



APPLICATION OF THE HEALTH BELIEF MODEL ON TREATMENT COMPLIANCE IN MULTIDRUG-RESISTANT TUBERCULOSIS PATIENTS

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ABSTRACT

Multidrug-resistant tuberculosis (MDR-TB) is a major health problem in Indonesia, with significant challenges in treatment adherence. The use of the Health Belief Model (HBM) can help explain factors influencing patient adherence to therapy. This study used a cross-sectional analytical design and was conducted at Dr. Soetomo General Hospital, Surabaya, from July to August 2025. The sample consisted of 36 MDR-TB patients on an 18-month regimen, selected using simple random sampling. The dependent variable was medication adherence, while the independent variables included perceptions of susceptibility, severity, benefits, barriers, cues to action, and self-efficacy. The research instrument was an HBM-based questionnaire. Data analysis was performed using linear regression. Multivariate analysis showed that perceived barriers significantly influenced treatment adherence ($b = -0.15$; 95% CI = -0.29 to -0.01 ; $p = 0.041$). Meanwhile, cues to action influenced treatment adherence, but were not statistically significant ($b=0.04$; 95% CI= -0.01 to 0.10 ; $p=0.102$). The regression model explained 18.9% of the variation in adherence. Perceived barriers have been shown to influence adherence in MDR-TB patients. Intervention efforts are needed to reduce perceived barriers in order to improve treatment adherence.

Keywords: health belief model; multidrug-resistant tuberculosis; treatment compliance

How to Cite (in APA Style)

Prasetya, V. P. W., Soedarsono, S., & Adiwino, R. P. (2026). Application of the Health Belief Model on Treatment Compliance in Multidrug-Resistant Tuberculosis Patients. *Indonesian Journal of Global Health Research*, 8(2), 699–706. <https://doi.org/10.37287/ijghr.v8i2.780>.

INTRODUCTION

Tuberculosis (TB) is an infectious disease caused by *Mycobacterium tuberculosis* that primarily affects the lungs (Deutsch-Feldman, 2021). According to the Global Tuberculosis Report 2024, there were 10.8 million TB cases with 1.25 million deaths globally in 2023, with Indonesia contributing 10% of global cases, the second highest after India (WHO, 2021). The Indonesian Ministry of Health (2022) reported 717,941 TB cases, a 61.98% increase compared to the previous year due to the impact of the COVID-19 pandemic. TB remains a major public health problem (Indonesian Ministry of Health, 2020), especially with the emergence of multidrug-resistant TB (MDR-TB), which is resistant to isoniazid and rifampicin.

MDR-TB treatment uses second-line drugs with a duration of 18–24 months, severe side effects, and challenges in implementation (Koirala et al., 2021). Therefore, patient adherence is crucial for preventing further resistance, reducing transmission, improving treatment outcomes, reducing mortality, and preventing complications (Sharma et al., 2018). The Health Belief Model (HBM) serves as an important framework for explaining patient adherence through the dimensions of perceived susceptibility, severity, benefits, barriers, cues to action, and self-efficacy (Glanz et al., 2015). Internal (age, knowledge, motivation) and external (family support, access to healthcare) factors also influence adherence (Arendse, 2015; Aldurayhim et al., 2023).

At Dr. Soetomo General Hospital in Surabaya, a referral hospital for MDR-TB in East Java, treatment adherence remains low among some patients, with 65.38% of new cases, 11.54% of treatment failures, 17.31% of relapses, and 5.77% of discontinuations (Soedarsono et al., 2024).

This situation highlights the need for further study. This study aimed to evaluate the relationship between perceptions based on the Health Belief Model and treatment compliance in MDR-TB patients at Dr. Soetomo Regional General Hospital, Surabaya.

