

Analysis of External and Internal Factors in Tuberculosis Control Program in Sinak District, Puncak Regency, Central Papua Province

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ARTICLE INFO

Keywords: Tuberculosis,
Internal Factors, External
Factors

Received : 10, April

Revised : 21, April

Accepted: 22, May

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ABSTRACT

Tuberculosis (TB) is an infectious disease that is still a public health problem in Central Papua, especially in Sinak District, Puncak Regency. This study aims to analyze the influence of internal and external factors that affect the effectiveness of TB prevention programs, and propose strategies to be implemented to improve the success of TB treatment. The research used a qualitative approach with a case study method. Data were collected through in-depth interviews, field observations, and document analysis using the SWOT method, then presented thematically. The results found that internally, limited human resources, limited facilities, and weak management systems were the main obstacles to the program. Externally, extreme and isolated geographical conditions, security disturbances from KKB, and lack of external support are the main challenges. Existing strategies have not optimally addressed the complexity of these obstacles. Therefore, increasing the quantity and quality of health workers, community-based approaches and cross-sectoral support are needed to improve the effectiveness of TB prevention programs specifically in Sinak District.

INTRODUCTION

Tuberculosis (TB) is an infectious disease caused by *Mycobacterium tuberculosis*, mainly affecting the lungs and spreading through the air. In addition to the physical impact, people with TB often experience social stigma, psychological pressure, and limitations in economic activities (Chomaerah, 2020). Globally, TB is the second leading cause of death from infectious diseases and ranks 13th on the list of leading causes of death (Jinyi et al., 2024; Wang, 2023). Based on 2019 data, the highest TB incidence rates were recorded in Sub-Saharan Africa and South Asia, while the lowest in developed regions such as North America and Western Europe (Chen et al., 2023).

The global TB strategy aims to reduce incidence by 90% and mortality by 95% by 2035, through early detection, effective treatment, and control of risk factors (Jinyi et al., 2024). In Indonesia, treatment coverage in 2022 reached 75%, but many challenges remain, including dropout rates, limited health workers, and suboptimal reporting systems (Zaenab et al., 2024; Sofiyatun, 2019).

In Central Papua, particularly Sinak District, TB treatment success is still low, only 63% by 2023, far from the national target of 80% (Sukatemin & Wijayanti, 2023). The main barriers include internal factors such as age, education, motivation, knowledge, drug side effects, and social stigma; and external factors such as access to health services, limited infrastructure, difficult geography, and unstable security conditions (Gunawan et al., 2017; Costa, 2022).

To understand these barriers in depth, a multidisciplinary approach is needed by combining the Health Belief Model (HBM), Elaboration Likelihood Model (ELM), and Dual Process Theory (DPT) theories. This approach enables a comprehensive analysis of patient adherence, communication effectiveness, and decision-making related to TB therapy (Azizi et al., 2018; Ismagilova et al., 2021; Greene, 2023).

Against this background, this study is entitled: "Analysis of External and Internal Factors in Tuberculosis Control Program in Sinak District, Puncak Regency, Central Papua Province". The aim is to identify specific constraints and formulate innovative strategies to improve treatment effectiveness and patient compliance during six months of therapy.

LITERATURE REVIEW

Tuberculosis (TB)

TB is an infectious disease caused by *Mycobacterium tuberculosis*, generally affecting the lungs but can spread to other organs. Transmission occurs through the air when the patient coughs or sneezes (Chomaerah, 2020). This bacteria can survive in a latent state in the body (Ahmad, 2011). TB is among the 10 leading causes of death in the world, with 1.3 million deaths in individuals without HIV and 300,000 in people with HIV in 2017 (Samsi et al., 2023).

TB Management

TB prevention strategies include early detection, complete treatment for six months with OAT, and community education to improve compliance

(Inayah & Wahyono, 2019). Challenges such as stigma and the myth that TB is a hereditary disease still hinder treatment efforts (Yunita et al., 2023).

Innovative Strategy

DOTS is a key strategy with five components: political commitment, microscopic diagnosis, directly supervised treatment, OAT availability, and a good reporting system (Kumalasari & Prabawati, 2021). Innovations such as digital health and telemedicine also support services in remote areas (Hidayat et al., 2024).

Treatment Adherence

Adherence to medication is essential for successful therapy. The elderly and patients on long-term therapy are prone to non-adherence due to various barriers, which requires ongoing education and monitoring (Patton et al., 2017; Liddelow et al., 2020).

