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DETERMINANTS OF ADHERENCE TO ANTI-TUBERCULOSIS DRUGS (ATD) AT BALOI PERMAI PRIMARY HEALTH CENTER, BATAM

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ABSTRACT
Adherence to anti-tuberculosis drugs (ATD) therapy is a critical determinant of successful tuberculosis treatment and the prevention of drug resistance. Non-adherence may lead to treatment failure, disease recurrence, and continued transmission within the community. Therefore, identifying factors that influence patient adherence is essential for strengthening tuberculosis control programs. This study aimed to examine factors associated with adherence to anti-tuberculosis medication among pulmonary tuberculosis patients at Baloi Permai Primary Health Center, Batam City. A quantitative cross-sectional study was conducted involving 39 patients undergoing anti-tuberculosis treatment. Data were collected using structured questionnaires assessing knowledge, attitudes, practices, family support, and the role of health workers. Statistical analysis was performed using Chi-square tests and logistic regression. The bivariate analysis revealed that patient attitude ($p = 0.050$) and family support ($p = 0.006$) were significantly associated with treatment adherence. Meanwhile, knowledge, practices, and the role of health workers were not significantly related to adherence ($p > 0.05$). Multivariate analysis identified family support as the most influential factor affecting adherence to anti-tuberculosis therapy (OR = 6.03; $p = 0.010$). In conclusion, family support is the strongest determinant of ATD adherence. Strengthening family-based approaches should be integrated into TB management programs at primary healthcare facilities.
Keywords: Tuberculosis, adherence, family support, health management

INTRODUCTION

Tuberculosis (TB) is major public health challenge at both global and national levels (Sani, 2025; Alsoukhni, 2023). The disease remains a serious concern due to its high transmission potential and its substantial contribution to global morbidity and mortality. Although tuberculosis is a preventable and treatable disease, it continues to be one of the leading causes of death from infectious diseases worldwide (Saunders, 2025). It was estimated that approximately 10.8 million people developed tuberculosis in 2023, with more than 1 million deaths attributed to the disease. These figures demonstrate that tuberculosis control continues to pose a major challenge for health systems across many countries (Jang, 2022; Jiangjing, 2025). Global initiatives such as the End TB Strategy have therefore established ambitious targets, including a 90% reduction in TB-related mortality and an 80% reduction in TB incidence by 2030 compared with 2015 levels (Nabila, 2023; Arsyad, 2024). Epidemiological data indicate that Indonesia ranks second worldwide after India in terms of the number of TB cases. This situation

highlights the urgent need to strengthen tuberculosis control strategies within the national health system (Mariska, 2025).

At the regional level, Batam City represents a unique urban island setting characterized by high population density and population mobility. It can increase the potential for infectious disease transmission, including TB. The Baloi Permai Primary Health Center remains one of the health facilities facing a relatively high burden of tuberculosis cases (Herdianti, 2025).

Successful TB treatment depends on patient adherence to anti-tuberculosis drug (ATD) therapy. Patients diagnosed with TB are required to undergo continuous treatment for at least 6 months. Consistent adherence to anti-tuberculosis medication is essential to ensure treatment success and to prevent the development of drug-resistant tuberculosis (Hermiati, 2024). Poor adherence to treatment can lead to serious consequences. Incomplete therapy may result in treatment failure, disease relapse, and the emergence of drug-resistant TB strains that are more difficult and costly to treat. Patients who do not adhere to their treatment regimen may continue to transmit the disease within their communities (Widiastutik, 2020).

Adherence to TB treatment is influenced by multiple determinants that involve individual, social, and health system factors. From a health behavior perspective, such as patient knowledge, attitudes, and practices play an important role in shaping adherence behavior. Family support can serve as an important source of motivation and supervision that encourages patients to complete their treatment. Health workers also play a crucial role by providing education, treatment monitoring, and continuous support (Adam, 2020; Hasina, 2023).
Efforts to improve tuberculosis treatment outcomes contribute directly to the achievement of the Sustainable Development Goals (SDGs), particularly Goal 3, which focuses on ensuring healthy lives and promoting well-being for all (Najah, 2022). Strengthening tuberculosis control strategies is also aligned with Indonesia's long-term national development vision toward Indonesia Emas 2045 (Mekar Sekuntum, 2024).