METHOD

Research Design

This study uses a cross-sectional analytical design. Data will be collected at a single point in time to analyze the relationship between variables. A cross-sectional analytical design was used to analyze the relationship between patient perceptions based on the HBM and treatment adherence in MDR-TB patients at Dr. Soetomo General Hospital, Surabaya, from July to August 2025.

Subject

The population in this study was all MDR-TB patients undergoing an 18-month treatment regimen at Dr. Soetomo General Hospital, Surabaya. The sample for this study was 36 MDR-TB patients selected using a simple random sampling technique.

Instruments Research

The research instrument used in this study was a questionnaire designed to measure patients' levels of medication adherence and the HBM constructs (perceived susceptibility, perceived severity, perceived barriers, cues to action, and self-efficacy). Each question item from the treatment adherence variable and the HBM construct was measured using a questionnaire with a Likert scale scoring (1 = never; 2 = rarely; 3 = sometimes; 4 = often; and 5 = very often). The results of the validity test of each question item for each variable showed an item total correlation value of ≥ 0.30 . Meanwhile, the results of the reliability test of each variable showed a Cronbach's alpha value of ≥ 0.70 .

Data Analysis

The data in this study were analyzed using univariate and bivariate analyses. The bivariate analysis used Pearson correlation to determine the relationship between perceptions of the HBM constructs and medication adherence.

RESULT

Sample Characteristics

The majority of respondents were male (61.11%), with the largest age group being older adults (41–65 years, 30.55%). The highest educational level was high school/vocational high school (47.22%), and the majority of respondents were employed (66.67%). Economically, the majority had an income of ≤ 1 million rupiah (49%), while only a small proportion had an income of > 5 million rupiah (8%). The majority of respondents were Javanese (75%). Regarding health conditions, 100% had no comorbidities (Table 1).

Based on table 2, all MDR-TB patients had a maximum score (15) on perceived susceptibility, benefits, severity, and self-efficacy, indicating high awareness of the disease and confidence in undergoing treatment. In contrast, perceived barriers were relatively low (mean = 5.67; SD = 1.33), indicating that patients still experience obstacles. Cues to action varied (mean = 9.08; SD = 3.52) with a range of values 3–15, indicating varying levels of external motivation. Meanwhile, patient compliance was still low (mean = 1.22; SD = 0.59) with a maximum score of only 3, indicating that although positive perceptions of the disease and treatment were high, this was not fully reflected in medication adherence.

Table 1.
Characteristics of dichotomous data subjects

Variable	f	%
Gender		
Male	22	61.11
Female	14	38.89
Age (years)		
19 – 40	22	61.11
41 – 65	11	30.55
> 65	3	8.33
Education		
Elementary School	13	36.11
Middle School	5	13.89
High School	17	47.22
Bachelor's Degree	1	2.78
Occupation		
Yes	24	66.67
No	12	33.33
Income		
0 to ≤ 1 million	18	49
> 1 million to ≤ 3 million	11	30
> 3 million to ≤ 5 million	4	11
> 5 million	3	8
Tribes		
Jawa	27	75
Madura	9	25
Comorbid		
Yes	0	0
No	36	100

Table 2.
Characteristics of MDR-TB Patients on an 18-Month Regimen Based on the Health Belief Model Construct

Variable	N	Mean	SD	Min	Max
Perceived Susceptibility	36	15	0	15	15
Perceived Benefit	36	15	0	15	15
Perceived Severity	36	15	0	15	15
Self-Efficacy	36	15	0	15	15
Perceived Barriers	36	5.67	1.33	2	9
Cues to Action	36	9.08	3.52	3	15
Compliance	36	1.22	0.59	1	3

Bivariate Analysis

Table 3.
Bivariate Pearson Correlation Test Results of Health Belief Model (HBM) Constructs with Medication Compliance in MDR TB Patients on the 18-Month Regimen

Independent Variable	Compliance	
	Pearson Correlation (r)	P
Perceived Susceptibility	-	-
Perceived Benefit	-	-
Perceived Severity	-	-
Self-Efficacy	-	-
Perceived Barrier	-0.41	0.012
Cues to Action	0.36	0.030