Theoretical Model

- a. Health Belief Model (HBM): Explains health behaviors based on perceptions of risks, benefits, and barriers (Carpenter, 2010; Wong et al., 2020).
- b. Elaboration Likelihood Model (ELM): Analyzes communication strategies through central (rational) and peripheral (emotional) pathways (Petty & Cacioppo, 1986; Littlejohn et al., 2017).
- c. Dual Process Theory (DPT): Shows decision making involves emotional and rational processes simultaneously (Cushman et al., 2006; Greene, 2023).

Internal and External Factors

Internal factors include limited human resources, logistics, and program management (Faradillah et al., 2021). External factors include family support, the role of health workers, access to services, and geographical barriers and weak policies (Padang et al., 2022; Sumampouw et al., 2022).

SWOT Analysis

SWOT helps identify strengths (medical staff, facilities), weaknesses (limited staff, weak management), opportunities (policy and technology), and threats (economy, disease burden) in the TB service system (Dias et al., 2020; Abedi et al., 2018).

METHODOLOGY

This study used a qualitative approach with a case study method to understand in depth the factors that influence the success of the tuberculosis (TB) prevention program in Sinak District, Puncak Regency, Central Papua. Informants consisted of health center health workers, patients and their families, as well as related parties such as the district head and security forces, who were selected purposively. The research was conducted in Sinak District in

March-April 2025 with data collection through observation, in-depth interviews, and documentation. Data analysis used the Miles and Huberman model which includes data reduction, data presentation, and conclusion drawing and verification. Data validity testing was conducted through triangulation, member checking, and audit trail to ensure credibility, transferability, dependability, and confirmability of findings.

RESEARCH RESULT

Human Resources

The TB control program at Puskesmas Sinak faces challenges related to limited human resources. Informant 1 stated that staff at Puskesmas Sinak are multitasking, including in the warehouse and maternity services, which reduces the focus on TB treatment. Informant 2 also highlighted the irregularity in the flow of examination and treatment, with services falling short of expectations, especially in health centers that lack adequate facilities. In addition, the lack of training for health workers is a major problem, as stated by Informant 4 and Informant 5, who expressed the limited technical training in the TB program where TB-specific training only took place once. Informant 6 added that although the reports provided by Puskesmas Sinak were good, the official reports to the district office had never been received in full, indicating gaps in administration.

Regarding the quality of service, Informant 10 emphasized that the presence of permanent medical personnel in this area is very important and needs to be increased, given the geographical conditions and local needs. Medical personnel also have to serve patients in the three main districts that have been split into 11 new districts. Although services in vulnerable areas can be said to be good, security threats are also a factor that hampers the performance of medical personnel, as stated by Informant 12. Family support is also a key factor in maintaining adherence to treatment, despite side effects, as stated by Informant 16 who revealed the role of the family in ensuring that patients regularly take medicine despite challenges such as the large size of the medicine.

The TB prevention program at Puskesmas Sinak faces challenges related to limited human resources (HR), both in terms of quantity and quality. Informant 1 revealed that staff are juggling other duties such as logistics and maternity services, which reduces the focus on TB treatment. Informant 2 highlighted that the flow of examination and treatment is still far from expectations, with a lack of facilities at the puskesmas. Technical training is also an issue as it is limited, as Informants 4 and 5 pointed out. Informant 6 noted that official reports have not been received by the office, suggesting problems with reporting. Family support in treatment is crucial, with Informant 10 emphasizing the need for resident medical personnel, and Informants 12 and 16 highlighting the role of families in ensuring patients adhere to treatment despite side effects.

Program Implementation Management

Based on interviews, the implementation of the TB program at Puskesmas Sinak still faces obstacles that reduce its effectiveness. According to Informant 1, the TB screening has used the DOTS program, but as stated by Informant 2, the DOTS program has been running, but the TB response had to be stopped due to safety concerns. Informant 3 highlighted the lack of control over patients who do not regularly take their medication. Informant 4 mentioned that the screening and treatment monitoring system is not optimal. Informant 5 and Informant 6 noted delays in drug distribution, which interfered with the smooth flow of treatment. Informant 13 mentioned the difficulty in reaching remote areas due to the size of the service area. Informant 15 added that security issues also affect the mobilization of health workers.

Based on the interview results, the implementation of the TB program at Puskesmas Sinak still faces several obstacles that reduce its effectiveness. Delays in program implementation, safety issues that cause service interruptions, and lack of control over patients who do not routinely take their medicines are the main challenges. In addition, delays in drug distribution and difficulties in reaching remote areas also worsen the condition. Despite efforts to improve, these factors indicate that the management of TB program implementation is not fully optimal.

