



TREATMENT SUPERVISION AND MEDICATION ADHERENCE AMONG TUBERCULOSIS PATIENTS WITHIN A HEALTH BELIEF MODEL FRAMEWORK

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ABSTRACT

Indonesia is the country with the second-highest number of tuberculosis (TB) cases in the world after India. TB is a chronic infectious disease caused by *Mycobacterium tuberculosis*. TB treatment requires a long duration and must be carried out consistently, which often leads to patients discontinuing their medication before completing the therapy. Patient adherence to medication plays a crucial role in determining treatment success. One of the factors influencing TB patients' adherence is the role of the Directly Observed Treatment (DOT) supervisor or Pengawas Minum Obat (PMO). This study aims to determine the relationship between the role of PMO in supervising medication intake using the Health Belief Model (HBM) approach and medication adherence among TB patients at RSD K.R.M.T Wongsonegoro, Semarang City. This survey-based study employed a non-experimental correlational quantitative design with prospective data collection. The instrument used was a structured questionnaire. The total sample consisted of 72 participants, selected using a non-probability purposive sampling technique. The instrument was tested for question content by experts and for validity and reliability using the Spearman correlation. Data were analyzed using bivariate analysis with the Spearman Rho test. The results showed an r-value of 0.385, indicating a moderately strong correlation, with a significance value of 0.001 (< 0.05). These findings demonstrate a significant relationship between the role of the TB PMO and medication adherence using the Health Belief Model (HBM) as a framework for understanding and predicting health behaviors based on individuals' attitudes, beliefs, and perceptions of health risks. The role of the Directly Observed Treatment supervisor (PMO) has a significant relationship with TB patient medication adherence when assessed using the HBM approach.

Keywords: HBM; medication adherence; tuberculosis

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INTRODUCTION

Health, according to Law No. 17 of 2023, is a physical, mental, and social condition that enables a person to live productively. Health efforts encompass various activities such as promotion, prevention, treatment, recovery, and end-of-life care, which are carried out continuously by the government and the community (DPR RI, 2023). Tuberculosis, or TB, is an infectious disease caused by the bacterium *Mycobacterium tuberculosis*, which attacks the lungs and other organs. In efforts to tackle TB, the government and community focus on prevention and health promotion, but do not neglect treatment and recovery, so that the number of sufferers, deaths, disabilities and transmission can be reduced (Health, 2024). Globally, tuberculosis is a major health problem. In 2015, there were approximately 10.4 million new cases and 480,000 drug-resistant TB cases. Six

countries, including Indonesia, account for 60% of the total TB cases worldwide. Although TB mortality rates fell by 22% between 2000 and 2015, the disease remains one of the leading causes of death globally (WHO, 2016).

Indonesia is one of the countries with a high burden of tuberculosis in the world, ranking second after India. Every year, the number of tuberculosis cases in Indonesia remains high, but the reported data does not adequately represent the actual situation due to under-reporting. The estimated number of tuberculosis cases nationwide reaches hundreds of thousands per year. The burden of TB is exacerbated by several factors, such as a dense population, limited access to health services, the presence of other diseases such as HIV and diabetes, low public awareness of TB symptoms, and differences in the quality of health services across regions. Age and education level are key factors in the HBM model related to efforts to prevent transmission and treat pulmonary TB. Educational media are needed to increase public knowledge about how to prevent and treat pulmonary TB (Juliati et al., 2020). The main problem in TB control is under-reporting, where several TB cases go unrecorded. This is because many patients seek treatment at private health facilities that do not report cases. Suboptimal recording and reporting systems, stigma that discourages people from seeking treatment, and delayed diagnosis due to limited testing resources all contribute to under-reporting. As a result, the number of recorded TB cases is much lower than the actual number, slowing down the achievement of TB elimination targets (Suryanti et al., 2025).

Data from the Central Java Health Office Health Profile document and data from the Central Statistics Agency for 2021 to 2023. The mapping results indicate that densely populated areas, such as Banyumas Regency and Semarang City, have higher TB case rates. This finding demonstrates that population density influences the spread of TB in Central Java. Additionally, environmental conditions, lifestyle, economic status, education, and other factors also contribute to the increase in cases. To reduce TB cases and deaths, collaboration across various sectors is required (Fitri, 2025).

