Jurnal Konseling dan Pendidikan
Volume 13, Number 3 2025

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Publication details, including author guidelines
URL: https://jurnal.konselingindonesia.com/index.php/jkp/about/submissions#authorGuidelines
Editor: Nilma Zola

Article History
Received: 11 Jul 2025
Revised: 27 Oct 2025
Accepted: 30 Oct 2025

How to cite this article (APA)
Windari, A., Retnowati, R., Subinarto, S., & Sugiarto, P. (2025). Mixed-methods assessment of electronic medical record implementation and its effects on medical record work units in hospital. Jurnal Konseling dan Pendidikan. 13(3), 207-216. https://doi.org/10.29210/1164600

The readers can link to article via https://doi.org/10.29210/1164600

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Jurnal Konseling dan Pendidikan
ISSN 2337-6740 (Print) | ISSN 2337-6880 (Electronic)

ISSN 2733-6740 (Print)
ISSN 2733-6880 (Electronic)

Jurnal Konseling dan

Volume 13 Number 3 (2025)
https://doi.org/10.29210/1164600

Article

Mixed-methods assessment of electronic medical record implementation and its effects on medical record work units in hospital

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Keywords:

Electronic medical records
Health information systems
Technology acceptance model
User satisfaction
Mixed-methods research

ABSTRACT

The Regulation of the Minister of Health Number 24 of 2022 mandates that all healthcare facilities in Indonesia implement Electronic Medical Records (EMR) to improve the quality and efficiency of health services. In response to this policy, this study utilized a cross-sectional mixed-methods approach to evaluate the implementation of EMR and its impact on medical record work units in a regional hospital. A total of 26 EMR users, consisting of medical record officers and relevant health workers, were selected through total sampling to provide both quantitative and qualitative data. The evaluation framework integrates the End User Computing Satisfaction (EUCS) and Technology Acceptance Model (TAM) to assess system quality, information quality, user satisfaction, and intention to continue using EMR. Quantitative findings demonstrate that information quality and system quality have strong and statistically significant relationships with intention to use EMR ($p = 0.001$), explaining 66.3% and 52.8% of the variance, respectively. Meanwhile, thematic analysis of qualitative data reveals that EMR enhances workflow efficiency, accelerates information retrieval, and strengthens service coordination across hospital units. However, challenges such as occasional system downtime, limited digital literacy among some users, and incomplete menu features still hinder optimal utilization. The integrated interpretation indicates that sustained user acceptance relies on the alignment between perceived usefulness and reliable system performance. This study underscores the need for continuous system refinement, structured and ongoing training, and adequate resource support to ensure EMR implementation contributes effectively to hospital service quality and digital health transformation in Indonesia.

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Introduction

The development of information technology has had a significant impact on various sectors of life, including the field of health services. The digitalization of health services not only includes registration and payment systems but also extends to patient data and information management systems through Electronic Medical Records (EMR). The development of information technology has brought significant changes in the health sector, especially in the management of medical records in healthcare facilities. One of the main innovations that has emerged is the implementation of Electronic Medical Records (EMR), which is designed to improve the quality of service, work

efficiency, data accuracy, and ease of access to patient information (Andika et al., 2025). Electronic medical records are increasingly being used across medical facilities in many countries (Rotmensch et al., 2017). One step that has the potential to accelerate change in the health sector, especially in terms of the development and integration of health data systems, is the implementation of electronic medical records (EMR) (Kassiuw, 2024). The use of EMR not only makes patient medical information more readable and available from almost any location in the world, but also changes the format of health records, and thus changes health care (Evans, 2016).

