

DESIGN OF A WEB-BASED EPIDEMIOLOGICAL SURVEILLANCE REPORTING DIAGNOSIS DATA AUTOMATION SYSTEM AT X HOSPITAL

Muhammad Al Chanif *, Mieke Nurmallasari, Hozizah Markam, Arief Ichwani

Health Information Management Study Program, Faculty of Health Sciences,
Universitas Esa Unggul

Jl. Arjuna Utara No.9, Duri Kepa, Kec. Kebon Jeruk, Kota Jakarta Barat, Indonesia

Email: muh41chanif@gmail.com

Abstract

The development of information technology encourages hospitals to improve the quality of health data management, including mandatory epidemiological surveillance reporting according to regulations. The difference in diagnosis formats between the ICD-10 standard and the Health Office reporting format remains an obstacle because the conversion process is carried out manually, potentially causing errors and delays in reporting. This study aims to design a web-based diagnosis data conversion automation system to improve the efficiency and accuracy of epidemiological surveillance reporting at Hospital X. The research method uses a qualitative descriptive approach through observation, interviews, and documentation studies, and system development uses the System Development Life Cycle method with a Waterfall approach that includes needs analysis, system design, implementation, testing, and operation and maintenance. The results of the research at the system needs analysis stage indicate the need for a diagnosis conversion automation system to improve the efficiency of epidemiological surveillance reporting. The design stage includes system modeling using UML (Unified Modeling Language) and UI (User Interface) user interface design. The implementation stage produces a web-based application using JavaScript, Node.js, and MySQL with Excel file upload features, diagnosis text conversion, and reference data management. The testing stage using Black Box Testing shows that all functions run as needed. The operation and maintenance phase shows that the system is running stably, is easy to use, and that system maintenance supports epidemiological surveillance reporting effectively, efficiently, and sustainably.

Keywords: Automation, Diagnosis, Surveillance, Epidemiology, ICD-10, web, SDLC, Waterfall

Introduction

The increasingly rapid development of information technology has had a significant impact on various aspects of human life, including the health sector. The use of information technology in hospitals plays a crucial role in improving the quality of health data management and supporting the effectiveness of information system-based healthcare services ^[1]. In line with these developments, hospitals are required to continuously adapt and update their medical record systems to meet operational needs and applicable service standards ^[2].

Law Number 44 of 2009 concerning Hospitals states that every hospital is required to record and report all hospital service activities through the implementation of the Hospital Management Information System (SIMRS) ^[3]. One form of mandatory reporting is health surveillance reporting, which involves the systematic and continuous collection, processing, analysis, and interpretation of health data as a basis for decision-making in efforts to effectively and efficiently control health problems ^[4]. Furthermore, Minister of Health Regulation Number 45 of 2014 emphasizes that health surveillance

aims to provide accurate and continuous data as a basis for decision-making at both the local and national levels ^[4].

All hospitals in the DKI Jakarta Province are required to report epidemiological surveillance through the official reporting system of the DKI Jakarta Provincial Health Office. Epidemiological surveillance reporting is a crucial component in the early detection and control of infectious diseases, requiring fast, accurate diagnostic data that meets reporting standards (5). The use of electronic systems in epidemiological surveillance has also been shown to increase the sensitivity and efficiency of disease reporting ^[5]. Previous research in Indonesia has shown that implementing electronic-based infection surveillance requires identifying the system's functional requirements as a basis for developing an effective system ^[6].

However, epidemiological surveillance reporting at Hospital X still involves manually converting diagnoses from ICD-10 format to the DKI Jakarta Provincial Health Office reporting format before uploading the data to the reporting system. This format difference has the potential to cause delays and inconsistencies in reporting data. Therefore, this study aims to design a web-based automated system for diagnostic data reporting in epidemiological surveillance at Hospital X to improve the efficiency and accuracy of the epidemiological surveillance reporting process.

