GIJES
Greenation International Journal of Engineering Science
+62 81210467572 https://research.e-greenation.org/GIJES greenation.info@gmail.com
GREENATION RESEARCH

DOI: https://doi.org/10.38035/gijes.v4i3

Mobile-Based Physician Information System Integrated with Hospital Information System at TK III Ciremai Hospital

Sunanto[1], Sani Fitriyani[2], Rini Suwartika Kusumadiarti[3]
[1]Politeknik Piksi Ganesha, Bandung, Indonesia, sunanto.arsyad@gmail.com
[2]Politeknik Piksi Ganesha, Bandung, Indonesia, sanybeii90@gmail.com
[3]Politeknik Piksi Ganesha, Bandung, Indonesia, rinisuwartika@gmail.com

Corresponding Author: sunanto.arsyad@gmail.com[1]

Abstract: The rapid advancement of health information technology has encouraged hospitals to provide fast, accurate, and integrated healthcare services that support physicians' clinical decision-making. At TK III Ciremai Hospital, access to patient information and electronic medical records is currently limited to desktop- and web-based Hospital Information Systems (HIS), restricting physicians' mobility and reducing the efficiency of healthcare service delivery. This study aims to design a mobile-based Physician Information System integrated with the Hospital Information System (HIS) to enable physicians to securely access clinical information through Android smartphones. A qualitative research approach was employed using observation, semi-structured interviews, and document analysis to identify system requirements. The system was designed using the Waterfall software development model, while Java, MySQL, RESTful APIs with JSON data exchange, and Unified Modeling Language (UML), including Use Case Diagrams and Entity Relationship Diagrams (ERD), were utilized to develop the system architecture and database design. The scope of this study is limited to the system design phase and does not include system implementation or performance evaluation. The study produced a prototype design of a mobile-based Physician Information System that provides access to patient demographic information, electronic medical records, laboratory and diagnostic examination results, and physicians' practice schedules while emphasizing data security and usability. The proposed design is expected to serve as a reference for developing integrated mobile physician information systems that improve healthcare service efficiency, enhance physicians' mobility, and support evidence-based clinical decision-making in hospitals.

Keywords: Mobile Health (mHealth), Physician Information System, Hospital Information System (HIS), Electronic Medical Records (EMR), Waterfall Model

Indonesian Abstract: *Perkembangan teknologi informasi kesehatan yang pesat telah mendorong rumah sakit untuk menyediakan pelayanan kesehatan yang cepat, akurat, dan terintegrasi guna mendukung pengambilan keputusan klinis oleh dokter. Di Rumah Sakit TK III Ciremai, akses terhadap informasi pasien dan rekam medis elektronik saat ini masih terbatas pada Sistem Informasi Rumah Sakit (SIRS) berbasis desktop dan web, sehingga membatasi mobilitas dokter dan mengurangi efisiensi dalam penyelenggaraan pelayanan kesehatan. Penelitian ini bertujuan untuk merancang Sistem Informasi Dokter berbasis*

mobile yang terintegrasi dengan Sistem Informasi Rumah Sakit (SIRS), sehingga memungkinkan dokter mengakses informasi klinis secara aman melalui smartphone berbasis Android. Penelitian ini menggunakan pendekatan kualitatif dengan teknik pengumpulan data berupa observasi, wawancara semi-terstruktur, dan analisis dokumen untuk mengidentifikasi kebutuhan sistem. Perancangan sistem menggunakan model pengembangan perangkat lunak Waterfall, sedangkan Java, MySQL, RESTful API dengan pertukaran data menggunakan format JSON, serta Unified Modeling Language (UML), termasuk Use Case Diagram dan Entity Relationship Diagram (ERD), digunakan dalam pengembangan arsitektur sistem dan perancangan basis data. Ruang lingkup penelitian ini dibatasi pada tahap perancangan sistem dan tidak mencakup implementasi maupun evaluasi kinerja sistem. Hasil penelitian menghasilkan rancangan prototipe Sistem Informasi Dokter berbasis mobile yang menyediakan akses terhadap informasi demografis pasien, rekam medis elektronik, hasil pemeriksaan laboratorium dan diagnostik, serta jadwal praktik dokter dengan tetap menekankan aspek keamanan data dan kemudahan penggunaan. Rancangan yang diusulkan diharapkan dapat menjadi referensi dalam pengembangan sistem informasi dokter berbasis mobile yang terintegrasi guna meningkatkan efisiensi pelayanan kesehatan, meningkatkan mobilitas dokter, serta mendukung pengambilan keputusan klinis berbasis bukti di rumah sakit.

Keywords: *Mobile Health (mHealth), Sistem Informasi Dokter, Sistem Informasi Rumah Sakit (SIRS), Rekam Medis Elektronik (RME), Model Waterfall*

INTRODUCTION

The rapid advancement of digital technologies has significantly transformed healthcare delivery worldwide. Hospitals increasingly rely on integrated Health Information Systems (HIS) to improve service quality, optimize clinical workflows, and support evidence-based decision-making. The adoption of digital health technologies, including Electronic Medical Records (EMRs), mobile health (mHealth), cloud computing, and interoperability standards, has enabled healthcare organizations to deliver more efficient, accessible, and patient-centered services. Mobile technologies, in particular, have become an essential component of modern healthcare because they provide healthcare professionals with immediate access to clinical information regardless of location, thereby improving communication, reducing response time, and enhancing continuity of care (Ventola, 2014). In Indonesia, the digital transformation of healthcare is reinforced by the Ministry of Health Regulation No. 24 of 2022, which mandates the implementation of Electronic Medical Records (EMRs) across healthcare facilities. The regulation requires hospitals to manage patient information electronically while ensuring data security, confidentiality, integrity, and accessibility for authorized healthcare professionals. Consequently, hospitals are expected to develop integrated Hospital Information Systems (HIS) capable of supporting clinical services through interoperable and secure digital platforms. Such integration is increasingly important as healthcare providers require timely access to comprehensive patient information to improve diagnosis, treatment planning, and patient safety.

Mobile health technologies can improve the quality and efficiency of healthcare services. Lin et al. (2025) found that integrating mobile applications with Electronic Medical Records (EMRs) allows physicians to access patient information in real time, improves communication among healthcare professionals, and supports faster clinical decisions. Ventola (2014) also reported that mobile applications help physicians access clinical information more easily, leading to better healthcare services. As smartphones are now widely used by healthcare professionals, mobile applications have become a practical way to access hospital information anytime and anywhere. However, many hospitals still have

difficulty providing flexible access to clinical information. At TK III Ciremai Hospital, physicians mainly use desktop- and web-based Hospital Information Systems (HIS) available at hospital workstations. During ward rounds, emergency care, or consultations outside their offices, physicians often need to return to a workstation to access patient data. In addition, laboratory results, radiology reports, electronic medical records, and physician schedules are stored in different systems. This makes it difficult to access complete patient information quickly and reduces the efficiency of clinical work. The absence of an integrated mobile physician information system also affects healthcare services. Delays in accessing patient information can slow clinical decisions, reduce work efficiency, and increase administrative tasks. Therefore, hospitals need a mobile system that provides secure, real-time access to patient information while remaining connected to existing Hospital Information Systems and Electronic Medical Records.