In the bivariate results, perceived susceptibility, perceived benefits, perceived severity, and self-efficacy could not be analyzed further due to lack of data variation (all respondents had maximum scores), so the correlation value was not available. Based on the bivariate test results, there was a significant relationship between perceived barriers and cues to action with medication adherence in MDR-TB patients. Perceived barriers were moderately negatively related to adherence ($r = -0.41$; $p = 0.012$), meaning that the greater the perceived barriers, the lower the patient's adherence.

Conversely, cues to action were moderately positively related to adherence ($r = 0.36$; $p = 0.030$), indicating that the stronger the external drive or motivation, the higher the patient's adherence.

Multivariate Analysis

Based on the linear regression results in Table 4, only perceived barriers significantly influenced medication adherence in MDR-TB patients ($b = -0.15$; 95% CI: -0.29 to -0.01 ; $p = 0.041$). This indicates that the higher the perceived barriers, the lower the level of adherence. Meanwhile, cues to action did not significantly influence adherence ($p = 0.102$). This regression model explained 18.9% of the variation in patient adherence to treatment.

Table 4.

Linear Regression Results of Health Belief Model (HBM) Constructs with Medication Compliance in MDR TB Patients with an 18-Month Regimen

Independent Variable	Koef. Regression (b)	95% CI		p
		Limit lower	Limit upper	
Perceived Barrier	-0.15	-0.29	-0.01	0.041
Cues to Action	0.04	-0.01	0.10	0.102
N observation = 36				
Adjusted R-squared = 18.9%				

DISCUSSION

Sample Characteristics

The majority of MDR-TB patients were male (61.11%), consistent with other studies showing a predominance of cases in men due to behavioral and work environment factors (Maulina et al., 2014; Yahaya, 2025). The majority were aged 19–40 years (61.11%), who were still in their productive phase (Cherry, 2021). Most had low education and incomes of less than IDR 1,000,000, a condition associated with a higher risk of MDR-TB due to socioeconomic limitations (Sutarto et al., 2022). Most worked in the informal sector, which increased barriers to therapy adherence.

Bivariate Analysis

a. Perceived Vulnerability and Treatment Adherence

All respondents had the maximum perceived susceptibility score (Mean = 15; SD = 0), indicating high awareness of the risks of MDR-TB. However, adherence remained low (Mean = 1.22; SD = 0.59). Due to the lack of variation (ceiling effect), a statistical relationship with adherence could not be tested (Fang et al., 2019). This finding suggests that although patients recognize the seriousness and personal risk of MDR-TB infection, awareness alone is not sufficient to ensure treatment adherence. According to the Health Belief Model (HBM), perceived susceptibility can motivate health behavior only when accompanied by other reinforcing factors, such as perceived benefits, self-efficacy, and cues to action (Rosenstock, 1974; Janz & Becker, 1984). The lack of association in this study may reflect the “ceiling effect,” where uniform high scores in susceptibility prevent variability needed for statistical testing (McHorney & Tarlov, 1995).

Furthermore, prior research indicates that in chronic diseases such as TB, diabetes, or HIV, high perceived vulnerability does not always translate into adherence if structural and psychosocial barriers persist, including treatment side effects, stigma, or socioeconomic challenges (Bhebhe et al., 2014). Therefore, while patient awareness of MDR-TB risk is crucial, interventions should also address practical and psychosocial barriers to adherence to achieve better treatment outcomes.

b. Perceived Severity and Treatment Adherence

All patients rated MDR-TB as a serious disease with a fatal risk (Mean = 15; SD = 0). However, the lack of variation prevented a statistical relationship with adherence (Fang et al., 2019). This finding indicates that while patients fully recognize the seriousness and potential fatal consequences of MDR-TB, this perception alone does not automatically translate into better adherence. According to the Health Belief Model (HBM), perceived severity can motivate individuals to engage in

preventive or therapeutic behaviors, but only when combined with other constructs such as perceived benefits, self-efficacy, and cues to action (Rosenstock, 1974; Janz & Becker, 1984).

