Systematic Literature Review: EMR and Health Information Competence in Indonesia's Digital Transformation

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ABSTRACT

Digital transformation drives the use of health information systems to integrate clinical, administrative, and operational data. In Indonesia, diverse infrastructure, administrative models, and workforce competencies pose challenges to electronic medical records (EMR) implementation. This study aims to analyze EMR adoption and its implications for strengthening the competence of Health Information and Medical Record (HIMR) professionals in Indonesia's digital transformation era. A systematic literature review was conducted using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) protocol. The review followed four stages: identification, screening, eligibility, and inclusion. A total of 180 articles were initially retrieved from electronic databases, including Google Scholar, ResearchGate, and Garuda Kemdikbud. After applying inclusion and exclusion criteria, 21 studies were selected for the final analysis. Findings highlight variations in EMR effectiveness, HIMR competence, data ethics and security, and technical and organizational barriers. EMR improves efficiency and accuracy of clinical documentation, yet competence development is limited by disparities in digital literacy and regulatory understanding. Strengthening advanced authentication, infrastructure standardization, and standard operating procedure is essential to enhance HIMR technical and managerial capacity for sustainable system integration.

Keywords: competence; digital transformation; electronic medical records; health information management; Indonesia

INTRODUCTION

Digital transformation has revolutionized healthcare management by driving the utilization of information technology in every medical service process. Health information systems now play a crucial role in managing clinical, administrative, and operational data in an integrated, efficient, and accurate manner (1). The implementation of electronic medical records (EMR) represents one of the key innovations in this transformation, replacing manual documentation with digital systems that prioritize data security and confidentiality. Access to patient medical histories becomes faster, coordination among service units such as registration, outpatient clinics, laboratories, and pharmacies is more effective, and the risk of documentation errors can be minimized. The presence of EMR supports the establishment of a responsive and integrated health information ecosystem aligned with national policies on healthcare digitalization (2).

Indonesia has a diverse and complex healthcare system, with thousands of public and private hospitals ranging from large urban medical centers to small rural clinics (3). Hospitals operate under different administrative systems, have varying levels of access to technology, and employ healthcare workers with diverse educational and cultural backgrounds (4). In recent years, Indonesia's healthcare services have undergone significant transformation through the implementation of the national health insurance program. This policy has increased the demand for medical services, compelling healthcare institutions to adopt more modern and efficient documentation mechanisms (5). The use of EMR has become a key element in the digitalization process, in line with government regulations requiring all healthcare facilities to transition from manual to electronic documentation no later than December 31, 2023.

The Indonesian Ministry of Health Regulation No. 24 of 2022 stipulates the mandatory implementation of EMR as an effort to improve the quality of healthcare services, reinforce the legal aspects of patient data

management, and ensure the confidentiality, security, and availability of medical information (6). Based on this policy, many hospitals have begun to implement digitalization strategies through the adoption of EMR. The system is projected to accelerate service workflows and optimize operational efficiency. The transition to electronic systems is not merely a technological change but represents a profound cultural shift in the management and utilization of information. Consequently, the shift from manual to digital systems continues to face considerable challenges (7).

The gap in EMR implementation across Indonesia remains considerable. Large urban healthcare facilities with sufficient budgets are generally faster and more prepared to transition to this system, whereas smaller facilities in rural areas are often constrained by limited resources (8). In addition, most healthcare facilities are not yet supported by Health Information and Medical Record (HIMR) professionals with adequate technical skills, in-depth knowledge, and sufficient motivation to manage information and perform electronic documentation (9). The success of EMR implementation in strengthening HIM workforce competence in the era of digital health transformation in Indonesia.