Several previous studies have developed mobile healthcare applications. For example, Lin et al. (2025) developed an integrated mobile clinical information platform that improved communication and made patient information easier to access through Electronic Medical Record integration.From a software engineering perspective, selecting an appropriate development method is important to ensure system quality and maintainability. The Waterfall model is still widely used in healthcare information system development because hospitals have structured workflows, clear documentation, and strict regulations. Its sequential phases—requirements analysis, system design, implementation, testing, deployment, and maintenance—provide a systematic development process and support software reliability and traceability. Despite the rapid growth of mobile healthcare applications, several research gaps remain. Most previous studies focus on usability, user acceptance, or mobile access to Electronic Medical Records (EMRs). Only a few discuss integration with Hospital Information Systems (HIS) using RESTful APIs. In addition, many studies emphasize system implementation rather than presenting a complete system design that can be used as a reference for future development. Research on mobile physician information systems in Indonesian military hospitals is also limited, even though these hospitals have unique organizational structures and security requirements.

To address these gaps, this study proposes the design of a Mobile-Based Physician Information System integrated with the Hospital Information System at TK III Ciremai Hospital, Indonesia. This study focuses on designing the system architecture, database, user interface, and RESTful API communication using the Waterfall model. The proposed design provides a practical reference for developing an integrated mobile system that enables secure, real-time access to patient information and supports physicians in delivering healthcare services more efficiently.

The objectives of this study are:

1. To analyze the functional and non-functional requirements of a mobile-based Physician Information System integrated with the Hospital Information System.
2. To design the system architecture, database model, and application workflow using Unified Modeling Language (UML) and Entity Relationship Diagrams (ERDs).
3. To design RESTful API communication for secure integration between the mobile application and the existing Hospital Information System.
4. To develop a prototype design using the Waterfall software development model as a reference for future implementation.

The rest of this paper is organized as follows. Section 2 reviews related studies on mobile health, Hospital Information Systems, Electronic Medical Records, and software engineering methods. Section 3 describes the research methodology. Section 4 presents the proposed system design and discusses the results. Finally, Section 5 concludes the study and provides recommendations for future work.

METHODS

Research Design

This study employed a qualitative research approach to explore physicians' information needs, clinical workflows, and system requirements for developing a mobile-based Physician Information System integrated with the Hospital Information System (HIS) at TK III Ciremai Hospital, Indonesia. A qualitative approach was considered appropriate because it enables an in-depth understanding of users' experiences, operational processes, and organizational requirements that cannot be adequately captured through quantitative methods (Tahir & Ismail, 2023). Data were collected through direct observation, semi-structured interviews, and document analysis to identify both functional and non-functional system requirements.

The software design process adopted the Waterfall software development model, which consists of sequential and well-documented development phases. The Waterfall model was selected because hospital information systems generally operate within highly regulated environments characterized by stable business processes, formal documentation requirements, and strict quality assurance procedures. According to Pressman and Maxim (2020), the Waterfall methodology is appropriate for software projects with clearly defined requirements, where each development phase serves as the foundation for the subsequent stage.

Figure 1 illustrates the research framework based on the Waterfall software development model.

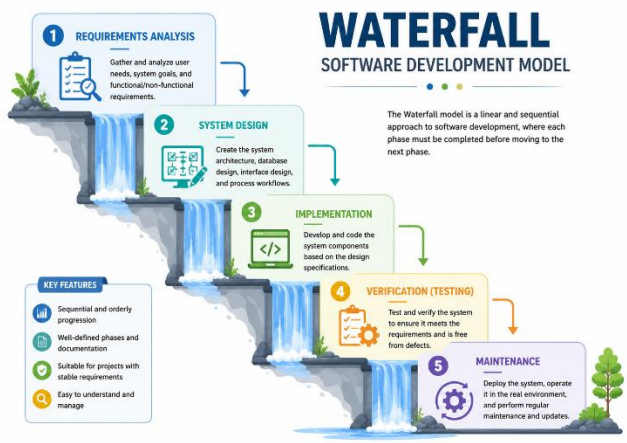

Figure 1. Waterfall Method

System Development Method

The proposed system was designed following four stages of the Waterfall model.

Requirements Analysis

The first stage involved identifying functional and non-functional requirements through direct observation and interviews with physicians and Hospital Information System (HIS) administrators. Functional requirements focused on clinical information access, patient records, laboratory results, physician schedules, and medical documentation. Non-functional requirements included usability, security, performance, interoperability, and data confidentiality.

System Design

Based on the identified requirements, a comprehensive system architecture was developed. The design included application architecture, database schema, system workflow, and communication mechanisms between the mobile application and the Hospital Information System. Unified Modeling Language (UML), including Use Case Diagrams,

Activity Diagrams, Sequence Diagrams, and Entity Relationship Diagrams (ERDs), was utilized to model system functionality and database relationships.

User Interface Design

The user interface was designed to provide physicians with a simple, intuitive, and efficient mobile application. Interface development emphasized ease of navigation, rapid access to patient information, readability, and consistency with physicians' clinical workflows. The interface was also designed to minimize interaction time during ward rounds and emergency situations.

Design Validation

The proposed system design was validated by prospective users, including physicians and HIS administrators, to ensure that the designed functionalities aligned with existing clinical workflows and operational requirements. The validation process aimed to obtain constructive feedback regarding system completeness, usability, and integration before implementation.

Data Collection

Multiple data collection techniques were employed to obtain comprehensive information regarding the current Hospital Information System and physicians' operational requirements.

Observation

Direct observations were conducted to understand physicians' clinical workflows and the operation of the existing Hospital Information System. The observations focused on patient registration, electronic medical record access, laboratory result retrieval, physician scheduling, and information exchange among hospital departments. Field notes and supporting documentation were recorded throughout the observation process.