The absence of variation (a “ceiling effect”) in severity perception suggests that almost all patients equally acknowledged the threat of MDR-TB, leaving no statistical room to examine its association with adherence (McHorney & Tarlov, 1995). Previous studies in TB and HIV contexts similarly report that although patients perceive the disease as highly severe, structural and psychosocial barriers (e.g., drug side effects, stigma, lack of social support, and financial burden) often undermine adherence (Mekonnen and Azagew, 2018).

c. Perceived Benefits and Treatment Adherence

All respondents had the maximum perceived benefits score (Mean = 15; SD = 0), believing that MDR-TB therapy provides significant benefits for healing and preventing complications. The lack of variation in scores prevented a relationship with adherence (Fang et al., 2019). This finding shows that although patients strongly acknowledged the therapeutic value of MDR-TB treatment, the uniformly high perception limited statistical testing due to a ceiling effect (McHorney & Tarlov, 1995). Within the Health Belief Model (HBM), perceived benefits are a central determinant of adherence, as individuals are more likely to engage in recommended health behavior when they believe it will yield positive outcomes (Rosenstock, 1974; Janz & Becker, 1984). However, evidence suggests that recognition of benefits alone is not sufficient if patients simultaneously face barriers such as treatment fatigue, drug side effects, stigma, or financial constraints (Tola et al., 2016).

Previous studies in TB, HIV, and chronic disease management contexts demonstrate that even when patients acknowledge the benefits of therapy, adherence often depends on the balance between perceived benefits and perceived barriers (Munro et al., 2007; Mekonnen & Azagew, 2018). Thus, while this study highlights patients’ strong belief in the value of MDR-TB treatment, effective adherence strategies must also focus on minimizing barriers and strengthening support systems to translate positive perceptions into sustained behavioral action.

d. Perceived Barriers and Treatment Adherence

The average barrier score was 5.67 (SD = 1.33). Barriers included drug side effects, cost, distance, work, and stigma. There was a significant negative association with adherence ($r = -0.41$; $p = 0.012$), meaning that high barriers decreased adherence. This is consistent with a study in Nigeria that highlighted that difficulty in taking medication regularly (perceived as a barrier) was an independent predictor negatively associated with TB treatment adherence (AOR = 0.14). The multivariate model also confirmed that perceived benefits and positive self-efficacy increased adherence (Gebremariam et al., 2021).

These findings align with the Health Belief Model (HBM), which posits that perceived barriers are often the strongest predictor of health behavior, sometimes outweighing perceived susceptibility, severity, or even benefits (Rosenstock, 1974; Janz & Becker, 1984). Barriers such as treatment side effects, financial burden, and stigma have been consistently documented as key obstacles to adherence in TB and other chronic conditions (Munro et al., 2007; Tola et al., 2016). In MDR-TB specifically, the prolonged treatment duration, high pill burden, and severe drug-related adverse effects are significant deterrents to sustained adherence (Khan et al., 2017).

The negative relationship observed in this study underscores the importance of addressing practical and psychosocial barriers through patient-centered interventions. Strategies such as providing financial and nutritional support, strengthening counseling services, reducing pill burden, and community-based DOTS programs have been shown to mitigate barriers and improve adherence (Mekonnen & Azagew, 2018; Gebremariam et al., 2021). Thus, while perceived benefits and self-

efficacy encourage adherence, without adequate management of barriers, patients remain at risk of treatment interruption or loss to follow-up.

e. Cues to Action and Treatment Adherence

The average cues to action score was 9.08 (SD = 3.52), encompassing family support, healthcare providers, and technological reminders. There was a significant positive association with adherence ($r = 0.36$; $p = 0.030$). The stronger the cues to action, the higher the adherence, consistent with a study in Uganda (Alinaitwe et al., 2025).

