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Electronic Medical Record Information System to Support Clinical Management of Web-Based Medical Report Resumes

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Abstract: Medical records are important documents that record patient information, including examinations, treatments, actions, and services. Article 46 paragraph (1) of the Medical Practice Law defines medical records as files containing patient identity, examination results, treatments, actions, and other services. Regulation of the Minister of Health No. 21 of 2020 concerning the Integration of Health Information Systems, in the Ministry of Health's Strategic Plan 2020-2024, emphasizes the importance of a fast, accurate, integrated, and electronic-based health information system. This study aims to develop an electronic medical record information system for creating web-based medical resumes, using Visual Studio Code, PHP, MySQL, and Laravel. The development method used is agile. The results of the study show that the application of the agile method in developing web-based medical resumes increases effectiveness and efficiency. The problem identified is manual medical resume writing, which is often illegible, making it less efficient. To overcome this, an electronic medical resume design was developed as part of an electronic medical record system, which allows for faster, timelier, and clearer medical resume creation. This medical resume management system is expected to increase efficiency and readability.

Keywords: Electronic Medical Records; Medical Resume; Information Systems; Governance; Web.

1. Introduction

Medical records are the documents that keep records and information about patients in the medical field that includes examinations, treatments, actions, and services provided to the patients. According to the Medical Practice Law, Article 46 paragraph (1), medical records are files containing records and documents concerning the identity of patients, examinations, treatments, measures and other services that have been provided to patients. The Health Information System as regulated in the Minister of Health Regulation No. 21 of 2020 concerning the Integration of Health Information Systems, stated in the Ministry of Health's Strategic Plan for 2020-2024 that the Health Information System aims to provide faster and more accurate health information services, sharing of resources, strengthening the implementation of integrated electronic-based standard Health Information Systems, strengthening the implementation of Health Information Systems in health care facilities [1]. This study aimed to use the Visual Studio code application with the PHP programming language, MySQL as database, and the Laravel framework to determine the electronic medical record information system in making a web-based medical resume. We will use agile development research methodology [2]. The results of this study indicate that web-based medical resumes by agile methods in system development resulted in beneficial for the effectiveness and efficiency of a medical resume [3][7]. The problem of this research is the handwritten medical resume that some medical resumes are not clear or readable, making the effect or efficiency not optimal [4][8]. Thus, to address the challenges faced, researchers developed a design for electronic medical resumes as part of the electronic health record system in order to develop efficient and effective medical resumes [9]. Medical resume management systems will permit the process to be done much quicker, more on time, and clearer.

The World Wide Web (Web) is a means of displaying online information in the form of text, images, sound, and interactive video. The web has features that connect documents (links) to each other, which can be accessed via a browser. Initially, the web was a collection of information connected to the internet via hypertext technology [5][6]. In software engineering, a web application is an application accessed via the web on a network such as the internet. Web applications are built with programming languages supported by web browsers, such as ASP, Perl, Java, JavaScript, PHP, Python, Ruby, and others. Agile is an iterative and evolutionary software development approach that prioritizes teamwork, budget and time efficiency, resulting in high-value software with limited formal documentation. Agile is a method for increasing productivity in project management and software development. Agile allows teams to adapt quickly and produce value quickly because it focuses on working on small tasks regularly rather than large launches [3][4]. This study begins by reviewing relevant previous research. Mita Mutia, *et al* (2023) conducted research on Electronic Medical Records in handling Medical Resumes by implementing Microsoft Visual Studio 2012 programming [10]. Ide Redika (2020) conducted research on designing a web-based medical resume interface using the Research and Development (R&D) research method using a qualitative approach, resulting in a web-based medical resume interface design product [8].

Based on research at Hospital X, problems were found in making medical resumes, namely doctors often do not complete medical resumes correctly, and doctors' writing is often illegible. To improve the quality of service, the hospital continues to improve the hospital information system (SIMRS) so that it can help the process of making medical resumes accurately and effectively. However, the SIMRS at Hospital X has not been able to effectively create patient medical resumes. Therefore, to support the creation of medical resumes, the author developed an Electronic Medical Record Information System to Support Clinical Governance of Web-Based Medical Resume Reporting.

