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Improving the Efficiency of Healthcare Services in Medical Practices Through a Web-Based Data Management System.

ABSTRACT

The patient data management system in healthcare services currently faces serious challenges regarding data security and availability. Many system users can access patient information without proper authorization, which increases the risk of sensitive data leaks and misuse of information. Doctors have not fully implemented comprehensive security protocols to maintain the confidentiality and integrity of data, further worsened by the lack of authentication mechanisms and staff education on digital security. Additionally, disruptions to the system can lead to downtime, reducing data availability and directly impacting healthcare operations. This research aims to enhance the efficiency of healthcare services in medical practices by developing a web-based data management system that presents accurate and up-to-date information. The system development follows the Waterfall method and incorporates One Time Password (OTP) security features to ensure controlled and secure data access. The implementation of this system is expected to improve the quality of healthcare services by speeding up service processes while safeguarding patient information.

Keywords: Health Services, Web Based, Waterfall, Data Management System, One Time Password.

INTRODUCTION

Digitalization has significantly impacted the improvement of healthcare services through the use of technology-based information systems (Alrahbi et al.; Sindhu, 2022). Digital systems speed up the management of patient data, allowing doctors to access medical records and crucial information more efficiently (Persis, 2025). In addition to enhancing service speed, digitalization also contributes to better accuracy and consistency of data, as integrated information systems help reduce recording errors and ensure that patient data is always current and valid (Syed R et al., 2023). Furthermore, web-based technology simplifies communication between doctors and patients, including health information sharing, appointment scheduling, and teleconsultations. This not only improves the patient experience but also strengthens the relationship between doctors and patients (Binci et al., 2022; Sreejesh et al., 2022; Cavacece et al., 2025).

Digitalization also allows doctors to monitor patients' health regularly by analyzing trends and disease patterns, which is crucial for creating care plans and prevention strategies (Syed et al., 2023). In terms of security, modern technology offers stronger data protection with advanced security features to prevent unauthorized access and leaks of sensitive information (Sheikh et al., 2021). The primary issue of this research is to understand how much web-based healthcare efficiency can enhance data security aspects.

This topic choice arises from complaints by patients and doctors about manual data management systems, leading to inefficient services and high risks for information security breaches. To address these issues, the researcher developed a web-based patient data management system equipped with One Time Password (OTP) security features. The development followed the Waterfall method to ensure each stage could be systematically analyzed and tested according to field needs. The OTP security feature guarantees that only authorized users can access patient data, allowing for efficient services without compromising data confidentiality.

Previous research highlights the urgency for innovations in healthcare technology. Sheikh et al. (2021) demonstrate that health information technology innovations can enhance decision-making processes and treatment outcomes. Lee and Lee (2021) emphasize the opportunities and challenges of contactless healthcare in the post-pandemic era, noting that user trust and infrastructure readiness remain significant obstacles. Garcia-Perez et al. (2023) stress the importance of resilience in health systems, particularly regarding cyber security and digital transformation. Albahri et al. (2023) recommend that artificial intelligence systems in healthcare must be reliable through quality assessments and bias risk evaluations. Meanwhile, Etemadi et al. (2023) identify challenges still needing resolution in the development of health recommendation systems. The concept of Medical 4.0, which combines IoT and cyber-physical systems, enables a more responsive healthcare service, according to Haleem et al. (2022). Additionally, blockchain technology provides solutions for security and transparency in patient data management (Hussien, 2021). Machine learning and artificial intelligence have also been shown to improve diagnostic accuracy and operational efficiency in healthcare (Javaid et al., 2022; Dicuonzo et al., 2023).