Although numerous studies have examined factors associated with TB treatment adherence, most previous research has primarily focused on individual determinants such as patient knowledge or attitudes without comprehensively integrating behavioral, social, and healthcare system factors within a single analytical framework. The complex interaction between patient behavior, family support, and the role of health workers in shaping adherence behavior remains insufficiently explored. Empirical evidence addressing these determinants in urban island settings characterized by high population mobility, such as Batam City, is still limited. This study offers a novel contribution by simultaneously examining patient behavioral factors, family support, and the role of health workers within a multivariate analytical model to identify the most influential determinants of adherence to anti-tuberculosis therapy among TB patients in the local primary healthcare context.

Based on the identified research gap, this study aims to examine the determinants of adherence to anti-tuberculosis medication among TB patients receiving treatment at Baloi Permai Primary Health Center in Batam City. Specifically, this study evaluates the influence of patient behavioral factors, including knowledge, attitudes, and practices, as well as external factors such as family support and the role of health workers on treatment adherence. This research seeks to identify the most influential factors affecting adherence to TB therapy within the context of primary healthcare services.

METHOD

This study employed a quantitative approach using a cross-sectional design to assess the relationship between several independent variables and adherence to anti-tuberculosis therapy. The study was conducted at Baloi Permai Primary Health Center, Batam City. The study population consisted of TB patients undergoing anti-tuberculosis drugs (ATD) treatment during the study period (July 2025-January 2026). Total of 39 respondents were included in the study. Data were collected through structured questionnaires that assessed patient knowledge, attitudes, practices, family support, and the perceived role of health workers. The primary outcome variable in this study was adherence to anti-tuberculosis drug (ATD) therapy. Data analysis was performed in two stages. Bivariate analysis was conducted using the Chi-Square test to examine the association between independent variables and treatment adherence. Multivariate analysis using logistic regression was carried out to determine the most influential factors affecting adherence after controlling for other variables.

RESULTS AND DISCUSSIONS

Univariat Analysis

Table 1. Characteristics of Respondents

Characteristics	F	%
Gender		
1. Male	22	56,4
2. Female	17	43,6
Productive Ages Group		
1. <15 years	0	0
2. 15-60 years	37	94,9
3. >60 years	2	5,1
Educational Background		
1. No School	0	0
2. Elementary	2	5,1
3. Junior High School	2	5,1
4. Senior High School	21	53,8
5. Bachelor Degree	14	35,9
Marital Status		
1. Single	20	51,3
2. Married	17	43,6
3. Widow	1	2,6
4. Widower	1	2,6
Occupation		
1. No Job	8	20,5
2. Laborer	1	2,6
3. Self Employed	18	46,2
4. Civil Servants	1	2,6
5. Others	11	28,2
Length of Therapy		
1. 0-2 months	14	35,9
2. 2-6 months	25	64,1
3. >6 months	0	0
Live with Family		
1. Yes	23	59
2. No	16	41
Swallowing Supervisor		
1. No One	11	28,2
2.Family	24	61,5
3. Health Worker	4	10,3
TOTAL	**39**	**100**

Based on the table above, the characteristics of the 39 respondents indicate that the majority were male, 22 respondents (56.4%). Most respondents were within the productive age group of 15–60 years, 37 respondents (94.9%). In terms of

educational background, 21 respondents (53.8%) had completed senior high school. Regarding marital status, 20 respondents (51.3%) were unmarried. Based on occupation, 18 respondents (46.2%) were self-employed or worked as private sector employees. The majority of participants had been undergoing tuberculosis treatment for a duration of 2-6 months, 25 respondents (64.1%). Most respondents lived with their families, 23 respondents (59%). Family members served as treatment supervisors for 24 respondents (61.5%).

Table 2. Descriptic Analysis

No	Variable	F	%
1	**Knowledge**		
	- Poor	11	28,2
	- Moderate	10	25,6
	- Good	18	46,2
2	**Attitudes**		
	- Poor	12	30,8
	- Moderate	11	28,2
	- Good	16	41,0
3	**Practices**		
	- Poor	6	15,4
	- Moderate	5	12,8
	- Good	28	71,8
4	**Family Support**		
	- Poor	3	7,7
	- Moderate	5	12,8
	- Good	31	79,5
5	**Role of Health Workers**		
	- Poor	1	2,6
	- Moderate	4	10,3
	- Good	34	87,2
6	**Adherence to ATD**		
	- Non-adherent	6	15,4
	- Adherent	33	84,6
TOTAL		**39**	**100,0**

Based on the table above, the distribution of the study variables among the 39 respondents shows that the majority demonstrated good levels across several measured factors. A total of 18 respondents (46.2%) had good knowledge regarding tuberculosis treatment. In terms of attitude, 16 respondents (41.0%) exhibited a positive attitude toward treatment adherence. Most participants demonstrated good practices, accounting for 28 respondents (71.8%). A high proportion of respondents also reported receiving strong family support, totaling 31 individuals (79.5%). Similarly, the role of healthcare workers was perceived as good by 34 respondents (87.2%). Overall, the majority of respondents were categorized as adherent to anti-tuberculosis medication, with 33 respondents (84.6%) demonstrating adherence to ATD therapy.