Budget and Funding

Based on interviews with 9 informants, the implementation of the TB program at Puskesmas Sinak faces several key constraints. According to Informant 1 and Informant 5, the reactive logistics procurement system, where drug requests are only made after a case is confirmed, leads to the risk of treatment delays and stock-outs. In addition, according to Informant 2, reliance on the Puncak District Health Office without outside assistance, such as NGOs or international organizations, worsens the condition of the program. Informant 3 highlighted that while village funds are available, they are rarely allocated to the health sector, reflecting weak coordination across sectors.

According to Informant 4 and Informant 6, the funding system is highly dependent on puskesmas heads and local policies, which can affect the sustainability of program operations. Informant 10 stated that the procurement of BCG vaccine is not adjusted to the real needs of the puskesmas, which hinders the implementation of prevention. In addition, according to Informant 14, there is no cooperation between security forces and puskesmas to specifically address TB. This causes difficulties in reaching remote areas, worsening the distribution of health services. Overall, reliance on a single funding source and a suboptimal logistics distribution system make the TB program vulnerable to disruption.

Drug Distribution & Availability

Based on interviews with informants, the drug procurement and logistics system at Puskesmas Sinak is still reactive, where drug requests are only made after there is a confirmed positive case of TB, risking delays in treatment.

Informant 1 and Informant 2 revealed that drug deliveries are only made after cases are confirmed, which can delay patient treatment. According to Informant 3, the supply of drugs and equipment is highly dependent on the local government, with no support from the province or outside parties. Informant 4 and Informant 6 mentioned that logistics are usually met, but distribution is highly dependent on reports from puskesmas; if reports are late, drug requests are also delayed.

In addition, Informant 5 highlighted the risk of drug wastage due to the positive case-based requisition system, while Informant 16 said that people in vulnerable areas such as Kilunggame often do not seek treatment if the situation is not safe. According to Informant 7, the distribution of vaccines and drugs does not always match the requests of puskesmas, as procurement is based on existing stocks in the district. This suggests the need for improvements in the procurement and distribution system to increase responsiveness to needs in the field.

Based on interviews with informants, the drug procurement system at Puskesmas Sinak is still reactive, only carried out after there is a confirmed positive case of TB, which risks causing delays in treatment. Informant 1 and Informant 2 stated that drugs are only sent after a case is confirmed, while Informant 3 added that the supply of drugs depends entirely on the local government. Informant 4 and Informant 6 mentioned that while logistics are usually met, distribution relies heavily on reports from puskesmas. Informant 5 highlighted the risk of drug wastage, while Informant 16 mentioned that people in vulnerable areas often do not seek treatment when the situation is unsafe. Informant 7 revealed that the distribution of vaccines and drugs often does not match the request of puskesmas.

Diagnostic Tools

Based on interviews with several informants, diagnostic tools at Puskesmas Sinak are very limited, with only microscopes available for TB diagnosis, while advanced tools such as TCM and x-rays are not available. According to Informant 1, the absence of supporting tools causes difficulties in diagnosing extrapulmonary TB cases, leading to the risk of misdiagnosis. Informant 2 also revealed that without supporting tools, they did not dare to state the diagnosis of extrapulmonary TB. The Head of Puskesmas, according to Informant 3, emphasized that services must be equipped with adequate equipment, but infrastructure limitations such as generators that are not powerful enough to support medical equipment hamper operations. Informant 4 stated that microscope calibration has not been realized, sampling difficulties, and lack of cross-checking efforts are obstacles. Informant 5 explained that although coordination between pharmacists and laboratories exists, unstructured procurement of equipment and reliance on the district office reduce efficiency. Informant 6 added that sterilizers cannot be used due to limited generator power, which hampers the effectiveness of TB diagnosis and services at Puskesmas Sinak.

Monitoring & Evaluation System

Based on interviews with several informants, the monitoring and evaluation system of the TB program at Puskesmas Sinak still faces obstacles. Informant 1 mentioned that reporting now uses the SITB application after training, replacing the previous manual system. However, Informant 2 revealed that patient tracking is only done for patients who come, while those who do not come are not detected. Informant 3 highlighted infrastructure issues, namely inadequate generators for medical equipment. Informant 4 added that microscope calibration has not been done despite attempts to write to the district office. Coordination between pharmacy and laboratory, according to Informant 5, still depends on the district office. Informant 6 revealed that the Health Office has not received TB reports from the Sinak Health Center, indicating that the monitoring system is still not really optimal. Informant 12 also added that TB cases are not recorded in the daily recap, which worsens recording and reporting.