2. Research Method

This study uses a descriptive qualitative approach to gain an in-depth understanding of the electronic medical record information system, especially in the clinical governance aspect of web-based medical resume reporting. A descriptive qualitative approach was chosen because the purpose of the approach is to explore a phenomenon as a whole, especially focusing on the answers or definitions of the situation in the study along with an in-depth analysis and review of the contextual environment of the problem being studied. In addition, this approach does not only focus on making quantitative measurements but also qualitative interpretations of the meanings and experiences associated with the implementation of the system. Data were collected using a series of complementary methods: observation, interviews, and analysis of related documents. The first data collection technique is observation, which aims to capture a direct picture of the medical resume workflow and the use of the information system used in the hospital. This can be observed by monitoring the routines of

medical personnel such as doctors and medical record officers with their routines in completing and collecting medical resumes. Notoatmodjo stated that observation is a systematic and planned process, including seeing, hearing, and recording the number and attributes of certain activities or situations that are relevant to the research problem. Thus, it can be known what challenges are experienced in the process of making manual medical resumes and how much benefit the implementation of the electronic medical record information system is. In addition, interviews are also another method of data collection with the aim of obtaining richer and deeper insights from key informants. These interviews include interviews with doctors, medical record staff, and hospital managers who are directly responsible for creating and maintaining medical resumes. Interviews were conducted in a semi-structured manner, by asking open-ended questions that provide space for informants to express their views, experiences, and expectations regarding the electronic medical record information system. These interviews also allow researchers to explore the problems identified during the observation stage, as well as understand the needs and expectations of users regarding the system to be developed. Data collected through descriptive interviews and observations are also supported by document analysis. Data were taken from patient medical records, medical resume forms, policies and procedures governing medical records, and other documents related to the study. This document analysis was conducted to obtain more complete data and information about the process of compiling medical resumes and to verify and strengthen the results obtained in other data collection methods. Document analysis also allows researchers to place the historical and structural context of the issues they are studying.

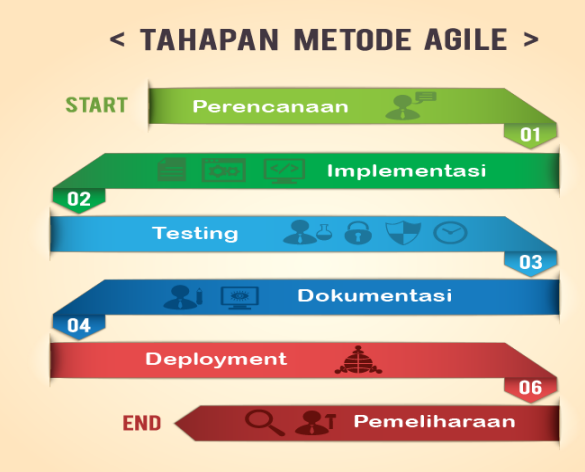

Figure 1. Agile Model

In developing this electronic medical record information system, the researcher used the agile development method. The agile method was chosen because of its iterative and evolutionary approach, allowing the development team to adapt flexibly to changing needs and feedback from users. This method prioritizes teamwork, time and budget efficiency, and produces high-value software with limited formal documentation. The stages in the agile method applied in this study include: (1) Planning, where the researcher identifies the features to be developed and determines their priorities; (2) Implementation, where the prioritized features are translated into program code; (3) Testing, where the software is tested to ensure its functionality and quality; (4) Documentation, where the development process and test results are documented; (5) Deployment, where the application is implemented in stages and repeatedly; and (6) Maintenance, where the application is monitored periodically to ensure performance and address any problems that may arise. By applying the agile method, it is hoped that the electronic medical record information system developed can meet user needs effectively and efficiently, and can continue to be developed and improved according to changing needs in the future.

3. Result and Discussion

3.1 Results

3.1.1 System Requirements Analysis

Needs analysis is one of the initial steps in the development of an electronic medical record information system as a clinical governance support on web-based medical resume reporting at Hospital X. Needs analysis aims to explore existing problems so that the needs of the system that will be developed can be formulated.

