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Original Article

The Design of the E-Tracer Medical Record System in the Digital Era to Improve Health Data Management

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Abstract

The quality of healthcare facilities is greatly influenced by their health data management practices. To keep up with the times and provide better care in this digital era, healthcare organizations must swiftly adopt electronic technology. Creating and implementing a workflow system for electronic medical records is the focus of this article. With the principles of the Xtreme Programming development method, which can enhance health data management, the approach is based on rapid and efficient adjustments as well as continuous improvement. The author identifies that the hospital still relies on manual systems without the E-Tracer application, which could evaluate and identify an objective framework to measure and assess staff performance. This is useful in driving Continuous Quality Improvement (CQI) and other forms of sustainable quality enhancement. As a result, processes that should be running effectively within the data management workflow are instead lagging behind. Consequently, there is a gap between the organization's goals and staff performance, which has not fully met the established operational requirements. The goal of this study is to design and implement the E-Tracer medical record system to enhance health data management in the digital era. The findings suggest that hospitals could benefit from the performance evaluation capabilities of the E-Tracer system in terms of data management and staff performance. The quality of health data management can be measured by reviewing the reports generated by this system over a certain period of time. These reports can help with things like access control and avoiding breaches in medical data.

Keywords: CQI, E-Tracer, Extreme Programming, Information System, Medical Records.

1. Introduction

Many industries, including healthcare, have undergone profound changes in modern times due to technological advancements. The processing of data into detailed information and the storage of data to support the smooth operation of procedures within an organization are both facilitated by computer technology (Tarenta et al., 2021). To aid in health-related decision-making, integrated systems known as Health Information Systems (HIS) have been developed. These systems handle data, technology, and human resources (Resolution No. 18, 2022, Minister of Health). To realize the vision of healthcare providers and achieve their objectives, every healthcare institution needs a management system that helps turn plans into action. Research by Asriati et al. (2022) highlights that hospitals are a type of healthcare provider. The medical records management unit is present in every hospital to track patient information and distribute it as needed (Suryanto et al., 2021). Managing patient medical data and providing services to patients is the responsibility of the medical records unit, which aims to be an effective data and information center (Ansori et al., 2022). According to the Minister of Health Regulation No. 24 (2022), "Medical records are documents that contain patient

identity data, examination results, treatment, actions, and other services provided to the patient." Medical records, which are confidential and easily verifiable, must be stored securely (Azizah et al., 2023). Therefore, the installation of medical records must be done carefully and according to protocols to achieve maximum quality. This is in line with Permana and Susilo (2022).

Centralization and decentralization are two main approaches for manually storing medical records based on their storage location (Suryani et al., 2023). However, this requires significant space and long procedures for retrieving and returning manual medical records, as they must be physically searched using medical record numbers, shelf numbers, and proper storage techniques. Accessibility to medical records is crucial because healthcare providers will struggle to care for patients without access to their complete medical history and relevant care instructions. Setiatin and Abdussalaam (2021) argue that the shortcomings of manual healthcare administration can be addressed by electronic medical records (Choironi and Heryawan (2023). The method of managing patient medical records digitally, relying on information and communication technology, is known as technology-based medical records management (Mahdani et al., 2023). However, there is a higher risk of damage to paper forms, such as tearing or fading, which can make the information difficult to read or the text illegible due to variations in the reader's understanding. Additionally, more space is required for storing medical records. Therefore, healthcare facilities must improve their service systems by utilizing advanced technology and skilled human resources (Tasya et al., 2023).

Improvements in data management in hospitals are expected to be realized through increased efficacy, efficiency, tidiness, and good integration resulting from the implementation of medical records information systems (Meilani & Sari, 2021). As stated in Minister of Health Regulation No. 24 (2022), "Every healthcare facility is required to implement Electronic Medical Records." Therefore, one of the solutions is the creation and implementation of the E-Tracer system, which is based on digital technology and addresses healthcare data management issues. This will lead to more effective and efficient health data supervision. It is believed that electronic medical records can create a searchable database, enabling the utilization of this information for both current and past research. Research by Penev et al. (2024) through the integration and digitalization of data, the E-Tracer technology provides an information system for the management, tracking, and monitoring of medical records effectively.

