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Original Article

Analysis of factors affecting the incidence of tuberculosis in Social community health center, Palembang: A cross-sectional study

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Abstract

Background: Pulmonary tuberculosis (TB) is influenced by both environmental and behavioral factors. The number of pulmonary TB cases in the working area of the UPTD Palembang Social Health Centre during 2022–2024 has fluctuated and remains below the expected target. This situation indicates the need for a comprehensive analysis to identify factors influencing the occurrence and transmission of TB, considering environmental and individual characteristics.
Objective: This study aimed to analyze the relationship between individual characteristics, behavioral factors, and environmental conditions with the incidence of pulmonary tuberculosis.
Methods: This study employed a quantitative approach with a cross-sectional design. The population consisted of all patients visiting the DOTS Poly at UPTD Puskesmas Sosial in 2024, totaling 433 individuals. Using purposive sampling, 81 respondents were selected. Data were collected from May to June 2025 and analyzed through univariate frequency distribution, bivariate chi-square tests, and multivariate multiple logistic regression.
Results: The results showed that age (p = 0.278) and education (p = 0.732) were not significantly related to pulmonary TB incidence. However, gender (p = 0.002; OR = 10.410), smoking habits (p = 0.002; OR = 11.778), ventilation (p = 0.001; OR = 51.750), and humidity (p = 0.001; OR = 14.233) were significantly associated. Among these, smoking habits were the most dominant factor influencing TB incidence.
Conclusion: There is a significant relationship between gender, smoking habits, ventilation, and humidity with the incidence of pulmonary tuberculosis. Smoking habits emerged as the most dominant risk factor. Health campaigns, counseling, and education about pulmonary TB prevention should be strengthened, especially targeting high-risk groups and promoting healthy living environments.

Background

Pulmonary Tuberculosis (TB) remains a serious global health problem. According to the World Health Organization (2024), there were approximately 10.8 million TB cases worldwide, with a global incidence rate of 134 per 100,000 population. Based on the Global TB Report 2024, Indonesia ranks second after India as the country with the highest number of TB cases. According to the Tuberculosis Information System (SITB) as of August 2, 2024, there were 505,007 confirmed TB cases, representing 46% of the national target of 90%. This means that around 54% of TB cases remain unrecorded—either undetected or unreported—posing a high potential risk for increased TB transmission in the community (Ministry of Health of the Republic of Indonesia, 2024).

In 2023, the number of suspected pulmonary TB cases receiving standardized services in South Sumatra Province reached 116,044 individuals (South Sumatra Provincial Health Office, 2024). The Case Detection Rate (CDR), defined as the proportion of pulmonary TB cases reported and treated compared to the estimated total new cases in the community, reflects the effectiveness of TB control programs in identifying cases. In 2023, the CDR in South Sumatra was only 27.8%, showing a sharp decline from the previous year's rate of 65%, and falling far below the WHO target of at least 90%.

The Case Notification Rate (CNR), indicating the number of pulmonary TB patients recorded and treated per 100,000 population, serves to monitor case detection trends over time. In 2023, South Sumatra Province reported a CNR of 111 cases per 100,000 population (South Sumatra Health Office, 2022). In Palembang City, a total of 63,104 suspected TB patients received standardized services in 2023, of which 7,464 pulmonary TB cases were bacteriologically confirmed and received treatment.

The Ministry of Health of the Republic of Indonesia has set a target CNR of 257 per 100,000 population and a CDR of 77%. TB

control efforts also include monitoring the Success Rate (SR) of treatment among new smear-positive pulmonary TB patients. In Palembang City, the SR in 2023 reached 92.9%, surpassing the national target of above 90%. This achievement reflects the effectiveness of healthcare workers in TB treatment management and indicates a high level of patient adherence to therapy. The success was further supported by the active involvement of Treatment Supervisors (Pengawas Menelan Obat, PMO) who accompanied patients throughout their treatment process (Palembang City Health Office, 2023).

According to data from the Social Community Health Center (Puskesmas Sosial), the percentage of case detection and treatment for pulmonary TB decreased in 2023 compared to the previous year. In 2022, the detection rate reached 19.94%, declined to 15.5% in 2023, but increased again to 21.28% in 2024. Nevertheless, these figures remain far below the government's target threshold of over 90% (Social Health Center, 2023).

