
ANALYSIS OF TRENDS AND DISTRIBUTION OF TUBERCULOSIS CASES IN THE SERVICE AREA OF PUSKESMAS TAMBAKAJI, 2023–2025

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Abstract . This study analyzed tuberculosis (TB) cases in the Tambakaji Public Health Center working area from 2023 to 2025. The findings indicate that TB cases remained consistently high during the three-year period, with fluctuating dominance between Tambakaji and Wonosari subdistricts. Tambakaji recorded the highest number of cases in 2023 and 2025, while Wonosari showed a temporary increase in 2024 before improving in 2025. Spatial mapping revealed persistent hotspots in several neighborhood units (RW) in Tambakaji, particularly RW 11 and RW 12, indicating a need for priority intervention. Meanwhile, Wonosari demonstrated an increasing number of low-case and zero-case areas in 2025. These results highlight the importance of strengthening area-based surveillance, contact tracing, health education, and environmental interventions to reduce TB transmission sustainably.

Keywords: *Tuberculosis, Spatial Distribution, Epidemiology, Public Health Center, Case Trends*

INTRODUCTION

Tuberculosis (TB) remains one of the leading infectious diseases worldwide, despite significant advances in diagnosis and treatment. According to the World Health Organization (WHO) in the *Global Tuberculosis Report 2023*, which covers more than 190 countries representing over 99% of the world's population, TB continues to pose a substantial global health burden (1). The incidence and mortality of tuberculosis (TB) remain significant, and although some indicators show improvement, global targets for reducing TB incidence and mortality have not yet been achieved (1). At the global level, this underscores that prevention, early detection, complete and effective treatment, and epidemiological surveillance remain key components of tuberculosis (TB) control strategies.

In the national context, Indonesia faces major challenges in tuberculosis (TB) control. Reports indicate that the estimated number of new TB cases in Indonesia reaches approximately 1,060,000 cases per year (2). For example, in 2023 the number of detected cases increased to 820,789 compared to the previous year. Nevertheless, case detection has not yet reached the target for full coverage, and treatment coverage as well as the achievement of the treatment success rate still need to be improved (3). In addition, high-risk populations, access to services at primary healthcare facilities (FKTP), and regional disparities indicate that although the national TB program has been actively implemented, its execution at the local level continues to face significant challenges.

In addition to factors influencing the occurrence of tuberculosis (TB), several primary studies indicate that TB relapse and treatment failure are affected by a combination of behavioral, clinical, and environmental factors. A cohort study in Indonesia by Pradipta et al. (2023) found that poor medication adherence and a history

of smoking significantly increased the risk of treatment failure and relapse of pulmonary TB, particularly among patients of productive age (4). A case–control study by Sari et al. (2024) conducted at primary healthcare facilities found that patients with comorbid diabetes mellitus had a higher risk of tuberculosis (TB) relapse compared with those without comorbidities, likely related to impaired immune responses and drug interactions (5).

An observational study by Putri et al. (2023) reported that poor household environmental conditions, particularly inadequate ventilation that does not meet established standards, were associated with an increased risk of TB relapse after treatment completion (6). Another factor that further worsens treatment outcomes is the occurrence of drug-resistant tuberculosis (MDR-TB). Cohort studies in Indonesia indicate that MDR-TB is strongly associated with a history of incomplete treatment and delays in the detection of drug resistance (7). These findings indicate that TB control at the primary healthcare center (puskesmas) level should not focus solely on the detection of new cases, but also on monitoring treatment adherence, managing comorbidities, and improving environmental factors to prevent relapse and treatment failure.

The service area of Puskesmas Tambakaji in Semarang City has characteristics that are important to analyze within the context of TB epidemiology. As a major city in Central Java, Semarang is characterized by high population density, high population mobility, and socio-economic disparities across subdistricts, all of which may influence the dynamics of TB transmission. Although there are limited publications specifically focused on the Puskesmas Tambakaji area, spatial studies conducted in Central Java indicate that residential density modeling and spatial distribution analysis contribute significantly to understanding TB risk patterns (8).

