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Design and Development of a Web Application for Outpatient Service Management at Sagaranten Community Health Center, Sukabumi Regency

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Abstract: This study aims to design a web-based outpatient service information system. The development of this system applies the waterfall method, with Data Flow Diagrams (DFD) used as modeling tools. Based on the findings, outpatient services at the Primary Healthcare Facility are still conducted manually. Patient data is stored using paper-based media, which leads to time-consuming data retrieval processes, as staff must search through paper sheets across multiple books and archives. Moreover, each entity is not yet integrated, resulting in slow, inaccurate, and irrelevant information output. To address these issues, an information system is needed to facilitate efficient data entry, collection, processing, searching, and reporting of patient data. The proposed information system is expected to reduce the existing problems in Primary Healthcare Facilities. With integrated media for data storage, patient data processing, and medical record files, registration officers can serve patients more quickly and easily during their visits for medical treatment.

Keyword: Design, Information System, Outpatient Care Facility, web, V-Model

INTRODUCTION

Advances in computer and information technology have brought significant changes in the healthcare sector, including in Indonesia. Society now recognizes that health is a basic right that should be accessible to every individual, family, and community, with the aim of achieving optimal health status through promotive, preventive, curative, and rehabilitative approaches. Changes in public behavior toward healthcare services have a direct impact on national health status (Ministry of Health of the Republic of Indonesia, 2023). Indonesia has a variety of healthcare facilities, such as community health centers (puskesmas), hospitals, private medical practices, pharmacies, and health laboratories. Previously, medical data processing was carried out manually. However, information technology has now accelerated the work of healthcare personnel, including in medical record information systems (SIRM). Although some puskesmas have implemented information systems, many still do not have an optimal system (Utami & Rahmat, 2022).

To ensure accountability, puskesmas are required to implement SP2TP, which includes the periodic collection of UKP and UKM data. Monthly reports to the health office often face problems such as duplicate entries, missing documents, or recording errors, which reduce the accuracy of reports. Therefore, puskesmas need to organize medical records as an essential part of health service management (Fitriani et al., 2021). Medical records play an important role in supporting the administrative order of healthcare services. Information in medical records is used not only by healthcare personnel but also by patients, insurance institutions, and other agencies. Recorded data includes patient identity, social information, and all medical actions received from registration until discharge from the healthcare facility (Siregar & Wahyuni, 2020). Patient registration is the starting point in the outpatient service process at puskesmas. UPT Puskesmas Sagaranten, as the primary healthcare facility in Sukabumi Regency, requires an accurate and reliable information system to improve service quality (Yulianti & Nugraha, 2021). Although the registration service system at Puskesmas Sagaranten runs fairly well, the process is not yet optimal because it is still carried out manually. This causes delays in service, particularly during patient data retrieval and document completion (Ramadhani & Kurniawan, 2022). Similar problems occur with new patients. Staff must record a large amount of information manually, which slows down the service. Sometimes, duplication occurs, or there is no medical record number, making the registration process inefficient (Rahmawati & Prasetyo, 2020; Hermawan, P. P., Abdussalaam, F., & Sari, I., 2024).

After registration, staff still have to copy information from medical records into the Outpatient Patient Register Book. This process is highly inefficient and prone to recording errors (Putra & Ningsih, 2022). Even though computers are used, monthly reporting such as LB1 and LB4 still takes a long time because data input is done after manual recording. Documents are often lost when borrowed between staff, which disrupts data accuracy and work efficiency (Mulyani & Yusuf, 2021; Joel, A. E., Yunengsih, Y., & Abdussalaam, F., 2023). Given these problems, Primary Healthcare Facilities urgently need an integrated and responsive computer-based information system. Proper hardware and software implementation can help manage administrative issues and improve service efficiency (Handayani et al., 2023).

METHOD

The V-Model method, which is part of the Software Development Life Cycle (SDLC), is an approach in software development that links testing stages with the development process simultaneously. Therefore, this method is highly suitable for use in developing information systems (Handoyo, J., 2023). In general, this approach adopts a stepwise process that includes requirements analysis, design, implementation, and testing. After these stages are completed, validation and verification processes are carried out as a form of re-testing, ensuring that the resulting information system achieves optimal quality when implemented.