Adherence to tuberculosis treatment is crucial because it affects the success of treatment. Adherence helps reduce the spread of the disease, prevent recurrence, accelerate the destruction of the causative bacteria, reduce drug resistance, and reduce disability in patients. As patient adherence increases, the number of tuberculosis cases can decrease significantly. It can be concluded that pulmonary tuberculosis patients at Hermina Depok General Hospital have a high level of adherence to anti-tuberculosis therapy, and educational interventions need to be continuously improved to maintain treatment success (Hardianita et al., 2025)

Efforts to improve compliance include monitoring medication use by a Medication Supervisor (MS). A good MS is usually a member of the immediate family, as they have a close emotional relationship and can consistently monitor and encourage the patient. In addition, families also assist with treatment costs, accompany patients to doctor's appointments, ensure patients take their medication daily, teach them how to use medication correctly, and explain the benefits and risks of non-compliance (Menkes, 2016). Patient non-compliance is the main cause of treatment failure, mainly because patients sometimes assume that they have recovered after two months of treatment. However, TB treatment requires a long time, which can make patients feel bored. This non-compliance increases the risk of developing Multi-Drug Resistant TB (MDR-TB), which is far more dangerous and difficult to cure. It is recommended that families encourage patients to continue participating in religious activities while still adhering to health protocols (Manurung, 2025).

Health Belief Model (HBM), which includes perceptions of vulnerability, severity, benefits, barriers, and self-efficacy. This model helps explain why people choose to behave healthily, namely because there is a perception of threat and a belief that preventive measures are effective (Chen et al., 2020).

Previous studies have shown that the HBM concept has a significant effect on TB treatment adherence. An individual's perception of risk, severity, barriers, benefits, and self-efficacy shapes their determination to complete treatment. Interventions based on HBM have been shown to be effective in improving the knowledge and behaviour of TB patients (Parwati et al., 2021).

(Parwati et al., 2021). This study aims to analyse the relationship between the role of medication supervisors and TB patient adherence using the HBM approach. The novelty of this study lies in combining coping strategies for managing the emotions of patients and their families with the latest technology to ensure the effectiveness of TB therapy and prevent resistance.

METHOD

The study was conducted at the TB Clinic of K.R.M.T. Wongsonegoro Hospital in Semarang from February to April 2025. The study design used a survey method with a non-experimental quantitative correlational approach that was prospective in nature. Data collection was conducted through questionnaires to determine the relationship between the PMO perception variable, measured based on the Health Belief Model (HBM) construct, and the TB medication adherence variable. The research subjects were PMOs of TB patients undergoing treatment at the hospital's TB clinic. The research population included all PMOs of TB patients at the Wongsonegoro Regional General Hospital TB Clinic, numbering 250 people per year from 2024 to 2025. The sample was calculated using the Slovin formula ($e = 0.1$), resulting in 72 respondents. The inclusion criteria included PMOs of TB patients who had been undergoing treatment for more than 1 month and were not in the category of discontinuing treatment. The patients included in the study were TB patients aged 1–65 years. The exclusion criteria were patients with a treatment duration that did not meet the requirements. This study only examines the problem of the object's condition at the time of the study to determine the relationship between the independent variable and the dependent variable. In collecting data in this study using a questionnaire. The subjects of this study will only involve TB PMO who are treated at RSD K.R.M.T Wongsonegoro Semarang City at the TB clinic. The population used in PMO TB patients who are at RSD K.R.M.T Wongsonegoro Semarang City at the TB clinic with a population of 250 in November 2024. The sample according to the inclusion criteria in this study is the TB patient medication supervisor at RSD K.R.M.T Wongsonegoro Semarang City at the TB clinic, in patients who have entered the treatment period of more than 1 month.

In TB patients who are not included in the category of patients who have discontinued treatment, namely those who have not taken their medication for 2 consecutive months or more before completing their treatment period. Furthermore, in TB patients aged 1–65 years. Medication adherence is a parameter of patient behavior in following medical instructions regarding dosage, frequency, and duration of treatment. Adherence is important to prevent drug resistance, especially in the treatment of diseases such as tuberculosis. Factors influencing adherence include patient knowledge, family support, and awareness of the importance of treatment.