In addition to environmental, social, and economic factors, recent studies indicate that clinical factors and comorbidities play an important role in the occurrence and progression of tuberculosis (TB). Comorbidities such as diabetes mellitus, HIV infection, malnutrition, and smoking behavior have been shown to increase the risk of progression from latent TB infection to active TB and to worsen treatment outcomes. Epidemiological studies in Indonesia demonstrate that TB patients with diabetes have a higher risk of treatment failure compared with those without comorbidities, while poor nutritional status contributes to reduced immunity, facilitating infection with *Mycobacterium tuberculosis*. A study by Wahyuni et al. (2024) found that nutritional status, smoking habits, and a history of household contact were significantly associated with TB incidence in primary healthcare service areas, indicating that clinical factors should be considered in the analysis of TB case distribution at the primary care level (9).

In operational practice, Puskesmas Tambakaji, as a primary healthcare facility, plays a key role in early detection, treatment, referral, treatment supervision, and monitoring of household contacts. In situations where local data have not yet been described in detail, analyzing trends and the distribution of cases within the service area of Puskesmas Tambakaji becomes highly relevant.

The main problem addressed in this study is the fluctuation in the number of TB cases and the lack of clarity regarding patterns of case distribution by time, patient characteristics (age, sex, occupation), and area of residence within the Puskesmas Tambakaji service area. Without sufficient understanding of case trends and distribution, TB control interventions at the primary healthcare level risk being poorly targeted or failing to optimally utilize available data for planning purposes. Therefore, this study is needed to provide local evidence through an analysis of TB case distribution trends in the Puskesmas Tambakaji service area, which is expected to serve as a basis for planning, evaluation, and strengthening TB control strategies at the primary healthcare level.

METHODS

The main problem addressed in this study is the fluctuation in the number of TB cases and the lack of clarity regarding patterns of case distribution by time, patient characteristics (age, sex, occupation), and area of residence within the Puskesmas Tambakaji service area. Without sufficient understanding of case trends and distribution, TB control interventions at the primary healthcare level risk being poorly targeted or failing to optimally utilize available data for planning purposes. Therefore, this study is needed to provide local evidence through an analysis of TB case distribution trends in the Puskesmas Tambakaji service area, which is expected to serve as a basis for planning, evaluation, and strengthening TB control strategies at the primary healthcare level.

RESULT

1. Tuberculosis Cases at Puskesmas Tambakaji by Subdistrict (Kelurahan)

Table 1. Frequency Distribution of Tuberculosis Cases at Puskesmas Tambakaji in 2023

No	Subdistrict	n	Percentage (%)
1.	Tambakaji	60	56.60%
2.	Wonosari	46	43.40%
Total		106	100%

Source: Pulmonary Tuberculosis Patient Data

Table 2. Frequency Distribution of Tuberculosis Cases at Puskesmas Tambakaji in 2024

No	Subdistrict	n	Percentage (%)
1.	Tambakaji	55	49.55%
2.	Wonosari	56	50.45%
Total		111	100%

Source: Pulmonary Tuberculosis Patient Data

Table 3. Frequency Distribution of Tuberculosis Cases at Puskesmas Tambakaji in 2025

No	Subdistrict	n	Percentage (%)
1.	Tambakaji	67	60.36%
2.	Wonosari	44	39.64%
Total		111	100%

Source: Pulmonary Tuberculosis Patient Data

Based on the data presented in table 1, the frequency distribution of pulmonary tuberculosis cases in the service area of Puskesmas Tambakaji in 2023 shows that, out of a total of 106 cases, Tambakaji Subdistrict recorded the highest number of cases, with 60 cases (56.60%). Meanwhile, Wonosari Subdistrict reported 46 cases (43.40%). These findings indicate that TB transmission in that year was more concentrated in Tambakaji, resulting in a higher disease burden in this area.

In 2024, as shown in table 2, the total number of cases increased to 111. The distribution of cases changed compared to the previous year, with Wonosari Subdistrict recording the highest number of cases at 56 cases (50.45%), slightly higher than Tambakaji Subdistrict, which reported 55 cases (49.55%). This shift in case dominance indicates dynamic TB transmission patterns, potentially influenced by factors such as population mobility, residential environmental conditions, or the intensity of case-finding activities.

