

ARTICLE INFORMATION

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## Effectiveness of mobile-phone short message service (SMS) reminders for adherence to anti-tuberculosis treatment among pulmonary tuberculosis patients: A systematic review

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### Abstract

**Background:** Tuberculosis (TB) is an infectious disease caused by bacteria *Mycobacterium tuberculosis*. TB treatment takes a long time, namely 6-9 months, so patient compliance in undergoing treatment is an important factor for the success of treatment. Several factors that can influence TB patient compliance include: drug side effects, distance from home to health facilities, and economic constraints. Use of information technology, such as short message service (SMS), can be an alternative to increase TB patient compliance. SMS is a communication technology that is affordable and easy to use, so it can be used by TB patients from various socio-economic backgrounds.

**Purpose:** Systematic review this is intended to assess the influence of use SMS reminder on treatment compliance in pulmonary TB patients.

**Method:** The method used is a systematic review. The source used comes from PubMed, ProQuest, Science Direct, Scopus, and Embase published from 2013 to 2023. The keywords in the search are Short Message Service (SMS) reminder AND Medication Adherence AND Pulmonary Tuberculosis Patient.

**Results:** There are ten articles showing the effectiveness of use SMS reminder on treatment compliance of pulmonary TB patients.

**Conclusion:** Usage SMS reminder can increase treatment compliance in pulmonary TB patients, as can be seen from research results that show increased treatment compliance rates, reduced drug dropout rates, and improved TB treatment outcomes. Therefore, SMS reminder can be an alternative that can be considered in the TB control program in Indonesia.

**Keywords:** Medication Adherence; Pulmonary Tuberculosis; Short Message Service (SMS) Reminder.

### INTRODUCTION

Tuberculosis (TB) is an infectious disease that generally attacks the lungs and is caused by the bacteria *Mycobacterium Tuberculosis*. Transmission occurs when bacteria enter the body through droplets in the air. TB is ranked 13th as the leading cause of death globally and is the infectious disease that causes the most deaths after COVID-19. It is estimated that around 10.6 million people are infected with TB, with the death toll reaching around 1.6 million. Indonesia is ranked second after India, with the highest number of TB cases in the world (World Health Organization, 2019).

Tuberculosis patients face a number of obstacles and problems, especially in terms of compliance following treatment, due to prolonged anti-tuberculosis treatment (OAT) (Naidoo, Theron, Rangaka, Chihota, Vaughan, Brey, & Pillay, 2017). Inability to complete the entire course of anti-tuberculosis drugs (OAT) can increase risk of recurrence, development of drug-resistant TB, treatment failure, disease progression which can cause complications and death, as well as continued transmission of infection (Van, Phu, Vinh, Son, Hanh, Nhat, & Thuong, 2020). Lack of patient

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knowledge about treatment and lack of ability in self-management, are the two dominant factors that influence non-adherence to taking medication (Liu, Lewis, Zhang, Lu, Zhang, Zheng, & Fielding, 2015).

Treatment of drug-sensitive tuberculosis requires 6 months of therapy, so problems often arise in carrying out treatment appropriately (Liu, Thompson, Dong, Sweeney, Li, Yuan, & Zhao, 2023). Non-adherence to treatment for 6 months can increase the risk of relapse and resistance to TB drugs. The need for management of TB cases such as direct supervision during treatment (Directly Observed Treatment Short course/ DOTS), support for drug accessibility and availability, as well as recording and reporting systems that support outcome evaluation (World Health Organization, 2019).

Adherence to tuberculosis therapy is an important part of successful tuberculosis treatment. The complexity and many factors involved in patient compliance with anti-tuberculosis drugs (OAT) requires a patient-centered care approach (World Health Organization, 2019). Compliance significantly influences therapy outcomes, measurement strategies and implementation improvement (Fang, Shen, Hu, Xu, Jun, Zhang, & Wu, 2019).

Improving health education, increasing public awareness, and implementing close monitoring are crucial to ensure that tuberculosis (TB) patients fully recover and to manage the disease effectively (Subbaraman, De Mondesert, Musiimenta, Pai, Mayer, Thomas, & Haberer, 2018).

