

Development of TB'DOTs Patient Monitoring System

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Abstract - This study addresses limitations of the manual TB DOTS process, including delayed reporting, lost records, and poor medication tracking. A web and mobile-based TB DOTS Patient Monitoring System was developed using the Waterfall SDLC. The system integrates patient registration, medication reminders, adherence tracking, reporting, and data visualization. Technologies include Laravel, PHP, MySQL, HTML, CSS, JavaScript, Bootstrap, Chart.js, and Flutter with SQLite. Evaluation results showed improved tracking efficiency and reduced workload, with an Excellent System Usability Scale score. The system supports treatment adherence and enhances TB DOTS service delivery.

Keywords - *TB DOTS, Patient Monitoring, Medication Adherence, Laravel, Flutter*

I. INTRODUCTION

Information technology now serves as a core aspect of most services delivered, monitored, and managed. Digital systems support healthcare workers by improving record keeping, communication, and patient monitoring, making healthcare processes faster and more efficient (Debnath, 2023).

Despite the availability of effective treatment, tuberculosis (TB) remains a serious public health problem in the Philippines. Many TB DOTS clinics still use manual and paper-based systems in recording patient information and monitoring treatment progress. This results in increased workload, delayed reporting, data loss, and difficulty in tracking medication adherence, which may lead to treatment interruption and drug resistance (Montemayor, 2023; Gumabay & Corpuz, 2021).

This project focuses on developing a TB DOTS Patient Monitoring System to address these challenges. The system is intended to benefit TB patients, healthcare workers, and TB DOTS clinics by providing centralized patient records, improved monitoring of medication intake, and reduced manual workload. The project was implemented in TB DOTS clinics that needed a reliable digital platform to improve treatment monitoring, enhance service delivery, and support better tuberculosis treatment outcomes.

II. STATEMENT OF THE PROBLEM

The implementation of the TB DOTS program in local health facilities often relies on manual and paper-based recording of patient information and treatment activities, which lacks a structured digital platform to support efficient monitoring and follow-up. This makes it difficult for health

workers to consistently track patient treatment progress, medication adherence, and scheduled laboratory examinations. Patients who fail to comply with their treatment regimen may experience delayed recovery, increased risk of relapse, and the potential development of drug-resistant tuberculosis, while health workers face challenges in providing timely interventions due to incomplete or delayed records.

TB DOTS clinic processes previously depended heavily on logbooks, paper treatment cards, and manual reporting systems. While these methods have been used for many years, they present several challenges, including delays in updating records, data entry errors, and inconsistencies in patient information. Health workers often experience difficulty retrieving patient records, verifying treatment history, and monitoring daily medication intake due to the lack of a centralized and organized database. Considerable time is spent searching through physical documents, manually updating records, and preparing required reports for monitoring and compliance purposes. This time-consuming process increases staff workload and reduces the time that could otherwise be dedicated to direct patient care, counseling, and follow-up activities. Furthermore, the absence of automated reminders and notifications contributes to missed medication schedules, poor follow-up compliance, and reduced treatment adherence among patients, especially those managing long-term treatment regimens.

This study aimed to address these concerns by developing a digital TB DOTS Patient Monitoring System that strengthens record-keeping, improves data accuracy, and enhances accessibility for both healthcare workers and patients. The system provides a centralized platform for storing patient records, tracking treatment progress, and monitoring medication adherence in a more efficient and secure manner. With the continuing burden of tuberculosis in the Philippines, the implementation of an organized and reliable monitoring system is both timely and necessary.

III. OBJECTIVES OF THE STUDY

This study aimed to develop a TB DOTS Patient Monitoring System and to address the challenges faced by the TB DOTS clinic and staff. Particularly, the study aims to:

1. To develop a web-based system that facilitates the recording, updating, and validation of TB patient information.
2. To implement a patient monitoring module for

- tracking treatment progress and medication intake.
- 3. To integrate an automated reminder feature to help patients follow their medication schedules.
- 4. To generate automated reports for patient records, treatment status, and clinic monitoring requirements.
- 5. To evaluate the developed system's usability, reliability, and effectiveness through user acceptance testing and feedback.

IV. REVIEW OF RELATED WORK

The reviewed studies show a global effort to improve healthcare information systems, particularly in patient monitoring, medication adherence, and public health program management. These systems were developed using either user-centered methodologies such as Agile and Scrum or structured approaches like the Waterfall Software Development Life Cycle. While both approaches have successfully produced functional healthcare applications, several recurring limitations are evident across existing studies, particularly in systems designed for long-term patient monitoring.