In 2025, based on the data presented in table 3, the number of recorded tuberculosis cases reached 111. However, it is important to note that the 2025 data do not yet cover a full calendar year, as data collection was conducted only up to 16 November 2025. Despite this limitation, the case distribution indicates that Tambakaji Subdistrict once again recorded the highest number of cases, with 67 cases (60.36%), while Wonosari Subdistrict reported 44 cases (39.64%). The increase in cases in Tambakaji compared to 2024 suggests a rise in local transmission or the presence of environmental factors that facilitate TB transmission, whereas the decrease in cases in Wonosari may reflect improvements in early detection and TB control efforts. As the 2025 data are incomplete, the case trend for this year should be considered preliminary and may change once full-year data become available.

1. Map of Tuberculosis Case Distribution at Puskesmas Tambakaji by Neighborhood Unit (RW)

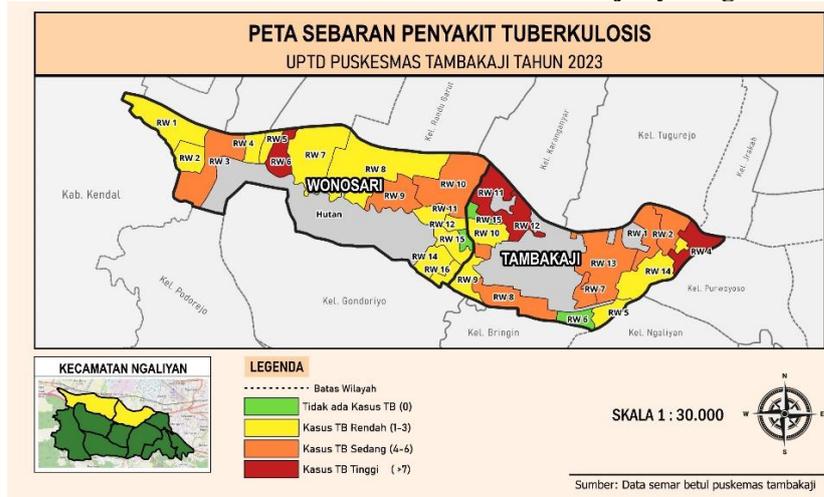


Figure 1. Map of Tuberculosis Distribution in the Service Area of Puskesmas Tambakaji, 2023

The 2023 map shows a relatively wide distribution of TB cases across the service area of Puskesmas Tambakaji. Red areas (>7 cases) are predominantly found in Tambakaji Subdistrict, particularly in RW 11, RW 12, RW 13, and RW 14, indicating that the highest TB burden is concentrated in these areas. Several neighborhood units are shown in orange (4–6 cases), such as RW 7, RW 8, RW 9, and RW 2, representing a moderate level of cases. Meanwhile, most neighborhood units in Wonosari Subdistrict fall into the yellow category (1–3 cases), indicating a low number of TB cases, and only a few RWs are classified as green (0 cases), meaning no reported cases. Overall, the dominance of red and orange areas reflects a high distribution of TB cases in 2023.

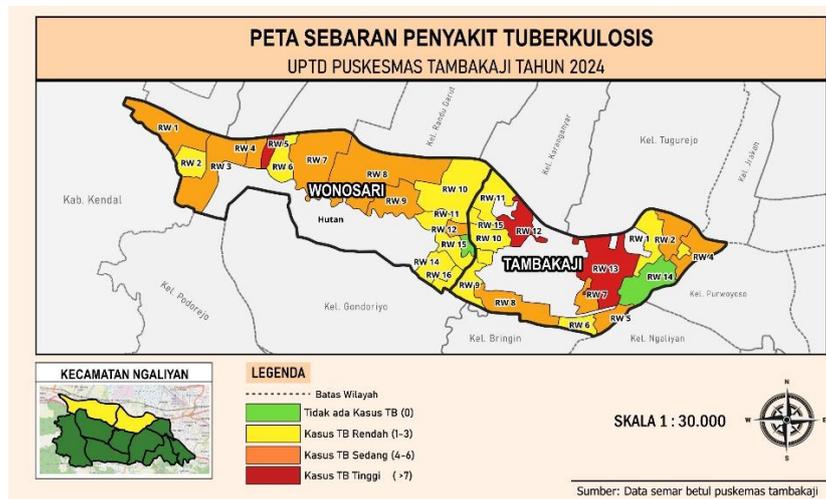


Figure 2. Map of Tuberculosis Distribution in the Service Area of Puskesmas Tambakaji, 2024

In 2024, Tambakaji Subdistrict remained the main center of TB cases. This is indicated by RW 11 and RW 12, which are shown in red (>7 cases), as well as RW 7, RW 13, and RW 15, which fall into the orange category (4–6 cases). This pattern suggests the presence of relatively strong transmission clusters in Tambakaji. Meanwhile, Wonosari Subdistrict was generally in the yellow category (1–3 cases), indicating a low number of TB cases, with several RWs already classified as green (0 cases).

