

# **The Determinants of Drug-Resistant Tuberculosis Incidence at the Special Lung Hospital, Health Department of the Provincial Government of North Sumatera, 2021-2024**

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## **ABSTRACT**

Along with the increase in tuberculosis (TB) cases, there has also been a rise in the number of Drug-Resistant Tuberculosis (DR-TB) cases, which poses a serious threat to global TB control efforts. Globally, there are 400,000 DR-TB cases according to the WHO report in 2024, with Indonesia contributing 7.4% of the total cases. In North Sumatra, the incidence of DR-TB cases reached 54%. This study aims to analyze and identify the factors influencing the incidence of DR-TB among DR-TB patients at the Special Lung Hospital of the Provincial Government of North Sumatra. The study uses a quantitative approach with a case-control design utilizing secondary data from the SITB application at the Special Lung Hospital of the Provincial Government of North Sumatra from 2021-2024. The sample consists of 204 individuals with a 1:1 ratio, comprising 102 individuals with DR-TB and 102 controls with non-DR-TB. The sampling technique used is purposive sampling. This study sets DR-TB incidence as the dependent variable, while independent variables include sex, employment status, age, treatment outcome, access to health service facilities, residence, contact examination, TB treatment history, diagnosis type, diabetes mellitus status, and HIV status. Data were analyzed using three tests: univariate analysis, bivariate analysis, and multivariate analysis with the use of statistical software version 22. The results show that factors significantly influencing DR-TB incidence include age (CI 95%: 4.7 [2.3-9.5]), employment (CI 95%: 3.4 [1.7-6.6]), and a history of previous TB treatment (CI 95%: 14.7 [5.5-39]).

Keywords: Tuberculosis, Drug-Resistant, SITB

## Introduction

According to the WHO report, a quarter of the global population is estimated to be infected with Tuberculosis (TB). TB is a contagious disease that can spread from one person to another, and it remains one of the leading causes of death globally in 2023 due to infectious agents, after being overtaken by coronavirus infections for three years. More than 10 million people continue to fall ill with TB each year, and the number has been steadily increasing since 2021, causing nearly twice as many deaths as HIV/AIDS (World Health Organization, 2024).

TB is a chronic infectious disease that is contagious, caused by *Mycobacterium tuberculosis* (Mtb), and can affect almost every organ in the human body. Although TB is a disease that can actually be prevented and is usually treatable with Anti-Tuberculosis Drugs (OAT) for six months, it continues to persist. The global treatment success rate for TB in 2023 reached 75%. However, this figure has not yet met the global target of 90% by 2029 (World Health Organization, 2024).

Along with the increase in TB cases, there has also been a rise in Drug-Resistant Tuberculosis (DR-TB) cases, which poses a significant challenge to global TB control strategies (Manggasa & Suharto, 2022). DR-TB can occur due to genetic mutations or the transmission of strains resistant to drugs (Akalu et al., 2024). DR-TB refers to Mtb that spontaneously mutates on the bacterial chromosome into resistant wild-type mutants (Anisah et al., 2021). The management of TB becomes a challenge due to the selective mechanism of the TB bacteria, where the sensitive bacteria are killed, while the resistant mutant population proliferates and develops immunity to anti-TB drugs (OAT) (Kementerian Kesehatan, 2020b).

Failure in TB treatment can have serious consequences, making the disease increasingly difficult to cure due to the development of bacterial resistance. This can lead to the emergence of drug-resistant TB (DR-TB) strains. Additionally, the risk of transmission increases because patients who do not recover successfully may become carriers of the infection, potentially spreading it to others (Rinfilia et al., 2022).

Drug resistance, whether MDR or RR, makes TB treatment more difficult, longer, and more expensive (World Health Organization, 2024), as the process is prolonged, involves stricter guidelines, and results in more severe side effects, posing a threat to global public health (Mizukoshi et al., 2021).

