



IMPLEMENTATION OF DOTS AS THE PRIMARY DETERMINANT OF TREATMENT ADHERENCE DURING THE INTENSIVE PHASE OF TUBERCULOSIS PATIENTS

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ABSTRACT

Tuberculosis (TB) remains a major public health burden, particularly in high-incidence countries such as Indonesia. The World Health Organization–recommended Directly Observed Treatment Short-course (DOTS) strategy plays a crucial role in improving treatment success; however, patient adherence during the intensive phase of treatment remains a significant challenge. This study aimed to analyze the relationship between the implementation of the DOTS strategy and adherence to anti-tuberculosis medication during the intensive phase among pulmonary TB patients in Bone Bolango Regency. This study employed a quantitative analytical design with a cross-sectional approach. A total of 75 respondents were recruited using total sampling. Data were collected through a structured questionnaire and analyzed using Chi-square tests and logistic regression analysis. The findings demonstrated significant associations between all DOTS components and treatment adherence, including government commitment ($p = 0.006$), microscopic examination ($p = 0.003$), treatment supervision ($p = 0.000$), drug availability ($p = 0.002$), and recording and reporting systems ($p = 0.004$). Treatment supervision was identified as the most dominant factor influencing adherence, with a p -value of 0.001 and an odds ratio (OR) of 0.133 (95% CI: 0.039–0.459). The implementation of the DOTS strategy is strongly associated with adherence to anti-tuberculosis medication during the intensive phase of treatment. Strengthening the role of treatment supervisors, ensuring consistent drug availability, and improving recording and reporting systems are essential to enhance treatment success.

Keywords: DOTS; intensive phase; medication adherence; tuberculosis

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INTRODUCTION

Tuberculosis (TB) is a communicable infectious disease caused by *Mycobacterium tuberculosis* that primarily affects the lungs. Transmission occurs through airborne droplet nuclei containing the bacteria, which are released when individuals with active TB cough, sneeze, or speak (Safitri & Suryani, 2022). Due to its high transmissibility, TB remains a persistent public health challenge, particularly in developing countries.

Globally, tuberculosis is among the top ten leading causes of death. It is estimated that nearly one-third of the world's population has been infected with *Mycobacterium tuberculosis* (Carryn et al., 2023). According to the World Health Organization (WHO) Global Tuberculosis Report 2023, pulmonary TB ranked as the second leading cause of death from a single infectious agent in 2022, following COVID-19, with nearly twice as many deaths as HIV/AIDS. More than 10 million new TB cases continue to occur annually, and without effective control measures, TB-related mortality is projected to increase by approximately 50% (WHO, 2023).

Indonesia ranks second globally in terms of TB burden, following India and China, with an estimated incidence of 969,000 cases per year (WHO, 2022). The Indonesian government aims to eliminate TB by achieving a 90% reduction in cases by 2025, with treatment coverage of 47% and a

treatment success rate of 83%. However, these targets remain challenging, particularly due to issues related to treatment adherence and the effectiveness of TB control programs (Khasanah et al., 2024).

Since 1995, the WHO has recommended the Directly Observed Treatment Short-course (DOTS) strategy as the cornerstone of TB control. This strategy emphasizes direct supervision by healthcare workers or treatment observers to ensure that patients take anti-tuberculosis drugs regularly, at the correct dosage, and according to the prescribed schedule (Ministry of Health of Indonesia, 2023). The DOTS strategy consists of five key components: (1) strong political commitment, (2) TB diagnosis through microscopic sputum examination, (3) standardized short-course chemotherapy with direct observation, (4) uninterrupted availability of anti-tuberculosis drugs, and (5) a standardized recording and reporting system. Effective implementation of DOTS is essential to improve cure rates, prevent treatment default, and reduce the risk of drug resistance by enhancing patient adherence (Carryn et al., 2024).

