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Design and Development of a Web-Based Daily Surgery Schedule Information System at Al-Ihsan Hospital

Qurrotul Aini [1*], Mughits Aditya [2]

[1,2] *Syarif Hidayatullah State Islamic University Jakarta, Faculty of Science and Technology, Information Systems, Ir. H. Juanda Street No. 95, Ciputat, East Ciputat District, South Tangerang City, Banten 15412,Indonesia*

Keyword

Daily Surgery Schedule; Information Systems; PHP; RAD

Corresponding Author:
qurrotul.aini@uinjkt.ac.id

Abstract

This research focuses on the design and implementation of a web-based daily surgery scheduling information system at Al-Ihsan Regional Hospital to overcome the limitations of the previously used manual scheduling process, which often caused data entry errors, scheduling conflicts, delays in information updates, and difficulties in accessing accurate schedule information. The system was developed using the Rapid Application Development (RAD) methodology, consisting of requirements analysis, system design and modeling using Unified Modeling Language (UML), and system implementation using the Laravel 8 framework (PHP based) to support application logic and rapid web development, Bootstrap for responsive and user-friendly interface design, and MariaDB as the database management system for storing and managing scheduling data. The application was deployed on an Apache web server through the Laragon environment. Data were collected through direct observation of hospital operational workflows, interviews with medical and administrative staff, and a review of relevant literature. The results of this study indicate that, based on User Acceptance Testing (UAT) involving five respondents with an average usability score of 4.4 out of 5, users perceived that the proposed system supported more efficient daily surgery scheduling activities, facilitated schedule monitoring, and reduced the likelihood of manual scheduling errors. In addition, users positively evaluated the usability of the interface for schedule management and monitoring activities. The implementation of authentication mechanisms and role-based access control was also perceived to support secure access management for sensitive scheduling information within the evaluated environment. Overall, this research demonstrates the practical application of information systems concepts in supporting digital transformation initiatives and improving operational performance within the hospital environment effectively and sustainably.

1. Introduction

The accuracy and effectiveness of surgery scheduling play a crucial role in determining the quality of hospital services. In practice, however, many hospitals continue to manage daily elective surgery schedules manually,

which often leads to operating room conflicts and delays in medical treatment. To address these challenges, a web-based information system was built entirely from scratch establishing a newly tailored digital architecture rather than modifying an existing legacy system to support more accurate, efficient, and real-time surgery scheduling management. The system was implemented using Laravel 8, Bootstrap, and MariaDB as the database management. system selected for their scalability, security features, and ease of system integration. The development process applied the Rapid Application Development (RAD) methodology, which emphasizes rapid and iterative prototyping, enabling user requirements to be identified and fulfilled within a relatively short development cycle. In the first development iteration, the prototype was evaluated by hospital administrative staff, who reported difficulties related to complex data entry forms and schedule readability. Based on this feedback, the interface layout and data organization were simplified to improve usability. In the second iteration, doctors evaluated the revised system and recommended clearer role separation and easier schedule monitoring. Consequently, Role-Based Access Control (RBAC) and a real-time monitoring interface were implemented to strengthen access security and operational accessibility. These iterative revisions demonstrate continuous user involvement and feature refinement within the RAD development cycle, resulting in a solution that better aligns with operational needs and scheduling performance [1].Furthermore, as demonstrated in recent studies, implementing a dedicated digital surgery scheduling system significantly improves theatre utilization and operational efficiency compared to manual methods [2].