Drug resistance in tuberculosis can occur in both newly infected patients who contract a resistant TB strain and in previously treated patients, such as those who experience treatment failure, relapse, or prematurely stop their treatment (Laili et al., 2024). Globally, in 2023, 79% of people (3.4/4.3 million) with bacteriologically confirmed pulmonary TB had undergone rifampicin resistance testing, an increase from 73% (2.9 out of 4.0 million cases) the previous year, and 69% (2.4/3.5 million) in 2021. The estimated proportion of TB patients diagnosed and treated who have MDR/RR-TB is 3.2% (95% UI: 2.5–3.8%) among new cases

and 16% (95% UI: 9.0–24%) among those previously treated (World Health Organization, 2024).

In Indonesia, the burden of TB places the country among the highest in the world for drug-resistant tuberculosis (DR-TB) cases, following India and Russia in 2023, with a proportion of DR-TB cases at 7.4% (World Health Organization, 2024). Furthermore, the notification of rifampicin-resistant (RR) and multidrug-resistant (MDR) TB in Indonesia reached 7,876 patients, with 392 cases of pre-Extensively Drug-Resistant Tuberculosis (pre-XDR/XDR). However, this number is still far below the national target of 28,000 DR-TB cases. Indonesia also faces challenges in the low initiation coverage of treatment. According to 2022 data, of the 12,531 detected DR-TB patients, only 8,089 (65%) began second-line TB treatment. The failure rate of DR-TB treatment over a decade is estimated to be around 50-55%, due to high rates of treatment interruption (20-30%) and mortality (15-20%). For the 2020 cohort, the treatment failure rate reached 49%, including cases of failure, death, lost to follow-up, and those not evaluated. This percentage still far exceeds the national target of a maximum of 20% (Laili et al., 2024).

In North Sumatra, the number of TB cases ranks third in Indonesia in 2024, following West Java and East Java, with an estimated 74,434 cases, down slightly from 83,949 cases in 2023. While the number has decreased marginally, it has not yet reached the national target of >90% (Kementerian Kesehatan, 2023). According to the Ministry of Health's TB report in 2023, the coverage of DR-TB case detection in North Sumatra reached 54%, still far from the national target of 80% for 2023 (Kementerian Kesehatan RI, 2023).

Meanwhile, at the UPTD Special Lung Hospital of the Health Department of the Provincial Government of North Sumatra, there are 109 DR-TB cases based on data from the Tuberculosis Information System (SITB).

Previous studies have examined various factors influencing drug-resistant TB, including sociodemographic aspects such as age, gender, employment status, and clinical characteristics (type of TB, comorbidities such as DM and HIV/AIDS, previous treatment history), access to healthcare services, and residence. According to Tenzin C, et al. (2020), one of the high-risk factors for developing drug-resistant TB is prior treatment (AOR: 5.90, 95% CI: 2.55–13.64). Similarly, Hugar L, et al., found that individuals with a history of previous TB treatment had a higher percentage of drug-resistant TB (69.5%). This is because prior treatment history is a significant factor for DR-TB cases, related to previous treatment outcomes such as failure, relapse, loss to follow-up, or patients who initially had drug-resistant TB (Hugar et al., 2022).

Similar findings were observed in other studies, which indicated that a history of previous TB treatment was associated with the occurrence of drug-resistant TB (Marahatta et al., 2010). In the case group, individuals with a history of failed or interrupted TB treatment were more likely to develop DR-TB, with a prevalence of 73.3% (Aderita et al., 2016). The occurrence of drug resistance in TB

patients can also be triggered by issues with drug absorption, caused by comorbidities such as Diabetes Mellitus (DM). TB patients with comorbidities such as TB-HIV coinfection or DM are considered significant risk factors for drug-resistant TB (Manggasa & Suharto, 2022).