The acceleration of medical record digitalization requires a deep understanding of the extent to which EMR can enhance the efficiency and accuracy of clinical documentation, strengthen the digital competence of HIMR professionals, and safeguard patient data confidentiality and integrity amid infrastructure challenges and organizational dynamics. This study aims to systematically examine how EMR implementation can reinforce the competence of HIMR human resources in Indonesia. A literature review was chosen to integrate empirical findings related to implementation achievements, competence gaps, ethical and information security aspects, as well as technical and managerial barriers. The results of this study are expected to provide an evidence-based foundation for the formulation of comprehensive policies and transformation strategies to strengthen the role of HIMR professionals in the era of national digital health transformation.

METHOD

This study is a systematic literature review that examines theories, concepts, and empirical findings relevant to the implementation EMR and the competence of HIMR professionals in Indonesia. The review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure methodological rigor and transparency. Researchers utilized the databases Google Scholar, Garuda Kemdikbud, and ResearchGate to identify articles related to the effectiveness of EMR implementation in strengthening the competence of HIMR professionals in Indonesia. The search strategy was conducted using a combination of keywords and Boolean operators as follows: "rekam medis elektronik" AND "kompetensi" AND "sumber daya manusia" AND "perekam medis dan informasi kesehatan". Additional keywords included medical recorders and health information. The search was restricted to articles published between 2020 and 2024, written in either Indonesian or English, and conducted within the Indonesian healthcare context.

