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The Effect of Utilizing Electronic Medical Record Data on Improving Patient Care Quality at Hospital X

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Abstract: The utilization of Electronic Medical Records (EMR) plays a central role in the digital transformation of healthcare services by improving efficiency, documentation accuracy, and evidence-based clinical decision-making. Although national policies such as the Indonesian Ministry of Health Regulation No. 24/2022 and the SATUSEHAT interoperability platform have accelerated EMR adoption, challenges remain, including limited infrastructure, workflow resistance, and uneven digital literacy among healthcare workers. This study aims to analyze differences in service quality indicators before and after EMR implementation at Hospital X, including registration waiting time, pharmacy waiting time, medication errors, SOAP completeness, and CDSS adoption. Using a quantitative pre–post comparison design and Mann-Whitney analysis, results show significant improvements across all indicators ($p < 0.001$). Registration and pharmacy waiting times decreased, medication errors declined, while SOAP completeness and CDSS usage increased markedly. All variables demonstrated large effect sizes ($r = 0.587$–0.924), indicating strong practical impacts of EMR implementation. These findings confirm that EMR contributes significantly to enhancing service efficiency, patient safety, and clinical documentation quality, providing valuable empirical evidence for strengthening digital health strategies in hospital settings.

Keyword: Utilization of Electronic Medical Record Data, Service Quality, Digitalization of Health Services, Clinical Decision Support System.

INTRODUCTION

Digital transformation in global healthcare systems is rapidly evolving in line with the increasing need for efficiency, documentation accuracy, and data integration between service units. The implementation of Electronic Medical Records (EMR) has become one of the key elements proven to improve the quality of clinical information management, accelerate real-time access to patient data, and support evidence-based decision-making processes through Clinical Decision Support Systems (CDSS) (Donnelly et al., 2023). Various studies show that the digitization of medical records has a direct impact on reducing documentation errors, increasing service continuity, and optimizing the reporting of quality indicators that were previously difficult to do through manual recording (Honavar, 2020).

In Indonesia, the need for health data integration is reinforced through national policies, including Regulation of the Minister of Health of the Republic of Indonesia Number 24 of 2022 concerning Medical Records, which requires health care facilities to adopt electronic medical record systems. This policy forms the foundation for the implementation of the SATUSEHAT platform, which targets cross-facility interoperability to create an integrated digital health ecosystem (Ministry of Health of the Republic of Indonesia, 2022). By the end of 2024, more than 90% of hospitals are reported to have connected to the platform, reflecting the accelerated adoption of EMR as part of the national healthcare transformation.

However, the implementation of RME in Indonesia still faces various strategic challenges. Limited technological infrastructure, resistance to workflow changes, uneven digital skills among health workers, and unstable connectivity are the main obstacles often reported in various studies in hospitals and community health centers (Aditya Kurniawan et al., 2025). A study by Hossain et al. 2025 found that many health facilities still rely on regulatory incentives rather than internal initiatives based on service quality needs. National data shows that around 48.9% of community health centers have not optimally adopted RME, revealing an implementation gap between basic service facilities and hospitals (Khasanah et al., 2024).

Previous studies have also highlighted that the success of RME implementation is influenced by multidimensional factors, such as organizational readiness, management support, recording culture, availability of training, and utilization of system features such as CDSS (Hossain et al., 2025; Paramesthi et al., 2024). In addition, a quantitative study by Upadhyay & Hu (2022) evaluating RME logs showed that the benefits of RME, such as reduced service waiting times, fewer medication errors, and improved documentation completeness, do not always occur automatically and often depend on the quality of system integration and the level of user adoption.

On the other hand, there is a significant gap in the literature: most studies in Indonesia still focus on user perceptions or implementation readiness assessments, rather than empirical analysis based on quality indicators before and after RME implementation. The lack of pre-post studies based on operational data limits our understanding of the real impact of RME on service quality, such as waiting times, medication errors, SOAP completeness, and real-time CDSS usage (Larasati et al., 2024).