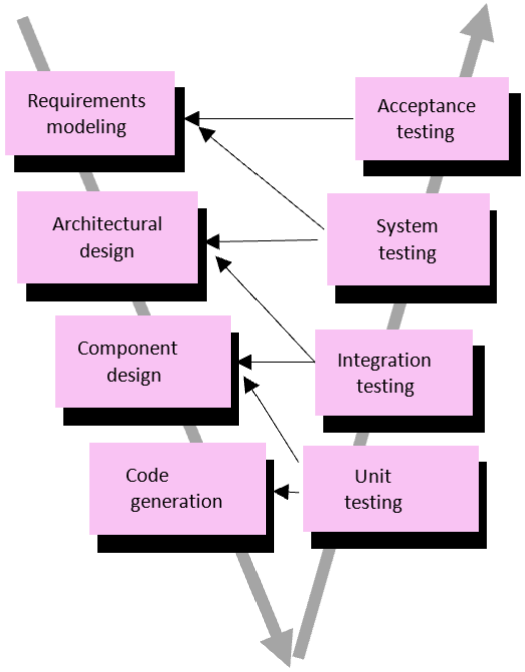

Figure 1. Pendekatan V-Model S. (Maryani, Y. Syahidin, and S. Setiatin. 2022)

This research applies the V-Model development model, which is a derivative of the conventional approach in software engineering, integrating development stages with systematic testing processes. This method was chosen because it is considered capable of improving software reliability and quality through structured communication, accurate modeling processes, and gradual implementation of development from the early stages. Each phase in the V-Model must undergo verification and validation processes before proceeding to the next stage. The relationship between system development stages and testing is depicted in parallel, where each development process is always followed by the corresponding testing phase (Pressman, R. 2015).

In its implementation, the author carried out several stages as follows:

a) System Requirements Identification
   The initial stage focused on analyzing the system requirements to be developed. This activity involved formulating the system model and detailing the technical specifications needed to operate the expected information system functions.
b) Architecture and Component Design
   At this stage, the system structure was designed comprehensively, including supporting elements to be used. In addition, process flow diagrams and database designs were prepared to optimize the system's functionality (Nurhaimah, D. S., Syahidin, Y., & Yunengsih, Y., 2023).
c) Coding Stage
   This stage involved translating the system design into program code using a specific programming language, with Web-based Programming as the development environment.
d) System Testing
   At this phase, testing was conducted using the black-box testing approach, in which the system was tested by providing inputs and evaluating outputs to ensure that the system operates according to the specified requirements (Fahrezi, A., Saam, F. N., Ibrahim, G. M., Syaiful, R. R., & Saifudin, A., 2022).

RESULTS AND DISCUSSION

A. System Requirements Identification

The system is required to have the capability to manage patient service processes in an integrated manner, from registration, examination, and laboratory services, to payment. The main system requirements include: recording data for new and existing patients, managing queues and referrals to polyclinics, documenting doctor and laboratory examination results, as well as handling financial transactions. The system must also provide a centralized database so that each unit can access patient information in real-time, ensuring the security and confidentiality of medical data, and generating administrative and financial reports automatically.

B. Architecture Design

The following figure illustrates the proposed flowmap design for the web-based outpatient service information system. This design was developed based on the results of user requirements analysis and aims to improve workflow efficiency, reduce data duplication, and accelerate service processes. The flowmap explains the flow of information from patient registration, medical services provided by staff, to administrative processes and data storage by administrative personnel. Each process flow and involved entity has been systematically integrated to reflect the application of information technology in supporting more effective, accurate, and well-documented services. This design constitutes a crucial part of developing an information system that aligns with the operational needs of the outpatient unit.

The context diagram of the outpatient service information system illustrates the relationship between the system and external entities directly involved in the service process. There are five main entities interacting with the system: admin, polyclinic staff, medical records staff, cashier, and management. The admin is responsible for managing user data, patient registration, and service reports. Polyclinic staff play a role in inputting examination data for patients visiting the outpatient clinic. Medical records staff are responsible for archiving medical data and ensuring information integration between services and patient documentation. Meanwhile, the cashier manages patient payment processes and financial transactions, and management uses data from the system for monitoring and managerial decision-making. The system acts as a central data processing hub, integrating all service activities so that information can be presented quickly, accurately, and in real-time.

Furthermore, the Level 1 Data Flow Diagram (DFD) presents a more detailed view of the processes occurring within the system.

1. Patient Registration: Conducted by administrative staff, covering the input of data for new patients as well as returning patient visits.
2. Polyclinic Services: Doctors or polyclinic staff input the results of patient examinations and medical treatments.
3. Medical Records Processing: Includes recording medical history and documenting patient visits.
4. Payment Processing: Involves calculating service fees and printing transaction receipts by the cashier.
5. Report Generation: Collected data is compiled into reports that can be used by management for analysis and evaluation.

Additionally, there is a user management process performed by the admin to manage accounts and system access rights. This DFD clearly depicts the relationships between processes and the flow of data within the system, providing a comprehensive overview of the integration of service functions in the web-based outpatient information system.