One common limitation identified is restricted platform accessibility, as many systems are developed as web-based applications only, limiting use by healthcare workers and patients who rely on mobile devices. In addition, several systems focus mainly on basic record management and reporting but lack real-time monitoring, automated reminders, and adherence-tracking features. These limitations make it difficult to immediately identify patients who miss medication schedules or fail to comply with treatment, increasing the risk of treatment interruption and drug resistance. Systems developed using strictly linear methodologies also show limited flexibility in adapting to evolving user needs, reducing their ability to integrate continuous improvements based on user feedback.

This study addresses these gaps by developing a TB DOTS Patient Monitoring System that integrates both web-based and mobile-based components to support healthcare workers and patients. The system uses the Waterfall methodology to ensure structured development and reliability, while incorporating patient-centered features such as medication reminders, treatment progress tracking, and centralized digital records. By utilizing technologies such as Laravel, PHP, MySQL, HTML, CSS, JavaScript, Bootstrap, and Flutter with SQLite, the system ensures accessibility, scalability, and usability. This study is not a duplication of existing works, as it focuses specifically on the workflow and monitoring needs of the TB DOTS program. Unlike general electronic medical record systems or basic medication reminder applications, the proposed system integrates patient registration, treatment monitoring, medication adherence tracking, automated reminders, and report generation tailored for TB DOTS clinics. It addresses key gaps such as limited mobile accessibility, lack of centralized records, and insufficient long-term adherence monitoring, while providing a user-friendly interface to support both healthcare workers and patients.

V. METHODOLOGY

The study used the Waterfall Software Development Life Cycle (SDLC), which follows a structured and sequential process consisting of requirements analysis, system design, development, testing, implementation, and evaluation. This methodology was selected to ensure systematic planning, clear documentation, and reliability, which are essential for healthcare information systems. System requirements were gathered through interviews, observations, and consultations with TB DOTS clinic staff to understand existing workflows, challenges, and monitoring needs.

During the design phase, system processes, user interactions, and database structures were modeled using use case diagrams, data flow diagrams, and entity relationship diagrams. These models provided a clear representation of how patient information, treatment records, and medication adherence data flow within the system. User interface designs were developed to ensure simplicity, consistency, and ease of use for healthcare workers and patients, supporting efficient data entry, navigation, and monitoring.

The system was implemented using Laravel (PHP) as the backend framework to handle system logic, authentication, validation, and report generation. The web interface was developed using HTML, CSS, JavaScript, and Bootstrap to ensure responsiveness across different devices. MySQL was used as the primary database for centralized storage of patient records, treatment progress, medication adherence, and reports. The mobile component was developed using Flutter with SQLite to support offline access. Development and testing were conducted using Visual Studio Code and XAMPP to ensure system accuracy, reliability, and readiness before deployment.

VI. RESULTS AND DISCUSSION

This section presents the evaluation, analysis, and discussion of the TB DOTS Patient Monitoring System, a web and mobile-based application developed to improve tuberculosis patient monitoring, medication adherence, and reporting processes. The results focus on system performance, usability, and efficiency, and compare the developed system with the existing manual, paper-based TB DOTS process used at the TB DOTS Clinic in Tagoloan, Misamis Oriental. Evidence from system outputs, functional testing, and usability evaluation demonstrates the effectiveness of the developed system in supporting TB DOTS operations.

A. System Performance Evaluation

The developed system demonstrated stable and reliable performance during system testing and user evaluation. The web and mobile applications successfully handled patient records, laboratory results, treatment regimens, medication tracking, notification scheduling, and report management without data loss or system errors. Automated validation of patient information and treatment data helped reduce manual checking, incomplete entries, and inconsistencies commonly observed in the paper-based TB DOTS process.

Report generation was significantly faster compared to the manual method. The system allowed administrators to generate patient treatment summaries, medication adherence reports, and monthly TB reports within seconds, improving documentation accuracy and reducing administrative workload. In addition, real-time monitoring, automated notifications, and offline data recording features enhanced patient adherence and supported better monitoring and decision-making by healthcare workers.

Fig. 1. Patient Registration Page

Figure 1 presents the Patient Registration Page of the TB DOTS Patient Monitoring System. This page displays patient demographic information, diagnosis details, and treatment classification. It allows health workers to accurately register patients in an organized and secure manner, replacing manual treatment cards and reducing the risk of lost or damaged records.