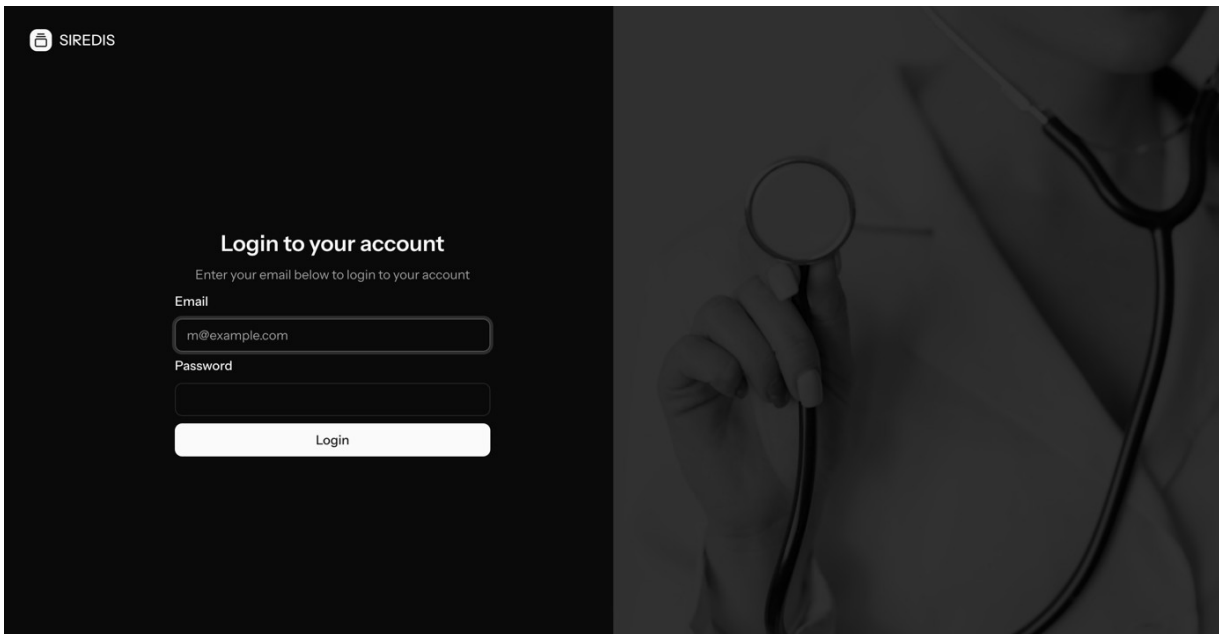
Overall, the literature indicates that the evolution of healthcare systems is continually driven by technological innovations. Hence, developing a web-based patient data management system with OTP security features represents a strategic move to enhance service efficiency while strengthening the security of patient information in medical practices.

This research employs a software engineering approach to develop a web-based Patient Data Management System for medical practices. The development process utilizes HTML and PHP programming languages, along with a MySQL database for centralized patient information management. The application is built using Visual Studio Code as the text editor, while the system design is created with UML (Unified Modeling Language), including Use Case Diagrams, Activity Diagrams, and Class Diagrams. This allows the system requirements to be modeled and visualized clearly and comprehensively. To accurately gather system requirements, the researcher collects data through interviews with doctors and healthcare staff, literature reviews related to the digitalization of healthcare services, and field studies observing the patient service processes and operational challenges firsthand. The combination of these three techniques ensures that the developed system meets real-world needs.

The development model used is Waterfall, as it supports a systematic, phased, and well-documented application construction process. Each stage produces outputs that serve as a foundation for the next stage, helping to minimize error risks from the start. The development phases begin with needs analysis to identify business processes for managing patient data and the challenges of the manual system. Next, system design is carried out through use case modeling, database design, and user interface design. The following phase is coding, which translates the system design into HTML and PHP programming language based on MySQL, as well as integrating the One Time Password (OTP) security feature for user authentication. Once the system is fully developed, testing is conducted using the Black Box Testing method, focusing on the alignment of input and output based on use cases without analyzing the internal code structure. Testing ensures that all functions operate as required, including login, medical record management, patient data retrieval, and OTP features. The final stage is the implementation of the system in medical practices to evaluate system performance, data security levels, and ease of use in real operational environments.

