operational effectiveness. In addition, improved care coordination indicates that EMR also plays a role in improving communication and collaboration between healthcare providers, leading to improved patient care quality [40].

Coordination of care between medical personnel improved after the implementation of EMR. EMR allows easier access to information for various parties (doctors, nurses, and other medical personnel), thereby improving collaboration and overall patient care [41], [42]. The implementation of EMR has been proven to increase the efficiency and productivity of health services by reducing the time to search for medical information, reducing administrative costs, and improving nurse coordination between medical personnel. The results of this study can be a basis for hospitals and

other healthcare providers to consider implementing or improving the EMR system as a strategy to improve the quality of managed health services.

Hospitals that have not adopted EMR should consider implementing this system to improve efficiency and quality of service. In addition, regular EMR training is needed to be able to utilize the system features optimally. Further research can be done to evaluate the impact of EMR on other aspects such as patient data security and patient satisfaction.

Electronic medical records are expected to improve the efficiency and quality of health services. However, the implementation of EMR can also pose new challenges related to patient safety. Some of the potential risks identified are data input errors, data leaks, and cybersecurity.

Several studies have obtained data that there have been errors in inputting medical data on patients due to human error when using EMR [17], [43], [44]. These errors include entering prescriptions, diagnoses, or test results. Data entry errors have serious implications for patient safety, such as medication errors and misdiagnosis. Patient data leaks occur due to technical errors, non-compliance with procedures, or malfeasance by staff. Data leaks can lead to patient privacy violations and reduce patient trust in the healthcare system. In addition, leaks of sensitive medical data can also be used for unethical or illegal purposes.

Errors in data entry within EMR systems can have serious consequences for diagnosis, treatment, and clinical decision-making. Studies have shown that data entry errors in EMRs range between 10-25%, depending on system complexity and user-related factors. For instance, a study in the United States found that 22.1% of medical errors were associated with incorrect data entry in EMRs [45]. A notable case occurred at the Dana-Farber Cancer Institute, where an incorrect medication dosage was entered into the EMR system, leading to a patient receiving excessive chemotherapy, which resulted in severe complications. These errors can stem from autocorrect or autofill inaccuracies, human fatigue or insufficient training, and interoperability challenges where mismatches between different systems lead to missing or altered critical patient information [46]–[49].

Cybersecurity threats in EMRs have also become a growing concern, especially as cyberattacks targeting healthcare institutions increase. In 2023 alone, more than **133 million patient records** were compromised due to data breaches in the healthcare sector. One of the most significant incidents was the **ransomware attack on Universal Health Services (UHS) in the United States in 2020**, which rendered its EMR system inoperable for several weeks. This disruption forced healthcare providers to revert to paper-based records, delaying patient care. Another major breach occurred in **SingHealth, Singapore, in 2018**, where hackers accessed **1.5 million patient records**, including the medical history of the country's Prime Minister. These security breaches often result from phishing or malware attacks, inadequate encryption protocols, and a lack of cybersecurity awareness among healthcare professionals[50]–[52].

Several studies have also stated that healthcare workers feel that their workplace EMR systems are vulnerable to cyberattacks. These concerns include threats such as ransomware, phishing, and unauthorized access to systems. The hospitals studied experienced at least one significant cyberattack incident in the past two years, resulting in system downtime and potential data loss. While EMR can improve the accessibility and accuracy of medical information, there are significant risks to patient safety. Data entry errors, data leaks, and cybersecurity challenges are some of the key risks that must be managed properly. Data entry errors can lead to potentially fatal medical errors, while data leaks and cyber threats can damage patient trust and harm healthcare institutions [53]–[55].

The use of EMRs has a complex impact on patient safety. While EMRs can improve the efficiency and accessibility of medical information, risks such as data entry errors,

data leaks, and cybersecurity threats must be taken seriously. Healthcare providers need to adopt appropriate risk mitigation strategies to ensure that the use of EMRs does not compromise patient safety.

