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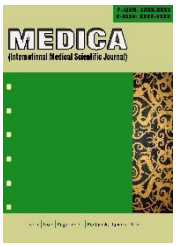

The Effectiveness of Electronic Medical Records by Nurses at Hospitals in East Kalimantan

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Abstract

The implementation of electronic medical records (EMRs) has increased significantly in hospitals worldwide, including in Indonesia, due to their potential to improve healthcare quality, enhance efficiency, reduce medical errors, and support clinical decision-making. However, the effectiveness of EMR implementation varies across healthcare settings, highlighting the need for systematic evaluation. This study aimed to assess the effectiveness of EMR implementation in hospitals in East Kalimantan, Indonesia. A quasi-experimental study with a two-group post-test-only design was conducted involving 188 participants from two hospitals. Data were collected simultaneously and analyzed using the Mann–Whitney U test with a significance level of 0.05. The results revealed significant differences between the two hospitals in the dimensions of quality ($p = 0.001$), facilities ($p = 0.028$), functionality ($p = 0.017$), user satisfaction ($p = 0.003$), and overall effectiveness ($p = 0.014$). Hospitals implementing EMRs demonstrated higher effectiveness scores compared with hospitals that had not implemented EMRs. In conclusion, EMR implementation significantly influences the effectiveness of medical record management. These findings highlight the importance of optimizing EMR systems to improve healthcare service quality and operational performance in hospitals.

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1. INTRODUCTION

Over the past few decades, the adoption of electronic medical records (EMRs) has increased substantially in hospitals worldwide. More than 95% of hospitals in the United States, 78% in Europe, and 85% in China have implemented EMRs (Holmgren et al., 2021; Liang et al., 2021; Uslu & Stausberg, 2021). An EMR is a digital version of a patient's medical history that contains administrative and clinical information, including demographic data, diagnoses, medications, treatment progress reports, laboratory results, radiology reports, vital signs, immunization records, and other healthcare-related information (Keshta & Odeh, 2021; Li et al., 2022a). By enabling rapid access to information and secure long-term data storage, EMRs support more effective healthcare delivery. Nevertheless, the success of EMR implementation varies considerably across countries and healthcare settings, indicating the need for continuous evaluation and the development of strategies to overcome implementation barriers (Al-Worafi, 2024; Li et al., 2021; Li et al., 2022b; Borges do Nascimento et al., 2023; Gabriel et al., 2022; Mwogosi & Kibusi, 2024; Upadhyay & Hu, 2022).

The implementation of EMRs offers numerous benefits for healthcare organizations. Previous studies have reported that EMRs improve healthcare quality, enhance time and cost efficiency, increase compliance with clinical guidelines, reduce documentation errors, and allow healthcare professionals to devote more time to direct patient care (Ariyanti et al., 2023; Faida et al., 2023; Mardi & Kom, 2022; Saputri et al., 2024). Furthermore, EMRs contribute to improved efficiency, safety, and quality of healthcare services while reducing patient waiting times (Albagmi, 2021; Gatiti et al., 2021; Gopidasan et al., 2022a). Healthcare workers generally demonstrate positive acceptance of EMR implementation (Alqudah et al., 2021; Kasaye et al., 2023; Lambert et al., 2023; Noeryosan et al., 2025). Compared with conventional paper-based records, EMRs enhance transparency through more complete, accurate, and legible documentation. Despite these advantages, evidence comparing the effectiveness of EMR implementation between hospitals that have adopted EMRs and those that still rely on conventional systems remains limited, as most previous studies have focused on a single institution or a single implementation group.