The intensive phase represents a critical period in TB treatment, during which patients receive a daily combination of four anti-tuberculosis drugs (Isoniazid, Rifampicin, Ethambutol, and Pyrazinamide) for the first two months. This phase aims to rapidly reduce the bacterial load, interrupt transmission, and improve clinical symptoms (Sabiti et al., 2021). Nevertheless, adherence during the intensive phase remains a major challenge. Factors such as drug side effects, limited knowledge, economic constraints, and inadequate family support often lead patients to discontinue or irregularly take their medication (Pratiwi et al., 2025). In fact, with regular treatment, patients generally become non-infectious within two weeks of initiating the intensive phase (Ministry of Health of Indonesia, 2023). Non-adherence during this period substantially increases the risk of treatment failure, relapse, drug resistance, and mortality (Pasaribu et al., 2023).

Data from the Bone Bolango District Health Office in 2024 indicate that TB remains an unresolved public health issue, particularly with regard to the implementation of the DOTS strategy in healthcare facilities. A total of 827 new TB cases were reported across primary health centers, with the highest numbers observed in Suwawa, Central Suwawa, Tilongkabila, and South Suwawa Health Centers. The district's wide geographic coverage, predominantly rural areas, long distances between patients' residences and health facilities, limited transportation, and socioeconomic constraints pose additional challenges to treatment access and continuity.

Preliminary observations conducted in June 2025 revealed that although the DOTS strategy has been implemented in these health centers, its execution has not been optimal. Fluctuating case detection and treatment outcomes were observed, along with a considerable number of patients failing to complete treatment, particularly during the intensive phase. Initial interviews with TB patients revealed misconceptions and behavioral barriers, including premature discontinuation of medication once symptoms improved, forgetfulness, intolerance to drug side effects, and unilateral cessation of treatment without family awareness. These findings highlight the need to critically evaluate the implementation of DOTS, particularly its core components, and their relationship with patient adherence during the intensive phase of TB treatment.

METHOD

This study employed a quantitative research design with an analytical observational approach using a cross-sectional design. The cross-sectional approach was applied to analyze the relationship between the implementation of the Directly Observed Treatment Short-course (DOTS) strategy and adherence to anti-tuberculosis medication during the intensive phase. Independent and dependent variables were measured simultaneously at a single point in time to assess their associations (Rahmawati, 2023). Although the DOTS strategy has been widely implemented as a national tuberculosis control policy, empirical evidence examining the comprehensive contribution of its

core components particularly government political commitment, standardized diagnosis, treatment supervision, drug availability, and recording and reporting systems to medication adherence during the intensive phase at the primary healthcare level remains limited. This study addresses this research gap by systematically analyzing these components within the local healthcare context.

The study was conducted from August 22 to October 4, 2025, at four primary healthcare centers: Suwawa Health Center, Central Suwawa Health Center, Tilongkabila Health Center, and South Suwawa Health Center. The study population comprised all pulmonary tuberculosis patients undergoing intensive-phase treatment within the catchment areas of the selected health centers. A total sampling technique was applied, whereby all eligible patients were included in the study, resulting in a total sample size of 75 respondents. The independent variables consisted of government political commitment, tuberculosis diagnosis through microscopic sputum examination, short-course chemotherapy with direct observation, availability of anti-tuberculosis drugs (ATDs) on a continuous basis, and standardized recording and reporting systems. The dependent variable was adherence to anti-tuberculosis medication during the intensive phase.

Data analysis was performed in three stages. Univariate analysis was conducted to describe respondents' characteristics, including age, sex, educational level, employment status, nutritional status, and type of tuberculosis. Bivariate analysis using the Chi-square test was applied to examine the association between independent variables and medication adherence. Multivariate analysis using logistic regression was performed to identify the most dominant factors influencing adherence during the intensive phase of tuberculosis treatment.

RESULT

Respondent Characteristics

A total of 75 respondents participated in this study. The distribution of respondent characteristics in the work area of Bone Bolango Regency in 2025 is presented in Table 1.