System design is the stage of translating analysis results into a structured design that serves as a reference for system implementation, ensuring functionality, ease of understanding, and support for further system development [3]. In the context of surgery scheduling, the continued use of manual methods in several hospitals still leads to issues such as scheduling conflicts and delays in medical procedures. Therefore, an integrated, real-time web-based information system is required to efficiently manage surgery schedule data through CRUD functionalities [4]. To support system planning and development, a SWOT analysis was applied to identify the organization's internal and external factors [5]. as well as to monitor potential operational threats such as patient mismanagement or data errors which can be effectively mitigated through the proper implementation of modern health information systems [6]. as well as the McFarlan Strategic Grid to classify the role of information systems based on their level of importance in supporting organizational performance [7]. System modeling was conducted using Unified Modeling Language (UML) as the standard language for object-oriented system analysis and design. UML provides various diagrams, such as use case, activity, sequence, and class diagrams, which are used to systematically visualize the system's structure and behavior [8]. The software development methodology known as Rapid Application Development (RAD) aims to accelerate the system development process by utilizing short, iterative work phases. As part of the system development life cycle, this approach can be regarded as a means of rapidly extending the Waterfall model through component-based architecture, enabling the delivery of an efficient system within a relatively short timeframe [9]. The Rapid Application Development (RAD) approach was selected because it employs prototyping and iterative work cycles to facilitate rapid system development with a high level of flexibility. This method supports continuous user participation, allowing the system to adapt to real-world requirements while reusing existing components to accelerate development. In addition, the adaptability of the RAD methodology enables quick modifications in response to evolving requirements throughout the system development phase [10].

Several previous studies have developed hospital information systems using the Rapid Application Development (RAD) method. Sopiah and Yehezkiel developed a nursing information system to integrate nurse activity data and reporting processes in hospital environments [11]. Meanwhile, Pratiwi et al. designed a web-based medical record information system to improve the management of patient data and healthcare services [12]. In addition, Hardiyanti et al. developed a hospital patient registration information system using the RAD method to improve the efficiency of administrative services [13]. This trend is also supported by the implementation of Permenkes No. 24 of 2022, which encourages healthcare facilities to adopt electronic medical records and integrated health information systems [14].

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However, most of these studies focus on nursing information systems, medical record management, or hospital reporting systems. Surgery scheduling is one of the critical operational activities in hospitals because it directly affects operating room utilization, coordination among medical personnel, and service efficiency [15]. Limited research specifically discusses the development of a web-based information system for managing daily surgery schedules in hospital environments. Therefore, this study aims to develop a web-based daily surgery scheduling information system using the RAD method to improve accessibility, scheduling accuracy, and coordination among hospital staff.

2. Research Method

The research report includes the research methodology, which describes the procedures for conducting the study, collecting data, and implementing the system, as illustrated in Figure 1.

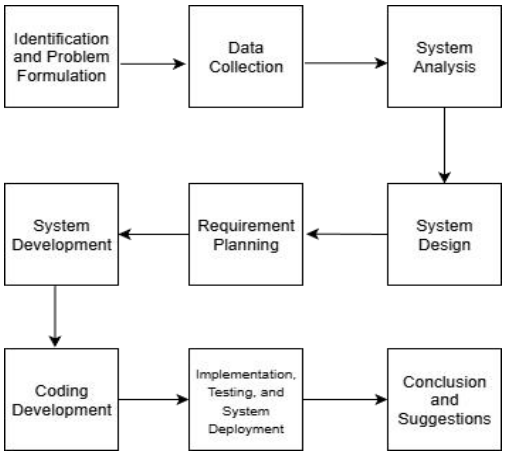


Figure 1. Research Method

The study began with problem identification and data collection through observation, interviews, and literature study, which were subsequently analyzed using SWOT analysis and the McFarlan Strategic Grid. The McFarlan Strategic Grid was utilized to evaluate the strategic contribution of the proposed system by categorizing its current and future impact on hospital operational activities. Previous studies have also applied the McFarlan Strategic Grid in healthcare information system planning to support application prioritization and strategic decision-making processes [16]. Following these analyses, the development process strictly applied the Rapid Application Development (RAD) methodology. It is important to note that the system was built entirely from scratch to ensure the new digital architecture aligns perfectly with the hospital's needs, rather than modifying an existing system. The RAD phases included requirement planning, system design, and the coding process using Laravel 8 (PHP framework), Bootstrap, and MariaDB. Prior to system implementation, system testing was conducted through functional testing and User Acceptance Testing (UAT). User Acceptance Testing (UAT) is widely used to evaluate user acceptance and system usability from the end-user perspective. The evaluation of information systems commonly focuses on effectiveness, efficiency, and user satisfaction aspects to determine whether the developed system meets user needs and expectations [17]. The UAT involved 5 respondents consisting of 3 administrators, 2 doctors from Al-Ihsan Hospital. The evaluation employed a usability questionnaire using a 5-point Likert scale because it provides a balanced approach for measuring user perceptions and is widely used in information system evaluation studies [18]. interface clarity, efficiency, security perception, and overall user satisfaction. The evaluation results showed an average usability score of 4.4 out of 5, indicating that users positively accepted the developed system and considered it supportive of daily surgery scheduling activities.

