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ANALYSIS AND DESIGN OF AN INTEGRATED HOSPITAL MANAGEMENT INFORMATION SYSTEM TO IMPROVE SERVICE QUALITY

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Abstract

The rapid development of information technology has significantly transformed healthcare services, particularly in improving hospital service quality. However, many hospitals still face challenges related to fragmented information systems, lack of integration, and inefficiencies in data management, which negatively impact service delivery and decision-making. This study aims to analyze and design an integrated Hospital Management Information System (HMIS) to enhance service quality and operational efficiency. The research employs a Research and Development (R&D) approach, combined with the Waterfall model for system development, including requirements analysis, system design, implementation, and testing. Data were collected through surveys, observations, and documentation from hospital stakeholders. The proposed system integrates key hospital functions such as patient registration, electronic medical records, pharmacy, laboratory, and reporting into a centralized, web-based platform. The results indicate that the developed system improves data accuracy, reduces processing time, enhances coordination among departments, and supports real-time decision-making. Furthermore, system testing using Black Box Testing confirms that the system meets functional requirements and performs reliably. In conclusion, the integrated HMIS significantly contributes to improving healthcare service quality, operational efficiency, and data management, making it a valuable solution for modern hospital environments.

Keywords: *Hospital Management Information System (HMIS), System Integration, Healthcare Service Quality, Digital Transformation, Waterfall Model, Electronic Medical Records (EHR)*

1. INTRODUCTION

The development of information technology has brought significant changes to the healthcare sector, particularly in improving the quality of hospital services. Digital transformation enables hospitals to manage data more effectively, integrate clinical and administrative processes, and deliver *patient-centered care* that focuses on patients' needs, preferences, and outcomes (Kenneth C. Laudon & Jane P. Laudon, 2022). In addition, digital systems support real-time data access, which is essential for timely diagnosis, treatment, and continuity of care. Furthermore, the implementation of digital technologies such as *Electronic Health Records* (EHR) and telemedicine has been proven to enhance operational efficiency and the quality of healthcare services (Mohammad Rahman et al., 2021; Kuo K. M. et al., 2020). EHR systems allow healthcare providers to store, retrieve, and share patient information systematically, reducing paperwork and minimizing redundancy. Previous studies also indicate that the use of EHR can improve patient data accuracy, reduce medical errors, and accelerate clinical decision-making processes (David W. Bates et al., 2003). In addition, EHR facilitates better communication among healthcare professionals,

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which contributes to improved patient safety and coordinated care. Meanwhile, the implementation of telemedicine has been shown to expand access to healthcare services, especially in remote and underserved areas, and increase patient satisfaction (Joseph C. Kvedar et al., 2014). Telemedicine enables remote consultations, monitoring, and follow-up care without requiring patients to visit healthcare facilities physically. This not only reduces travel time and costs but also helps healthcare systems manage patient loads more effectively, especially during public health emergencies. However, despite these advantages, the lack of system integration remains a major issue in many hospitals, leading to delays in service delivery and poor information quality (William H. DeLone & Ephraim R. McLean, 2003). In many cases, different departments use separate systems that are not interconnected, resulting in inefficiencies in data sharing. Other studies further emphasize that non-integrated systems can result in data fragmentation, duplication of information, and reduced effectiveness in coordination among healthcare professionals (Hardeep Singh et al., 2015). This fragmentation can negatively impact clinical outcomes, as incomplete or inconsistent information may lead to inappropriate medical decisions. Therefore, the integration of health information systems is crucial to ensure seamless data exchange, improve service efficiency, and enhance the overall quality of healthcare delivery. A well-integrated system can support better decision-making, strengthen collaboration among healthcare providers, and ultimately improve patient outcomes.