Table 1.
Distribution of Respondent Characteristics (n = 75)

Variabel	Category	f	%
Gender	Male	47	62,7
	Female	28	37,3
Age	10–19 years	2	2,7
	20–59 years	56	74,7
	>60 years	17	22,7
Education	Elementary School	8	10,7
	Junior High School	11	14,7
	High School	48	64,0
	College	8	10,7
Employment Status	Student	2	2,7
	Laborer	13	17,3
	Farmer	1	1,3
	Trader	12	16,0
	Self-Employed	20	26,7
	Civil Servant	4	5,3
Nutritional Status	Unemployed	23	30,7
	Less	43	57,3
	Normal	32	42,7
Types of TB	More	0	0
	Drug-Sensitive TB (SO)	75	100
	Drug-Resistant TB (RO)	0	0

The majority of respondents were in the productive age of 20–59 years (74.7%) and male (62.7%). Most of the respondents had a high school education (64.0%) and were not employed (30.7%). In terms of nutritional status, more than half of the respondents had a poor nutritional status (57.3%). All respondents were drug-sensitive tuberculosis patients (100%).

DOTS Strategy: Government Commitment

Table 2.

Distribution of Respondents Based on Government Commitment		
Government Commitment	f	%
Less Role	21	28
Role	54	72

Most respondents (72%) stated that the government's commitment plays a role in supporting adherence to taking anti-tuberculosis drugs.

DOTS Strategy: Microscopic Examination

Table 3.

Distribution of Respondents Based on Microscopic Examination			
No	Microscopic Examination	f	%
1	Less Role	20	26.7
2	Role	55	73.3

As many as 73.3% of respondents stated that microscopic examinations play a role in supporting medication adherence.

DOTS Strategy: Drug Supervision (PMO)

Table 4.

Distribution of Respondents by PMO			
No	Medication Supervision	f	%
1	Less Role	15	20
2	Role	60	8

Most respondents (80%) considered that supervision of taking medication plays a role in the implementation of pulmonary tuberculosis treatment.

DOTS Strategy: Drug Availability

Table 5.

Distribution of Respondents Based on Drug Availability			
No	Drug Availability	f	%
1	Less Role	18	24
2	Role	57	76

As many as 76% of respondents stated that the availability of drugs plays a role in supporting medication adherence.

DOTS Strategy: Recording and Reporting System

Table 6.

Distribution of Respondents Based on Recording and Reporting System			
No	Recording and Reporting System	f	%
1	Less Role	27	36
2	Role	48	64

The majority of respondents (64%) assessed that the recording and reporting system plays a role in supporting medication compliance.

Medication Compliance

Table 7.

Distribution of Respondents Based on Medication Compliance

No	Medication Compliance	f	%
1	Less Role	27	36
2	Role	48	64

Most of the respondents (74.7%) fell into the category of adherence to anti-tuberculosis treatment.

The Relationship between Government Commitment and OAT Drug Compliance

Table 8.

The Relationship between the Government's DOTS Strategy and Compliance with Intensive Phase Anti-Tuberculosis Drug Compliance in Pulmonary TB Patients

Government Commitment	Compliance with Taking Anti-Tuberculosis Pulmonary Drugs				Total	P	
	Non-compliant		Obedient				
	f	%	f	%	f	%	
Less Role	10	47.6	11	52.4	21	100	0.006
Role	9	16.7	45	83.3	54	100	

Table 8, in the group of respondents who assessed that the government's commitment played a lesser role, there were 10 respondents (47.6%) who were non-compliant and 11 respondents (52.4%) who were compliant in taking anti-tuberculosis drugs. On the other hand, in the group that assessed the government's commitment to play a role, the proportion of compliance was much higher, namely 45 respondents (83.3%), with only 9 respondents (16.7%) not compliant.

The results of the Chi-Square test showed a value of $p = 0.006$ ($p < 0.05$), which indicates a significant relationship between government commitment and adherence to taking anti-tuberculosis drugs. These findings show that the better the government's support and commitment, the higher the level of patient adherence to treatment.

The Relationship of Microscopic Examination with Compliance with OAT Medication Compliance

Table 9.

