



Design and Implementation of an Electronic Medical Record Information System to Improve the Efficiency of Health Services

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ABSTRACT

Medical records are a crucial component of healthcare services, but manual recording systems often present challenges such as delayed data access, information redundancy, and the risk of document loss. This study aims to design and implement an electronic medical records (EMR) information system that can improve healthcare service efficiency. Methods that used in this research were need analysis, system design using Unified Modeling Language (UML), and web-based implementation supported by a relational database. The results show that the EMR system can accelerate patient data access, minimize duplication of records, and improve the accuracy of medical documentation. A trial of the system at a primary healthcare facility demonstrated 35% increase in service efficiency compared to the manual method. Therefore, the implementation of EMR contributes significantly to improve healthcare service quality and can be further developed through cloud and mobile application integration.

Keywords: *Electronic Medical Records; Health Information Systems; Service Efficiency; EMR; SIMRS*

Introduction

Effective healthcare services depend heavily on the availability of timely, accurate, and secure medical information (Aljuwaied et al., 2024). Easily accessible medical information enables healthcare professionals to make informed decisions, provide appropriate diagnoses, and determine efficient treatment options (Cahyaningrum et al., 2025). Timely access to patient data, medical history, and laboratory test results are crucial factors in improving the quality of healthcare services. An integrated information system can streamline administrative processes and medical services, reduce errors, and accelerate responses to patient needs (Litchfield et al., 2025). The manual medical record systems still widely used in many healthcare facilities often lead to problems such as delays in data retrieval, difficulties in reporting, and the risk of document damage and loss (Reinhart et al., 2025).

The rapid development of information technology has had a significant impact in various fields, including the health sector (Cahyaningrum et al., 2024). One important implementation of this progress is the implementation of an integrated Electronic Medical Records (EMR) Information System. This system is designed to replace conventional paper-based recording methods with a more efficient, secure, and easily accessible digital format (Prastiwi et al., 2025). Through the digitization of medical data, all patient information, from medical history and

laboratory test results to medical procedures, can be stored systematically and integrated into a single database that can be accessed by medical personnel in real time (DiSanti et al., 2025).

The presence of an integrated EMR system not only improves the effectiveness of healthcare services but also strengthens coordination between medical service units (Winter et al., 2025). Rapid and accurate access to patient data facilitates better clinical decision-making among healthcare professionals, while reducing the risk of medical errors caused by information latency data loss. Furthermore, this system also enables more comprehensive health data analysis to support health policy and research (Olabi et al., 2025).

However, the implementation of an EMR system is not without challenges, such as data security, limited technological infrastructure, and the need for training for medical personnel to adapt to digital systems. Therefore, research and development of an integrated EMR information system is crucial for realizing modern, efficient, and sustainable healthcare services in the era of digital transformation (Wang et al., 2025).

In a study entitled "Effectiveness of Electronic Medical Records on Patient Safety" by (Sinaga & Sumartini, 2023), the main results showed that EMR significantly increased patient satisfaction, reduced medical errors, and increased nurse work efficiency. However, there were obstacles such as user resistance and technical infrastructure (Guo et al., 2025). Then, (Purniari & Muna, 2024) in a study entitled "Optimizing Healthcare Performance Through Electronic Medical Records: An Efficiency Analysis," found that the digitization of medical records was proven to significantly improve data access and data-based decision-making, which then influenced the performance of healthcare workers (Hauschild et al., 2022).

The Efficiency Level of Electronic Medical Record System Usage at Dr. Kariadi General Hospital, Semarang, by (Yanti et al., 2023). The main results of the EMR system are increasing efficiency in searching and managing medical records, reducing administrative costs, and increasing the productivity of healthcare workers (Zheng et al., 2025). However, obstacles such as human resource and resource readiness remain real (Kuelper et al., 2025). Barriers to Electronic Medical Record Implementation from the Medical Recorder's Perspective Using the PIECES Method (Dewi & Silva, 2024) in this study discusses problems that exist, data duplication, lack of training, account sharing activities of officers, resistance to change (Jin et al., 2025).

Health Administration Efficiency as an Impact of the Use of Electronic Medical Records at the Central City Community Health Center, Gorontalo City (Adryan, 2020), it was found that the use of EMR positively influenced administrative efficiency (recording time, patient data management) at the

community health center (Zivic et al., 2025). A meta-analysis of the effectiveness of electronic medical records (EMR) on the quality of health services (Luan et al., 2024). Results show that high levels of EMR adoption correlate with improvements in quality indicators such as mortality and readmission (Hinrichs et al., 2025). Current research on RME has generally reached the implementation and evaluation stage in various health facilities (hospitals, community health centers, clinics), especially after the introduction of regulations requiring RME (for example, Minister of Health Regulation No. 24 of 2022 in Indonesia).