From the results of observations and interviews that have been conducted there are several points related to system needs, namely: (1) The process of compiling medical resumes is still done manually by writing on the forms provided. This is a process that has proven to be lengthy with a high susceptibility to errors, in medication writing as well as in the interpretation of medical information. One of the unique features of medical resumes is the doctor's handwriting, which is often illegible and creates an obstacle in the processing and utilization of medical resumes. (2) Medical resume compilation requires a well-functioning medical resume management information system. It is hoped that this system will help in speeding up the process of making medical resumes, eliminating human errors, while ensuring that the info recorded in the system is complete and verifiable. (3) The developed information system must also ensure that the computer-generated medical resumes are clearly legible, neat, and complete. This is crucial as it supports the level of medical services and facilitates the process of clinical evaluation, both on the part of the treating physician and by other interested parties. An organized, easily readable and structured medical resume will reduce the chances of interpretation and enhance the efficacy of medical communication. (4) Furthermore, the medical resume management information system is also developed to minimize the need for storage space that continues to increase. Digital medical resume data, on the other hand, can be stored in an organized manner, optimizing access and needing much less space. Moreover, it will help speeding up the process of searching and retrieving the medical resume data in the future. (5) The application of system is expected to enhance the precision and integrity of medical data, and make the audit and monitoring process easier to improve the quality of health services Data loss will be reduced with an integrated system and will always have up to date data with reporting and analyzing medical data is easier and fast.

3.1.2 System Design

The design of this medical resume management information system aims to provide a clear picture of the system's workflow and interactions between components. This system design includes several diagrams and models, including:

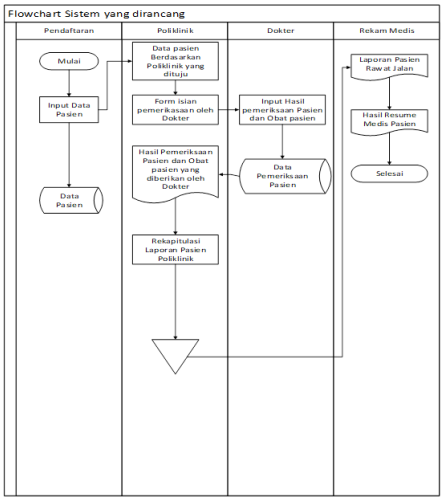

Figure 2. Flowchart Proposed by Researchers

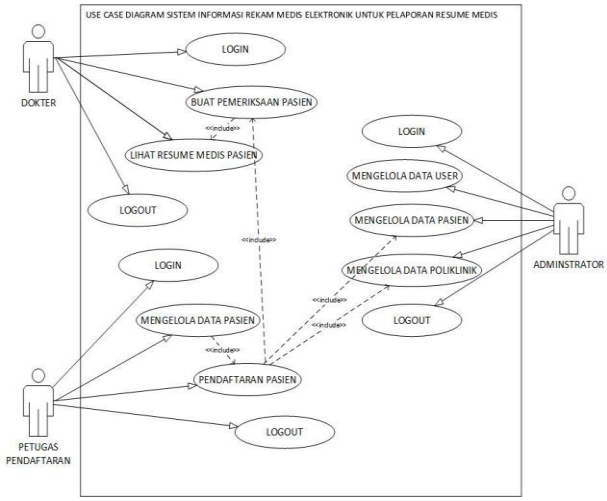

Figure 3. Usecase Proposed by Researchers

System Flowchart (Figure 2), This flowchart illustrates the overall system workflow, from the user login process to the process of creating and storing medical resumes. This flowchart shows the sequence of steps that must be taken by the system user, as well as how the system responds to each action. According to Azhar *et al.,* (2023), a flowchart is a diagram that shows the relationship between processes and statements, as well as the sequence or steps of a program [18]. The flowchart proposed by the researcher illustrates the system workflow in a structured and systematic manner, from user login, patient data input, filling in medical information, to creating and storing medical resumes. Usecase Diagram (Figure 3), This usecase diagram illustrates the interaction between actors (users) and the system. Actors in this system include registration officers, doctors, and administrators. The usecase diagram shows the functions that can be performed by each actor, such as logging in, inputting patient data, filling in medical information, and creating medical resumes. According to Syahputra *et al.*, (2019), the usecase diagram shows the relationship between actors and the system, and describes how actors interact with the system or functions available in the system [19]. The use case diagram proposed by the researcher provides a clear picture of the role and function of each actor in the system, as well as their interactions with the system.

