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Identification of Timeliness of Anti-Tuberculosis Drug Intake and Pulmonary Tuberculosis Cure Rate at An-Nisa Hospital

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***Abstract** (Times New Roman 10 pt, bold, italics)*

Tuberculosis (TB) is the third leading cause of death across all age groups in Indonesia, as well as the leading cause of death from infectious diseases, with treatment success highly dependent on patient adherence, particularly the timeliness of anti-tuberculosis drug intake. This study aims to identify the relationship between medication timing adherence and the level of recovery among pulmonary TB patients at An-Nisa Hospital. This study employed a quantitative method with a cross-sectional approach. The study population consisted of tuberculosis patients who had undergone treatment at An-Nisa Hospital for six months. A total of 108 respondents were selected using an accidental sampling technique. The study was conducted in August 2025 over a period of two weeks at An-Nisa Hospital. Data were collected using a questionnaire. Data analysis using Spearman rank test. The findings demonstrated a statistically significant and moderate positive relationship between the timeliness of anti-tuberculosis drug intake and the pulmonary tuberculosis cure rate at An-Nisa Hospital (p = 0.000; r = 0.490). This study found a statistically significant and moderate positive relationship between the timeliness of anti-tuberculosis drug intake and the cure rate of pulmonary tuberculosis at An-Nisa Hospital.

Background (Times New Roman 12 pt, bold)

Pulmonary tuberculosis (TB) remains a significant public health problem in Indonesia. According to the World Health Organization (WHO), Indonesia ranks second among countries with the highest TB burden globally, with an estimated 1.09 million cases and more than 125,000 deaths annually. In line with this, data from the Indonesian Ministry of Health indicate that in 2023 there were approximately 821,200 notified TB cases through the Tuberculosis Information System (SITB), representing about 77% of the national target, with a treatment success rate of around 86%, which has not yet reached the national target of ≥90% (WHO, 2025b, 2026).

This condition indicates that there is still a gap in the success of pulmonary TB treatment in Indonesia. One of the key contributing factors is patient adherence to therapy, particularly the timeliness of anti-tuberculosis drug intake. Irregular medication timing may lead to suboptimal drug levels in the body, thereby increasing the risk of reduced cure rates, relapse, and the development of drug resistance. Therefore, research is needed to identify the relationship between the timeliness of medication intake and pulmonary TB cure rates as a basis for improving treatment outcomes.

This condition indicates a persistent gap in the success of pulmonary TB treatment in Indonesia. Patient adherence, particularly the timely intake of anti-tuberculosis medication, is a critical determinant of treatment success. Delayed or irregular medication intake may lead to subtherapeutic drug exposure, enabling *Mycobacterium tuberculosis* to persist and increasing the likelihood of relapse, treatment failure, and the emergence of drug-resistant strains. Therefore, maintaining consistent medication timing is essential to achieve optimal therapeutic

drug concentrations and maximize treatment effectiveness. This study was conducted to investigate the relationship between the timeliness of medication intake and pulmonary TB cure rates, providing evidence to support strategies for improving treatment outcomes (Kemenkes, 2025).

According to Erlina Burhan et al. (2021), tuberculosis (TB) is one of the oldest infectious diseases in human history and remains a significant global public health problem (Perhimpunan Dokter Paru Indonesia, 2021). Defines tuberculosis as a chronic disease caused by infection with *Mycobacterium tuberculosis*, which primarily affects the lungs but may also involve other organs such as bones, skin, and the brain. Tuberculosis can affect individuals of all age groups; however, the highest incidence occurs among the productive-age population, leading to a decline in the quality of human resources (Wadah Kemitraan Penanggulangan Tuberkulosis, 2022).