EMR is a computer-based patient health information management system, allowing for fast and accurate storage, access, and exchange of medical data. Electronic medical records are very important but sensitive personal information. This data is needed by healthcare providers, insurance companies, pharmacies, researchers, patient families, and others to check the patient's health regularly (Dubovitskaya et al., 2017). The presence of this system is a solution to various limitations in manual medical record systems, such as the risk of losing documents, limited storage space, and slow access to medical information. Electronic medical records are medical records created with technology and managed by electronic systems. Electronic systems are electronic-based systems that can be used to collect, monitor, store, and disseminate electronic-based information (Ikawati et al., 2025). Electronic medical records can complement various medical records that are synchronized with the medical information that patients collect each time they visit (Harahap et al., 2024). Data from electronic medical records should be directly usable in services, both when patients are being treated and when analyzing data from many patients. This will greatly assist in the development of more precise and personalized treatments (Halpern et al., 2016; Nguyen et al., 2017). EMR are well known to improve the standards of patient care in different sectors (Choubey et al., 2016).

The Indonesian government, through the Ministry of Health of the Republic of Indonesia, has responded to this need by issuing the Regulation of the Minister of Health (Permenkes) Number 24 of 2022 concerning Medical Records (Kemenkes, 2022). n this regulation, all health care facilities are required to implement EMR in stages. This is in line with efforts to realize the integration of an effective and efficient national health care system, as well as support digital transformation in the health sector. Permenkes also emphasizes the importance of data interoperability between systems and patient information security as key aspects in the development of EMR. The implementation of EMR brings various benefits, such as increasing work efficiency, accelerating clinical decision-making, and improving patient safety. The implementation of EMR is expected to reduce medical errors, increase efficiency and cost-effectiveness, and support the decision-making process, which will ultimately improve the quality of health services (Siswati et al., 2025). With the help of electronic health records, people can improve patient care, implement performance standards in clinical practice, and encourage clinical research (Cowie et al., 2017). Electronic medical records are very useful for obtaining information about patients' medical history, diagnosis, and medical procedures performed (Susanto et al., 2024).

However, the implementation of EMR in the field often faces a number of challenges, including infrastructure readiness, limited human resources, user adaptation to new systems, and obstacles in data integration between service units. Currently, there are still obstacles that hinder the EMR service process, both from human and system components (Siswati et al., 2025). Several health workers complained about the use of EMR because of their unpreparedness to adapt to technological developments (Resty & Hariyati, 2024). EMR is able to store a lot of important information related to patient data. However, its use for advanced analysis still faces technical and non-technical obstacles (Xiao et al., 2018). Inadequate training, limited access to computers, low digital literacy, and inadequate technical support are other obstacles that are often found. Conversely, organizational readiness, management support, structured training, and the availability of adequate technological infrastructure are all factors that greatly influence the success of EMR implementation (Farid & Maharani, 2025). Therefore, evaluation of the implementation of EMR is important to determine the extent to which this system has been successful and its impact on the performance of related work units, especially the medical records unit, which is at the forefront of patient data management.

Evaluation of the implementation of information systems such as EMR not only focuses on the availability of technology but must also consider aspects of human resources, work processes, and the results achieved. To solve various problems that arise from the implementation of EMR, a system evaluation is needed to evaluate health care facilities that have implemented it (Silva & Dewi, 2023). The evaluation process for the implementation of EMR is carried out to be able to determine the "road map" and provide an overview of the sustainability of the use of electronic health records (Faida & Ali, 2021). The medical records work unit has a crucial role in ensuring the accuracy, confidentiality, and availability of patient data. Therefore, understanding changes in workflow, adaptation challenges, and the benefits felt after the implementation of EMR is important information in efforts to improve the quality of hospital services as a whole

RS PKU Muhammadiyah Gamping, as one of the private hospitals in Yogyakarta, has adopted an Electronic Medical Records (EMR) system in compliance with the Regulation of the Minister of Health Number 24 of 2022. As part of its vision as an excellent Islamic hospital, digital transformation in service delivery becomes a strategic priority. However, despite several EMR implementations reported in Indonesia, existing studies predominantly focus on system usability from general health workers or evaluate system readiness rather than measuring the integration between user satisfaction, acceptance, and the implications for medical record operations. Research that simultaneously assesses EMR implementation effectiveness using a standardized evaluation model while analyzing the practical impact on medical record work units remains limited. Previous evaluations often rely solely on quantitative outcomes, making it difficult to capture workflow challenges, administrative burden shifts, and contextual barriers experienced by medical record personnel.