Providing social support, collaboration, implementing effective communication between health service providers and patients, monitoring directly or indirectly through the role of medication swallow supervisor (PMO), as well as family involvement as a reminder for patients is an adherence intervention can be done (Oren, Bell, Garcia, Perez-Velez, & Gerald, 2017). Compliance interventions through education, counseling, psychological support, reminders and trackers, as well as the use of digital health technologies can improve treatment outcomes patient TBC (Alipanah, Jarlsberg, Miller, Linh, Falzon, Jaramillo, & Nahid, 2018).

The application of digital technology to improve compliance with tuberculosis treatment could be a promising approach. The development of digital

technology-based interventions is very important, especially equipped with personal feedback, which can provide consistent and beneficial effects in increasing treatment adherence in TB patients (Ridho, Alfian, Van Boven, Levita, Yalcin, & Pradipta, 2022). Digital technology, such as text messaging and electronic pill boxes, can help patients follow medication therapy, increase interactions with health care providers and improve compliance and treatment outcomes (Liu et al., 2023).

Managing treatment management of pulmonary TB patients via SMS is effective in increasing the success rate of completing treatment, reducing negligence or forgetting doses, drug withdrawal, and increasing awareness of sputum re-examination (Fang, Guan, Tang, Tao, Zou, Wang, & Pan, 2017). Several developing countries have taken advantage of the development of mobile health technology (mHealth) Short Message Service (SMS) as an application to increase patient motivation and compliance with TB treatment (Bediang, Stoll, Elia, Abena, & Geissbuhler, 2018).

## RESEARCH METHOD

A systematic review with a review of research articles to answer research questions using PICO "What is the use Short Message Service (SMS) reminder effective for treatment compliance in pulmonary tuberculosis patients?" The research article search method use electronic data base namely PubMed, ProQuest, Science Direct, Scopus, and Embase to identify articles published from 2013 to 2023.

Research articles were obtained using keywords Short Message Service (SMS) reminder AND Medication Adherence AND Pulmonary Tuberculosis Patient. Selection of research articles using Preferred Reporting Items for Systematic Review and Meta Analysis (PRISMA). Articles with the same title were excluded in the first stage, then the title and abstract were screened to identify and eliminate irrelevant articles.

Exclusion criteria were articles that did not full paper, articles under 2013, publications not in English, qualitative research, quantitative cross sectional, cohort, case control, mini review, literature review, systematic review and meta-analysis. Inclusion criteria were (i) articles that full paper and