Therefore, this study was designed to fill this gap by conducting a quantitative analysis of the impact of RME implementation on several key indicators of service quality in hospitals. This study focuses on evaluating changes in registration and pharmacy waiting times, medication error rates, SOAP documentation completeness, and CDSS utilization rates after RME implementation. The findings are expected to contribute theoretically to strengthening the literature on RME implementation in developing countries, while also providing practical recommendations for hospital management in designing more effective, sustainable, and adaptive RME development strategies tailored to organizational needs.

METHOD

Research Design and Approach

This study uses a quantitative approach with a pre-post comparison study design. This design was chosen to analyze differences in service quality indicators before and after the implementation of Electronic Medical Records at Hospital X. This approach allows researchers to evaluate the impact of EMR implementation directly using actual data from two different periods. The entire analysis process is objective because it utilizes secondary data that is automatically recorded in the system.

Operational Definition of Variables

1. Independent Variable (X)

Utilization of Electronic Medical Records (EMR) This variable describes the status of implementation and use of the EMR system in health care facilities. The variable is categorized into:

Table 1. Operational Variable X Electronic Medical Records (EMR)

Variabel	Operational Definition	Indicator	Scale	Data Source
EMR Utilization (X)	Status EMR system usage in the clinical service process, compared between the conditions before implementation (PRE) and after implementation (POST).	• PRE = period before EMR usage (semi-manual) • POST = period after EMR is actively used in all service flows	Nominal	EMR logs & EMR implementation policies

2. Dependent Variable (Y)

Service Quality Indicators

Table 2. Operational Variable Y Service Quality Indicator

Variable	Operational Definition	Measurement Method	Unit / Scale	Data Sources
1. Registration waiting time (Y1)	The time required for patients from arrival to completion of the registration process at the counter.	Average time (minutes) recorded in the queue system / RME.	Ratio (minutes)	RME logs
2. Pharmacy waiting time (Y2)	The time it takes from when the prescription is received by the pharmacy until the medication is received by the patient.	Average prescription processing time in minutes.	Ratio (minutes)	RME logs / Pharmacy system
3.Medication error rate (Y3)	Frequency and severity of medication errors based on error level classification (A-I).	Percentage of errors per 100 prescriptions / error level category.	Ratio / Nominal	Medication error reports
4. Completeness of SOAP documentation (Y4	Percentage of SOAP (Subjective, Objective, Assessment, Plan) documentation completeness recorded by healthcare personnel.	Percentage of complete SOAPs compared to all visit records.	Ratio (%)	RME documentation audit
5. CDSS adoption rate (Y5)	The level of utilization of Clinical Decision Support Systems (CDSS) in clinical decision-making.	Number of "hits per case," which is the number of CDSS alerts/recommendations opened compared to the total number of cases.	Ratio (frequency)	CDSS usage report

Research Paradigm (Inter-Variable Relationship Model)

The use of RME as an independent variable (X) affects service quality, which is measured through five dependent variables, namely registration waiting time, pharmacy waiting time, medication error rate, SOAP record completeness, and CDSS adoption rate. The change in RME usage status from PRE to POST is expected to improve effectiveness, efficiency, and patient safety.