RESULTS AND DISCUSSION

The research activities carried out after signing the research contract involved obtaining patient data from the clinic to create a system prototype. This prototype incorporates OTP security through email during data verification, helping to protect patient data from misuse by unauthorized individuals. The data input into the management system is secured with OTP since access is verified in real-time by authorized users. Here are the captured achievements of the research:



1

Figure 1 Login page

The figure 1 above on the login page illustrates the access point into the system. Users will input their credentials here, leading to an OTP verification process sent to their email to ensure secure login.

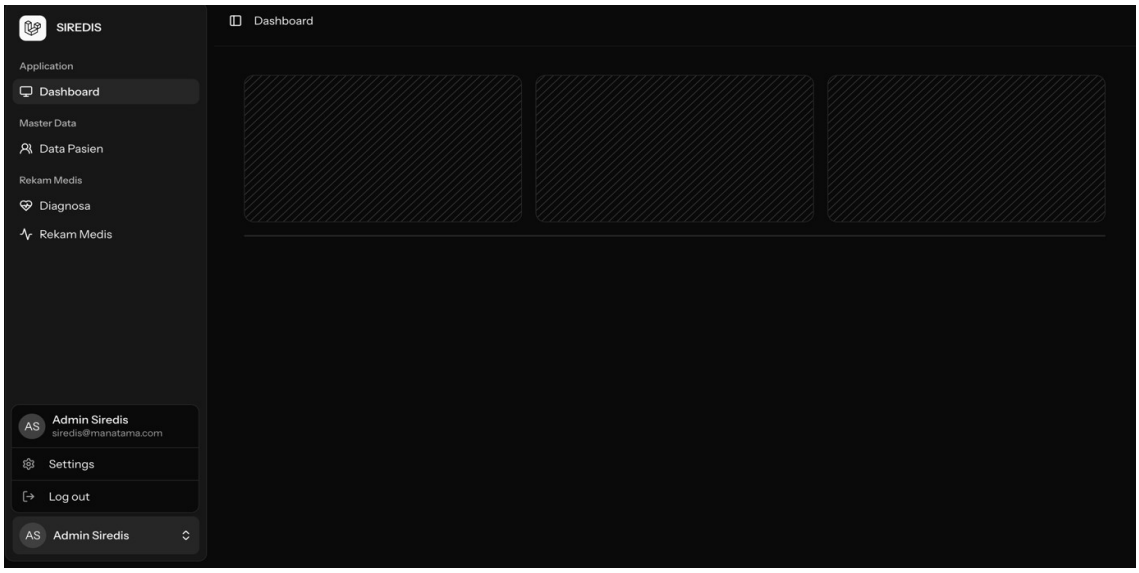


Figure 2 Login page with an email and OTP

After a successful login, the first page displayed is a dashboard featuring diagrams that present the existing data. Access to this dashboard is granted only to users who have been verified through their email with an OTP code, as shown in figures 2 and 3.