Based on the above phenomena regarding factors influencing DR-TB incidence, and building on previous findings, the researcher is interested in conducting a study at the UPTD Special Lung Hospital of the Health Department of the Provincial Government of North Sumatra, as there has been limited research on the factors affecting DR-TB incidence at this location. Previous studies have generally focused on one influencing variable, while many variables could be connected to DR-TB incidence, such as the failure of TB treatment, which could contribute to the emergence of drug resistance, eventually leading to DR-TB. This study aims to identify and analyze various factors influencing DR-TB incidence and examine the proportion of patients who have and have not developed DR-TB at the Special Lung Hospital of North Sumatra. The results of this study are expected to contribute to the development of policies tailored to the most dominant risk factors in the strategy to reduce or manage TB cases, helping achieve the target of TB elimination by 2030, particularly in North Sumatra.

## **Methodology**

Methodology contains analysis about Data, Source of Data, Research Model, and Hypothesis Formulation (if quantitative research). Also state the hypothetical relationships (hypothesis creation starts from the variables that influence the variables that are influenced).

This study uses a quantitative approach with a case-control design based on secondary data obtained from the SITB application at the UPTD Special Lung Hospital of the Health Department of the Provincial Government of North Sumatra, with a patient data range from the start of treatment in 2021 to 2024. The study has received ethical clearance approval from the Research Ethics Committee of Medistra Lubuk Pakam Health Institute, No. 021.D/KEP-MLP/IV/2025.

SITB is an integrated reporting system used by various relevant stakeholders, including healthcare facilities such as community health centers (puskesmas), hospitals, private doctor practices, clinics, laboratories, pharmacies, and government agencies like the Health Department at the district/city level, provincial level, and the Ministry of Health. This system functions to input and report data related to Drug-Sensitive Tuberculosis, Drug-Resistant Tuberculosis, laboratory results, and logistics through an integrated digital system. SITB was implemented nationwide starting January 1, 2020, to replace the previous reporting system, the Integrated Tuberculosis Information System (SITT) (Ministry of Health of the Republic of Indonesia, 2020). All healthcare services are required to record and report all detected and treated TB data at each service unit (Ministry of Health, 2020b).

The sample data in this study is divided into two categories: the case category (individuals confirmed with DR-TB) and the control group (patients with tuberculosis other than DR-TB), recorded in the SITB of the UPTD Special Lung Hospital of the Provincial Health Department of North Sumatra from 2021 to 2024. The sample selection used a 1:1 ratio for cases and controls with purposive sampling, meaning samples were selected based on criteria relevant to the research objectives. A total of 204 people were included, with 102 in the case group and 102 in the control group. Inclusion criteria consisted of patients with DR-TB residing in North Sumatra who began treatment between 2021 and 2024, while exclusion criteria involved patients with incomplete data in SITB.

This study identifies DR-TB occurrence as the dependent variable, which is influenced by other variables, categorized into two: the control category, consisting of patients with TB not diagnosed with DR-TB, and the case category, consisting of patients confirmed with DR-TB. The classification of DR-TB includes several types: resistance to one first-line anti-TB drug, such as isoniazid (H); resistance to more than one first-line drug like isoniazid and ethambutol (HE) (Mono Resistance); resistance to both isoniazid (H) and rifampicin (R) (Poly Resistance); resistance to isoniazid and rifampicin (HR) (Multi-Drug Resistance); resistance to a fluoroquinolone group drug (e.g., capreomycin) (Pre-XDR); resistance to both a fluoroquinolone group drug and one second-line injectable anti-TB drug (e.g., capreomycin, kanamycin) (XDR); resistance to rifampicin, including monoresistance and poliresistance (TB Rifampicin Resistance) (Li et al., 2016). Meanwhile, the independent variables include gender, employment status, age, treatment outcome, access to healthcare facilities (fasyankes), place of residence, contact examination, TB treatment history, diagnosis type, DM status, and HIV status.