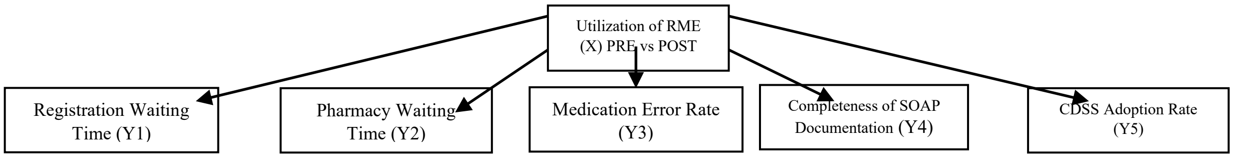

Figure 1. Research Paradigm

Research Location and Time

The research was conducted at Hospital X, a health care facility that has implemented an RME system in accordance with the provisions of Minister of Health Regulation No. 24 of 2022 concerning Medical Records. Data collection was conducted in two periods: PRE period (manual data): June 3, 2024 – December 3, 2024, and POST period (RME data): June 3, 2024 – December 3, 2024. The POST period was selected after the RME system stabilization period (at least 6 months after go-live) to ensure that the data reflected stable usage and eliminated temporary effects (Hawthorne Effect). The research stages included data extraction, cleaning, and statistical analysis using a quantitative comparative approach.

Population and Sample

The study included all patients who had complete records for the periods before (PRE) and after (POST) the implementation of RME. Sample selection was performed using total sampling, in which all patient data that met the inclusion criteria for both periods were included as part of the study sample. The total observation data analyzed in the comparative test was N (PRE) = 25 and N (POST) = 25, so that N (total) = 50. This approach ensured that all relevant operational data could be analyzed comprehensively and representatively in relation to service conditions.

Variables, Instruments, and Data Sources

The independent variable in this study is the status of RME utilization with two main categories, namely PRE and POST. The dependent variables consist of five service quality indicators: (1) registration waiting time, (2) pharmacy waiting time, (3) medication error rate based on error level, (4) completeness of SOAP documentation in percent, and (5) Clinical Decision Support System (CDSS) adoption rate measured by hits per case.

The instruments and data sources used were derived from secondary RME system data, including RME logs, medication error records, and CDSS usage reports. Data were obtained directly from the hospital information system to ensure accuracy.

Research Procedure

The research procedure began with the process of extracting data from the RME system according to the specified variables. The data obtained then went through a data cleaning stage to remove duplications, detect missing data, and ensure the validity of the records. Once the data is deemed suitable, descriptive analysis is performed to describe the distribution and characteristics of the data for each research variable. The next stage is inferential analysis to test the differences in results between the PRE and POST periods.

Data Analysis Techniques

Data analysis was performed using IBM SPSS Statistics software version 25. Normality testing was performed using Shapiro-Wilk to determine the appropriate type of comparative test. If the data were normally distributed, the analysis of differences between the PRE and

POST periods was performed using an independent t-test. However, if the data were not normally distributed, the Mann-Whitney test was used as a non-parametric alternative. In addition to comparative tests, effect size was calculated using Cohen's d to assess the magnitude of the effect of RME implementation on each service quality indicator. If the data was not normally distributed, r (based on Z-score) was used as a non-parametric effect size. All statistical tests used a significance level of $p < 0.05$ (Akbar et al., 2024).

RESULT AND DISCUSSION

The results of quantitative analysis on the impact of Electronic Medical Records on various service quality indicators, including waiting time, completeness of SOAP documentation, medication errors, and the adoption rate of Clinical Decision Support Systems (CDSS). The analysis was conducted descriptively and inferentially to compare conditions before (PRE) and after (POST) the implementation of EMR.

Before conducting an inferential analysis to see the differences between the periods before (PRE) and after (POST) the implementation of Electronic Medical Records, the descriptive statistical results of all research variables were presented. These descriptive statistics aim to provide an initial overview of the distribution of values, data trends, and basic characteristics of each service quality indicator measured. This presentation is important as a basis for understanding the data context before further testing. The descriptive statistical results are shown in Table 1.