Patient Factors

Based on interviews with informants, patients' experience of TB treatment is influenced by several factors. Informant 1 explained that patients who are educated tend to understand the importance of long-term treatment, such as six months of treatment. In addition, Informant 2 mentioned that people in the area generally have a high spirit to take their medication regularly, showing good enthusiasm for the treatment program. Informant 3 added that there is no negative stigma associated with TB, which makes treatment easier as people do not see TB as a disease to be shunned. However, technical challenges also exist, as Informant 4 expressed about inaccuracies in sample collection, which can affect the accuracy of diagnosis and treatment.

Informant 5 revealed that education can only be provided to patients who are present, while patients who do not come do not get the necessary information. Informant 16 mentioned that the fear of large medication sizes can reduce patients' willingness to take medication regularly. Therefore, to improve treatment success, attention needs to be paid to education, community support, proper sample collection, and overcoming psychological barriers related to medication. Most patients have low educational backgrounds, but if properly educated, they can understand the importance of completing six months of treatment. Education is usually only provided during counseling or when patients come to collect their medication.

Geographical

Based on interviews with informants, geographical factors are the main barrier to accessing health services at Puskesmas Sinak. Informant 1 explained that access to the puskesmas is often hampered by broken bridges due to bad weather or landslides, hampering transportation routes and slowing down services. Informant 2 and Informant 11 mentioned that the hilly terrain requires patients to walk 2-72 hours to reach the health center, which greatly worsens access to health services, especially for patients living in remote areas.

Informant 2 also added that the cold and humid weather in this region discourages patients from going outside, leading to delayed visits to health facilities. Informant 3 mentioned that although the roads are more level, landslides and rain still hamper the distribution of health services to other districts, although people often seek alternative routes.

Logistics distribution is also hampered, as explained by Informant 4 and Informant 5, who mentioned that delays in patient arrival and medicine delivery often occur due to difficult access to remote areas and disruption of air transportation due to bad weather. Informant 6 explained that poor environmental conditions, such as unhealthy air circulation from smoke in the honai, meant that patients needed to be referred to the city for better treatment. The unstable security situation, as mentioned by Informant 11, also limits services to the villages and results in services being limited to the puskesmas. Overall, geographical factors involving difficult terrain, bad weather, landslides and security conditions pose major challenges to ensuring optimal access to TB services in the region.

Geographical factors at Puskesmas Sinak are a major barrier to accessing health services. The hilly terrain and bad weather, such as landslides and rain, often hamper transportation, requiring patients to walk up to two hours to reach the health center. Cold and damp natural conditions also reduce patients' motivation to visit. In addition, infrastructure and transportation limitations, such as broken bridges or disrupted air transportation, slow down logistics distribution and drug delivery. Unstable security factors due to threats from the KKB restrict services to villages, resulting in limited services at the puskesmas. Overall, these geographical challenges hamper the effectiveness of TB services in the region.

Health Access

Community access to healthcare services at the Sinak Health Center is heavily influenced by geographic, transportation, and security factors. According to Informant 1, efforts to travel to villages for outreach services are hindered by security issues along the routes. Informant 2 mentioned that patients often have to walk between 30 minutes and up to 72 hours (including overnight stays along the way) just to reach the health center, due to hilly terrain and the absence of public transportation. Informant 3 added that home visits have never been conducted because of the long distances and security concerns, forcing health workers to wait for patients to come to the health center instead. Informant 4 also emphasized that the lack of transportation means the community must rely solely on walking to access healthcare services. Additionally, the distribution of medicine is hampered by transportation shortages. Informant 5 revealed that medicine deliveries are often delayed due to unfavorable weather conditions. Health surveillance in the area is extremely limited. As stated by Informant 6, the threats to security and difficult geographical conditions make health workers reluctant to conduct examinations outside the health center.

Political Situation

Based on interviews with informants, the tense political situation in 2024 hindered access to healthcare services at the Sinak Health Center. Informant 1 explained that healthcare services were temporarily halted due to security issues, with residents too afraid to leave their homes, preventing them from seeking treatment. Informant 2 added that outreach services such as mobile clinics and integrated health posts (posyandu) could not be carried out due to unsafe conditions. Security disruptions caused by armed criminal groups (KKB) also affected healthcare workers. As described by Informant 2, a hostage-taking incident made staff feel threatened and unwilling to continue services or facility development in the area.

Informant 3 confirmed that only safe areas could be served, indicating a strong dependency on security for the continuity of services. Delays in medical examinations and a decline in patient numbers also occurred due to public fear of unsafe conditions, as noted by Informant 4. Informant 5 explained that medicine distribution was disrupted because logistics retrieval was hindered by security threats. Moreover, Informant 6 stated that patient screening and tracing became impossible due to health workers' fear of traveling into unsafe areas.