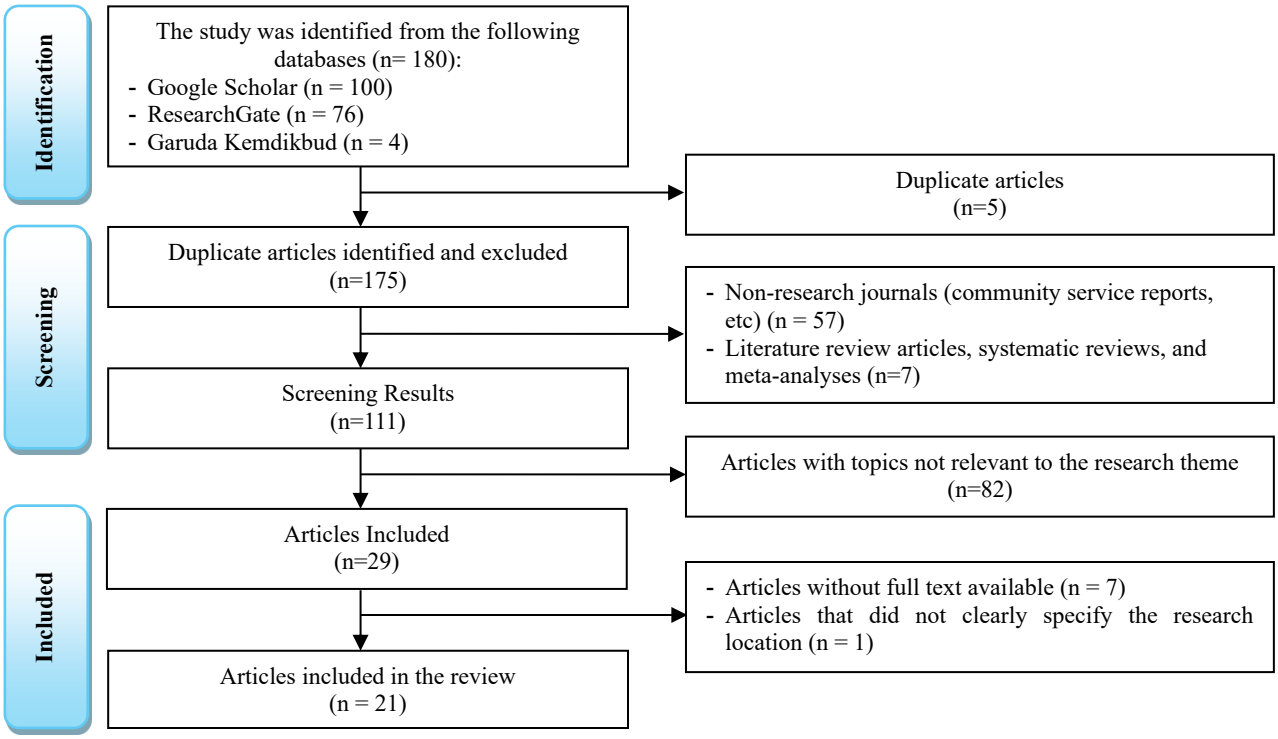

Figure 1. PRISMA Flowchart

A total of 180 articles were identified during the initial search. Following duplicate removal and the application of inclusion and exclusion criteria, 21 articles were selected for detailed analysis. The extracted information covered publication year, research objectives, study design, methods, and principal findings. The selected articles were analyzed using an annotated bibliography approach, allowing the researcher to synthesize findings and align them with the study objectives. The analysis focused on identifying variations in EMR implementation effectiveness, HIMR professional competence, ethical and data security considerations, and technical or organizational barriers

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RESULTS

A total of 180 articles were identified, consisting of 100 from Google Scholar, 76 from ResearchGate, and 4 from Garuda Kemdikbud. After removing 5 duplicate records, 175 articles were screened based on titles and abstracts. During screening, 57 non-research publications, 7 literature/systematic reviews, and 82 articles with irrelevant topics were excluded. This left 29 articles for full-text eligibility assessment, from which 7 were excluded due to unavailable full text and 1 due to unclear research location. Finally, 21 articles were included in the review and the summary of selected articles is shown in Table 1.

Table.1 Extraction of Research Results

No	Author, Year	Research Objectives dan Location	Research Methods	Results
1	Husni, 2022	EMR security and privacy; Hospital in Madura, East Java	Qualitative study	Security and privacy systems are fairly good; Standard Operating Procedure (SOP) not yet available; touchscreen devices limited
2	Putri and Pertiwi, 2022	EMR implementation; Community Health	Qualitative study	Bridging performed manually due to limited Human Resources (HR), network issues, and

No	Author, Year	Research Objectives dan Location	Research Methods	Results
		Center in Padang, West Sumatra		absence of dedicated Information Technology (IT) staff
3	Bariyah, Ningtyas and Setiawan, 2023	EMR implementation, HR; Hospital in Purbalingga, Central Java	Qualitative study	Constraints include low staff competence, inability in coding/indexing, and suboptimal EMR management
4	Jayanthi and Lazuardi, 2023	Factors influencing EMR implementation; Hospital in Mataram, NTB	Qualitative study	Integration of human, organizational, and technological factors is crucial for successful EMR implementation