According to Susilo et al. (2023), this system is designed as a centralized electronic health data storage system that facilitates easy access and information sharing among authorized healthcare providers from various facilities. It also enhances health data management and enables interoperability between healthcare facilities. In their study, Alomar et al. (2024) note that it helps policymakers implement evidence-based health policies and makes data-driven decision-making easier. Legal aspects of administration, civil, and criminal law are all relevant to healthcare overall, as noted by Abdulhamid (2021).

As long as the E-Tracer system can store medical records in an Ms. Access database, it can review files containing medical records for medical assistance or legal processes. One of the many uses of E-Tracer in health data management is to monitor various aspects over a certain period to ensure everything is proceeding as planned. Another use is to maintain patient information security by using an encrypted system exclusive to authorized parties (Choironi & Heryawan, 2023).

Readers are expected to be able to inspire the substance, stages, and benefits of designing E-Tracer medical record system to accelerate effectiveness and accuracy in health data management. They will also be able to discern the urgency and complexity of

conventional medical record administration, outline the principles and essential components in the E-Tracer architecture, seek an analysis of the impact of its application in optimizing medical data management, and explore its advantages and expansion potential in the healthcare landscape. The goal of this study is to design and implement the E-Tracer medical record system to enhance health data management in the digital era. It aims to address inefficiencies in manual medical record systems by developing a digital solution that improves data accessibility, accuracy, and security. This research introduces the E-Tracer system to enhance medical record management in healthcare facilities by transitioning from manual to digital systems. The findings help healthcare institutions improve their operations and adopt innovative technologies for better decision-making and service delivery.

2. Literature Review

Electronic database management, made possible by the use of computers and network technology, enables better storage and retrieval of patient information, facilitating easier and faster access to patient records, which in turn helps in making more accurate decisions and leads to better care. Healthcare practitioners are better able to communicate with each other through electronic medical records, which improves service coordination and reduces medical errors (Adeniyi et al., 2024). This system was developed to promote the growth of healthcare services working together with digital technology to manage medical records and monitor data synergistically. Electronic Medical Records (EMR) can be tracked and managed by E-Tracer throughout its lifecycle, from storage to borrowing and return, thanks to a centralized database system and an intuitive user interface. An important part of healthcare modernization is the transition from paper-based data systems to electronic ones. To input and handle physical documents in the system, those documents must first be converted into a digital format using scanning capabilities. Efficient and accurate medical information administration and processing are supported by the E-Tracer system, ensuring that all patient data, whether current or new, can be easily, correctly, and securely accessed in an electronic format.

1. Improvement in Data Accessibility and Accuracy

Based on previous research, E-Tracer helps improve the availability and accuracy of medical records when used in electronic medical record systems. For example, research by Maisa Putra and Alfauzain (2021) indicates that hospitals can reduce errors in administration and data storage by switching to E-Tracer medical records. This supports findings that also show the E-Tracer system accelerates workflows and data retrieval that were previously tedious and prone to errors and delays.

2. Increased Operational Effectiveness and Health Data Management

According to a study by Yada and Aramaki (2023), using technology to display patient medical record data in the E-Tracer system can help doctors make better and faster assessments. The authors also found that the E-Tracer system enhances the quality of healthcare services by providing quicker and more informative data to medical staff, thus improving the efficiency of medical data management.

3. Security and Accuracy of Medical Record Data

In line with these findings, research by Zhang et al. (2019) investigates how the E-Tracer system can benefit from decentralized data storage technologies to better secure electronic medical records, ensure data integrity, and implement more effective access controls. This result supports the idea that E-Tracer, when paired with the right technology based on user needs, can significantly improve the security and authenticity of patient data; this, in turn,

leads to clear and understandable audit trails, which are crucial for ensuring the accuracy of information stored in electronic medical records.