Data in this study will be analyzed using three tests: univariate analysis, bivariate analysis, and multivariate analysis. Univariate analysis will describe the distribution of TB drug-resistant patient characteristics based on frequency, including treatment adherence and treatment outcomes. Bivariate analysis will evaluate the relationship between independent and dependent variables using the chi-square test, with the association measure being the Odds Ratio (OR). Subsequently, multivariate analysis will be conducted using logistic regression statistical testing at a 5% significance level and a 95% confidence interval (CI), assuming the time variable remains constant. All data will be processed and analyzed using version 22 of the statistical software.

## **Result and Discussion**

This case-control study analyzes secondary data from the SITB of the UPTD Special Lung Hospital of the Provincial Government of North Sumatra for the years 2021-2024, using 204 research samples that were selected based on inclusion criteria. Based on the characteristics, the majority of the TB patients included in this study are in the adult group, aged 19-59 years (72.1%), male (70.6%), employed (71.6%), newly diagnosed with TB (66.7%), did not undergo contact examination

(96.1%), had bacteriologically confirmed TB (76.5%), were HIV negative (98.3%), had no DM history (98.5%), had healthcare facilities (fasyankes) within the same district/city (67.6%), and resided in urban areas (71.6%).

**Table 1. Results of Chi-Square Analysis on Factors Affecting the Occurrence of Drug-Resistant TB (TB RO) (Source: SITB 2021-2024)**

Variable	Case		Control		Total		OR (CI 95%)	p value
	n	%	n	%	N	%		
<b>Age</b>								
Infants & Toddlers (<5 tahun)	0	0,0	16	100	16	7,8		
Children (5-9 tahun)	0	0,0	8	100	8	3,9		
Adolescent (10-18 tahun)	1	7,7	12	92,3	13	6,4	4,7	0,000*
Adult (19-59 tahun)	87	58,5	62	41,5	147	72,1	(2,3-9,5)	
Elder;y (>60 tahun)	14	70,0	6	30,0	20	9,8		
<b>Gender</b>								
Male	72	49,3	73	50,7	144	70,6	0,9	0,525
Female	30	50,0	29	50,0	60	29,4	(0,5-1,7)	
<b>Occupation</b>								
Employed	61	41,1	85	58,9	146	71,6	1,1	0,000*
Unemployed	41	70,7	17	29,3	58	28,4	(0,6-2,2)	
<b>Contact Investigation</b>								
Yes	5	5,0	3	2,9	8	3,9	0,6	0,350
No	97	95,0	99	96,1	196	96,1	(0,1-2,5)	
<b>History of TB Treatment</b>								
Long-standing	60	86,8	9	13,2	68	33,3	14,7	0,000*
New	42	30,9	93	69,1	136	66,7	(6,7-32)	
<b>History of DM</b>								
Yes	25	58,1	18	41,9	43	21,1	1,5	0,135*
No	77	47,2	84	52,8	161	78,9	(0,8-3,1)	
<b>HIV Status</b>								
Positive	1	33,3	2	66,7	3	1,5	0,5	0,507

Negative	101	49,8	100	50,2	201	98,5	(0,04-5,7)	
<b>Diagnosis Type</b>								
Bacteriologically Confirmed	102	64,7	55	35,3	156	76,5	1,9	0,000*
Clinically Diagnosed	0	0,0	47	46,6	48	23,5	(1,6-2,2)	
<b>Distance to Health Facility</b>								
Different District/City	32	48,5	34	51,5	66	32,4	0,9	0,479
Whitin the Same District/City	70	50,0	68	50,0	138	67,6	(0,5-1,7)	
<b>Residence</b>								
Urban	75	50,7	71	49,3	146	71,6	1,2	0,353
Rural	27	46,6	31	53,4	58	28,4	(0,6-2,2)	

Referring to the results of the bivariate analysis using the chi-square test presented in Table 1, the Odds Ratio (OR) for the adult age group (19-59 years) is 4.7 (2.3-9.5), and the OR for the elderly age group (>59 years) is 1.7 (0.6-4.6). Compared to infants & toddlers, children, and adolescents, this means that the adult age group has a 4.7 times higher risk, and the elderly age group has a 1.7 times higher risk of developing MDR-TB. The p-value for age is 0.000 ( $p < 0.05$ ), indicating that the age variable is significant in the occurrence of MDR-TB. The OR for gender (male) is 0.9 (0.5-1.7), which means that males are 0.9 times less likely than females to develop MDR-TB. The p-value for gender is 0.525 ( $p > 0.05$ ), indicating that this variable is not significant in the occurrence of MDR-TB.

