

The Impact of a Medicine Reminder Application on Adherence among tuberculosis Patients in Primary Healthcare Banjar Regency

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Abstract. Adherence to medication is necessary to lower tuberculosis patient dropout rates. Patient non-adherence to tuberculosis treatment will hinder the success of therapy for the disease. Digital technology can enable the development of a smartphone application to improve tuberculosis patients' medication adherence. The objectives of this study was to determine the effect of a medication reminder application on tuberculosis patients' medication adherence in a primary health care setting. This pre-experimental study used a one-group pretest-posttest design and a questionnaire to obtain prospective data. The data for this study were gathered using the Adherence Starts with Knowledge (ASK) questionnaire. As a research intervention, the medication reminder application was used. Eleven individuals met the requirements for inclusion. The results indicated that all patients (100%) had a modest degree of adherence prior to the intervention. Following the intervention, 62.5% of patients maintained a moderate level of medication adherence, while 37.5% maintained a high level of medication adherence. These findings demonstrate that patients' medication adherence improves when they use the medication reminder application. The program may be distributed to tuberculosis sufferers to maximize their disease treatment.

Keywords: medication adherence; medication reminder; smartphone application; tuberculosis

1 Introduction

Tuberculosis killed up to ten million people worldwide in 2018. According to the World Health Organization (WHO), tuberculosis claimed 1.2 million lives in 2018. Indonesia is third in the world in terms of annual incident cases. In 2018, 563,879 instances were reported [1]. The rate of tuberculosis in South Kalimantan was 45.8% in 2020. The number of tuberculosis cases in Banjar Regency in 2020 was the second greatest in South Kalimantan, following Banjarmasin City at 14.4%. The number of Tuberculosis cases in Banjar Regency was 11.5% in 2019. For the year 2020, this figure rose to 15.4% of cases [2].

The primary difficulties in tuberculosis treatment are the duration and complexity of the drug regimen, both of which impair medication adherence. Adherence with tuberculosis medication is

necessary to minimize the dropout rates [3]. Patient nonadherence with tuberculosis treatment will jeopardize the disease therapy success, resulting in treatment failure, recurrence, and medication resistance [4]. In South Korea, research revealed that tuberculosis patients adhered to their regimen at a rate of 56.5% [5]. According to research conducted in Indonesia, the percentage of tuberculosis patients who stick to their drug regimen is between 54 and 76% [6], [7], [8]. Non-adherence to prescribed tuberculosis medication is a barrier to the tuberculosis treatment program's success in Indonesia [9]. Tuberculosis is treatable, however the lengthy course of therapy (6 months) necessitates medication adherence by the patient [10].

A systematic review study explains that tuberculosis patient adherence with medication can be improved through interventions such as digital health technology (applications on smartphones) [4], [11], [12]. One way to do this is for the patient's smartphone to be installed with a medication reminder application [13]. According to research conducted in Uganda, medication reminder strategies encourage patients to take their medication on time [14]. According to research conducted in Indonesia, the use of digital applications for medicine administration improves medication adherence in individuals with diabetes mellitus and hypertension [15], [16].

Certain characteristics are included in the medication reminder application that was discovered in Indonesia. The program relates to the website, allowing supervisors to keep tabs on tuberculosis patients' medication adherence. Patients need just to create an account on the application page. The application's alert feature will remind the patient to take medication on time [17]. Additionally, there are elements that assist the patient in determining the sort of treatment and establishing a certain time to take the medication. The alarm will prompt the patient to take medication at the time he or she has specified beforehand [15]. Additionally, there is also a prescription reminder application that includes a calendar, recommendations, and information about tuberculosis [18]. The medication reminder application developed in this study includes medication alerts, medication history, daily medication indicators, and information regarding tuberculosis disease and medicines.

There is still a dearth of research on the usage of digital medication reminder applications in tuberculosis patients in Indonesia. As such, this study aimed to examine the effect of deploying a reminder application on tuberculosis patients' medication adherence in a primary health care setting. The objectives of this study was to determine the effect of a medication reminder application on tuberculosis patients' medication adherence in a primary health care setting.