This body of literature highlights the importance of the E-Tracer system in improving the accuracy and effectiveness of health data management. The error rate in medical record data management can be reduced using E-Tracer, which is based on Microsoft Access, according to previous research (Maisa Putra & Alfauzain, 2021). Therefore, it is highly recommended that E-Tracer be developed in accordance with international standards to support the improvement of healthcare services. Healthcare institutions can increase operational efficiency in handling electronic medical records and ensure the security and reliability of medical record data with the proper implementation of tracers.

Currently, healthcare providers still use paper-based manual medical record systems, which are simple but inefficient in managing data and accessing patient information, even though technological advancements in healthcare have been widely implemented.

1. Technology Resource Limitations

Available resources may become a constraint in the implementation of the E-Tracer system. Proper technical involvement, including appropriate software and hardware, is required for this system. System performance can be affected by insufficient resources. For example, research conducted at the Urug Health Center in Tasikmalaya City shows that a shortage of electronic tracers is a major barrier in the implementation of E-Tracer (Yulia et al., 2021).

2. Human Resource Skills

The competence and familiarity of medical staff with using the electronic tracking system are crucial for the successful implementation of the system. Improper training and understanding can reduce the system's effectiveness. The reliability of data collected through interviews depends on the expertise and openness of the sources, according to a study conducted at the Islamic Hospital of Banjarmasin (Taufik, 2022).

Adoption of electronic medical record (EMR) systems has been linked to increased healthcare quality and efficiency, according to a number of studies. For instance, a study conducted by Stausberg and Uslu (2021). Examined the research on the benefits of electronic medical records (EMR) in hospital care and discovered that their use can raise the standard and effectiveness of medical care.

Additionally, studies conducted by Naamneh & Bodas (2024) demonstrates how using an EMR can improve the availability of medical information while lowering prescription errors and nurses burden. But according to Tawfik et al. (2024) it's also crucial to remember that some research has shown that doctor's use of EMR increases their administrative workload, which could exacerbate burnout symptoms. Consequently, in order to guarantee user acceptance and system efficacy, EMR deployment should be supported by an intuitive interface design and sufficient training.

3. Methods

Flexibility and Adaptation to Changing Demands are key components of the research process, which is a methodical approach to data analysis and implementation.

3.1. Data Collection Methods

Data for this system were collected using a descriptive qualitative analysis method. The goal of collecting information was based on field survey results.

a. Observation

In this phase, the researcher intensively gathered field data to support the development of the E-Tracer system at RSUD Oto Iskandar Dinata.

b. Interviews

Personnel responsible for the storage and retrieval of files, as well as the coordinator of the medical records department, were interviewed.

c. Literature Review

Journals and research papers were reviewed to create this work. Additionally, online papers that support my beliefs about the chosen challenges were also collected.

3.2. Development Methodology

In this phase, the researcher intensively gathered field data to support the development of the E-Tracer system at RSUD Oto Iskandar Dinata.

The researcher used a subset of the Agile Methodology from Extreme Programming (XP) for the system design. Ward Cunningham, Kent Beck, and Ron Jeffries were the first to propose Extreme Programming (XP), a lightweight perspective on software development (Hartawan et al., 2021). The ability to quickly and effectively adapt to new circumstances is another important component of this approach.

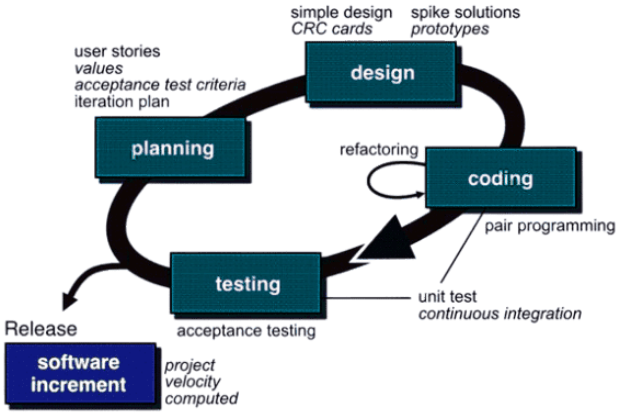

Figure 1. Extreme Programming

The stages in this methodology are as follows:

1. Planning

In this first step, user requirements are gathered to ensure that users have a clear understanding of what they want (Supriyatna & Puspitasari, 2021). Additionally, this stage focuses on identifying the system development objectives.