Several studies have demonstrated that environmental factors have a significant relationship with the incidence of pulmonary TB. For example, research conducted in Kedaton District, Bandar Lampung, revealed associations between TB incidence and the physical condition of the home environment—particularly lighting, housing density, and ventilation systems (Handayani, 2011; Sari, Rahayu, & Fitriana, 2022). Similarly, a study by Sriratih et al. (2021) evaluated various indoor environmental aspects related to pulmonary TB incidence in developing countries, focusing on variables such as natural lighting, occupant density, ventilation systems, room temperature, humidity, and the type of cooking fuel used. The findings showed that high housing density and inadequate ventilation were the most significant factors accelerating TB transmission in those regions (Sriratih, Nugroho, & Lestari, 2021).

Based on the data from the UPTD Social Community Health Center of Palembang City, which shows fluctuating pulmonary TB case detection rates each year, further research is needed to analyze the correlation among agent, host, and environmental factors related to pulmonary TB cases. Since no previous study has examined pulmonary TB incidence at this health center, this study aims to analyze the factors affecting the incidence of pulmonary tuberculosis at the Social Community Health Center, Palembang.

Methods

Study Design

This study employed a quantitative cross-sectional design to identify the factors associated with the incidence of pulmonary tuberculosis (TB) in the working area of the UPTD Social Community Health Center, Palembang. The study focused on analyzing the correlation dynamics among risk and consequence variables through an observational method involving simultaneous data collection at a single point in time. The research was conducted at the UPTD Social Community Health Center, Palembang City, South Sumatra Province, for one month—from April to May 2025. The location was chosen because its TB case detection rate remained far below the established target.

Sampling

The population consisted of all patients who visited the DOTS Clinic and were registered in the 2024 medical records at the UPTD Social Community Health Center, totaling 433 patients. The Slovin formula was used to determine the sample size, and the purposive sampling technique was applied to select 81 respondents. The inclusion criteria included patients who visited and were recorded at the DOTS Clinic, had no comorbid diseases, and agreed to participate in the study. The exclusion criteria included patients who did not visit or were not recorded at the DOTS Clinic, had other diseases, or refused to participate.

Instruments

The instrument used in this study was a structured questionnaire developed based on the study variables and tested for validity and reliability. The questionnaire included demographic and environmental factors such as age, gender, education, smoking habits, lighting, ventilation, occupancy density, room temperature, humidity, and pulmonary TB status. Age was classified as productive (15–44 years) or non-productive, gender as male or female, and education as high (senior high school to university) or low (junior high school

or below). Smoking habits were categorized as smoker or non-smoker, lighting was considered adequate if the intensity reached at least 60 lux and non-glare, and ventilation was classified as adequate if the ventilation area exceeded 10% of the room floor area. Occupancy density was deemed adequate if it met the standard of at least 8 m^2 per person. Room temperature was considered appropriate if between 18°C and 30°C, and humidity was classified as appropriate if within 40%–60% relative humidity. TB incidence was categorized as positive if the respondent was diagnosed with pulmonary TB and negative if not diagnosed.

Data Collection

Data collection was conducted using both primary and secondary data obtained through structured interviews and questionnaire administration. Prior to data collection, respondents were asked to sign a written informed consent form as an agreement to participate. The researcher and the assisting team provided a detailed explanation of the research objectives and questionnaire-filling procedures to ensure participants understood the process. The interviews were conducted in a comfortable and private setting to maintain respondent confidentiality. All participant responses were recorded systematically in the questionnaire.

Data Analysis

The data collected were processed and tabulated using Microsoft Excel and analyzed using SPSS software. Univariate analysis was performed to describe the frequency distribution of each variable, while bivariate analysis using the chi-square test examined the relationship between the dependent variable (TB incidence) and independent variables (age, gender, education, smoking habits, lighting, ventilation, occupancy density, temperature, and humidity) with a significance level of $p < 0.05$. Multivariate analysis using multiple logistic regression was then conducted to identify the most dominant factor influencing the incidence of pulmonary TB. The results were presented in tables accompanied by narrative explanations of the relationships among variables.

Ethical Considerations

This research complied with ethical standards throughout all stages of the study. Each respondent provided written informed consent before participation. The researcher ensured confidentiality, anonymity, and voluntary participation of all respondents. All data obtained were used solely for research purposes, and participants were informed of their right to withdraw from the study at any time without any negative consequences.