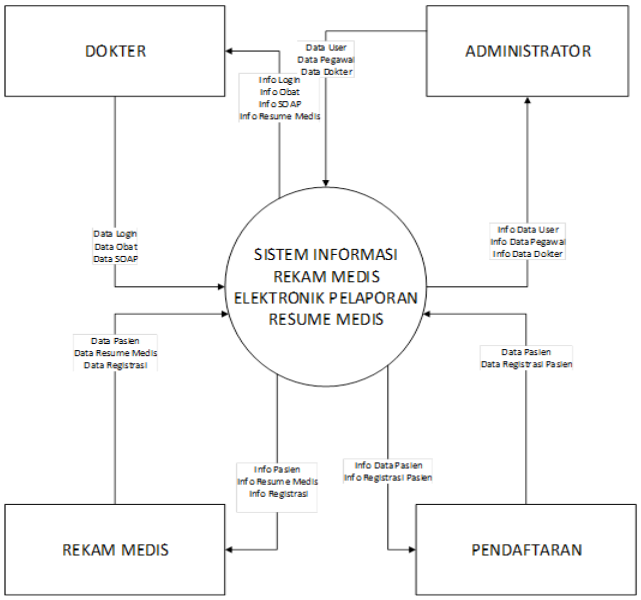

Figure 4. Context Diagram Proposed by Researchers

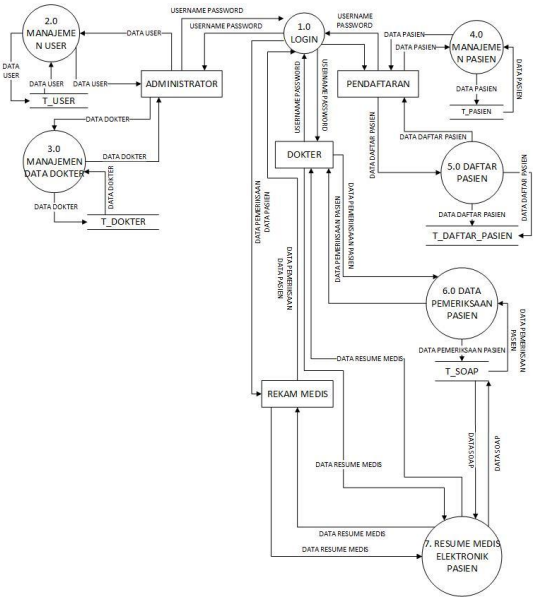

Figure 5. Data Flow Diagram (DFD) Proposed by Researchers

Context Diagram (Figure 4), This context diagram describes the system boundaries and the system's interactions with the external environment. This diagram shows that the medical resume governance information system interacts with users (registration officers, doctors, and administrators), as well as with the database to store medical record data. According to Imam & Nugraha (2018), the context diagram is used to describe the scope of the system. The context diagram proposed by the researcher provides a clear picture of the system boundaries and the system's interactions with its external environment [20]. Data Flow Diagram (DFD) (Figure 5), This DFD describes the data flow in the system. DFD shows how data is processed and transferred between processes in the system, starting from patient data input, filling in medical information, to creating and storing medical resumes. According to Imam & Nugraha (2018), Data Flow Diagram (DFD) is a tool that provides a complete and detailed picture of the system, both existing and still in the design stage [20]. The DFD proposed by the researcher provides a detailed picture of the data flow in the system, as well as how data is processed and transferred between processes.

3.1.3 Interface Design

The interface design of this medical resume management information system is designed with the aim of providing an intuitive and easy-to-use user experience. This interface design includes several main displays, namely:

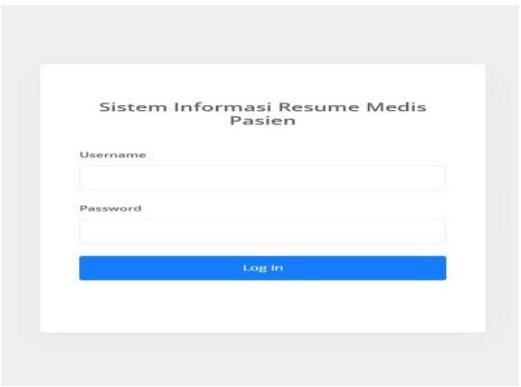

Figure 6. User Login

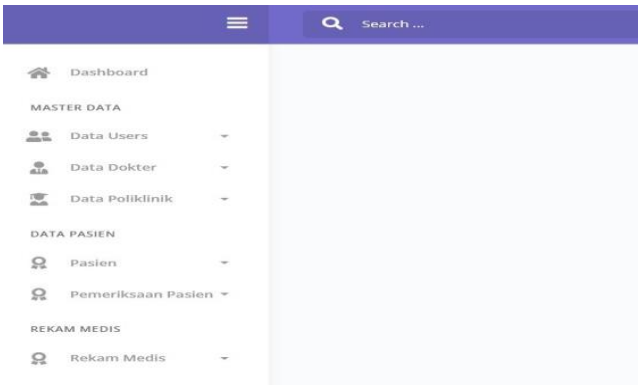

Figure 7. Main Menu

Login Page (Figure 6), This page is used by users to log into the system by entering their registered username and password. The login page is designed to be simple and easy to understand, with the aim of ensuring that

only authorized users can access the system. Main Menu (Figure 7), After successfully logging in, users will be directed to the main menu. This main menu displays several menu options, such as User Data, Doctor Data, Polyclinic Data, Patient Data, and Medical Record Data. The main menu is designed with a clear and structured appearance, so that users can easily access the features they need.

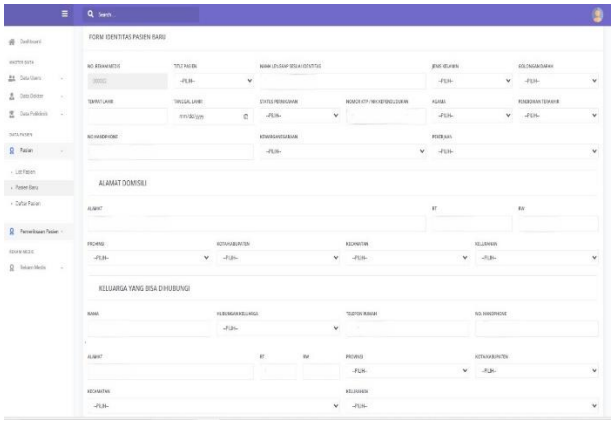

Figure 8. New Patient Identity Form

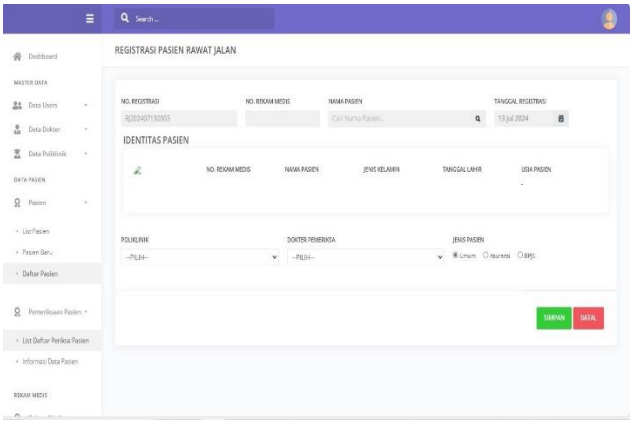

Figure 9. Outpatient Registration

New Patient Identity Form (Figure 8), This form is used by the registration officer to enter new patient identity data. This form is designed with a simple and easy-to-fill display, with the aim of ensuring that patient data is recorded completely and accurately. Outpatient Registration (Figure 9), This display is used by the registration officer to register outpatients. This display is designed to simplify the patient registration process, by displaying relevant information and allowing officers to quickly enter patient data.

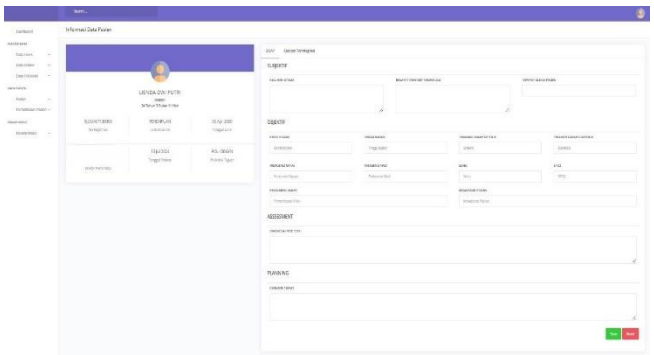

Figure 10. Patient Data Information

RESUME MEDIS RAWAT JALAN

Outpatient Medical Resume

No Rekam Medis Pasien : 000001
Nama Pasien : LIENDA DWI PUTRI
Jenis Kelamin Pasien : PEREMPUAN
Tanggal Pemeriksaan : 13 Jul 2024
Klinik Tujuan : POLI OBGYN

