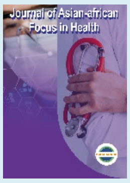

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Influence of factors individual characteristics, health services, and medical treatment on the incidence of tuberculosis in HIV/AIDS patients

Bagus Dadang Prasetiyo[1], Ratna Wardani[1], Yuly Peristiowati[1]

[1]Program Pasca Sarjana, Institut Ilmu Kesehatan (IIK) Strada Indonesia

*Corresponding Author: Bagus Dadang Prasetiyo

Email: jendbagus@itsk-soepraoen.ac.id

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Abstract

This study aims to analyze the influence of individual characteristics, health services, and medical treatment on the incidence of tuberculosis in HIV/AIDS patients. This study uses associative research with a quantitative approach. The data used came from TB incidence services in HIV/AIDS patients from 2019 to 2022, with a sample of 500 patients selected using non-probability sampling techniques with purposive sampling methods. The variables studied included age, gender, marital status, place of residence, type of health facility, right to treatment class, treatment complications, and delay in ARV treatment. Data analysis was performed using logistic regression model. The results showed a significant effect of age, gender, marital status, residence, type of health facility, right to treatment class, treatment complications, and delayed ARV treatment on the incidence of tuberculosis in HIV/AIDS patients.

Introduction

The World Health Organization (WHO) in 2017 estimated that the death rate caused by TB-HIV co-infection reached 300,000 worldwide or 13 cases per 261,000 population. A total of 1.6 million people will die from TB in 2021 (including 187,000 people with HIV). Worldwide, TB is the 13th leading cause of death and the 2nd infectious killer after COVID-19 (ahead of HIV and AIDS) (WHO, 2023). It accounts for 32% of deaths in people living with HIV and AIDS (PLWHA) (Nishijima et al., 2020). The mortality rate in TB-HIV co-infection is four times greater than in patients without TB. HIV is a major risk factor for TB becoming active (Duarte et al., 2018). In 2018 it was estimated that 8.62% of people affected by TB were HIV positive (Utami et al., 2022). Globally, people with HIV positive status are at 20 times greater risk of developing TB than people with HIV negative status. The number of deaths among people living with HIV reached 770,000 in the same year. TB is the leading cause of death in people living with HIV, with 251,000 deaths attributable to TB-HIV co-infection in 2018 and accounting for one-third of deaths among people living with HIV.

Data from the Ministry of Health of the Republic of Indonesia, reported that the prevalence of TB-HIV co-infection cases in Indonesia from 2009 amounted to 2,393 to 7,796 in 2017. WHO reported that in 2018 the estimated mortality rate in Indonesia for TB patients with HIV positive status was 5,300 cases. This means that 2 out of 100,000 Indonesians are at risk of death from TB-HIV/AIDS co-infection. The Ministry of Health of the Republic of Indonesia has tried to improve access to treatment by providing referral hospitals for HIV Acquired Immune Deficiency Syndrome (AIDS) treatment, but ease of access in terms of distance is not always an option. They often choose health facilities (hospitals) that are far away to avoid stigma and discrimination (Filteau & Manno, 2023).

The influence of individual characteristics, health services, and medical treatment on the incidence of tuberculosis in HIV/AIDS patients is essential to understanding the intricacies of the relationship between two diseases that are often correlated and have a serious impact on the welfare of society (Bell & Hansen, 2021). First, individual characteristics play a central role in

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this context; the weakened immune system of HIV/AIDS patients makes them more susceptible to infections, including tuberculosis, and age factors, such as in children and the elderly, can increase the risk of the disease (Resende et al., 2019). Secondly, aspects of healthcare play an important role, where limited accessibility and lack of health education may hinder early detection and treatment of tuberculosis in individuals concurrently suffering from HIV/AIDS (Chanda-Kapata et al., 2022).