Results

The results of the study involving 81 respondents in the working area of the UPTD Social Community Health Center, Palembang City, in 2025 produced univariate analysis findings in the form of frequency distribution, as presented in Table 1.

Based on Table 1, it can be seen that among the 81 respondents, most were in the non-productive age group, totaling 55 respondents (68%). The majority were male, accounting for 61 respondents (75.3%), and most had a low education level, totaling 49 respondents (60.5%). Respondents with a history of smoking were 55 (67.9%). In terms of environmental factors, 70 respondents (86.5%) had inadequate lighting, 73 respondents (90.1%) had inadequate ventilation, 64 respondents (79%) lived in overcrowded housing, 57 respondents (73%) had inappropriate room temperatures, and 64 respondents (79%) had inadequate humidity levels. Regarding pulmonary tuberculosis status, the majority of respondents, 71 (88%), were negative for pulmonary TB.

Based on Table 2, it can be seen that among the 81 respondents, 5 respondents in the non-productive age group (9.1%) experienced pulmonary tuberculosis, which was fewer compared to 50 respondents (90.9%) in the same age group who did not experience pulmonary tuberculosis. The result of the bivariate analysis showed a p-value of 0.278, which is greater than 0.05, indicating no significant association between age and the incidence of pulmonary tuberculosis.

Table 1. Frequency Distribution of Respondents at the Social Community Health Center, Palembang City

Variables	Frequency (n)	Percetage (%)
Age		
Productive	26	32
Non-productive	55	68
Gender		
Male	61	75,3
Female	20	24,7
Education		
High	32	39,5
Low	49	60,5
Smoking History		
Non-smoker	26	32,1
Smoker	55	67,9
Lighting		
Adequate	11	13,5
Inadequate	70	86,5
Ventilation		
Adequate	8	9,9
Inadequate	73	90,1
Occupancy Density		
Adequate	17	21
Inadequate	64	79
Room Temperature		
Appropriate	24	27
Inappropriaate	57	73
Humidity		
Appropriate	17	21
Inappropriaate	64	79
Incidence of Pulmonary Tuberculosis		
Positive	10	12
Negative	71	88

Among 10 respondents who experienced pulmonary tuberculosis, 3 respondents (9.4%) were male, which was fewer compared to female respondents. The bivariate analysis yielded a p-value of 0.002 (< 0.05) with an Odds Ratio (OR) of 10.410 and a 95% Confidence Interval (CI) of 2.369–45.741. This means that male respondents were 10.410 times more likely to experience pulmonary tuberculosis compared to female respondents.

Respondents with higher education levels had fewer tuberculosis cases, with only 3 respondents (9.4%) experiencing pulmonary tuberculosis compared to those with lower education levels. The bivariate analysis showed a p-value of 0.732, indicating no significant relationship between education level and tuberculosis incidence. Among 10 respondents who experienced pulmonary tuberculosis, 8 respondents (12.5%) were smokers, while among 71 respondents who did not experience tuberculosis, 18 respondents (87.5%) were non-smokers. The bivariate analysis produced a p-value of 0.002 (< 0.05) with an OR of 11.778 and a 95% CI of 2.287–60.665, indicating that respondents who smoked were 11.778 times more likely to develop pulmonary tuberculosis compared to non-smokers.

Among 10 respondents who experienced pulmonary tuberculosis, 4 respondents (16.7%) lived in houses with inadequate ventilation, while among 71 respondents without tuberculosis, 69 respondents (83.3%) had inadequate ventilation. The bivariate analysis showed a p-value of 0.001 (< 0.05) with an OR of 51.750 and a 95% CI of 7.808–342.997, indicating that respondents living in houses with inadequate ventilation were 51.750 times more likely to experience pulmonary

tuberculosis compared to those whose houses met ventilation standards.