The Relationship between DOTS Strategy for Microscopic Examination and Compliance with Intensive Phase Anti-Tuberculosis Medication Compliance in Pulmonary Tuberculosis Patients

Microscopic Examination	Compliance with Taking Anti-Tuberculosis Pulmonary Drugs				Total	P	
	Non-compliant		Obedient				
	f	%	f	%	f	%	
Less Role	10	50	10	50	20	100	0.003
Role	9	16.4	46	83.6	55	100	

Table 9 shows that in respondents who considered microscopic examination to be less playful, the number of non-compliant and non-compliant patients was equally large, as many as 10 respondents (50%) each. On the other hand, in the group that assessed that microscopic examinations played a role, the majority of respondents complied with taking medication, namely 46 respondents (83.6%), while those who did not comply were only 9 respondents (16.4%). The results of the Chi-Square test obtained a value of $p = 0.003$ ($p < 0.05$), which means that there is a significant relationship between microscopic examination and adherence to taking anti-tuberculosis drugs. Optimal microscopic examinations play a role in increasing patient confidence in diagnosis and treatment, thereby encouraging adherence during the intensive phase.

The Relationship of Medication Supervision (PMO) with OAT Medication Compliance

Table 10.

The Relationship between DOTS Drug Monitoring Strategy and Compliance with Intensive Phase Anti-Tuberculosis Drug Compliance in Pulmonary TB Patients

Medication Supervision	Compliance with Taking Anti-Tuberculosis Pulmonary Drugs				Total		P
	Non-compliant		Obedient		f	%	
	f	%	f	%			
Less Role	9	60	6	40	15	100	0.001
Role	10	6.7	50	83.3	60	100	

Table 10, in respondents who assessed that drug supervision played a lesser role, most patients did not comply, namely 9 respondents (60%), while only 6 respondents (40%) complied. On the other hand, in the group that assessed that supervision of taking drugs played a role, the majority of respondents complied with taking drugs, namely 50 respondents (83.3%), with only 10 respondents (16.7%) not compliant. The Chi-Square test showed a value of $p = 0.001$ ($p < 0.05$), which indicates a very significant relationship between medication supervision and adherence to anti-tuberculosis medication. These results confirm that the presence and active involvement of PMOs play an important role in ensuring the regularity and sustainability of patient treatment.

The Relationship of Drug Availability with Compliance with OAT Medication Compliance

Table 11.

The Relationship between DOTS Strategy of Drug Availability and Compliance with Intensive Phase Anti-Tuberculosis Drug Compliance in Pulmonary Tuberculosis Patients

Drug Availability	Compliance with Taking Anti-Tuberculosis Pulmonary Drugs				Total		P
	Non-compliant		Obedient		f	%	
	f	%	f	%			
Less Role	10	55.6	8	44.4	18	100	0.002
Role	9	15.8	48	84.2	57	100	

Table 11 shows that among respondents who assessed the availability of drugs as less important, there were 10 respondents (55.6%) who were non-compliant and 8 respondents (44.4%) who were compliant. On the other hand, in the group that assessed the availability of drugs as a role, the level of compliance was much higher, namely 48 respondents (84.2%), while those who did not comply were only 9 respondents (15.8%). The results of the Chi-Square test obtained a value of $p = 0.002$ ($p < 0.05$), which showed a significant relationship between drug availability and adherence to taking anti-tuberculosis drugs. The guaranteed and ongoing availability of drugs plays an important role in preventing drug withdrawal and increasing the success of therapy.

The Relationship of the Recording and Reporting System to OAT Medication Compliance

Table 12.

The Relationship between the DOTS Strategy of the Recording and Reporting System with the Compliance of Intensive Phase Anti-Tuberculosis Drugs in Pulmonary Tuberculosis Patients

Recording and Reporting System	Compliance with Taking Anti-Tuberculosis Pulmonary Drugs				Total		P
	Non-compliant		Obedient		f	%	
	f	%	f	%			
Less Role	12	44.4	15	55.6	27	100	0.004
Role	7	14.6	41	85.4	48	100	

Table 12, in the group of respondents who assessed the recording and reporting system as less active, there were 12 respondents (44.4%) who were non-compliant and 15 respondents (55.6%) who were compliant. On the other hand, in the group that assessed the recording and reporting system as playing, the majority of respondents showed high compliance, namely 41 respondents (85.4%), with only 7 respondents (14.6%) not compliant.