Security Stability

According to the informants, the heightened political tensions in 2024 significantly impacted healthcare services at the Sinak Health Center, particularly with regard to the tuberculosis (TB) program. Informant 1 mentioned that when gunfire was heard, both patients and healthcare workers were afraid to leave their homes, leading to a suspension of services at the health center. The compromised security also meant that outreach activities such as mobile clinics and integrated health posts could not be carried out, limiting services only to safer areas. Informant 2 added that a hostage incident made healthcare workers feel threatened and unwilling to continue providing services in high-risk areas. They even expressed fear of becoming targets in the conflict. Informant 3 explained that services could only be provided in secure areas, while in vulnerable regions, normal healthcare operations were not possible. Informant 4 stated that many patients avoided seeking treatment due to unsafe conditions, causing delays in both diagnosis and treatment.

Furthermore, Informant 5 explained that medicine distribution was hampered because logistics could not be retrieved under security threats. Informant 6 added that screening and case-tracing activities had come to a halt as staff felt too unsafe to leave and perform their duties. Informant 11 noted that although emergency services were still operational, routine services such as home visits and other outreach activities had to be suspended due to ongoing threats. Informant 12 also pointed out that although security personnel were willing to escort healthcare workers, overly visible collaboration with the military or police could raise suspicion and increase safety risks for the staff. Therefore, they must approach such interactions with caution.

All statements indicate that the lack of security has severely affected the smooth implementation and effectiveness of TB services and worsened community access to timely treatment and medical examinations.

Social, Economic, and Cultural Factors

Based on interviews with informants, social, economic, and cultural factors play a significant role in tuberculosis (TB) management at the Sinak Health Center. Informant 1 revealed that low-income patients often prioritize working over seeking medical treatment, which hinders treatment adherence. Informant 2 stated that the local habit of chewing betel nut increases the risk of transmission, while Informant 3 highlighted respiratory issues caused by living in honai—traditional huts filled with smoke. Informant 4 added that the habit of spitting after chewing betel nut disrupts proper sample collection procedures and increases the risk of TB transmission.

Informant 5 explained that limited public awareness about the importance of treatment leads to a lack of proactive health-seeking behavior. Informant 6 noted that although the West Sinak area is safer, people there do not experience social stigma associated with TB. However, Informant 16 stated that the practice of living together with TB patients without proper isolation worsens the spread of the disease within families. These factors indicate that local culture and economic challenges are significant obstacles to TB control efforts in the area.

Language barriers also affect communication, especially for elderly patients who struggle to understand Indonesian, thereby limiting TB education efforts. Low income forces patients to choose between working and continuing their treatment. The habit of chewing areca nut and betel leaves worsens hygiene conditions and facilitates disease transmission, while inadequate housing—such as non-ventilated honai—exacerbates the condition of TB patients. These factors hinder both prevention and treatment, although strong family support remains a positive aspect in patient care.

Community Support

Based on interviews with informants, the TB program at Sinak Health Center faces major challenges due to its total dependence on the Puncak District Health Office. There is no external support from international institutions or non-governmental organizations in the form of funding, logistics, medicine, or medical equipment. Cross-sector coordination, including with security forces, is also limited due to sociopolitical considerations, which causes the TB program to operate in isolation without involvement from external stakeholders. Informant 1 mentioned that they have yet to receive any external support, while Informants 2 and 3 confirmed the program's reliance on the District Health Office for logistics and supplies. Informants 5 and 6 also noted that there is no formal mechanism to involve the military or police in the program, and support from NGOs has been absent since 2020.

There is potential for cross-sector support involving around 200 personnel from the military and police, but unfortunately, there has been no specific collaboration for the TB program, as explained by Informant 12.

Informant 16 described how families actively supervise patient treatment despite challenges such as large pill sizes. On the other hand, Informant 7 highlighted the active role of health volunteers in escorting patients from remote villages to the health center. Informants 8 and 9 emphasized the importance of collaboration between healthcare workers and security forces, which helps foster a sense of safety and support for health services. Informant 10 also noted that the Sinak community does not stigmatize TB patients, demonstrating a strong sense of social solidarity. Overall, despite the lack of external institutional support, community involvement plays a crucial role in ensuring the success of the TB program.

DISCUSSION

Human Resources

Human resources (HR) in the tuberculosis (TB) control program in Sinak District play a crucial role in determining the effectiveness of treatment and early detection. Based on SWOT analysis, the program's strengths include the presence of a complete set of professional personnel, such as doctors, nurses, laboratory analysts, and pharmacists, which facilitates the implementation of TB services. Additionally, the presence of midwives responsible for immunization and maternal and child health (MCH) is a key factor in prevention and early TB detection.