In Indonesia, the importance of EMR implementation is reinforced by Minister of Health Regulation No. 24 of 2022 concerning medical records, which requires all healthcare facilities to implement EMRs. However, implementation remains uneven, particularly in East Kalimantan, where some hospitals have only partially implemented EMR systems in selected units. Common challenges include limited internet connectivity, inadequate hardware infrastructure, difficulties integrating multiple application systems, poor system quality, and concerns regarding data security and privacy. Additional barriers include low digital literacy among healthcare workers, resistance to transitioning from paper-based systems, high implementation costs, substantial investments in software and infrastructure, employee training requirements, and ongoing maintenance expenses. During the transition period, EMR adoption may also temporarily slow patient care processes. Moreover, healthcare facilities that fail to implement EMRs may face regulatory consequences, including written warnings, reduced accreditation status, and suspension of operating permits.

Inadequate EMR implementation may generate adverse consequences for both healthcare workers and patients. Increased dependence on digital systems can contribute to dissatisfaction, inefficiency, stress, frustration, and burnout among healthcare professionals, potentially compromising patient safety and quality of care (Calderon et al., 2024; Lee & Kang, 2021; Nemesure et al., 2021). Therefore, continuous evaluation is essential to identify implementation challenges, mitigate potential risks, and provide

decision-makers with evidence-based information for system improvement (Compagner et al., 2025; Lindén-lahti et al., 2022; Pruitt et al., 2023). Several key challenges have been identified during EMR implementation, including cost and resource constraints, risk assessment, governance and consensus building, system customization, workflow integration, usability testing, and user training. Previous studies have also highlighted a gap between theoretical models of information system adoption and stakeholder perspectives. Stakeholder commitment and involvement have been recognized as critical success factors, whereas inadequate support and negative attitudes among healthcare workers are among the most important causes of implementation failure (Puspitasari & Sari, 2024; Tsehay & Matlhaba, 2025; Wikansari & Santoso, 2022).

To ensure that EMRs are implemented effectively and deliver the expected benefits, systematic evaluation frameworks are required. The effectiveness of information technology implementation can be assessed using the Technology Acceptance Model (TAM), which focuses on perceived usefulness, perceived ease of use, and behavioral intention, as well as the Human, Organization, and Technology-Fit (HOT-Fit) framework, which evaluates system use, user satisfaction, organizational structure, environmental factors, system quality, information quality, and service quality. Given that EMR implementation in hospitals in East Kalimantan has not yet been fully optimized or sustained, this study aimed to examine the effectiveness of EMR implementation among nurses by assessing four dimensions quality, facilities, function, and satisfaction and comparing hospitals that have implemented EMRs with those that have not.

2. METHOD

This quasi experimental study used a two-group post-test-only design, which aimed to analyse the effectiveness of nurses' electronic medical record implementation in hospitals. The participants were nurses working in inpatient wards. Furthermore, this study was conducted in two regional general hospitals in East Kalimantan. The population in this research were nurses who work in two hospitals in East Kalimantan. A total of 188 nurses participated, 94 nurses from RSUD A.W Sjahranie as a intervention group and 94 nurses form RSUD I. A Moeis as a control group. In total, 188 nurses were selected as participants through purposive sampling. The participants were nurses who met the following criteria: willingness to participate, at least 1 year of ward work experience, and prior experience preparing medical records for patients. The participants were excluded if they were unable to complete the study.

The data collection instrument used was a two-part questionnaire. The first section contained general information about the participants and consisted of six items, including gender, age, education level, length of service, nurse position, and computer skills. The second section included 53 items on the effectiveness of electronic medical records, such as quality (24 items), facilities (14 items), benefits (8 items), and user satisfaction (7 items). Furthermore, the effectiveness of nurses' electronic medical record implementation was measured on a 4-point Likert scale, with 1 indicating strongly disagree and 4 indicating strongly agree. Furthermore, the validity and reliability of the instrument were tested on 30 nurses, with a Pearson correlation significance value of 0.021 (Sig. <0.05) and a Cronbach's alpha reliability test of 0.817. The effectiveness of electronic medical record implementation was tested using the Mann-Whitney U test. The confidence level used in this study was 95% ($\alpha = 0.05$).