Individual characteristics play a significant role in increasing the risk of tuberculosis incidence in HIV/AIDS patients. According to a study by Dutta & Gupta (Dutta & Gupta, 2018), they found that a compromised immune system in individuals with HIV/AIDS makes them more susceptible to tuberculosis infection. This is due to a decrease in the number of CD4+ cells, which have a crucial role in maintaining the body's immunity against pathogens. In addition, age is also an important consideration, as supported by a study by Ernawati et al. (Ernawati et al., 2020), which showed that children and the elderly with HIV/AIDS have a higher risk of developing tuberculosis compared to other age groups. Therefore, an in-depth understanding of these factors can help in designing more effective prevention and treatment strategies (Camillo et al., 2022). Healthcare aspects have also been shown to have a major impact on the incidence of tuberculosis in HIV/AIDS patients. A study by Pinakesty et al. (Pinakesty et al., 2022) highlighted that limited accessibility to health services and lack of health education among HIV/AIDS patients may hinder early detection and treatment of tuberculosis. Improving healthcare accessibility through education programs, routine check-ups, and counseling services can play a key role in reducing the double burden borne by individuals with both diseases.

The importance of health education in reducing the incidence of TB in HIV/AIDS patients. The Health Belief Model theory can provide an in-depth understanding of how an individual's knowledge and understanding of disease and prevention efforts can shape health service-seeking behavior. Research by Nanda et al. (Nanda et al., 2023) showed that HIV patients who have good knowledge about TB tend to be more proactive in seeking health services, allowing for more effective early detection and treatment (de Resende et al., 2021). Meanwhile, in the medical treatment domain, continuity of HIV/AIDS treatment is a crucial factor; patients who are inconsistent in taking antiretroviral (ARV) treatment or do not adhere to their treatment plan may be at higher risk of developing TB (Umeta et al., 2022).

The effectiveness of TB therapy is also an important aspect of disease management in HIV/AIDS patients. Research by Budi et al. (Budi et al., 2018) showed that inappropriate or ineffective treatment in patients with HIV/AIDS can increase the risk of TB spread and severity. Therefore, this study not only highlights the need to maintain continuity of HIV/AIDS therapy but also emphasizes the importance of developing TB treatment protocols that suit the specific conditions of patients with HIV/AIDS. With a deeper understanding of the complex dynamics between individual characteristics, health services, and medical treatment, it is hoped that this study can open the door for the development of more targeted and effective intervention strategies in the management and prevention of TB in HIV/AIDS-affected populations. Research by Ranganath et al. (Ranganath et al., 2022) highlighted that non-adherence to HIV/AIDS treatment can be an important predictor of TB progression in individuals concurrently suffering from both diseases.

Antiretroviral (ARV) therapy in children and the elderly is the unique focus of this study. In the context of age, the pattern of patient engagement in ARV therapy can vary substantially. Research by Anaam & Alrasheedy (Anaam & Alrasheedy, 2023) suggests that psychosocial factors and social support can play a crucial role in treatment continuation in this age group. By detailing the impact of age through biological and psychosocial studies, this study enriches

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our insight into the relationship between age and TB incidence in HIV/AIDS patients, and is expected to form the basis for planning more personalized and effective prevention and intervention strategies.

Method

Design

This study adopted a quantitative approach, which aims to test hypotheses using numerical data (Creswell, 2018). The type of research conducted is associative research, which focuses on the relationship between the incidence of tuberculosis in HIV/AIDS patients and other variables, using quantitative analysis methods (Sugiyono., 2017). The data used were service-specific data on TB incidence in HIV/AIDS patients from 2019 to 2022, with research conducted in the period April-July 2023.

Instruments and Subjects

This study involved a population of HIV patients registered in ICD (International Classification of Diseases) 10, with a total population of 5,690 patients. The sampling technique used was non-probability sampling with a purposive sampling method, where 500 samples were selected based on characteristic criteria that included complete data on individuals, health services, and medical factors. This approach allowed the researcher to select a sample that specifically met the defined study variables, with the aim of gaining greater insight into the relationship between HIV and associated factors such as TB.