RESULT

This study was conducted prospectively by following the examination schedule of patients who came to the hospital through the TB polyclinic. The schedule was determined proportionally according to the number of online registrations made each day. Patients who had registered were analysed prospectively to ensure that they met the inclusion criteria for receiving the questionnaire. The tool used in this study was a questionnaire completed by the patient's guardian or family member, referred to as the PMO (Medication Supervisor). This study aims to identify the relationship between the success of TB therapy and constructs such as perceived susceptibility (awareness of risk), perceived seriousness (seriousness of the disease), perceived benefits (benefits of treatment), perceived barriers (barriers to treatment), and the dependent variable, which is medication adherence.

Data was collected using questionnaires administered to TB patients undergoing treatment at the TB Clinic of K.R.M.T Wongsonegoro Regional General Hospital from February to April 2025. In addition to HBM variables, the study also collected data on respondent characteristics such as age, education level, occupation, income, and duration of treatment. To test the validity of the instrument, a content validity test was conducted by three experts in February 2025 to ensure the suitability and feasibility of the questionnaire items before use. The approach used was the Content Validity Index (CVI), a statistical method that has been widely used in the last 10 years. CVI consists of two parts, namely i-CVI (item-by-item validity) and s-CVI (scale validity). The content and construct validity of the questions were calculated based on the percentage of expert assessment agreement (ACP). The instrument was declared valid if the items used were relevant and capable of measuring the intended construct. The content validity test procedure followed six steps (Astari, 2025). The steps are to prepare a validation sheet, select experts, validate items, review the construct domain, assign scores, and calculate the CVI. This test is important to ensure that the instrument actually measures the specified variables (Puspitasari & Febrinita, 2021). In content validity testing (CVI), an item is considered valid if it achieves a CVI value corresponding to the number of experts. The criteria for the content validity value of individual items (CVI) are: if there are 2 experts, the CVI value must be at least 0.80; if there are 3–5 experts, the CVI value must be 1; if there are at least 6 experts, the CVI value must be greater than 0.83; if there are 6–8 experts, the CVI value must be greater than 0.83; if there are at least 9 experts, the CVI value must be greater than 0.78 (Puspita et al., 2021). In this study, 3 experts were used, all of whom gave a CVI value of 1 for all questionnaire items, so the instrument was declared content valid.

Table 1.
Questionnaire Content Test

Questionnaire	Number of Experts Agree (Appropriate)	I-CVI
Perceived Susceptibility	3	1
Perceived Severity	3	1
Perceived Benefits	3	1
Perceived Barriers	3	1
Medication Adherence	3	1
Average		1

Source: Primary data, processed in 2025

The validity test of the questions was conducted on 30 PMO patients at the TB Clinic of K.R.M.T Wongsonegoro Hospital in March 2025. Respondents filled out the questionnaire, then the data was analysed using SPSS with Spearman's Rho correlation. The instrument was declared valid if the calculated *r* value was greater than the table *r* value, indicating that the questionnaire items were relevant and measured the intended construct. The construct validity test results showed that all questionnaire items had a calculated *r* value greater than the table *r* value (0.361) at a 5% significance level, so all items were declared valid. The construct validity test was conducted on 30 respondents who accompanied patients taking medication at

the TB Clinic of K.R.M.T Wongsonegoro Hospital in March 2025. Respondents filled out the questionnaire provided. This test was conducted to measure the extent to which the questionnaire provided accurate and relevant results for the research objectives. The results of the questionnaire were calculated using SPSS to determine the r-count value. The calculation of r was used to determine whether the results were greater than r-table, which indicated that the questionnaire was valid. This validation test was conducted using Spearman Rho in SPSS to determine the r value. In the reliability test, the test was conducted on 30 PMOs of patients at the RSD K.R.M.T Wongsonegoro TB Clinic in March 2025. Respondents complete the prepared questionnaire. Reliability testing aims to assess the consistency of measurement results. An instrument is considered reliable if it produces stable results when reused on the same subject. The results of reliability testing ensure that the questionnaire is suitable for use as a research data collection tool. Reliability testing is a step to ensure that the measurement instrument or tool used is consistent in providing the same results when its use is repeated. An instrument can be said to be reliable when it can be relied upon to provide consistent results, which is a prerequisite for validity. Reliability refers to the consistency of measurement. A reliable instrument can be trusted to collect actual data.