The OR for employment status is 1.1 (0.6-2.2), meaning that individuals who are employed are 1.1 times more likely to develop MDR-TB compared to those who are unemployed. The p-value for employment status is 0.000 ( $p < 0.05$ ), showing that this variable is significant in the occurrence of MDR-TB. The OR for distance to healthcare facilities within the same district/city is 0.9 (0.5-1.7), indicating that people who live within the district/city are 0.9 times more likely to develop MDR-TB compared to those who live further away. The p-value for healthcare facility distance is 0.479 ( $p > 0.05$ ), indicating that this variable is not significant in the occurrence of MDR-TB.

The OR for living in urban areas is 1.2 (0.6-2.2), which means that people living in urban areas are 1.2 times more likely to develop MDR-TB compared to those living in rural areas. The p-value for living area is 0.353 ( $p > 0.05$ ), indicating that this variable is not significant in the occurrence of MDR-TB. The OR for the

absence of contact history is 0.6 (0.1-2.5), meaning that individuals with no contact history are 0.6 times less likely to develop MDR-TB compared to those with a contact history. The p-value for contact history is 0.350 ( $p > 0.05$ ), indicating that this variable is not significant in the occurrence of MDR-TB.

The OR for a history of long-term treatment is 14.7 (6.7-32), meaning that individuals with a history of previous treatment are 14.7 times more likely to develop MDR-TB compared to those who have received new treatment. The p-value for treatment history is 0.000 ( $p < 0.05$ ), indicating that this variable is significant in the occurrence of MDR-TB. The OR for a history of diabetes mellitus (DM) is 1.5 (0.8-3.1), meaning that individuals with a history of DM are 1.5 times more likely to develop MDR-TB compared to those without DM. The p-value for DM history is 0.135 ( $p > 0.05$ ), indicating that this variable is not significant in the occurrence of MDR-TB.

The OR for HIV status is 0.5 (0.04-5.7), meaning that individuals with a negative HIV status are 0.5 times less likely to develop MDR-TB compared to those with positive HIV status. The p-value for HIV status is 0.507 ( $p > 0.05$ ), indicating that this variable is not significant in the occurrence of MDR-TB. The OR for bacteriological confirmation is 1.9 (1.6-2.2), meaning that individuals with bacteriological confirmation are 1.9 times more likely to develop MDR-TB compared to those with clinical diagnosis. The p-value for TB diagnosis type is 0.000 ( $p < 0.05$ ), indicating that this variable is significant in the occurrence of MDR-TB.

Multivariate analysis in this study was performed using logistic regression with the backward method. Before conducting the multivariate test, a selection of candidates for the multivariate test was made based on the results of the chi-square test with a p-value  $< 0.25$ , which included 7 variables. The backward method was applied by eliminating variables step by step, starting from the variable with the OR closest to zero to the one with the highest OR, then evaluated based on the p-value until the final model was obtained, which was statistically appropriate and representative.

