

TUBERCULOSIS MONITORING INFORMATION SYSTEM - COMORBID (SIMTB-CO) APPLICATION IN MEDAN CITY

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ABSTRACT

Multidrug resistant TB (MDR-TB) is triggered by a long treatment process and access to health facilities, potentially leading to TB treatment failure or lost to follow up. Various approaches in the treatment process have been carried out, but have not produced good results. To achieve the TB elimination target by 2030, new and innovative strategies are needed to identify TB, strengthen and expand laboratory-based surveillance, track initial loss to follow up (iLTFU) of MDR-TB patients, and develop TB vaccines. This study aims to design an application capable of tracking lost to follow up patients with a developed monitoring information system, which is expected to be able to send notifications for taking medication, visit schedules, patient tracking and TB-related education (SIMTb-Co application). The waterfall method was chosen to assess the use of SIMTb-Co (Comorbid Tb Monitoring Information System) application in several health centres in Medan City. The assessment of the use of the application has been started in June-August 2024 and it can be concluded that the SIMTb-Co application can be used in the service of pulmonary patients at Puskesmas and can show the treatment track record of pulmonary TB patients from the beginning of treatment until they are declared cured.

Keywords: SIMTb-Co; Loss to follow up; Application; Tuberculosis

INTRODUCTION

The target of TB elimination by 2030 requires all stakeholders to reduce the incidence of TB to 65/100,000 population. TB control must be supported by all levels of the cross-sector together with all levels of society in order to realize TB Elimination 2030. Digitalizing the monitoring of TB patients' medication and implementing a mechanism so that TB patients can receive treatment until they are cured is one of the efforts to achieve the 2030 TB Elimination target (1).

In 2023, researchers succeeded in analyzing the variables that more dominantly influenced the incidence of increased cases of Pulmonary TB in Medan city from 210 TB patients spread across seven (7) public health centers in Medan city (2). The results of this study can be used as the basis for designing a model of efforts to prevent the transmission of pulmonary TB and efforts to reduce the increase in Drug Resistant Tuberculosis (TB-RO). This application is expected to be able to monitor compliance with taking medication up to the

specified limit, be able to track the location of the patient's residence and predict transmission and be able to send transmission prevention education to family members.

The SITB (Tuberculosis Information System) application that has been used so far in the existing Puskesmas in North Sumatra province is considered to be lacking in monitoring the patient's medication compliance (3). This application design is called SIMTb-Co (TB-Comorbid Monitoring Information System), which is expected to be able to develop the SITB application that has been used so far at the Puskesmas. This application also implements GIS features to track TB patients at the puskesmas who have been recorded through the previous system, with the construction of this application it can help the puskesmas in monitoring patients. The research problem is how the effectiveness of the SIMTb-Co application (Comorbid Tb monitoring information system) in monitoring taking medicine and overcoming Lung TB in Medan city. The purpose of the research is to build the SIMTb-Co application (Comorbid Tb monitoring information system), test it and assess the results achieved.

METHOD

The research method is the waterfall method, known as the Software Development Life Cycle (SDLC). This method is used because application development uses a systematic approach and is carried out in stages. The waterfall method is a classic model that is systematic and sequential in building software (4). The software development process is divided into several stages, including requirements analysis, design, implementation, testing, and maintenance.

The samples in this study were 5 public health centers selected from 41 public health centers in Medan city with the criteria of providing the most services to patients with Pulmonary TB in the last 1 year. Data collection techniques were carried out by giving questionnaires to application users (puskesmas officers) and drawing conclusions on the results obtained related to user convenience and information obtained as well as the weaknesses and advantages of the SIMTb-Co application (Comorbid Tb information system).