Overall, TB distribution in 2024 remained concentrated in Tambakaji, while Wonosari appeared to be relatively well controlled.

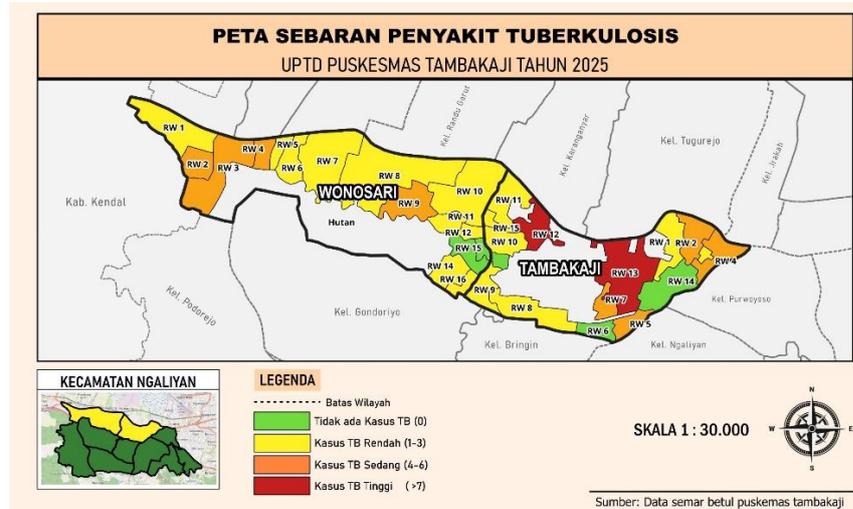


Figure 3. Map of Tuberculosis Distribution in the Service Area of Puskesmas Tambakaji, 2025

In 2025, the distribution of TB cases showed improvement, particularly in Wonosari Subdistrict, as indicated by an increasing number of RWs classified as green (0 cases), such as RW 3 and RW 14, and the predominance of yellow RWs (1–3 cases). This pattern suggests that Wonosari is increasingly moving toward a low TB burden. Nevertheless, Tambakaji Subdistrict remained the area with the highest TB burden, as reflected by RW 11 and RW 12, which continued to be classified as red (>7 cases), as well as RW 7, RW 13, and RW 15, which were in the orange category (4–6 cases). This indicates that, despite overall improvement, Tambakaji remained a priority area for TB control efforts in 2025.

DISCUSSION

The study results indicate dynamic trends in tuberculosis (TB) cases within the service area of Puskesmas Tambakaji during the 2023–2025 period, characterized by fluctuations in the number of cases and variations in distribution across subdistricts. Overall, the number of TB cases increased from 106 cases in 2023 to 111 cases in 2024 and remained at 111 cases in 2025, although the 2025 data do not yet represent a full calendar year. In terms of spatial distribution, Tambakaji Subdistrict consistently recorded the highest TB burden in two of the three years observed, namely in 2023 (56.60%) and 2025 (60.36%). In contrast, Wonosari Subdistrict experienced an increase in cases in 2024, making it the subdistrict with the highest number of cases that year (50.45%), before declining again in the following year. This pattern suggests that TB transmission dynamics are influenced by varying factors such as environmental conditions, population density, mobility, and differences in the intensity of case-finding activities across years (10).