The findings of this study show that most respondents adhered to the anti-tuberculosis drug (ADT) regimen. A comparable pattern was reported by Lilis Andriani (2023) at Puskesmas Pahandut, where 28 of 35 participants (80%) complied with their prescribed treatment. This consistency suggests that adherence among tuberculosis patients in primary healthcare settings can be relatively high when treatment supervision and patient support are adequately implemented. From a clinical and public health perspective, strong adherence is a critical determinant of successful tuberculosis management. Adherence reflects the extent to which patients follow health workers instructions regarding medication intake, including dosage, timing, and treatment duration. The relatively high adherence observed in this study may indicate effective patient counseling and monitoring practices within the health service. Sustained adherence is essential not only for achieving treatment success but also for preventing unfavorable outcomes. According to the World Health Organization (2020), inadequate adherence may result in treatment failure, treatment

interruption, and the emergence of drug-resistant tuberculosis.

Bivariat Analysis

Table 3. Bivariat Analysis

Variable	Adherence to ATD				Total	%	p-value
	Non-Adherent	%	Adherent	%			
Knowledge							
Poor	1	2,6	10	25,6	11	28,2	0,328
Moderate	3	7,7	7	17,9	10	25,6	
Good	2	5,1	16	41,0	18	46,2	
Attitudes							
Poor	0	0,0	12	30,8	12	30,8	0,050
Moderate	4	10,3	7	17,9	11	28,2	
Good	2	5,1	14	35,9	16	41,0	
Practices							
Poor	0	0,0	6	15,4	6	15,4	0,248
Moderate	0	0,0	5	12,8	5	12,8	
Good	6	15,4	22	56,4	28	71,8	
Family Support							
Poor	2	5,1	1	2,6	3	7,7	0,006
Moderate	2	5,1	3	7,7	5	12,8	
Good	2	5,1	29	74,4	31	79,5	
Role of Health Workers							
Poor	0	0,0	1	2,6	1	2,6	0,594
Moderate	0	0,0	4	10,3	4	10,3	
Good	6	15,4	28	71,8	34	87,2	

Bivariate analysis using the Chi-square test revealed that attitudes (p = 0.050) and family support (p = 0.006) were significantly associated with adherence to anti-tuberculosis medication. Conversely, knowledge, practices**,** and the role of health workers were not significantly related to treatment adherence (p > 0.05).

The findings indicate that attitude and family support were significantly related to adherence to anti-tuberculosis medication, whereas knowledge, practices, and the role of health workers did not demonstrate a significant influence on treatment adherence.

The chi-square analysis indicated that patient knowledge was not significantly associated with adherence to anti-tuberculosis drug (ATD) therapy (p=0.328). Similar findings were reported by Alamsyah (2025) at Lawawoi Primary Health Centre (p=0.083) and Fitriani (2019) at Pasundan Health Centre (p=0.056), both of which also found no significant relationship between knowledge and treatment adherence. Within the behavioral framework proposed by Lawrence W. Green 2005), knowledge functions primarily as a predisposing factor that shapes awareness but may not directly translate into consistent health behavior without enabling and reinforcing influences.

In contrast, patient attitude showed a significant association with OAT adherence (p=0.050), consistent with findings by Widyastuti (2023) at at Kedokanbunder Primary Health Centre (p=0.001). Attitude

reflects an individual's evaluative response toward a particular object or behavior, which may manifest as either favorable or unfavorable perceptions. It consists of positive and negative attitudes (Azwar, 2016). Positive attitudes toward treatment may strengthen patients' motivation and acceptance of long-term therapy.

Meanwhile, patient practices were not significantly related to adherence (p=0.248), suggesting that observable health behaviors may be influenced by broader contextual determinants. A comparable result was observed in the study by Alamsyah (2025) (p=0.347). Although practices represent the observable manifestation of health behavior, they are often shaped by multiple interacting determinants, including predisposing, enabling, and reinforcing factors. Consequently, behavioral practices may not independently predict treatment adherence without broader contextual support (Notoatmodjo, 2014).