2. Design

To facilitate implementation, use case and activity diagrams are included in the design at this stage (Lamada et al., 2023).

3. Coding

This is the phase where the software is actually created, and the system's model design is translated into code (Supriyatna & Puspitasari, 2021).

4. Testing

During this phase, users decide which features and functionalities of the system will be utilized. The system's inputs and outputs are tested to ensure everything functions as expected (Supriyatna & Puspitasari, 2021). With this approach, time and costs can be optimized.

Additionally, XP provides direct steps that allow the development team to address issues as they arise.

3.3. Use Case Diagram

This diagram illustrates the interaction between the system and the users responsible for operating the program.

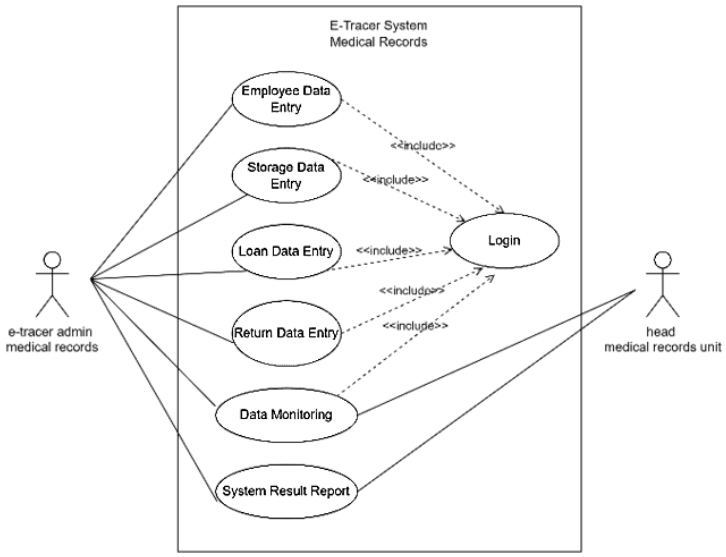

Figure 2. Use Case Diagram E-Tracer

To authenticate that only authorized personnel can access and operate the E-Tracer system, the process begins with a designated medical records staff member assuming the role of system administrator. This system covers the entire file lifecycle, from storage to borrowing and returning, while also monitoring medical record data to generate summary reports that show whether the hospital's borrowing and returning practices meet established standards. Paper files are scanned and stored in the system, and patient demographics are used to input old patient files, which are then converted into electronic form.

Since new patients do not have prior records, their information can be directly entered into the electronic medical record (EMR) system, eliminating the need to scan paper files. After entering all required patient data into the E-Tracer system, borrowing an electronic medical record simply involves filling out a borrowing form and searching for the medical record using the patient's medical record number (No. RM). To return the medical record, the same E-Record can be located by searching with the same medical record number. By entering the borrowing and return dates into the patient's electronic medical record system, monitoring data can be generated.

This process helps individuals determine the duration required to return the E-Record and ultimately generates reports that indicate whether the use of the EMR complies with the hospital's standard procedures.

3.4. Activity Diagram

In software development, activity diagrams can be useful for depicting the workflow or functionality of a system. Unlike sequence diagrams, which show actor actions, activity diagrams represent the activities or processes within the system itself (Adiguna and Musthofa, 2022).