2. LITERATURE REVIEW

2.1 Hospital Management Information System

A *Hospital Management Information System* (HMIS), commonly referred to as *Sistem Informasi Manajemen Rumah Sakit (SIMRS)*, is an integrated system used to manage all hospital activities, including patient registration, medical records, pharmacy services, billing, and managerial reporting. This system is designed to support the seamless flow of information across departments, enabling hospitals to operate in a more structured and coordinated manner (Rainer R. Kelly & Brad Prince, 2021). By integrating various functional units, HMIS plays a crucial role in improving data accessibility and organizational performance.

Furthermore, the implementation of HMIS has been shown to significantly enhance operational efficiency and service quality in healthcare institutions. It reduces manual processes, minimizes administrative errors, and accelerates service delivery, thereby improving patient satisfaction (Joseph Tan, 2010; Kuo K. M. et al., 2020). In addition, HMIS facilitates better decision-making by providing accurate, timely, and comprehensive information for healthcare providers and hospital management.

However, despite its benefits, the successful implementation of HMIS still faces several challenges, particularly related to system integration, user adoption, and data interoperability. Many hospitals continue to struggle with fragmented systems that hinder effective communication between departments, leading to inefficiencies and potential risks in patient care (William H. DeLone & Ephraim R. McLean, 2003). Therefore, continuous development, proper training, and strong system integration are essential to maximize the effectiveness of HMIS in supporting high-quality healthcare services.

2.2 System Integration

System integration is the process of connecting multiple subsystems so they can automatically exchange data and function as a unified system. It enables different applications and databases to communicate seamlessly, reducing data redundancy and improving overall system efficiency (Kenneth C. Laudon & Jane P. Laudon, 2022). In healthcare settings, system integration plays a crucial role in ensuring that information flows smoothly across departments, supporting faster decision-making and improving the accuracy of information used in clinical and administrative processes.

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In the context of hospitals, integration allows various units such as outpatient clinics, laboratories, and pharmacies to access patient data in real time. This capability enhances coordination among healthcare professionals, reduces delays in service delivery, and minimizes medical errors caused by incomplete or fragmented information (Hardeep Singh et al., 2015). Moreover, integrated systems contribute to better patient care by ensuring that healthcare providers have comprehensive and up-to-date patient information, ultimately improving service quality and patient outcomes.

2.3 Healthcare Service Quality

Healthcare service quality can be assessed through several key dimensions, including service timeliness, diagnostic accuracy, patient data security, and patient satisfaction. These aspects reflect how well healthcare providers deliver services that meet patients' expectations and clinical needs. High-quality healthcare services not only focus on medical outcomes but also emphasize efficiency, safety, and patient-centered care (Avedis Donabedian, 1988). In addition, service quality in healthcare is closely related to the ability of institutions to provide reliable, responsive, and empathetic services, which significantly influence patients' perceptions and trust.

A well-implemented information system can significantly improve these aspects by enabling faster service delivery, reducing diagnostic errors, and ensuring the security and confidentiality of patient data. Health information systems facilitate accurate data management, support clinical decision-making, and enhance communication among healthcare professionals (William H. DeLone & Ephraim R. McLean, 2003). Furthermore, the use of digital systems has been shown to increase patient satisfaction by providing more efficient and transparent services, ultimately contributing to improved overall healthcare quality (Kuo K. M. et al., 2020).

2.4 Waterfall Model

The *Waterfall Model* is a linear and sequential software development methodology in which each phase must be completed before proceeding to the next, making it suitable for projects with clearly defined and stable requirements (Winston W. Royce, 1970). This model consists of several structured stages, including requirements analysis, system design, implementation (coding), testing, deployment, and maintenance, where each phase has specific deliverables and documentation (Ian Sommerville, 2016). The requirements analysis phase focuses on identifying user needs, followed by system design to define architecture and specifications, then implementation where the system is developed into code, and testing to ensure the system meets the defined requirements. After that, the system is deployed for actual use, and finally, maintenance is carried out to improve performance and fix any issues that arise. Although the Waterfall Model is easy to understand and manage, its rigid structure makes it less flexible to accommodate changes during development (Roger S. Pressman, 2014).

