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Article

SIM Puskesmas: An Integrated Management Information System for Administration, Doctor Consultations, and Web-Based Pharmacy Services at UPT Karang Anyer Using Research and Development (R&D) Approach

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Abstract: Primary health care facilities such as Community Health Centers (Puskesmas) face inefficiencies due to manual data collection. This study aims to develop an integrated web-based Community Health Center Management Information System (SIM-PUSKESMAS) to improve service efficiency and data accuracy. Using the Research and Development (R&D) method with the Waterfall model, the system was designed using UML and implemented with PHP and MySQL. The novelty of this study lies in the seamless integration of Queue Management, SOAP-based Medical Records, and Pharmacy inventory in a single architecture, addressing the fragmentation issues found in previous systems. The system was tested using Black Box testing and User Acceptance Testing (UAT). The results showed a 100% functional success rate in Black Box testing. Furthermore, UAT results from 10 respondents indicated a user satisfaction score of 88.4% (Very Good), demonstrating that the system is highly effective. Comparison with manual systems shows that this digital system significantly reduces administrative time and improves clinical data accuracy. It is concluded that SIM-PUSKESMAS effectively ensures data integrity and supports better governance.

Keywords: Information Systems; Websites; Health services

1. Introduction

Community Health Centers (Puskesmas) are healthcare facilities that play a crucial role in Indonesia. These institutions provide comprehensive, integrated, and sustainable healthcare services to the community to improve overall public health. Furthermore, Puskesmas serve as the spearhead of the national healthcare system, focusing on promotive and preventive efforts, not just curative ones. Their strategic role makes Puskesmas a crucial institution in ensuring equitable, accessible, and high-quality healthcare for all levels of society [1], [2]. The government strives to maintain the consistent performance of community health centers (Puskesmas) with the aim of facilitating public access to healthcare services, including the management of patient data, employee data, and medication records used in the centers. However, in practice, data recording in several Puskesmas is still carried out manually, by writing information on paper sheets that are then stored in archive shelves or on laptops. This condition leads to significant delays when retrieving patient data or reports related to medication usage when needed [3], [4].

Digital transformation in the healthcare sector has become a strategic step in addressing challenges related to efficiency and service accuracy at primary healthcare facilities such as community health centers (Puskesmas). The use of web-based information systems enables every administrative and healthcare service process to be connected in real time, allowing data to be updated and accessed anytime without spatial or temporal limitations. Integration between work units from administrative services and medical consultations to pharmaceutical services creates a more effective and transparent workflow [5]. In addition, the implementation of a web-based system also supports centralized data management, minimizes the risk of information loss, and provides an accurate data foundation for managerial decision-making [6]. Thus, the implementation of an integrated information system at Puskesmas Karang Anyer is not only focused on improving operational efficiency, but also serves as a concrete step toward sustainable digitalization of healthcare services.

However, existing studies often focus on partial solutions. For instance, Marfalino et al. [7], [8] focused solely on geographical mapping, while other studies primarily addressed administrative data without integrating clinical records (SOAP) and pharmacy inventory in real-time. A significant research gap remains in developing a fully unified system that connects patient registration queues directly to medical records and pharmacy stock for rural healthcare centers. This study addresses this gap by proposing SIM-PUSKESMAS, which integrates these three core modules to ensure data continuity and minimize redundancy.

2. Materials and Methods

2.1 Research Approach

This study employs a Research and Development (R&D) approach with the aim of producing a web-based integrated information system capable of improving service efficiency and data management at Puskesmas Karang Anyer. This approach was chosen because it allows the researcher not only to conduct needs analysis, but also to design, implement, and test the system [7], [8]

2.2 Data collection

The data collection stage was carried out using three primary methods to ensure comprehensive requirement gathering:

1. Direct Observation: Conducted to observe the actual service flow and identify bottlenecks in the existing manual system [7], [8].
2. Semi-structured Interviews: Performed with key stakeholders, including administrative staff, doctors, and data managers, to explore specific system requirements and identify challenges in information management [7], [8].
3. Administrative Archive Documentation: Used as a secondary data source to verify the accuracy of the information obtained through observation and interviews. This triangulation ensures the data aligns with end-user needs [7], [8].