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3. Result and Discussions

3.1 Requirements Planning Phase

SWOT analysis and the McFarlan Strategic Matrix were applied in the system evaluation to identify internal and external aspects as well as to assess the strategic value of the system. Tables 1 to 2 present the analysis results.

Table 1. SWOT Analysis of the Current System

Strength (S)	**Weakness (W)**
The administrator manages daily surgery schedules through manual data entry or Excel file uploads into the web-based system.	Dependence on administrators may limit doctors' access to scheduling information..
Opportunity (O)	**Threat (T)**
Growing adoption of digital health systems in Indonesian hospitals, government digital transformation initiatives, and increasing availability of cost-effective open-source web technologies support wider implementation of surgery scheduling systems.	System downtime may disrupt surgery scheduling operations, resistance from users unfamiliar with digital workflows may affect adoption, and future network connectivity may introduce data security vulnerabilities.

Table 2. McFarlan Strategic Grid Analysis

Strategic	**High Potential**
A web-based surgical scheduling system allows direct access for administrators and doctors, thereby improving operational efficiency.	Data security systems, automatic backup mechanisms, and real-time monitoring have the potential to become essential requirements in preventing future attacks.
Key Operational	**Support**
The surgical scheduling database is not yet scalable.	Supporting administrative systems assist operational activities; however, their impact is minimal during system disruptions.

The findings obtained from the SWOT analysis and McFarlan Strategic Grid were directly translated into several system design decisions. The identified strength related to centralized schedule management supported the development of integrated scheduling functionalities, while the weakness concerning dependence on administrators led to the implementation of a role separation mechanism in which doctors were assigned view-only access to surgery schedule information. Furthermore, the opportunities associated with the increasing adoption of digital health systems and digital transformation initiatives encouraged the development of a scalable web-based architecture. The identified threats regarding operational disruptions and data security risks informed the implementation of authentication and Role-Based Access Control (RBAC) mechanisms. In addition, the High Potential quadrant emphasizing real-time monitoring motivated the development of the Live-View feature to support faster schedule dissemination and monitoring activities. These analysis outcomes served as the foundation for defining the functional requirements and design priorities of the developed system.

3.2 System Design

The system design phase focused on translating user requirements gathered during the RAD requirement planning stage into an operational web-based surgery scheduling system. The design emphasized usability,

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security, and operational efficiency through structured authentication, role separation, and organized data management features aligned with the research objectives.

To support access security and role separation, the system implements a Role-Based Access Control (RBAC) approach that assigns different access privileges to administrators and doctors according to their responsibilities within the surgery scheduling process. RBAC is commonly applied in healthcare information systems to ensure that users can only access functions and information relevant to their authority levels [19].

The identification of system actors was conducted to define user responsibilities and access boundaries within the developed system. Table 3 presents the actors involved in the daily surgery scheduling system, including administrators, patients, and doctors, together with their respective roles in supporting scheduling operations.

Table 3. Actor Identification

No	Actor	Description
1	Admin	The admin is authorized to manage and input patient data into the database.
2	Patient	The patient registers with the administration to participate in the daily surgery schedule.
3.	Doctor	The doctor can view patient data to check the surgery schedule without the assistance of the admin.

3.3 Development

This section presents the user interface (UI) design developed to support the research objectives related to security, efficiency, and usability within the daily surgery scheduling process.

Figure 2 presents the login interface used to authenticate users before accessing the system. The implementation of authentication supports the research objective related to security by restricting access privileges according to authorized user roles.