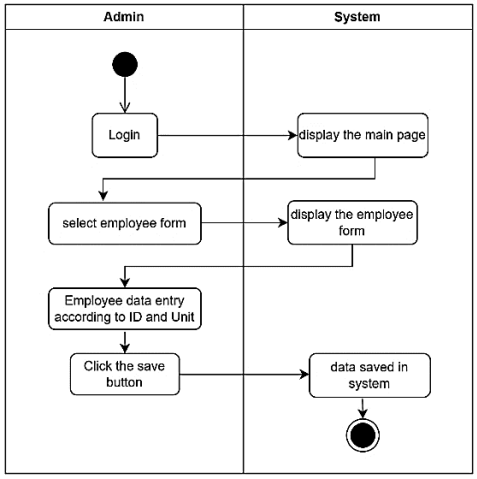

Figure 3. Activity Diagram for E-Tracer Employee Data Entry

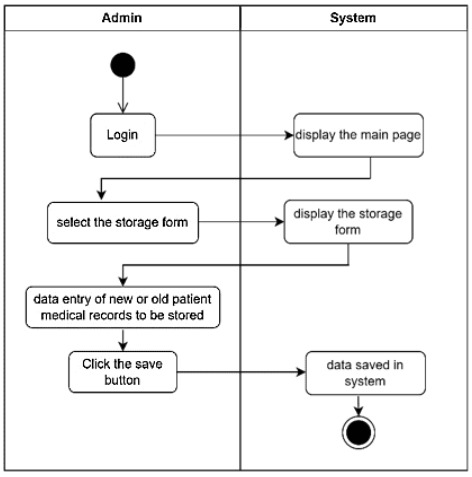

Figure 4. Activity Diagram for E-Tracer Data Storage Entry

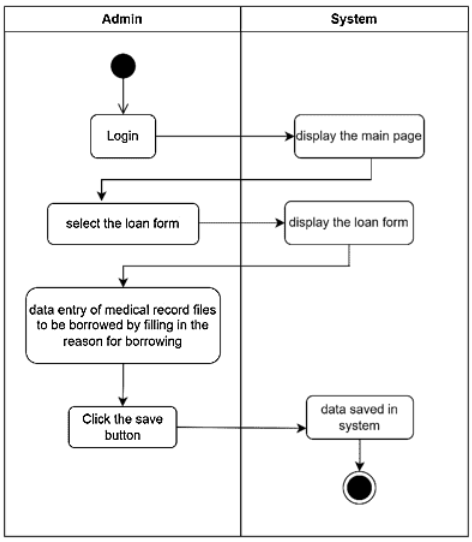

Figure 5. Activity Diagram for E-Tracer Loan Data Entry

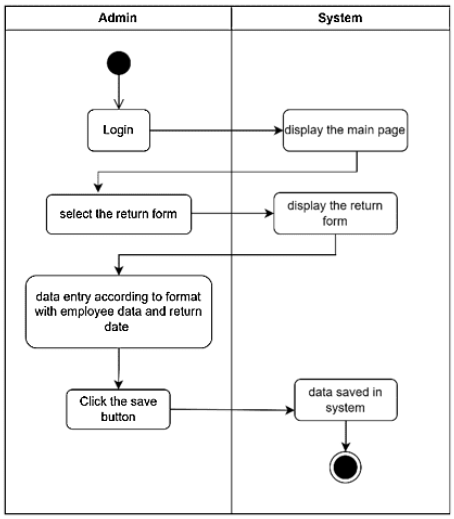

Figure 6. Activity Diagram for E-Tracer Return Data Entry

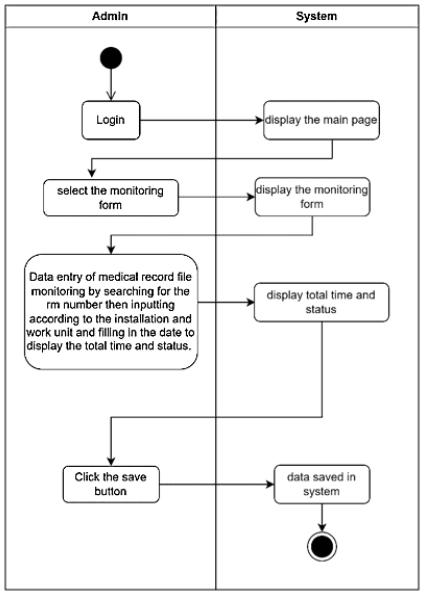

Figure 7. Activity Diagram for E-Tracer Monitoring

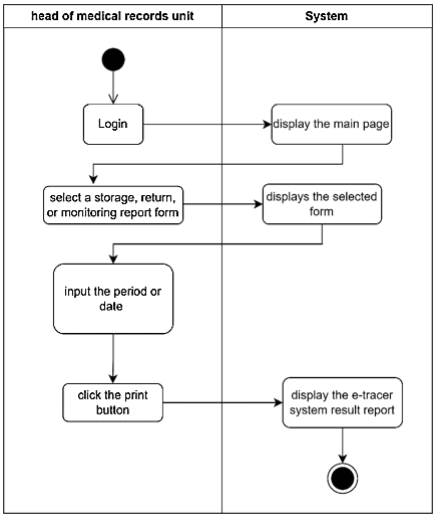

Figure 8. Activity Diagram for E-Tracer System Report Results

4. Results and Discussion

The E-Tracer technology facilitates the transition from paper-based recording to digital recording in healthcare facilities, while maintaining processes that comply with internal regulations. In this way, medical centers will be able to monitor the ongoing operational systems. The software architecture of E-Tracer produces the following results :

Figure 9. Form Login

Figure 9 is the display of the login form. This is the main page that will be shown by the system when run by the user.

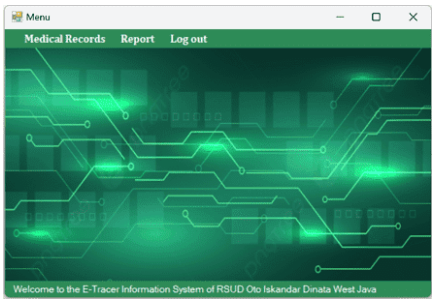

Figure 10. Main Page

Figure 10 presents a projection of the main menu that appears after participants successfully log into the E-Tracer system. The features displayed on this page include employee data input, storage, borrowing, returns, monitoring, and printing of E-Tracer report results.