**Table 2. Results of Logistic Regression Analysis (Source: SITB 2021-2024)**

Variable	Crude		Adjusted	
	OR (CI 95%)	p-value	OR (CI 95%)	p-value
Age (reff Infants & Toddlers, Children)	3,3	1,000		

Adolescents (10-18 tahun)	(1,4-8,1)			
	3,3	0,002	4,7	0,002
Adults (19-59 tahun)	(1,4-8,1)		(2,3-9,5)	
	0,01	0,289		
Elderly (>60 tahun)	(0,01-0,19)			
<b>Occupation</b> (reff Unemployed)				
Employed	0,13	0,000	3,4	0,000
	(0,05-0,4)		(1,7-6,6)	
<b>Contact Investigation</b> (reff No Contact)				
Has Contact	0,7	0,730		
	(0,9-5,2)			
<b>History of TB Treatment</b> (reff New)				
Long-standing	14,7	0,000	14,7	0,000
	(5,5-39)		(5,5-39)	
<b>History of DM</b> (reff No History of DM)				
Has a History of DM	0,43			
	(0,2-1,2)	0,104		
<b>Diagnosis Type</b> (reff Clinically Diagnosed)				
Bacteriologically Confirmed	2,490	0,997		

The results from the final model based on Table 2 show that after controlling for diagnosis type, contact history, and history of diabetes mellitus (DM), factors significantly associated with MDR-TB occurrence include age, with adults being 4.7 (2.3–9.5) times more likely to develop MDR-TB compared to other age categories. The working group is 3.4 (1.7–6.6) times more likely to develop MDR-TB compared to the non-working group, followed by individuals with a history of previous TB treatment, who are 14.7 (5.5–39) times more likely to develop MDR-TB compared to those without a history of TB.

From these findings, the researcher explores several factors that are significantly associated with the occurrence of MDR-TB at the UPTD RS Khusus Paru, Health Department of North Sumatra Province, from 2021 to 2024. The study found that after controlling for diagnosis type, contact history, and DM history, three

factors were significantly associated with MDR-TB: age in the adolescent category, individuals who are working, and a history of TB treatment.

Referring to the findings of this study, a history of previous TB treatment carries a 14.7-fold higher risk compared to new TB patients. According to Nugrahaeni et al., drug resistance is linked to a history of previous treatment, with the likelihood of resistance being four times higher, while the occurrence of MDR-TB is 10 times higher or more compared to individuals who have never been treated for TB (Nugrahaeni, 2015). This finding is similar to Tola's study, where new TB patients had a 3-fold higher chance of successful treatment compared to those with a history of TB treatment (Tola et al., 2019). Similarly, Wulandari's research indicates that patients with a history of previous treatment are 3.6 times more likely to develop MDR-TB compared to new patients (Wulandari & Ronoatmodjo, 2024).

This was also confirmed by Muñoz-Sellart et al., who stated that patients with a history of previous treatment have a 2-fold greater likelihood of developing MDR-TB compared to those with no treatment history (Muñoz-Sellart et al., 2010). This might occur because patients with a history of previous treatment tend to have lower adherence to medication compared to new patients. Additionally, it could be due to misinformation regarding medication, lack of knowledge and incorrect information, side effects of drugs, and weak monitoring systems, including the absence of supervision regarding medication intake and food that supports treatment effectiveness. These conditions allow TB bacteria to develop resistance to previously used anti-TB drugs, leading to treatment failure and the patient falling into the MDR-TB category.

Furthermore, in this study, the influence of age on MDR-TB occurrence indicates that adults (19–59 years old) are 3.3 times more likely to develop MDR-TB. This finding is supported by Simorangkir et al., who found that patients with MDR-TB aged  $\leq 45$  years had a higher risk of TB compared to those aged  $> 45$  years. This is due to higher activity levels in this age group, which potentially disrupt treatment adherence. The group aged  $\leq 45$  years is considered at high risk for TB transmission due to greater social interaction, which increases the frequency of exposure to TB. Additionally, this age group also has a higher proportion of individuals still working, leading to lower adherence to treatment, which can result in treatment failure and contribute to the spread of MDR-TB in the community (Simorangkir et al., 2023).

This is consistent with the study conducted by Widiastuti et al., 2017, which showed that the majority of MDR-TB patients were aged  $> 45$  years, followed by the 25-45 year and  $< 25$ -year-old groups. These groups are in their productive years, which makes them more vulnerable to TB transmission due to higher interaction with others and increased mobility, increasing the likelihood of transmission (Widiastuti et al., 2017). Furthermore, Lubis et al. also stated that 85.5% of MDR/RR TB patients were aged 15–55 years (Lubis & Lubis, 2021).