This finding emphasizes the role of external triggers and support systems in sustaining long-term adherence to MDR-TB treatment. Within the Health Belief Model (HBM), cues to action function as the immediate stimuli that prompt individuals to translate health beliefs into concrete behavior (Rosenstock, 1974; Janz and Becker, 1984). In the context of TB, these cues may include reminders from healthcare providers, encouragement from family members, peer support, and digital health interventions such as SMS reminders or mobile applications (Chaiyachati et al., 2013; Iribarren et al., 2017).

Prior studies show that consistent cues to action improve adherence by reinforcing motivation and overcoming forgetfulness or treatment fatigue. For instance, research in Uganda demonstrated that family and peer support significantly enhanced TB treatment adherence (Alinaitwe et al., 2025). Similarly, systematic reviews have found that technological interventions, particularly mobile phone-based reminders, are effective in improving adherence in TB and HIV therapy (Subbaraman et al., 2018).

f. Self-Efficacy and Treatment Adherence

All respondents had maximum self-efficacy (Mean = 15; SD = 0), indicating confidence in their ability to undergo MDR-TB therapy. However, without score variation, the relationship with adherence could not be tested. These results confirm that high self-efficacy alone does not always guarantee consistent adherence (Sirait et al., 2021).

Self-efficacy is a crucial construct in the Health Belief Model (HBM) and other behavioral theories, defined as an individual's confidence in their ability to perform a specific health behavior under challenging circumstances (Bandura, 1997). High self-efficacy has been consistently linked to better adherence across chronic diseases, including HIV, diabetes, and TB (Tola et al., 2016). However, evidence shows that self-efficacy needs to be supported by favorable environmental and structural conditions to translate into sustained adherence (Schunk and DiBenedetto, 2020).

The ceiling effect in this study indicates that all respondents reported very high self-confidence in completing therapy, making it impossible to statistically evaluate the predictive effect of self-efficacy on adherence. Moreover, prior research highlights that even with high self-efficacy, barriers such as medication side effects, stigma, and lack of social support may undermine adherence (Munro et al., 2007; Gebremariam et al., 2021). Thus, while fostering self-efficacy is important, interventions should integrate psychosocial support, patient-centered counseling, and enabling resources to ensure that confidence is effectively translated into consistent treatment adherence.

Multivariate Analysis

Linear regression results showed that only perceived barriers significantly influenced MDR-TB treatment adherence ($b = -0.15$; 95% CI = -0.29 to -0.01 ; $p = 0.041$). This confirms that patient-perceived barriers are the dominant factor influencing adherence. Barriers such as medication side effects, fatigue due to long therapy duration, and limited transportation costs for routine check-ups are frequently reported by MDR-TB patients (Sharma et al., 2018). The cues to action variable did

not have a significant effect in the multivariate model ($p = 0.102$), although it was associated with adherence in the bivariate analysis. This suggests that external incentives are not strong enough if the patient's perceived barriers remain high. This regression model explained 18.9% of the variation in patient adherence. Therefore, interventions should focus on reducing patient barriers, for example through medication side effect management, psychosocial support, and improving access to healthcare services.

CONCLUSION

Perceived barriers have been shown to influence adherence in MDR-TB patients. Intervention efforts are needed to reduce perceived barriers in order to improve treatment adherence.

