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Web-Based Inpatient Medical Record Review Information System Design Using the Agile Method: Implementation at RSUD Bandung City

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Abstract: Inpatient medical record review is a major activity in ensuring the quality, completeness, and consistency of hospital healthcare documentation. Besides ensuring compliance with documentation standards, the review process also ensures that clinical services are accurately recorded for reference in future medical, legal, and administrative matters. This study aims to design a web-based information system that will facilitate structured, efficient, and integrated review workflows between medical record officers and other related units. The development of the system uses the Agile method which prioritizes flexibility and fast adaptation to user feedback so that improvements can be made iteratively. The prototype created can manage data input on reviews, generate summary results as well as reduce human errors usually found in manual entries. The hospital currently uses Google Spreadsheets and Google Forms which are tools with too many columns and prone to errors hence making tracking time and data inefficient. Usability testing using the System Usability Scale (SUS) obtained an average score of 68.13 which is categorized as "acceptable" usability indicating that the system is easy to use and feasible for real implementation. This system is then a basic solution for workflow simplification, validation accuracy improvement, and increasing documentation reliability of medical records in hospital environments.

Keywords: Medical Record Review; Information System Design; Agile Method; Performance Improvement; Completeness of Medical Record.

1. Introduction

Indonesian Law No. 44 of 2009 defines hospitals as healthcare institutions delivering individual health services across inpatient, outpatient, and emergency care settings [1]. Healthcare service quality depends not only on medical personnel expertise but also on the effectiveness of supporting systems like medical record management. Technological advancement has shifted medical record management from manual to digital platforms, enabling computerized review processes [2]. The Minister of Health Regulation No. 24 of 2022 mandates electronic medical record management aligned with digital transformation, prioritizing data security and confidentiality principles [3]. Medical records document complete patient healthcare histories, serving as references for medical decision-making and service quality evaluation (Ministry of Health, 2008). Beyond storing patient information, medical records function as tools for assessing hospital service quality [4]. Minister of Health Decree No. 129/Menkes/SK/II/2008 establishes that high-quality medical records achieve 100% completeness across all documentation components [5].

Information system design offers solutions for improving performance, efficiency, accuracy, and integration in hospital medical record management [6]. Hospital performance enhancement includes evaluations through open and closed medical record reviews [7]. Open reviews occur during active patient treatment, while closed reviews take place after document return to medical records units. Despite technological implementation efforts, many hospitals struggle to design systems that adequately support medical record review processes. Several previous studies have developed information system applications supporting both review types. Lungguh Sri Astuti *et al.* (2024b) designed a closed medical record review system using Visual Studio Ultimate 2013 [8]. Although stable within internal environments, the system lacks multi-device accessibility and restricts functionality to closed reviews only. Unlike previous work, the current research develops a web-based medical record review information system supporting both open and closed reviews. Built using Visual Studio Code as code editor and Laravel Framework for architecture, the system enables medical record officers to conduct reviews during patient treatment (open review) and post-discharge (closed review). Multi-device accessibility without special installation requirements enhances practicality, efficiency, and responsiveness.

Observations and interviews with medical record officers at Hospital X in Bandung City revealed continued reliance on inefficient tools—Google Spreadsheets and Google Forms. Review forms contain questions assessing medical record document completeness with response options: "Lengkap" (Complete), "Tidak Lengkap" (Incomplete), and "Tidak Digunakan" (Not Used). While easily accessible, spreadsheet use creates limitations in efficiency, data validation, and input accuracy. Excessive columns and rows produce cluttered displays, complicating navigation and increasing data entry error risks. Insufficient input validation controls significantly impact collected data accuracy. Cases frequently occur where medical record reviews proceed using forms despite inappropriateness, yet results still indicate form usage with statuses like "Lengkap" or "Tidak Lengkap."

Although several studies have attempted digital medical record review system development, most remain limited in scope and methodology. Amalia *et al.* (2021) and Lungguh Sri Astuti *et al.* (2024b) developed systems supporting only closed record reviews restricted to desktop environments, reducing flexibility and multi-device accessibility [9][8]. Many prior studies, including work by Haryati *et al.* (2023), applied traditional development models like Waterfall or RAD, lacking flexibility for iterative improvements and rapid user feedback [10]. Another critical gap involves primarily functional evaluations without quantitative data on efficiency gains, error reduction, or user satisfaction. These limitations underscore the need for adaptive, web-based solutions integrating both open and closed reviews, supporting multi-device accessibility, and employing Agile methodology. Addressing these gaps ensures not only functional performance but also measurable improvements in efficiency, accuracy, and user acceptance. Current systems fail to fully meet accessibility, speed, and accuracy needs in managing patient medical information. In response, the study aims to design web-based medical record review information supporting performance improvement and data processing accuracy in hospitals. Through the approach, we anticipate enhanced efficiency, minimized data entry errors, and broadened user access for process participants.