This study started with an ethical clearance application from the university, followed by a study permit application from the hospital director. The data collection process started by explaining informed consent to participants. The purpose of this study and the data

collection methods were explained to participants, with assurances that all information provided would remain confidential. Nurses participated voluntarily and anonymously, and data collection was carried out from September 10-15, 2025. The questionnaire was distributed through Google Forms and given to participants. An explanation was provided before participants voluntarily completed the questionnaire anonymously. The personal information they provided was kept confidential, and the data was used only for study purposes. This research was conducted in two hospitals in Samarinda, East Kalimantan, namely A.W Sjahranie hospital as the intervention group and I.A. Moeis hospital as the control group. This study received approval from the ethics committee of the East Kalimantan Ministry of Health Polytechnic (Approval Number: DP.04.03/7.1/07653/2025).

3. RESULTS AND DISCUSSION

Table 1. Characteristics of nurses based on gender, education, position, computer skills, and training at Hospitals A and B.

Variables	Hospital A (n=94)		Hospital B (n=94)	
	Number	Percentage	Number	Percentage
Gender				
Male	20	21.3	24	25.5
Female	74	78.7	70	74.5
Education				
Diploma 3	46	48.9	38	40.4
Bachelor	3	3.2	0	0
Ners	40	42.6	54	57.4
Master	5	5.3	2	2.1
Nurse Position				
Staff Nurse	64	68.1	76	80.9
Team Leader/PN	23	24.5	9	9.6
CCM	5	5.3	1	1.1
Ward Head	1	1.1	8	8.5
Nursing Manager	1	1.1	0	0
Computer Skills				
Poor	2	2.1	5	5.3
Good	92	97.9	89	94.7

Table 1 shows that most nurses in Hospitals A (78.7%) and B (74.5%) were female. In Hospital A, most nurses held a Diploma 3 degree (48.9%), while the rest held Bachelor's and Master's degrees. In Hospital B, most nurses held a Ners (professional nurse) degree (57.4%), with the remainder holding Diploma 3 and Master's degrees. The majority of participants at Hospitals A (68.1%) and B (80.9%) were staff nurses. The remainder were team leaders, primary nurses (PN), clinical care managers (CCM), a ward head, and a nursing manager. The majority of nurses were computer literate, with 97.9% at Hospital A and 94.7% at Hospital B.

Table 2. Characteristics of Nurses by Age and Length of Service.

Variables	Hospital A (n=94)		Hospital B (n=94)	
	Median	Min-Max	Median	Min-Max
Age	34	24-51	37	24-56
Length of service	9.5	2-29	12	2-14

Table 2 shows that the median age of nurses at Hospital A was 34 years (range 24-51 years), whereas at Hospital B, it was 37 years (range 24-56 years). The median length of service at Hospital A was 9.5 years, with a range of 2-29 years, while at Hospital B, the median length of service was 12 years, with a range of 2-14 years.

Table 3. Distribution of medication record effectiveness based on system quality, system facilities, system benefits, and total effectiveness.

Variables	Hospital A (n=94)		Hospital B (n=94)	
	Median	Min-Max	Median	Min-Max
System Quality				
Availability	12	10-16	11	8-15
Convenience	12	10-16	11	8-16
Completeness	12	8-15	10	7-16
Accuracy	12	10-16	11	8-15
Timeliness	9	8-12	7	5-10
Legality	12	9-14	9	7-13
System Facilities				
Nursing Process	12	9-16	11	9-13
EWS	12	10-16	9	7-10
Technological Competence	9	7-12	9	5-12
Error Reporting	9	6-12	7	5-10
System Benefits				
DSS	12	8-16	10	6-14
Manager Role	13	10-16	9	7-12
Satisfaction	21	17-25	18	15-24
Total effectiveness	187.5	157-241	156	129-191

Table 3 shows that, based on descriptive analysis, the effectiveness of electronic medical records, measured in terms of quality, facilities, and system benefits, was higher at Hospital A than at Hospital B, with the exception of the technological competence sub-variable. The total system effectiveness score also shows that the implementation of the electronic medical record system at Hospital A was better, with a median score of 187.5, compared to Hospital B, with a median score of 156.