Table 3. Descriptive Statistics of Research Variables on RME Utilization

	N	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*
Registration Waiting Time	50	10	43	27,30	9,368
Pharmacy Waiting Time	50	15	66	44,02	13,463
SOAP Completeness (%)	50	64	100	83,48	11,214
CDSS Adoption (Hit/Case)	50	0	3	1,02	1,169
Medication Error Level	50	1	3	1,50	0,678
***Valid* N**	**50**				

The descriptive analysis results show variations in values across all service quality indicators. The average registration waiting time is 27.30 minutes (SD = 9.37), while the average pharmacy waiting time is 44.02 minutes (SD = 13.46). These values indicate that the pre-RME service process still requires a relatively long time. The completeness of SOAP had a fairly high average of 83.48%, but there was still variation between 64% and 100%, indicating inconsistency in clinical recording. The average CDSS adoption score of 1.02 indicates that the use of clinical decision features is still low. Meanwhile, medication errors averaged 1.50, indicating that mild to moderate medication errors still occur. Overall, this data provides a basic picture of service quality before conducting a PRE-POST comparative analysis.

Table 4. Shapiro–Wilk Normality Test Results for the PRE and POST Groups

		Shapiro-Wilk		
	Period	***Statistic***	***df***	***Sig.***
Registration Waiting Time	PRE	0,829	25	0,001
	POST	0,930	25	0,088
Pharmacy Waiting Time	PRE	0,870	25	0,004
	POST	0,867	25	0,004

Shapiro-Wilk				
	Period	***Statistic***	***df***	***Sig.***
Medication Error Level	PRE	0,789	25	0,000
	POST	.	25	.
SOAP Completeness (%)	PRE	0,972	25	0,694
	POST	0,964	25	0,492
CDSS Adoption (Hit/Case)	PRE	.	25	.
	POST	0,809	25	0,000

The Shapiro-Wilk normality test results in Table 2 provide an overview of the data distribution patterns in the PRE and POST periods for each research variable. In general, it can be seen that most variables do not follow a normal distribution, so further analysis needs to consider the use of non-parametric statistical methods.

For the registration waiting time variable, the data in the PRE period showed a significance value below 0.05, indicating a non-normal distribution. In contrast, in the POST period, the p-value was close to the normality limit, so the distribution was relatively better. For pharmacy waiting time, both periods produced p-values < 0.05, meaning that the data were not normally distributed in either the PRE or POST periods.

The medication error variable also showed abnormality in the PRE period, while the value in the POST period did not appear due to the categorical and homogeneous nature of the data. In contrast, SOAP completeness was the only variable that showed a normal distribution in both periods, indicated by a p-value above 0.05.

Meanwhile, CDSS adoption did not have a test value in the PRE period because the data did not meet the calculation requirements, and the POST value showed abnormalities. Looking at this pattern, it can be concluded that the majority of variables were not normally distributed. Therefore, a comparative analysis between PRE and POST was appropriately conducted using the Mann-Whitney non-parametric test.

Table 5. Mann-Whitney Test Results (Ranks) on PRE and POST Comparison

Ranks				
	Periode	***N***	***Mean Rank***	***Sum of Ranks***
Registration Waiting Time	PRE	25	34,06	851,50
	POST	25	16,94	423,50
	Total	50		
Pharmacy Waiting Time	PRE	25	34,50	862,50
	POST	25	16,50	412,50
	Total	50		
Medication Error Level	PRE	25	35,50	887,50
	POST	25	15,50	387,50
	Total	50		
SOAP Completeness (%)	PRE	25	13,02	325,50
	POST	25	37,98	949,50
	Total	50		
CDSS Adoption (Hit/Case)	PRE	25	13,00	325,00
	POST	25	38,00	950,00
	Total	50		

The results of the analysis in Table 3 show clear changes between the periods before (PRE) and after (POST) the implementation of RME. The mean rank values for registration and pharmacy waiting times were higher in the PRE group, indicating that patients took longer to complete the service process during that period. Similar findings were also seen in the medication error variable, where higher scores in the PRE period indicate that more medication errors occurred before the RME system was implemented.

Conversely, the opposite pattern was seen in the SOAP completeness and CDSS adoption indicators. These two variables showed a much higher mean rank in the POST group. This means that after RME was implemented, the quality of medical record keeping, especially in the SOAP component, improved significantly. In addition, the use of the Clinical Decision Support System (CDSS) also increased, indicating that healthcare workers were increasingly utilizing the system's features to support clinical decision-making.