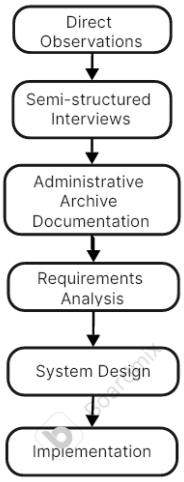


Figure 1. Research Stages Flowchart

Figure 1 illustrates the sequence of research stages, beginning with direct observations, semi-structured interviews, and the collection of administrative archive documentation as the initial data-gathering methods. These three methods are used to obtain preliminary information regarding service workflows and system needs at Puskesmas Karang Anyer. The collected data is then analyzed in the requirements analysis stage to identify the main problems and functional needs that the system must address. The results of this analysis serve as the basis for the system design process, which focuses on designing the structure, workflow, and user interface of the system. The final stage is implementation, where the design is transformed into an operational information system that can be utilized by users in accordance with real field requirements.

2.3 System Design

System design was carried out using an analysis and modeling approach with Unified Modeling Language (UML) as the main tool. UML was chosen due to its ability to visually and structurally represent object-oriented systems, making it easier to perform requirements analysis, architectural design, and communication among development team members. The system modeling includes several main diagrams as follows:

1. Use Case Diagram, used to define the interactions between actors (admin, doctor, pharmacist, and patient) and the main system functions, such as login, patient data management, medical consultations, prescription management, and report generation.
2. Class Diagram, used to model the relationships between core entities such as User, Patient, Doctor, Medicine, and Medical Record.
3. Sequence Diagram, It functions to illustrate the sequence of communication between objects in executing system processes, starting from the user request to the system's generated response.
4. Activity Diagram, It represents the overall flow of activities, including login, data input, and report generation. This diagram is important for verifying process logic and identifying potential overlaps in activities [11], [12].

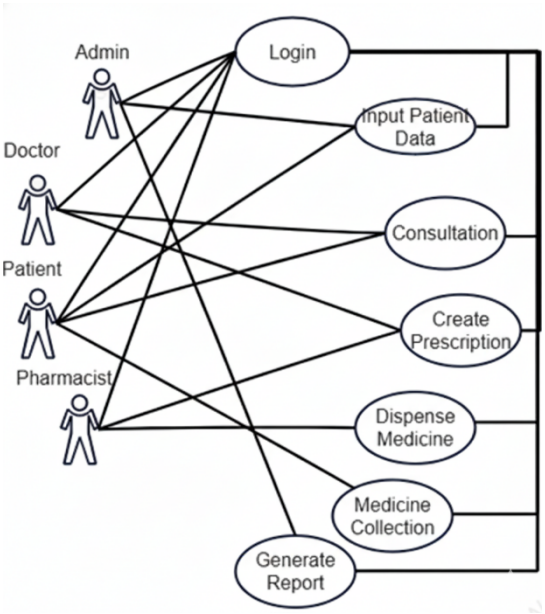


Figure 2. Use Case Diagram of the Integrated Puskesmas Information System

In Figure 2, the system workflow shows how the admin, doctor, pharmacist, and patient interact through the processes of login, patient data input, consultation, prescription creation, medicine preparation, medicine collection, and reporting. Each actor has different roles but remains interconnected, so that all medical service activities can be digitally coordinated and efficiently managed within one integrated system.

2.4 System Implementation

The implementation phase was carried out using a web-based application development approach with a combination of open-source technologies. The system was developed as a dynamic web-based application that supports real-time data management, is integrated, and easily accessible through the Puskesmas local network [13]. The programming languages and technologies used include:

1. PHP (Hypertext Preprocessor) is used as a server-side scripting language to manage system logic, handle authentication processes, and connect to the database.
2. MySQL serves as the Database Management System (DBMS) used to store data centrally and ensure the integrity and consistency of patient, doctor, and drug data.
3. HTML (HyperText Markup Language) s used as the main structure of the user interface.
4. CSS (Cascading Style Sheets) is used to style the interface, ensuring responsiveness and compliance with modern user interface design principles.
5. JavaScript is applied to enhance interactivity, perform input validation, and improve the overall user experience [14], [15]

All development was carried out within the XAMPP environment, which serves as a local server to integrate PHP, Apache, and MySQL. After internal testing was completed, the system was deployed on the Karang Anyer Puskesmas server for operational use.