Research Variables and Operational Definition of Variables

Table 1. Research Variables and Operational Definition of Variables

No.	Variables	Operational Definition	How to Measure	Measurement Result	Measure Scale
Dependent Variable					
1	Incidence of tuberculosis in HIV/AIDS patients	HIV/AIDS patients infected with Mycobacterium tuberculosis	Secondary Data	1 = Early Infection 2 = Advanced Infection	Nominal
Independent Variable					
2	Age	Number of years passed by the participant up to the date of inpatient service.	Secondary Data	Patient Age (in years)	Ordinal
3	Gender	Sexual identity based on physiological characteristics	Secondary Data	1 = Male 2 = Female	Nominal
4	Marital Status	Legal marriage bond according to the rule of law and religious teachings	Secondary Data	1 = Unmarried 2 = Married 3 = Divorced	Nominal
5	Residence	Location of residence	Secondary Data	1 = District 2 = City	Nominal

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6	Type of Health Facility	Types of first-level health facilities registered with JKN	Secondary Data	1 = General Practitioner 2 = Primary Clinic 3 = Health Center	Nominal
7	Treatment Level Entitlement	Type of treatment class during hospitalization according to the patient's class entitlement	Secondary Data	1 = Level 1 2 = Level 2 3 = Level 3	Ordinal
8	Treatment Complications	Identify and measure any problems or difficulties that arise during the antiretroviral (ARV) treatment period	Secondary Data	1 = Complication 2 = No complications	Nominal
9	Delayed Antiretroviral (ARV) Treatment	Delay or delay in starting or continuing ARV treatment after HIV diagnosis	Secondary Data	1 = Compliant 2 = There is a delay in treatment	Nominal

Data Analysis

Logistic regression models were used to estimate the probability of TB incidence based on the independent variables. Logistic regression model equation:

$$log\left(\frac{P(Y=1)}{1-P\;(Y=1)}\right)=\;\beta_0+\beta_1X_1+\beta_2X_2+\cdots.+\beta_nX_n$$

Where: P(Y=1) is the probability of TB occurrence, β0 is the intercept, and βi is the coefficient for the independent variable Xi.

Result and Discussion

Overall Model Fit

The overall model fit is indicated by the Log Likelihood Value (-2LL value). Based on the results of the regression analysis, it shows that the initial -2Log likelihood value (block number = 0) before entering the independent variables is 137.609. After the seven independent variables were entered, the final -2Log likelihood value (block number = 1) decreased to 125.342. The difference between the initial -2Log likelihood and the final -2Log likelihood shows a decrease of 12.267. It can be concluded that the initial -2Log likelihood value (block number = 0) is greater than the final -2Log likelihood value (block number = 1), resulting in a decrease. This indicates that the hypothesized model is in accordance (fit) with the data, so the addition of independent variables to the model shows that the regression model is getting better or in other words H_0 is accepted.

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Table 2. Overall Model Fit

Overall Model fit	
-2Log likelihood (block number = 0)	137.609
-2Log likelihood (block number = 1)	125.342

Nagelkerke's R Square

The variability of the independent variable in explaining the dependent variable is measured using the coefficient of determination which can be seen from the Nagelkerke R Square value. Based on the results of the regression analysis, the coefficient of determination seen from the Nagelkerke R Square value is 0.385. This indicates that the ability of the independent variables, namely age, gender, marital status, place of residence, type of health facility, right of care class, treatment complications, and delay in antiretroviral (ARV) treatment in explaining the dependent variable, namely the incidence of tuberculosis in HIV/AIDS patients, is only 38.5%. While the rest is explained by other variables outside of this research model which amounted to 61.5%.

Table 3. Model Summary

Model Summary			
Step	**-2 Log likelihood**	**Cox & Snell R Square**	**Nagelkerke R Square**
1	506.991a	.285	.385
a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.			