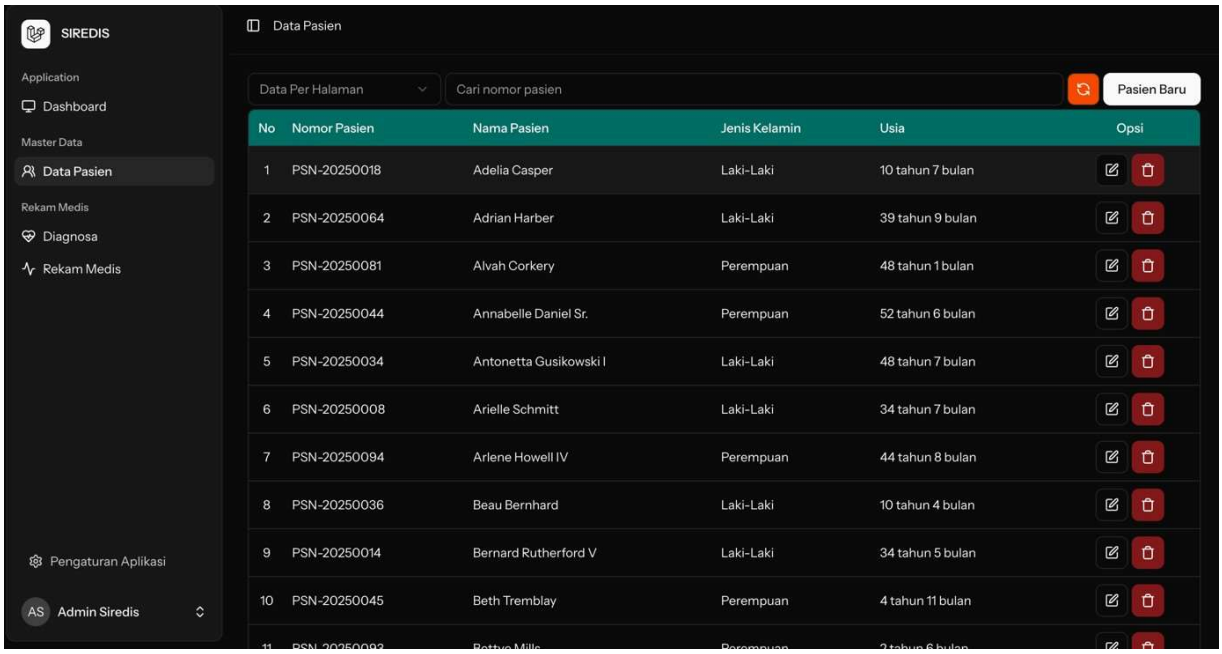


Figure 3 Login page displays patient data

The next page displays patient data, where all information from patients who have undergone examinations is stored in the database. In addition to patient data, there is also a diagnosis menu that includes the outcomes after being processed by the doctor, which will be saved in the medical records section, as shown in figure 4.