Figure 3. Web-Based Information System Architecture of Karang Anyer Puskesmas

Figure 3 visualizes the system architecture, which adopts the fundamental 3-tier model a design decision essential for enforcing the principle of separation of concerns. This architecture strategically separates the Browser presentation layer, the PHP application layer executing business logic, and the MySQL data layer as an isolated repository for data persistence. This clear separation not only simplifies debugging and maintenance processes but also ensures system scalability and security, as modifications in one layer do not directly affect the others. Consequently, this architectural foundation guarantees a robust system that can adapt to the evolving operational needs of the Puskesmas in the future.

2.5. Testing and Evaluation Metrics

To validate the system's effectiveness, this study measures two key variables:

1. Functional Validity (Black Box): Evaluates whether all system features (Login, Queue, SOAP, Pharmacy) function according to the design specifications. The indicator is a "Valid" status for every test case.
2. User Acceptance (UAT): Measures end-user satisfaction. A questionnaire using a Likert scale (1-5) was distributed to 10 respondents (consisting of administrative staff, doctors, and system verifiers) to evaluate aspects such as User Interface (UI), User Experience (UX), and Performance.

3. Results

3.1. Login Page Interface

The login page serves as the access point to SIM-PUSKESMAS. The system validates access for Administrators, Doctors, Pharmacists, and Patients. This page also provides a 'Register New Account' function specifically for patient registration.

(a) (b)

Figure 4. (a) Login page interface; **(b)** Account registration page interface.

3.2. Dashboard Page

The dashboard page of this program presents processed and inputted data managed by the System Administrator, as shown in Figure 5. The dashboard displays key statistical summaries, such as the number of patients, total staff, and daily visit charts, while providing quick access to the main functions.

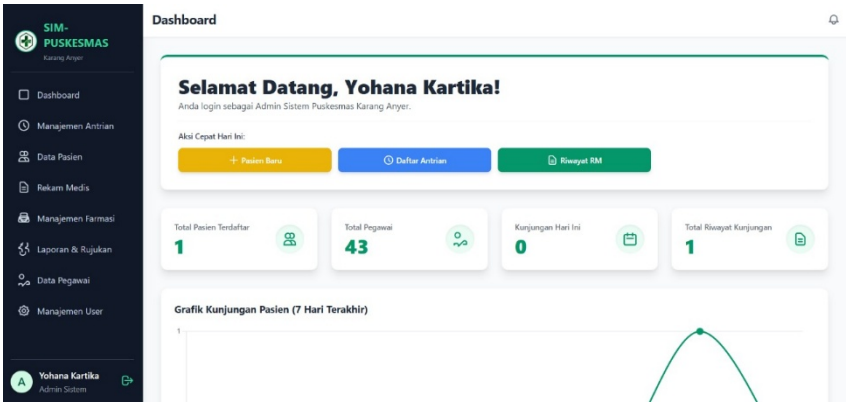


Figure 5. Dashboard Page.

3.3. *Patient Registration Page*

The Patient Registration page is a form used to collect essential patient identity data. The information entered includes Medical Record Number, Patient Name, demographic data (Gender, Date of Birth, Religion, Marital Status), contact information (Phone/Cellphone, Address), and BPJS Number (if available).