2 Methods

2.1 Research Design and Participants

This pre-experimental study employed a one-group pretest-posttest design and utilized a questionnaire in prospective data collection. Permission was obtained from the ethics committee and the research location for the research to be undertaken. Respondents who expressed an interest in participating were asked to provide informed consent.

2.2 Ethical Clearance

The current study has been approved by the ethics committee from the Faculty of Medicine of Universitas Lambung Mangkurat, Banjarmasin, South Kalimantan (No. 620/KEPK-FK ULM/EC/V/2021) in 2021.

2.3 Population

The study population consisted of all tuberculosis patients who matched the inclusion criteria and sought treatment at the Martapura 1 Primary Health Care in Banjar Regency, South Kalimantan in May 2021. Patients with tuberculosis who were on anti-tuberculosis medication, over the age of 17, and capable of using an android smartphone were included in the study. Exclusion criteria included patients who were not willing to participate in the study, patients whose contact numbers were not found, and did not respond when contacted via text message or telephone, and patients with a high level of adherence based on the results of a survey questionnaire.

2.4 Instrument

The research data were collected using informed consent, data collection sheets (age, gender, occupation, comorbidity, and medication), a questionnaire, and an android application for medication reminder. In this investigation, medication adherence in tuberculosis patients was assessed using a modified Adherence Starts with Knowledge (ASK) questionnaire¹⁸. The questionnaire elicits information about the patient's medication regimen, including the time, frequency, and dose of medicine, as well as the patient's beliefs and reluctance to take medication. The questionnaire consists of ten statements, each of which has a score ranging from 1 to 50 [19].

Prior to its use, the research team examined the validity and reliability of the ASK questionnaire utilized in this study. Twenty tuberculosis patients from a different health center were involved in the validity and reliability testing. The validity test revealed a value of $r \geq 0.444$, indicating that the questionnaire statements were valid. The reliability test using Cronbach's alpha revealed that all question items had a value greater than 0.7, indicating that the questionnaire's statements were reliable.

The medication reminder application (Tuntas TB) is equipped with features such as medication alarms, medication history, and the ability to record the patient's daily medication regimen, as well as information regarding tuberculosis disease and treatments. The medication reminder application will automatically ring when the patient's medication timer expires.