Spatial analysis of the case distribution maps shows that RWs classified in the red category (>7 cases) were predominantly located in Tambakaji Subdistrict throughout all years of observation, particularly RW 11 and RW 12, which consistently emerged as transmission clusters. This finding reinforces the conclusion that these areas represent priority targets for intervention. RWs in the orange category (4–6 cases) were also frequently identified in Tambakaji, indicating the continued presence of active transmission potential. These findings are consistent with TB mapping studies that demonstrate transmission clusters commonly occur in densely populated areas and in locations with specific environmental conditions (11). Studies in Indonesia have also shown that variations in TB case numbers across regions are strongly influenced by population density characteristics and local spatial factors. Spatial modeling using a Geographically Weighted Negative Binomial

Regression approach found that population density and the distribution of healthcare facilities play a significant role in explaining interprovincial variation in TB cases in Indonesia, reflecting heterogeneity in transmission risk across regions (12).

Geographic Information System (GIS)-based mapping approaches have also been widely used to identify TB clusters at the local level. TB mapping studies in Kupang City demonstrated concentrations of cases in specific subdistricts during the 2019–2023 period, reinforcing that TB distribution is uneven and strongly influenced by local area conditions (13).

In addition, spatial analysis of TB incidence in West Aceh Regency found positive associations between population density, housing conditions, and clean and healthy living behaviors (PHBS) with TB occurrence. These findings underscore that environmental factors and community behavioral patterns play an important role in the formation of TB transmission clusters at the community level (14).

In contrast, Wonosari Subdistrict gradually showed improvement, as indicated by an increasing number of RWs classified as green (0 cases) and the dominance of the yellow category (1–3 cases) in 2025, reflecting reduced TB transmission. Improvements in Wonosari may illustrate enhanced effectiveness of TB control activities, such as active surveillance, strengthened routine treatment, community education, and improved contact tracing. Conversely, the consistently high number of cases in Tambakaji Subdistrict highlights the need for a more in-depth evaluation of residential conditions, housing density, health-seeking behavior, and the coverage of case-finding services. Furthermore, the increase in cases in Tambakaji in 2025 may be influenced by improved detection or reporting, although the possibility of ongoing local transmission cannot be ruled out. This is consistent with studies indicating that strengthened surveillance activities, education, and treatment monitoring contribute to reductions in TB cases at the subdistrict level (15).

In addition to regional and environmental factors, healthcare service aspects also play a role in the high number of TB cases in certain areas. The National Clinical Practice Guidelines for Tuberculosis Management emphasize that an increase in detected cases does not necessarily reflect program failure, but may instead indicate improvements in case detection and reporting systems. Therefore, the high number of cases in Tambakaji Subdistrict in 2025 may be influenced by intensified active case-finding activities, although the possibility of ongoing local transmission still warrants close attention.

Overall, the study findings underscore the importance of an area-based management approach in TB control at the primary healthcare center level, with a particular focus on high-risk RWs. Case distribution data presented in tables and maps are crucial for setting program priorities, including planning home visits, household contact investigations, environmental interventions, and more intensive health education campaigns in areas with identified transmission clusters (1).

CONCLUSION

Based on data from 2023–2025, the number of tuberculosis (TB) cases in the service area of Puskesmas Tambakaji shows a fluctuating pattern but remains relatively high. In 2023, a total of 106 cases were recorded, increasing to 111 cases in 2024, and remaining at 111 cases in 2025 (up to November). Spatially, Tambakaji Subdistrict recorded the highest number of cases in 2023 and 2025, while Wonosari Subdistrict temporarily became the area with the highest number of cases in 2024. Mapping of case distribution indicates that transmission clusters are predominantly located in several neighborhood units (RW) in Tambakaji, particularly RW 11 and RW 12, which consistently reported high case numbers each year. In contrast, Wonosari showed improvement in 2025, as reflected by an increasing number of RWs with no reported cases. Overall, the distribution of TB cases in Puskesmas Tambakaji indicates that Tambakaji remains a priority area for intervention, while Wonosari tends to experience a decline in cases toward the end of the observation period.

With the availability of TB case mapping, the puskesmas is encouraged to utilize these findings as a basis for more targeted prioritization of intervention areas. Mapping can support the puskesmas in directing active case-finding activities, household contact investigations, and health education efforts toward RWs with higher case concentrations. Furthermore, this mapping can be used to strengthen coordination with community health volunteers, village officials, and local leaders to ensure that prevention efforts are more acceptable and actively involve the community. Case mapping may also serve as a routine annual evaluation tool to assess program effectiveness, identify changes in transmission patterns, and design more focused, comprehensive, and sustainable TB control strategies without stigmatizing specific areas.

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