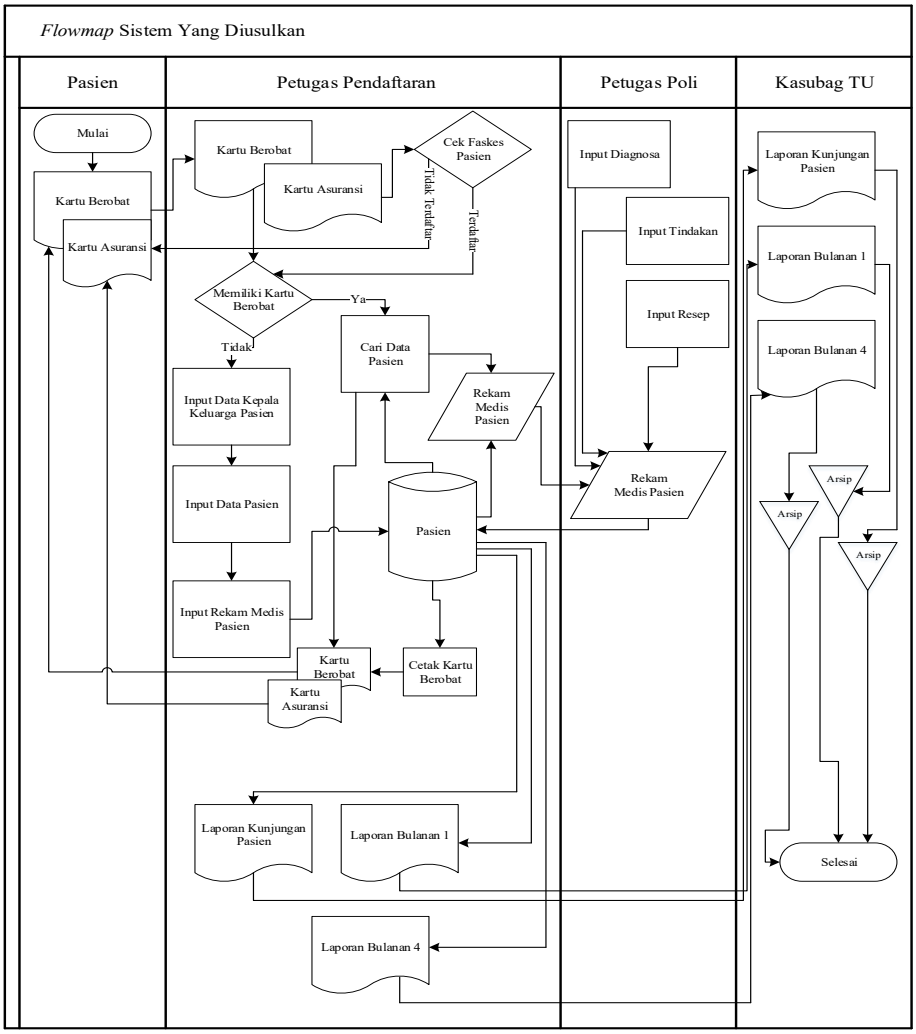

Figure 2. Outpatient Service Flowmap

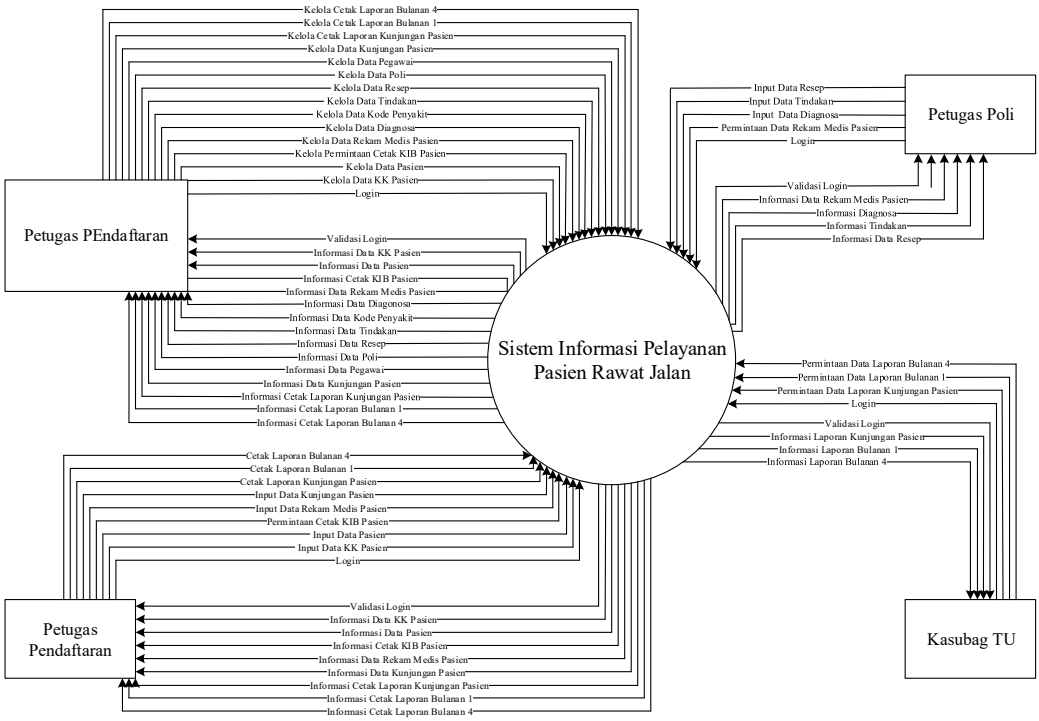

Figure 3. Context Diagram

The Entity Relationship Diagram (ERD) and database table structure of this system illustrate a complex yet structured relationship among various entities involved in patient service processes and medical information recording at the hospital. The main entities identified in the diagram are patient, staff, visit, diagnosis, treatment, medication, and room. Each entity has attributes that describe specific characteristics, such as the patient entity storing identity data like patient_id, patient_name, gender, and date_of_birth.The visit entity connects patients with service data such as visit date, target unit, and registration number, and also serves as a link to other entities like diagnosis and treatment. Relationships between entities are represented as one-to-many and many-to-many, illustrated through linking entities such as patient_diagnosis, patient_treatment, and patient_medication, each recording multiple data entries based on patient visits.

The staff entity contains attributes like staff_id and staff_name, and is connected to the treatment entity and other services performed by medical personnel. Additionally, the room entity describes the allocation or location of patients during inpatient care and is linked to the visit and patient entities. The table structure shows the implementation of these relationships in the form of relational tables with primary and foreign keys to maintain data integrity. For example, the visit table has patient_id as a foreign key from the patient table, while treatment_id and staff_id in the patient_treatment table serve as foreign keys from the treatment and staff tables. With this design, the database system can support integrated, accurate, and detailed data storage for patient services, medical record documentation, and further medical data analysis. The relational model also allows flexibility in developing a health information system that is adaptive to the hospital's needs in the digital era.