Tuberculosis mainly affects the respiratory system, particularly the lungs, which function as the primary site of gas exchange between atmospheric air and the bloodstream (Kurniasih, E & Daris, 2017). Transmission of *Mycobacterium tuberculosis* occurs through airborne particles rather than surface contact. When patients with active pulmonary TB cough, sneeze, shout, or sing, bacteria are expelled from the lungs into the air and may be inhaled by others (Irianti & Mada, 2018). Resistance of *Mycobacterium tuberculosis* (MTB) arises from spontaneous chromosomal mutations. In patients who have never received anti-tuberculosis drugs (OAT), the proportion of naturally resistant mutants is very low. However, TB treatment creates selective pressure that eliminates drug-sensitive bacteria while allowing resistant mutant strains to proliferate, resulting in acquired drug resistance (Kemenkes, 2020).

Survey data indicate that tuberculosis is the third leading cause of death in Indonesia after cardiovascular and respiratory diseases across all age groups and remains the leading cause of mortality from infectious diseases (POM, n.d.). All pulmonary TB patients receive anti-tuberculosis drugs as the cornerstone of TB treatment. Anti-tuberculosis therapy is one of the most effective strategies for preventing further transmission of TB-causing bacteria (Kemenkes, 2017).

Non-adherence to TB treatment is a major factor contributing to bacterial mutation and drug resistance (Kigozi et al., 2017). Poor adherence leads to prolonged treatment duration, increased risk of disability, higher infectivity, treatment resistance, and even death (Clara Aulia Rachmah et al., 2023a). This condition is particularly dangerous among TB–HIV co-infected patients. Non-adherence in TB–HIV patients may cause interactions between anti-tuberculosis drugs and antiretroviral therapy (ART), resulting in increased toxicity and treatment complications (Boshoff et al., 2023).

Long-term TB treatment requires high levels of patient motivation (Clara Aulia Rachmah et al., 2023b). Prolonged treatment often leads to fatigue, boredom, and resignation, which may ultimately reduce adherence to medication. Failure to ensure adherence in TB–HIV treatment significantly increases the risk of therapeutic failure and drug resistance (Khoerunisa et al., 2023). Considering that the timing of medication intake plays a crucial role in the TB recovery process, this study aims to identify the relationship between the timeliness of anti-tuberculosis drug intake and the cure rate of pulmonary TB patients at An-Nisa Hospital.

Inappropriate timing of medication intake among pulmonary TB patients may compromise treatment effectiveness and result in suboptimal recovery outcomes. Therefore, this study proposes identifying the timeliness of medication intake as a strategic approach to improve treatment control, enhance patient adherence, and ultimately achieve optimal recovery among pulmonary TB patients.

Methods

This study employed a quantitative method with a cross-sectional approach to observe and measure medication timing adherence, the level of recovery among tuberculosis (TB) patients, and respondent characteristics simultaneously (Nisa et al., 2023). The study was conducted at An-Nisa Hospital over a two-week period in August 2025. The study population consisted of TB patients who had undergone treatment at An-Nisa Hospital for at least six months. A total of 108 respondents were selected using an accidental sampling technique. The study sample included all TB patients who had received TB treatment for six months during the August–December period.

Data were collected using questionnaires and observation sheets, comprising both primary and secondary data. Statistical analysis was performed using the spearman test including the calculation of correlation coefficient values to determine the strength of the relationship between variables. The measurement instruments used in this study consisted of questionnaires and observation sheets, utilizing both primary and secondary data sources.

The research was conducted through several stages. First, preliminary study permission and research approval letters were obtained from An-Nisa Hospital, and ethical clearance form LPPM Universitas Yatsi Madani No. 638/LPPM-UYM/XI/2025. Second, the study population and sample were determined using an accidental sampling technique. Third, ethical clearance was obtained prior to data collection. Fourth, preparation for the research implementation was carried out, including the development and preparation of research instruments such as questionnaires and observation sheets. Fifth, data collection was conducted by obtaining informed consent from respondents, followed by the administration of questionnaires and observation of laboratory results as indicators of TB treatment success. Sixth, the collected data were entered, processed, and analyzed using the Spearman rank correlation test, and the results were then interpreted. Seventh, the manuscript was prepared for publication. Finally, the final report was completed, and the research findings were disseminated.

Result and Discussion

Results

The results of the study on the identification of medication timing adherence and level of recovery showed the following findings. Result of this study were describes in tables below.