Table 2.
Reliability Test

Variabel	Item	Alpha	Alpha Coefficient	Description
Perceived Susceptibility	5	0,679	0,6	Reliabel
Perceived Severity	5	0,619	0,6	Reliabel
Perceived Benefits	5	0,620	0,6	Reliabel
Perceived Barriers	5	0,662	0,6	Reliabel
Medication Adherence	8	0,841	0,6	Reliabel

Source: Primary data, processed in 2025

Reliability describes the level of consistency and stability of data or findings. Unreliable data cannot be processed further because it will produce biased conclusions. A measuring instrument is considered reliable if its measurements show consistent results over time. If the Cronbach Alpha value is greater than 0.6, it is considered reliable, whereas if the Cronbach Alpha value is less than 0.6, it is not reliable. Based on the table above, each statement has a Cronbach's Alpha value greater than 0.6, so it can be concluded that all satisfaction statements are reliable. It is considered reliable if the Cronbach Alpha value is above 0.6. The analysis of respondent characteristics in this study describes the basic profile of 72 TB medication companions (PMO), determined using the Slovin formula.

The WHO states that compliance is influenced by five domains, namely socio-economic factors, treatment factors, health system factors, disease factors, and patient factors. The characteristics examined included gender, age, occupation, income, and duration of treatment. These factors can influence how respondents understand the research instrument and how they provide answers. Thus, respondent characteristics are important to ensure that the information obtained is accurate, contextually appropriate, and relevant to the research objectives.

The results of the analysis show that most respondents were over 40 years of age (41.7%), female (63.9%), and had a high school education (43.1%). The most common occupation was private employee (47.2%), with a monthly income of 3–4 million rupiah (40.3%). The most common duration of treatment support was 2–6 months (34.7%). Higher education tends to make it easier for individuals to accept and understand health information, while lower education can hinder the acceptance of new knowledge (Kendi et al., 2021). This study was conducted with 72 respondents who were medication companions at the TB clinic of K.R.M.T Wongsonegoro Hospital in Semarang, calculated using the Slovin formula. The medication companions filled out and answered questionnaires provided by the researchers.

The strength of the relationship between the role of TB medication assistants and medication adherence was tested using the HBM method. From the results of the completed questionnaires, the strength of the relationship was calculated using SPSS. The role of medication assistants in TB patient medication adherence can be carried out using the belief and health methods. This method includes: first, increasing individuals' perceptions of vulnerability to the negative effects of discontinuing TB treatment, such as wider spread of the disease and increased risk of complications. Second, increasing perceptions of the severity of TB so that individuals realise the serious consequences of not completing treatment, including long-term health effects. Third, strengthening perceptions about the benefits of regular TB treatment, such as faster recovery and lower risk of TB spread. Fourth, reducing perceived barriers by addressing factors such as treatment costs, drug side effects, and social stigma through comprehensive education and social support (Anindhita et al., 2024). By applying this approach based on the Health Belief Model (HBM), it is hoped that there will be an increase in awareness and involvement of medication companions in TB treatment, thereby increasing patient medication adherence.

Table 3.
Respondent Characteristics

Characteristic	f	%
Age		
< 20	3	4,2
20 – 25	9	12,5
26 – 30	10	13,9
31 – 25	12	16,7
36 – 40	8	11,1
> 40	30	41,7
Gender		
Male	26	36,1
Female	46	63,9
Level of Education		
Primary school	6	8,3
Secondary school	14	19,4
Senior secondary school	31	43,1
Higher education	21	29,2
Work		
Government	8	11,1
Private sector	34	47,2
Farmers	3	4,2
Fishermen	1	1,4
Self-employed	5	6,9
Not working	9	12,5
Others	12	16,7
Income		
1 - 2 million	18	25
2 - 3 million	16	22,2
3 - 4 million	29	40,3
> 4 million	9	12,5
Duration of Treatment (months)		
1 - 2 months	23	31,9
2 - 6 months	25	34,7
> 6 months	24	33,3