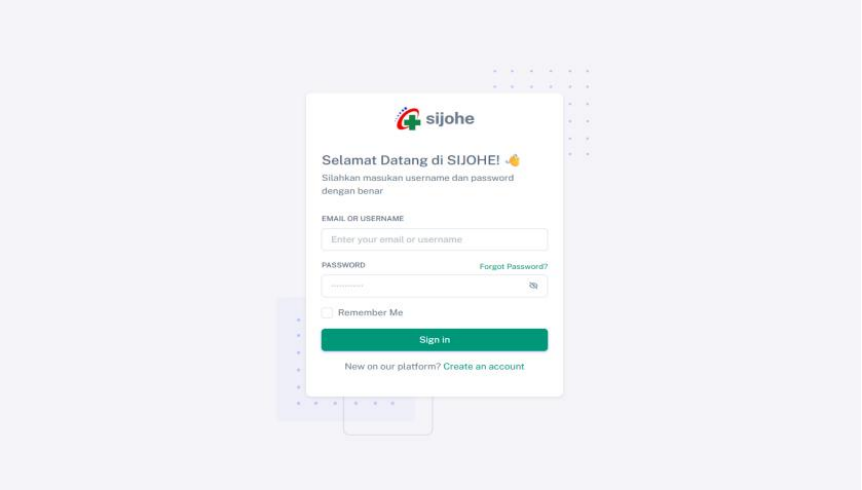


Figure 2. User Login Page

Figure 3 illustrates the dashboard interface that centralizes scheduling information within a single page. This design contributes to operational efficiency by enabling users to monitor daily scheduling activities more quickly and reducing the need for manual navigation across multiple pages.

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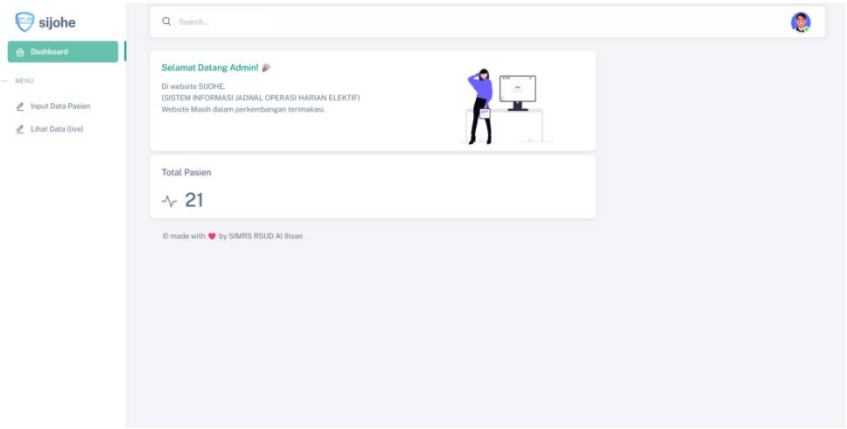


Figure 3. Dashboard

Figure 4 shows the surgery schedule input interface. The structured form design and validation mechanism improve usability and support scheduling accuracy by helping users enter data in a more organized manner while reducing the possibility of duplicate or incorrect schedule entries.

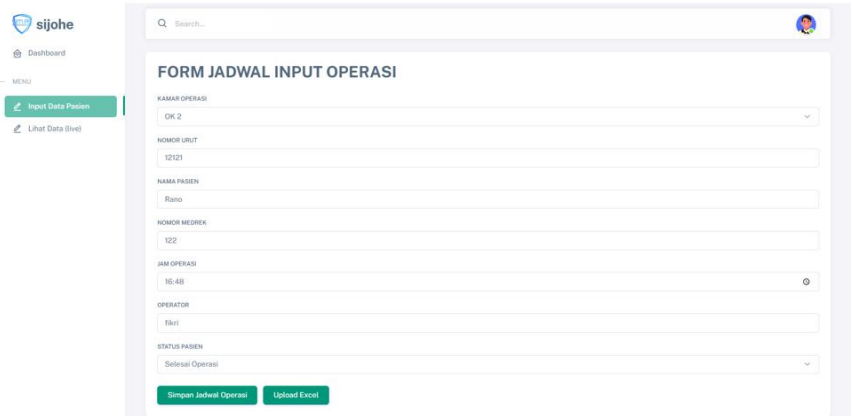


Figure 4. Surgery Schedule Input Form

Figure 5 presents the Live-View monitoring interface used for displaying real-time surgery schedule information. This feature supports operational efficiency and accessibility by facilitating rapid information dissemination without relying on manual communication procedures.