The results of the Chi-Square test showed a value of $p = 0.004$ ($p < 0.05$), which means that there is a significant relationship between the recording and reporting system and adherence to taking anti-tuberculosis drugs. A good recording and reporting system helps healthcare workers monitor patients more effectively, thereby supporting improved medication adherence.

Table 13.

Binary Logistics Regression Results

Independent Variables	B	Wald	Sig	Exp (B)	95,0% C.I for EXP(B)	
Government Commitment	19.565	0.000	0,999	3.141	0.000	-
Microscopic Examination	0.000	0.000	1.000	1.000	0.000	-
Medication Supervision	-2.015	10.206	0,001	0,133	0.039	0.459
Drug Availability	-1.041	1.101	0,294	0.353	0.051	2.468
System Recording and Reporting	-1.109	1.337	0.248	0.330	0.050	2.162

The results of the logistic regression showed that medication supervision (PMO) was the most dominant factor influencing patient adherence. Patients with non-optimal PMO had an 87% lower chance of adherence than patients with a good PMO (OR = 0.133; $p = 0.001$).

DISCUSSION

The Relationship between the DOTS Strategy of Government Commitment and Adherence to Anti-Tuberculosis Drug (OAT) Intake during the Intensive Phase among Pulmonary TB Patients

The study results demonstrate a significant association between government commitment within the DOTS strategy and adherence to anti-tuberculosis drug intake among pulmonary TB patients ($p = 0.006$). This finding indicates that stronger government support in TB control programs contributes substantially to improved patient adherence. Most respondents were male (62.7%), predominantly working as laborers or self-employed workers with heavy workloads and unstable schedules. Government-supported services, including regular supervision and assured drug distribution, play a critical role in maintaining adherence among this group. This finding is consistent with Phiri et al. (2021), who reported that men are more vulnerable to treatment interruption due to work-related obligations and income concerns. Similar conclusions were reported by Appiah et al. (2023) and Portnoy et al. (2023), highlighting the influence of both direct and indirect treatment costs on adherence.

The majority of patients were in the productive age group of 20–59 years (74.7%), where adherence is often challenged by work commitments. Government-funded programs, such as free TB treatment and the provision of treatment supervisors (PMO), help sustain adherence in this group. Among elderly patients (>60 years; 22.7%), government commitment is even more essential due to mobility limitations and declining memory. This aligns with findings by Nourian et al. (2025), which showed that adherence among elderly TB patients is strongly influenced by healthcare system performance. In terms of employment status, unemployed patients (30.7%) depend heavily on government support due to limited financial resources, while self-employed patients and laborers (17.3%) face time constraints that hinder adherence. Community-based and flexible healthcare services supported by strong government commitment have been shown to improve adherence in these populations (Pradipta et al., 2022). More than half of the respondents were undernourished (57.3%), a condition associated with increased risk of side effects and non-adherence. Government interventions such as nutritional supplementation, dietary counseling, and medical support are therefore critical for improving adherence among undernourished patients, as supported by Dagefa et al. (2021) and Isa et al. (2022). These findings confirm that government commitment is a key determinant of adherence, influencing treatment outcomes across gender, age, employment status, and nutritional condition, and reinforcing the importance of sustained public-sector support for effective and equitable TB control.

The Relationship between the DOTS Strategy of Microscopic Examination and Adherence to Anti-Tuberculosis Drug (OAT) Intake during the Intensive Phase among Pulmonary TB Patients

The study findings indicate a significant association between microscopic examination and adherence to anti-tuberculosis treatment ($p = 0.003$), highlighting the role of sputum smear testing not only as a diagnostic tool but also as a key component of treatment monitoring within the DOTS strategy. Routine microscopic examinations increase patients' awareness of their disease status and reinforce adherence by demonstrating treatment progress. Most respondents were male (62.7%), many of whom worked as laborers, self-employed workers, or farmers, limiting their ability to attend regular visits. Nevertheless, scheduled smear examinations helped improve adherence by reinforcing the importance of continuing therapy, consistent with findings by Tobing et al. (2021), who reported increased motivation among male patients after receiving clear laboratory results.