However, the shortage of personnel remains a major issue, as healthcare workers must cover an excessively large service area. The excessive workload – where nurses are required to handle multiple roles – leads to fatigue and may reduce the quality of healthcare services.

Program Implementation Management

The implementation of the TB program in Sinak District faces several weaknesses that can hinder the effectiveness and smooth delivery of services. One of the main issues is the lack of laboratory analysts and the limited availability of reagents, which leads to inaccurate lab test results. Moreover, the absence of a cross-checker for laboratory findings reduces diagnostic reliability. This increases the perceived barriers among healthcare providers in delivering appropriate treatment, as they lack accurate tools to properly diagnose TB.

According to the Health Belief Model (HBM), when healthcare providers perceive significant barriers to accurate diagnosis – such as lack of facilities or limited equipment – they are more likely to disregard or fail to follow proper treatment protocols, resulting in suboptimal care (Janz & Becker, 1984).

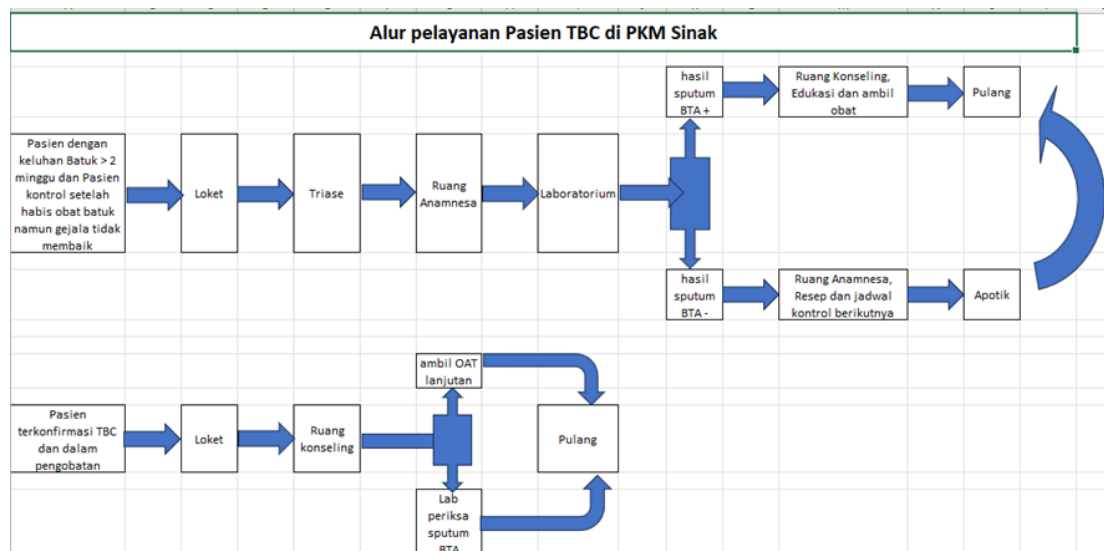


Figure 1. OAT and Diagnostic Aid Procurement Request Flow

Budget and Funding

Based on the analysis of budget allocation and funding mechanisms for the tuberculosis (TB) program in Sinak District, several key factors were found to influence the program's operational efficiency. One of the main strengths lies in the availability of essential medical supplies—specifically, anti-TB medications, vaccines, and diagnostic tools—which are consistently provided by the District Health Office. This steady supply is crucial in supporting the overall implementation of the TB control program.

In addition, the program benefits from the allocation of the Operational Health Assistance (Dana BOK) fund from the central government. This funding significantly aids day-to-day operations, including TB-related activities such as case finding, outreach, and follow-up treatments. Importantly, the head of the community health center (Puskesmas) is granted authority to manage operational funds with flexibility. This autonomy enables swift budget adjustments in response to emergent needs, enhancing the responsiveness of the healthcare service delivery.

However, a major challenge persists in the form of financial dependency. The program heavily relies on a single funding source—specifically, the District Health Office—without having any alternative or supplementary sources of funding. This reliance increases the program's vulnerability to budgetary disruptions and limits its ability to scale up or innovate in TB control efforts.

Drug Distribution and Availability

The distribution and availability of TB medication constitute a critical element in the success of TB prevention and control efforts in Sinak District. A notable strength of the program is the availability of Anti-Tuberculosis Drugs (OAT) and Bacillus Calmette-Guérin (BCG) vaccines, both supplied by the District Health Office. The delivery of OAT is demand-driven and based on the number of registered patients, which helps prevent overstocking and wastage of medical supplies.