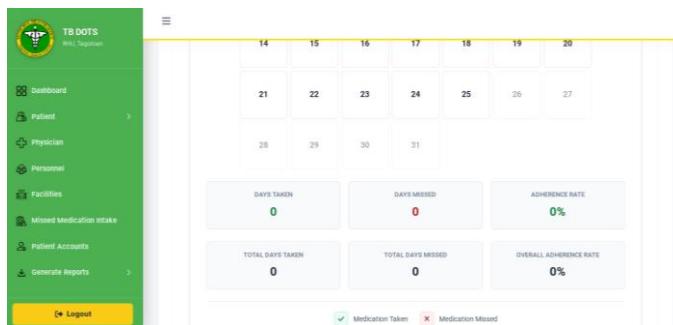


Fig. 2. Treatment Monitoring and Medication Tracking Page

Figure 2 presents the Treatment Monitoring Page, which shows the patient's treatment phase, daily medication intake, missed doses, and adherence status. This page supports accurate tracking of patient compliance and enables health workers to easily identify non-adherence and take appropriate actions.



Fig. 3. Mobile Application Notification and Progress Tracker

Figure 3 presents the Mobile Application interface showing medication reminders and the patient health progress bar. Through this interface, patients receive automated alerts for medication intake and sputum test schedules while visually tracking their treatment progress. This feature improves adherence and reduces dependence on manual follow-ups by health workers.

B. Usability Results And Analysis

Usability of the TB DOTS Patient Monitoring System was evaluated using the System Usability Scale (SUS). The evaluation involved TB DOTS health workers and selected patients who interacted with the system to perform common tasks such as patient registration, treatment monitoring, medication logging, notification management, and report generation.

The results indicate that users found the system easy to use, well-organized, and efficient in completing assigned tasks. The interface design supported users with limited technical skills, allowing them to navigate the system with minimal guidance. Features such as clear menus, visual indicators, and simplified workflows helped reduce errors and improve task completion time.

TABLE I. SYSTEM USABILITY SCALE (SUS) RESULT

System Usability Scale (SUS) Questionnaire					
	P1	P2	P3	P4	P5
1. I would like to use this application frequently.	4	4	3	3	2
2. I found some parts of the application confusing.	1	3	3	3	1
3. The application is simple and easy to use.	4	4	4	4	3
4. I think I would need help from others to use it.	0	0	4	3	2
5. The features of the application work smoothly together.	4	4	4	3	3
6. Some functions feel unclear or hard to understand.	3	3	4	3	2
7. Most people could learn to use the application quickly.	2	3	3	4	3
8. Using the application can be frustrating at times.	2	4	3	3	2
9. I feel comfortable and confident using the application.	4	4	3	3	2
10. Certain features are difficult to figure out.	3	4	4	3	1
Total x 2.5	67.5	82.5	87.5	80	52.5
					Average: 74

Table I presents the final System Usability Scale (SUS) score of the TB DOTS Patient Monitoring System. The system obtained a SUS score interpreted as 74, indicating high user satisfaction. This result confirms that the system meets usability

standards for healthcare-related information systems. The usability findings demonstrate that the system effectively supports TB DOTS clinic operations by reducing user effort and improving overall workflow efficiency..

C. System-Based Functional Comparison

TABLE II. FUNCTIONAL COMPARISON OF MANUAL VS.WEB-BASED APPLICATION

Feature	Manual Process	Developed Web Application
Record Retrieval	Finding records takes a long time	Records can be accessed instantly from the system
Patient Registration	Patient details are written on paper	Patient details are entered and stored digitally
Treatment Monitoring	Treatment progress is checked manually	Treatment progress is monitored in real time
Medication Tracking & Reminders	No automatic reminders for patients	The system sends reminders for medication intake
Report Generation	Reports are prepared manually	Reports are generated automatically

VII. CONCLUSION AND FUTURE WORK

A. Conclusion

The development of the TB DOTS Patient Monitoring System successfully modernized the tuberculosis treatment monitoring process at the TB DOTS Clinic in Tagoloan, Misamis Oriental. By replacing manual, paper-based workflows with a web and mobile-based platform, the system streamlined patient registration, medication tracking, adherence monitoring, and report generation. Technical evaluation showed that all functional modules passed system testing and operated as expected. Furthermore, the system achieved an Excellent System Usability Scale (SUS) rating, confirming that it is an effective and user-friendly solution for improving TB patient monitoring. Overall, the system enhances treatment adherence, reduces administrative workload, and supports better delivery of TB DOTS services.

B. Future Work

To enhance the system's impact, the following improvements are proposed:

- Integrate SMS notifications to provide medication reminders, appointment schedules, and treatment updates.
- Develop a Progressive Web Application (PWA) to allow offline access in areas with limited internet connectivity.
- Expand mobile application support to include both Android and iOS platforms for wider accessibility.
- Add a QR code or patient ID tagging feature for faster and more accurate patient record retrieval.
- Include an admin announcement board for posting health advisories, clinic updates, and reminders.
- Incorporate advanced reporting and analytics tools to support treatment monitoring and program evaluation.

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