Classification Matrix

The classification matrix shows the predictive power of the logistic regression model to predict the likelihood of an alternation in the incidence of tuberculosis in HIV/AIDS patients. Based on the results of the regression analysis, the ability of the model to predict the occurrence of risk alternation or not having the risk of post-vaccination COVID-19 infection is 75.6%. From the table above, the probability of HIV/AIDS patients who have a risk of tuberculosis in the primary diagnosis is 86.2% of the total sample of 500 data. Meanwhile, HIV/AIDS patients who have a risk of tuberculosis in the secondary diagnosis are 59.9% of the total sample of 500 data.

Table 4. Classification Table

Classification Tablea					
	Observed		**Predicted**		
			Y_ Incidence of _TB_HIV		**Percentage Correct**
			HIV	**HIV_TB**	
Step 1	Y_ Incidence_of _TB_HIV	1.00	257	41	86.2
		2.00	81	121	59.9
	Overall Percentage				75.6
a. The cut value is .500					

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Logistic Regression Model

Table 5. Logistic Regression Analysis Results

		B	S.E.	Wald	df	Sig.	Exp(B)	Information
Step 1a	**X1_Age**	**.033**	**.008**	**17.010**	**1**	**.000**	**.967**	**Positive Significant**
	X2_Gender	-.571	.225	6.416	1	.011	.565	Negative Significant
	X3_Marital_Status	1.108	.306	13.104	1	.000	3.029	Positive Significant
	X4_Residence	.892	.248	12.982	1	.000	2.441	Positive Significant
	X5_Type_of_Health_Facility	-.596	.195	9.358	1	.002	.551	Negative Significant
	X6_Treatment_Level_Entitlement	.621	.154	16.306	1	.000	1.861	Positive Significant
	X7_Treatment_Complications	-2.550	.314	65.932	1	.000	.078	Negative Significant
	X8_ Delayed_ ARV_Treatment	.973	.223	19.062	1	.000	2.645	Positive Significant
	Constant	2.259	1.038	4.736	1	.030	9.570	Positive Significant
a. Variable(s) entered on step 1: X1_Age, X2_Gender, X3_Marital_Status, X4_Residence, X5_Type_of_Health_Facility, X6_Treatment_Level_Entitlement, X7_Treatment_Complications, X8_ Delayed_ ARV_Treatment.								

Based on the table above, which is the result of the analysis of logistic regression, the logistic regression equation can be formulated as follows:

$$Y = 2.259 + 0.033X1 - 0.571X2 + 1.108X3 + 0.892X4 - 0.596X5 + 0.621X6 - 2.550X7 + 0.973X8 + e$$

Based on the logistic regression equation above, the relationship between the independent variables and the dependent variable can be analyzed, among others: 1) The constant value (α) is 2,259, meaning that if the independent variable is constant, the value of the incidence of tuberculosis in HIV/AIDS patients is 2,259; 2) The age variable has a positive coefficient value of 0.033, meaning that if every one-unit increase in age with the assumption that the value of other variables remains constant, it will increase the incidence of tuberculosis in HIV/AIDS patients by 0.033; 3) The gender variable has a negative coefficient value of 0.571, meaning that if every one-unit increase in gender with the assumption that the value of other variables remains constant, it will reduce the incidence of tuberculosis in HIV/AIDS patients by 0.571; 4) The marital status variable has a positive coefficient value of 1.108, meaning that if every one-unit increase in marital status with the assumption that the value of other variables remains constant, it will increase the incidence of tuberculosis in HIV/AIDS patients by 1.108; 5) The residence variable has a positive coefficient value of 0.892, meaning that if every one-unit increase in residence with the assumption that the value of other variables remains constant, it will increase the incidence of tuberculosis in HIV/AIDS patients by 0.892; 6) The variable type of health facility has a negative coefficient value of 0.596, meaning that if every one-unit increase in the type of health facility with the assumption that the value of other variables remains constant, it will reduce the incidence of tuberculosis in HIV/AIDS patients by 0.596;

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7) The right level of care variable has a positive coefficient value of 0.621, meaning that if there is a one-unit increase in the right class of care with the assumption that the value of other variables remains constant, it will increase the incidence of tuberculosis in HIV/AIDS patients by 0.621; 8) The treatment complication variable has a negative coefficient value of 2.550, meaning that if there is a one-unit increase in treatment complication consultation with the assumption that the value of other variables remains constant, it will reduce the incidence of tuberculosis in HIV/AIDS patients by 2.550; 9) The ARV treatment delay variable has a positive coefficient value of 0.973, meaning that if every one-unit increase in ARV treatment delay with the assumption that the value of other variables remains constant, it will increase the incidence of tuberculosis in HIV/AIDS patients by 0.973.