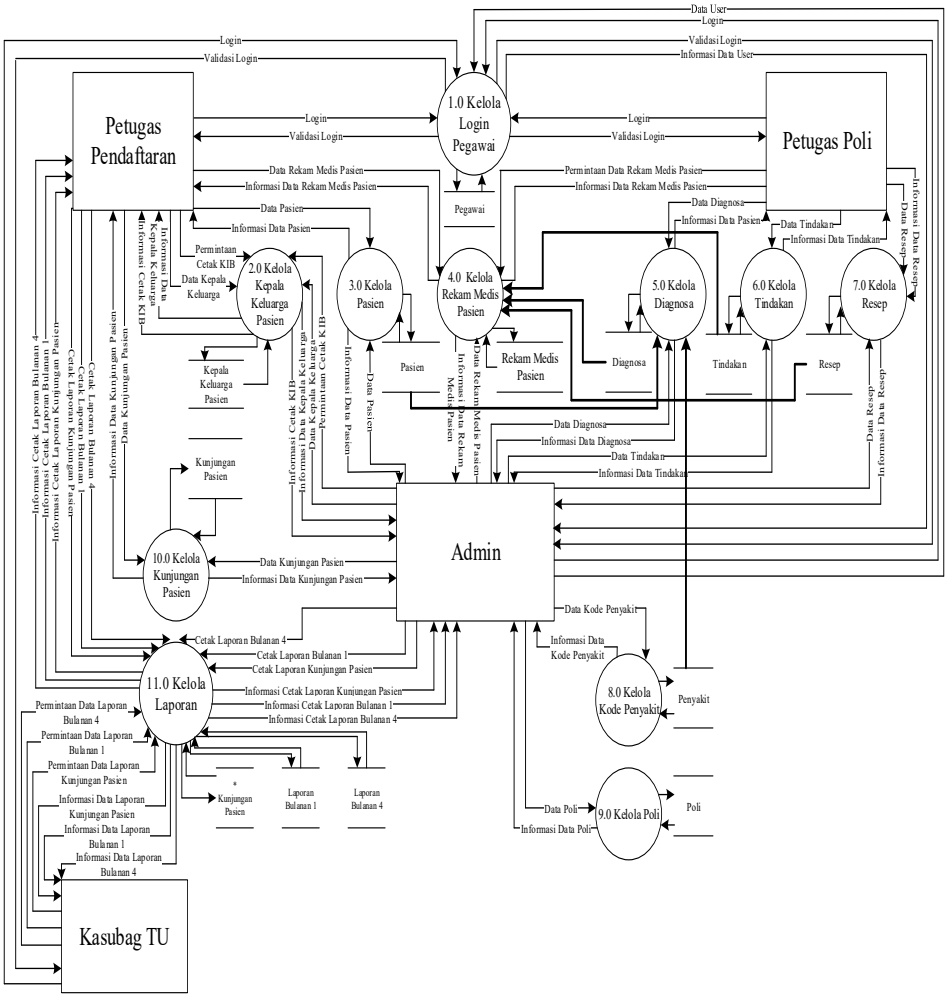

Figure 4. Level 0 Data Flow Diagram (DFD)

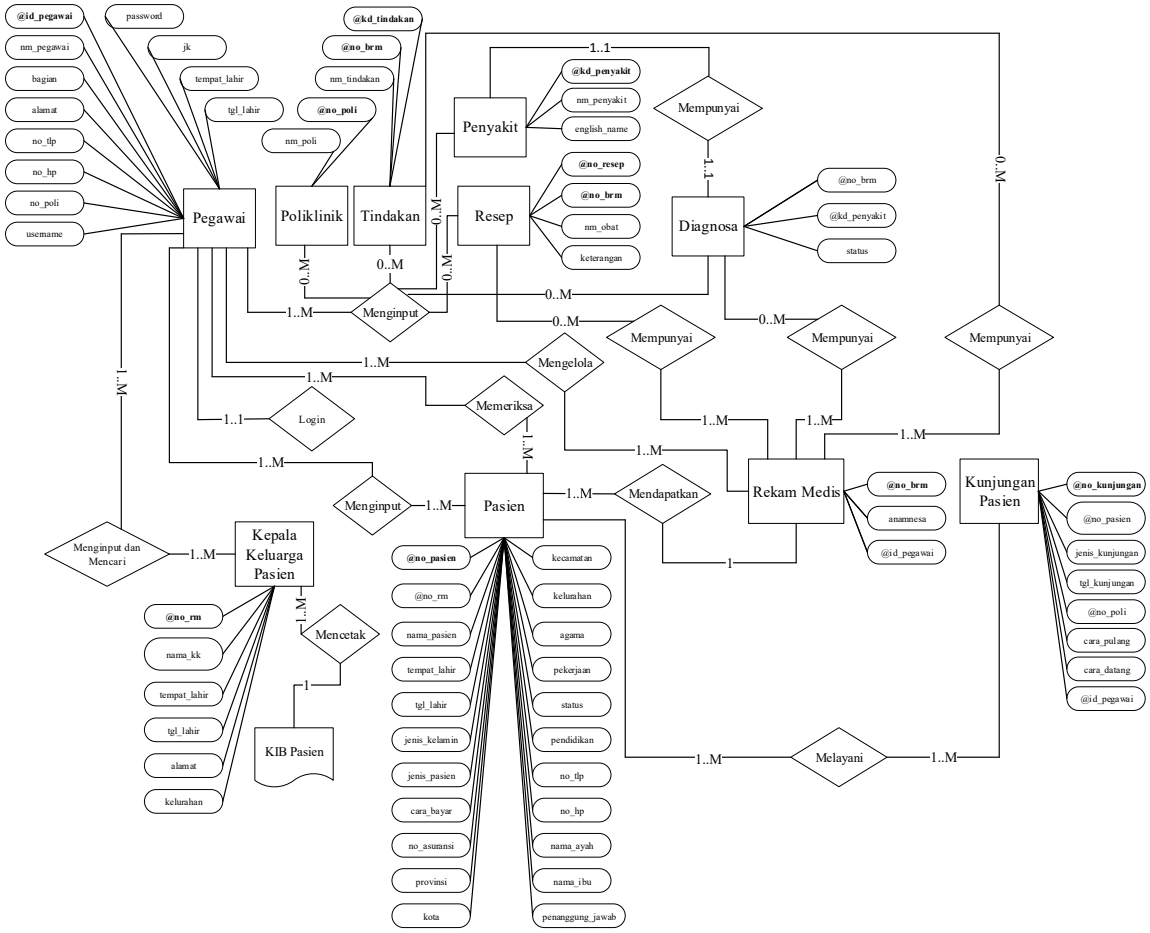

Figure 5. Entity Relationship Diagram (ERD)