Source: Primary data, processed in 2025

Characteristics of Respondent Questionnaire Responses In this study, by testing the characteristics of respondents' yes or no answers, researchers can obtain more accurate and complete information about respondents' opinions and behaviours. In this study, the characteristics of questionnaire responses were determined to find out the number of

respondents who answered yes or no to each questionnaire question. The purpose of testing the characteristics of respondents' yes or no answers was to identify the proportion of respondents who answered yes or no. The characteristic test is used to analyse the distribution of respondents' answers, measure respondents' agreement or disagreement with a statement or question, and make comparisons between groups of respondents: The characteristic test is used to make comparisons between groups of respondents who answered yes and no. Based on the table above, it shows that medication companions answered 'yes' more than 'no'. Questionnaire Frequency Test for Questionnaire Frequency HBM Method.

Table 4.
Distribution of the HBM Method Questionnaire

Distribution of the HBM Method Questionnaire			
Description		Frequency	Percentage (%)
Valid	Good	55	76,4
	Fair	15	20,8
	Poor	2	2,8

Source: Primary data, processed in 2025

In this study, the questionnaire frequency was determined using the following assessment criteria: good (76%–100%), adequate (75%–55%), and poor (<55%). The questionnaire was distributed to determine the level of knowledge regarding the role of medication companions in TB patient medication adherence using the HBM method. The table above shows that the role of medication companions was rated as good (76.4%), moderate (20.8%), and poor (2.8%). The majority of respondents rated their role as good in assisting TB patients with medication. Frequency of Patient Medication Compliance Questionnaires: In this study, the frequency of questionnaires was determined using the criteria of compliance (51%-100%) and non-compliance (<50%). The distribution of compliance in this questionnaire was used to determine the level of medication compliance in TB patients using the HBM method.

Table 5.
Distribution of Medication Adherence Questionnaires

Description		Frequency	Percentage (%)
Valid	O bedient	70	97,2
	Disobedient	2	2,8

Source: Primary data, processed in 2025

Overall, applying an HBM-based approach that strengthens PMO awareness and engagement is expected to improve TB medication adherence. These findings highlight the importance of integrating behavioural models and supportive supervision into TB control programmes to reduce non-adherence and prevent the development of drug-resistant TB. From the results of the table above, the frequency of the medication adherence questionnaire using the HBM method obtained results of 97.2% of patients who were compliant and 2.8% of patients who were not compliant.

Table 6.
Relationship Test

Relationship between the Role of PMO TBC and Medication Adherence Using the HBM Method	
Correlation Coefficient	Value Sig (P-value)
0,385	0,001

Source: Primary data, processed in 2025

A value of 0.385 in the table indicates a positive relationship between the role of the PMO and TB patients' compliance in taking medication. In terms of correlation strength categories, 0.00–0.19 = very weak; 0.20–0.39 = weak to moderate; 0.40–0.59 = moderate; ≥0.60 = strong (Anindhita et al., 2024), Therefore, this relationship falls into the weak to moderate category. This interpretation means that the better the role of the PMO, the higher the level of patient medication compliance, although the effect is not particularly significant. A p-value of 0.001, which is less than 0.05, indicates that the relationship is statistically significant. The

likelihood of this relationship occurring by chance is very small, so the results obtained can be trusted. Thus, there is a significant relationship between the role of the PMO and the medication adherence of TB patients.