2. Related Work

Previous studies on healthcare information systems have explored diverse designs, technologies, and methodologies. Amalia *et al.* (2021) focused on desktop-based review systems, while Haryati *et al.* (2023) emphasized digitization to improve efficiency [9][10]. However, these systems lacked accessibility across multiple devices. Other studies have applied structured methodologies such as Waterfall and RAD, but these approaches often limited system adaptability to changing requirements [6][19]. Recent research highlights Agile as a more flexible framework for healthcare IT development. Mahadhir (2021) and Putri *et al.* (2024)

demonstrated Agile's adaptability in various healthcare contexts [20][11]. Franco *et al*. (2025) demonstrated a 40% improvement in audit efficiency through the use of hybrid mobile-web systems [21]. Similarly, Mahdani *et al*. (2023) and Mutia *et al*. (2023) provided evidence of Agile's effectiveness in improving medical record governance and patient summary systems, although evaluations of long-term performance remain limited [3][2]. Meanwhile, Lungguh Sri Astuti *et al*. (2024b) specifically applied Agile to closed medical record review, but their work did not extend to open review contexts [8].

Comparative studies have also examined different development frameworks. Meilani and Sari (2021) presented a desktop-based emergency department system, but the technology used was outdated and lacked scalability [18]. Mahadhir (2021) offered an alternative framework for public services, though not directly related to healthcare [20]. Beyond local studies, international works such as Jensen *et al*. (2013) and Denis *et al*. (2019) evaluated web-based patient-reported outcomes (PRO) systems, highlighting improvements in clinical monitoring and survival outcomes, but also revealing challenges related to interoperability and high implementation costs 0[23][24][25][26]. Garcia *et al*. (2019) further emphasized the importance of EHR interoperability [25], while Christensen *et al*. (2025) combined Agile and user-centered design (UCD) in a clinical decision support system, though with complex implementation demands [27]. More recently, Ayotomiwa *et al*. (2025) designed a hospital patient management system that improved operational efficiency but lacked considerations for data security and integration with national medical record standards [28].

Several studies emphasize the digitization and validation of medical record data as a means to improve efficiency, accuracy, and reduce errors from manual entry [9][19][8]. Methodologically, iterative approaches like Agile are consistently shown to provide greater adaptability in responding to user needs [20]. From a technical perspective, web-based architectures developed with PHP or JavaScript and supported by MySQL databases remain the most widely applied in healthcare systems because they enable centralized, real-time access to clinical data [28][13][10][15]. Building upon previous work, our study extends the application of Agile to hospital-based medical record review by integrating both open and closed review processes within a web-based system. The approach addresses the limitations of earlier systems by combining methodological flexibility, accessibility across devices, and a broader review scope, while aiming to deliver measurable improvements in performance outcomes.

3. Research Method

This study employs the Agile method combined with a qualitative approach, aiming to support accurate information and improve the quality of medical summary documentation [11]. Through the qualitative approach, the researcher collected data directly from primary sources such as medical record officers and doctors through field interaction and observation. The collected data is descriptive in nature and is used to design a system that aligns with the actual needs and conditions within the hospital environment.

Figure 1. Agile Method

3.1 Research Stages

The Agile method consists of six iterative stages: (1) Plan – at the initial stage, the researcher collected data from respondents such as medical record officers and doctors through interviews and observations of the current spreadsheet-based process. Based on the findings, a list of user requirements and a general overview of the system to be developed were compiled. This stage resulted in a functional and non-functional requirements document, which serves as the foundation for the development backlog. (2) Design – the researcher developed the system design, covering both the user interface (UI) and the data structure. The design was created with careful consideration of usability, ensuring that it would be easy to use for medical