Hypothesis Testing

Based on table 5, the results of hypothesis testing using logistic regression analysis can be obtained as follows:

The first hypothesis (H_1) is that there is an effect of age on the incidence of tuberculosis in HIV/AIDS patients. The Wald (t) test results show that the tcount value is greater than the ttable (17.010 > 1.9649) and the probability value is smaller than the significant level (0.000 < 0.05). Based on the test results, it can be concluded that H_1 which states that there is an effect of respondent age on the incidence of tuberculosis in HIV/AIDS patients is accepted. It can be interpreted that there is a significant effect of respondents' age on the incidence of tuberculosis in HIV/AIDS patients.

The second hypothesis (H_2) is that there is an effect of gender on the incidence of tuberculosis in HIV/AIDS patients. The Wald (t) test results show that the tcount value is greater than the ttable (6.416 > 1.9649) and the probability value is smaller than the significant level (0.011 < 0.05). Based on the test results, it can be concluded that H2, which states that there is an effect of respondent gender on the incidence of tuberculosis in HIV/AIDS patients, is accepted. It can be interpreted that there is a significant influence of respondents' gender on the incidence of tuberculosis in HIV/AIDS patients.

The third hypothesis (H3) is that there is an effect of marital status on the incidence of tuberculosis in HIV/AIDS patients. The Wald (t) test results show that the tcount value is greater than the ttable (13.104 > 1.9649) and the probability value is smaller than the significant level (0.000 < 0.05). Based on the test results, it can be concluded that H3, which states that there is an effect of respondents' marital status on the incidence of tuberculosis in HIV/AIDS patients, is accepted. It can be interpreted that there is a significant effect of respondents' marital status on the incidence of tuberculosis in HIV/AIDS patients.

The fourth hypothesis (H4) is that there is an effect of place of residence on the incidence of tuberculosis in HIV/AIDS patients. The Wald (t) test results show that the tcount value is greater than the ttable (12.982 > 1.9649) and the probability value is smaller than the significant level (0.000 < 0.05). Based on the test results, it can be concluded that H4, which states that there is an effect of the respondent's place of residence on the incidence of tuberculosis in HIV/AIDS patients, is accepted. It can be interpreted that there is a significant effect of the respondent's place of residence on the incidence of tuberculosis in HIV/AIDS patients.

The fifth hypothesis (H5) is that there is an effect of the type of health facility on the incidence of tuberculosis in HIV/AIDS patients. The Wald (t) test results show that the tcount value is greater than the ttable (9.358 > 1.9649) and the probability value is smaller than the significant level (0.002 < 0.05). Based on the test results, it can be concluded that H5, which states that there is an effect of the type of respondent's health facility on the incidence of tuberculosis in

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HIV/AIDS patients, is accepted. It can be interpreted that there is a significant effect of the type of respondent's health facility on the incidence of tuberculosis in HIV/AIDS patients.

The sixth hypothesis (H6) is that there is an effect of the right class of care on the incidence of tuberculosis in HIV/AIDS patients. The Wald (t) test results show that the tcount value is greater than the ttable (16.306 > 1.9649) and the probability value is smaller than the significant level (0.000 < 0.05). Based on the test results, it can be concluded that H6, which states that there is an effect of respondents' hospitalization class rights on the incidence of tuberculosis in HIV/AIDS patients, is accepted. It can be interpreted that there is a significant influence of the respondent's right class of care on the incidence of tuberculosis in HIV/AIDS patients.