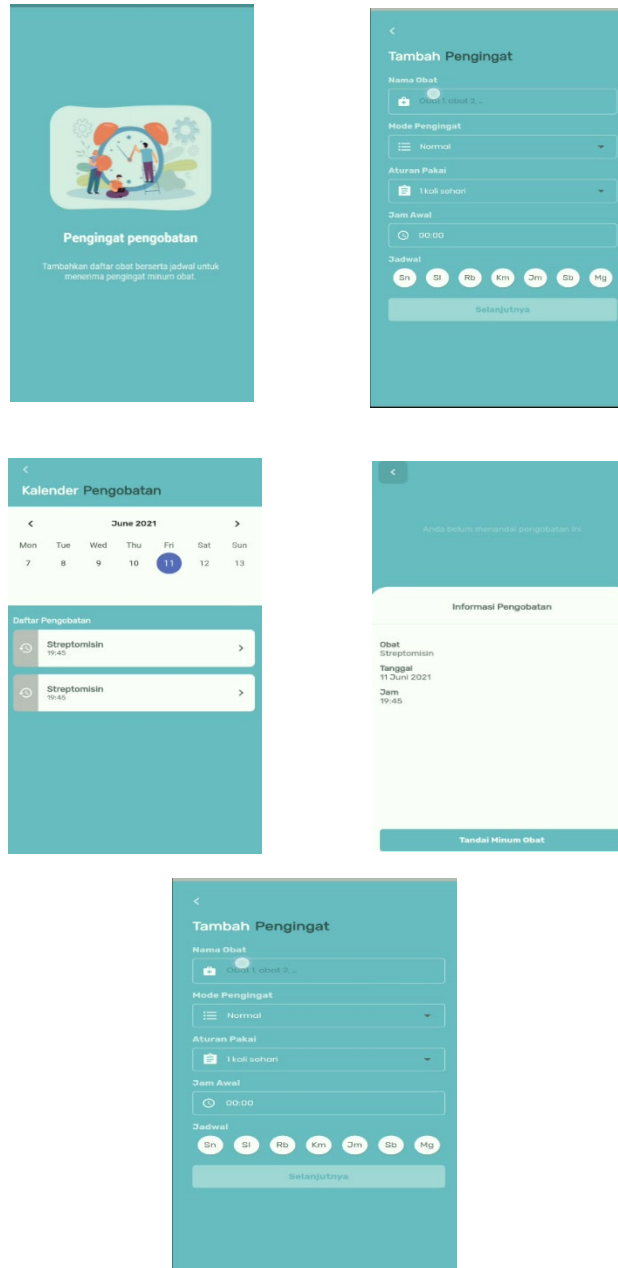


Fig. 1. The medication reminder application (Tuntas TB)

2.5 Intervention

Patients who met the criteria for inclusion signed an informed consent form. The patients were then asked to complete the ASK adherence questionnaire prior to the intervention. All respondents are tuberculosis patients who were getting routine health care at the Martapura 1 Public Health Center. These individuals were treated for seven days with the installation of a medication reminder application (Tuntas TB). Patients were asked to complete the ASK adherence questionnaire seven days later. The questionnaire was presented in a google form. Respondents could access an instructional video for using the medication reminder application (Tuntas TB) before installing it on their smartphone. The application was installed online.

2.6 Data Analysis

There are five response alternatives on the ASK adherence questionnaire (strongly agree, agree, neutral, disagree and strongly disagree). The questionnaire contains positive statements rated 1 (strongly agree); 2 (agree); 3 (neutral); 4 (disagree); and 5 (strongly disagree), as well as negative statements rated 5 (strongly disagree); 4 (agree); 3 (neutral); 2 (disagree); and 1 (strongly disagree). The patients' medication adherence was classified into three categories: strong adherence (10-13 points), moderate adherence (14-29 points), and low adherence (30-50 points). The data analyzed were those collected from patients who completed the study. The Wilcoxon test was used to determine the effect of utilizing a medication reminder application on the patients' medication adherence. Data analysis was run in the SPSS version 20 program.

3 Results and Discussion

This study examined the characteristics of tuberculosis patients, including their age, education, occupation, comorbidities, and number of medications taken. Eleven respondents met the study inclusion criteria. The limited number of respondents may be due to the covid 19 pandemic situation, so that respondents who regularly visit the health centre are limited. The respondents ranged in age from 20 to 71 years, and the majority (9 patients, or 81.82%) were of productive age (15–54 years). In Indonesia, the majority of tuberculosis cases occur within the young and productive age group [20]. The average age of tuberculosis patients was 36 to 47 years [21], [22]. Half of the respondents (54.54%) have completed their secondary school. In Indonesia, where most tuberculosis patients have a low level of education^{5,6}, this study revealed a different picture. Most of the respondents (63.64%) reported having a job, having no comorbid conditions (54.5 %), and using one to two tuberculosis medications (54.5%). The present investigation identified tuberculosis patients who also had diabetes mellitus. Diabetes mellitus (DM) is a chronic condition that results from either the body's incapacity to effectively utilise insulin or the pancreas' insufficient insulin production [23]. Table 1 summarises the characteristics of the study respondents.

Table 1. Respondents' Characteristics

No	Respondents' Characteristics	Frequency (n=11)	Percentage
1	Age (years old)		
	20-39	3	27.27
	40-59	6	54.54
	≥60	2	18.18
2	Level of education		
	Elementary	3	27.27
	Secondary	6	54.54
	Higher Education	2	18.18
3	Occupation		
	Working	7	63.64
	Not working	4	36.36
4	Comorbidity		
	With comorbidity	5	45.5
	Without comorbidity	6	54.5
5	Number of medications taken		
	1-2	6	54.5
	>2	5	45.5

Prior to utilizing the medication reminder application, the patients' overall medication adherence score ranged from 15 to 24. The lower the total score, the more adherence there is. Prior to the intervention, all respondents (100%) showed a moderate level of medication adherence. However, following the intervention, the total adherence score of the patients decreased to between 11 and 23. Half (62.5%) of the respondents indicated a moderate level of adherence, while 37.5% indicated a high level of adherence.