Semi-Structured Interviews

Semi-structured interviews were conducted with 8 physicians from different clinical departments and 2 Hospital Information System (HIS) administrators at TK III Ciremai Hospital. Participants were selected using purposive sampling based on their direct involvement in patient care and daily use of the Hospital Information System. Physicians were required to have at least one year of clinical experience and regularly use the HIS, while administrators were selected because of their responsibility for system management and maintenance. The interview guide included open-ended questions, such as: (1) How do you currently access patient information during clinical practice? (2) What difficulties do you experience when using the existing HIS? (3) What features do you expect from a mobile physician information system? (4) What patient information should be available through the mobile application? (5) What security and access control features are important for the system? Each interview lasted approximately 30–45 minutes and was conducted face-to-face with participants' consent.

In addition, direct observation was carried out for two weeks in outpatient clinics, inpatient wards, and the emergency department to understand physicians' workflows and identify challenges in accessing patient information. Field notes were recorded to document system usage, information flow, and operational constraints. The proposed system design was validated using a questionnaire completed by the same participants. The questionnaire consisted of 10 statements evaluated using a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The validation covered four aspects: (1) functional suitability, (2) ease of use and interface design, (3) completeness of system features, and (4) overall usefulness of the

proposed system in supporting physicians' clinical activities. The questionnaire results were analyzed descriptively to evaluate participants' perceptions of the proposed system design. This version provides the details requested by reviewers while remaining concise and appropriate for the Methods section of an international journal.

Document Analysis

Document analysis was performed to examine hospital operational procedures, Hospital Information System documentation, Electronic Medical Record policies, software specifications, and relevant healthcare regulations. In addition, scientific journals, books, and international standards related to health information systems, mobile health technologies, interoperability, and software engineering were reviewed to establish the theoretical foundation of the study.

Research Instrument

The primary research instrument was the researcher, supported by structured observation guidelines, interview protocols, and document review forms. Observation guidelines were developed to systematically record clinical workflows and information system utilization. Interview protocols ensured consistency in exploring participants' experiences and system requirements. Document review forms facilitated systematic analysis of hospital regulations, technical documentation, and relevant literature.

Data Validation

To enhance the credibility and trustworthiness of the findings, this study employed **methodological triangulation** by integrating data obtained from observations, interviews, and document analysis. The consistency of information collected from different sources was compared and verified to ensure the accuracy of identified system requirements. Feedback obtained during the design validation stage further strengthened the reliability of the proposed system design.

Data Analysis

The collected qualitative data were analyzed using thematic analysis. The analysis began with data reduction, followed by coding, categorization, and identification of recurring themes related to physicians' information needs, existing system limitations, and expected system functionalities. The resulting themes were subsequently translated into functional and non-functional system requirements, which served as the basis for designing the proposed mobile-based Physician Information System integrated with the Hospital Information System.

RESULTS AND DISCUSSION

Results

This study produced the design of a mobile-based Physician Information System integrated with the Hospital Information System (HIS) to support clinical services at TK III Ciremai Hospital, Indonesia. Since the scope of this research was limited to the system design phase, the results focus on the proposed system architecture, functional requirements, workflow design, and user interface rather than software implementation or performance evaluation. The proposed system was developed based on user requirements identified through direct observation, semi-structured interviews with physicians and HIS administrators, and document analysis of existing clinical workflows. These findings provided the foundation for designing a mobile application capable of improving physicians' access to clinical information while maintaining interoperability with the existing Hospital Information System.

System Requirements Analysis

System requirements analysis was conducted to identify the current clinical workflow and determine the functional and non-functional requirements of the proposed mobile application. The analysis examined how physicians currently access patient information through the existing Hospital Information System and identified operational challenges that affect the efficiency of healthcare service delivery. Figure 2 illustrates the existing clinical workflow at TK III Ciremai Hospital. Under the current system, physicians access patient information through a desktop- or web-based Hospital Information System. Clinical information, including electronic medical records, laboratory results, radiology reports, and physician schedules, is distributed across multiple subsystems, requiring physicians to navigate several interfaces to obtain comprehensive patient information. This process becomes less efficient during ward rounds, emergency situations, or consultations conducted outside fixed workstations.

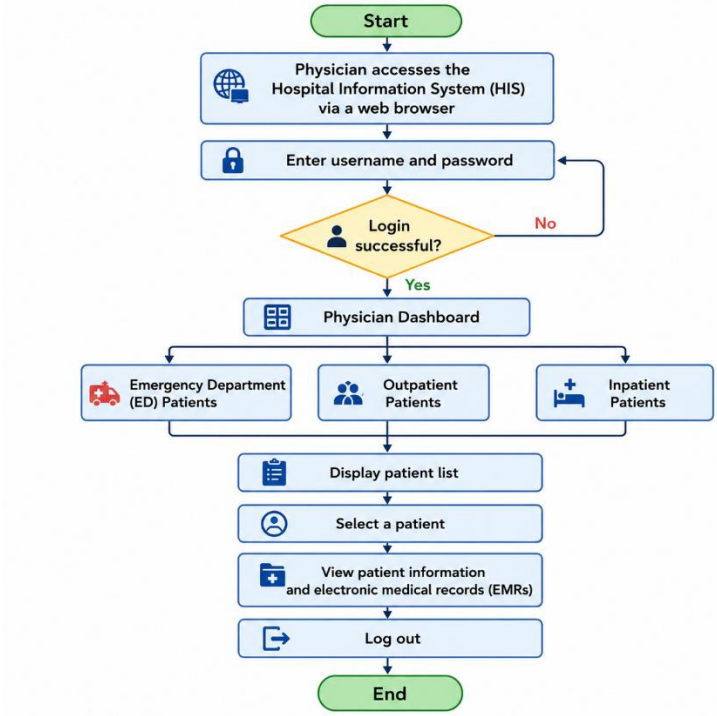

Figure 2. Existing Clinical Workflow at TK III Ciremai Hospital

The requirements analysis revealed several essential functionalities for the proposed mobile-based Physician Information System. Physicians require secure and real-time access to patient demographic information, Electronic Medical Records (EMRs), laboratory and radiology results, medication histories, and physician schedules through a single mobile platform. In addition to functional requirements, several non-functional requirements were identified, including data security, user authentication, system availability, ease of use, and interoperability with the existing Hospital Information System through RESTful APIs. These findings indicate that the proposed mobile application should not only improve physicians' mobility but also streamline clinical workflows by providing integrated access to multiple clinical information sources within a secure and user-friendly environment. The identified requirements subsequently served as the basis for designing the overall system architecture, database structure, application interfaces, and communication mechanisms presented in the following sections.

System Design

The system design phase aimed to develop the workflow of the proposed mobile-based Physician Information System integrated with the Hospital Information System (HIS).

The proposed workflow was modeled using a flowmap to illustrate the interaction between physicians and the integrated information system throughout the clinical service process.