Therefore, there is a clear need for a comprehensive examination integrating both measurable system outcomes and user experiences. This study addresses that gap by applying a cross-sectional mixed-methods design based on the End User Computing Satisfaction (EUCS) model and Technology Acceptance Model (TAM). The evaluation focuses not only on perceived usefulness and system quality but also on operational consequences in medical record departments–an area rarely highlighted in prior research. The novelty of this study lies in its convergent approach that enriches statistical findings with qualitative evidence, enabling more accurate recommendations for strengthening EMR sustainability. The results are expected to guide hospital policy improvement and provide references for similar institutions in enhancing digital health transformation effectively and efficiently.

Methods

This study employed a convergent mixed-methods design, as quantitative data alone could not fully describe user acceptance of the EMR system, while qualitative data were required to understand the contextual barriers and experiences influencing implementation outcomes. Both datasets were collected in a single phase and later integrated to produce triangulated interpretations. The study was conducted with EMR users in the medical record work unit at RS PKU Muhammadiyah Gamping, Yogyakarta. Using total sampling, a total of 26 participants were recruited who met the inclusion criteria, namely active EMR users with a minimum of six months of work experience and willingness to participate. Individuals on long leave were excluded. All 26 respondents completed quantitative questionnaires, and purposive sampling was applied within the same pool to select interview participants with diverse levels of satisfaction and intention scores, ensuring variation in perspectives.

Quantitative data were obtained using a structured questionnaire adapted from the End User Computing Satisfaction (EUCS) model to assess information and system quality, as well as from the Technology Acceptance Model (TAM) to measure perceived usefulness, perceived ease of use, attitude, and intention to use EMR. EUCS method is used to measure the level of satisfaction of users of an application system by comparing expectations and reality from EMR development. Evaluation using this model emphasizes more on end user satisfaction with technological aspects based on

information quality, including content, accuracy, format, timeliness, and system quality, including training, ease of use, documentation, interface, and system speed (Aggelidis & Chatzoglou, 2012). the impact of EMR on users is measured through three main dimensions, namely the dimensions of staff, data and information, patient care, and economic impact (Tsai et al., 2020).

The instrument underwent translation and back-translation, expert validation, pilot testing, and reliability analysis where Cronbach s alpha for each construct exceeded 0.70. Quantitative analysis included descriptive statistics, Pearson correlation, and regression modelling with tests of normality and multicollinearity conducted to meet statistical assumptions. Meanwhile, qualitative data were collected through semi-structured interviews to explore workflow changes, digital literacy constraints, and perceived impacts on efficiency and service coordination. All interviews were audio-recorded, transcribed verbatim, and analyzed using thematic analysis. Credibility was enhanced through double-coding, peer debriefing, and member checking.

Data integration was performed at the interpretation stage through a joint display matrix comparing key statistical results with qualitative themes and generating meta-inferences. In cases of convergence or divergence, additional transcript checks and outlier analysis were conducted to maintain analytical rigor. To ensure research quality across methodologies, this study applied multiple validity strategies: construct and reliability testing for quantitative data, and triangulation, audit trails, and thick description for qualitative data. Ethical approval was obtained from the institutional review board, and all participants signed written informed consent. Data confidentiality was safeguarded through anonymization and secure storage, with no incentives provided during participation.

Results and Discussion

Result

The study discusses the implementation of the Electronic Medical Record (EMR) system and its impact on the medical record work unit in health care facilities, especially at PKU Muhammadiyah Hospital, Yogyakarta. The findings of this study were analyzed to describe the extent to which the EMR system has been implemented in accordance with the established standards and how these changes affect operational aspects, work efficiency, and service quality in the medical record unit. The research data were obtained from medical personnel working at PKU Muhammadiyah Hospital, Yogyakarta. The sample distribution is presented in Table 1.