Recommendations that can be submitted are regular training for health workers on the proper use of EMR to reduce the risk of data input errors. Hospitals also need to adopt strong encryption technology and strict authentication procedures to protect patient data from leakage. In addition, hospitals must develop a comprehensive cybersecurity policy, including an incident response plan and regular security audits.

The implementation of EMR is expected to improve the quality of health services through better information management, faster and more accurate access to patient data, and increased operational efficiency. Several studies aimed at evaluating the extent to which EMR actually affects the quality of health services, especially in terms of disease management, patient monitoring, and medical team coordination, stated that EMR allows for more detailed and structured patient data recording, which helps in the management of chronic diseases such as diabetes, hypertension, and heart disease. The automatic reminder feature in EMR for routine check-ups and medication administration helps reduce human error and ensures that patients receive appropriate care on time. [56].

The implementation of EMR is integrated with health monitoring devices that allow for real-time monitoring of patient conditions. This is especially useful for patients with chronic conditions that require continuous monitoring. EMR provides sufficient data for predictive analysis to identify patient risk for further complications, allowing for preventive interventions [56]. EMR also helps ensure a smooth transition from one healthcare provider to another, reducing the risk of information errors and improving continuity of care. In addition, the messaging feature in EMR allows for faster and more documented communication between members of the medical team, increasing the efficiency of clinical decision-making.

The implementation of EMR has a positive impact on the quality of health services. Chronic disease management becomes more structured and effective, patient monitoring is more comprehensive and accurate, and medical team coordination is smoother and more efficient. However, several studies have also found several challenges that need to be addressed, such as the need for ongoing staff training and change management to optimize the use of EMR.

EMR has been shown to improve the quality of healthcare services through improved disease management, patient monitoring, and medical team coordination. EMR can also serve as an effective tool in improving operational efficiency and the quality of patient care. However, to achieve optimal results, support is needed in terms of training and adaptation of work processes in healthcare facilities.

The recommendation is that medical personnel need to receive regular training on the use of EMR to ensure they can take full advantage of the system's features. Healthcare facilities should consider EMR with other technologies such as remote monitoring devices and predictive analytics systems. In addition, there needs to be a policy that supports the use of EMR to improve communication and coordination between medical teams.

4. Conclusions

Implementation of EMR/EMR has been shown to improve the efficiency and productivity of healthcare services by reducing the time required to search for medical information, lowering administrative costs, and improving care coordination among healthcare professionals. The use of EMR/EMR allows for quick and easy access to patient data, which significantly improves the clinical decision-making process and operational management in healthcare facilities. Although EMR/EMR can improve the accessibility and accuracy of medical information, there are several risks to patient safety that must be

considered, such as data input errors, patient data leaks, and cybersecurity challenges. Data input errors can result in medical errors that can potentially harm patients, while data leaks and cyber threats can undermine patient trust in the healthcare system.

The implementation of EMR contributes positively to improving the quality of health services, including chronic disease management, better patient monitoring, and more efficient coordination of medical teams. EMR facilitates better collaboration between medical personnel and allows real-time monitoring of patient conditions, which improves continuity of care and the effectiveness of clinical interventions. To maximize the benefits of EMR while mitigating its risks, specific and actionable recommendations should be considered. Healthcare facilities should develop robust cybersecurity protocols for EMR systems, including multi-factor authentication (MFA), regular penetration testing, and data encryption to prevent unauthorized access. Comprehensive training programs should be provided to healthcare personnel to reduce data input errors and enhance awareness of cybersecurity best practices. Additionally, implementing automated data validation systems can help detect and correct potential input errors before they affect patient care. Healthcare institutions should also establish incident response plans to address data breaches promptly and minimize potential harm. By implementing these targeted strategies, healthcare facilities can strengthen the security and reliability of EMR systems, ensuring that digital transformation in healthcare enhances both efficiency and patient safety.

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Conflicts of Interest: none declared

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