1. Flowmap

The flowmap presented in Figure 3 illustrates the operational workflow of the proposed mobile-based Physician Information System integrated with the Hospital Information System (HIS). The process begins when a physician launches the mobile application and authenticates by entering a valid username and password. The system subsequently verifies the login credentials to ensure that the user has authorized physician privileges. If authentication fails, the user is prompted to re-enter the login credentials until successful authentication is achieved. After successful authentication, the system performs user identity verification before displaying the main dashboard. From the dashboard, physicians can select the required clinical service module, including the Emergency Department (ED), Outpatient, Inpatient, or Dashboard (Moment) module, depending on the healthcare service being provided. Once a service module is selected, the system retrieves and displays the corresponding patient list. Physicians may then select an individual patient to access detailed patient information, including demographic data, Electronic Medical Records (EMRs), laboratory results, radiology reports, and other relevant clinical information.

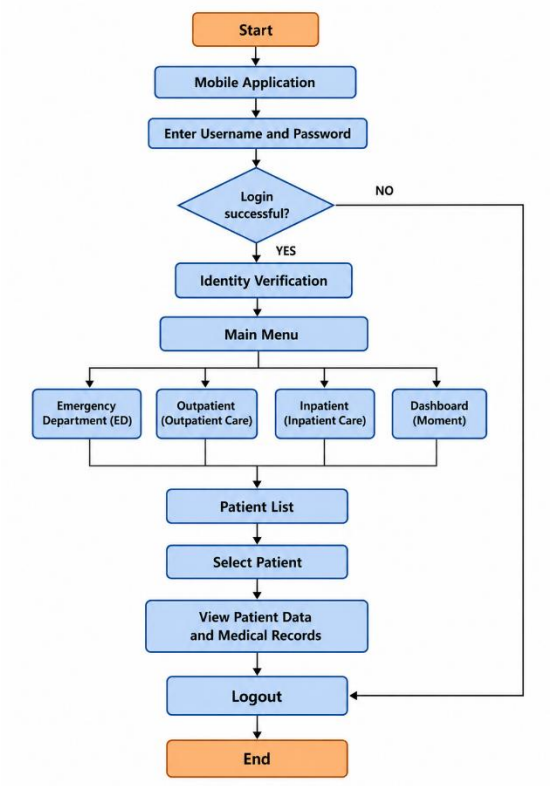

Figure 3. Flowmap of the Proposed Mobile-Based Physician Information System Integrated with the Hospital Information System (HIS)

The retrieved information supports physicians in performing clinical examinations, documenting medical findings, monitoring patient conditions, and making evidence-based clinical decisions. Upon completion of clinical activities, physicians can securely terminate their session by selecting the logout function, ensuring that patient information remains protected from unauthorized access. The proposed workflow is designed to improve physicians' accessibility to clinical information while maintaining compatibility with the existing clinical workflow and operational procedures implemented at TK III Ciremai

Hospital. Consequently, the proposed mobile application enhances physicians' mobility and information accessibility without disrupting established healthcare service processes.

2. Entity Relationship Diagram (ERD)

The Entity Relationship Diagram (ERD) presented in Figure 4 illustrates the database structure of the proposed mobile-based Physician Information System integrated with the Hospital Information System (HIS). The database consists of seven primary entities: Doctor, Patient, Medical Record, Examination Result, Doctor Schedule, Medical Service, and Authentication, which collectively support clinical service processes and secure information management. The Doctor entity contains the attributes Doctor_ID and Doctor_Name and is associated with the Authentication entity through the login process using User_ID and Password, ensuring that only authorized physicians can access the system. Each physician is also linked to the Doctor Schedule entity, which stores scheduling information, including Schedule_ID and Service_Date_Time, to support clinical service planning and availability. During healthcare service delivery, physicians provide medical care to Patients, and each consultation or treatment is documented in the Medical Record entity. This entity contains the attributes Medical_Record_ID and Diagnosis and serves as the central repository for patients' clinical information. The Medical Record entity is further associated with the Examination Result entity, which stores diagnostic information, including Examination_Result_ID and Examination_Type, representing laboratory tests, radiology reports, and other supporting clinical examinations. In addition, the Medical Record entity is related to the Medical Service entity, which contains Medical_Service_ID and Service_Type. This entity categorizes the healthcare services provided, such as Emergency Department (ED), Outpatient, and Inpatient services. Establishing this relationship enables the system to associate each medical record with the corresponding healthcare service, thereby improving data organization and facilitating clinical reporting.

Overall, the proposed ERD demonstrates an integrated database architecture that supports the complete clinical workflow. The process begins with physician authentication, followed by physician scheduling, patient management, medical record documentation, and the recording of examination results based on the healthcare services provided. This integrated data model serves as the foundation for developing a secure, efficient, and interoperable mobile-based Physician Information System capable of supporting clinical decision-making and improving healthcare service delivery.

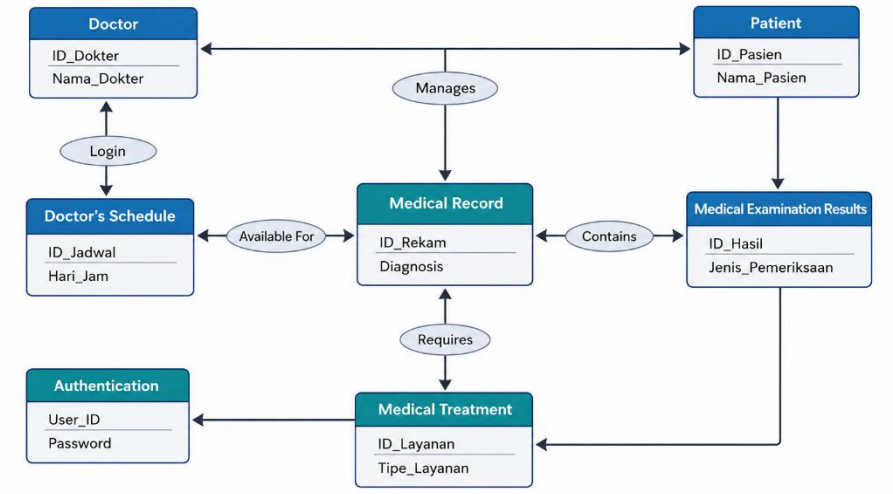

Figure 4. Entity Relationship Diagram of the Proposed Mobile-Based Physician Information System Integrated with the Hospital Information System (HIS)

3. Use Case Diagram

The Use Case Diagram presented in Figure 5 illustrates the interactions between system users and the proposed mobile-based Physician Information System integrated with the Hospital Information System (HIS). The system involves two primary actors: Physician and HIS Administrator (SIMRS Staff). The Physician serves as the primary actor and authenticates through the login function to gain secure access to the system. After successful authentication, the physician can perform several core functions, including viewing patient information, documenting Electronic Medical Records (EMRs) for Emergency Department (ED), Outpatient, and Inpatient services, reviewing laboratory and diagnostic examination results, managing clinical schedules, and accessing the clinical dashboard for monitoring healthcare activities.