Table 1. Distribution of Research Respondents

Demographics	Quantity	Percentage (%)
Gender		
Male	8	30.8
Female	18	69.2
Age Group		
< 30 years	15	57.7
> 30 years	11	42.3
Position		
Executive	25	96.2
Supervisor	1	3.8
Education		
High School	1	3.8
D3	24	92.4
D4/S1	1	3.8
Work Period		
< 6 years	12	46,2
> 6 years	14	53,8

Based on the analysis results of Table 1, most respondents were female (69.2%), aged <30 years (57.7%), in executive positions (96.2%), with D3 education (92.4%), and with work periods > 6 years (53.8%). Furthermore, an analysis was carried out on the dimensions of the quality of information provided on the RME. The results are shown in the following Table 2.

Table 2. Distribution of Information Quality Dimensions

Aspect	STS	TS	S	SS
RME provides accurate information and is following the needs of officers (content)	0 (0%)	0 (0%)	11 (42.3%)	15 (57.7%)
The information produced by RME is very accurate (accuracy)	0 (0%)	0 (0%)	18 (69.2%)	8 (30.8%)
The RME interface is easy to understand so that officers can do their work faster (format)	0 (0%)	0 (0%)	12 (46.2%)	14 (53.8%)
RME provides current/real-time information (timeliness)	0 (0%)	0 (0%)	12 (46.2%)	14 (53.8%)

*STS: Strongly Disagree; TS: Disagree; S: Agree; SS: Strongly Agree

The results of the analysis related to the quality of RME information showed that all respondents answered "agree" and "strongly agree" on aspects in the information quality dimension. This means that all respondents are satisfied with the aspects of content, accuracy, format, and timeliness of the quality of information on the RME that is currently running. The third analysis is related to the quality of the RME system.

Table 3. Distribution of System Quality Dimensions

Aspect	STS	TS	S	SS
Training is provided before and during the use of RME (training)	0 (0%)	0 (0%)	19 (73.1%)	7 (26.9%)
Officers find it easy to use RME (ease of use)	0 (0%)	0 (0%)	14 (53.8%)	12 (46.2%)
There is a written/electronic explanation of the RME function and how to use it (documentation)	0 (0%)	2 (7.7%)	17 (65.4%)	7 (26.9%)
The RME interface makes it easy to import, process and export data/information (interface)	0 (0%)	0 (0%)	16 (61.5%)	10 (38.5%)
The speed of RME is good, from the start of the activity until the results are displayed on the layer (system speed)	0 (0%)	0 (0%)	21 (80.8%)	5 (19.2%)

*STS: Strongly Disagree; TS: Disagree; S: Agree; SS: Strongly Agree

The results of the analysis showed that all respondents answered Agree and Strongly Agree on the aspects of training, ease of use, interface, and system speed, meaning that respondents felt satisfied with the four aspects. However, on the documentation aspect, there were 2 respondents (7.7%) who answered Disagree, meaning that there is still dissatisfaction with the documentation aspect of the current RME.

The results of the analysis showed that all respondents answered Agree and Strongly Agree on the aspects of perceived ease of use, intention to use, attitude toward using, and actual system use, meaning that respondents felt satisfied with the four aspects. However, on the aspect of perceived usefulness and attitude, there was 1 respondent (3.8%) who answered "strongly disagree," and there was 1 respondent (3.8%) who answered "disagree," meaning that there was still dissatisfaction from the aspect of perceived usefulness and attitude towards the current RME. Furthermore, a data normality test was carried out. The results of the data normality test using histogram graphs and normality curves showed that the variables of information quality, system quality, and intention to

use RME had a curve resembling a bell shape, meaning that the three variables were normally distributed.