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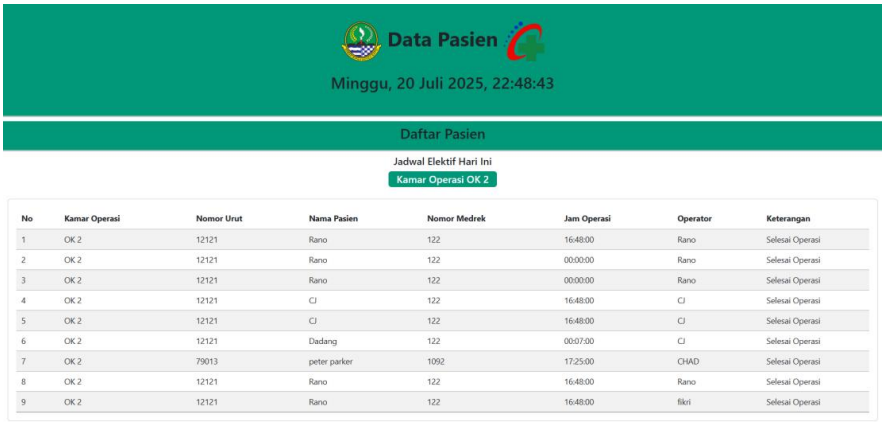


Figure 5. View Data Page (Live)

3.4 Testing

System testing was conducted to verify that the technical results align with the research objectives. Beyond basic login and logout functionality, the testing phase emphasized data integrity and access security. Table 4 details the scenario-based testing, including User Acceptance Testing (UAT) with hospital staff. The testing results indicate that the implemented Role-Based Access Control (RBAC) appropriately separates administrative privileges from medical view-only access, contributing to improved system security. fulfilling the claim of enhanced system security. Additionally, The conflict-prevention testing demonstrated that the validation mechanism was capable of identifying and blocking duplicate scheduling inputs during the evaluated test scenarios. supporting scheduling accuracy and reducing the potential occurrence of duplicate or conflicting schedules during operational activities.

Table 4. Testing for Admin and Doctors

No	Test Scenario	Pre-Condition	Expected Behavior	Analytical Observation & Result	Status
1	Admin Authentication	User enters valid credentials via the login page.	System authenticates and directs to the main dashboard.	Authentication testing conducted on 10 login attempts showed that valid credentials consistently granted access according to assigned user roles.	Success
2	Surgery Data Entry	Admin inputs new patient schedule without any time conflicts.	Data is securely saved into the database.	All tested schedule entries were successfully stored and retrieved from the database without detected data loss during evaluation.	Success
3.	Conflict Validation	Admin deliberately inputs a schedule for an already booked Operating Room.	System blocks the input and displays a validation error.	During 10 simulated duplicate scheduling attempts, the validation mechanism successfully blocked conflicting entries and generated warning notifications.	Success
4.	TV Live-View Sync	Admin updates or deletes a schedule on the dashboard.	The Live-View interface updates asynchronously.	Schedule updates performed by administrators were reflected in the monitoring interface during testing without requiring manual synchronization.	Success
5.	Doctor Access Restriction Verification	Doctor logs into the system and attempts to access the	System blocks the action and displays an access-denied	During role-restriction testing, doctor accounts were unable to access administrative input and	Success

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No	Test Scenario	Pre-Condition	Expected Behavior	Analytical Observation & Result	Status
		surgery schedule input form or edit existing schedule data.	notification.	editing functions. The system consistently displayed an access restriction message, confirming that RBAC correctly separated administrative privileges from doctor view-only access.	