Method

This research is a Research and Development (R&D) study aimed at designing and developing a web-based system capable of automating diagnostic data in the epidemiological surveillance reporting process to the DKI Jakarta Provincial Health Office. The Research and Development approach was used because this research not only focuses on analyzing system requirements but also produces a product in the form of a web-based information system (xx).

The system development method used in this research is the Software Development Life Cycle (SDLC) with the Waterfall model approach. This model was chosen because it has structured and systematic development stages, making it suitable for use in designing information systems with clearly identified needs ^[7]. The Waterfall approach in the SDLC consists of the following five stages ^[8]:

a. System Requirements Analysis

This stage involves identifying and analyzing system requirements based on the problems and user needs of the system to be developed. All system requirements are collected and analyzed as the basis for system design, ensuring that the resulting system optimally meets user needs.

b. System Design

The system design stage aims to provide an overview of the system to be developed. This stage involves designing the system architecture based on previously determined requirements, as well as developing the structure, components, and relationships between system components as the basis for the development process.

c. System Implementation (Coding)

The implementation stage involves developing the system according to the previously created design. Researchers implement the system design into a program using a programming language so that the system can be run according to its intended function.

d. System Testing

The system testing stage uses the Black Box Testing method to ensure that each function in the system operates according to user needs and produces the expected output.

e. Operation and Maintenance

In this final stage, the developed system is put into operation by the user. Furthermore, a periodic system maintenance process is carried out to maintain optimal system performance and allow for further development, such as fixing errors or adding new features.

Result

Based on observations, interviews, and documentation studies of the epidemiological surveillance reporting process in hospitals, it was discovered that the process of converting diagnoses from ICD-10 format to the Health Office reporting format is still done manually using Excel files. This process involves adjusting diagnostic terms one by one according to the specified reporting format, which is time-consuming and potentially leads to errors in adjusting the diagnosis format. Data collection results indicated that the system required by users includes an Excel file upload feature for automatic diagnosis conversion, a text-based diagnosis conversion feature, and a diagnostic reference data management feature as the basis for the conversion process.

Based on these requirements, a User Interface (UI) was designed, consisting of an Excel file upload page, a text-based diagnosis conversion page, and a diagnostic reference data management page as the system's user interface. Next, the system was designed using a Unified Modeling Language (UML) approach, including use case diagrams, sequence diagrams, and class diagrams to illustrate user interactions with the system, the diagnosis conversion process flow, and the structure of the system. Furthermore, a database was designed using MySQL to store the diagnostic reference data. The system implementation results in a web-based application built using the JavaScript programming language, with Node.js as the server-side and MySQL as the database. The developed system consists of three main menus: an Excel file upload menu for automatic diagnosis conversion, a text-based diagnosis conversion menu for direct diagnosis searches, and a diagnostic reference data management menu used in the diagnosis conversion process.

System testing was conducted using the Black Box Testing method to ensure each system function meets user requirements. Testing was conducted on the Excel file upload feature, text-based diagnosis conversion, and diagnostic reference data management. The system testing results are shown in Tables 1-3.

Table 1 Black Box Testing Upload Excel Menu

Fungsi	Input	Output	Hasil
Excel Upload	ICD-10 diagnosis Excel file	File uploaded	Valid
Convert	Excel file valid	ICD-10 diagnoses converted to Dinkes format	Valid
Download result	File converted	Downloaded file	Valid

Table 2 Black Box Testing Input Text Menu

Fungsi	Input	Output	Hasil
Input diagnosis	ICD-10 diagnosis text	Text converted	Valid
Invalid diagnosis	Text diagnosis not available	Message not found	Valid

Table 3 Black Box Testing Kelola Data Menu

Fungsi	Input	Output	Hasil
Add diagnosis	ICD-10 diagnosis and Dinkes diagnosis	Data saved	Valid
Delete diagnosis	Data selected	Data saved	Valid
Edit diagnosis	Data selected	Data saved	Valid

Based on the test results in the table above, all system features can be run according to the predetermined test scenarios, allowing the system to support the diagnosis conversion process in epidemiological surveillance reporting. The system can be run locally using localhost and provides diagnostic reference data management features that allow users to customize reference data according to epidemiological surveillance reporting needs.