record officers. (3) Develop – after completing the design phase, the researcher began developing the web-based system. The web interface was designed with a focus on ease of navigation and simplicity in page structure, to facilitate users in entering review data. Each web page was built to be responsive and user-friendly, tailored to match the workflow that was previously carried out manually using spreadsheets. (4) Testing – after the system was fully developed, the researcher conducted internal testing to ensure that all system components functioned as designed and that no errors occurred during the data input or output processes. The testing was carried out using a black-box testing approach, in which the researcher evaluated the system based on its responses to various types of input, without examining the internal code structure. (5) Deploy – after completing internal testing and confirming that the system functions as designed, the researcher proceeded to the deployment phase. This phase involved the limited implementation of the system within the hospital environment for initial trial use by medical record officers. The limited deployment aimed to identify potential issues that may arise during real-world usage, as well as to test the system's stability and compatibility with devices commonly used in the hospital. This process also included the configuration of the MySQL database. (6) Review – after the system was successfully deployed, the researcher conducted a series of trial runs under real-world conditions, though still on a limited scale. This testing aimed to ensure that all features operated according to the predefined functional specifications [12]. The testing was carried out internally by the researcher without direct involvement of end-users, while still taking into account the actual workflow within the hospital environment.

3.2 Research Materials and Tools

This stage represents the most fundamental phase of the research, aimed at analyzing the requirements for developing the necessary system. It was carried out through observation, interviews with medical record officers, and direct trial of the system in use at that time. Based on the findings, it was concluded that the hospital required a new system that could better support the review process, both open and closed, to enhance effectiveness and efficiency.

3.3 Data Collection Methods

Data collection employed three complementary methods: (1) observation of the review process using spreadsheets, by closely examining how medical record officers performed their workflow; (2) structured interviews with 20 respondents (medical record staff and physicians) to explore problems, expectations, and user needs related to the system to be developed; and (3) document analysis of questionnaire formats and previously used spreadsheet templates, which served as references for system feature development. To ensure validity, triangulation of data sources was applied, while risk mitigation strategies included daily database backups, role-based access control, and fallback manual reviews in the event of system downtime.

3.4 System Design

This design was developed to provide a clear understanding of the system workflow and the interactions between its components [13]. During the design process, various diagrams and models were used to present the concept in a structured manner. The system design includes several diagrams and models: Flowmap (Figure 2) illustrates the mechanism of the developed system, starting from medical record officers reviewing and assessing the medical records, up to the generation of quarterly reports presented in Portable Document Format (PDF). Context Diagram (Figure 3) provides a general overview of the designed information system, along with the entities involved, in a more concise and simplified manner [14]. Data Flow Diagram (Figure 4) illustrates the data logic within the system, as well as the flow of data between processes and the relationships between the system and external entities, in greater detail compared to the previous diagrams. Figure 4 illustrates the initial process in which the medical record officer logs in by entering their credentials, such as "Username" and "Password". Once successfully logged in, the medical record officer proceeds with the review process, and the corresponding data is stored in the database. The officer can then generate reports by filtering the review data and selecting the starting month corresponding to the first month of the quarter for which the report is to be generated. Finally, the report produced by the system is submitted to the head of medical records and the hospital director.