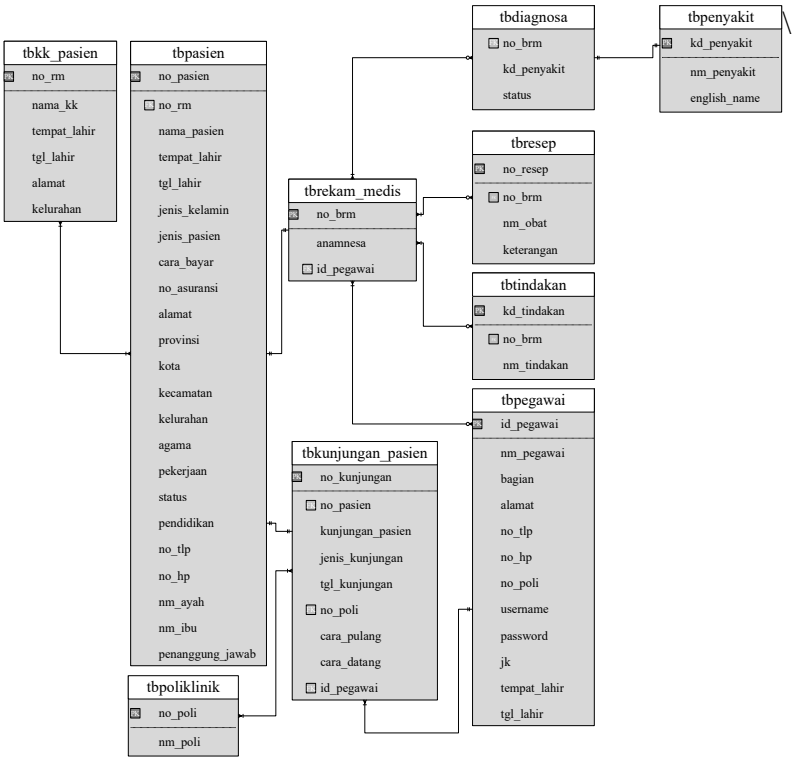

Figure 6. Table Relationships

C. Coding Stage

The web-based programming stage using PHP begins with system requirement planning and interface design, followed by the creation of the database structure using MySQL to store data in an integrated manner. Next, program code is developed using PHP and HTML to connect the web interface with the database through CRUD processes (Create, Read, Update, Delete). Subsequently, functional testing is conducted to ensure that each feature, such as registration, data input, and report generation, operates correctly. The final stage involves implementation and interface refinement so that the system can be accessed interactively via a web browser and display program outputs according to user requirements.