Discussion

The research results indicate that the diagnosis conversion process for epidemiological surveillance reporting in hospitals was previously carried out manually by adjusting diagnoses from the ICD-10 format to the Health Office reporting format using Excel files. This situation has the potential to cause data format inconsistencies and delays in the reporting process. Therefore, the development of a web-based diagnosis conversion automation system was carried out based on user needs obtained through observation, interviews, and documentation studies. This finding aligns with research by Aldi (2022) and Herawati & Negara (2021), which states that the needs analysis stage in the Waterfall method serves as the basis for determining system specifications to meet user needs ^[9].

The system design was carried out using the Unified Modeling Language (UML) approach and User Interface (UI) design tailored to user needs in the diagnosis conversion process. The use of UML helps describe user interactions, system process flows, and system structure before the implementation phase. This aligns with research by Haerani, Hendriyati, & Nugroho (2023), which explains that system modeling using UML can improve the clarity of system structure and maintain consistency between user needs and system implementation ^[10]. Furthermore, the simple and structured interface design supports the system's ease of use, as explained by Saputro & Wahyudin (2020) ^[11].

The system was implemented by developing a web-based application using JavaScript, Node.js, and MySQL, which provides Excel file upload, text-based diagnosis conversion, and diagnostic reference data management. The presence of this reference data management feature allows the system to continuously adapt to changing reporting needs. Test results using the Black Box Testing method indicate that all system functions operate according to user requirements. This finding aligns with research by Setiawan, Geni, & Putra (2024) and Gustinov, Azani, & Al Ghani (2023), which states that the Black Box Testing method is effective in ensuring the functionality of a web-based system meets user requirements ^{[12], [13]}.

Furthermore, the developed system can be run locally and supports maintenance processes through flexible management of diagnostic reference data. The system's ability to adapt to changing reference data demonstrates its potential for continued use as needed for epidemiological surveillance reporting. This is in line with research by Akbar & Fauzi (2023) and Al Fajar, Dar, & Rohani (2022) which explains that the operation and maintenance stages in the Waterfall method play an important role in maintaining the sustainability and relevance of the system to changing user needs ^{[14], [15]}.

Conclusion

Based on the results of the web-based system design using the Software Development Life Cycle (SDLC) method with the Waterfall model approach, it can be concluded that in the system requirements analysis stage, functional and non-functional requirements were successfully identified as the basis for system development. The system design stage focused on developing a simple, interactive, and easy-to-use User Interface (UI), as well as system modeling using the Unified Modeling Language (UML) which includes use case diagrams, activity diagrams, sequence diagrams, and class diagrams. The system was then successfully implemented as a web-based application using the JavaScript programming language with the Node.js runtime environment and MySQL database. The developed system is capable of automatically converting ICD-10 diagnoses into the Health Office reporting format. Testing results using the Black Box Testing method show that all system functions run according to requirements and produce output that matches user input. In the operation and maintenance stage, the system can run well in the local environment and is ready for use, with maintenance activities focused on updating diagnosis data and repairing the system if necessary.