Table 4. Comparison of the effectiveness of electronic medical record implementation at Hospitals A and B (n=188).

Variables	Median	MRank	p-value
Quality			
Hospital A	66	139.59	0.001*
Hospital B	59.5	49.41	
Facilities			
Hospital A	68.5	140.88	0.028*
Hospital B	59	48.12	
Function			
Hospital A	22.5	132.92	0.017*
Hospital B	20	56.08	
Satisfaction			
Hospital A	21	136.01	0.003*
Hospital B	7	52.99	

Variables	Median	MRank	p-value
Total Effectiveness			
Hospital A	177.5	141.49	0.014*
Hospital B	156	47.51	

**Mann-Whitney U test*

The analysis results in Table 4 show significant differences in the sub-variables of quality (p=0.001), facilities (p=0.028), function (p=0.017), satisfaction (p=0.003), and total effectiveness (p=0.014) between Hospitals A and B. In general, there is a difference in the effectiveness of electronic medical record implementation between Hospitals A and B (p-value < 0,05).

Effectiveness of electronic medical record implementation.

The results show a significant difference in the effectiveness of medical record system implementation between hospitals that have implemented electronic medical records and those that have not. These results are in line with previous studies, which found that implementing an information technology (IT)-based medication system significantly improves effectiveness, quality, productivity, facilities, usefulness, convenience, accuracy, and timeliness (De Benedictis et al., 2020; Gopidasan et al., 2022b; Salleh et al., 2021). These findings are also consistent with the theoretical concept that the implementation of a good information system should be relevant and related to the problem at hand, have good accuracy, and be available promptly to support decision-making (Baker El-Ebiary et al., 2020; Hamdat et al., 2024; Torab-Miandoab et al., 2023). Based on descriptive data, the effectiveness of electronic medical records implementation is influenced by nurses' computer skills. Conversely, length of service and age have no impact. Nurses find electronic medical records helpful in providing patient care. The implementation of electronic medical records has proven to be more effective in addressing the challenge of providing medical records that support professional healthcare services to the public.

Quality of electronic medical records.

The results show a significant difference in the quality of medical record systems between hospitals that implement electronic medical records and those that do not. The system quality and information quality significantly influence the use of hospital information systems. These results are consistent with previous studies that found a significant relationship between system quality and the effectiveness of electronic medical record implementation (Derecho et al., 2024; Sugiarti et al., 2020; Suwarti et al., 2025).

The implementation of electronic medical records provides a system that is readily accessible to nurses with appropriate access rights. Electronic medical records also facilitate nurses’ patient care. The system includes operating instructions and has been integrated with the hospital information system. The data generated by electronic medical records is accurate and accountable. Data in electronic medical records is real-time and can be accessed immediately when needed.

The analysis showed that the quality of the IT system, including availability, ease of use, completeness, accuracy, timeliness, and legality, has improved in hospitals that have implemented electronic medical records. The availability and user-friendliness of the system can reduce nurses’ workload, enabling greater focus on patients care. The completeness, timeliness, and accuracy of data in the technology-based medication system can provide real-time information to nursing managers for decision-making. The

legality of the information system ensures that patients and nurses feel safe and comfortable in carrying out their roles as providers.

Benefits of electronic medical records.

The results are consistent with previous studies, which found that decision support systems (DSS) significantly impact the effectiveness of health IT system implementation (Khalifa, 2024; Pierce et al., 2025). The electronic medical records provide information that can support decision-making. The information contained in electronic medical records is highly accurate and available in real time, providing a reliable basis for managerial decision-making and policy development. Information management competency is crucial for the decision-making process in nursing management. The information generated by electronic medical records is accurate, relevant, accountable, and timely. These results are consistent with (Manoppo et al., 2021), who found that the role of nursing managers significantly affects the effectiveness of IT system implementation.