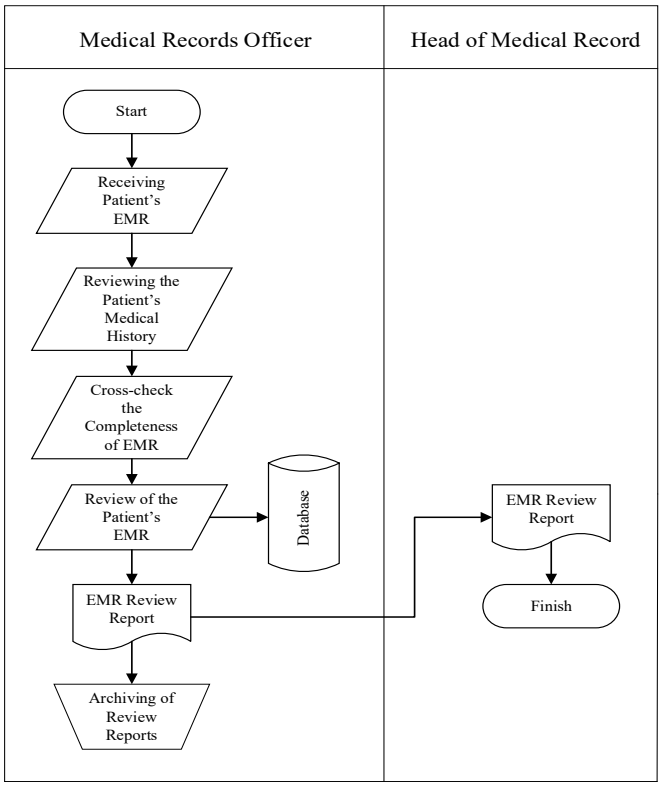

Figure 2. Flowmap

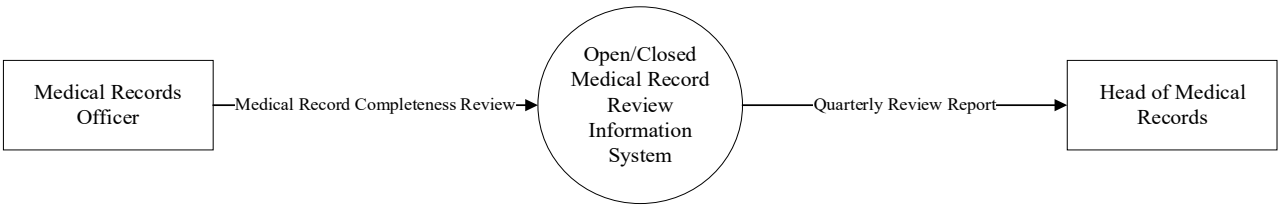

Figure 3. Context Diagram

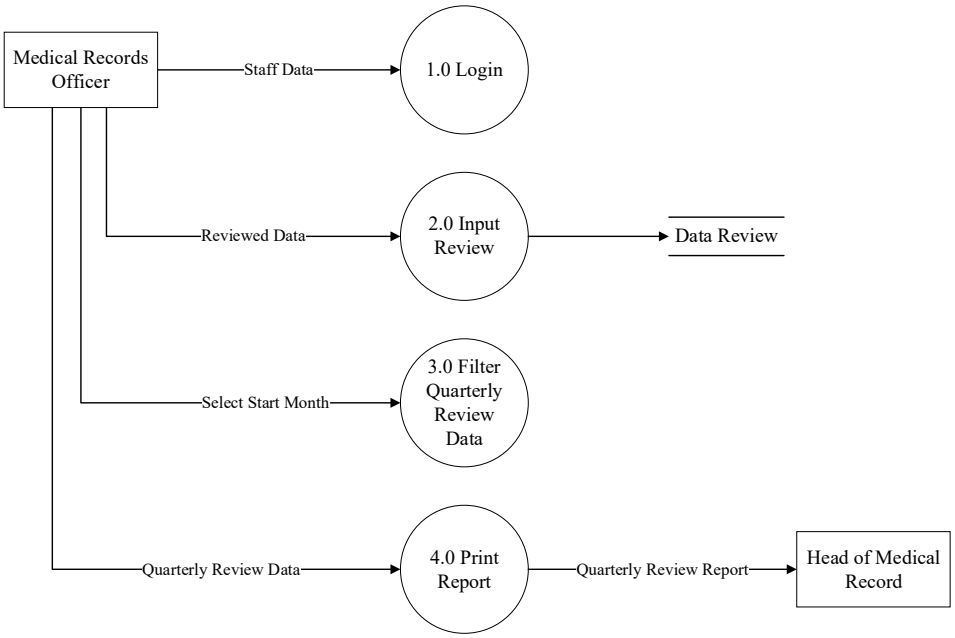

Figure 4. Data Flow Diagram

3.5 Agile Implementation

The system was developed using the Agile methodology through four sprints, each lasting two weeks. This iterative approach allowed continuous integration of user feedback from medical record staff and physicians. Laravel was selected as the development framework due to its strong security features (role-based

authentication, CSRF protection), extensive community support, and high scalability, making it suitable for hospital information systems.

Table 1. Sprint Planning and Testing Focus

Sprint	Main Feature(s)	Testing Focus (Black-Box)
Sprint 1	User authentication (login)	Login with username & password → system displays Dashboard
Sprint 2	Review data (open & closed), edit functionality	Save review results to "Review Data"; edit review results updated correctly
Sprint 3	Quarterly reporting	Generate PDF report with completeness percentages in tables and bar charts
Sprint 4	User management & system exit	Update username information; logout user account securely

3.6 Research Schedule and Location

This study was conducted over a period of approximately six months, from June to November. This timeframe covered all stages of the research, including planning, data collection, system design and development, testing, and the preparation of the final report. The research was carried out at one of the hospitals located in the city of Bandung. The selection of this location was based on several considerations, including the hospital's openness to innovations in information systems, the evident need to improve the efficiency of the medical record review process, and the support provided by the hospital's management. The hospital environment allowed the researcher to directly interact with healthcare professionals and medical record staff, enabling effective and optimal data collection and system trial processes.