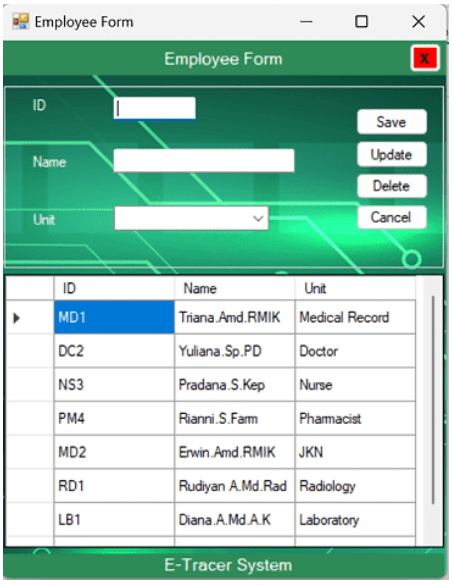

Figure 11. Employee Form

Figure 11 shows the first feature in this system, which is employee data entry. In this feature, users are required to input employee data as an integration for the next features that the user will run in the system.

Figure 12. Storage Form

Figure 12 illustrates the second data input function, which is storage. This function has two parts: one for new patients at various stages and another for existing patients at different phases. The process of transferring paper medical records to an electronic system involves scanning and storing the file contents, as well as uploading the file into the system. This process is necessary for existing patients who already have a medical history. When handling new patients without prior medical records, the patient's information is entered into the system, converting it into electronic medical records.

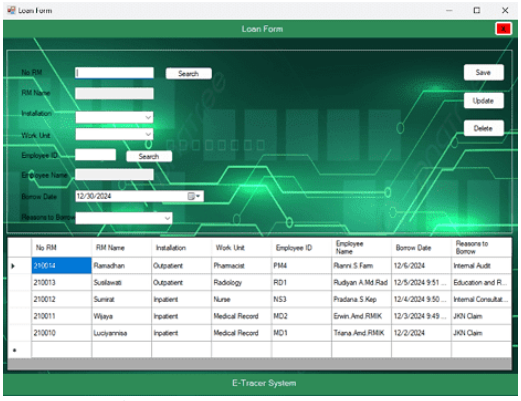

Figure 13. Loan Form

After saving the electronic medical record (EMR) in the E-Tracer system, the EMR will immediately be linked to another form (Figure 13). Users can access their EMR data using the system's borrowing form function, and their information will be stored in the system's database, allowing them to borrow electronic medical records.