Table 1. Frequency Distribution of Pulmonary Tuberculosis Patient Characteristics, Medication Timing Adherence and Level of Recovery

Characteristic	n	%
Age (Years)		
Young adults (20-39 years)	83	76.9
Middle aged adults (40-59 years)	23	21.3
Elderly	2	1.9

Total	108	100
Gender		
Male	48	44.4
Female	60	55.6
Total	108	100
Medication timing adherence		
Non Adherent	18	16.7
Adherent	90	83.3
Total	108	100
Level of Recovery		
Not Recovered	20	18.5
Recovered	88	81.5
Total	108	100

Source: Primary Data, 2025

Based on Table 1, the frequency distribution of the demographic characteristics of pulmonary tuberculosis respondents shows that the most dominant age group was young adults (20–39 years), comprising 83 respondents (76.9%). In terms of sex, females were more dominant, with 60 respondents (55.6%). The frequency distribution of medication timing adherence shows that the majority of respondents were highly adherent, with 90 respondents (83.3%). And than, the frequency distribution of level of recovery indicates that most respondents recovered were 88 respondents (81.5%).

Table 2. Spearman Test Identification of Timeliness of Anti-Tuberculosis Drug Intake and Pulmonary Tuberculosis Cure Rate at An-Nisa Hospital

Variable	*Mean*	SD	Min-Max	p-value	r
Medication timing adherence	2.83	0.374	2-3	0.000	0.490
Level of recovery	1.81	0.390	1-2		

Source: Primary Data, 2025

The results showed that the mean score of medication timing adherence was 2.83 with a standard deviation of 0.374 and a range of 2–3, indicating that most respondents demonstrated a relatively high level of adherence to the prescribed medication timing. Meanwhile, the mean level of recovery was 1.81 with a standard deviation of 0.390 and a range of 1–2, suggesting that the majority of patients were in the improved or recovered category. Based on Table 4, the results of the Spearman correlation test showed a p-value of 0.000, indicating a significant relationship between medication timing adherence and family support. The correlation coefficient (r) was 0.490, which indicates a strong positive correlation.

Discussion

The results of this study indicate that medication timing adherence is significantly associated with level of recovery, with a significance value (p-value) of 0.000 and a correlation coefficient of 0.490, indicating a moderate positive relationship. In a study conducted by Rachmah et al. (2023), it was found that patients' level of knowledge and motivation were significantly associated with adherence to anti-tuberculosis medication among pulmonary TB patients at RS An-Nisa Tangerang. The study demonstrated that patients who had better knowledge of tuberculosis and the importance of treatment, as well as higher motivation to complete therapy,

tended to be more adherent to taking their medication according to the prescribed schedule. Medication adherence is one of the key factors in achieving optimal therapeutic outcomes and increasing the likelihood of pulmonary TB cure, as a regular treatment schedule helps maintain effective drug concentrations against *Mycobacterium tuberculosis* in the body. These findings are consistent with the understanding that patient education and internal motivation are key determinants of treatment-related behavior, where inadequate knowledge or motivation may lead to non-adherence, increasing the risk of treatment failure and drug resistance (WHO, 2025a).

These findings are consistent with previous studies demonstrating that consistent adherence to anti-tuberculosis medication plays a crucial role in treatment success and recovery among pulmonary TB patients. For example, a study conducted at Rokan Hulu District Hospital reported that the majority of patients with high adherence levels were declared cured (83.9%), with a statistically significant difference compared to patients with lower adherence (Pratiwi & Syafina, 2025). Similarly, an educational intervention using leaflets at the Surakarta Pulmonary Health Center (BBKPM) successfully improved patient adherence, increasing adherence rates from 40.9% to 63.6% (Millata Hanifa & Nurul Mutmainah, 2022a). In addition, a quantitative study conducted in pulmonary hospitals in Indonesia found that self-efficacy reflecting patients' confidence and intrinsic motivation was significantly associated with medication adherence (Elisabeth et al., 2025). Collectively, these findings indicate that the timeliness and consistency of anti-tuberculosis drug (OAT) intake are not only theoretically important but are empirically proven to be closely related to treatment outcomes.