5	Lakhmudien *et al.*, 2023	EMR regulations, HIMR competence; Hospital in Kudus, Central Java	Qualitative study	Most HIMR staff lack understanding of EMR regulations/system design; low IT literacy; need training
6	Latifah and Anshari, 2023	EMR implementation; Hospital in Banjarmasin, South Kalimantan	Qualitative study	EMR implementation runs well; HR sufficient; hardware adequate; training not yet optimal
7	Putri, Anshari and Persadha, 2023	EMR implementation; Hospital in Banjarmasin, South Kalimantan	Qualitative study	Hospital ready in terms of HR and applications, but lacks SOP and legality of digital signatures.
8	Puranegara and Sari, 2023	EMR implementation, HR; Hospital in Bekasi, West Java	Qualitative study	Majority of staff unable to perform tasks according to standards; HIS not yet optimal
9	Rusmana and Sari, 2023	EMR implementation; Community Health Center in Cianjur, West Java	Qualitative study	Constraints: untrained HR, limited facilities, slow development, weak EMR governance
10	We'e, Nugroho and Siswatibudi, 2023	EMR implementation, security; Hospital in Yogyakarta	Qualitative study	EMR improves efficiency of time, labor, and cost; hindered by system errors and weak internet connection
11	Ananda and Ulfah, 2024(20)	Barriers to EMR implementation, HR; Hospital in Bandung, West Java	Qualitative study	Barriers: insufficient HR, limited devices, unstable network, uneven understanding
12	Ansori *et al.*, 2024	EMR implementation, HR; Hospital in South Jakarta, DKI Jakarta	Qualitative study	Optimal EMR implementation and consistent use contribute to increased HR satisfaction
13	Azizah, Supriyanto and Rois, 2024	EMR implementation; Hospital in Bandar Lampung, Lampung	Qualitative study	EMR implementation appropriate in terms of budget, facilities, and SOP; HR not HIMR professionals
14	Darsono, 2024	Evaluation of EMR implementation; Hospital in Yogyakarta, DI Yogyakarta	Qualitative study	EMR implementation aligned with policy structure and function; utilization accommodated in system
15	Haryanto *et al.*, 2024	EMR implementation, infrastructure; Clinic in Cirebon, West Java	Qualitative study	Clinic fairly ready; constraints include training, network, and suboptimal system integration
16	Mudzakir, 2024	EMR implementation, HR; Hospital in Sidoarjo, East Java	Qualitative study	EMR implementation good; HR competence adequate; services easier, faster, and more efficient