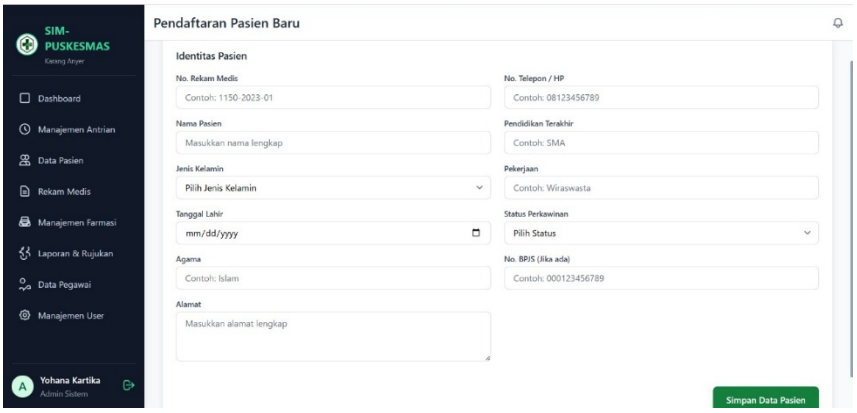
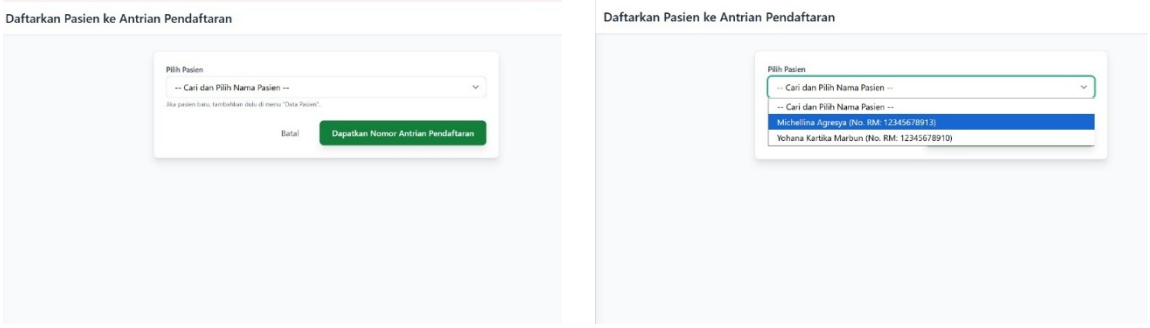


Figure 6. New Patient Registration Page.

3.3. *Patient to Registration Queue*

This page functions to process the registration of registered patients into the service queue. The process involves selecting a patient from a dropdown menu displaying Name and Medical Record Number, after which the staff clicks the 'Get Registration Queue Number' button to validate the patient into the queue system, as shown in the figure 7:

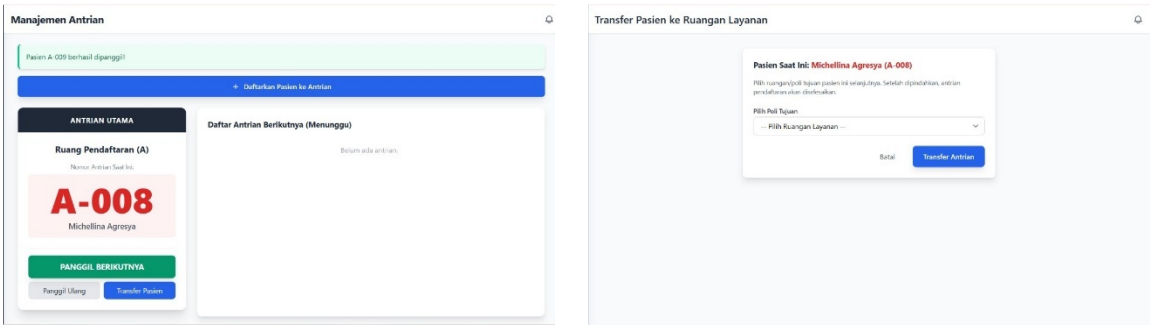


(a) (b)

Figure 7. (a) Queue Registration Form; **(b)** Patient Selection from the List.

3.4. Queue Management Page

The Queue Management page is designed to call the queue and includes a Transfer Patient button. This button leads to a form used to select the patient's next destination clinic, completing the registration queue process, in Figure 8.



(a) (b)

Figure 8. **(a)** Main Interface of Queue Management**; (b)** Patient Transfer Form.

3.5. Patient Data Page

The Patient Data page displays a list of registered patients. This page functions to search for patient information, add new patients, and provides actions such as Queue Registration and editing patient data, showed in Figure 9.