Overall, this mean rank pattern provides a consistent picture that the implementation of RME has contributed positively to improving service quality, both through process efficiency, reduction of errors, and improvement in documentation quality.

Table 6. Mann-Whitney Test Results for Comparison of PRE and POST Service Quality Indicators

Test Statistics[a]

	Registration Waiting Time	Pharmacy Waiting	*Medication Error Level*	SOAP Completeness (%)	CDSS Adoption (Hit/Case)
Mann-Whitney U	98,500	87,500	62,500	0,500	0,000
Wilcoxon W	423,500	412,500	387,500	325,500	325,000
Z	-4,154	-4,367	-5,578	-6,056	-6,536
Asymp. Sig. (2-tailed)	0,000	0,000	0,000	0,000	0,000

a. Grouping Variable: PRE/POST

The results of the analysis based on the Mann-Whitney test show a very significant change in all service quality indicators after the implementation of RME. All variables recorded a significance value of $p < 0.001$, indicating that the differences between the PRE and POST periods did not occur by chance but were the real impact of the system implementation.

More specifically, registration waiting times decreased significantly (U = 98.500), indicating that the initial service process became faster and more structured. A similar pattern was seen in pharmacy waiting times (U = 87.500), where the use of RME contributed to a more efficient prescription and drug delivery process.

From the patient safety aspect, the medication error rate also decreased significantly (U = 62.500), confirming that digital system support plays a role in minimizing medication errors. Meanwhile, the completeness of SOAP documentation increased dramatically (U = 0.500), reflecting improvements in the quality of medical documentation that is more consistent and in accordance with standards.

Additionally, the adoption rate of the Clinical Decision Support System (CDSS) showed a very significant increase (U = 0.000), indicating that healthcare professionals are increasingly utilizing decision support features in EHRs to support safer and more accurate clinical practices.

Because the normality test results show that most variables are not normally distributed, nonparametric tests are more appropriate for analyzing differences. To complement the interpretation of the strength of these differences, an effect size based on the r value was used, which was calculated from the ratio between the Z value and the root of the sample size (r = Z/√N). This approach is standard in non-parametric analysis because it provides an overview of how much influence the treatment or system changes have on the variables being tested, even though the data does not meet the parametric assumptions. The r value is then interpreted using Cohen's limits, namely 0.1 (small), 0.3 (medium), and 0.5 (large), so that it can be assessed whether the PRE and POST differences are not only statistically significant but also practically meaningful.

Table 7. Effect Size (r) Mann–Whitney Test Based on Z Value

Variables	Z	N	r (Effect Size)
Registration Waiting Time	-4,154	50	0,587
Pharmacy Waiting Time	-4,367	50	0,618
Medication Error Level	-5,578	50	0,789
SOAP Completeness (%)	-6,056	50	0,856
CDSS Adoption (Hit/Case)	-6,536	50	0,924

The results of this study indicate that the use of Electronic Medical Records has a strong and significant impact on improving the quality of patient care in hospitals. All indicators analyzed, ranging from waiting times, medication errors, documentation completeness, to the adoption of Clinical Decision Support Systems (CDSS), experienced significant changes after the implementation of EMR. These findings are not only statistically significant based on the Mann-Whitney test, but also highly meaningful in practical terms, as evidenced by the high effect size (r) values for all variables.

First, registration waiting times showed an effect size of 0.587, which is categorized as a large effect. This indicates that the presence of EMRs can improve the efficiency of the initial patient administration process. This improvement likely stems from the automation of data verification, the reduction of duplicate records, and the improvement of a more structured front-office workflow. These findings are consistent with previous studies reporting that RME plays an important role in speeding up the registration process and reducing the administrative burden on medical personnel (Ikawati, 2024; Setiatin et al., 2023).