The main stages of the Waterfall Model include:

a. Requirements Analysis, Identifying and understanding user needs and system requirements.
b. System Design, Designing the system architecture and overall structure based on the requirements.
c. Implementation, Developing the system by converting the design into program code.
d. Testing, Evaluating the system to ensure it functions correctly and meets the specified requirements.
e. Maintenance, Performing updates and fixes to maintain system performance after deployment.

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3. METHODOLOGY

3.1 Research Method

This study employs the *Research and Development (R&D)* method, which aims to produce a system and evaluate its effectiveness. This method is widely used in developing and validating products, including information systems, to ensure they meet user needs and function effectively in real-world settings (Walter R. Borg & Meredith D. Gall, 1983). Therefore, the R&D approach is suitable for developing information systems that address practical problems in healthcare environments.

Through this approach, the research not only analyzes existing issues but also proposes a practical solution in the form of an integrated hospital information system. In addition, the R&D method allows iterative testing and refinement, ensuring that the developed system is both functional and effective in improving service quality and operational efficiency (Thiagarajan Sivasailam et al., 1974; William R. Van Den Akker, 1999).

3.2 System Development Method

The system development process in this study follows the *Waterfall Model*, a structured and sequential approach in which development activities are carried out in clearly defined phases. This model is widely applied in software engineering because it provides a systematic framework that facilitates planning, documentation, and control throughout the development lifecycle (Balaji S. & Murugaiyan M. S., 2012). The first stage involves analyzing system requirements based on real conditions in the hospital environment to ensure that the developed system addresses actual operational needs and user expectations.

The next stages include system design using UML diagrams and database modeling to define system structure and data flow, followed by system implementation using web-based technologies. Finally, the system undergoes testing to evaluate its functionality and reliability before deployment. The structured nature of the Waterfall Model allows each phase to have clear deliverables and evaluation criteria, which helps improve system quality and development efficiency, especially in projects with stable and well-defined requirements (Ruparelia N. B., 2010).

3.3 Data Collection Techniques

Data were collected through surveys administered to hospital managers, healthcare professionals, and administrative staff regarding the utilization of digital technologies, the condition of digital infrastructure, and perceptions of competitive advantage. The survey instrument was designed to capture respondents' experiences and evaluations of how digital systems are implemented and used in daily hospital operations.

In addition, secondary data were obtained from internal hospital documentation and technical reports related to digital infrastructure. These data were used to complement the primary data, providing a more comprehensive understanding of the actual conditions of digital implementation and supporting the validation of the research findings.

3.4 Data Analysis

Data were analyzed using Structural Equation Modeling (SEM) with software such as AMOS or SmartPLS to test the hypotheses regarding the effects of digital technology (X1), digital technology utilization (X2),