Table 4. Distribution of RME Usage Intention Dimensions

Aspects	STS	TS	S	SS
The use of RME makes me fast in doing my job (Perceived Usefulness and Attitude)	1 (3.8%)	0 (0%)	10 (38.5%)	15 (57.7%)
The use of RME improves performance (Perceived Usefulness and Attitude)	0 (0%)	1 (3.8%)	13 (50%)	12 (46.2%)
The way to use RME is easy to learn and use (perceive ease of use)	0 (0%)	0 (0%)	16 (61.5%)	10 (38.5%)
Will continue to use RME to support future work (Intention to use)	0 (0%)	0 (0%)	13 (50%)	13 (50%)
Will motivate other users who do not want to use RME (Intention to use)	0 (0%)	0 (0%)	17 (65.4%)	9 (34.6%)
Do not mind using RME in daily work (attitude toward using)	0 (0%)	0 (0%)	13 (50%)	13 (50%)
Often use RME to complete work (Actual system use)	0 (0%)	0 (0%)	11 (42.3%)	15 (57.7%)

*STS: Strongly Disagree; TS: Disagree; S: Agree; SS: Strongly Agree

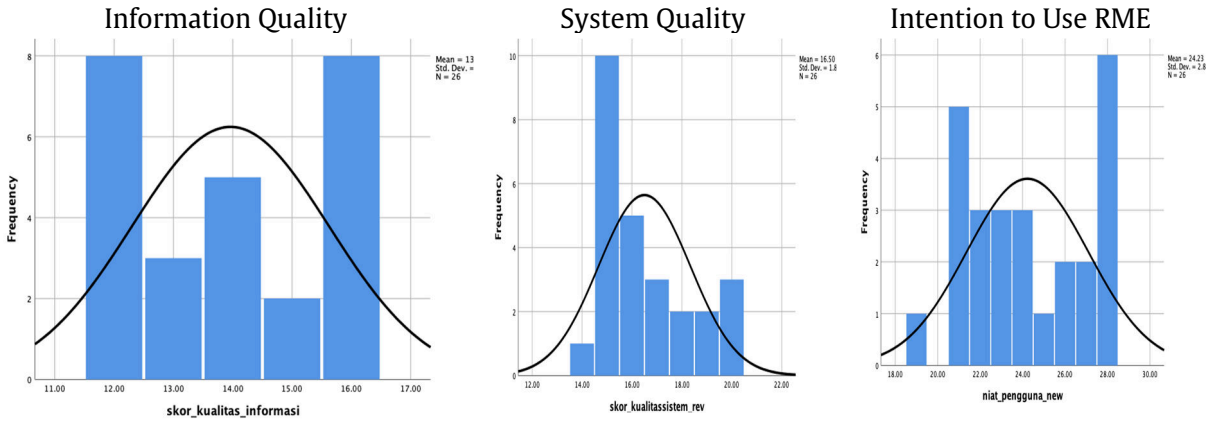

Figure 1 Data Normality Test

To determine the factors that influence the intention to use the Electronic Medical Record (EMR) system, correlation and regression analyses were conducted on two main dimensions, namely information quality and system quality. These two dimensions were chosen because they are important components in the successful implementation of a health information system. Information quality refers to the extent to which the data presented by the system is reliable, accurate, and relevant to users, while system quality reflects the stability, speed, and ease of use of the system technically. The results of this analysis aim to identify the strength of the relationship between each of these dimensions and the intention to use EMR by health workers in the relevant work unit. A summary of the results of the analysis is presented in Table 6.

The relationship between information quality and intention to use RME shows a very strong relationship (r = 0.815) and has a positive pattern, meaning that the better the quality of the information, the greater the intention to use RME by officers. From the results of the analysis, the coefficient of determination (R2) = 0.663 means that the quality of information can explain 66.3% of the variation in intention to use RME. The results of the statistical test showed that there was a significant relationship between information quality and intention to use RME (p = 0.001). The relationship between system quality and intention to use RME shows a very strong relationship (r =

0.727) and has a positive pattern, meaning that the better the quality of the system, the greater the intention to use RME by officers.