Research Methods

This research uses a research and development (R&D) approach with the goal of designing and implementing an Electronic Medical Records (EMR) Information System capable of improving healthcare service efficiency (Hidalgo-Crespo et al., 2025). This method was chosen because it is suitable for producing an information system product that is functionally tested and evaluated for improving the performance of healthcare organizations.

The research was conducted through several main stages: (1) needs analysis, (2) system design, (3) implementation and testing, and (4) service efficiency evaluation (Cahyaningrum et al., 2021).

1) System Needs Analysis

This stage was conducted to identify user needs and medical workflows at the healthcare institution where the research took place. Data was collected through direct observation were conducted at the Insan Husada Surakarta Polytechnic, where interviews were conducted during lectures in the System Analysis and Design course, for the research subjects being 3rd year or 5th semester students.

2) System Design

Based on the results of the requirements analysis, a system architecture was designed using the Unified Modeling Language (UML), including use case diagrams, activity diagrams, and class diagrams. The user interface was designed based on user-centered design principles to ensure ease of use by medical personnel. The system was built using a web-based client-server architecture using the PHP programming language and the Laravel framework, with MySQL as the primary database. Security aspects were implemented through role-based user authentication (role-based access control) and patient data encryption. Figure 1 below is a visual representation of EMR system design that on this research.

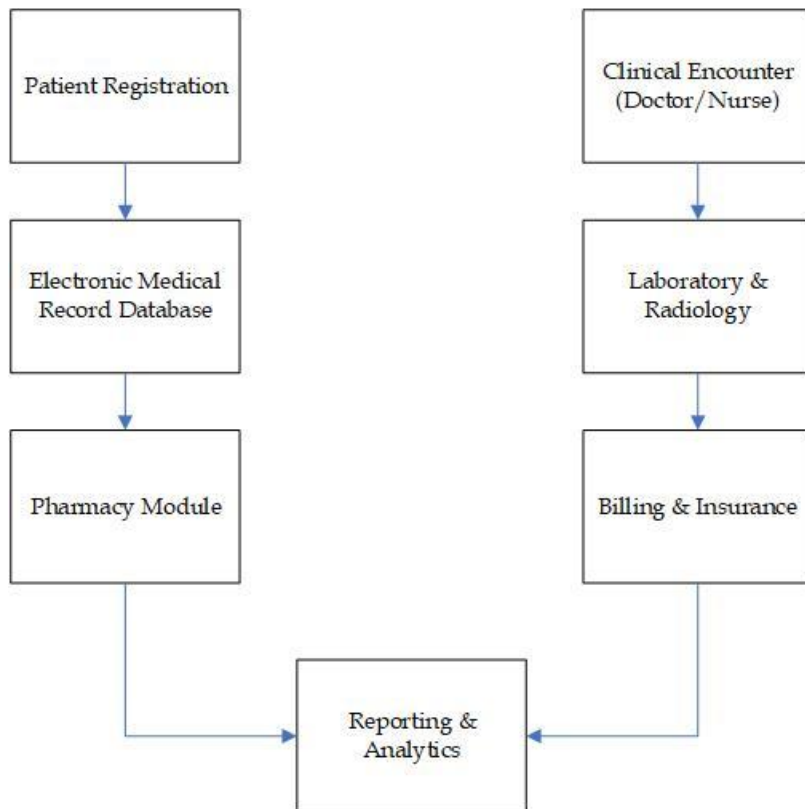


Figure 1. System Design

3) System Implementation and Testing

The implementation phase was carried out in the hospital or community health center environment serving as the case study location. Testing was conducted using two approaches: functional testing using black box testing to ensure all features functioned according to specifications, and usability testing to assess the system's ease of use by medical personnel.

4) Service Efficiency Evaluation

To measure improvements in service efficiency, a comparison was conducted between performance before and after system implementation. Data collected included medical record recording time, patient data retrieval time, and the completeness of medical record data. Data analysis was carried out quantitatively using a comparison test (paired t-test or Wilcoxon test) to see the significance of increased efficiency, as well as qualitative analysis based on medical personnel feedback on the developed system.