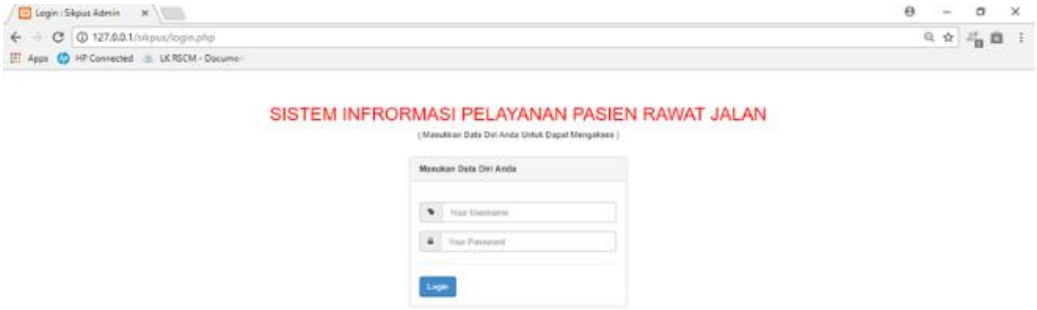

Figure 7. Login

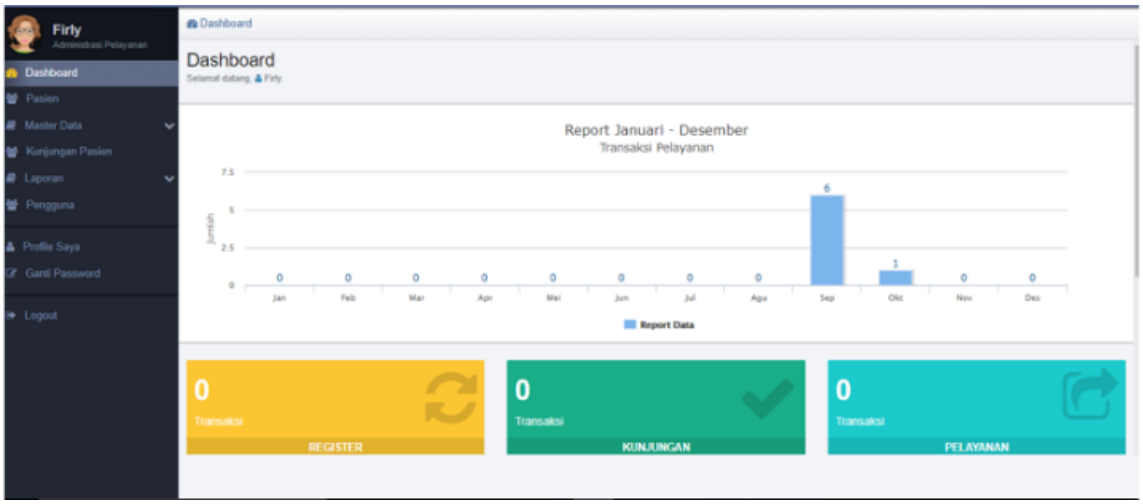

Figure 8. Main Menu

The figure displays the web-based service system dashboard, which serves as the main page for admins or staff to monitor service activities. On the left side, there is a navigation menu to access main features such as patient data, master data, reports, users, and profile settings. The central area displays a transaction report graph for services from January to December, providing an overview of activity volume each month. Meanwhile, three indicator boxes below the graph show the number of transactions in the Register, Visit, and Service categories in real-time. This dashboard facilitates users in monitoring and managing service data quickly and in an integrated manner.

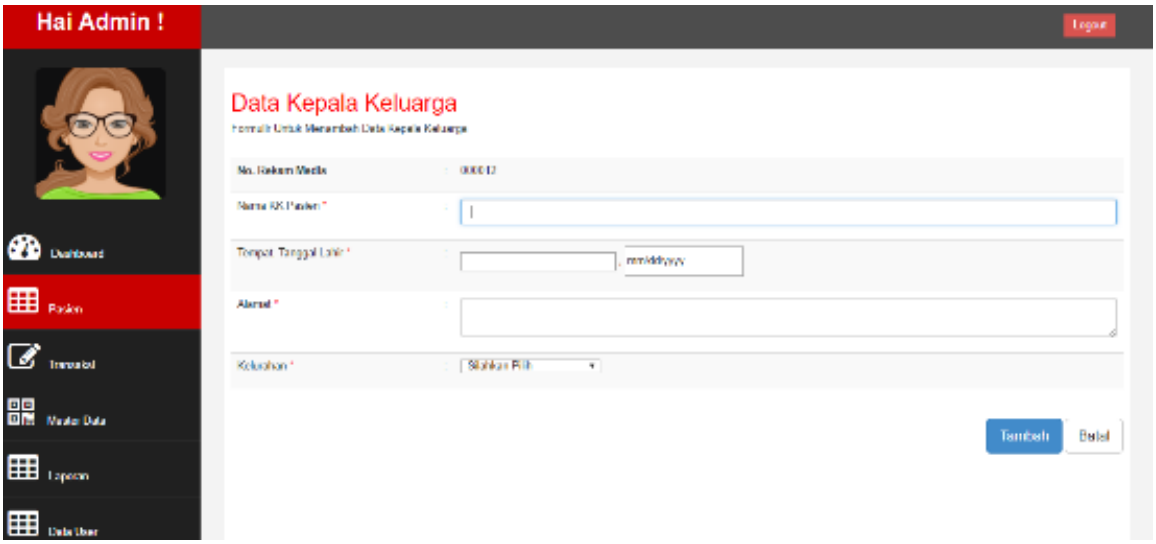

Figure 9. Head of Family Data Entry

The figure displays the web-based administration system interface for adding new head of family data. On this page, the admin can fill out a form containing information such as the head of family's identification number, full name, place and date of birth, address, and select the sub-district from the available list. Once all data is entered correctly, the admin can click the "Save" button to store the data in the system or the "Cancel" button to abort the process. This page facilitates the digital management and recording of head of family data, ensuring that information is stored neatly and in a structured manner.