Table 6. Relationship between Information Quality and System Quality to Intention to Use EMR

Dimension	r	R^2	Line Equation	P. Value
Information Quality	0.815	0.663	RME usage intention = 4.546 + 1.410 * information quality	0.001
System Quality	0.727	0.528	RME usage intention = 5.485 + 1.136 * system quality	0.001

From the results of the analysis, the coefficient of determination (R^2) = 0.528 means that the quality of the system can explain 52.8% of the variation in intention to use RME. The results of the statistical test showed that there was a significant relationship between system quality and intention to use RME (p = 0.001).

Table 7. Distribution of Impact of RME Implementation

Aspek	STS	TS	S	SS
Impact on staff				
1. Increased efficiency	0 (0%)	0 (0%)	13 (50%)	13 (50%)
2. Improved communication	0 (0%)	0 (0%)	16	10
3. Reduced workload	0 (0%)	3	(61.5%)	(38.5%)
4. Clarified workflow	0 (0%)	(11.5%)	16	7 (27%)
5. Supported disease management and quality	0 (0%)	0 (0%)	(61.5%)	7 (26.9%)
management	0 (0%)	0 (0%)	19	6 (23.1%)
6. Supported learning and decision-making		0 (0%)	(73.1%)	8 (30.8%)
			20	
			(76.9%)	
			18	
			(69.2%)	
Impact on Data and Information				
1. Ease of access to data and information	0 (0%)	0 (0%)	15	11
2. Improved data quality and accuracy	0 (0%)	0 (0%)	(57.7%)	(42.3%)
3. Data storage and backup reduce data loss	0 (0%)	0 (0%)	15	11
			(57.7%)	(42.3%)
			11	15
			(42.3%)	(57.7%)
Impact on Patient Care				
1. Improved quality of care	0 (0%)	0 (0%)	15	11
2. Reduced patient waiting time	0 (0%)	1 (3.8%)	(57.7%)	(42.3%)
			13 (50%)	12 (46.2)
Economic Impact				
1. Increased productivity	0 (0%)	0 (0%)	12	14
2. Reduced costs	0 (0%)	1 (3.8%)	(46.2%)	(53.8%)
3. Increased revenue and reimbursement	0 (0%)	2 (7.7%)	10	15
			(38.5%)	(57.7%)
			18	6 (23.1%)
			(69.2%)	

The results of the analysis of the impact on staff, respondents agreed that after the implementation of RME, it had an impact on increasing efficiency, increasing communication, reducing workload, clarifying workflow, supporting disease management and monitoring staff performance according to standards and guidelines, and providing learning support and assisting in decision making. However, there were 3 respondents (11.5%) who answered that they did not agree that the implementation of RME had an impact on reducing workload. The results of the analysis of the impact on data and

information: all respondents agreed that after the implementation of RME, it had an impact on ease of access to data and information, increasing data quality and accuracy, and reducing the possibility of data being lost. The results of the analysis of the impact on health services, all respondents agreed that after the implementation of RME, it had an impact on improving the quality of service and reducing patient waiting time. The results of the analysis of the economic impact: respondents agreed that after the implementation of RME, it had an impact on increasing productivity, reducing costs, and increasing income and reimbursement (Howley et al, 2015). However, 2 respondents (7.7%) answered that they did not agree that the implementation of RME had an impact on increasing income and reimbursement.

Discussion

Based on the results of the study on the implementation and its impact on the intention to use Electronic Medical Records (EMR) at PKU Muhammadiyah Hospital Yogyakarta, it was found that the quality of information and system quality have a significant role in shaping user intentions to continue using EMR. Most respondents showed a high level of satisfaction with the quality of information provided by the system, including content, accuracy, format, and timeliness. For example, in terms of content, 57.7% of users stated that they strongly agreed that EMR had provided accurate and complete medical information. This is in line with the provisions of the Minister of Health Regulation No. 24 of 2022 which emphasizes the importance of recording complete and comprehensive medical records. In addition, 69.2% of users agreed that the system was able to minimize errors through the presentation of accurate information. In terms of the format of information presentation, more than half of users felt that the data display was clear and easy to understand, in accordance with the Ministry of Health's reporting standards. The information displayed was also considered timely by 53.8% of respondents, supporting the need for efficient clinical decision-making.