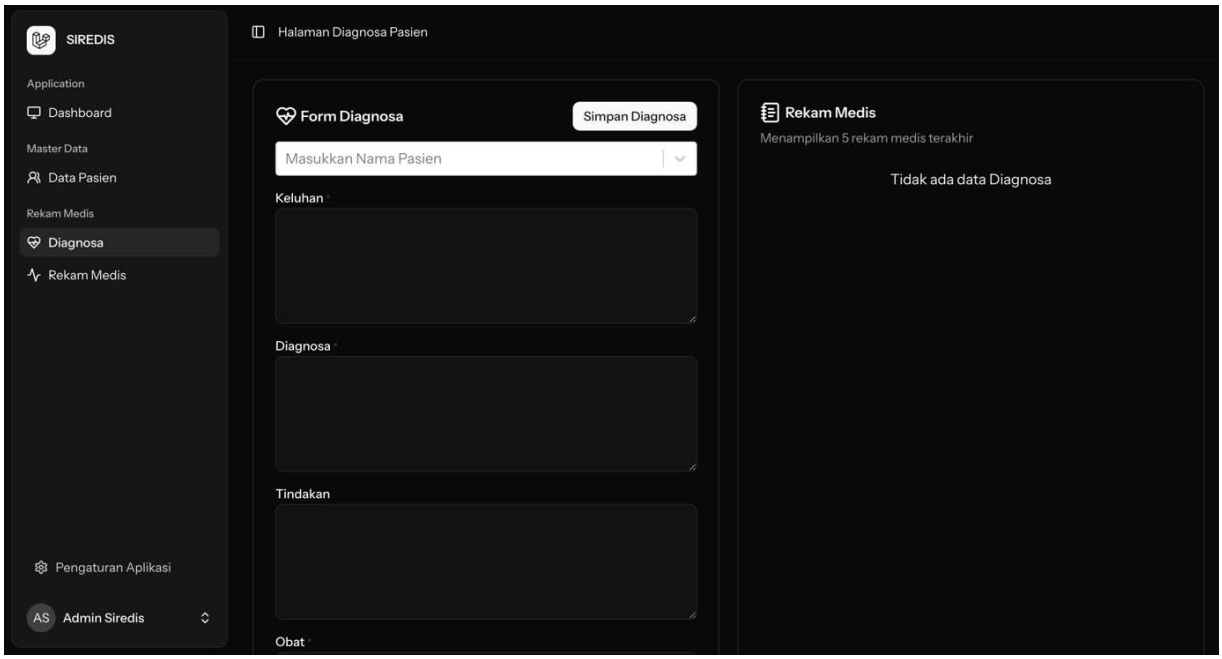


Figure 4 Medical records page

The medical records page includes fields for entering the patient's name, complaints, diagnosis, actions taken, and medications. All this information will be recorded under the medical records menu, as illustrated in figures 4.

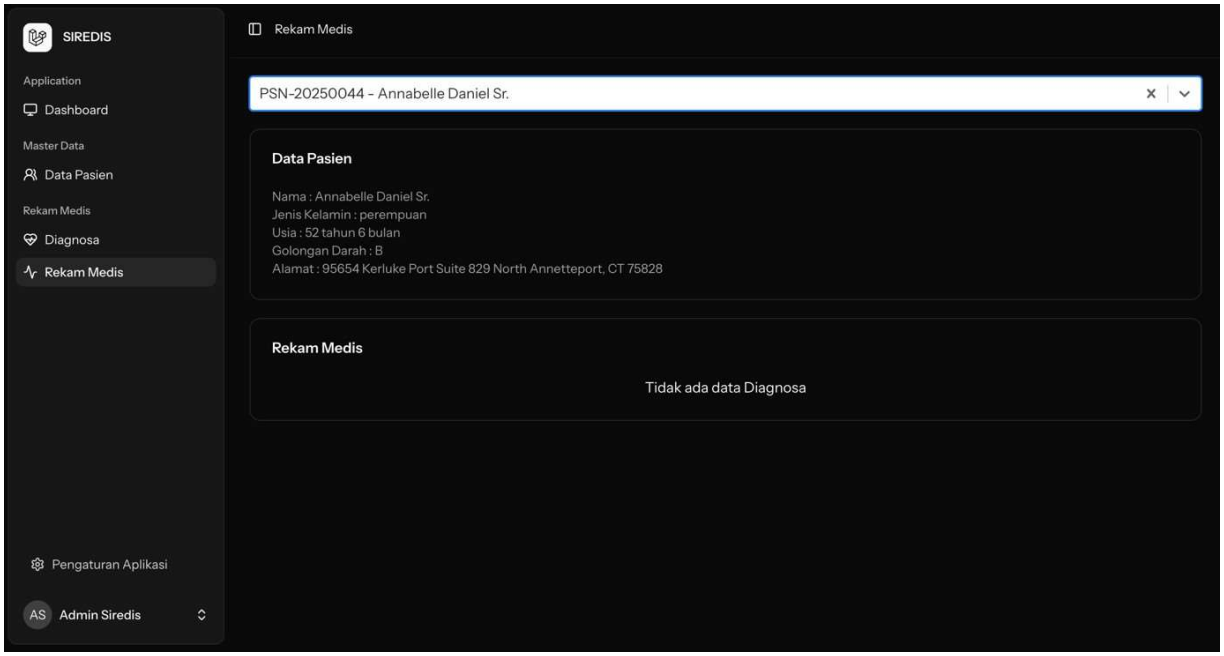


Figure 5 Medical records

Here is the medical records page resulting from the diagnosis menu. Additionally, there is a settings menu for configuring the system, as shown in table 5 and 6.