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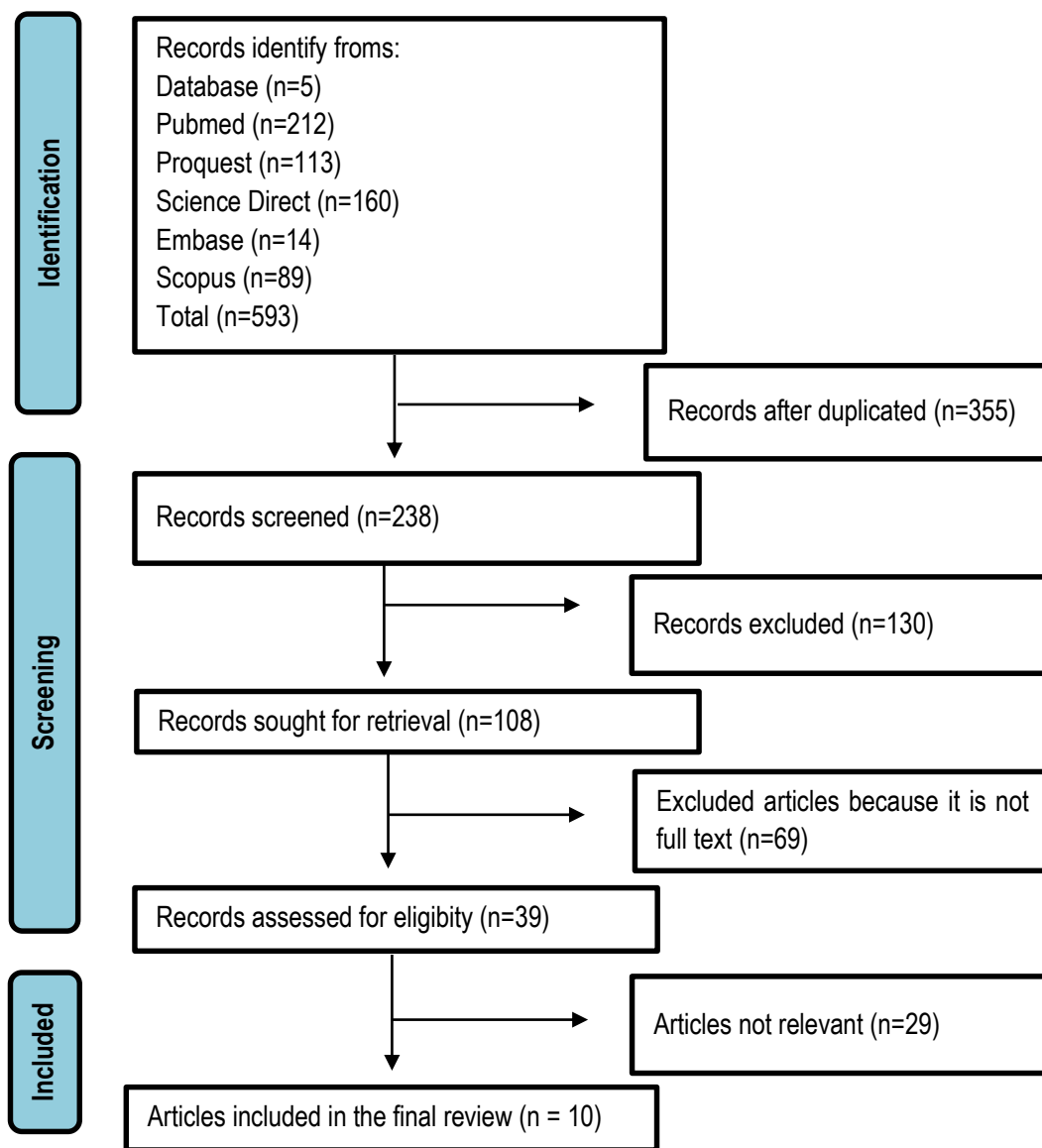
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open accessed English (ii) uses quantitative research methods Randomized Controlled Trial or RCT (iii) articles published in 2013-2023 (iv) pulmonary TB patients, anti-tuberculosis drug (OAT) treatment, intensive phase or advanced phase, age

over 18 years (v) Short Message Service (SMS) reminder OR text message reminder OR short message service (v) primary outcome: Treatment adherence.

**RESEARCH RESULTS**



**Figure 1. Diagram of PRISMA Flow**

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**Table 1. The Main Characteristics of Included Studies**

Author, Year, Country	Purpose	Method	Result
(Iribarren, Beck, Pearce, Chirico, Etchevarria, Cardinale, & Rubinstein, 2013) (USA).	Assessing a text message intervention to improve tuberculosis (TB) treatment adherence.	A randomised controlled trial.	The feasibility of this intervention was proven through high levels of access to mobile phones, ease of use of short messaging (SMS), the majority of phones having only basic features, low participant refusal rates, and a lack of understanding about tuberculosis (TB). The acceptability of this intervention was also evident from the positive responses of participants who felt heard, supported, and responsible for their treatment and many reported compliance without needing reminders. Participants in the SMS group reported an average daily compliance rate of 77%, whereas only 53% of the group used a daily reminder calendar. In evaluating initial effectiveness, microscopic tests and treatment results showed similar results in both groups.
(Van, Phu, Vinh, Son, Hanh, Nhat, & Thuong, 2020) (United Kingdom).	Determine whether the WelTel intervention can increase the success rate of treatment adherence in patients with latent TB infection and to evaluate the extent to which this intervention is cost effective.	A randomised controlled trial.	Treatment completion, referring to the percentage of respondents who complete at least 80% of prescribed Isoniazid (INH) doses within 12 months of starting treatment, has become a commonly used standard to assess the level of adherence in patients experiencing Latent Tuberculosis Infection (LTBI).
(Liu, Lewis, Zhang, Lu, Zhang, Zheng, & Fielding, 2015) (USA).	Assess the effectiveness of text messages and monitor treatment for increasing treatment compliance in TB patients.	A randomised controlled trial.	An average of 20% of respondents per month missed a dose of TB treatment, around 29.9% in the control group, with a variation rate between 16.0% to 48.1%. In the group receiving text messages, it was slightly lower, at around 27.3%, although the difference was not statistically significant, with a 95% confidence range between 0.71 to 1.24. For the group using medication monitoring, the percentage was