The majority of patients were of productive age (20–59 years; 74.7%), a group that tends to make rational health decisions based on objective test results. In contrast, elderly patients (>60 years; 22.7%) often faced physical barriers to accessing services; thus, easily accessible microscopic examination services were essential for maintaining adherence. This finding aligns with Ginting et al. (2022), who demonstrated a strong association between routine laboratory examinations and improved adherence among elderly TB patients. Regarding employment status, unemployed and self-employed patients had greater flexibility to access examination services, while laborers and traders depended heavily on integrated examination and drug delivery systems. Barriers such as long travel distances, transportation costs, and stigma continue to hinder treatment completion, emphasizing the importance of service accessibility (Marahatta et al., 2020). More than half of the respondents were undernourished (57.3%), a condition associated with increased fatigue and drug side effects that may reduce adherence. However, laboratory evidence of improvement served as a strong motivational factor for continued treatment. This is supported by Izudi et al. (2022), who reported delayed sputum conversion among undernourished patients but noted that observable improvement reinforced treatment continuation.

Some patients remained sputum-positive after the intensive phase and were found to have diabetes mellitus. Kasim et al. (2025) reported that TB patients with diabetes have more extensive lung lesions and a higher risk of treatment failure due to impaired immunity. These findings underscore DOTS principles that emphasize strict monitoring of adherence, especially among patients with comorbidities. Integrating adherence monitoring with clinical assessment is therefore essential for improving treatment outcomes during the intensive phase. Overall, microscopic examination serves not only as a diagnostic method but also as an educational and motivational tool that enhances adherence across diverse demographic and clinical groups, supporting sustained engagement in TB therapy.

The Relationship between the DOTS Strategy of Treatment Observation and Adherence to Anti-Tuberculosis Drug (OAT) Intake during the Intensive Phase among Pulmonary TB Patients

The study results demonstrate a significant association between treatment observation (PMO) and adherence to anti-tuberculosis medication among pulmonary TB patients ($p = 0.001$). This finding indicates that the presence of a treatment observer—whether a healthcare worker, community volunteer, or family member—plays a critical role in improving adherence. PMO ensures medication intake while also providing psychological support, motivation, and assistance in managing drug side effects. Most patients were male (62.7%), primarily working as laborers, traders, or self-employed individuals, whose high mobility and work demands often hinder adherence. The presence of PMO was crucial in maintaining regular medication intake in this group, consistent with findings by Nisah et al. (2022), which identified work-related busyness and forgetfulness as key causes of non-adherence among male TB patients in the informal sector.

The majority of respondents were of productive age (20–59 years; 74.7%), a group prone to missed doses due to work activities. PMO support helped maintain treatment consistency. Among elderly patients (>60 years; 22.7%), treatment observation was even more essential due to declining memory and independence, in line with findings by Pujaningtyas et al. (2023). Regarding employment status, unemployed patients were easier to supervise by family members, while laborers and traders faced higher risks of treatment interruption due to mobility. Direct supervision by PMO effectively reduced this risk, as also reported by Komariah et al. (2023). More than half of the patients were undernourished (57.3%), a condition associated with increased drug side effects and risk of treatment discontinuation. PMO played a vital role in encouraging continued therapy and communicating patient complaints to healthcare providers. This finding aligns with Wagnew et al. (2022), who reported better adherence among undernourished TB patients receiving adequate supervision and social support.

In addition, one patient with a history of stroke and poor nutritional status nearly discontinued treatment due to discomfort after medication intake. Nutritional education and dietary recommendations, including snakehead fish (*Channa striata*), were provided as supportive interventions. Kasim et al. (2017) demonstrated that improved nutritional intake, particularly albumin supplementation, enhances immune function and treatment outcomes in chronic disease patients, underscoring the importance of nutritional support alongside DOTS implementation. Overall, this study confirms that PMO is a strategic and effective component of the DOTS strategy, improving adherence across different demographic and clinical characteristics. Beyond supervision, PMO functions as social and psychological support, substantially contributing to successful pulmonary TB treatment outcomes, particularly during the intensive phase.