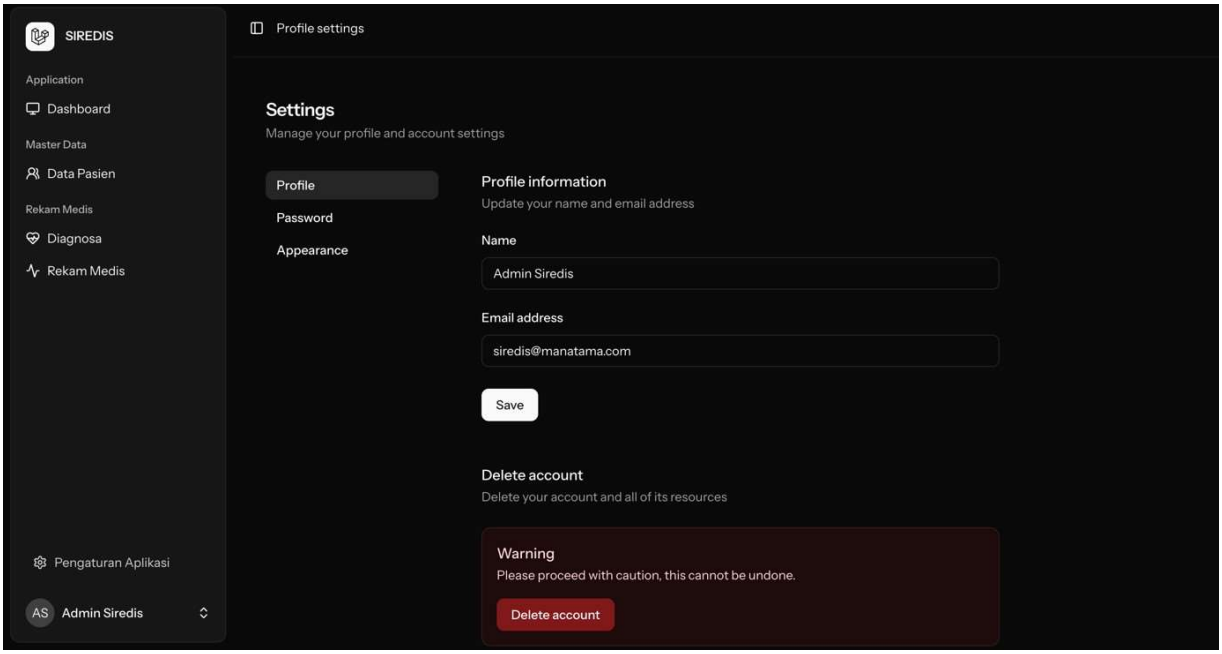


Figure 6 The diagnosis menu

From the stages of system development, Sheikh et al. (2021) view health information technology innovations within the context of national health learning systems. They emphasize that digital technology adoption can enhance decision-making processes and improve patient care outcomes. Meanwhile, Lee and Lee (2021) identify opportunities and challenges for contactless healthcare in the post-COVID-19 era, showing that despite an increase in health technology adoption, issues like user distrust and infrastructure problems still need addressing to fully realize the potential of these services. The importance of resilience in health systems, particularly regarding cyber security and digital transformation, is highlighted by Garcia-Perez et al. (2023). According to Etemadi et al. (2023), open issues and challenges in developing such systems are identified, along with techniques that can be employed to enhance their effectiveness. These sources indicate that the development of a system must consider data security, especially regarding the authority accessing that data.

CONCLUSION

This research has successfully developed a web-based Patient Data Management System to enhance the efficiency of healthcare services in medical practices. The constructed system accelerates service processes by providing centralized, easily accessible patient data, medical records, and diagnosis histories. The integration of One Time Password (OTP) security features effectively limits access to authorized users, ensuring the confidentiality and integrity of patient data is maintained. Implementation evaluations indicate that the system reduces the risk of recording errors, improves data accuracy, and streamlines administrative

service flows compared to the previous manual methods. Thus, the development of a web-based information system equipped with OTP authentication mechanisms proves to be an effective solution for improving service efficiency while strengthening data security aspects in medical practices.

REFERENCES

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