No	Author, Year	Research Objectives dan Location	Research Methods	Results
17	Khazizah and Hardiana, 2024	EMR implementation; Hospital in Seruyan, Central Kalimantan	Qualitative study	Constraints: unsystematic management/ governance, lack of regulations and HR, difficulty in data integration
18	Pratiwi, Ahmad and Effendy, 2024	EMR implementation; Hospital in Buton, Southeast Sulawesi	Qualitative study	HIMR staff trained, but EMR implementation not optimal; weak management support, slow computers, no SOP
19	Surya *et al.*, 2024	EMR implementation, infrastructure; Hospital in Tomohon, North Sulawesi	Qualitative study	Hospital has infrastructure, network, and competent HR for EMR implementation
20	Susilawati *et al.*, 2024	EMR readiness, HR; Hospital in Mataram, NTB	Qualitative study	EMR training unavailable; limited facilities/devices; no SOP for EMR application
21	Wahyuntara, Wahyati and Tugasworo, 2024	EMR confidentiality; Hospital in Semarang, Central Java	Qualitative study	EMR implementation fairly effective; constraints include regulatory understanding and limited IT staff

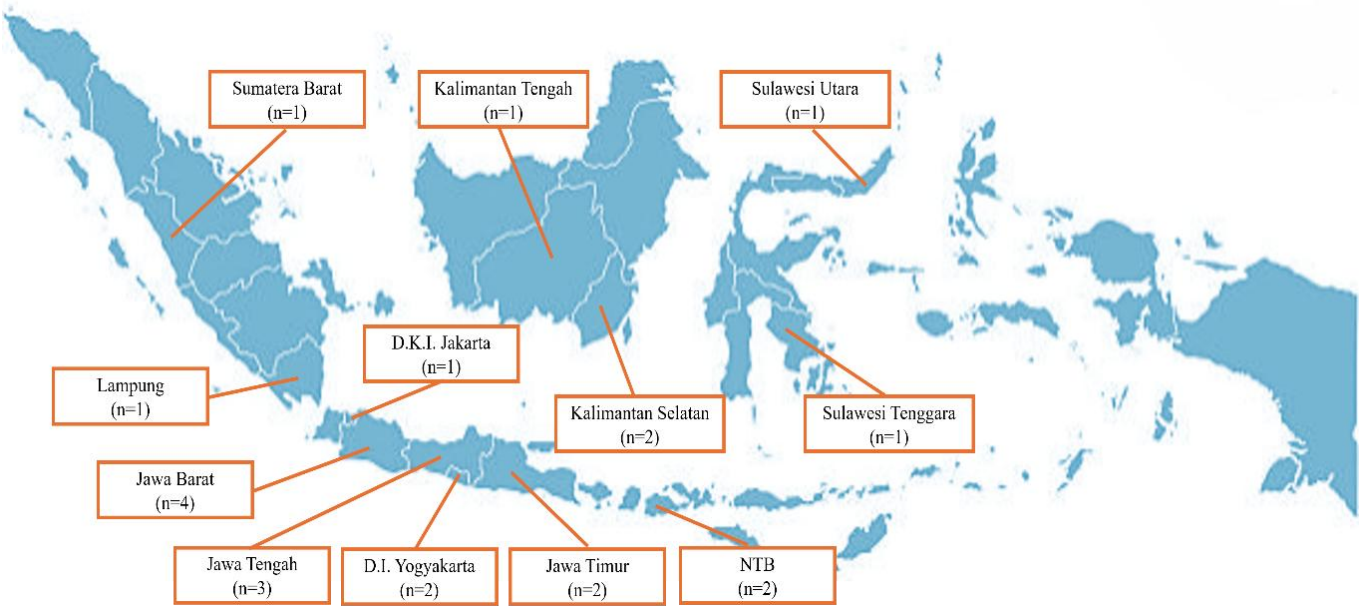

Figure 2. Geographical Mapping

The geographical mapping of studies on the effectiveness of EMR implementation in strengthening the competence of HIMR professionals in Indonesia illustrates the distribution of research locations across various provinces in Sumatra, Java, Kalimantan, Sulawesi, and West Nusa Tenggara. This visualization, as shown in Figure 2, emphasizes cross-regional representation, ranging from government centers and metropolitan cities to areas facing diverse infrastructural challenges, serving as the basis for analyzing the success of EMR in enhancing the capabilities of health information management personnel. The geographical overview facilitates understanding of local characteristics and contextual challenges that influence the effectiveness of EMR implementation, while also providing a foundation for formulating more adaptive and sustainable strategies for strengthening HIMR professionals.

DISCUSSION

The digital transformation of Indonesia's health sector positions Electronic Medical Records (EMR) as a fundamental component in the management of both clinical and administrative data. The success of EMR adoption largely depends on the readiness of technological infrastructure and the competence of Health Information and Medical Record (HIMR) professionals in operating the system, maintaining data reliability, and analyzing information for decision-making. The discussion explores the effectiveness of EMR implementation in healthcare services, the contribution of EMR to strengthening HIMR human resource competence, the mechanisms for ethical protection and data security, and the technical as well as organizational challenges that hinder system integration.

Effectiveness of Electronic Medical Record (EMR) Implementation

The utilization of EMR establishes a fully integrated health data network, enabling medical personnel to instantly access patient histories, reduce the potential for recording errors, and ensure the integrity of information (31). The system harmonizes processes across patient registration, clinical services in outpatient clinics, laboratory examinations, and pharmaceutical distribution, while simultaneously reducing reliance on paper documents and physical archive space to achieve cost efficiency and environmental sustainability. The speed and transparency of services provided also contribute to improved patient satisfaction, while data security is maintained in accordance with national health digital transformation policies (32).

The implementation of electronic medical records in hospitals across Indonesia still demonstrates significant differences in the level of system integration. Puranegara and Sari (2023) reported that in several facilities, crucial processes such as the preparation of general consent and patient visit reporting remain dependent on paper documents because the hospital information system has not yet synchronized data automatically, thereby hindering service efficiency and information accuracy. Similar findings were presented by Putri and Pertiwi (2022), who identified obstacles in connecting community health center data with the national claims system, where failures in automation, particularly in maternal and child services, forced staff to perform manual corrections due to incomplete anamnesis data. Ananda and Ulfah (2024) further explained that in surgical units, the simultaneous use of paper formats alongside electronic systems resulted in duplicated tasks and slowed documentation, especially when patient volumes increased.