Moreover, the availability of BCG vaccines adheres to the distribution standards established by the Disease Prevention and Control (P2) Division of the Ministry of Health. These vaccines play an essential role in the prevention of TB, particularly among infants and young children. The efficient coordination between healthcare providers and the District Health Office ensures that both the quantity and quality of TB medications are maintained to support effective treatment protocols in the region.



Figure 2. OAT and Diagnostic Aid Procurement Request Flow

Diagnostic Tools

Adequate diagnostic tools are critically important in implementing the TB control program in Sinak District. The availability of diagnostic equipment, including for sputum smear (BTA) examination and BCG vaccines provided by the District Health Office, is a key strength of the program. Nevertheless, there are several issues that need to be addressed to ensure accurate TB diagnosis. Some of the available diagnostic tools are not properly calibrated, which poses a risk of inaccurate results, particularly in sputum BTA examinations that often produce false negatives (Nuryaningsih et al., 2023). Furthermore, the limited availability of alternative tools such as GeneXpert for molecular diagnosis and LED microscopes for sputum examination constrains early detection capacity and optimal TB case monitoring (Murib et al., 2024).

Monitoring and Evaluation System

The success of TB control efforts is significantly influenced by an effective monitoring and evaluation (M&E) system. One of the program's main strengths is the adoption of the SITB application, which began implementation in early 2025 to support digital reporting. This application facilitates electronic recording and monitoring processes. Training TB program staff to improve their electronic documentation skills is also an essential step to enhance the quality of TB case reporting and tracking (Rosiska et al., 2019). However, the system has not yet been fully integrated and still experiences problems in manual data entry, which can lead to errors in patient case reporting. The use of the SITB application also faces challenges due to the unstable internet network in Sinak District.

Patient Factors

Patient adherence to TB treatment is a crucial factor in the program's success. A key strength of the program is the high level of patient knowledge regarding TB treatment, reflected in their strong adherence to completing the six-month therapy regimen (Padang et al., 2022). Strong family support also plays a significant role in motivating patients to follow through with their treatment until completion.

Geographical Factors

The main geographical challenge in TB control in Sinak District is the difficult transportation access and extreme weather conditions, which hinder the distribution of medicines, medical personnel, and health services. Moreover, limited infrastructure and communication systems exacerbate the situation. To overcome these challenges, alternative strategies can be adopted, such as utilizing communication and transport technologies like helicopters or drones for delivering medicine and healthcare personnel to remote areas, satellite phones for telemedicine consultations with doctors, and the use of radio and handy talkies in areas without mobile network coverage.

Healthcare Access

Difficult terrain and limited road access reinforce interview findings regarding service delivery barriers. Integrating spatial data helps assess the alignment between field experience and actual geographic conditions, and clarifies the distribution challenges of healthcare services in remote areas.

Political Situation

The political situation in Sinak District has a significant impact on the implementation of the TB control program. The continued commitment of the central government to the TB program, even amid political instability, is a supporting factor for the program's continuity. The central government, through the Health Office, ensures the distribution of necessary medicines and diagnostic tools and upholds national policies supporting TB elimination. However, a major challenge lies in the dependency on local government policies, which are often influenced by unfavorable local political dynamics for TB control efforts.

Security Stability

The unstable security situation in Sinak District greatly affects the TB control program. Ongoing tensions and armed conflicts in the region obstruct the delivery of medical logistics, including essential medications and diagnostic tools needed for early TB detection. This instability also disrupts health services, particularly in monitoring patients undergoing routine treatment or conducting home visits to track TB patients' progress.

Social, Economic, and Cultural Factors

In the context of TB control, social, economic, and cultural factors play a crucial role in the program's success. Based on the situational analysis, multiple factors

influence the program's effectiveness, including both community support and challenges arising from social and cultural conditions. One of the main strengths is the presence of strong family support, which enhances patient adherence to treatment—especially through assistance with medication intake and laboratory follow-up. Support from traditional leaders or local community figures is also vital in reinforcing health messages within the community.

Community Support

In the context of TB control, social, economic, and cultural factors play a crucial role in the program's success. Based on the situational analysis, multiple factors influence the program's effectiveness, including both community support and challenges arising from social and cultural conditions. One major strength is the absence of stigma in the community that would marginalize TB patients. On the contrary, the community feels grateful when the disease is diagnosed and treatment is available. Support from traditional leaders or local community figures also plays a key role in reinforcing public health messages within the community.