Family support, emerged as a significant determinant of adherence (p=0.006). The present study identified family support as a significant factor influencing adherence to anti-tuberculosis drug (ATD) therapy. This finding is consistent with previous studies conducted by Widyastuti (2023) at Kedokanbunder Primary Health Centre (p=0.006) and Lestari (2023) at Tenayan Raya Primary Health Centre (p=0.000), both of which reported a statistically significant relationship between family support and medication adherence among tuberculosis patients. The consistency of these findings across different primary healthcare settings highlights the critical role of the family environment in sustaining long-term treatment behaviors. From a behavioral perspective, this result aligns with the PRECEDE–PROCEED framework proposed by Lawrence W. Green (2005), which emphasizes the importance of reinforcing factors in maintaining health-related behaviors. Family support functions as a reinforcing mechanism by providing emotional encouragement, practical assistance, and continuous supervision during the prolonged course of tuberculosis therapy. Given that TB treatment requires strict adherence over several months, sustained family involvement may enhance patients' motivation, reduce treatment fatigue, and strengthen commitment to therapy. Consequently, integrating family-centered approaches into tuberculosis control programs may substantially improve treatment adherence and overall therapeutic outcomes.

Conversely, the role of health workers was not significantly associated with ADT adherence (p=0.594). A similar result was reported by Anshar (2023) at Tasikmalaya Primary Health Care (p=0.173). Although health workers provide essential functions such as patient education, treatment supervision through the DOTS strategy, and motivational support, these contributions may not directly translate into adherence unless reinforced by consistent support from the patient's immediate social environment.

Multivariat Analysis

The multivariate analysis was performed using binary logistic regression with the Backward Stepwise (Conditional) procedure to identify the most relevant

predictors of adherence to anti-tuberculosis medication, it was because the independent variables included both statistically significant and non-significant factors. The procedure began with the full model, incorporating all candidate variables, and subsequently removed non-significant variables with higher p-values in a stepwise manner. The elimination process was conducted gradually until the most appropriate final model was obtained, as presented in the table below:

Table 4. Independent Variable Based on p-value

Variabel	p-value	Conclusion
Health Workers (X5)	0,549	Not signifikan
Knowledge (X1)	0,328	Not signifikan
Practices (X3)	0,248	Not Signifikan
Attitudes (X2)	0,050	Signifikan
Family Support (X4)	0,006	Signifikan

Table 5. Coefficient of Determination

Step	Nagelkerke R Square
1	.754
2	.747
3	.637
4	.604

Based on the table above, the first step of the logistic regression analysis showed a Nagelkerke R Square value of 0.754**,** indicating that approximately 75.4% of adherence to anti-tuberculosis medication could be explained by the variables included in the model (knowledge, attitude, practices, family support, and the role of health workers). The remaining 24.6% of the variation in treatment adherence was attributed to other factors not examined in this study. After conducting variable selection in steps two, three, and four by gradually removing variables according to the order presented in Table 4, the Nagelkerke R Square value decreased to 0.604**.** This result suggests that 60.4% of adherence to anti-tuberculosis medication was explained by the remaining variables in the final model, specifically attitude and family support, while the remaining 39.6**%** was influenced by other factors outside the scope of this study.

Table 6. Simultaneous Test (*Omnibus Test*)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	22.216	10	.014
	Block	22.216	10	.014
	Model	22.216	10	.014
Step 2	Step	-.255	2	.880
	Block	21.960	8	.005
	Model	21.960	8	.005
Step 3	Step	-4.120	2	.127
	Block	17.840	6	.007
	Model	17.840	6	.007
Step 4	Step	-1.159	2	.560
	Block	16.681	4	.002
	Model	16.681	4	.002

The Omnibus Test of Model Coefficients indicated that the logistic regression model significantly improved the prediction of adherence to anti-tuberculosis medication compared with the intercept-only model (x^2 = 16.681; df = 4; p = 0.002). This result demonstrates that the set of independent variables included in the analysis collectively contributes to explaining variation in treatment adherence. The significance of the Block and Model statistics across the modeling steps further confirms that the regression model provides a better overall fit than a null model without predictors.