The Relationship between the DOTS Strategy of Drug Availability and Adherence to Anti-Tuberculosis Drug (OAT) Intake during the Intensive Phase among Pulmonary TB Patients

The study findings show a significant association between drug availability and adherence to anti-tuberculosis treatment ($p = 0.002$), indicating that continuity of therapy strongly depends on the consistent availability of medications at healthcare facilities. Reliable drug supply increases patient motivation and treatment completion, whereas stock-outs or distribution delays reduce adherence and elevate the risk of drug resistance. Male patients (62.7%), particularly those working as laborers, traders, or self-employed individuals, require easy and continuous access to medications due to high mobility, while female patients (37.3%) also depend on guaranteed availability to maintain treatment consistency. This finding aligns with Yanthi et al. (2025), who reported a higher risk of treatment interruption among men when drug availability is disrupted. Most patients were of productive age (20–59 years; 74.7%), for whom treatment continuation is highly influenced by accessibility. Drug shortages often lead to treatment discontinuation due to work constraints, whereas elderly patients (>60 years; 22.7%) are similarly affected because limited mobility restricts access to distant facilities (Ginting et al., 2022).

In terms of employment, unemployed and self-employed patients relied heavily on the consistent provision of free TB medication, while laborers and traders were more vulnerable to non-adherence when drug stocks were interrupted due to time constraints (Amalia et al., 2022). Additionally, more than half of respondents were undernourished (57.3%), a condition that increases vulnerability to treatment interruption when drug supply is inconsistent (Febriyanti et al., 2025). Although all patients had drug-sensitive TB, uninterrupted drug availability remains critical to preventing future resistance. Even brief stock disruptions may increase resistance risk, as emphasized by the WHO (2022). Overall, consistent drug availability is a fundamental prerequisite for sustaining adherence across all patient groups and for preventing the emergence of drug-resistant TB.

The Relationship between the DOTS Strategy of Recording and Reporting Systems and Adherence to Anti-Tuberculosis Drug (OAT) Intake during the Intensive Phase among Pulmonary TB Patients

The results of this study indicate a significant association between recording and reporting systems and adherence to anti-tuberculosis drug intake ($p = 0.004$). Accurate and systematic recording by healthcare workers plays a vital role in monitoring treatment progress, identifying patients at risk of non-adherence, and enabling timely follow-up interventions. Male patients, who comprised the majority of respondents (62.7%) and were often engaged in labor-intensive or informal occupations with high mobility, were particularly prone to missed follow-up visits. Robust recording systems allow healthcare workers to promptly detect absences and initiate follow-up actions, as similarly reported by Samal et al. (2021). Recording systems were also beneficial for female patients (37.3%), many of whom were unemployed, by facilitating closer monitoring of treatment adherence. Most patients were of productive age (20–59 years; 74.7%), a group characterized by high activity levels that may hinder regular health facility visits. For this group, structured recording systems are essential to ensure treatment regularity. Among elderly patients (>60 years; 22.7%), organized recording is especially important due to age-related cognitive decline and increased dependence, as emphasized by Popescu et al. (2022).

In terms of employment status, unemployed and self-employed patients required continued monitoring despite easier access, while laborers and traders faced higher risks of treatment interruption due to work demands, making routine reporting critical for early detection of non-adherence (Syahridal et al., 2022). Additionally, more than half of respondents were undernourished (57.3%), a condition associated with increased vulnerability to drug side effects and treatment dropout, thereby necessitating close monitoring through medical records (Febriyanti et al., 2025). Although all patients had drug-sensitive TB, proper recording remains essential to prevent future drug resistance. Even minimal non-adherence can increase resistance risk, and strong recording systems have been shown to improve treatment success and reduce MDR-TB incidence (WHO, 2022). Overall, recording and reporting systems function as strategic tools not merely administrative processes in sustaining adherence, strengthening the DOTS program, and preventing drug resistance.