Flow of SIMTb-Co Application Design (Comorbid Tb information system):

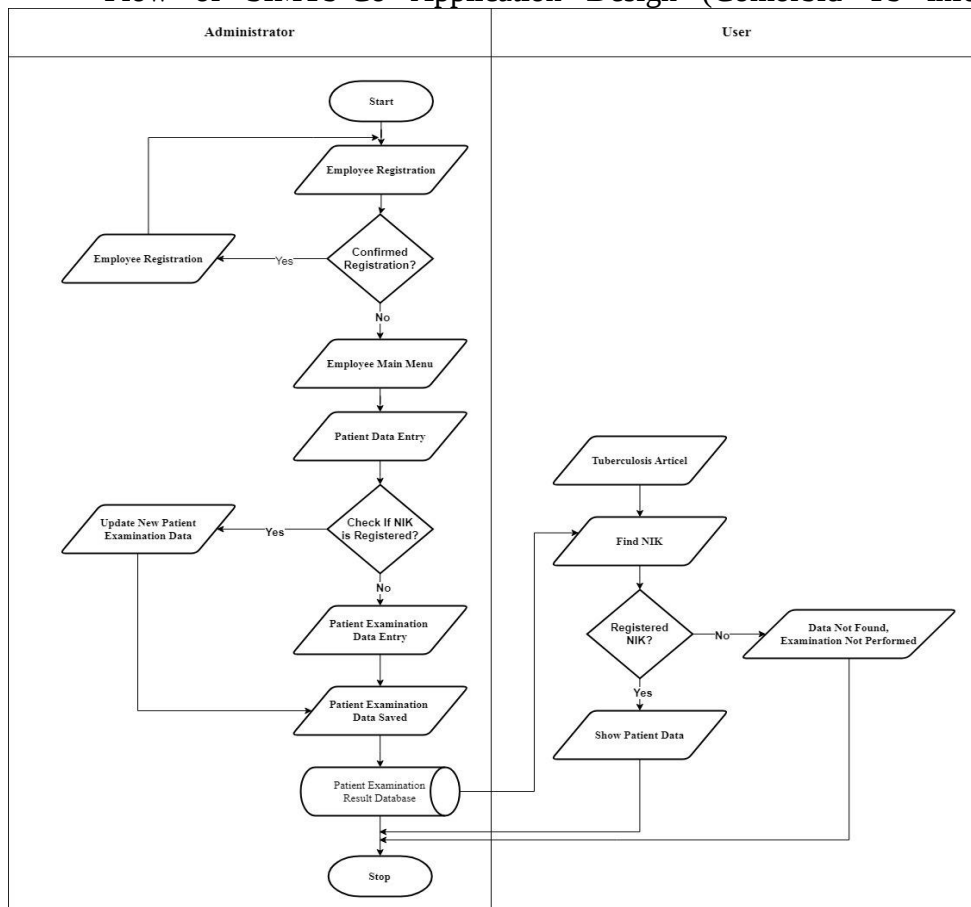


Figure 1 Flow Algorithm of SIMTb-Co Application Design (Comorbid Tb Information System)

The SIMTb-Co application design flow algorithm above shows the flow of application use by users (Lung Tb service officers at the Puskesmas). Data input starts from user registration and patient registration by entering the Population Identification Number (NIK). Data entry starts from biodata, address using GPS (Global Positioning System), data on household members, examination results including sputum examination, lung and Mantoux test and treatment obtained during the specified period. All this data is stored in the application database.

RESULTS AND DISCUSSION

User Satisfaction Level

A total of 5 Puskesmas (Puskesmas Sering, Puskesmas Glugur Darat, Puskesmas Tuntungan, Puskesmas Sentosa Baru and Puskesmas Helvetia) which have the highest number of visits by

patients with pulmonary TB, were sampled for the use of the SIMTB-Co application. The results of the satisfaction survey conducted on the use of the SIMTB-Co application for Pulmonary TB service officers in the five selected Puskesmas, obtained a description of responses about the use of the application as follows:

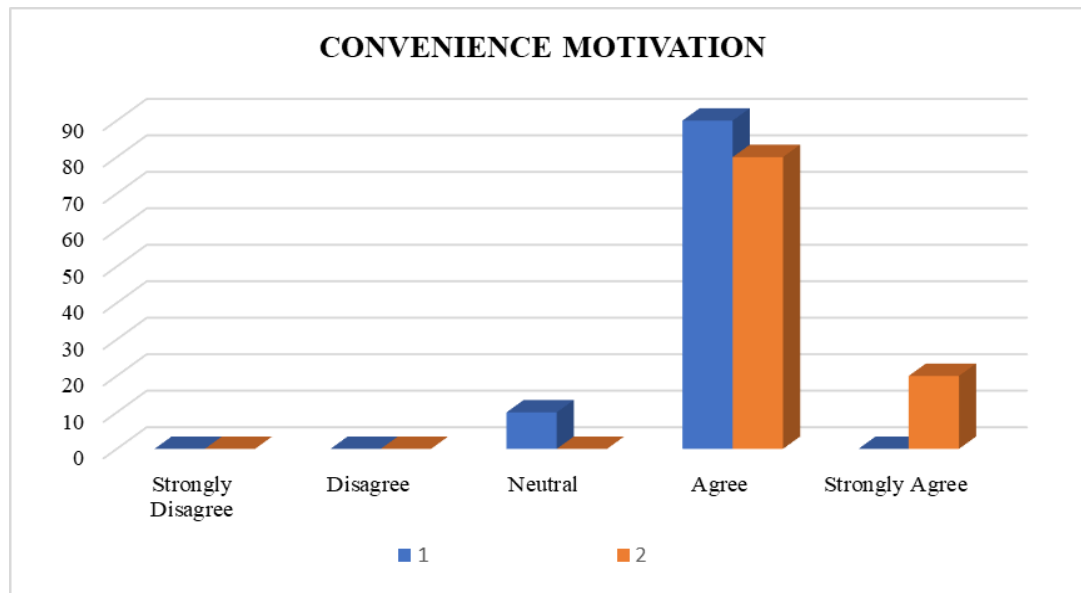


Figure 2 Bar Chart of Responses to the Convenience Motivation

The table above shows, the convenience motivation statement obtained from 30 Health workers (5 officers from 5 selected Puskesmas), as many as 90% responded in agreement on the ease of use of the SIMTB-Co application and 80% on clear and easy to understand information related to the use of the SIMTB-Co application.

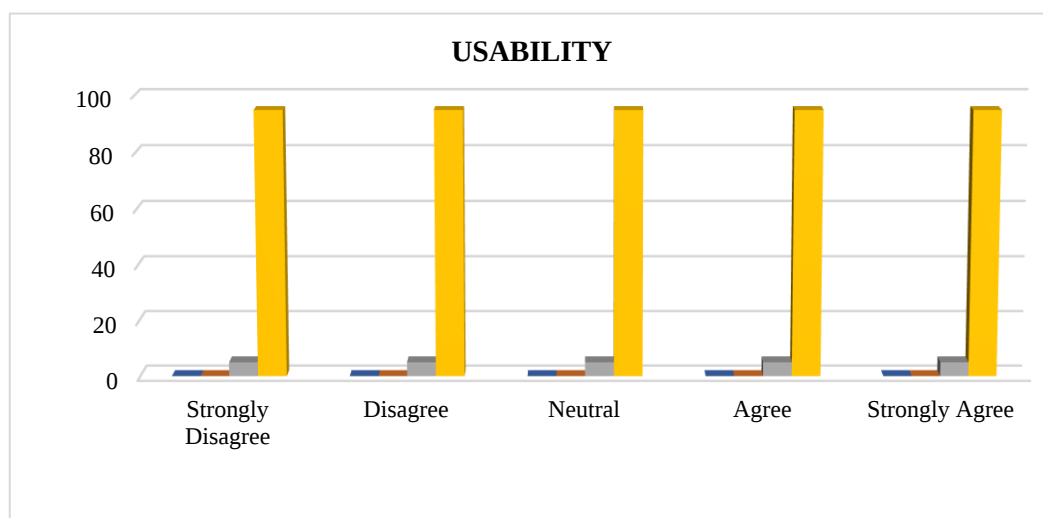


Figure 3 Bar Chart of Responses to the Usability

Regarding the usability statement, 95% of responses strongly agreed on the ease, delivery of messages, tracking residence, providing reviews of the SIMTB-Co application. This application is also equipped with GPS (Global Positioning System), making it possible to obtain the exact location of the patient's residence. This makes it possible to obtain a mapping of the spread of Lung TB based on risk factors for transmission based on the distance of people with Lung TB from healthy people around them.