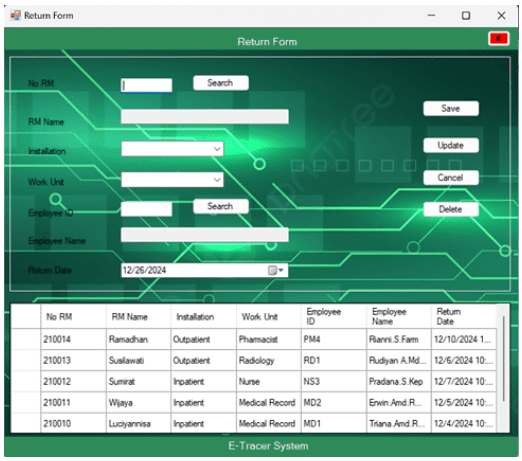

Figure 14. Return Form

Figure 14 shows that after borrowing the EMR data, it must be returned using the E-Tracer system. To do this, enter the patient's EMR number into the search bar, fill out the return form, and finally, save the data to the database archive.

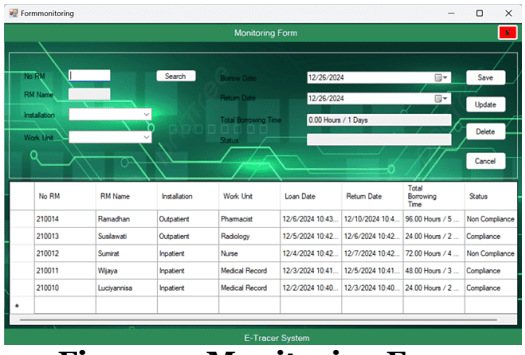

Figure 15.Monitoring Form

Figure 15 shows a feature that allows users to view employee activities at a specific healthcare facility in terms of the electronic medical record system, to check whether the workflow is in compliance with internal procedures.

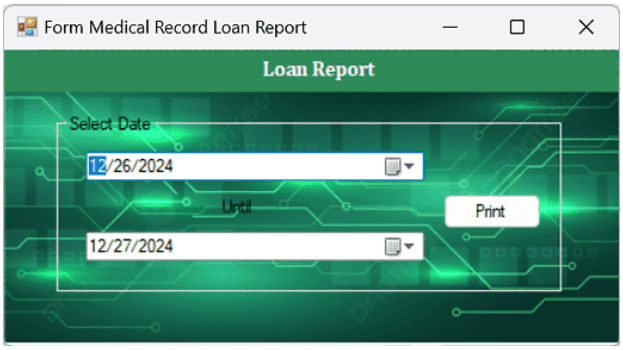

Figure 16. Loan Report Printing Form

Figure 16 shows a feature that allows users to view how many EMRs were borrowed during a specific period and to analyse the average reasons for the need for electronic medical records.

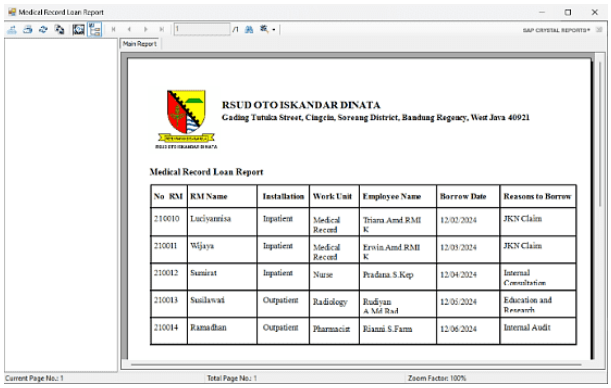

Figure 17. Loan Report Printing Results

Figure 17 shows a projection of the printed report results for borrowings during a specific period.