The seventh hypothesis (H7) is that there is an effect of treatment complications on the incidence of tuberculosis in HIV/AIDS patients. The Wald (t) test results show that the tcount value is greater than the ttable (65.932 > 1.9649) and the probability value is smaller than the significant level (0.000 < 0.05). Based on the test results, it can be concluded that H7, which states that there is an effect of respondents' treatment complications on the incidence of tuberculosis in HIV/AIDS patients, is accepted. It can be interpreted that there is a significant effect of respondents' treatment complications on the incidence of tuberculosis in HIV/AIDS patients.

The eighth hypothesis (H8) is that there is an effect of ARV treatment delay on the incidence of tuberculosis in HIV/AIDS patients. The Wald (t) test results show that the tcount value is greater than the ttable (19.062 > 1.9649) and the probability value is smaller than the significant level (0.000 < 0.05). Based on the test results, it can be concluded that H8, which states that there is an effect of respondents' ARV treatment delay on the incidence of tuberculosis in HIV/AIDS patients, is accepted. It can be interpreted that there is a significant effect of respondents' ARV treatment delay on the incidence of tuberculosis in HIV/AIDS patients.

Factors Associated with Tuberculosis Incidence among HIV/AIDS Patients

Age has a significant effect on the incidence of TB in HIV/AIDS patients. The older the respondent, the higher the risk of developing TB, as shown by the tcount value of 17.010 which is greater than the ttable (1.9649) and a probability value of 0.000 which is statistically significant. This finding is consistent with previous studies showing that patients with latent TB infection have higher CD4 cell counts (Gutierrez et al., 2009). In addition, studies have also noted that age, especially in men aged 20-59 years, is a vulnerable group to TB/HIV (Lee et al., 2010).

Gender affects the incidence of TB in HIV/AIDS patients, with women having a higher risk than men, as indicated by a tcount of 6.416 and a probability value of 0.011. This finding is in line with Hutapea (Hutapea, 2015) study which indicates that the risk of women being infected with HIV/AIDS is 2-4 times greater than men, because the anatomy of the female genitalia is more extensive, facilitating the transmission of infection through sperm during sexual intercourse. Discriminatory treatment and women's lack of access to sexual education also exacerbate this condition, making them more vulnerable to unwanted and unsafe sex, both inside and outside of marriage, and impacting on their health and that of their children (Azza, 2017).

Marital status also affects the incidence of TB, with married respondents having a higher risk of developing TB than those who are not married, as shown by the tcount value of 13.104 and a probability value of 0.000. This result is different from the research of Cahyati (Cahyati & Muna, 2019) and Widiyanti (Widiyanti, 2016) who did not find a significant relationship between marital status and the incidence of tuberculosis in PLWHA. Aliyu et al. (Aliyu et al., 2018) even found that those who were unmarried had a higher correlation with HIV-TB co-

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infection, while Sylvani et al. (Maria Anggi Sylvani et al., 2020) showed that marital status was not significantly associated with TB incidence bivariately.

Place of residence influenced the incidence of TB, where respondents living in cities had a higher risk than those living in districts, with a tcount of 12.982 and a probability value of 0.000. This is in line with studies showing that TB cases are more common in urban environments, especially among migrants, than in rural areas (van Hest et al., 2014). Factors such as overcrowding, inadequate infrastructure, and limited access to health services make urban residents more vulnerable to TB (Snyder et al., 2016). In addition, population mobility, health disparities, TB-related stigma, malnutrition, air pollution, and physical environmental conditions in cities contribute to the high risk of TB infection (Oladele et al., 2020), (Bhargava et al., 2021), (Wang et al., 2022), (Wanti et al., 2022). The relationship between HIV infection and TB has also shown that factors such as age, gender, treatment history, and living in urban areas may increase the risk of HIV/TB co-infection (Sebastiao & et al, 2023).