Table 1 Frequency Distribution of Responses to the Use of SIMTB-Co Application in terms of Influence of Social Networking Sites and E-Service Quality

No	PERNYATAAN	%				
		1	2	3	4	5
A INFLUENCE OF SOCIAL NETWORKING SITES						
1	I often use social networking platforms, such as Instagram, Facebook, and TikTok				80	20
2	I trust recommendations about using apps (SIMTB-Co) on social networking platforms				85	15
3	I often see advertisements through social networking platforms				85	15
4	I often see comments and reviews through social networking platforms				85	15
B E-SERVICE QUALITY						
1	I feel comfortable with the completeness of the data that can be entered on the application (SIMTB-Co).			10	75	15
2	I believe that the application (SIMTB-Co) will not publish information about people with TB.			10	75	15
3	The use of the application (SIMTB-Co) provides customer service to facilitate communication with people with Lung TB.			10	75	15
4	The application (SIMTB-Co) informs detailed data of people with Lung TB.			10	75	15
5	The application (SIMTB-Co) is in accordance with the needs of TB services and TB patients			10	75	15
6	The application (SIMTB-Co) is available whenever needed.			10	75	15
7	I can find the information I need easily on the application (SIMTB-Co)			10	75	15
8	I do not find it difficult to operate the application (SIMTB-Co) that I am currently using.			10	75	15

(1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree)

GPS (Global Positioning System) is a satellite navigation system designed to provide information about location, speed, and time with high accuracy. The GPS system works by utilising a network of satellites orbiting the earth to provide accurate location information to users wherever they are. By utilising signals from a minimum of four satellites, GPS devices can calculate and provide information about the user's position with high accuracy (5,6) (6)(7).

The future hope is that with an application equipped with GPS, it will be easier for health workers to track, search or visit patients if found not continuing treatment. This method is an alternative effort in monitoring the compliance of patients with Pulmonary TB in the treatment process and early detection of potential transmission to family members or neighbours of patients.

Data on patients with Lung TB that are entered completely, both old and new patients, will be stored properly in the application and the application is able to show a graph of the data. Likewise, the medicines obtained by Lung TB patients who come to visit the Puskesmas will be recorded, including the dose and duration of drug use until the next visit. This shows the application's ability to separate new and old data and document data that has been entered so that it can facilitate users in analyzing it.

One of the novelties in the SIMTb-Co application is, notification in the form of a direct message that goes to the patient's WhatsApp number or the number of one of the family members or people who monitor the patient's eating medicine.

WhatsApp Application Programming Interface, which is a programme interface that allows a system to communicate and interact with other systems (8). SIMTb-Co application, capable of sending notifications, in the form of short messages to take medicine. This notification is expected to be a reminder for patients to be able to take their medicine regularly, so that patients who are loose to follow up can be avoided.

The digital age has changed the way humans communicate. There are great benefits in facilitating human communication and cooperation. This device has become a useful tool, which shapes humans into a digital society that is always connected at all times(8,9). Besides the great benefits that can be obtained, it is necessary to be aware of the negative impacts it causes.

The positive impact of WhatsApp for users, the occurrence of efficient communication where the communication process is easily connected without being limited by time and geographical boundaries while the negative impact can be the spread of false information or hoaxes that can affect people's perceptions of an issue, interference in productivity, especially if users are too often fixated on group chats or message notifications, privacy policies and user data security (8,9).

WhatsApp's presence in the digital age has changed the way we communicate, work and interact with each other. WhatsApp provides great benefits in facilitating communication

and collaboration, but must be aware of its negative impacts and work together to overcome the challenges that arise (10).