REFERENCES

- Aldurayhim JSE, Bawazir BA, Alharbi NO, Almutairi MG, Aloyayqilah KM, Alanazi AZ, Mutairi RA, et al. (2023). Medication adherence strategies: Enhancing patient compliance and outcomes. *Journal of International Crisis and Risk Communication Research*, 6(1), 45–60. <https://jicrcr.com/index.php/jicrcr/article/view/2045>
- Alinaitwe B, Shariff NJ, Madhavi Boddupalli B (2025). Treatment adherence and its association with family support among pulmonary tuberculosis patients in Jinja, Eastern Uganda. *Sci Rep* 15, 11150 (2025). <https://doi.org/10.1038/s41598-025-96260-8>
- Arendse SM, Khoza-Shangase K (2025). A cross-sectional, descriptive qualitative study of information counselling during tuberculosis treatment in South Africa: Awareness of XDR-TB patients on ototoxic effects. *International Journal of Environmental Research and Public Health*, 22(1), 91. <https://doi.org/10.3390/ijerph22010091>
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.
- Bhebhe LT, Van Rooyen C, Steinberg WJ (2014). Attitudes towards tuberculosis and treatment adherence in a community-based programme in the Free State province, South Africa. *African Journal of Primary Health Care & Family Medicine*, 6(1), 1–8. <https://doi.org/10.4102/phcfm.v6i1.597>
- Chaiyachati KH, Ogbuaji O, Price M, Suthar AB, Negussie EK, Bärnighausen T. Interventions to improve adherence to antiretroviral therapy: a rapid systematic review. *AIDS*. 2014 Mar;28 Suppl 2:S187-204. doi: 10.1097/QAD.0000000000000252.
- Cherry K (2021). Intimacy vs. isolation in psychosocial development. *Verywell Mind*. <https://www.verywellmind.com/intimacy-versus-isolation-2795739>
- Fang XH, Shen HH, Hu WQ, Xu QQ, Jun L, Zhang ZP, Kan XH, Ma DC, Wu GC. Prevalence of and Factors Influencing Anti-Tuberculosis Treatment Non-Adherence Among Patients with Pulmonary Tuberculosis: A Cross-Sectional Study in Anhui Province, Eastern China. *Med Sci Monit*. 2019 Mar 14;25:1928-1935. doi: 10.12659/MSM.913510. PMID: 30869079; PMCID: PMC6429981.
- Deutsch-Feldman M, Pratt RH, Price SF, Tsang CA, Self JL (2021). Tuberculosis - United States, 2020. *MMWR Morb Mortal Wkly Rep*. 70(12):409-414. doi: 10.15585/mmwr.mm7012a1.
- Gebremariam RB, Wolde M, Beyene A. Determinants of adherence to anti-TB treatment and associated factors among adult TB patients in Gondar city administration, Northwest, Ethiopia: based on health belief model perspective. *J Health Popul Nutr*. 2021 Nov 27;40(1):49. doi: 10.1186/s41043-021-00275-6.
- Glanz, K, Rimer BK, Viswanat K (2015). *Health Behavior Theory, research, and practice*. Jossey-Bass
- Iribarren S, Beck S, Pearce PF, Chirico C, Etchevarria M, Cardinale D, Rubinstein F. TextTB: A Mixed Method Pilot Study Evaluating Acceptance, Feasibility, and Exploring Initial Efficacy of a Text Messaging Intervention to Support TB Treatment Adherence. *Tuberc Res Treat*. 2013;2013:349394. doi: 10.1155/2013/349394. Epub 2013 Dec 12.
- Janz NK, Becker MH (1984). The Health Belief Model: A decade later. *Health Education Quarterly*, 11(1), 1–47. <https://doi.org/10.1177/109019818401100101>