Medication adherence is a critical component of drug therapy success [24]. The extent to which an individual adheres to the instructions for their medication or receives advice from a healthcare professional is referred to as adherence [25]. Medication adherence is a complex issue driven by several interrelated factors. Patients, therapy, health systems, and social and economic factors all have the potential to influence patient medication adherence [6], [26]. All these elements play a role in determining patients' medication adherence, and so there are no other factors that can have a substantial impact on their adherence with taking medication. According to Bea et al. (2021), patient characteristics (age and comorbidities) and therapy regimen can have a considerable impact on medication adherence [5]. Due to multimorbidity and polypharmacy, geriatric patients (60 years) are at a higher risk of non-adherence to therapy than other age groups. Comorbid patients are more likely to undergo sophisticated treatment or many medications, and thus are less likely to adhere to medication [27]. The number of drugs taken by chronic disease patients can influence their level of adherence, with fewer drugs taken implying better adherence [27]. According to Pameswari et al. (2016), patient medication adherence is influenced by a desire to recover internally, family support, and accurate information from medical staff [6].

According to the measurement results, patients' nonadherence with medication is due to the notion that taking medication more than once a day is uncomfortable (36.4 %), forgetting to take medication (9.1 %), and taking medication more than or less than the authorized amount (9.1%). The overall scores of the patients' medication adherence level prior to and following the intervention (i.e., the use of a medication reminder application) are shown in Figure 1.