WhatsApp social networking application is widely used on smartphones, this application is designed to make communication and circulation of messages clearer and faster, thanks to internet and wifi technology that keeps users connected, this application also allows users to send and receive real-time location information, photos, videos, audio and text messages (9).

WhatsApp social network allows sharing different types of data and resources, ensuring effective communication and interaction, and even creating joint activities in groups (8).

The notification facility in the SIMTB-Co Application is expected to serve as a reminder for patients with pulmonary TB to take their medication. The availability of this message is an effort that can help PMOs (supervisors of taking medicine) in reminding patients to take their medicine. It is hoped that in the future, pulmonary TB patients will avoid drug resistance due to negligence, forgetfulness and irregularity in taking medication in accordance with the treatment programme.

Drug resistance in pulmonary tuberculosis (TB) is one of the major challenges in the treatment and control of this disease. Resistance occurs when TB bacteria develop and become insensitive to the drugs normally used to treat it. The use of OAT requires a high level of adherence to achieve therapeutic success and prevent drug resistance.

Adherence indicates the extent to which the history of drug use is in accordance with the prescribed treatment and indicates a commitment between the patient and the health worker. Controlling pulmonary TB requires patient compliance in taking the prescribed drugs, in terms of dosage and duration of treatment. The increase and uncontrollability of pulmonary TB cases is inseparable from the problem of drug resistance as a result of inadequate treatment due to suboptimal compliance. This situation will become an opportunity for transmission or will infect healthy people (11,12).

The serious threat posed by drug-resistant tuberculosis (DR-TB) will result in significant treatment costs, as naturally occurring genetic mutations in the microorganism population will hinder TB treatment. The threat of DR-TB requires serious attention because it is more virulent than regular TB. Patients with DR-TB will transmit the drug-resistant bacteria to others.

Transmission of DR-TB can occur through patients with OAT resistance, from patients who have received TB treatment for > 1 month, from patients who have failed treatment, patients who relapse or return after dropping out of treatment (13,14).

The increase in Ro's TB cases will be a public health problem that will also have an impact on economic losses, as adult TB patients will lose work time which will result in a loss of annual household income. The cost and duration of treatment will increase with resistance cases, which require longer treatment times (18-24 months) compared to regular TB treatment, in addition to other adverse social impacts, such as stigma where the community will ostracise the patient's family. Non-compliance of TB patients in taking medication regularly is an obstacle to achieving high cure rates (13,15–17).

The use of the SIMTB-Co application is assessed by users in terms of convenience and usability motivations. Convenience motivation refers to the extent to which users feel that the application makes work easier and more convenient, including ease of access, flexibility in use. If the application is well designed and easy to use, users will be more likely to use it regularly. This convenience includes features such as patient data, drug data, past visits, reminders for patients to take their medication.

In terms of usability, this relates to the extent to which the app fulfils the user's needs and provides tangible benefits. This includes relevant features, effective functionality, and measurable results. If the user perceives that the app provides useful information, helps in treatment, and facilitates communication, then it will be more motivating to use it. Usability also includes aspects such as support in health monitoring and provision of educational resources.

Convenience motivation and usability are crucial for increasing user adoption and satisfaction with online applications. Applications that are convenient to use and useful will be better able to encourage users to stay engaged in their treatment and health monitoring (18).

The SIMTB-Co application was built and designed to provide convenience in the management of tuberculosis (TB) treatment, which is expected to have a significant positive impact, both for patients and health workers. In the future, this application is expected to improve treatment adherence, where the application can remind patients to take medicine regularly and follow the control schedule, thus improving treatment compliance.

The app also provides clear and detailed information about TB, symptoms, treatment, and the importance of adherence, distancing, environmental hygiene and consuming nutritious food with the aim of educating users so that anyone who can open this app, will get information

related to Tuberculosis disease. Through this application, users or health workers can also monitor compliance with treatment and medication. The application can show a track record of visits and treatment obtained by the patient, so that Health workers can assess the accuracy of the current visit schedule so that the treatment programme can continue to be monitored until the patient is declared to have completed his treatment and declared cured.