The type of health facility used by respondents influenced the incidence of TB, with health services from general practitioners having a higher risk than puskesmas and private clinics, as evidenced by the tcount value of 9.358 and probability value of 0.002. Research shows that Mycobacterium tuberculosis (Mtb) nosocomial infections increase in areas with high TB burden, and healthcare facilities play an important role in TB transmission (Paleckyte et al., 2021). The risk of patient-to-healthcare worker transmission is often overlooked in low- and middle-income countries, with many healthcare facilities lacking appropriate infection control practices (Joshi et al., 2006), (Temesgen & Demissie, 2014). Health workers face high risks due to frequent interactions with patients who transmit the disease (Bhebhe et al., 2014), and the challenges of managing drug-resistant TB add to this complexity (Mussie et al., 2019). The WHO recommends infection prevention and control measures to reduce TB transmission, including diagnosis and treatment of latent TB infection (McCreesh et al., 2022), (Wortham, 2018). Meta-analyses highlight the ongoing challenges posed by TB in healthcare and the importance of managing nosocomial TB transmission (Uden et al., 2017), (Chisompola et al., 2020).

The right class of care also affects the incidence of TB, with respondents in the higher class of care (Class III) having a higher risk than the lower class, supported by the tcount value of 16.306 and a probability value of 0.000. Javali et al. (Javali et al., 2014) showed that participants in care class III had the smallest proportion of health service utilization compared to care classes I and II, in line with Notoatmodjo (Notoatmodjo, 2010) statement that the tendency to access health services is positively related to education and income levels. Participants in hospitalization classes I and II, with better work and education backgrounds, have higher financial conditions so that they can more easily access health services. Yancy et al. (Yancy et al., 2004) also shows that the largest cost of care is for participants of hospitalization class II, followed by hospitalization class I, and finally hospitalization class III. This study strengthens the significant relationship between the right class of care and the incidence of tuberculosis in HIV/AIDS patients, related to the educational and economic background of the participants.

Treatment complications had a significant effect on TB incidence, with respondents who experienced treatment complications having a higher risk of developing TB, as evidenced by the tcount value of 65.932 and probability value of 0.000. Studies show that TB treatment can lead to drug resistance, which affects the success of therapy, especially in drug-resistant strains (Xu et al., 2018), (Balasubramanian et al., 2014). Other medical conditions such as HIV infection also affect the immune response to TB treatment and can decrease the effectiveness of antiretroviral therapy (ART) (Assefa et al., 2014). Patients with systemic lupus

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erythematosus (SLE) taking immunosuppressive drugs are also at high risk of developing TB (Cheng et al., 2019), while an increased incidence of TB occurs in patients with diabetes mellitus, requiring multiple screening and appropriate prevention strategies (Xhardo et al., 2022).

Delayed ARV treatment influenced TB incidence, with respondents who experienced delays having a higher risk than those who were adherent, supported by a tcount of 19.062 and a probability value of 0.000. Effective TB control programs emphasize the importance of early diagnosis and prompt initiation of treatment (Storla et al., 2008). In Indonesia, ARV therapy is the main strategy in the management of HIV/AIDS, with the aim of reducing viral replication, improving immunological function, and extending the life of patients (Jocelyn et al., 2024). Studies in South Africa show a higher level of adherence to ARVs compared to TB drugs (O'Donnell et al., 2014). Early initiation of ARV therapy in TB-HIV patients in Indonesia was shown to improve survival rates (Maemun et al., 2020), while newly diagnosed patients with TB co-infection have more treatment options (Demitto et al., 2019). Delays in TB diagnosis and treatment can worsen clinical severity, with a risk of treatment deterioration of 10.3% per year (Virenfeldt et al., 2014), making rapid diagnosis and timely treatment key to reducing TB mortality, especially in healthcare workers (Pan et al., 2015).

Conclusion

Based on the test results, it was found that all hypotheses proposed were accepted because the t-count value was greater than the t-table and the probability value was smaller than the specified significance level ($\alpha = 0.05$). This indicates that there is a significant effect of age, gender, marital status, place of residence, type of health facility, right to treatment class, treatment complications, and delay in ARV treatment on the incidence of tuberculosis in HIV/AIDS patients.

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