Conversely, several institutions have successfully leveraged management support and internal IT teams to accelerate EMR adoption. Haryanto *et al.* (2024) highlighted that Klinik Pratama Indocement placed strategic information technology planning and continuous training as the foundation of a digital work culture that supports comprehensive implementation. Latifah and Anshari (2023) provided a similar perspective, noting that self-registration services facilitated patient flow and reduced queues, although minor network disruptions still required anticipation. Wahyuntara, Wahyati and Tugasworo (2024) emphasized that standardizing operational procedures and internal document formats is essential for strengthening data security evaluation and ensuring consistency in implementation. Husni (2022) revealed that the application of digital informed consent in surgical units remains limited and has not yet been regulated in standardized guidelines, resulting in uneven implementation. Despite technical constraints, consistency in the use of electronic medical records (EMR) is directly proportional to improvements in administrative efficiency and data accuracy, which in turn enhances healthcare worker satisfaction (21). For optimal implementation, hospitals need to focus on comprehensive system integration, continuous training, and the standardization of supporting documents to ensure sustained improvements in healthcare service quality (12,13,25,27,28).

Professional Competence of HIMR Personnel

The utilization of digital technology and the strengthening of adequate infrastructure are closely correlated with improved performance among Health Information and Medical Record (HIMR) professionals. Access to EMR systems, documentation software, and automated coding

features aligns with the core competencies of HIMR staff in documentation, information management, and disease classification (33). HIMR personnel need to be equipped with continuous education that encompasses mastery of health information systems, application of updated coding standards, understanding of privacy regulations, and analytical skills to extract strategic information from medical records. The combination of technological proficiency and professional competence among HIMR staff is essential in supporting a healthcare system that is adaptive and quality-oriented (34).

The study conducted by Lakhmudien *et al.* (2023) revealed that the understanding of medical record personnel regarding recent regulations is often limited, with many staff members not fully familiar with the content of Ministry of Health Regulation No. 24 of 2022 or its relation to other supporting regulations. Although some facilities have established development teams involving medical record officers, physicians, and IT staff in accordance with Ministry of Health Regulation No. 55 of 2013, and have organized initial training and socialization programs, digital literacy and technical mastery of EMR applications still need to be strengthened to ensure that operations can run more independently and efficiently (11,16). The study by Puranegara and Sari (2023) revealed variations in the ability to carry out EMR-based processes. Several registration officers and clinical coders still relied on manual procedures or performed physical corrections due to limited skills in designing electronic workflows and selecting appropriate diagnostic codes. Similar findings were reported by Ananda and Ulfah (2024), who observed that some staff members, being more accustomed to paper-based documentation, experienced difficulties when transitioning to hybrid electronic systems. This resulted in slower data entry and negatively affected the speed of medical services.

The findings of Darsono (2024) and Haryanto *et al.* (2024) indicate that digital maturity has placed human resource components at a relatively adequate level of readiness, yet formal training and technical guidelines remain weak. The urgent need to develop system usage manuals and to conduct advanced training has been highlighted to ensure that user competencies are evenly distributed and that staff can address technical challenges without relying on external support. In line with the studies of Azizah, Supriyanto and Rois (2024) and Khazizah and Hardiana (2024), evidence shows that several registration units still lack officially certified health information and medical record personnel as required by the Ministry of Health, which may compromise the quality of data management. Most registration staff come from non-medical record backgrounds, while IT units rely only on a few staff with general computer education and lack programmers or cybersecurity specialists. Therefore, recruitment and career development for HIMR professionals need to be optimized in accordance with Chapter 13 of Ministry of Health Regulation No. 24 of 2022 to ensure that professional competencies are adequately fulfilled.

Various studies recommend intensifying advanced training, providing technical assistance, and consistently disseminating regulations to harmonize perceptions among implementers, strengthen user confidence, and accelerate staff adaptation to EMR systems. In this way, human resource readiness will become more robust, allowing EMR implementation to proceed independently and sustainably (Jayanthi and Lazuardi, 2023; We'e, Nugroho and Siswatibudi, 2023; Ansori *et al.*, 2024; Mudzakir, 2024). The combination of technological literacy and professional expertise among HIMR personnel is a decisive factor in the successful application of health information systems that are responsive, efficient, and of high quality. Equipped with such knowledge and skills, HIMR professionals serve not only as technical executors but also as strategic partners in data-driven decision-making, documentation quality assurance, and compliance with healthcare service accreditation standards (36).