This finding also aligns with research by Emmi Bijawati, SKM et al., which indicated that the majority of MDR/RR-TB patients were in the productive age range of 15 to 55 years. This age group is considered at higher risk due to their higher activity levels compared to older adults. Thus, the majority of TB patients undergoing treatment belong to the productive age group. Although the highest age distribution is among those aged 45 to 53 years, there are also patients from younger age groups (Emmi Bijawati et al., 2018).

Regarding employment, the study found that individuals in this category have a 3.4-fold higher risk of developing MDR-TB. This is due to the higher likelihood of exposure among workers who interact with many people, such as healthcare workers or public service employees, or those who interact with individuals infected with MDR-TB. Additionally, enclosed and crowded work environments such as factories or offices with poor ventilation can increase the risk of MDR-TB transmission, as TB bacteria spread more easily in these settings. Furthermore, some workers may be exposed to chemicals or dust that harm the lungs, and unhealthy working conditions such as long working hours or inadequate rest can weaken the immune system.

This finding is in line with a study by Ismah et al., which stated that individuals with high-risk occupations, such as healthcare workers and laborers, are at high risk for MDR-TB. In that study, 404 individuals with high-risk jobs had TB, and 28.3% of them had MDR-TB (Ismah et al., 2024).

The SITB is an integrated recording system for TB patients managed by the government through the Ministry of Health. This system includes various important variables such as age, gender, start and end dates of treatment, and treatment outcomes. In addition, it records comorbidities such as diabetes mellitus (DM) and HIV, the type of TB by location and diagnosis, and the funding source for anti-TB drugs (OAT). Data entry is done directly at healthcare facilities, minimizing the risk of data loss and ensuring data accuracy, as the system is connected to the drug stock requests at the pharmacy unit. The Ministry of Health also periodically conducts socialization on SITB data entry procedures and provides video guides accessible through the official Ministry of Health website (Kementerian Kesehatan, 2020). Due to its completeness and validity, data from SITB can serve as a reliable secondary data source.

This study provides an overview of the determinants of MDR-TB occurrence in selected regions by comparing two case categories and controls. Further research is needed on this topic, such as including more variables like medication adherence, monitoring of medication intake, and other factors influencing MDR-TB occurrence. It is hoped that this research will contribute to the development of existing TB prevention and treatment programs to improve treatment success. The WHO has outlined several key pillars and components in its strategy for TB control, known as End TB. This strategy consists of three stages: The first stage focuses on integrating

health services with TB patients, including early case detection, providing treatment for all TB patients, cross-program collaboration such as TB/HIV, handling comorbid diseases like diabetes mellitus (DM), offering preventive therapy for high-risk individuals, and vaccination programs. The second stage emphasizes the importance of building strong policies and support systems, including sufficient resources for treatment and prevention efforts, community participation, and the implementation of a national health insurance system and social protection to reduce poverty and other social determinants. The third stage focuses on increasing research and innovation continuously to develop new approaches that maximize the use of existing innovations (World Health Organization, 2022).

## Conclusion

Based on the results of the research conducted on the determinants of MDR-TB occurrence at the UPTD RS Khusus Paru, Health Department of the North Sumatra Provincial Government from 2021 to 2024, the following conclusions can be drawn that The most dominant factors significantly influencing MDR-TB occurrences based on logistic regression testing are age (CI 95%: 4.7 [2.3-9.5]), occupation (CI 95%: 3.4 [1.7-6.6]), and history of previous TB treatment (CI 95%: 14.7 [5.5-39]). This is expected to contribute to the development of policies that are adjusted to the most dominant risk factors to achieve the target of ending TB elimination, especially in North Sumatra.

## Declaration of Competing Interest

The authors declare that they have no competing interests

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