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			about 17.0%, indicating a greater reduction in underdosing, and in the group receiving a combination of both methods, the percentage was even lower, about 13.9%. There were no significant differences in mean ratios based on age, education level, or gender. The coefficient of variation of the primary endpoint among the control group was 0.24.
(Mohammed, Glennerster, & Khan, 2016) (USA).	Measuring the effect of Zindagi SMS, a two-way SMS reminder system on the success of treatment for tuberculosis patients.	A randomized controlled trial.	There was no significant difference between the group using Zindagi SMS and the control group in treatment efficacy. Both groups showed similar treatment success rates, namely around 83%. Additionally, analyzes did not indicate any significant impact of the program on self-reported levels of medication adherence during treatment visits.
(Nhavoto, Grönlund, & Klein, 2017) (USA).	Maintain consistency and compliance with antiretroviral (ARV) and anti-tuberculosis (OAT) therapy in Mozambique.	A randomized controlled trial.	SMS systems with unique features, namely the ability to automatically respond to questions from respondents and provide appropriate answers, are highly appreciated. useful, reliable, trustworthy, reduces failure to take medication, avoids loss of follow-up control, improves communication between health service providers and respondents and helps in providing education and motivation. The majority of respondents (HIV 90%, TB 88%: reported never forgetting to take control), (HIV 82%, TB 97%: reported never forgetting to retake medication).
(Oren, Bell, Garcia, Perez-Velez, & Gerald, 2017) (USA).	Determine the acceptability and feasibility of text reminders in improving patient compliance with latent TB infection.	A randomized controlled trial.	Feasible use of text messaging to improve adherence to infection treatment latent tuberculosis.
(Fang, Shen, Hu, Xu, Jun, Zhang, & Wu, 2019) (USA).	Knowing the extent to which the use of SMS reminders via cellphone can increase the compliance of patients who are undergoing anti-TB treatment through the DOTS program.	A randomised controlled trial.	Treatment failure occurred in 7 respondents (4.7%), of which 3 respondents (4.1%) came from the intervention group and 4 respondents (5.4%) from the control group. There was no statistically significant difference between the two groups in terms of treatment failure (p= 0.983).

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(Fang, Guan, Tang, Tao, Zou, Wang, & Pan, 2017) (USA).	Assess the importance of using Short Messaging Services (SMS) in the management of pulmonary tuberculosis (TB) patients to improve treatment adherence and health awareness, as well as providing a scientific basis to support wider use of this model and the development of relevant policies and supporting measures.	A randomised controlled trial.	The treatment completion rate in the intervention group (96.25%) was significantly higher than that in the control group (86.84%) (C2=9.52, P=0.002). The treatment discontinuation rate and missed dose rate in the intervention group were significantly lower than those in the control group (C2=10.41, P=0.001; C2=28.54, P<0.001). After the treatment period was completed, the rate of patients undergoing reexamination in the intervention group was significantly higher compared with the control group (except reexamination after 5 months of treatment).
(Bediang, Stoll, Elia, Abena, & Geissbuhler, 2018) (USA).	Assessing the use of Short Message Services (SMS) every day as a reminder to increase the level of compliance with taking anti-tuberculosis drugs (OAT) and the recovery of tuberculosis patients undergoing treatment for 6 months.	A randomised controlled trial.	There were no significant differences between the two groups in secondary outcomes at three different appointments. A very high and similar level of satisfaction with the general management of patients was found in both groups, namely around 99.5% and 99.2% (p-value = 0.41).
(Johnston, Van der Kop, Smillie, Ogilvie, Marra, Sadatsafavi, & Lester, 2018) (Switzerland).	Evaluate whether two-way SMS communication between health care providers and LTBI patients starting therapy can improve the rate of successful completion of LTBI treatment, health quality of life (HRQoL), and satisfaction with LTBI care.	A randomised controlled trial.	Completion of treatment with the proportion of respondents completing treatment $\geq 80\%$ of the 9INH dose prescribed in 12 months, or $\geq 80\%$ of the prescribed 4RIF dose prescribed within 6 months.