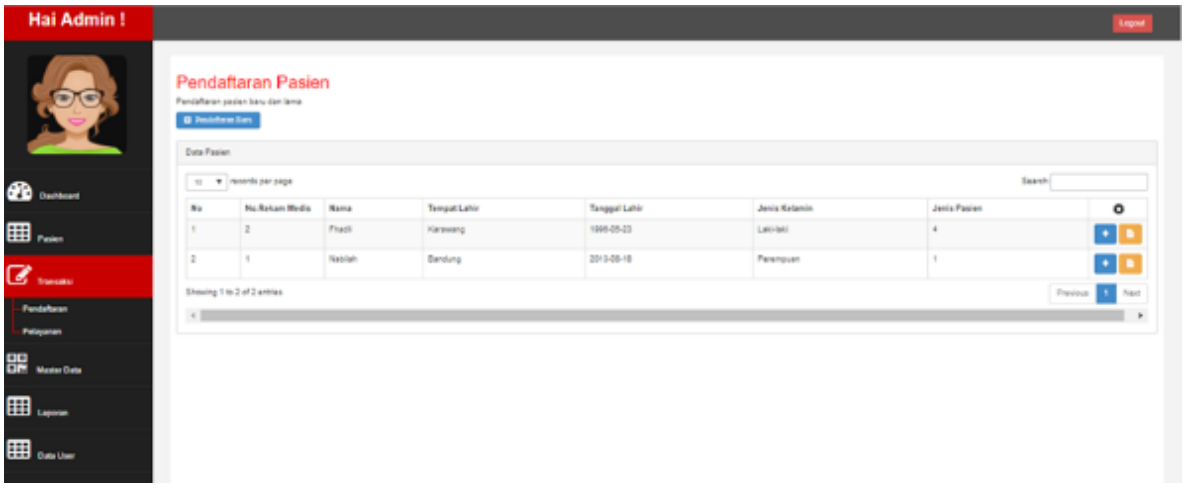

Figure 10. Patient Data Management

The figure displays the web-based administration system interface under the Patient Registration menu. This page functions to display and manage patient data already registered in the system. The admin can view the patient list, which includes information such as medical record number, name, place and date of birth, gender, and patient type. Additionally, there is a "Add Patient" button at the top to register new patients, as well as edit and delete buttons for each row to update or remove patient information. This feature facilitates digital, fast, and organized management and recording of patient data by the admin.

Table 1. Login Form System Testing

Test Class	Testing Method	Test Result	Test Outcome
Login Validation	Username = true, Password = trueUsername = true, Password = falseUsername = false, Password = trueUsername = false, Password = false	- If Username = true and Password = true, the user can log into the system- If Username = true and Password = false, the user cannot log into the system- If Username = false and Password = true, the user cannot log into the system- If Username = false and Password = false, the user cannot log into the system	Successful

Table 2. System Testing of Patient Head of Family Data Input Form

Test Class	Testing Method	Test Result	Test Outcome
Add Head of Family Data	On the head of family data form, fill in all fields and click the Add button	Medical Record Number appears automatically	Successful
	On the head of family data form, leave fields incomplete and click Add	Medical Record Number does not appear automatically	Successful
Save Head of Family Data	Fill in all head of family data and click Save to store in the database	Message "Head of Family Data Successfully Saved" appears and data shows in the datagridview	Successful
	Leave head of family data incomplete and click Save	Message "Data Not Complete" appears	Successful
Search Head of Family Data	Enter correct data of the head of family to search	The searched head of family data appears in the datagridview	Successful
	Enter incorrect data of the head of family to search	Message "Data Not Found" appears	Successful
Edit Head of Family Data	Enter correct changes to the head of family data in the form	Message "Data Successfully Updated" appears and changes are shown in the datagridview	Successful
	Enter incorrect changes to the head of family data in the form	Message "Data Not Found" appears	Successful
Delete Head of Family Data	Select the correct head of family data to delete	Message "Are you sure you want to delete this data?" appears and the data is removed from the database	Successful
Print Patient KIB	Select the correct head of family data to print	Preview form appears showing the data to be printed	Successful
	Select incorrect data to print	Preview form appears empty	Successful

CONCLUSION

In the outpatient service process at Primary Health Care Facilities (FKTP), record-keeping is still carried out manually. Registration staff record the head of family identity in address or regional books as a basis for assigning medical record numbers to new patients. This information is then transcribed into the Patient Identity Card (KIB) and the outpatient register book. For existing patients, the process of retrieving medical records depends on the patient bringing their treatment card. Common problems include duplication of medical record numbers and inconsistent patient data. There are cases where a single medical record number is assigned to more than one patient or cannot be found in the archives, requiring staff to issue new numbers and create new medical record files. Registration becomes even more complicated if a patient does not bring their treatment card or forgets the head of family identity, as staff must manually search for data, which prolongs service time.

Other issues in the registration process include manual recording of service results and reporting activities. Clinic staff record patient examination results in medical record files, and registration staff then copy them into the polyclinic register book, handling one patient file at a

time. Monthly reports, such as Monthly Report 1 (LB1) and Monthly Report 4 (LB4), are also prepared manually, with the risk of document loss due to frequent handovers between service units. To address these problems, the proposed solution is to develop a computerized, integrated, and efficient outpatient service information system. This system is designed using PHP programming language and a MySQL database, enabling safer patient data storage, faster data retrieval, and ease in generating reports required by the FKTP.

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