The linear regression analysis presented in Table 6 shows that information quality has a very strong relationship with the intention to use EMR, with a correlation coefficient (r) of 0.815 and a contribution of independent variables (R^2) of 66.3%. This means that information quality is able to explain more than half of the variation in the intention to use EMR by health workers. The quality of the system also shows a strong positive relationship, with r = 0.727 and R^2 = 52.8%. Thus, the better the quality of information and systems received by users, the greater their tendency to continue using EMR in their daily activities. In terms of system quality, users expressed satisfaction with aspects of training, ease of use, interface, and speed of data access, which also influenced the intention to use RME. However, it was found that 7.7% of respondents were dissatisfied with the system documentation aspect. Documentation is an important part of the system because it acts as a guide in using RME features. To support the adaptation process to this new digital system, functional documentation is needed that is easily accessible and understood by users.

The implementation of EMR also shows a real impact in increasing staff work efficiency, access to data and information, patient services, and economic aspects. EMR implementation was also found to improve efficiency, service quality, and economic performance. Digital data storage increased accessibility and reduced risk of data loss, while automatic backups strengthened security, consistent with findings by Farid & Maharani (2025). Most respondents stated that the use of EMR can improve work efficiency by reducing patient data search time and simplifying workflows. In terms of data and information, all respondents agreed that EMR makes it easier to access data, increases accuracy, and reduces the risk of data loss. Digital data storage carried out through a server with automatic backup is believed to be able to guarantee the security and sustainability of information while saving physical space. A positive impact was also felt in patient services, where all respondents stated that there was an increase in service quality and a reduction in waiting time. This is in line with previous studies showing that the use of the EMR system can accelerate the health service process.

terms of the economy, most respondents felt that RME contributed to increased productivity and cost efficiency. The implementation of RME can reduce operational costs and potentially increase the income of health care facilities, especially hospitals (Parwata et al., 2025). This system is considered

to be able to increase income and accelerate the reimbursement process, although 7.7% of respondents have not felt this impact directly. Overall, this study not only validates previous research but also strengthens theoretical understanding by clarifying how information and system quality affect behavioral intention through improved usefulness, usability, and satisfaction. These mechanisms ensure that EMR contributes positively to both individual performance and hospital service quality, providing a strong rationale for continued system refinement and broader digital transformation in healthcare organizations.

Conclusion

Medical record officers expressed overall satisfaction with the EMR system currently implemented at PKU Muhammadiyah Gamping Hospital, Yogyakarta. Quantitative analysis demonstrated a strong relationship between system quality and information quality with officers intention to use EMR. Information quality accounted for 66.3% of the variation in EMR usage intention, while system quality accounted for 52.8%. These findings reaffirm that better structured, accurate, and accessible information as well as reliable system functionality influences the willingness of staff to adopt digital medical records. From a qualitative perspective, EMR implementation has brought positive impacts on the medical record work unit, including improved work efficiency and communication, reduced administrative burden, more structured workflows, enhanced clinical decision-making, better disease management support, compliance with standards, reduced patient waiting times, and secure data accessibility that supports cost-effectiveness.

However, this study has several limitations that should be acknowledged. First, the sample size was relatively small and limited to a single hospital setting, thus reducing generalizability to broader healthcare contexts. Second, the cross-sectional design restricts the ability to capture changes in user perception over time. Third, the possibility of response bias exists, especially related to self-reported satisfaction and performance improvements. To mitigate these concerns, this study utilized instrument validation procedures and data triangulation from both quantitative and qualitative sources. Future studies are recommended to involve multiple hospitals with larger samples and adopt longitudinal or experimental designs to better assess causal effects and long-term sustainability of EMR adoption. Such methodological advancement can strengthen evidence-based decision-making in digital health transformation and guide hospitals in optimizing EMR implementation effectively and adaptively.

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