Furthermore, pharmacy waiting time has an effect size of 0.618, which is also classified as large. This impact shows that the use of RME also increases the speed of pharmacy services, particularly through the electronic prescribing (e-prescription) feature, reduction of input errors, and integration between doctors, nurses, and pharmacists on a single digital platform. This efficiency is in line with the literature by Nugroho & Pramudita (2024), which confirms the effectiveness of RME in speeding up drug dispensing and reducing queues at pharmacy facilities.

For the medication error level variable, an effect size of 0.789 was found, which is classified as very large. This shows that the implementation of RME has contributed significantly to reducing the rate of medication errors. Features such as automatic alerts, dose validation, and drug interaction checks are believed to be the main factors that help healthcare professionals avoid errors in the prescribing, transcribing, dispensing, and administering processes (Laurenxius et al., 2025). This significant improvement is in line with the study by Hossain et al. (2025), which states that RME is an important tool in improving patient safety.

The indicator of clinical documentation completeness or SOAP also showed a very significant change with an effect size of 0.856. This means that RME has succeeded in improving the consistency, structure, and completeness of medical records. Electronic systems encourage healthcare workers to follow documentation standards, reduce missing data, and provide a standard format that facilitates audit and service quality evaluation. These findings indicate that EMR not only serves as a recording tool but also as an instrument for improving clinical quality (Aditya Kurniawan et al., 2025).

The last variable, namely CDSS adoption (Hit/Case), produced an effect size of 0.924, which is classified as very large and close to a perfect effect. This means that CDSS usage increased dramatically after RME implementation. Clinical reminder systems, safety alerts, and decision support became part of an integrated work process, making them easier for healthcare professionals to use. This increase in adoption shows that well-implemented RME can change the clinical behavior of healthcare professionals towards more evidence-based practices (Ariani, 2023; Belard et al., 2017).

The very strong improvement in safety and documentation indicators (Medication Error Level, r = 0.789) is most likely the result of the RME system design at Hospital X, which implements forced functions and tight integration. This forced function requires healthcare workers to fill in all required SOAP fields before continuing service or validating CDSS use (e.g., rejecting dose alerts) with written clinical justification. This design mechanism has proven effective in overcoming user resistance and inconsistencies in documentation, ensuring that the benefits of RME are not only available but also actively used in clinical practice. Key success factors also include strong management commitment, ongoing training, and adequate IT infrastructure, which are essential elements for overcoming common barriers to EMR implementation in Indonesia.

Overall, the results of this study provide strong evidence that EMR implementation has a significant positive impact on the quality of patient care. Improvements occurred not only in terms of operational efficiency, but also in terms of patient safety and clinical documentation. These findings are consistent with previous literature emphasizing the importance of healthcare digitization, while also making a tangible contribution to the development of EMR at Hospital X, particularly in the context of PRE-POST evaluations, which are still rarely conducted.

CONCLUSION

This study shows that the use of Electronic Medical Records has a significant and meaningful impact on improving the quality of patient care in hospitals. Based on PRE and POST analysis using the Mann-Whitney test and effect size (r) calculations, all indicators studied showed strong improvement after the implementation of EMR.

EMR has been proven to reduce registration and pharmacy waiting times, with a large effect size (r = 0.587 and r = 0.618). This shows that the digitization of administrative and pharmacy workflows provides a real increase in efficiency in the patient service process. In addition, the medication error rate decreased significantly (r = 0.789), indicating that clinical safety features in RME such as alerts, data validation, and e-prescribing play an important role in improving patient safety.

The completeness of clinical documentation (SOAP) also increased significantly (r = 0.856), indicating that RME supports more structured, complete, and consistent recording standards. The adoption of Clinical Decision Support Systems (CDSS) increased dramatically (r = 0.924), reflecting that the integration of CDSS in EMR effectively encourages the use of clinical reminders and decision support by healthcare professionals. Overall, this study provides empirical evidence that the implementation of EMR not only has a statistically significant impact but also provides strong practical benefits for improving service quality.

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