Table 2. Bivariate Analysis of Factors Associated with the Incidence of Pulmonary Tuberculosis

Variables	Incidence of Pulmonary Tuberculosis				Total		Pvalue	OR (95% CI)
	Positive		Negative					
	n	%	n	%	n	%		
Age								
Productive	5	9,1	50	90,0	55	100	0,278	-
Non-productive	5	19,2	21	80,8	26	100		
Gender								
Male	7	14,3	13	85,7	20	100	0,002	10,41 (2,36-45,74)
Female	3	9,4	58	90,6	61	100		
Education								
High	7	14,3	42	85,7	49	100	0,732	-
Low	3	9,4	29	90,6	32	100		
Smoking History								
Non-smoker	8	12,5	18	87,5	26	100	0,002	11,77 (2,28-60,66)
Smoker	2	11,8	53	88,2	55	100		
Lighting								
Adequate	2	18,2	9	81,8	11	100	0,619	-
Inadequate	8	81,8	62	88,6	70	100		
Ventilation								
Adequate	6	10,5	2	89,5	8	100	0,001	51,75 (7,80-342,9)
Inadequate	4	16,7	69	83,3	73	100		
Occupancy Density								
Adequate	8	12,5	56	87,5	64	100	1,000	-
Inadequate	2	11,8	15	88,2	17	100		
Room Temperature								
Appropriate	4	16,7	20	83,3	24	100	0,472	
Inappropriaate	6	10,5	51	89,5	57	100		
Humidity								
Appropriate	7	14,3	10	85,7	17	100	0,001	14,23 (3,14-64,35)
Inappropriaate	3	9,4	61	90,6	64	100		

Among 10 respondents with pulmonary tuberculosis, 2 respondents (11.8%) lived in overcrowded housing, while among 71 respondents without tuberculosis, 15 respondents (88.2%) lived in overcrowded conditions. The bivariate analysis showed a p-value of 1.000, suggesting no significant association between occupancy density and tuberculosis incidence.

Among 10 respondents who experienced pulmonary tuberculosis, 3 respondents (9.4%) had inadequate humidity levels in their homes, while among 71 respondents who did not experience tuberculosis, 61 respondents (90.6%) had inadequate humidity. The bivariate analysis yielded a p-value of 0.001 with an OR of 14.233 and a 95% CI of 3.148–64.351, indicating that respondents whose homes had inadequate humidity were 14.233 times more likely to experience pulmonary tuberculosis compared to those living in homes with adequate humidity.

Among 10 respondents with pulmonary tuberculosis, 4 respondents (16.7%) lived in houses with inappropriate room temperatures, while among 71 respondents without tuberculosis, 20 respondents (83.3%) lived in houses with inappropriate temperatures. The bivariate analysis showed a p-value of 0.472, indicating no significant relationship between room temperature and pulmonary tuberculosis incidence. Meanwhile, 8 respondents (81.8%) who experienced pulmonary tuberculosis lived in houses with inadequate lighting, whereas among 71 respondents who did not experience tuberculosis, 62 respondents (88.6%) also had inadequate lighting. The bivariate analysis showed a p-value of 0.619, indicating no

significant association between lighting and tuberculosis incidence.

Table 3. Final Stage of Multiple Logistic Regression Analysis

Variables	B	Pvalue	OR	95 % CI
Smoking History	0.736	0.295	2.087	0.526 – 8.279
Humidity	-1.678	0.124	0.187	0.022 – 1.584
Constant	3.881	0.082	48.482	

Based on the results of the bivariate analysis, variable selection for the multivariate analysis was carried out to identify those potentially associated with pulmonary tuberculosis incidence. The selection of candidate variables for inclusion in the multivariate model was determined using a simple logistic regression test. According to Hastono (2018), if the bivariate analysis result shows a p-value < 0.25, the variable can be included in the multivariate analysis. However, if the p-value > 0.25, the variable may not be included unless it is considered substantively important for the model.

The results of the final multiple logistic regression analysis showed that the Nagelkerke R Square value was 0.771, and the Cox and Snell R Square value was 0.229. These results indicate that the independent variables included in the model collectively explained 77.1% and 22.9% of the variation in the incidence of pulmonary tuberculosis, respectively.

Among the analyzed variables, smoking habits were found to have the strongest influence on the incidence of pulmonary tuberculosis. The analysis yielded an Odds Ratio (OR) of 2.087, meaning that respondents who had a smoking habit were 2.087 times more likely to develop pulmonary tuberculosis compared to those who did not smoke. This finding suggests that smoking is the most dominant risk factor contributing to pulmonary tuberculosis among respondents in the working area of the UPTD Social Community Health Center, Palembang City.