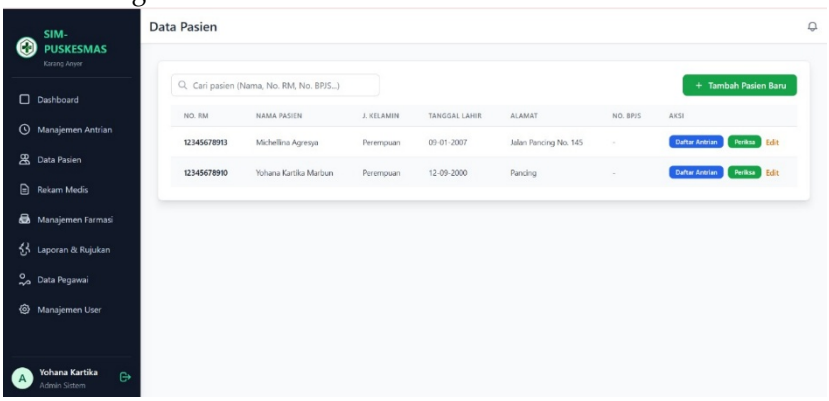
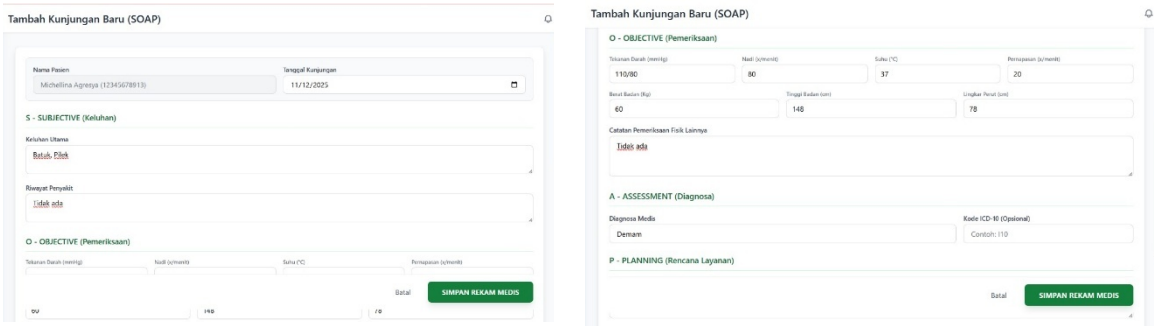


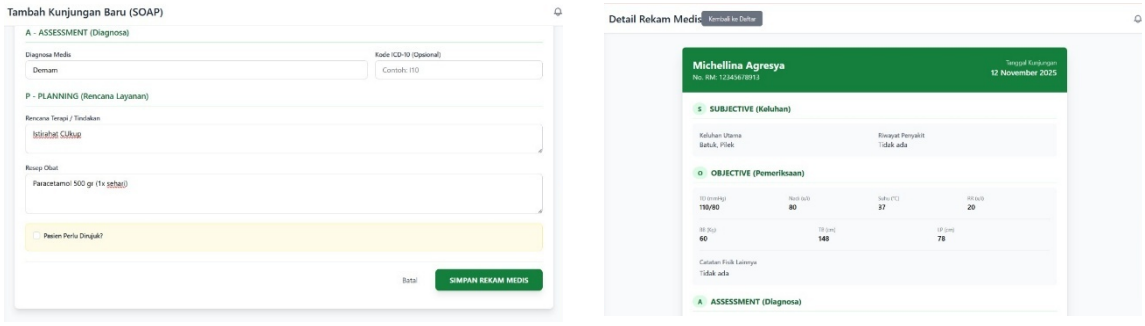
Figure 9. Patient Data Page.

3.6. Medical Record Page

This page is responsible for documenting and reviewing patient Medical Records using the SOAP standard, showed in Figure 10. The New Visit Form is used by Doctors to input data on Complaints, Examinations, Diagnoses, and Service/Prescription Plans, while the Medical Record Detail Page serves as the output, displaying all stored SOAP data for the purpose of reviewing the patient's medical history.



(a) (b)

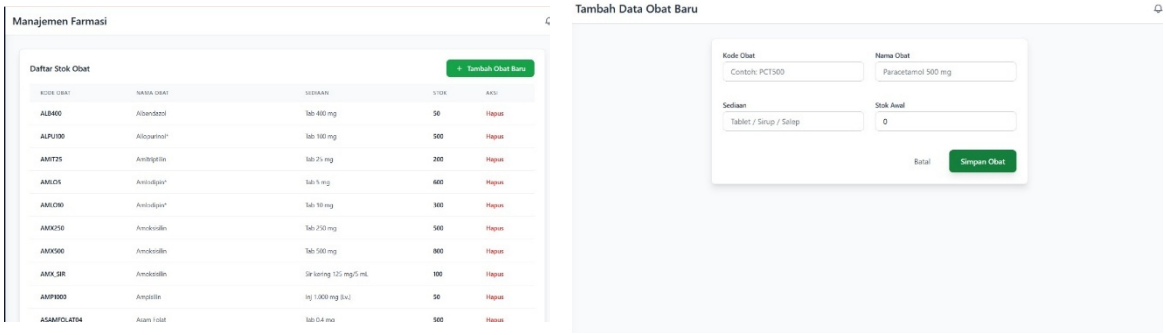


(c) (d)