Ethics and Information Security

Electronic medical records (EMR) serve as legitimate evidence of all healthcare procedures, and their implementation requires well-planned information system strategies. Such strategic formulation is essential to prevent medical errors arising from the use of information technology. Data security aspects, ranging from storage methods to access mechanisms, must be guaranteed in accordance with established standards by authorized institutions, while EMR

users such as healthcare professionals are obliged to respect patient confidentiality (37). Issues of data security and confidentiality in electronic transactions remain a significant challenge in Indonesia, particularly in EMR implementation. Although EMR is considered capable of accelerating medical performance, improving efficiency, and ensuring data continuity through reliable backup systems, the potential for privacy violations due to system breakdowns or cyberattacks remains high. The elevated risk of medical information leakage carries serious ethical and legal implications, including violations of patient privacy rights and misuse of data by unauthorized parties (38).

The study by Wahyuntara, Wahyati and Tugasworo (2024) revealed that hospitals have enforced policies and procedures to safeguard the confidentiality, integrity, and availability of EMR data. Standards for information management and patient document handling are implemented through restricted access based on authorization, individual authentication systems, and user activity monitoring in accordance with legal provisions regarding the disclosure of medical records with or without patient consent. Husni (2022) further reported that, at the technical level, software is protected with daily data backups, antivirus programs, firewalls, and encryption, while hardware security is ensured through the physical arrangement of server rooms with iron racks, temperature and humidity control, backup power supplies via UPS and generators, and surveillance using CCTV. All medical staff, non-medical staff, and third-party vendors are required to sign confidentiality agreements to uphold privacy commitments.

The studies by Darsono (2024) and Pratiwi, Ahmad and Effendy (2024) revealed that although basic mechanisms have been fulfilled, authentication systems still rely on usernames and passwords, making them vulnerable to credential leakage if not accompanied by advanced security measures. There has been no implementation of biometric authentication, smart cards, or more detailed data access classifications, while several procedures continue to be performed manually, leaving privacy violation risks unresolved. Similar concerns were raised in the other studies, which reported practices such as account storage on shared computers and irregularities in independent data backups, reflecting low levels of data security awareness among staff (12,13,26).

In contrast to the study by Surya *et al.* (2024), which highlighted that collaboration with the Department of Communication and Information Technology has helped strengthen defenses against cyberattacks and maintain network stability, challenges related to connection availability and delayed responses during server disruptions remain unresolved. Therefore, enhancing security requires the adoption of multi-factor authentication as well as structured and periodic security evaluations. Suwani *et al.* (2024) emphasized that stakeholders, including government authorities and health application developers, must ensure that every system and policy complies with the highest standards of security and data privacy. Moreover, healthcare facilities must demonstrate strong commitment to implementing layered security systems, encompassing user authentication, data encryption, and regular software updates to safeguard information integrity and protect patient rights in the era of digital transformation (40). This step is crucial to build public trust in digital health services and to ensure that patient medical information remains protected. Existing regulations have established a legal framework to preserve data confidentiality in EMR, including limiting access rights exclusively to authorized personnel and defining clear operational procedures for each stage of patient data management. Training and dissemination of standard operating procedures must also be expanded to foster a culture of security awareness across all levels of healthcare staff (38).

Technical and Organizational Challenges

The era of digital transformation underscores the importance of reliable and high-quality data integration as the foundation for modernizing healthcare services. Although intended to facilitate the flow of information, its implementation encounters various challenges (41). A wide range of health applications developed by central government, local government, and private entities apply different data formats and standards, resulting in fragmented patient medical records across multiple platforms that are difficult to consolidate. In addition, many healthcare facilities in certain regions still rely on manual

paper-based documentation, limiting the optimal use of electronic data (3).