4. Result and Discussion

4.1 Results

To provide a clearer overview of the application design, this section presents the user interface of the medical record review system. The interface includes the login page, the main dashboard, the medical record completeness check form (with status options such as complete, incomplete, or not applicable), as well as the final report generated by the system. Each screen is designed with ease of use in mind for both medical record officers and doctors, focusing on readability of information and efficiency in data entry. The interface layout is also structured to ensure optimal integration with the database and to support quick and accurate validation of review results according to user needs [15].

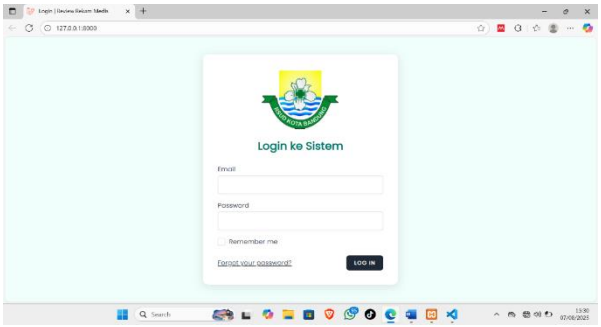

Figure 5. Form Login

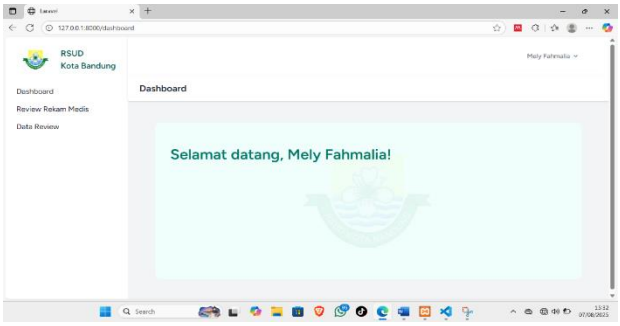

Figure 6. Dashboard

Figure 5 shows the login interface where medical record officers enter their username and password to access the system with role-based authentication. Figure 6 displays the main dashboard providing navigation access to key system features including data entry, management, and report generation. Figure 7 presents the review data input form with assessment criteria and status options (complete, incomplete, or not applicable) for medical record evaluation. Figure 8 shows the data review page displaying all entered review records with options to view, search, filter, and edit data.

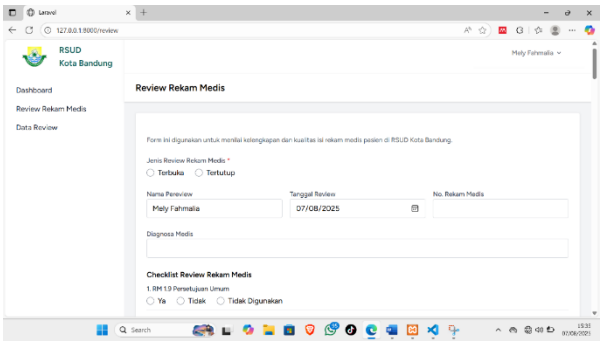

Figure 7. Form Input Data Review

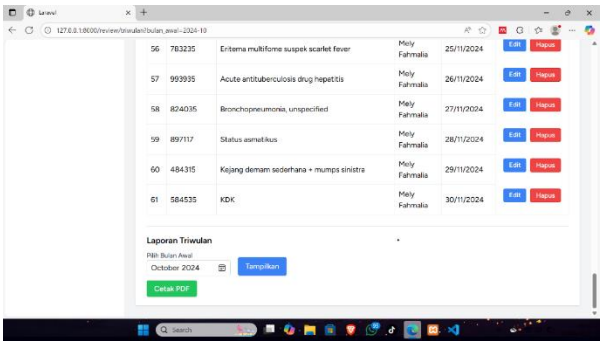

Figure 8. Data Review

Figure 9 presents the quarterly review report in PDF format, displaying medical record completeness percentages in a structured table. Figure 10 displays bar charts visualizing completeness percentages for each assessment criterion, facilitating quick data interpretation.