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## DISCUSSION

There were 10 studies included, with a randomized controlled trial (RCT) design. Study locations come from various countries, including Cameroon, China, Pakistan, Canada, Argentina, United States, Africa. The number of samples in the 10 RCT articles varied, with the smallest number of respondents being 37 and the largest being 2207 respondents. Respondents included patients with tuberculosis (TBC) and latent tuberculosis infection (LTBI). Study quality was assessed using The Joanna Briggs Institute (JBI) randomized controlled trial (RCT) design. The results of the Critical Appraisal show that all studies were declared valid because most of them fell into the issue category, the objectives were clearly explained, the sample assessment was carried out randomly, everyone involved in the research was analyzed, but the blinding method was not explained.

TB patients will receive automatic messages from the system containing reminders regarding drug use. The patient's telephone number is previously entered into the web platform which can be used to verify whether the message has been received by the patient. Each patient is expected to provide a response to the system as confirmation of receipt of the reminder message. If the patient is unresponsive, the next step will involve a telephone call. The results of the analysis show that the use of SMS reminders and telephone call reminders can significantly increase the level of compliance of latent TB patients, as measured by increased treatment completion rates, increased self-reporting, reduced missed drug doses, and reduced treatment duration (Oren et al., 2017).

The use of SMS reminders and Communication Monitoring (MM) via drug monitoring boxes can increase the level of compliance of TB patients. In the SMS reminder, patients will receive a message reminding them to take their medication according to a predetermined schedule. The message will be sent again if the patient does not respond. Meanwhile, the medication monitor box is equipped with an audio device that will sound according to the patient's medication schedule. This box will continue to sound until the patient actually takes the medicine. The results of the analysis show that although SMS reminders are not able to increase compliance with

taking TB medication, Communication Monitoring via a medication monitor box can significantly increase patient compliance in following the schedule for taking TB medication (Liu et al., 2015).

The use of digital technology plays an important role in achieving successful treatment which requires involvement and long-term commitment to the chronic disease treatment process. One of them involves the use of reminder messages via SMS to increase the level of treatment compliance of TB patients (Molton, Pang, Wang, Qiu, Wu, Rahman-Shepherd, & Paton, 2016). SMS or short message service is one of the most common forms of communication via mobile telephone, can be accessed everywhere and has the potential to be an effective tool for improving interactions between patients and health care providers. Improved communication via SMS messaging has the potential to improve health literacy levels, quality of care, and treatment outcomes for a variety of medical conditions, including active TB and LTBI (Lester, 2013).

The use of SMS for medication adherence in chronic diseases as a communication tool is relatively economical and can be applied in both high and low income countries (Thakkar, Kurup, Laba, Santo, Thiagalingam, Rodgers, & Chow, 2016). Two-way SMS communications, in which messages include content sent by a healthcare provider and elicit a response from the patient, have been associated with improved medication adherence (Wald, Butt, & Bestwick, 2015). The use of SMS applications is considered an innovative therapeutic approach and promises success, by increasing treatment completion rates, reducing missed doses and treatment interruption rates, as well as strengthening awareness of the need to undergo re-examination in pulmonary TB patients (Fang et al., 2017).

## CONCLUSION

Health technology, especially digital technology, provides a number of benefits, especially in the health sector. For example, in the treatment of chronic diseases such as tuberculosis. This can be achieved through implementation, one of which is a reminder system using SMS reminders to increase

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TB treatment compliance. Different from directly observed therapy (DOT), regular use of SMS reminders can significantly increase the treatment completion rate of TB patients, reduce the rate of missed doses and the rate of treatment interruptions, and increase self-awareness of TB patients. Therefore, SMS may be a promising new therapeutic strategy in TB management with the aim of improving patient compliance and health awareness.

SMS reminders are a promising therapeutic strategy in TB management with the aim of increasing patient compliance and health awareness. Mobile phone SMS reminders are an economical, effective, and widely accepted tool in our daily clinical practice. The implementation of the SMS application is very simple and can be implemented easily. Both healthcare workers and interested patients can quickly master its use. TB patient compliance with treatment can be improved by sending regular reminder messages via cell phone.

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