The implementation of EMR in many facilities continues to be hampered by interrelated technical and organizational constraints. From an infrastructure perspective, several hospitals lack adequate hardware, with computers frequently malfunctioning and internet connections often unstable. Wi-Fi coverage does not extend to all service areas, causing frequent interruptions in data input and errors in system bridging (11,20). Furthermore, some installations are equipped with only a single touchscreen device for informed consent, without specific standard operating procedures, leading to uncertainty in procedure execution (10). Other studies reported similar findings, noting that although healthcare facilities such as Klinik Pratama Indocement and RSU Anwar Medika have provided servers, backup power, and cloud-based applications, there remains a need to increase the number of devices, expand RAM capacity, and improve connection speed to ensure smooth system operation during peak loads (24,25,29).

The absence of official and detailed standard operating procedures in most facilities has resulted in inconsistent EMR implementation, even though cross-unit teams have been established to manage workflows (16,27). Darsono (2024) and Lakhmudien *et al.* (2023) found that inter-unit coordination has not been formally regulated through internal policies, leaving responsibilities unclear and slowing the adaptation to a digital work culture. These findings are supported by Bariyah, Ningtyas and Setiawan (2023) and Haryanto *et al.* (2024), who noted the lack of daily patient workload management systems and the absence of incentives for technical staff, which has increased resistance since changes are perceived as adding administrative burdens.

Another challenge in EMR implementation, namely the limited number of IT personnel and their absence in some registration units, which has led to dependence on external vendors and the Department of Communication and Information Technology (22,28). As a result, technical problems cannot be resolved independently and repair responses are often delayed. Many staff members have not fully mastered e-prescription features or the integration of e-Lab and BPJS, even though the Mobile JKN application has been connected, leaving several processes constrained by hybrid manual-electronic practices (13,18). Therefore, strengthening infrastructure, developing official Standard Operating Procedure (SOP), recruiting competent IT personnel, and conducting advanced training are crucial steps to ensure effective and sustainable EMR implementation. Efforts to standardize data, upgrade IT infrastructure, and provide intensive training for HIMR personnel are indispensable to enable integrated systems to function effectively (42).

The findings indicate that the implementation of electronic medical records (EMR) has successfully accelerated patient registration processes, improved patient handling, and enhanced the accuracy and availability of medical information in real time. The main obstacles arise from uneven levels of digital literacy among HIMR personnel and resistance within work culture to changes in established processes, which reduce the potential for system optimization. Although some facilities are already equipped with servers, networks, and basic hardware, operational consistency requires standardized internal policies and operating procedures. Strengthening the competencies of HIMR staff through continuous technical training is a key strategy to increase user independence. Comprehensive alignment of SOP and the establishment of cross-unit coordination mechanisms will integrate digital workflows without overlap or information leakage. When human resource competencies, organizational governance, and technological readiness are simultaneously reinforced, the EMR ecosystem is expected to evolve into a reliable, secure, and sustainable system in line with the vision of national digital health transformation.

CONCLUSION

The implementation of electronic medical records (EMR) has improved efficiency and accuracy in clinical documentation, yet disparities in digital literacy and limited regulatory

understanding among HIMR personnel continue to hinder technical and managerial competence. This highlights the need for structured training curricula, continuous education on EMR features, digital health regulations, and data security practices, supported by certification and periodic assessments to strengthen user independence and system reliability. However, current adoption remains uneven across facilities, with infrastructure gaps, reliance on basic authentication, and inconsistent SOP limiting scalability and sustainability. Future research should therefore examine competency-based training models, evaluate advanced security mechanisms such as multi-factor authentication, and explore organizational strategies for harmonizing SOP and infrastructure investment to ensure EMR evolves into a secure, reliable, and sustainable system aligned with national digital health transformation goals.

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