The results of this study indicate that, based on User Acceptance Testing (UAT) involving five respondents with an average usability score of 4.4 out of 5, users perceived that the developed web-based surgery scheduling information system supported more efficient scheduling management and facilitated schedule monitoring activities. The implementation of backend validation mechanisms helped prevent duplicate scheduling inputs during the evaluated testing scenarios. Furthermore, the Rapid Application Development (RAD) methodology enabled iterative refinement through continuous user feedback, resulting in interface simplification, role separation, and enhanced monitoring functionality. These findings are consistent with previous studies demonstrating that the RAD methodology supports the rapid development of integrated hospital information systems while improving the accessibility and efficiency of medical record and administrative services[11],[12],[13]]. However, unlike previous studies that primarily focused on nursing management, medical records, or patient registration, the present study specifically addresses the management of daily surgery schedules. In addition, the Live-View feature enhanced operational accessibility by enabling faster dissemination of scheduling information during the evaluated testing process. These findings are also consistent with previous scheduling information system studies reporting that improved schedule visibility and accessibility support operational coordination and reduce scheduling-related issues [20]. The integration of real-time schedule monitoring, backend validation, and role-based access within a single web-based platform represents the main contribution of the proposed system in supporting more efficient surgery scheduling management.

The usability score obtained in this study also compares favorably with findings reported in other campus and healthcare information system evaluations. A usability testing study of a university KKD (community service program) information system, evaluated using the System Usability Scale across 75 respondents, reported a satisfaction score of only 59%, which falls into the marginal acceptability range despite the same system achieving high effectiveness (98%) and efficiency (94.89%) scores on task-based performance measures [18]. This gap between functional performance and user satisfaction in that study stands in contrast to the present findings, where the average usability score of 4.4 out of 5 reflects a uniformly positive perception across interface clarity, efficiency, and satisfaction dimensions. Several factors plausibly explain this difference. First, the cited study evaluated an already-deployed system through retrospective testing, without the iterative, user-involved refinement cycle that RAD provides; the present system, by contrast, incorporated direct feedback from administrative staff and doctors during two development iterations, which directly shaped interface simplification and role separation before deployment. Second, the much smaller and more targeted respondent group in this study, comprising five users who were also the system's primary intended operators, may have produced a more favorable but less generalizable usability assessment compared to the broader and more heterogeneous 75-respondent sample in the cited study. A usability evaluation of a pharmacy management information system reported a comparatively higher System Usability Scale score of 79.17, categorized as good and acceptable [17], a result more consistent with the present findings despite differences in measurement instrument. Taken together, these comparisons suggest that the positive usability perception observed in this study is plausible given the RAD methodology's emphasis on iterative user involvement, but should be interpreted with appropriate caution given the limited and non-representative sample size, a limitation already acknowledged in the conclusion of this study.

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4. Conclusions and Future Works

The development of the web-based daily surgery scheduling information system using the Rapid Application Development (RAD) method demonstrated that the developed system supported daily surgery scheduling management through authentication, role separation, validation mechanisms, and real-time monitoring features. Based on User Acceptance Testing (UAT) involving five respondents from Al-Ihsan Hospital, with an average usability score of 4.4 out of 5, users positively evaluated the system in supporting scheduling activities, monitoring accessibility, and access management within the evaluated environment.

This study has several limitations. First, the User Acceptance Testing (UAT) involved only five respondents from a single hospital environment, which may limit the generalizability of the usability findings to broader healthcare settings. Second, the developed system has not yet been evaluated under real production conditions involving live patient data and full-scale hospital operational workloads. Third, the scope of the developed system is limited to daily surgery scheduling activities and does not cover other hospital operational modules such as electronic medical records, billing systems, or integrated clinical management processes.

Future research may focus on integrating the developed system with Electronic Medical Record (EMR) platforms to support broader clinical interoperability. In addition, further studies should involve larger and more diverse respondent samples to strengthen the validity of usability evaluations. Performance benchmarking under high-load operational conditions can also be conducted to evaluate system scalability, response time, and reliability within real hospital environments.

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