- Kementerian Kesehatan Republik Indonesia (2020). Laporan Situasi Tuberkulosis di Indonesia. Jakarta: Kementerian Kesehatan Republik Indonesia.
- Kementerian Kesehatan Republik Indonesia (2022). Laporan Tahunan Tuberkulosis di Indonesia. Jakarta: Kementerian Kesehatan Republik Indonesia.
- Khan M, Walley J, Witter S, Shah SK, Javeed S (2017). Tuberculosis patient adherence to direct observation: Results of a social study in Pakistan. *Health Policy and Planning*, 20(6), 354–365. <https://doi.org/10.1093/heapol/czi047>
- Koirala S, Borisov S, Danila E, Mariandyshev A, Shrestha B, Lukhele N, et al. Outcome of treatment of MDR-TB or drug-resistant patients treated with bedaquiline and delamanid: Results from a large global cohort. *Pulmonology* 2021. <https://doi.org/10.1016/j.pulmoe.2021.02.006>.
- Maulina N, Hayati Z, Hasballah K, Zulkarnain Z, Waraztuty I, Defadheandra A (2024). Rifampicin Resistant Tuberculosis Among Presumptive Pulmonary Tuberculosis in Province Referral Hospital, Indonesia: Dynamic Cases of a 7-Year Report. *J Res Health Sci*. 24(1):e00601. doi: 10.34172/jrhs.2024.136.
- McHorney CA, Tarlov AR (1995). Individual-patient monitoring in clinical practice: Are available health status surveys adequate? *Quality of Life Research*, 4(4), 293–307. <https://doi.org/10.1007/BF01593882>
- Mekonnen HS, Azagew AW (2018). Non-adherence to anti-tuberculosis treatment, reasons and associated factors among TB patients attending at Gondar town health centers, Northwest Ethiopia. *BMC Research Notes*, 11, 691. <https://doi.org/10.1186/s13104-018-3789-4>
- Munro SA, Lewin SA, Smith HJ, Engel ME, Fretheim A, Volmin J. (2007). Patient adherence to tuberculosis treatment: A systematic review of qualitative research. *PLoS Medicine*, 4(7), e238. <https://doi.org/10.1371/journal.pmed.0040238>
- Rosenstock IM (1974). The Health Belief Model and preventive health behavior. *Health Education Monographs*, 2(4), 354–386. <https://doi.org/10.1177/109019817400200405>
- Schunk DH, DiBenedetto MK (2020). Motivation and Social Cognitive Theory. *Contemporary Educational Psychology*, 60, <https://doi.org/10.1016/j.cedpsych.2019.101832>
- Sharma, S. K., et al. (2018). Factors associated with treatment adherence among patients with multidrug-resistant tuberculosis: a systematic review and meta-analysis. *PLoS One*, 13(10), e0205220.
- Sirait N, Parwati I, Dewi NS, Suraya N. Validitas Metode Polymerase Chain Reaction GeneXpert MTB/RIF pada Bahan Pemeriksaan Sputum untuk Mendiagnosis Multidrug Resistant Tuberculosis. *Maj Kedokt Bandung*. 2013 Dec;45(4):234–9.
- Soedarsono et al. (2024). Limited success and high attrition in the 9-month all-oral regimen for MDR-TB: Evidence from a tertiary care setting in Indonesia. [Manuscript]. Sub-pulmonology Department of Internal Medicine, Faculty of Medicine, Hang Tuah University.
- Subbaraman R, de Mondesert L, Musiimenta A, Pai M, Mayer KH, Thomas BE, Haberer J. Digital adherence technologies for the management of tuberculosis therapy: mapping the landscape and research priorities. *BMJ Glob Health*. 2018 Oct 11;3(5):e001018. doi: 10.1136/bmjgh-2018-001018.
- Tola HH, Tol A, Shojaeizadeh D, Garmaroudi G (2015). Tuberculosis Treatment Non-Adherence and Lost to Follow Up among TB Patients with or without HIV in Developing Countries: A Systematic Review. *Iran J Public Health*44(1):1-11. PMID: 26060770; PMCID: PMC4449995.
- Yahaya JY (2025). Sociodemographic determinants of multidrug-resistant tuberculosis in Lesotho: A case-control study. *PLOS Glob Public Health*. 5(7):e0004075. doi: 10.1371/journal.pgph.0004075.
- World Health Organization (2021). Global tuberculosis report 2021. Geneva: World Health Organization