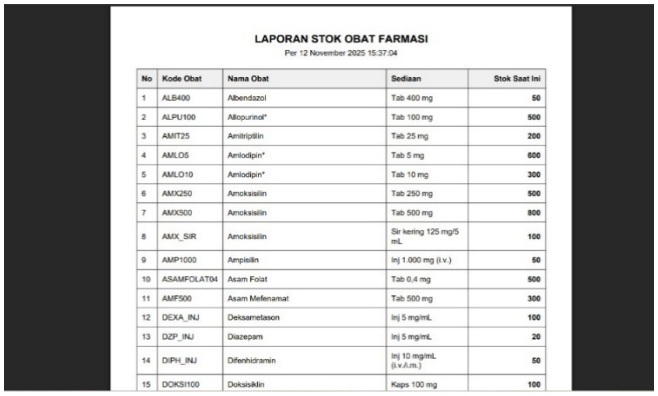
Figure 10. **(a-c)** Medical Record Input Form(SOAP); **(d)** Stored Medical Record Details.

3.7. Pharmacy Management Page.

The Pharmacy Management page serves as the control center, displaying a table of Drug Stock, including Code, Name, and Quantity. This page functions to monitor inventory status, add new drugs, and manage existing stock.



(a) (b)



LAPORAN STOK OBAT FARMASI

Per 12 November 2025 15:37:04

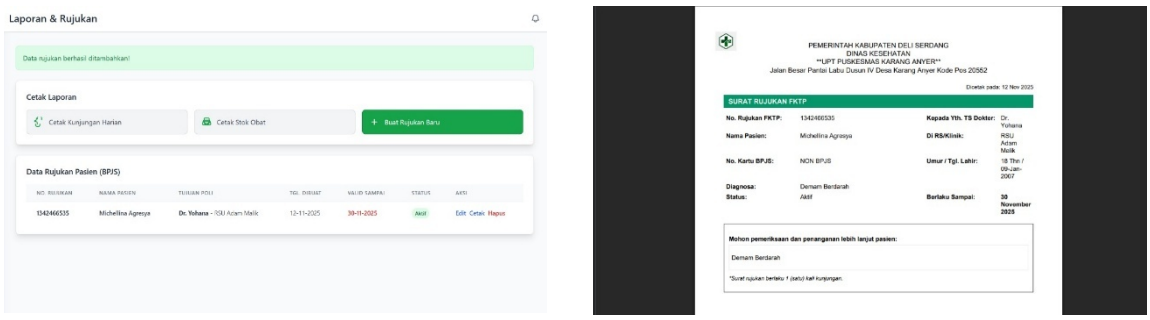
No	Kode Obat	Nama Obat	Sediaan	Stok Saat Ini
1	ALB400	Albendazol	Tab 400 mg	50
2	ALPU100	Allopurinol*	Tab 100 mg	500
3	AMIT25	Amitriptilin	Tab 25 mg	200
4	AMLO5	Amlodipin*	Tab 5 mg	600
5	AMLO10	Amlodipin*	Tab 10 mg	300
6	AMX250	Amoksisilin	Tab 250 mg	500
7	AMX500	Amoksisilin	Tab 500 mg	800
8	AMX_SIR	Amoksisilin	Sir kering 125 mg/5 mL	100
9	AMP1000	Ampisilin	Inj 1.000 mg (I.v.)	50
10	ASAMFOLAT04	Asam Folat	Tab 0,4 mg	500
11	AMF500	Asam Mefenamat	Tab 500 mg	300
12	DEXA_INJ	Deksametason	Inj 5 mg/mL	100
13	DZP_INJ	Diazepam	Inj 5 mg/mL	20
14	DIPH_INJ	Difenhidramin	Inj 10 mg/mL (I.v./I.m.)	50
15	DOKSI100	Doksisiklin	Kaps 100 mg	100

(c)

Figure 10. (a) Drug Stock List; **(b)** New Drug Data Entry Form; **(c)** Drug Stock Printout.