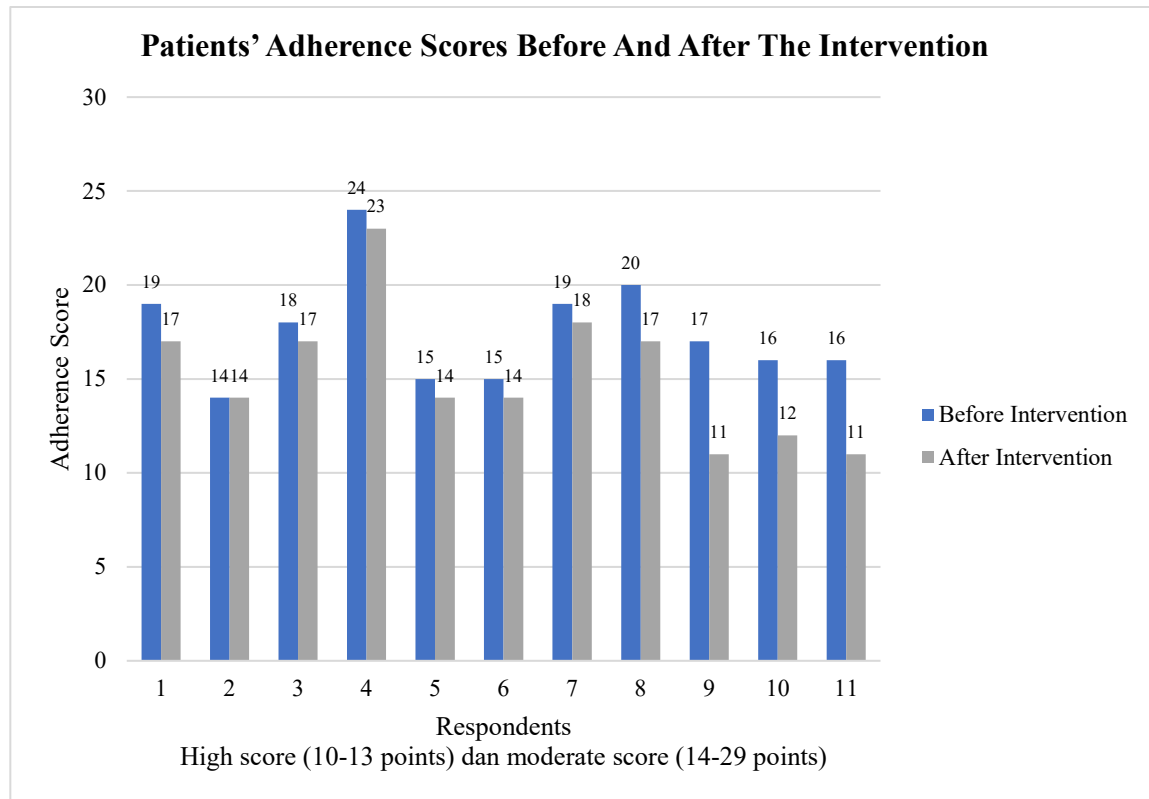


Fig. 2. Patients' Adherence Scores Before and After the Intervention

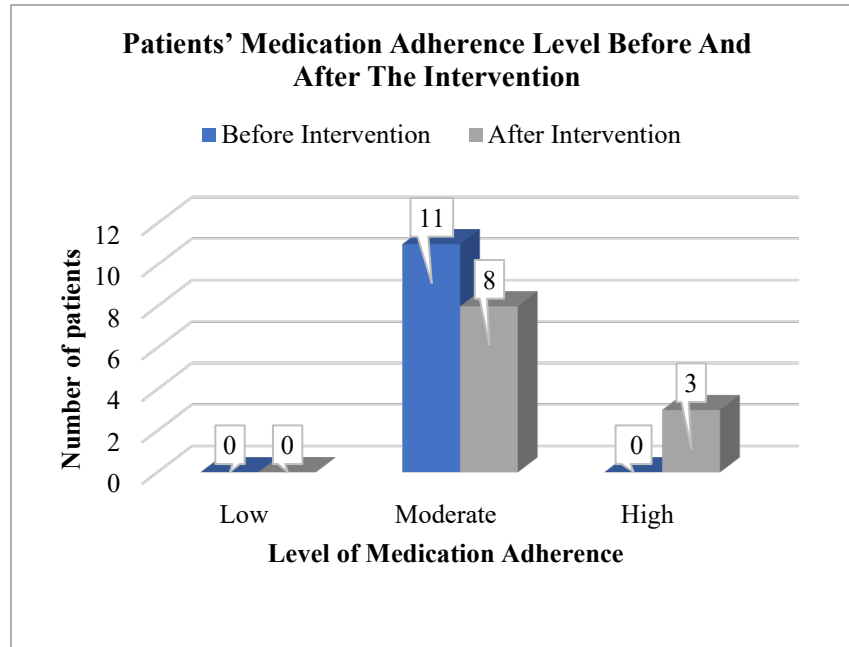


Fig. 3. Patients' Medication Adherence Level Before and After the Intervention

Most patients in this study reported a moderate level of adherence at pretest. These patients perceived taking medication more than once a day as inconvenient, frequently forgetting to take medication and taking more or less medication than suggested. These factors may contribute to medication non-adherence in these patients. The findings of this study corroborate earlier research indicating that patients have low treatment adherence because they forget to take their prescription, believe they have improved, and are less comfortable with the side effects of tuberculosis medications[10], [28].

The results showed that there was a difference in the patients' medication adherence level from moderate to high following the intervention. The Wilcoxon test produced a p-value of 0.005, showing a significant change in the patients' medication adherence rate before and after utilizing the medication reminder application. The examination of the patients' medication adherence level before and after the intervention is shown in Table 2.