The role of nursing managers in IT begins with introducing IT systems to enhance service performance. Nursing managers facilitate the implementation and improvement of these systems by engaging all user groups. Throughout the IT implementation process, managers act as change agents, addressing and overcoming resistance to adoption. Understanding the dynamics of the change process is crucial for the successful adoption and sustainability of these systems. The successful implementation and sustainability of information systems requires managers with leadership qualities, vision, and commitment (Arabi et al., 2022; Hawash et al., 2020; Hawash et al., 2024).

Satisfaction with Electronic Medical Records.

These findings show a significant relationship between nurse satisfaction and the effectiveness of electronic medical record implementation. The results are consistent with previous studies that found a relationship between satisfaction levels and the effectiveness of electronic medical records (Jaber et al., 2021; Khairat et al., 2020; Ramoo et al., 2023).

As the primary users of EMRs, nurses play a central role in the success of digital health systems. Their satisfaction and acceptance of technology are essential for facilitating the introduction, adoption, and sustained use of EMRs within healthcare organizations. High levels of satisfaction encourage greater system utilization and contribute to improved clinical workflows and service delivery outcomes.

Previous studies have demonstrated that nurse satisfaction with IT-based healthcare systems contributes to enhanced patient safety, streamlined work processes, improved quality of care, and more comprehensive documentation. Therefore, healthcare organizations should prioritize user-centered system design, continuous technical support, and ongoing training programs to improve user satisfaction and maximize the benefits of EMR implementation.

Several limitations should be considered when interpreting the findings of this study. First, the study was conducted in only two hospitals, which may limit the generalizability of the findings to other healthcare settings. Second, the sample size was relatively limited and participants were selected using a non-random sampling technique, potentially introducing selection bias. Third, the analysis was restricted to bivariate statistical testing and did not control for potential confounding variables that may influence EMR effectiveness. Finally, the data were not normally distributed, limiting the use of more advanced parametric analytical approaches. Future studies should involve a larger number of hospitals, employ probability sampling methods, and utilize multivariate

analyses to provide a more comprehensive understanding of the factors influencing EMR implementation effectiveness.

4. CONCLUSION

In conclusion, there are significant differences in the effectiveness of medical record systems between hospitals that have implemented electronic medical records and those that do not in East Kalimantan hospitals. These differences include system quality (availability, convenience, completeness, accuracy, timeliness, legality), facilities (nursing process, early warning system, technological competence, error reporting), benefits (managers' role, decision support system), and user satisfaction.

The implementation of electronic medical records in nursing is highly recommended to improve the quality of nursing care in hospitals. To improve the effectiveness of electronic medical record implementation, it is necessary to enhance nurses' skills in using the system. This can be achieved through both formal and informal education, including training in electronic medical record processes and computer literacy. The implementation of electronic medical records also requires strong management support to ensure the adequate provision of facilities and infrastructure. The management should ensure that the adoption process of electronic medical records among nurses runs smoothly. The continuous evaluation of electronic medical record implementation is necessary. The development of IT-based medical records can be adapted to regional conditions, as well as prioritise local elements and Indonesia's health culture.

The implementation of electronic medical records is highly recommended as an effort to improve the quality of service in hospitals. In implementing electronic medical records, hospital management must consider the quality of the system developed, such as availability, ease of use, completeness, accuracy, timeliness, and legality. The electronic medical record system must also include nursing processes, early warning systems, DSS, and user satisfaction. Nurses as users must be prepared for the adoption process of the electronic medical record system. Preparation can be done by providing training on how to use electronic medical records. The implementation of electronic medical records must be evaluated continuously and sustainably to ensure its implementation is appropriate. Recommendations for further research are the need for research and development of a comprehensive medical record system nationally.

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