The medical record documentation process and access to examination results are integrated with the existing Hospital Information System (HIS) through a centralized data integration mechanism. This integration ensures that patient information is stored consistently within a single repository, enabling real-time access to up-to-date clinical data while minimizing data duplication and maintaining information consistency across hospital departments. The HIS Administrator (SIMRS Staff) is responsible for managing and maintaining the interoperability between the mobile application and the Hospital Information System. This role includes monitoring data synchronization, maintaining system connectivity, and ensuring that integrated clinical information remains accurate, secure, and available to authorized users.

Overall, the Use Case Diagram demonstrates a clear separation of responsibilities between the two actors. Physicians primarily interact with the system to support clinical care and medical decision-making, whereas HIS administrators focus on system administration, data integration, and maintaining the reliability of information exchange. This role-based interaction contributes to secure system operation, efficient clinical workflows, and seamless interoperability between the mobile application and the existing Hospital Information System.

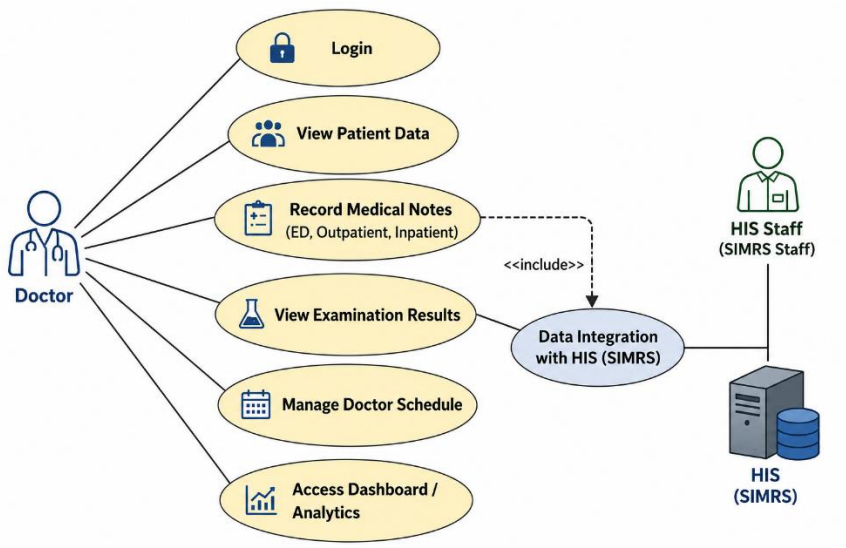

Figure 5. Use Case Diagram of the Proposed Mobile-Based Physician Information System Integrated with the Hospital Information System (HIS)

4. User Interface Design

The user interface was designed to provide physicians with a simple, intuitive, and efficient platform for accessing clinical information through mobile devices. The interface emphasizes usability, accessibility, and consistency with physicians' clinical workflows to

facilitate rapid information retrieval during healthcare service delivery. The proposed interface is presented as a series of mockups illustrating the primary application screens, including the login page, patient information, and Electronic Medical Records (EMRs).

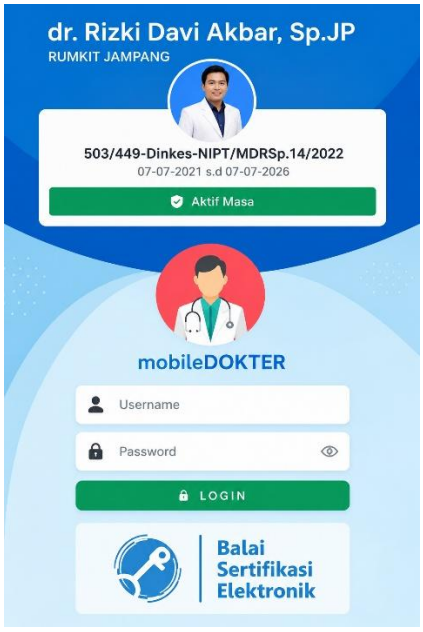

Figure 6. Mockup of the Mobile-Based Physician Information System Login Interface

Figure 6 presents the login interface of the proposed mobile-based Physician Information System, which serves as the entry point for authorized users. The interface displays the application identity together with an authentication form consisting of username and password input fields that must be completed by the physician before accessing the system. After selecting the "Sign In" button, the system validates the submitted credentials to verify the user's authorization. Upon successful authentication, the system performs an additional identity verification process using Balai Sertifikasi Elektronik (Electronic Certification Authority) to strengthen access security. This additional authentication layer ensures that only authorized physicians can access patient information and clinical services, thereby protecting sensitive medical data and complying with healthcare information security requirements.

The login interface adopts a clean and minimalist design with clear navigation components, readable typography, and responsive input controls to enhance usability across mobile devices. By integrating secure authentication with a user-friendly interface, the proposed design supports efficient physician access while maintaining the confidentiality, integrity, and security of patient information within the integrated Hospital Information System (HIS).

Discussion

System Requirements Analysis

The system requirements analysis revealed that physicians at TK III Ciremai Hospital require rapid, integrated, and real-time access to clinical information at the point of care. The current Hospital Information System (HIS) primarily relies on desktop- and web-based applications, requiring physicians to access patient information through fixed workstations. This limitation reduces physicians' mobility during ward rounds, emergency care, and outpatient services, making it difficult to obtain comprehensive patient information promptly. Consequently, delays in accessing Electronic Medical Records (EMRs), laboratory results, and diagnostic reports may affect the efficiency of clinical workflows and the timeliness of medical decision-making. Figure 6 illustrates the current integrated clinical progress note interface used within the Hospital Information System. Although the system successfully

consolidates multidisciplinary clinical documentation into a centralized Electronic Medical Record, access remains restricted to workstation-based environments. As a result, physicians cannot efficiently retrieve or review patient information while providing care in different clinical settings, highlighting the need for a mobile solution capable of extending HIS functionality to smartphone devices.