3.8. Reports and Referral Page

This page manages patient referral data and report printing. The main page displays the Patient Referral history and provides an option to print reports. The output is an official FKTP Referral Letter document containing detailed referral information, as showed in Figure 11.

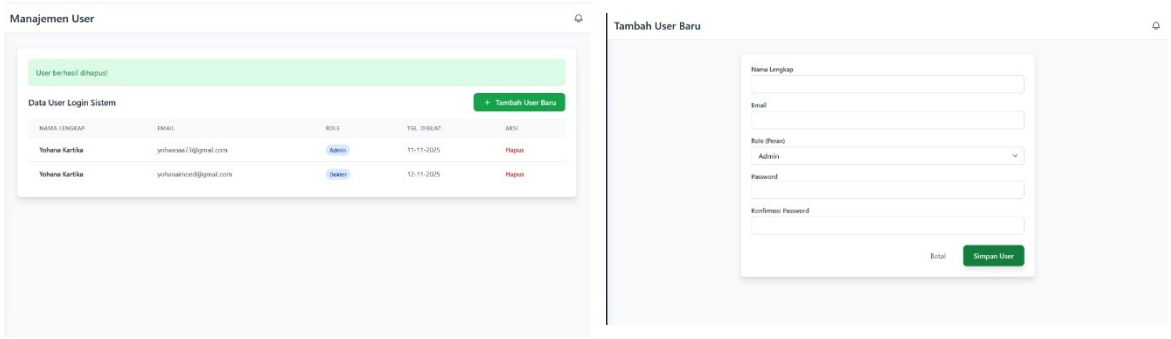


(a) (b)

Figure 11. **(a)** Main Page; **(b)** Example of FKTP Referral Letter.

3.9. User Management Page

This page is specifically designed for the Administrator to manage all system user accounts. It displays User Login data and provides functions to add new users as well as delete existing user accounts, in Figure 12.



(a) (b)

Figure 12. **(a)** User Management Page; **(b)** Add User Form.

3.10. System Testing Results

The system underwent rigorous testing to ensure it met the defined objectives. The testing phase was divided into functional testing and user acceptance testing.

3.10.1. Black Box Testing Results

Functional testing was performed using the Black Box method to ensure every module operates according to specifications. The summary of test results is presented in Table 1. Based on the table, all test scenarios show a "Valid" status, indicating that the system has a 100% functional success rate and is free from critical errors in its main features.

Table 1. Black Box Testing Results

No	Test Case Scenario	Expected Result	Actual Result	Status
1	Admin & Doctor Login	System directs user to Dashboard based on access rights	System successfully displays the specific Dashboard page	Valid
2	New Patient Registration	Patient identity data is stored in the MySQL database	Data is stored successfully and appears in the patient list	Valid
3	Queue Generation	System generates a unique queue number (e.g., A-001)	Queue number is generated and displayed correctly	Valid
4	Medical Record Input (SOAP)	Medical assessment data is saved in the patient's history	SOAP data is saved completely and linked to the patient	Valid
5	Pharmacy Stock Update	Drug stock decreases automatically after a prescription is saved	Drug stock quantity decreases according to the prescription	Valid
6	Print Referral Letter	System generates and downloads a Referral Letter (PDF)	PDF file is generated and downloaded successfully	Valid
7	User Management	Admin can add new users or delete existing accounts	User data is successfully added or removed from the system	Valid

3.10.2. User Acceptance Testing (UAT) Results

To measure the level of satisfaction and system feasibility, UAT was conducted with users (Admins and Medical Staff). The assessment utilized a Likert scale (1-5). The recapitulation of the assessment results is shown in Table 2.