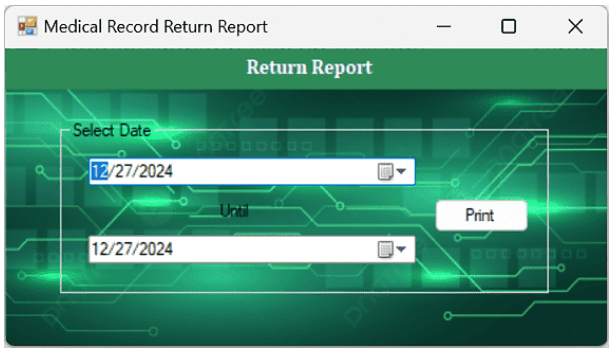

Figure 18. Medical Record Return Report

Figure 18 shows a feature that allows users to see how many electronic medical records were returned during a specific period.

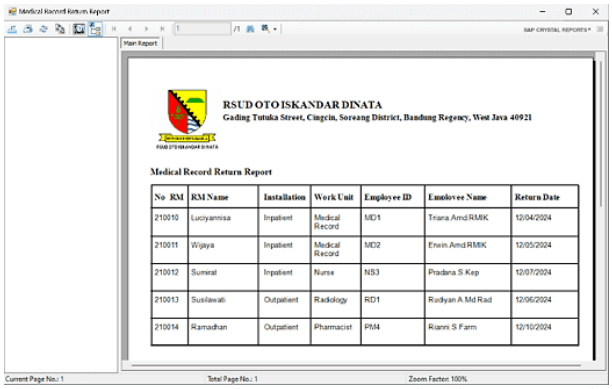

Figure 19. Return Report Printing Results

Figure 19 shows a projection of the printed report results for returns during a specific period.

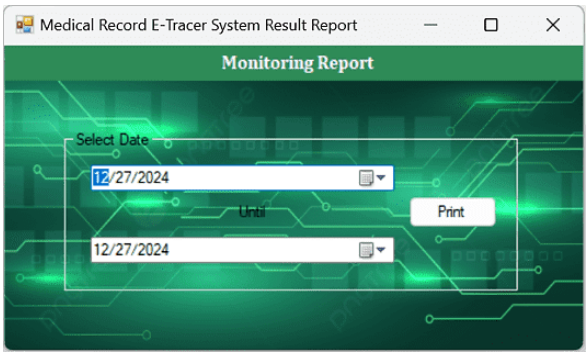

Figure 20. Monitoring Report Printing Form

Figure 20 shows a feature that provides the final result for printing a comprehensive report of all electronic medical records.

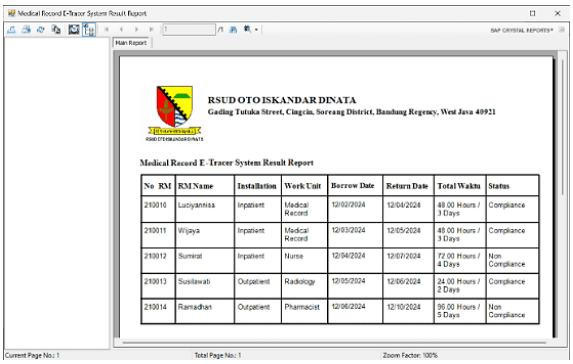

Figure 21. Monitoring Report Printing Results

The report detailing the total number of electronic medical records that comply with protocols and those that do not can be seen in Figure 21, which is the final product of the E-Tracer system. The head of the medical records unit can use this report as a starting point to evaluate the hospital's workflow by identifying which departments have not followed the specified processes when implementing the electronic medical record system.

5. Conclusion

The E-Tracer medical record system is an IT-based software solution aimed at simplifying and unifying patient record administration. Paper records should no longer be necessary in this advanced digital age. Recent technical developments, changes in healthcare policies, and the growing awareness of the value of electronic medical records all contribute to the push for this research. Promoting adequate technology infrastructure in healthcare institutions is also crucial for encouraging effective implementation. If we want the E-Tracer system to function as intended, improving operational efficiency and patient care, we must address these constraints.

It is important to socialize the system before implementing it to ensure that users can access and use this software system to its fullest potential, which will improve healthcare data management. To continuously enhance the system with cutting-edge features based on future needs, an evaluation is also necessary after the system has been used.

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