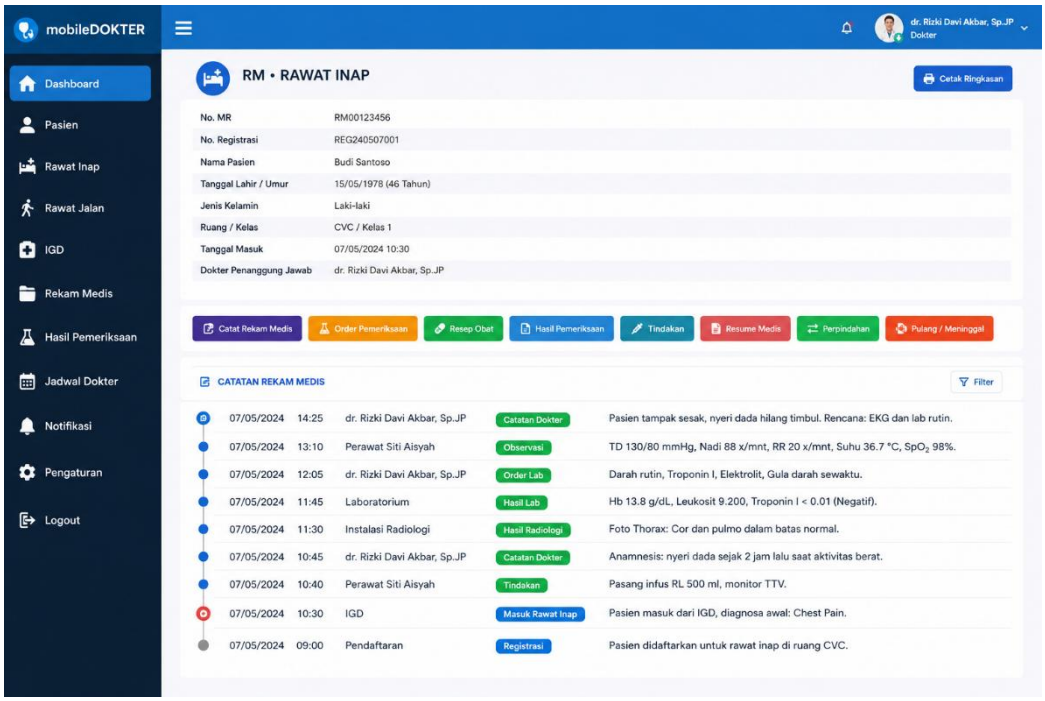

Figure 7. Integrated Clinical Progress Notes Interface

These findings are consistent with the Indonesian Ministry of Health Regulation No. 24 of 2022, which mandates the implementation of integrated Electronic Medical Records that are securely managed and accessible to authorized healthcare professionals according to their roles and responsibilities. The regulation emphasizes interoperability, information security, and timely access to patient information as fundamental requirements for digital healthcare systems. The identified requirements are also supported by previous studies. Ventola (2014) reported that mobile technologies significantly improve physicians' access to clinical information at the point of care, thereby increasing workflow efficiency and supporting evidence-based medical practice. More recently, Lin et al. (2025) demonstrated that integrating mobile applications with Electronic Medical Record (EMR) systems enables real-time access to patient data, improves communication among healthcare professionals, and enhances the quality and timeliness of clinical decision-making.

Based on these findings, the proposed mobile-based Physician Information System was designed to provide secure and integrated access to patient demographic information, Electronic Medical Records (EMRs), laboratory and radiology results, physician schedules, and other essential clinical information through a smartphone-based interface. By extending the existing Hospital Information System to mobile devices, the proposed system is expected to improve physicians' mobility, streamline clinical workflows, and facilitate faster and more informed clinical decision-making while maintaining compatibility with the hospital's existing information infrastructure.

System Design Using the Waterfall Model

The proposed mobile-based Physician Information System was designed using the Waterfall software development model, which provides a structured and sequential approach to software development. This methodology was selected because healthcare information systems typically operate in highly regulated environments where system stability,

comprehensive documentation, and compliance with institutional policies are critical. The sequential nature of the Waterfall model facilitates systematic requirement analysis and design, ensuring that each development phase is completed before progressing to the next stage. Figure 7 illustrates the access control mechanism implemented in the proposed system. When users attempt to access functions beyond their authorization level, the system generates an access notification indicating insufficient privileges. This mechanism supports role-based access control (RBAC) by ensuring that physicians can access only the clinical information and system functions corresponding to their assigned responsibilities.

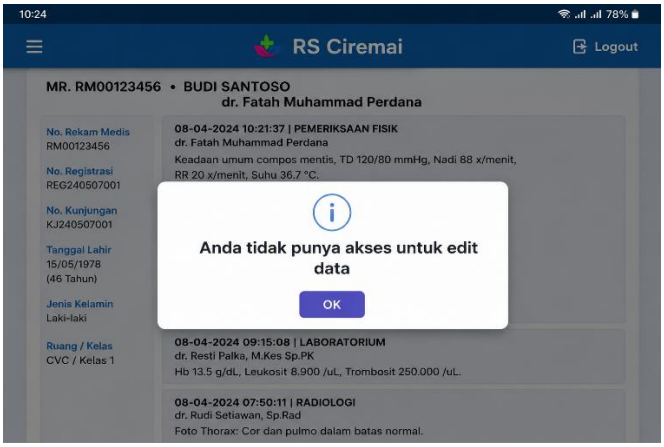

Figure 7. Access Authorization Notification

The implementation of access control is particularly important in healthcare information systems because patient information contains highly sensitive personal and clinical data. Restricting access based on user roles minimizes the risk of unauthorized data modification and supports compliance with healthcare information security policies. The additional authentication mechanism also strengthens data confidentiality and protects the integrity of Electronic Medical Records (EMRs) within the integrated Hospital Information System (HIS). The selection of the Waterfall model aligns with the operational characteristics of TK III Ciremai Hospital, where software development must comply with standardized clinical procedures, organizational policies, and regulatory requirements. Healthcare applications generally require extensive documentation and controlled system changes to ensure patient safety and operational continuity. Therefore, a structured software development methodology is more appropriate than iterative approaches for designing mission-critical clinical information systems. These findings are consistent with previous software engineering studies. Pressman and Maxim (2020) emphasized that the Waterfall model remains suitable for projects with stable and well-defined requirements because it provides complete documentation and facilitates quality assurance throughout the software development lifecycle. Similarly, Sommerville (2021) argued that sequential development improves software traceability, validation, and maintainability, making it particularly appropriate for healthcare environments that demand regulatory compliance and comprehensive documentation. Overall, the proposed system design demonstrates that combining a structured software development methodology with role-based access control provides a robust architectural foundation for developing secure and reliable mobile healthcare applications. This approach supports future implementation by ensuring that system functionality, information security, and clinical workflow requirements are systematically addressed throughout the software development process.