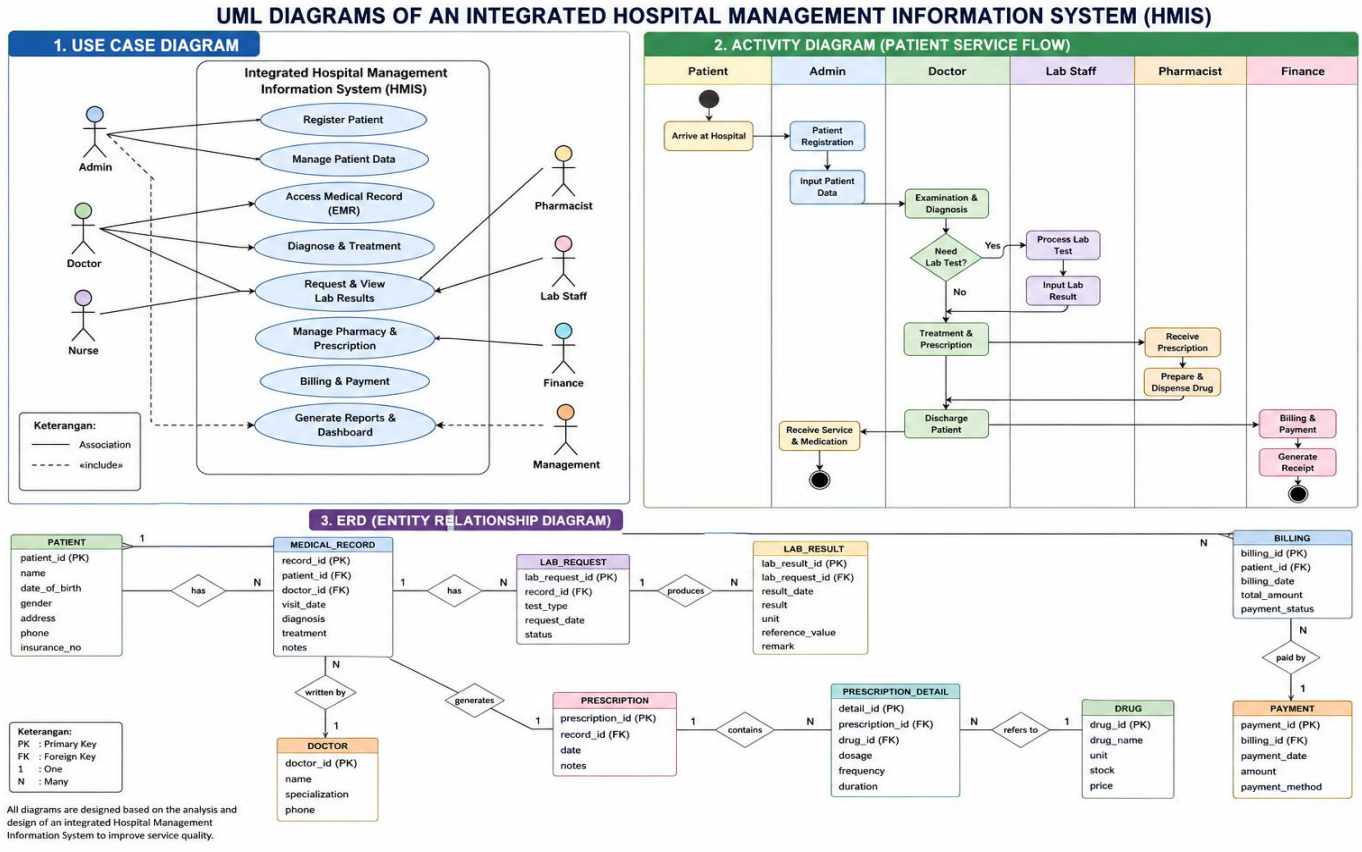
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and digital infrastructure (X3) on the competitive advantage of hospitals (Y), as well as the mediating role of user satisfaction and the moderating effect of digital culture factors [T3, T5, T9].

4.RESULTS AND DISCUSSION

The results of this study indicate that the existing hospital information system is still fragmented, partially manual, and lacks integration between departments. This condition leads to inefficiencies in data processing, duplication of information, delays in service delivery, and increased risk of human error. Furthermore, the absence of real-time data access makes it difficult for healthcare professionals to make timely and accurate decisions.

To address these issues, this study developed a web-based integrated Hospital Management Information System (HMIS) that connects all major hospital functions into a centralized platform. The system integrates patient registration, electronic medical records, pharmacy, laboratory, billing, and reporting modules. The use of a centralized database ensures that all data are stored consistently and can be accessed in real time by authorized users. The implementation results show significant improvements in several aspects. First, data accuracy is enhanced due to the reduction of manual input and duplication. Second, service efficiency increases as processes become faster and more automated. Third, coordination among departments improves because all units share the same data system. Fourth, decision-making becomes more effective due to the availability of real-time and reliable information. System testing using the Black Box Testing method confirms that all system functions operate correctly according to user requirements. Users also reported improved usability and satisfaction due to the system's user-friendly interface. Overall, the study proves that the implementation of an integrated HMIS can significantly improve hospital service quality, operational efficiency, and organizational performance. This system also supports digital transformation initiatives in healthcare institutions and provides a strong foundation for future technological development.