Saya dokter yang merawat/memeriksa dengan ini menyatakan keterangan tersebut diatas lengkap dan benar

Anamnesis
Mual, Muntah, Pusing

Pemeriksaan Fisik
BB : 54 Kg,
TB : 156 Cm,
SUHU : 36 °C,
TD : 110/110 mmHg,
SPO2 : 98 %,
Frek nafas : 20 x/mnt,
Frek Nadi : 82 x/mnt,

Diagnosa Free text
Emesis Gravida

Tindakan Medis
Vit D3 1000 1x1, Vit B 1x1, Asam Folat 1x1, Ondan 3x1

Bekasi, 13 Jul 2024
Dokter Yang Memeriksa

Figure 11. Medical Resume Results

Patient Data Information (Figure 10), This view is used by doctors to write patient history. This view is designed to make it easier for doctors to fill in patient medical information, by providing structured and easy-to-understand columns. Medical Resume Results (Figure 11), This view displays the results of the medical resume that has been filled in by the doctor. This view is designed to display medical resume information clearly and structured, so that it is easy to read and understand by interested parties. The design of this system interface is designed by considering ease of use and user work efficiency. A simple, clear, and structured display is expected to minimize data input errors and speed up the process of processing medical record data..

3.1.4 Software System Testing

Software system testing is done using the black box testing method. This method is chosen because it focuses on testing the functionality of the system, without paying attention to the internal structure of the program code. Black box testing aims to ensure that the system functions according to predetermined specifications and meets user needs. Testing is done by testing various system usage scenarios, from login, data input, to creating a medical resume. The test results are presented in Table 1, which shows that the system functions as expected.

Table 1. Black Box System Testing

No.	Testing Activities	Expected results	Test Results	Conclusion of Test Results
1	Login using your username and password, then click login.	The main menu will be displayed if the login is successful.	The system displays the main menu.	As expected
2	Adding Doctor Data	The doctor data menu is used to add doctor data. Then, enter the doctor data and save it.	The form has been filled in and matches the data entered.	As expected
3	Adding Polyclinic Data	Add polyclinic data through the polyclinic data menu. Then input the polyclinic data and save it.	The form has been filled in and matches the data entered.	As expected
4	Adding Patient Data	Add patient data through the new patient menu. Then input patient data and save.	The form is filled in and matches the inputted data and will appear in the patient examination menu.	As expected
5	Adding Medical Resume Data	Adding medical resume data via the patient examination menu (Patient Data Information)	The form has been filled in and matches the data entered.	As expected

The test results prove that the Electronic Medical Record Information System to Support Clinical Governance of Web-Based Medical Resume Reporting produces effective and efficient medical resume reporting.

3.2 Discussion

The results of the needs analysis, system design, interface design, and system testing that have been performed indicate several key points that are the focus of discussion in this study. This research is focused on designing an electronic medical report information system that can help clinical governance on a web-based medical resume reporting at Hospital X. The resulting system from this study brings about solutions to the existing problem and a capability of an efficient and effective solution delivering a management information system for medical resumes. The electronic medical record information system that has been developed is significantly efficient and effective in this regard and serves the purpose of managing resumes effectively. In short, the process of creating medical resumes manually by hand, which was time-consuming and prone to errors, can be done digitally through the system. This system helps by making doctors enter patient medical information in a structured and easily readable way, which in turn reduces the chances of misinterpretation and makes building medical resumes faster. Moreover, such a system enables the experience data of medical resume to be stored digitally, which can save time and physical storage space, and can be easily searched and retrieved later. So this system is not only a solution to saving time and resources but also to ensure the correctness and honesty of medical data.