User Interface Design

The user interface was designed to support physicians' mobility by emphasizing usability, simplicity, and efficient navigation during clinical service delivery. The interface

follows a user-centered design approach that enables physicians to access essential clinical information with minimal interaction, thereby reducing cognitive workload during routine examinations, ward rounds, and emergency care. The design prioritizes clarity, consistency, and rapid information retrieval to facilitate efficient clinical workflows. Figure 8 presents the patient list interface of the proposed mobile-based Physician Information System. The interface displays essential patient information, including registration number, patient identity, age, and clinical service status, within a structured and easily accessible layout. Physicians can select an individual patient to access detailed Electronic Medical Records (EMRs), laboratory results, radiology reports, clinical progress notes, and other supporting medical information. The use of expandable menu components organizes clinical information into logical categories, enabling physicians to locate relevant data quickly without excessive navigation.

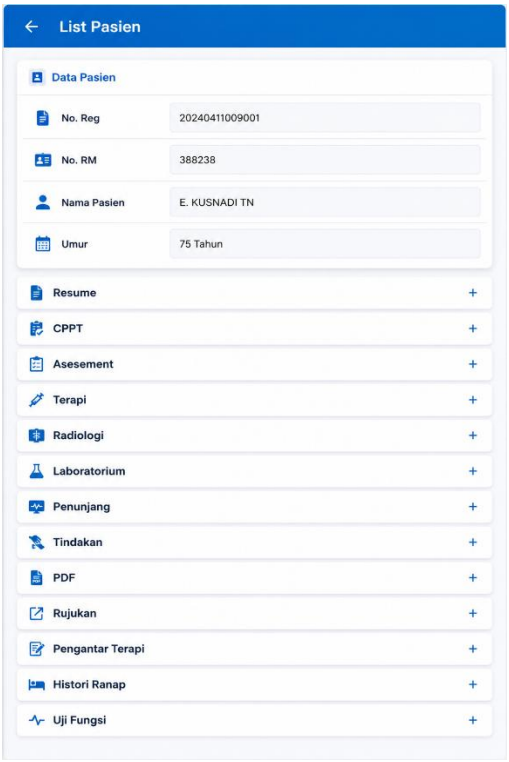

Figure 8. Patient List Interface of the Proposed Mobile-Based Physician Information System

The interface design adopts a minimalist layout with clear typography, standardized icons, and consistent color schemes to improve readability across various mobile devices. Navigation components are arranged hierarchically according to physicians' clinical workflows, minimizing unnecessary interactions and supporting rapid access to frequently used functions. This design approach is particularly beneficial in time-sensitive healthcare environments where physicians require immediate access to patient information. These findings are consistent with the study by Handayani et al. (2022), which reported that usability and user interface quality significantly influence healthcare professionals' acceptance of Hospital Information Systems. Systems with intuitive navigation, consistent layouts, and clear information presentation improve user satisfaction and increase the likelihood of successful technology adoption within healthcare organizations.

From the perspective of ISO 9241-11, which defines usability in terms of effectiveness, efficiency, and user satisfaction, the proposed interface addresses these three dimensions by providing an intuitive navigation structure, minimizing the number of interactions required to retrieve clinical information, and presenting patient data in a clear and organized manner. Furthermore, the interface design aligns with Nielsen's usability heuristics, particularly the principles of consistency and standards, visibility of system status, and recognition rather than recall, thereby reducing users' cognitive effort and facilitating efficient interaction with

the system. Overall, the proposed user interface provides a practical foundation for future implementation of the mobile-based Physician Information System. By combining user-centered design principles with integrated access to clinical information, the interface has the potential to improve physicians' productivity, support timely clinical decision-making, and enhance the overall quality of healthcare service delivery.

Validation

The proposed system design was evaluated through user validation to determine its suitability for supporting physicians' clinical activities at TK III Ciremai Hospital. Validation involved 10 participants, consisting of eight physicians and two Hospital Information System (HIS) administrators, using a structured questionnaire with a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The evaluation assessed system functionality, interface usability, information security, and overall system suitability. The validation produced an overall average score of 4.56 out of 5.00, indicating a high level of user acceptance. The highest scores were obtained for clinical functionality, data security, and navigation usability, demonstrating that the proposed design effectively supports physicians' operational needs while remaining compatible with existing clinical workflows. Respondents particularly appreciated the integration of Electronic Medical Records (EMRs), laboratory results, radiology reports, and physician schedules into a single mobile application, which is expected to improve the speed and efficiency of accessing clinical information. They also considered the user interface simple and intuitive, although several respondents suggested minor improvements to dashboard notifications and information presentation.

These findings are consistent with the Information Systems Success Model proposed by DeLone and McLean, which states that system quality, information quality, and service quality positively influence user satisfaction and intention to use an information system. The high validation scores indicate that the proposed system provides reliable functionality, integrated clinical information, and a user-friendly interface that contribute to positive user perceptions. The results are also supported by the Unified Theory of Acceptance and Use of Technology (UTAUT) developed by Venkatesh et al. Physicians believed that the proposed application would improve their clinical performance by providing fast and secure access to integrated patient information (performance expectancy). The simple interface and navigation reduced the effort required to operate the application (effort expectancy), while integration with the existing Hospital Information System and support from hospital infrastructure provided favorable conditions for future implementation (facilitating conditions).

From an information security perspective, the proposed design incorporates multi-factor authentication (MFA), role-based access control (RBAC), and electronic certificate-based authentication to protect sensitive patient information. These mechanisms support the principles of confidentiality, integrity, and availability (CIA Triad), ensuring that only authorized users can access clinical data while supporting compliance with healthcare information security requirements. Overall, the validation results demonstrate that the proposed system design is technically feasible and well accepted by prospective users. Although this study is limited to the system design and prototype validation stages and has not yet been implemented in a real clinical environment, the high acceptance score indicates that the proposed architecture provides a strong foundation for future system development, implementation, and usability evaluation at TK III Ciremai Hospital.

Table 2. Prototype Design Validation Results

Aspects Assessed	Average Score (1–5)	Remarks
Emergency Department (ED) Module Functionality	**4.7**	Comprehensive functionality consistent with ED clinical workflow
Outpatient and Inpatient	**4.6**	Integrated EMRs, laboratory results,

Module Functionality		radiology reports, and referral information
Patient Information Dashboard	**4.3**	Real-time clinical summary; dashboard notifications require minor improvements
Navigation and User Interface	**4.5**	Simple, intuitive, and easy to learn
Patient Data Security	**4.7**	Secure login, user authentication, and certified electronic signature support
Overall Average	**4.56**	High level of system suitability and usability

CONCLUSIONS AND RECOMMENDATIONS

This study presents the design of a mobile-based Physician Information System integrated with the Hospital Information System (HIS) at TK III Ciremai Hospital, Indonesia, with the objective of improving physicians' access to clinical information and supporting efficient healthcare service delivery. The findings demonstrate that the proposed system successfully addresses the identified user requirements by providing an integrated design that enables secure access to patient demographic information, Electronic Medical Records (EMRs), laboratory and radiology results, physician schedules, and other essential clinical information through a mobile platform. The system architecture, database model, RESTful API communication, and user interface were developed using the Waterfall software development model, resulting in a structured and well-documented system design suitable for highly regulated healthcare environments. The validation results indicate that the proposed design is well accepted by prospective users. The prototype evaluation involving eight physicians and two Hospital Information System (HIS) administrators produced an overall average score of 4.56 out of 5.00, indicating a high level of acceptance regarding system functionality, usability, navigation, and information security. These findings suggest that the proposed design effectively supports physicians' clinical workflows while maintaining compatibility with the existing Hospital Information System. Furthermore, the integration of secure authentication mechanisms, role-based access control, and centralized clinical information management provides a solid foundation for protecting sensitive patient information and supporting evidence-based clinical decision-making.