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4.1 Analysis of Existing System

The analysis shows that the current system has several limitations, including lack of integration, manual data processing, and delays in service delivery, which reduce efficiency and increase the risk of data errors. These challenges are commonly found in healthcare organizations that rely on fragmented information systems, leading to poor data quality and ineffective coordination between departments (Ate Boonstra et al., 2014).

In addition, report generation becomes more difficult due to scattered data across different units, making it harder for management to obtain accurate and timely information. This condition highlights the urgent need for a more integrated information system that can support seamless data exchange, improve operational performance, and enhance the overall quality of healthcare services (William H. DeLone & Ephraim R. McLean, 2003).

4.2 Proposed System Design

The proposed system is a web-based integrated *Hospital Management Information System (HMIS)* that includes modules for patient registration, electronic medical records, pharmacy, laboratory, and reporting. Such integrated systems are designed to streamline healthcare processes and improve data management across different functional units (Rashid L. et al., 2012). By incorporating multiple modules into a single platform, the system reduces redundancy and enhances the efficiency of hospital operations.

The system uses a centralized database that allows real-time access to information, enabling healthcare providers to retrieve accurate and up-to-date patient data. This integration improves coordination between departments, supports better clinical decision-making, and enhances overall service quality (Kuo K. M. et al., 2020; Ate Boonstra et al., 2014).

4.3 System Implementation and Testing

The system is developed using PHP and MySQL as the database management system, which are widely used technologies for building web-based applications due to their flexibility, scalability, and cost-effectiveness (Paul DuBois, 2019). The implementation focuses on user-friendly interfaces and system efficiency to ensure ease of use and optimal performance for healthcare personnel. A well-designed interface is essential to improve user acceptance and enhance system usability in healthcare environments (Jakob Nielsen, 2012).

System testing is conducted using *Black Box Testing* to ensure that all functionalities work correctly without focusing on internal code structures. This testing method evaluates the system based on input-output analysis to verify that it meets the specified requirements (Glenford J. Myers et al., 2011). The results indicate that the system performs as expected and meets user requirements, demonstrating that the developed system is reliable and suitable for implementation in a hospital environment.

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4.5 DISCUSSION

The implementation of an integrated *Hospital Management Information System (HMIS)* significantly improves operational efficiency and reduces data processing errors by enabling automated workflows and centralized data management. It also enhances decision-making by providing accurate, timely, and real-time information that supports clinical and administrative processes (Anandhi Bharadwaj, 2000; Mohammad Rahman et al., 2021). These findings are consistent with previous studies, which show that digital health systems contribute to improved service quality, better coordination among healthcare providers, and enhanced organizational performance through effective use of information technology (Kuo K. M. et al., 2020; Ate Boonstra et al., 2014).

5. CONCLUSION

This study concludes that the analysis and design of an integrated Hospital Management Information System (HMIS) provide a significant contribution to improving healthcare service quality and operational performance in hospitals. The findings reveal that the existing system, which is fragmented and partially manual, leads to inefficiencies, data inconsistencies, and delays in service delivery. Through the application of the Research and Development (R&D) method and the Waterfall development model, this study successfully developed a web-based integrated system that connects key hospital functions, including patient registration, electronic medical records, pharmacy, laboratory, and reporting modules.

The implementation of the proposed system demonstrates substantial improvements in data accuracy, processing speed, and inter-departmental coordination. In addition, the system supports real-time access to information, enabling more effective and timely decision-making by healthcare professionals and hospital management. The testing results confirm that the system meets functional requirements and operates reliably in supporting hospital activities. Overall, the integrated HMIS enhances service efficiency, reduces administrative errors, and improves patient satisfaction. Therefore, it is recommended that hospitals adopt integrated information systems as part of their digital transformation strategy. Future research should focus on large-scale implementation and evaluating long-term impacts on hospital performance, user satisfaction, and patient outcomes.

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