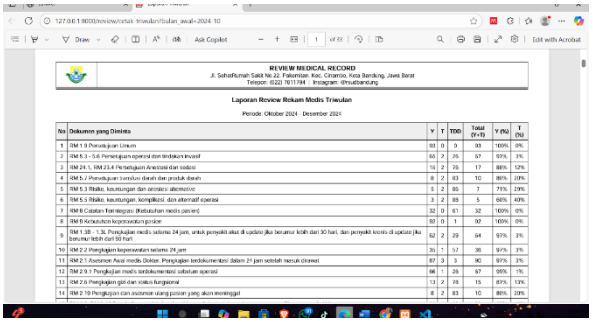

Figure 9. Review Data Report

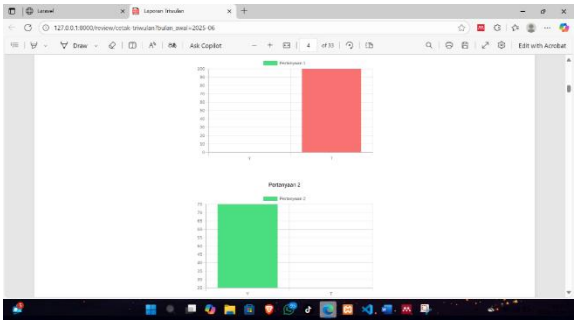

Figure 10. Review Data Report Chart

The black-box testing method is a software testing approach that evaluates the functionality of a system by examining the relationship between input data and the resulting output, without inspecting the internal structure or implementation details of the program [16][17]. This stage was conducted to ensure that the system developed in this study operates optimally as intended and fulfills user requirements [18]. The results of the testing are presented in Table 2.

Table 2. Results of Black-Box Testing for the Medical Record Review System

Testing Scenario	Desired Implementation	Test Results	Conclusion
Fill in the "Username" and "Password" fields, then click the "Login" button	The user will successfully login, and the system will display "Dashboard" page	Successfully displays the "Dashboard"	Match
Reviewing the results of patient medical record analysis, both open and closed	The review results will be saved to "Review Data"	The data has been successfully saved in "Review Data"	Match
Editing errors in the review results within "Review Data"	The edited data will be updated according to the changes made by the user	The edited data has been successfully updated	Match
Create a quarterly review report by selecting the starting month of the quarter, then pressing the "Tampilkan" button to show the data, followed by pressing the "Cetak" button to generate the report in PDF	The system will generate a PDF review report containing the percentage of patient medical record completeness presented in tables and bar charts	The system successfully generated and displayed the PDF review report page	Match
Editing user login information	The username will be updated according to the changes made by the user	The username has been successfully updated	Match
Logging out the user account by pressing the "Logout" button	The user account will be logged out of the system and must enter login information again to access the system	The account has been successfully logged out	Match

Usability evaluation using the System Usability Scale (SUS) was conducted with 20 respondents to assess user satisfaction and system feasibility. The evaluation results are presented in Table 3 and visualized in Figure 11.

Table 3. System Usability Scale (SUS) Evaluation Outcomes

Responden	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total Score	SUS Score
R1	4	3	4	2	4	0	4	2	4	2	29	72.5
R2	4	2	4	2	4	2	4	2	4	2	30	75
R3	4	1	4	3	4	2	4	2	1	2	27	67.5
R4	4	2	4	2	1	1	4	1	4	2	25	62.5
R5	4	3	3	2	4	3	4	2	3	2	30	75
R6	4	5	2	2	4	2	3	0	4	2	28	70
R7	4	2	4	2	2	2	4	2	4	2	28	70
R8	3	2	4	1	4	3	4	2	3	3	29	72.5
R9	4	2	4	3	2	2	4	2	4	1	28	70
R10	4	2	4	2	4	2	4	0	2	2	26	65
R11	4	3	4	0	4	0	4	2	4	2	27	67.5
R12	4	2	3	3	1	2	4	0	4	2	25	62.5
R13	4	2	4	2	4	2	4	2	4	2	30	75
R14	4	2	4	2	3	0	4	2	3	2	26	65
R15	4	2	4	1	4	3	3	2	4	2	29	72.5
R16	4	2	4	1	4	2	4	2	4	2	29	72.5
R17	4	0	1	3	2	2	4	3	2	2	23	57.5
R18	4	0	4	0	4	1	4	2	4	2	25	62.5
R19	3	2	1	2	3	2	4	2	1	3	23	57.5
R20	3	2	4	2	4	1	4	2	4	2	28	70
Mean												68.13
Total												1362.5