Tabel 7. Partial Test (*Wald Test*)

Variables in the Equation									
								95% C.I.for EXP(B)	
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1	X1	.440	.756	.339	1	.561	1.553	.353	6.840
	X2	.957	.813	1.384	1	.239	2.603	.529	12.818
	X3	-18.954	7687.560	.000	1	.998	.000	.000	.
	X4	1.824	.848	4.622	1	.032	6.195	1.175	32.673
	X5	-17.603	12626.956	.000	1	.999	.000	.000	.
	Constant	103.129	44349.108	.000	1	.998	6.143		
Step 2	X2	1.011	.823	1.511	1	.219	2.749	.548	13.780
	X3	-18.544	8044.080	.000	1	.998	.000	.000	.
	X4	1.815	.842	4.645	1	.031	6.140	1.179	31.986
	X5	-17.128	13139.370	.000	1	.999	.000	.000	.
	Constant	101.390	46218.437	.000	1	.998	1.079		
Step 3	X2	.846	.801	1.116	1	.291	2.331	.485	11.214
	X3	-18.380	8394.695	.000	1	.998	.000	.000	.
	X4	1.855	.841	4.870	1	.027	6.391	1.231	33.192
	Constant	49.908	25184.085	.000	1	.998	473088		
Step 4	X3	-17.599	8598.192	.000	1	.998	.000	.000	.
	X4	1.509	.695	4.715	1	.030	4.522	1.158	17.652
	Constant	50.399	25794.577	.000	1	.998	77273		
Step 5	X4	1.797	.698	6.632	1	.010	6.033	1.536	23.691
	Constant	-2.824	1.750	2.603	1	.107	.059		

The Wald test results indicate that among the examined predictors, only family support (X4) showed a statistically significant association with adherence to anti-tuberculosis medication. In the final model (Step 5), X4 remained significant (B = 1.797; Wald = 6.632; p = 0.010) with an odds ratio of Exp(B) = 6.033 (95% CI: 1.536-23.691). This finding suggests that patients who received strong family support were approximately 6.03 times more likely to adhere to ATD therapy compared with those with lower support. In contrast, knowledge (X1), attitude (X2), practice (X3), and the role of health workers (X5) were not statistically significant (p > 0.05). These results highlight family support as the dominant determinant of treatment adherence.

The logistic regression model can be expressed as follow :

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \ldots\ldots \beta nXn$$
$$= -2,824 + 1,797\ x$$

a) x = 1 (with family support)

$Y = -2,824 + 1,797\ (1) = -1,027$

$p = 1 / (1+ e^{-y})$

$= 1 / (1+ e^{-(-1,027)})$

$= 1 / (1+ e^{1,027}) = 1 / (1+ 2,79) = 0,26$

b) x = 0 (without family support)

$Y = -2,824 + 1,797\ (0) = -2,824$

$p = 1 / (1+ e^{-y})$

$= 1 / (1+ e^{-(-2,824)})$

$= 1 / (1+ e^{2,824}) = 1/(1+ 16,85) = 0,056$

Note: p = probability of Adherence to Anti-Tuberculosis Drugs (ATD)

e = 2,72 (Euler's number)

$e^{1,027} = 2,79$

$e^{2,824} = 16,85$

Based on logistic regression equation, the probability of adherence to anti-tuberculosis drug (ADT) increases when patients receive family support. Patients with family support have an adherence probability of 26,4%, whereas patients without family support have an adherence probability of 5,6%.

Multivariate analysis further identified family support as the dominant factor influencing ATD adherence (OR=6.03; p=0.010), indicating that patients who received strong family support were substantially more likely to comply with their treatment regimen. Similar findings were reported by Widyastuti (2023), who identified family support as a significant predictor of adherence (p=0.013). According to Friedman (20210), family support encompasses emotional, informational, instrumental, and appraisal components that can strengthen patients' motivation and treatment commitment.

CONCLUSION

The findings indicate that the independent variables collectively contributed significantly to adherence to anti-tuberculosis drugs (ATD) . However, partial analysis revealed that family support was the only variable with a statistically significant effect and emerged as the dominant determinant of treatment adherence, while knowledge, attitude, practice, and the role of health workers were not significant predictors. These findings underscore the critical role of family involvement, in sustaining long-term tuberculosis treatment adherence.

SUGGESTIONS

Tuberculosis control strategies in primary healthcare settings should prioritize family-centered interventions, including structured education, treatment supervision, and active family engagement, in order to strengthen patient adherence and improve overall treatment outcomes.

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