DISCUSSION

This study demonstrates that the role of Drug Intake Supervisors (Pengawas Minum Obat/PMO) has a statistically significant and moderate positive correlation with medication adherence among tuberculosis (TB) patients when analysed using the Health Belief Model (HBM). The correlation coefficient ($r = 0.385$) with a p-value of 0.001 indicates a meaningful relationship between PMO involvement and patients' adherence to TB medication regimens. The findings support the theoretical framework of the Health Belief Model, which posits that health-related behaviours are influenced by individuals' perceptions of susceptibility, severity, benefits, barriers, cues to action, and self-efficacy (Rosenstock, 1974; Champion & Skinner, 2008). In the context of TB treatment, PMOs act as an important cue to action by reminding, encouraging, and supervising patients to take their medication regularly. This role helps strengthen patients' perceived benefits of adherence and reduces perceived barriers, such as forgetfulness, treatment fatigue, or fear of side effects (Suwarni, Giovani, et al., 2024). The moderate strength of the correlation suggests that while PMO involvement alone does not fully determine adherence behaviour, it plays a crucial supportive role within a broader behavioural and social context. TB treatment requires long-term commitment, typically lasting 6–9 months, which often leads to declining adherence over time. Previous studies have consistently shown that social support and treatment supervision significantly improve adherence and treatment outcomes in TB patients (WHO, 2023; Munro et al., 2007). Moreover, PMO engagement may enhance patients' self-efficacy by providing reassurance, emotional support, and practical assistance during treatment. Increased awareness and active involvement of PMOs can therefore foster sustained behavioural change, aligning with HBM assumptions that behaviour change is more likely when individuals feel supported and confident in their ability to complete treatment.

Riset (Permatasari et al., 2020) discusses the relationship between the role of medication supervisors and patient compliance in taking anti-TB drugs in South Denpasar. This study used questionnaires and the Spearman rho test method. The results showed a strong relationship between the role of medication supervisors (PMO) and patient compliance in taking TB medication ($p\text{-value} = 0.001 < \alpha = 0.05$, $r = 0.44$). Another study by (Aris et al., 2021) Discussing the relationship between the role of the family as medication supervisors (MS) and patient perceptions of TB patient medication adherence at the Deket Community Health Centre in Lamongan District. With an α value of 0.01, a p value of 0.000 was obtained, indicating a relationship between the role of the family as MS and TB patient medication adherence at the Deket Community Health Centre in Lamongan. The strength of the relationship can be seen from the correlation value. A value of 0.00–0.25 is considered very weak, 0.25–0.50 is moderate, 0.51–0.75 is strong, 0.76–0.99 is very strong, and 1.00 means a perfect relationship. If the value is close to 1, it means the relationship is stronger (Sugiyono, 2018). Based on the table, a correlation coefficient of 0.385 was obtained, which falls into the moderately strong category. Additionally, the significance result of 0.001 is less than 0.05, so it is considered significant. The importance of medication adherence is a measure of the success of TB therapy. (Suwarni, Faizah, et al., 2024). These results indicate a relationship between the role of the TB PMO and patient medication adherence. The perception or belief that someone is supervising them in taking their medication can influence the level of adherence of these patients.

Based on the table above, the correlation coefficient was 0.385, indicating a moderate strength of correlation between the role of the TB Drug Intake Supervisor (PMO) and medication adherence. The significance value was 0.001, which is lower than the threshold of 0.05, demonstrating that this relationship is statistically significant. These findings indicate a meaningful association between the involvement of PMOs and patients' adherence to TB medication regimens. The results suggest that the presence and active role of PMOs contribute to improved medication adherence among TB patients. This relationship can be explained through the Health Belief Model, which emphasizes that individual perceptions, beliefs, and external support play an important role in shaping health-related behaviours. PMOs function as a key supportive factor by providing supervision, reminders, and motivation, thereby reinforcing patients' beliefs about the benefits of adherence and reducing perceived barriers to completing long-term TB treatment. Consequently, the perception and belief system of individuals who accompany and supervise TB patients during medication intake may directly influence patients' adherence behaviour. Strengthening the role of PMOs and enhancing their awareness of patient needs may therefore lead to improved treatment compliance and better therapeutic outcomes in TB management.

CONCLUSION

The role of the PMO TBC in TB medication adherence can be seen from the Spearman's rho test on the PMO role questionnaire using the HBM method with medication adherence, which is significant = 0.001 (< 0.05). The result of $r = 0.385$ has a sufficient correlation strength, indicating that there is a relationship between the role of the PMO TBC and medication adherence using questions from the HBM method. There is a relationship between the role of PMO TBC and medication adherence using the HBM (Health Belief Model) method as a tool to understand and predict a person's health behaviour based on attitudes, beliefs, and perceptions of health risks. The role of the Medication Supervisor has a significant relationship with TB patient adherence using the HBM approach.

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