An electronic medical record information system is also essential for supporting clinical governance at Hospital X. An integrated system allows medical records data to be accessed easily and quickly by authorized medical personnel. This enables doctors to have comprehensive and accurate data of patient history, thus doctors can make better and more effective medical decisions. This system also makes communication within the medical personnel easier by allowing them to share one patient's medical data in an efficient manner. In addition, this system is also facilitated in the audit and monitoring process, so that hospital management can monitor the quality of the medical services provided and carry out improvements as needed. As a result, this system not only increases operational efficiency, but also enhances the overall quality of medical services. The success of the implementation of the system is also influenced by the interface designs of this e-medical record information system. - The interface is designed keeping in mind the ease of use and work efficiency of users. A simple and structured display makes it easier for the user to handle the system; there is no need for rigorous training. Login page, main menu page, data entry form, result page, they are designed to minimize the possibility of errors when entering data. As a result, the system is not only efficient but also user-friendly for all the users such as Doctors, Registrars, and Administrators.

This black box testing method test proves that the system can run as it should according to the specification desired. This is being tested by testing scenarios ranging from login, input some data to make a medical resume. The testing result states that all system functionalities work properly and there are no critical errors or bugs. This is evidence of the system developed successfully achieving the functional requirements and ready for implementation in the hospital environment. Black box testing also instills confidence that the system can safely and effectively be used by users. Agile methods in the development of this system also contribute significantly to the successful execution of this project. With agile, the development team can respond more flexibly to changing needs and feedback. The agile methodology has an iterative and evolutionary process that allows the team to continue to refine and expand upon the work done, resulting in a system that meets the user's needs. Furthermore, agile methodologies also emphasize collaboration and communication in such a way that the system development process is carried out smoothly and efficiently. So, agile methods have become the right choice for this electronic medical record information system development.

This study makes valuable contributions for the building of health information systems, especially within the clinical governance of medical resume reporting. This electronic record information system is a model for the implementation of similar systems in other hospitals. Moreover, this study offers further perspectives into the significance of integrated and user-friendly strategy in health information systems development. Therefore, this study makes contributions not only to Hospital X by providing practical solutions, but also to the body of literature on health information systems generally by offering theoretical and methodological contributions. Despite the important results of this study, there are some limitations that must be taken into account. The study was only performed in one hospital, so the conclusions of this study might not be generalizable to different hospitals with different characteristics. Moreover, as with other similar efforts, this study has not addressed data security and privacy aspects in depth in depth, which is a significant issue in the deployment of health information systems. Accordingly, it is suggested to do research in multiple hospitals with different characteristics and also have more studies on the factors of data security and privacy. On top of that, future research can also identify the prospective capabilities of strong technologies like artificial intelligence and machine learning in developing smart e-HRIS providing adaptive electronic medical record information systems. This study successfully establishes an electronic medical record information system capable of supporting the clinical governance of web-based medical resume reporting for Hospital X with proven effectiveness and efficiency in medical resume management, clinical governance support, friendly interface design, and system validation through black box testing. The contributions of the current study are considerable both to the development of health information systems, and to providing the best recommendations for future studies. Therefore, this research is anticipated to offer substantial advantages for hospitals and society.

4. Related Work

This study is based on various studies and relevant literature related to electronic medical record information systems, medical resume governance, and system development methodology. This literature review aims to provide a strong theoretical and empirical foundation for this study, as well as to identify research gaps that can be filled by this study. The Ministry of Health of the Republic of Indonesia has issued Regulation of the Minister of Health Number 24 of 2022 concerning Medical Records [1]. This regulation is the legal basis for the implementation of medical records in Indonesia, including electronic medical records. This regulation regulates various aspects related to medical records, from the definition, type, format, storage, to the use of medical records. This regulation also emphasizes the importance of medical records as legal documents and tools in medical services. This regulation is an important reference in the development of electronic medical record information systems in this study, to ensure that the system developed is in accordance with applicable standards and regulations.

Several studies have been conducted related to the development of web-based medical record information systems. Haryanto (2024) developed a web-based medical record information system at the Gaga Medika Clinic [2]. This study shows that a web-based medical record information system can increase efficiency and effectiveness in managing medical record data, as well as facilitate access to information for medical personnel. Another study by Sasqia Yovita Dewi (2021) also developed a web-based medical record health service information system using the Laravel framework [8]. This study shows that the use of the Laravel framework can accelerate the system development process and produce a more structured and easy-to-manage system. Choirur Roziqin *et al*. (2022) also developed a web-based electronic medical record system that shows the

potential of web systems in increasing the efficiency and accuracy of medical data [14]. These studies provide an overview of the potential and benefits of web-based medical record information systems in improving the quality of health services.