The Most Effective DOTS Strategy Variable Influencing Adherence to Anti-Tuberculosis Drug Intake during the Intensive Phase among Pulmonary TB Patients

Based on the binary logistic regression analysis, treatment observation (PMO) was the most significant DOTS component influencing adherence, with a p -value of 0.001 and an odds ratio of 0.133 (95% CI: 0.039–0.459). This indicates that patients without adequate PMO were 87% less likely to adhere to treatment than those receiving proper supervision, underscoring PMO as a critical determinant of timely and regular medication intake during the intensive phase of TB therapy. These findings are consistent with studies showing that PMO involvement by healthcare workers or family members improves adherence through direct supervision, reminders, emotional support, and early management of side effects (Lestari et al., 2024; Opperman & Preez, 2023). PMO plays a particularly important role among productive-age and elderly patients, as well as among male patients with high work mobility, who are more vulnerable to non-adherence (Nisah, 2023).

In addition to PMO consistent drug availability was also associated with better adherence, especially among unemployed patients and laborers, as uninterrupted access to free TB medication supports treatment continuation (Yanthi et al., 2025). Although all patients in this study had drug-sensitive TB, strong supervision, recording systems, and drug availability remain essential to prevent drug resistance, as emphasized by the WHO (2022). These results further support evidence that DOTS remains the cornerstone of TB control, aiming to improve treatment success and prevent drug resistance (Sazali et al., 2022). Overall, treatment observation (PMO), reinforced by consistent

drug availability, represents the most dominant and effective factors within the DOTS strategy for improving adherence during the intensive phase of TB treatment, particularly among productive-age male patients and those with increased vulnerability to non-adherence.

Study Limitations

Despite the significant findings, this study has several limitations that should be acknowledged. First, the cross-sectional design limits the ability to establish causal relationships between the components of the DOTS strategy and adherence to anti-tuberculosis drug intake; the observed associations reflect conditions at a single point in time. Second, adherence to treatment and several DOTS-related variables were assessed using self-reported data, which may be subject to recall bias and social desirability bias, potentially leading to overestimation of adherence levels. Third, this study was conducted in a limited number of primary healthcare centers within Bone Bolango Regency, which may restrict the generalizability of the findings to other regions with different health system capacities or sociodemographic characteristics. Additionally, potential confounding factors such as psychological status, stigma, substance use, and household support were not explored in depth. Future studies employing longitudinal designs, objective adherence measurements, and broader contextual variables are recommended to strengthen causal inference and provide a more comprehensive understanding of DOTS implementation and treatment adherence.

CONCLUSION

Based on data from 75 pulmonary tuberculosis patients in the service area of Bone Bolango Regency, Gorontalo Province, this study concludes that effective implementation of the Directly Observed Treatment, Short-course (DOTS) strategy is significantly associated with adherence to anti-tuberculosis medication during the intensive phase of treatment. All core components of the DOTS framework government commitment, microscopic examination, treatment supervision (PMO), drug availability, and recording and reporting systems demonstrated significant associations with patient adherence ($p < 0.05$).

Government commitment, reflected in policy support, service accessibility, and facilitation of TB control programs, contributed to improved treatment regularity, particularly among productive-age patients and those who rely heavily on public health services. Regular microscopic examination strengthened patients' confidence in diagnosis and treatment progress, thereby reinforcing adherence across both productive-age and elderly groups. Treatment supervision (PMO) emerged as the most influential determinant of adherence, as confirmed by binary logistic regression analysis ($p = 0.001$; OR = 0.133; 95% CI: 0.039–0.459), underscoring its pivotal role in ensuring consistent medication intake, especially among productive-age men, informal workers, and undernourished patients who are at heightened risk of treatment interruption.

In addition, consistent drug availability was essential for maintaining treatment continuity and preventing non-adherence and the potential development of drug resistance, while robust recording and reporting systems facilitated early identification of non-adherent patients and timely corrective interventions. Collectively, these findings highlight the need to strengthen treatment supervision, ensure uninterrupted drug supply, and optimize health information systems as integrated priorities to enhance tuberculosis treatment outcomes, particularly in high-burden settings.

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