The primary contribution of this research lies in the development of a comprehensive architectural design for a mobile-based Physician Information System that integrates mobile health technologies with an existing Hospital Information System through RESTful API-based interoperability. Unlike many previous studies that primarily focused on application implementation, usability evaluation, or isolated mobile healthcare functionalities, this research emphasizes a systematic software engineering approach encompassing requirements analysis, Unified Modeling Language (UML), Entity Relationship Diagram (ERD), database design, user interface design, and secure integration architecture. The study also contributes practical knowledge by addressing the specific operational requirements of an Indonesian military hospital, where regulatory compliance, structured workflows, and information security are critical considerations. Consequently, the proposed design provides a practical blueprint for future implementation of integrated mobile healthcare applications in similar healthcare institutions.

Despite these contributions, several limitations should be acknowledged. First, the study is limited to the system design and prototype validation stages, and therefore does not include software implementation or real-world deployment within the hospital environment. As a result, system performance, response time, interoperability efficiency, and clinical impact could not be evaluated. Second, the validation involved a relatively small number of participants from a single hospital, which may limit the generalizability of the findings to other healthcare settings. Finally, the study focused primarily on physicians' requirements and

did not investigate the perspectives of other healthcare professionals, such as nurses, pharmacists, or laboratory personnel, who also interact with the Hospital Information System. Future research should extend this work by implementing the proposed system in a real clinical environment and evaluating its technical performance, usability, and clinical effectiveness through longitudinal studies involving a larger and more diverse group of healthcare professionals. Future investigations may also assess the impact of the mobile application on physicians' productivity, patient safety, workflow efficiency, and clinical decision-making using standardized evaluation models such as ISO/IEC 25010, the System Usability Scale (SUS), or the Technology Acceptance Model (TAM). From a technical perspective, future development could incorporate interoperability standards such as HL7 FHIR, cloud-based architectures, and artificial intelligence technologies to support predictive analytics and clinical decision support. In addition, expanding the application to include multidisciplinary healthcare professionals and integrating advanced security mechanisms, such as biometric authentication and zero-trust security architectures, would further enhance the applicability and scalability of the proposed system. These developments would strengthen the role of mobile health technologies in supporting secure, efficient, and patient-centered digital healthcare services.

REFERENCES

Adler-Milstein, J., Holmgren, A. J., Kralovec, P., Worzala, C., Searcy, T., & Patel, V. (2023). Electronic health record adoption and interoperability among U.S. hospitals: Progress and remaining challenges. Health Affairs, 42(2), 210–218. https://doi.org/10.1377/hlthaff.2022.01234

Beierle, F., Neuhäuser, L., Prokosch, H. U., & Sedlmayr, M. (2023). Data quality challenges in electronic health records: A systematic review. Journal of Clinical Medicine, 12(5), 1782. https://doi.org/10.3390/jcm12051782

DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: A ten-year update. Journal of Management Information Systems, 19(4), 9–30. https://doi.org/10.1080/07421222.2003.11045748

Faradiba, F., Hidayanto, A. N., & Sandhyaduhita, P. I. (2023). Development of mobile health applications to improve patient monitoring in Indonesian hospitals. Healthcare Informatics Research, 29(3), 198–210. https://doi.org/10.4258/hir.2023.29.3.198

Fielding, R. T. (2000). Architectural styles and the design of network-based software architectures (Doctoral dissertation). University of California, Irvine. https://www.ics.uci.edu/~fielding/pubs/dissertation/top.htm

Handayani, P. W., Hidayanto, A. N., Sandhyaduhita, P. I., & Ayuningtyas, D. (2022). Factors affecting hospital information system acceptance in Indonesian hospitals. BMC Medical Informatics and Decision Making, 22(1), 198. https://doi.org/10.1186/s12911-022-01988-4

Idris, M., Rahman, A., & Nugroho, Y. (2024). Mobile electronic medical record system for improving physicians' access to patient information. International Journal of Medical Informatics, 186, 105402. https://doi.org/10.1016/j.ijmedinf.2024.105402

International Organization for Standardization. (2018). ISO 9241-11:2018 Ergonomics of human-system interaction—Part 11: Usability: Definitions and concepts. https://www.iso.org/standard/63500.html

Kementerian Kesehatan Republik Indonesia. (2022). Peraturan Menteri Kesehatan Republik Indonesia Nomor 24 Tahun 2022 tentang Rekam Medis. https://peraturan.bpk.go.id/

Kharrazi, H., Wang, C., & Scharfstein, D. (2022). Interoperability of health information systems using RESTful APIs: Current challenges and future directions. Journal of Biomedical Informatics, 132, 104122. https://doi.org/10.1016/j.jbi.2022.104122

Lin, S., Bates, D. W., Allen, J., Wright, A., & Mao, L. (2025). Mobile electronic health record applications and physician workflow efficiency: A multicenter study. International Journal of Medical Informatics, 191, 105598. https://doi.org/10.1016/j.ijmedinf.2025.105598

Nielsen, J. (1994). Usability engineering. Morgan Kaufmann.

Oracle. (2024). Java documentation. https://docs.oracle.com/en/java/

Pressman, R. S., & Maxim, B. R. (2020). Software engineering: A practitioner's approach (9th ed.). McGraw-Hill.

Sommerville, I. (2021). Software engineering (11th ed.). Pearson.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 27(3), 425–478. https://doi.org/10.2307/30036540

Ventola, C. L. (2014). Mobile devices and apps for health care professionals: Uses and benefits. Pharmacy and Therapeutics, 39(5), 356–364.

World Health Organization. (2021). Global strategy on digital health 2020–2025. https://www.who.int/publications/i/item/9789240020924

MySQL. (2024). MySQL 8.4 Reference Manual. Oracle Corporation. https://dev.mysql.com/doc/

Google. (2024). Android Developers: Build apps for Android. https://developer.android.com/