Research related to electronic medical record governance is also a concern in this literature review. Mahdani *et al*. (2023) studied electronic-based medical record governance in the preparation of outpatient polyclinic reports using the Agile method [9]. This study shows that the Agile method can be used in the development of a medical record information system, with a flexible and adaptive approach. Mutia *et al*. (2023) also studied electronic medical record governance based on information technology in handling patient medical resumes using the Agile method [10]. This study shows that an electronic medical record information system can simplify the process of handling medical resumes and increase the efficiency of medical personnel. Wonosari Hospital (2021) has also implemented electronic medical resumes in inpatient rooms, which shows that digitizing medical resumes can increase data efficiency and accuracy [7]. These studies provide insight into the importance of good electronic medical record governance in supporting health services.

In the development of this electronic medical record information system, the Agile method is one of the focuses of the literature review. Muhammad Robith Adani (2023) explains the Agile development method in software development [3]. The Agile method emphasizes an iterative and incremental approach, with a focus on team collaboration and adaptation to changing needs. Iqbal Musyaffa (2023) also explains the Agile development method, including its definition, stages, and advantages [4]. The Agile method allows the development team to respond to changing user needs quickly and flexibly and produce a system that is more in line with user expectations. These studies provide a theoretical basis for the use of the Agile method in information system development.

Several other relevant studies were also reviewed, although not directly related to medical records. Burhanuddin Damanik (2021) designed a junior high school information system using PHP CodeIgniter [5], which provides an overview of the use of the PHP framework in developing web-based information systems. Istiqomah & Hidayat (2021) developed a website information system as a promotional media and information facility in a hospital [6], which shows the potential of websites to support communication and information in the hospital environment. Arif Setyawan *et al*. (2021) designed a web-based extracurricular system and SMS gateway [11], which provides an example of implementing a web-based information system in an educational context. Ihramsyah & Yasin (2023) designed a web-based sales information system application [12], which provides an overview of the use of web-based information systems in a business context. These studies provide insight into various applications of web-based information systems in various contexts.

Eka Permana *et al*. (2022) studied the design of an information system for the provision of inpatient medical record documents using Visual Studio 2010 [13], which shows the importance of information systems in managing medical record documents. Research by Kesdam & Banjarmasin (2023) in the form of a literature review regarding the development of electronic medical records in Indonesia provides an overview of the trends and challenges in the implementation of electronic medical records [15]. Maryati & Utami (2023) studied the optimization of the quality of health services in clinics with the implementation of a web-based medical record information system [16], which showed that the medical record information system can improve the quality of health services. Rusydi & Hamzah (2022) studied the implementation of medical records at the Labuang Baji Regional Hospital in Makassar City [17], which provides an overview of the challenges and opportunities in the implementation of medical records in hospitals.

Literature review shows that web-based electronic medical record information systems have great potential in improving the efficiency and effectiveness of medical record management, as well as supporting good clinical governance. Agile methods have also proven effective in developing flexible and adaptive information systems. However, there is still a research gap related to the implementation of electronic medical record information systems in the context of medical resume governance, especially in the context of hospitals in Indonesia. This study aims to fill this gap, by developing an electronic medical record information system that can support clinical governance of web-based medical resume reporting at Hospital X as well as with medical record information systems, medical resume governance, and system development methodology. This literature review also helps in formulating research questions, research objectives, and appropriate research methodology.

5. Conclusion

To fulfil the research objectives, a dedicated web-based Electronic Medical Record Information System, known as SIRME, was developed to facilitate clinical governance of medical resume reporting. This system

was developed using the Agile method, which is characterized by iterative development and focuses on delivering high-quality products in response to changing user needs. We chose the Agile way because we wanted to facilitate the development of a system involving dialogue on how the system should behave and evolve over time and allow the development team to adjust the system as per the changes in environment factors. Results from the application of the SIRME indicated a marked improvement over the traditional method of creating a medical resume. This system easily transitioned away from the labor and error-intensive manual one to a fast, digital process. Therefore, in this study concluded that the application of abased-web Electronic Medical Record Information System according to Agile method have been effective in improving efficiency and effectiveness to compile medical resume in hospital. Not only that this system speeds up resume of medical so that the data resulting in more accurate and integrity, and ultimately contribute to improve the quality of health services in Hospital X.

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