Discussion

This study aimed to analyze the factors associated with the incidence of pulmonary tuberculosis (TB) in the working area of the UPTD Social Community Health Center, Palembang City, in 2025. Among the 81 respondents, 10 respondents (12%) were diagnosed with pulmonary TB. The results of the bivariate analysis revealed significant relationships between gender, smoking habits, ventilation, and humidity with the incidence of pulmonary tuberculosis. After conducting multivariate analysis, smoking habits were identified as the dominant factor, with an Odds Ratio (OR) value of 2.087.

In contrast, no significant associations were found between age, education, housing density, temperature, and lighting with the incidence of pulmonary tuberculosis. These findings are consistent with studies conducted by Dias et al. (2022), Tosepu et al. (2023), and Rachim (2014), which also reported no relationship between age and TB incidence. Theoretically, age may influence the immune system, but it is not always the main determinant of tuberculosis infection. According to Notoatmodjo (2012), age represents a biological determinant that can affect an individual's resistance to infection; however, its effect is often overshadowed by environmental conditions, healthy lifestyle behaviors, and nutritional status. Therefore, age may serve as an explanatory variable but not a single predictor in epidemiological studies of tuberculosis.

Similarly, the results regarding education level are consistent with studies by Muhammad (2019), I. Putu Yudi and Subardin A.B. (2021), and Widiati and Majdi (2021), which found that education did not have a significant influence on pulmonary TB incidence. Several Indonesian-based studies have indicated that both formal education and health education play crucial roles in TB prevention. Muhammad (2019) explained that individuals with higher

education tend to absorb information about TB prevention more effectively and practice better hygiene behaviors, thereby indirectly reducing infection risk. Mulyati et al. (2019) further emphasized that continuous health education through interactive and audiovisual models significantly improves community health workers' knowledge and enhances early detection and TB control at the community level. However, some studies, such as one conducted in Palu (2021), reported no direct relationship between formal education and pulmonary TB incidence (p = 1.000), while still acknowledging that limited access to quality health information among lower education groups contributes to TB vulnerability.

The findings on lighting are in line with studies by Hasanah et al. (2021), Anggraini et al. (2020), and Dinata et al. (2020), which concluded that natural lighting was not significantly correlated with sputum smear positivity among pulmonary TB patients at Tlogosadang Health Center. However, most houses in these studies failed to meet the environmental health standards for healthy housing (ventilation ≥ 10%, lighting ≥ 60 lux). Theoretically, natural lighting—particularly sunlight exposure—is believed to reduce infection risk because ultraviolet rays can kill airborne and surface microorganisms. This finding supports Notoatmodjo's (2011) environmental sanitation theory, which states that adequate indoor lighting improves air quality and inhibits bacterial growth. Nevertheless, in practice, lighting rarely acts as an independent determinant of TB transmission, as it is often influenced by other factors such as ventilation, housing density, and residents' habits of opening windows and doors.

The findings related to housing density are consistent with those of Majampoh et al. (2019), Budianto (2015), and Rizka Santi et al. (2023), which used an observational cross-sectional approach and concluded that variables such as ventilation, lighting, humidity, flooring type, and housing density showed no significant relationships (Putri et al, 2025; Suryani et al, 2025). Theoretically, this aligns with Notoatmodjo's (2011) statement that disease transmission depends not only on occupancy density but also on the interaction of environmental factors, including ventilation, cleanliness, and healthy behaviors. In densely populated houses, TB transmission risk can be reduced if ventilation and sanitation are adequately maintained (KK et al, 2025).

The results regarding temperature are in agreement with studies conducted by Febriyanti and Mathofani (2020), Irfan (2020), and Damayanti et al. (2018), which found no significant relationship between minimum temperature (r = 0.438; p = 0.238) or maximum temperature (r = 0.088; p = 0.822) and TB incidence. Although average temperature showed some significance, most temperature indicators were not significantly correlated overall. Theoretically, room temperature affects residents' comfort and health, but according to Notoatmodjo (2011), temperature is not a primary environmental factor in the transmission of infectious diseases like TB. Factors such as ventilation, humidity, and housing density play a greater role because they influence air circulation and the concentration of infectious droplets indoors. Thus, while extreme temperatures may weaken immunity, they do not directly correlate with increased TB incidence.