CONCLUSIONS AND RECOMMENDATIONS

In the implementation of the tuberculosis (TB) control program in Sinak District, this study identified both internal and external factors influencing its effectiveness. The internal factors identified and analyzed include the limited quantity and quality of human resources, suboptimal program management, full dependence of program funding on the District Health Office, disrupted distribution and availability of medicines and diagnostic tools due to weather conditions, extreme topography, and security issues. Other internal issues involve inadequate diagnostic equipment, the absence of a well-established monitoring and evaluation system, and problems arising from within the TB patients themselves and their surrounding environment.

Meanwhile, the external factors identified and analyzed include extreme geographical conditions, limited and difficult access to healthcare facilities due to inadequate infrastructure and the absence of land transportation, a politically unstable environment, ongoing security threats due to the presence of armed criminal groups (KKB), and socio-economic and cultural conditions that do not sufficiently support the effectiveness of the TB program. In addition, there is a lack of external support to sustain the implementation of the TB control program in Sinak District.

There are numerous strategic opportunities and innovations that could be implemented to enhance the effectiveness of the TB control program in Sinak District. These include the use of technological support, policies from the local government, and maximizing the involvement of external cross-sectoral support, which will be further elaborated in the recommendation section below.

Sinak Health Center (Puskesmas Sinak) can enhance the effectiveness of the TB control program by leveraging the strengths and opportunities previously analyzed through a SWOT matrix, as outlined below:

- a. Recommendations for the internal operations of the Puskesmas:
Strengthen internal partnerships to enhance TB screening and tracing in coordination with the Immunization and Maternal and Child Health (MCH) programs. Involve Puskesmas staff in specialized TB training and cross-program multitasking skills to ensure that program implementation, workload, and reporting are not dependent on a single individual. Conduct continuous training for community health volunteers (cadres), who will also serve as Directly Observed Treatment (DOT) supervisors (PMOs) in their villages. A portion of the Operational Health Fund (BOK) should be allocated specifically for TB program activities.
- b. Recommendations for the Puncak District Health Office:
Implement a cross-checking system and regular calibration of diagnostic equipment to ensure the accuracy of test results. Conduct regular evaluations and monitoring of DOTS implementation at the Puskesmas. Shorten the supply chain by establishing a pharmaceutical warehouse in Timika to reduce distance and delivery time. Provide continuous training for Puskesmas staff to maintain the quality of healthcare personnel in Puncak District.
- c. Recommendations for the Puncak District Government:
Formulate and enact a regional regulation (Perda) on the protection of healthcare workers and their families, including the imposition of a "Head Payment Fine" penalty on anyone who threatens their safety, so that healthcare workers can reside and serve in the community without fear or pressure. Enact a regulation allocating a portion of Village Funds to health-related expenses, such as transportation costs for cadres to the Puskesmas, communication tools for village cadres to stay in contact with Puskesmas doctors during emergencies, and printing educational media (posters and leaflets) about TB to be distributed within the village. Another regulation should mandate Village Funds allocation for road infrastructure maintenance to improve community access to essential services.
- d. Recommendations for cross-sectoral stakeholders within the operational area of Sinak District:
Security forces from various units should ensure the safety of healthcare workers and their families, support medicine distribution using drones and security vehicles, assist with patient evacuation using ground vehicles or helicopters when weather conditions prevent planes from landing at the airport. Security personnel can also serve as PMOs during village patrols by delivering TB medications or collecting sputum samples for laboratory analysis at the Puskesmas. Contractors operating in the area can be involved through their CSR programs in the health sector, such as supplying fuel for Puskesmas generators, offering patient transport on company aircraft, and assisting with patient evacuation using company-owned land vehicles. Students from Berea Bible School, as well as local high school and junior high school students, should be

trained and empowered as TB Ambassadors, PMOs, and health educators in the Dani language. During weekends, when they return to their villages, they can help disseminate health information and deliver TB medications to patients living in remote areas to prevent treatment discontinuation.

It is expected that the implementation of these potential recommendations—optimized from the available opportunities—will significantly improve the effectiveness of the TB control program in Sinak District.

ADVANCED RESEARCH

This study is limited to identifying the internal and external factors influencing the TB control program in Sinak District and formulating potential innovative strategies that can be implemented based on field conditions using a qualitative approach. A quantitative study is needed to assess the extent to which these internal and external factors affect the effectiveness of the TB control program in Sinak District, as well as to measure the magnitude of change that occurs when the proposed potential strategies are implemented at the Sinak Health Center.

ACKNOWLEDGMENT

The author extends sincere gratitude to all parties who willingly participated and supported this research from beginning to end.

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