Table 2. User Acceptance Testing (UAT) Results

No	Assessment Aspect	Average Score (Scale 1-5)	Category
1	User Interface (UI) Design	4.6	Very Good
2	Ease of Use (Usability)	4.7	Very Good
3	System Access Speed	4.5	Very Good
4	Feature Suitability	4.8	Very Good
5	Data and Report Accuracy	4.6	Very Good
-	Total Average	4.64 (92.8%)	Very Feasible

Data in Table 2 shows that the system obtained a total average score of 4.64 or 92.8%. Based on the feasibility category, this score indicates that SIM-PUSKESMAS falls into the "Very Feasible" category and is well-accepted by users to support daily community health center operations.

4. Discussion

The implementation of the Web-based Management Information System (SIM-PUSKESMAS) at UPT Karang Anyer has proven to be a significant step towards digitizing primary healthcare services. Based on the results obtained, this section discusses the interpretation of findings, comparisons with previous studies, and the limitations of the current system.

4.1. Interpretation of Main Findings

The study confirms that the proposed system operates effectively. As evidenced by the Black Box testing results, in Table 1, the system achieved a 100% success rate across all functional modules, including Registration, Medical Records (SOAP), and Pharmacy Management. This indicates that the logic errors and data redundancies often found in manual systems have been successfully eliminated.

Furthermore, the User Acceptance Testing (UAT) score of 92.8%, in Table 2, demonstrates a high level of satisfaction among doctors and administrative staff. This high score is primarily attributed to the "Ease of Use" and "Feature Suitability" aspects. The integration of the SOAP medical record format directly with the pharmacy module allows for real-time stock deductions, addressing the administrative inefficiency issues highlighted in the introduction. This automated workflow significantly reduces the waiting time for patients and minimizes human error in drug inventory recording.

4.2. Comparison with Previous Research

The results of this study align with and expand upon several previous researchers' findings:

1. Comparison with Manual Systems: Consistent with the problems identified by Desi [7], [8] and Hanafi et al. [4], manual data recording leads to delays in data retrieval. SIM-PUSKESMAS solves this by digitizing the archive, reducing data search time from minutes to seconds.
2. Comparison with Similar Web-Based Systems: Saidy et al. [7], [8] developed a web-based health information system focusing on general data management. However, our study offers a more specific contribution by implementing a comprehensive Pharmacy Management module that is automatically linked to the doctor's prescription input. While Saidy's work emphasized the general architecture, SIM-PUSKESMAS emphasizes the interconnectivity between the polyclinic and the pharmacy.
3. Comparison regarding Workflow Integration: Firdaus Trama et al. [7], [8] highlighted the importance of workflow transparency in Electronic Medical Records. SIM-PUSKESMAS answers this need by providing a role-based dashboard (Admin, Doctor, Pharmacist) that ensures every staff member can track the patient's status in real-time, a feature that was often lacking in earlier, fragmented implementations.

4.3. Limitations of the Study

Despite the successful implementation, this study has several limitations that need to be acknowledged:

1. Network Scope: The system currently runs on a Local Area Network (LAN) using a local server (XAMPP) for security and cost-efficiency reasons. This means the system cannot be accessed by patients from their homes for online registration.
2. Lack of External Integration: The current version of SIM-PUSKESMAS operates independently and has not yet been integrated with the national health insurance system (BPJS P-Care) or other external health platforms.
3. Mobile Accessibility: The interface is web-based and optimized for desktop use by staff. A dedicated mobile application for patients to monitor queue numbers remotely has not yet been developed.

5. Conclusions

This study successfully designed and implemented the Integrated Management Information System (SIM-PUSKESMAS) at UPT Karang Anyer using the Research and Development (R&D) approach. The system was developed to address the inefficiencies of manual data recording by integrating queue management, medical records (SOAP), and pharmacy inventory into a single web-based architecture.

The significant findings of this study are demonstrated through rigorous testing. The Black Box testing results indicated a 100% functional success rate, confirming that all core modules operate

without errors. Furthermore, the system received a strong positive response from medical staff, with User Acceptance Testing (UAT) yielding an average score of 92.8%, classifying the system as "Very Feasible" for operational implementation. These results prove that the system effectively improves service speed and data accuracy compared to the previous manual method.

For future research, it is recommended to expand the system's capabilities to address current limitations. Future development should focus on building a mobile application (Android/iOS) to allow patients to register online from home. Additionally, interoperability should be enhanced by developing an API to integrate SIM-PUSKESMAS with the national health insurance system (BPJS P-Care), enabling seamless data exchange and broader healthcare connectivity.

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