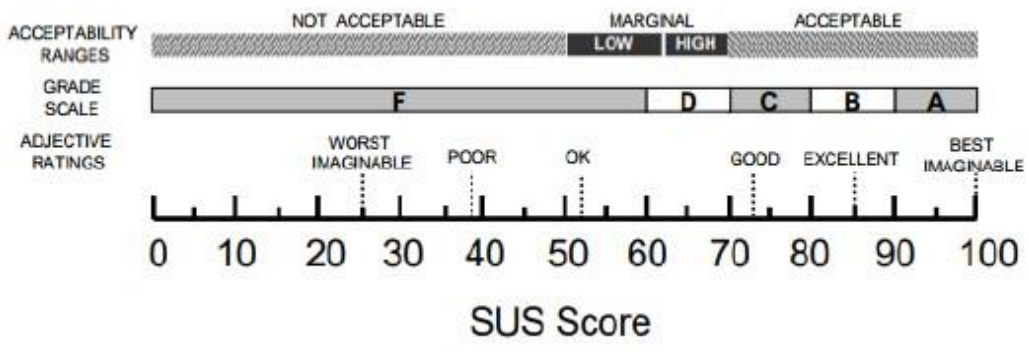

Figure 11. Respondent SUS Scores and Average Results

4.2 Discussion

Usability evaluation with the System Usability Scale (SUS) yielded 68.13 as an average score from 20 respondents, which is slightly above the standard SUS benchmark of 68. This means that it falls within the "acceptable" usability category. The scores ranged between 57.5 (poor) and 75 (good), indicating some variability in user perceptions. Many of the respondents rated positively on ease of use and functionality; however, there were sufficient numbers who indicated difficulties to impact the overall rating for usability. These findings indicate that while the system may generally be feasible for use, it requires further refinement particularly regarding interface design, workflow efficiency, and feature consistency toward achieving a more uniform user experience and elevating usability rating into "good" or "excellent." Black-box testing results show that all six testing scenarios were completed successfully with each test case fulfilled as per required implementation. This confirms that core functionalities of the system such as user authentication, data entry and editing, report generation, and user management are functioning correctly without any critical errors. These functional tests have been passed successfully to validate the readiness of this system for use in a hospital environment. However, variability in SUS scores emphasizes continuous user feedback and iterative improvements to specific usability issues raised by individual users. Future improvements should be directed

toward navigation path streamlining, visual consistency enhancement across interfaces, and more comprehensive training for users to maximize adoption of the system as well as satisfaction.

5. Conclusion

This study successfully designed and developed a web-based inpatient medical record review information system using the Agile method as its development approach. The system was designed to replace the previous manual method, which relied on Google Spreadsheet and Google Form, and had proven to be inefficient, prone to input errors, and difficult for data tracking. The results of the system development demonstrate several key achievements: (1) the system facilitates the review of medical records both open (while the patient is still hospitalized) and closed (after the patient has been discharged); (2) it features the ability to input review data, edit previously entered data, and generate quarterly reports in PDF format, complete with percentages and bar charts; (3) it is capable of improving work efficiency, data validation accuracy, and ease of access, as it is web-based and can be used on various devices without additional installation; (4) through the Agile method approach, which includes the stages of planning, design, development, testing, limited implementation, and evaluation, the system has been tested using the black-box testing method and has shown results that meet user requirements; and (5) usability testing using the System Usability Scale (SUS) produced an average score of 68.13, which falls into the "acceptable" usability category and indicates that the system is generally user-friendly and feasible for practical use, though still requiring further refinement to reach the "good" category.

From a cost-benefit perspective, the reduction in review time and error rate indicates potential operational savings for the hospital through increased staff productivity and reduced need for rework. However, this study has several limitations. The system was tested only in one hospital with a limited number of respondents, and performance testing was restricted to functional scenarios and stress tests without broader scalability evaluation. Future research is recommended to extend implementation to multiple hospitals, integrate advanced features such as AI-based document validation, and conduct longitudinal evaluations regarding cost-effectiveness and user adoption levels. As a roadmap for further development, this study recommends: (1) integration with the hospital information system to enable seamless data exchange and reduce redundant data entry; (2) implementation in the form of a progressive web application to support more optimal cross-device access and offline functionality; and (3) provision of training and capacity-building programs for end users to ensure sustainable system adoption and maximize the benefits of digital transformation in medical record management.

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