According to Notoatmodjo's (2012) public health theory, gender differences can influence susceptibility to infectious diseases due to variations in activity levels, environmental exposure, and behavioral patterns. Men generally have higher mobility, spend more time outdoors, and are more frequently exposed to unhealthy environments, including contact with active TB patients. Moreover, smoking habits and physically demanding occupations, which are more common among men, can weaken the respiratory system and increase vulnerability to Mycobacterium tuberculosis. These findings are supported by studies by Maulana et al. (2021), Rahayu (2021), and Pralambang et al. (2021), as well as a national literature review showing that males have an OR of approximately 4.19, indicating that men are about four times more likely than women to develop pulmonary TB. Other sociodemographic factors such as age ≥36 years, low education, marital status, occupation,

and nutritional status also significantly contribute to TB incidence.

Active smokers tend to experience decreased immune function and impaired respiratory defense mechanisms, making them more susceptible to Mycobacterium tuberculosis infection. Cigarette smoke contains irritant substances such as carbon monoxide, which damage respiratory cilia and increase infection risk. This study's findings are consistent with those of Nabila and Rahayu (2022), Suharmanto (2024), and Tandang (2018), which demonstrated a strong relationship between smoking habits (active or passive) and pulmonary TB. The age at smoking initiation and duration of smoking were also found to significantly affect TB risk, with OR values reaching up to 21. Furthermore, Harahap et al. (2017), using IFLS 2014 data published in the Journal of Public Health Sciences, found that smoking intensity (frequency and duration) remained a significant independent risk factor for pulmonary TB even after controlling for age, gender, education, BMI, and home environment.

Poor ventilation in houses leads to inadequate air circulation, allowing infectious particles from TB patients to persist in the air and increasing the risk of household transmission. This finding aligns with studies by Wulandari et al. (2022), Harahap (2020), and Amalia (2024), which concluded that ventilation is the most dominant environmental factor associated with pulmonary TB incidence (OR = 6.146, $p < 0.05$). Theoretically, this finding supports Notoatmodjo's (2011) concept of environmental sanitation, which asserts that poor ventilation increases the risk of respiratory infections, including tuberculosis. Inadequate ventilation results in humid, oxygen-poor indoor air that promotes the growth of pathogenic microorganisms. Mycobacterium tuberculosis, the bacterium responsible for TB, can survive longer in closed, poorly ventilated spaces, thus increasing the likelihood of transmission.

Humidity was also found to have a significant relationship with pulmonary tuberculosis incidence. This finding is consistent with studies by Monica (2020), Indriyani et al. (2016), and Sri Novita Sari et al. (2018), which, using a case-control approach, confirmed that indoor humidity significantly correlated with TB occurrence. Theoretically, this is supported by the Healthy Housing Sanitation Guidelines from the Ministry of Health of the Republic of Indonesia (2014), which state that high indoor humidity provides a favorable environment for microorganisms, including pathogenic bacteria. Notoatmodjo (2011) also explained that poor humidity worsens indoor air quality, reduces oxygen levels, and increases the risk of respiratory infections. Mycobacterium tuberculosis thrives in enclosed and humid environments, thereby increasing transmission risk. Based on these findings and supporting evidence, this study concludes that inadequate humidity is one of the main environmental factors influencing the incidence of pulmonary tuberculosis in the working area of the UPTD Social Community Health Center, Palembang City.

Conclusion and Recommendation

Based on the results of this study, there was a significant relationship between gender, smoking habits, ventilation, and humidity with the incidence of pulmonary tuberculosis in the working area of the UPTD Social Community Health Center, Palembang City, in 2025. However, no significant relationship was found between age, education, lighting, housing density, and room temperature with the incidence of pulmonary tuberculosis. The results of the multivariate analysis showed that smoking habits were the dominant factor associated with the occurrence of pulmonary tuberculosis.

It is recommended that direct home visits be conducted for patients who have been diagnosed with pulmonary tuberculosis to perform contact investigations among family members and neighbors who have close contact with TB patients. The implementation of these activities should be carried out by the TB program team, together with the TB program physician, TB health cadres, health promotion officers, and environmental health personnel at the Social Community Health Center. In addition, the involvement of families and community TB cadres in the villages as Treatment Supervisors (PMO) is highly

encouraged to support patient adherence and strengthen community-based TB control efforts.

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Declaration on the Use of AI
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