On the other hand, several studies have identified various risk factors and causes of non-adherence or untimely medication intake among pulmonary TB patients. A study conducted in a pulmonary hospital in Medan revealed that more than 60% of respondents reported low adherence, which was attributed to factors such as forgetting to take medication, work-related busyness leading to missed doses, discomfort associated with medication intake, difficulty remembering medication schedules, and lack of self-motivation (Ginting et al., 2024). Other analyses have highlighted inadequate patient knowledge regarding TB, anti-tuberculosis drugs, treatment duration, and the consequences of incomplete therapy, as well as insufficient support from family members and healthcare providers, as significant barriers to adherence (Husna & Irawan, 2024). The interaction of internal factors (motivation, beliefs, and self-efficacy) and external factors (family and social support, access to information, and treatment supervision) plays a critical role in determining whether patients adhere to prescribed medication schedules (Tasyakurillah, 2023).

Considering these determinants of non-adherence, various intervention strategies can be implemented in healthcare facilities, such as An-Nisa Hospital, to improve the timeliness of medication intake and increase the likelihood of treatment success. One proven effective strategy is patient education that provides clear information regarding the importance of medication adherence, treatment duration, consequences of non-adherence, and motivation enhancement (Millata Hanifa & Nurul Mutmainah, 2022b). Another alternative approach involves the use of reminder tools or digital interventions, such as mobile applications that help patients record and receive reminders for medication schedules. A study on the use of the TOBAT ("Tekun Minum Obat") application demonstrated that such interventions significantly improved medication adherence and enhanced the quality of life of pulmonary TB patients (Putra, 2024). Additionally, family and social support—such as reminders from family members, routine follow-up visits, and motivational encouragement—plays an essential role in helping patients complete TB treatment successfully (Pratama et al., 2022).

Pulmonary TB remains a major public health concern, and treatment success is highly dependent on adherence and consistency in medication intake. The World Health Organization (WHO) and national TB guidelines emphasize the importance of supervision and adherence monitoring to achieve optimal treatment outcomes. Timeliness of medication intake refers to the regular consumption of anti-tuberculosis drugs according to the prescribed daily schedule, which is essential for maintaining effective drug concentrations and preventing drug resistance. Recent literature indicates that even minor missed or delayed doses may increase the risk of unfavorable treatment outcomes. Timely medication intake helps maintain therapeutic concentrations of first-line anti-TB drugs (isoniazid, rifampicin, pyrazinamide, and ethambutol), thereby accelerating bacteriological conversion and preventing the selection of resistant strains (Ferreira et al., 2025).

From a policy and practice perspective, WHO and national guidelines recommend adherence monitoring through treatment cards, directly observed therapy (DOT), or digital adherence technologies, along with social and psychological support packages to improve treatment outcomes. The findings of this study are aligned with these recommendations (WHO, 2025a). However, previous large-scale intervention studies have shown that the effectiveness of adherence interventions may vary depending on contextual factors and implementation quality (Puchalski Ritchie et al., 2020). Medication adherence among TB patients is influenced by multiple dimensions, including access to healthcare services, clinical management, operational aspects within drug-dispensing facilities, sociocultural factors, and community stigma.

Conclusion

This study demonstrates that the timeliness of medication intake plays a crucial role in the cure rate of pulmonary tuberculosis patients at An-Nisa Hospital. Patients who take anti-tuberculosis drugs on time tend to have a higher likelihood of recovery compared to those who are inconsistent or delayed in taking their medication. These findings emphasize that the success of TB treatment is determined not only by the availability and type of medication but also by patients' discipline in adhering to the prescribed treatment schedule.

Furthermore, this study identifies that the timeliness of medication intake is influenced by various factors, including individual factors (such as knowledge, motivation, and medication side effects), family and social factors (family support and treatment supervisors), as well as healthcare service factors (patient education, monitoring, and reminder systems). Therefore, a comprehensive and sustainable approach is essential to improve medication timeliness and ultimately increase pulmonary TB cure rates.

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