References

- [1] A. R. Muttaqin, A. Wibawa, and K. Nabila, "Inovasi Digital untuk Masyarakat yang Lebih Cerdas 5.0: Analisis Tren Teknologi Informasi dan Prospek Masa Depan," *J. Inov. Teknol. dan Edukasi Tek.*, vol. 1, no. 12, pp. 880–886, 2021, doi: 10.17977/um068v1i122021p880-886.
- [2] et al Muhammad Ath Thariq, Muchammad Dimas Mufti Baskara, "SYSTEMATIC LITERATURE REVIEW: ANALISIS PENERAPAN KECERDASAN BUATAN DALAM BIDANG KESEHATAN," no. April, pp. 168–173, 2024.
- [3] Depkes RI, "Undang-Undang Nomor 44 Tahun 2009," 2009, *Jakarta*. [Online]. Available: ???
- [4] Permenkes No 45 Tahun 2014, "Permen Kesehatan Republik Indonesia Nomor 45 Tahun 2014 Tentang Penyelenggaraan Surveilans Kesehatan," *Permenkes No 45 Tahun 2014*, vol. Nomor 65, no. 879, pp. 2004–2006, 2015.
- [5] D. L. Tm, M. Koeswo, and K. Rokhmad, "Faktor Penyebab Kurangnya Kinerja Surveilans Infeksi Nosokomial di RSUD Dr . Iskak Tulungagung The Causes of Low Performance on Nosocomial Infection Surveillance at Dr . Iskak Hospital Tulungagung," *J. Kedokt. Brawijaya*, vol. xx, no. xx, pp. 186–194, 2010.
- [6] A. Rasisputra, A. Arwan, and F. Amalia, "Pengembangan Sistem Surveilans dalam Pencegahan dan Pengendalian Infeksi pada RSUD Haji Surabaya," *J. Pengemb. Teknol. Inf. dan Ilmu Komput.*, vol. 5, no. 4, pp. 1471–1480, 2021.
- [7] D. M. Vira Adi Kurniyanti, "PERBANDINGAN MODEL WATERFALL DENGAN PROTOTYPE PADA PENGEMBANGAN SYSTEM INFORMASI BERBASIS WEBSITE," *J. Syntax Fusion J. Nas. Indones.*, vol. 2, no. 12, 2022, [Online]. Available: <https://pdfs.semanticscholar.org/3f22/f56bbbfe6edab25e042ae1392dd138edffc5.pdf>
- [8] I. Sommerville, *SOFTWARE ENGINEERING Ninth Edition*. 2011.
- [9] H. Sri, N. Yudha, D. Putra, F. H. Fuadi, and F. D. Abdul, "Application of the Waterfall Method on a Web-Based Job Training Management Information System at Trunojoyo University Madura," vol. 4026, 2021.
- [10] R. Haerani, P. Hendriyati, P. A. Nugroho, and M. Luqman, "WATERFALL MODEL IMPLEMENTATION IN INFORMATION SYSTEMS WEB BASED GOODS DELIVERY SERVICE The progress of the world of technology is currently very fast , reaching various fields ;

- therefore , more and more companies are trying to develop their businesses ,” vol. IX, no. 3, pp. 501–508, 2023.
- [11] H. S. I. W. A. Iskandar, “Development of a Web-Based Online Library Information System at the National University Using the Waterfall Method: Development of a Web-Based Online Library Information System at the National University Using the Waterfall Method,” *J. Mantik*, no. Vol. 4 No. 1 (2020): May: Manajemen, Teknologi Informatika dan Komunikasi (Mantik), pp. 300–310, 2020, [Online]. Available: <https://iocscience.org/ejournal/index.php/mantik/article/view/748/499>
 - [12] A. Setiawan, B. Y. Geni, R. Laple, and S. Putra, “Designing a Website-Based Information System for Cibadak Village Using the Waterfall Method,” vol. 06, no. 01, pp. 14–23, 2024.
 - [13] M. D. Gustinov *et al.*, “Analysis of Web-Based E-Commerce Testing Using Black Box and White Box Methods,” *Int. J. Inf. Syst. Innov. Manag.*, vol. 1, no. 1 SE-, pp. 20–31, Jun. 2023, doi: 10.55583/ijisim.v1i1.687.
 - [14] M. F. & A. F. Akbar, “Application of Waterfall Method In Design Of Web-Based Library Information System Program Case Study at Elementary School Warungnangka Kabupaten Subang,” vol. 6, no. 1, pp. 72–85, 2023, doi: 10.36378/jtos.v6i1.3065.
 - [15] M. Al Fajar, M. H. Dar, and R. Rohani, “Application of Waterfall model in development of family planning participants information system,” *Sink. J. dan Penelit. Tek. Inform.*, vol. 6, no. 2 SE-, pp. 679–686, May 2022, doi: 10.33395/sinkron.v7i2.11387.