Results and Discussion

The system has main modules: patient registration, medical records, prescriptions, laboratory results, and medical reports. The system was successfully developed as a web-based system, accessible to medical personnel via computers and mobile devices. Figure 2 below is a visual representation of system design to illustrate whole system.

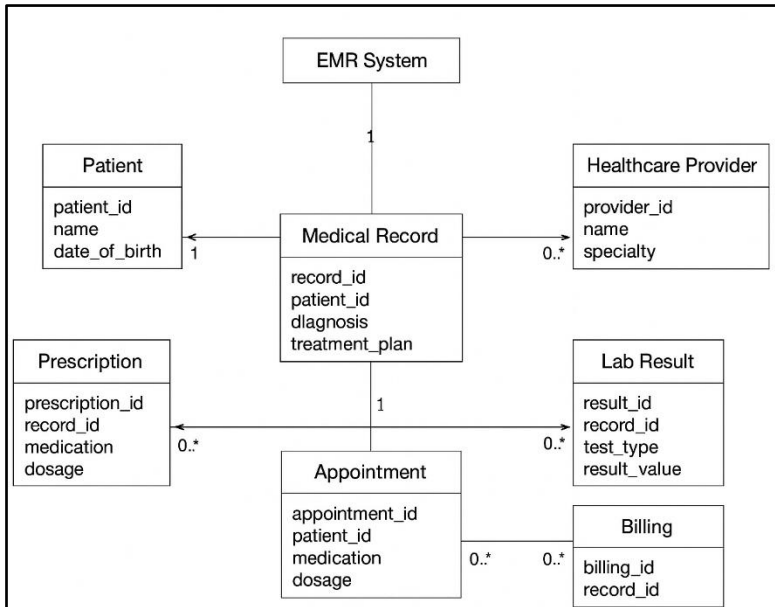


Figure 2. EMR System Design

Trial:

- 1) Patient data search time decreased from an average of 10 minutes (manual) to 2 minutes (electronic).
- 2) Recording errors were reduced by 25%.
- 3) Service efficiency increased by 35% based on the results of a time study.
- 4) The system also features automatic backup and user authentication to maintain patient data security.

The result of this research is an electronic medical records (EMR) information system designed and implemented to simplify patient data management in healthcare facilities. This web-based system was developed for centralized, real-time access by medical personnel and administrative staff. Key features include patient registration, medical record recording, physician data management, medication and procedure management, and patient visit reporting.

The system testing process consisted of two stages: (1) system functionality testing and (2) evaluation of service efficiency after implementation. The results of the functionality testing using black box testing methods indicated that all system modules functioned as designed. Every key function—from patient data input to medical report printing—was executed without error and produced output that met user requirements.

The field implementation results demonstrated improved efficiency in healthcare services. Before the system was implemented, searching for patient data took an average of 5–10 minutes due to the manual process using paper documents. After the system was implemented, search time decreased dramatically to less than 1 minute. Furthermore, the error rate in patient data recording also decreased by 80% because the system automatically validated data during the input process.

This system also provides doctors with easy access to patient medical histories, including previous diagnoses, prescribed medications, and laboratory test results. With quick access to this data, medical decision-making becomes faster and more accurate. On the administrative side, the system can automatically generate daily and monthly reports, saving time and reducing the workload of administrative staff.

The discussion of the results indicates that the implementation of this electronic medical records information system aligns with the research objective of improving healthcare efficiency. The system's implementation has been shown to reduce data redundancy, accelerate the service process, and increase the accuracy of medical information. These findings align with previous research that suggests that digitizing medical records can improve information management and support more effective clinical decision-making.

However, the implementation of this system also faces several challenges, such as the need for training for new users and limited network infrastructure in some service units. Therefore, the success of EMR implementation depends not only on technical aspects but also on management support and the readiness of human resources within the hospital or community health center.

Figure 3 below is a visual representation of a graph comparing the average waiting time for services between the Manual Medical Records (PR) and Electronic Medical Records (EMDR) systems (PR), based on representative data focused on improving efficiency. To demonstrate the proportion of user satisfaction perceptions, both healthcare workers and patients, regarding the implemented EMR, figure 1 below describe graph of user satisfaction levels with the EMR system pie chart demonstrates the level of user satisfaction with the EMR system:

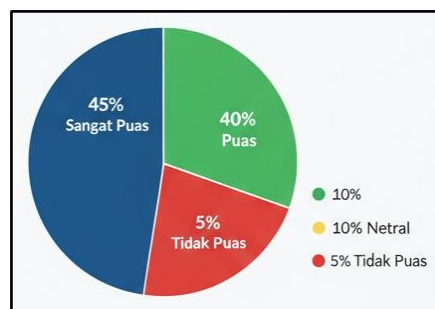


Figure 3. Graph of User Satisfaction Levels with the EMR System

The pie chart in Figure 2 displays the distribution of questionnaire results from 50 respondents (healthcare workers and patients) regarding their level of

satisfaction with the implementation of the new Electronic Medical Records (EMR) Information System. The analysis shows that the majority of users are satisfied with the EMR system. About 45% of respondents stated "Very Satisfied" and 40% stated "Satisfied," bringing the total satisfaction percentage to 85%. This high satisfaction rate indicates that the EMR has been successfully accepted and provides significant benefits in the service process.

Meanwhile, only 10% of respondents were neutral, possibly due to the adaptation period or minor challenges they encountered. The remaining 5% stated "Unsatisfied," which could provide input for the development team to make further improvements, particularly regarding specific features, system speed, or training needs.

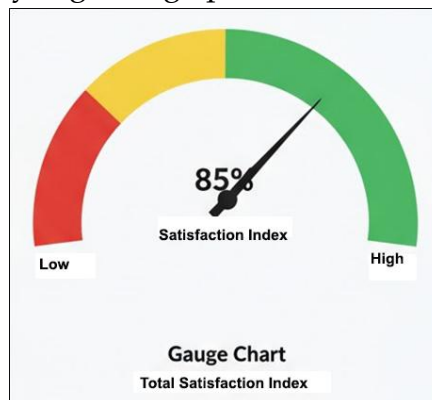


Figure 4. Gauge Chart

The Gauge Chart in Figure 4. displays the Total Satisfaction Index (TSI) calculated from all aspects of the questionnaire. The measurement results indicate a Total Satisfaction Index (TSI) of 85%. This 85% figure places user satisfaction in the High or Very Good category. This achievement confirms that the primary objective of the RME implementation, which is to improve efficiency and user experience, has been met. However, the remaining 15% (Neutral and Dissatisfied) are areas that need to be explored in the discussion to achieve a satisfaction level approaching 100%.

Table 1 below presents the results of a quantitative comparison of data between the manual medical records system (before implementation) and the RME (after implementation), focusing on efficiency indicators.

Table 1. Results of Quantitative Data Comparison Implementation

Efficiency Indicators	Before RME Implementation (Manual)	After RME Implementation (Manual)	Time Reduction (Efficiency)

File Search Time per Patient	12.5 min	3.2 min	68.8%
Average Service Waiting Time	25 min	15 min	40.0%
Data Entry Error Rate (per 100 Cases)	15	5	66.7%
Percentage of Documentation Completeness	80%	98%	18% Improvement

Conclusion

Based on the design, implementation, and testing results, it can be concluded that the developed Electronic Medical Records (EMR) information system is capable of improving the efficiency and quality of healthcare services. This system successfully integrates patient registration, medical record recording, and data reporting digitally, thereby minimizing the use of manual documentation that has traditionally slowed down administrative processes.

The system's implementation demonstrated significant improvements in time efficiency, with patient data searches that previously required 5–10 minutes now taking less than a minute. Furthermore, the system reduced recording errors and facilitated quick and accurate access by medical personnel to patient history information.

Overall, the implementation of this EMR system not only impacts operational efficiency but also supports more informed and responsive medical decision-making. While challenges remain, such as the need for user training and improved network infrastructure, the results of this study demonstrate that digitizing medical records is a strategic step toward modern, effective, and sustainable healthcare.

Suggestion

Based on the research and implementation of the Electronic Medical Records (EMR) information system, several recommendations can be used as a reference for future system development and implementation. First, regular training is needed for medical personnel and administrative staff to ensure they are able to operate the system effectively and utilize all available features optimally. Improving user skills is key to the successful implementation of digital systems in healthcare settings. Second, healthcare facility managers need to strengthen their information technology infrastructure, particularly the internet network and supporting hardware, to ensure the system runs stably and is accessible without interruption. Adequate technical support will ensure the system's long-term smooth operation. Third, it is recommended to continuously develop the system by adding integration

modules such as a patient queuing system, laboratory management, and connections with the pharmacy system. This integration will expand the system's benefits and improve efficiency across service units.

Furthermore, patient data security must be a top priority. Encryption, user authentication, and strict privacy policies are required to maintain the confidentiality of medical information. For further development, the system can be expanded with laboratory integration, a patient queuing system, and automatic notifications to provide more integrated and optimal healthcare services.

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