The SIMTb-Co application is also considered to help with epidemiological analysis, so that health workers can formulate better strategies in TB control.

In terms of the influence of social networking sites and e-service quality, SIMTB-Co application users have an influence on social networking sites and e-service quality. The influence of social networking sites, on the SIMTB-Co application can be used to disseminate educational information about TB and the importance of treatment. This can increase public awareness and encourage users to download and use the app. The use of the SIMTB-Co app can provide social support. The social networking platform allows patients to connect with others who have similar experiences, creating a community of support that can motivate users to actively use the app. It takes positive reviews and user experiences shared on social networks can increase the trust and interest of others to try the app.

In terms of e-service quality, the majority of users expressed their agreement with the quality of the application, including speed, intuitive user interface, and availability of features. This is very useful in influencing user experience. High-quality applications are more likely to be used regularly. E-service quality also expresses security and privacy. The SIMTb-Co app, guarantees patient data security, which includes data protection can increase user trust.

Social networking sites and e-service quality complement each other in influencing app usage. Social networks can expand reach and increase awareness, while e-quality of service ensures a positive user experience, which in turn encourages higher and sustained app usage (18).

The SIMTB-Co application, designed to facilitate users or officers of Lung TB services at Puskesmas in documenting patient data, family data, examination results, treatment history so that it can be known that patients who get TB program services are truly cured. This application will make it easier for health workers to capture patients who are lost to follow up and can immediately find them by looking for the patient's address that has been recorded by GPS in the application. Potential transmission can also be detected easily, by looking at data on family members who live in the same house as the patient. The information contained in the

application can be the initial data for health workers to suspect the occurrence of transmission in patients who have dropped out of the drug.

The results of the trial conducted for 3 months, related to the use of the application by Lung TB service officers in 5 (five) Puskesmas in Medan City, obtained several advantages and disadvantages of the application as follows:

Advantages of the Application:

- a. The SIMTB-Co application already provides a map feature (location of the patient's residence), so that it can easily find the patient's location during a home visit.
- b. The SIMTB-Co application already has a WhatsApp notification feature, so that it can send notifications to Pulmonary TB patients to take medicine every day.

Disadvantages of the Application:

- a. The SIMTB-Co application is not yet linked to the data of the population and civil registration office (dukcapil) so that it must re-input the complete data of new patients.
- b. SIMTB-Co application is not synchronised with puskesmas data, so data is not updated with puskesmas data.
- c. The SIMTB-Co application is only specialised in Pulmonary TB disease
- d. SIMTB-Co application does not provide a live chat feature for direct consultation with doctors
- e. The SIMTB-Co application does not provide a stock feature for pulmonary TB drugs available at the puskesmas.
- f. The SIMTB-Co application is not synchronised with the data of health centre employees
- g. The SIMTB-Co application does not provide a queue booking feature for treatment.

Literature studies on various application trials state that the weaknesses of using online-based applications include; accessibility of technology where not all patients have access to devices or the internet needed to get notifications from health workers; digital literacy users may experience difficulties in using technology, thus requiring additional training; data security, the need for protection of patient personal data to maintain privacy and information security. Application development requires an approach that considers accessibility and user needs (18,19).

CONCLUSIONS

- a. The SIMTb application (Comorbid Tb monitoring information system) as a tool to identify and document the history of patients with Pulmonary TB can be used in the service of pulmonary patients at the Puskesmas.
- b. The results of a satisfaction survey conducted on the use of the SIMTB-Co application to Lung TB service officers in five selected Puskesmas, obtained the majority responded to the ease of use of the SIMTB-Co application.
- c. The results of a survey conducted in assessing responses to the use of the SIMTB-Co application in terms of the Influence of Social Networking Sites and E-Service Quality, the majority of users agreed with the ease of use of the application.
- d. The results of the SIMTb-Co application trial, can show the treatment track record of pulmonary TB patients from the beginning of treatment until they are declared cured.

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