Table 2. I Patients' Medication Adherence Level Before And After The Intervention

Level of Adherence (scores)	N (%)		P-value
	Before	After	
Low (30-50)	0 (0)	0 (0)	0.005*
Moderate (14-29)	11 (100)	8 (62.5)	
High (10-13)	0 (0)	3 (37.5)	

N= 11 respondents; P-value tested using Wilcoxon, (*) significant difference ($P<0.05$)

Taking medication more than once a day burdens the patient, even more so if the substances used have negative effects. Patients with chronic diseases who take medicine once a day are more adherence than those who take medication twice a day [27]. Patients' outside-of-home activities, such as work, cause them to occasionally forget to take their medication [26]. Patients may alter their pharmaceutical doses because they feel better and disregard the recommended dose (according to a prescription). Long-term treatment for diseases such as tuberculosis tries to eradicate the bacteria from the body as a whole. Therefore, disobedience to prescribed medicine can have a negative impact on the outcome of tuberculosis treatment[20].

The challenge for tuberculosis sufferers is to complete their treatment. Nonadherence can develop during the patient's treatment [10]. Systematic review research found that interventions utilizing digital health technology, such as smartphone applications, can enhance tuberculosis patients' medication adherence [4], [11], [12]. The usage of cellphones by health care professionals can assist them in communicating with patients and socializing therapy. This can aid patients in adhering to their prescription regimens [29].

The medication reminder application used in this study is available in Indonesian. The application was developed with the assistance of a research team and information technology professionals. The findings of this study demonstrate that medication adherence improves following the usage of a medication reminder application. The increase in patient adherence was statistically significant. Alarms or medication reminder applications are critical for reminding patients to take their medication on time and avoiding delays or even forgetting to take medication [30]. Patients with tuberculosis who occasionally forget to take their medication can benefit from the use of a medication reminder application.

Additionally, the medication reminder application developed in this study offers information regarding disorders and drugs. This feature enables the reminder application to help patients adhere to their medications. According to Alipanah et al. (2018), offering treatments such as illness education and drug therapy can help increase tuberculosis patients' medication adherence [4]. Patients should be informed about the importance of adhering to prescription regimens, medication rules, and significant side effects because these factors can affect patient medication adherence [6], [26]. The adherence of patients to their treatment can be enhanced by addressing issues related to the drug used and its adverse effects, as well as by assisting them in comprehending and accepting their disease and treatment [31]. Gebreweld et al. (2018) discovered that patients with tuberculosis were frequently unaware of the normal period of treatment (6 months) or the repercussions of discontinuing treatment [32]. Knowledge is critical in motivating patients to contribute to tuberculosis control [33].

Several studies have demonstrated that the use of medication reminders can enhance medication adherence in people with chronic diseases [15], [16], [34]. Reminders to take medication that are programmed to read according to the patient's medication schedule can help patients adhere to their drug regimen [32]. Patients may benefit from digital applications that offer information and reminders to take medication. These applications might assist patients in modifying their lifestyles and increasing medication adherence. Patient awareness of therapy influences recovery, and an active alarm based on the patient's medication regimen can help boost medication adherence [35]. The optimal utilisation of technology in educational interventions and reminders to enhance patient therapy adherence is recommended by patient-centered care (PCC) [36].

One of the study's limitations is that data collection can only be done online (through Whatsapp and Google Form) owing to the pandemic. Under these circumstances, it was impossible to explain the research and use of the application directly to the patients enrolled in this study. Explanations of research and applications were exclusively supplied over Whatsapp in the form of an instructive video. Because not all patients at the Martapura 1 Public Health Center could utilize smartphones, the study's sample size was also limited. The ASK adherence questionnaire was not commonly used in similar studies, particularly among tuberculosis patients.

The intervention implemented in this study also lacks in its development process. The development of the intervention should involve a survey of tuberculosis patients to ascertain the need for applications in therapy. However, the research team gathered data only on health professionals who assist in the treatment of tuberculosis patients. Following the intervention, patients were asked to provide feedback on the application used. The application was subsequently re-implemented for new users based on the suggestions of these patients. In fact, the development of an application should include feature testing to guarantee that it functions effectively.

4 Conclusions

The use of a medication reminder application can greatly improve tuberculosis patients' medication adherence (37.5%). Medication reminder programs can be used to optimize tuberculosis patient treatment.

5 Acknowledgments

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