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Article

The Tuberculosis Program : A Managerial Epidemiology Perspective

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Abstract

Background: Tuberculosis (TB) remains a global health problem, including in Indonesia. The East Nusa Tenggara Province Health Center (SITB) reported 10,110 TB cases (56%) in 2024. Tuberculosis (TB) remains a significant public health problem in Indonesia, including in Kupang Regency, East Nusa Tenggara Province. The gap between the estimated number of TB cases and the cases that were successfully detected and reported indicates that there are still various challenges in implementing TB control programs at the regional level. These challenges relate to managerial aspects, resource availability, health care systems, and community involvement. **Objective**: This study aims to describe the implementation of the tuberculosis program from a managerial epidemiology perspective in Kupang Regency in 2025. **Methods:** This study used a descriptive research design. Data were obtained through in-depth interviews with TB program managers at primary and referral health care facilities. **Results:** The results of the study indicate that the implementation of the TB program in Kupang District has not been optimal in almost all managerial and service components.

Keywords: *Managerial Epidemiology, TB Program Effectiveness, Kupang Regency*

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1. Introduction

The 2023 Global TB Report shows that Indonesia is the country with the second highest estimated TB burden after India, with an incidence rate of 1,060,000 cases or 385 per 100,000 population and a mortality rate of 141,000 or 51 per 100,000 population. Additionally, current challenges that require attention include drug-resistant TB (DR-TB), TB-HIV co-infection, TB in children, and TB in the general population, as well as in specific or vulnerable groups.

According to data from the East Nusa Tenggara Province tuberculosis information system (SITB) for 2024, 10,110 cases of TB (56%) have been detected. There are still around 7,851 of the 17,961 TB cases that have not been detected or reported. Undetected cases

can be a source of TB transmission in the community. Meanwhile, the achievement of TPT administration in 2024 based on SITB data on household contacts was 13% (target 58%). This certainly indicates that there is still a gap in TB case detection, treatment success, and TPT administration. TB case detection in Kupang District in 2024 was 454 cases (38%), with approximately 755 cases still undetected from the target of 1,209 [1]

Efforts to combat TB in Indonesia have focused on promotion and prevention, although treatment and rehabilitation remain necessary[2] Improving access to comprehensive health care facilities is an important strategy for reducing morbidity, disability, and mortality due to TB, as well as breaking the chain of transmission.[3] However, one of the major challenges in TB control efforts is accurate and rapid diagnosis. Early detection of TB is crucial for initiating appropriate treatment and preventing drug resistance, which often poses a challenge in TB control, especially in drug-resistant TB (TB-RO)[4]The national TB control program has implemented TB prevention policies outlined in the 2020-2024 national strategy, one of which is the provision of Tuberculosis Prevention Therapy (TPT) to household contacts, people living with HIV (PLHIV), and other at-risk groups. The results of modeling conducted by Dye et al., 2013[5] show that the End TB Strategy target for 2035 can only be achieved by combining effective active TB treatment efforts and TB prevention efforts with the provision of PPT in cases of Latent Tuberculosis Infection (LTBI).[6]

This shows that the End Tuberculosis (TB) Strategy target for 2035 can only be achieved by combining effective active TB treatment efforts and TB prevention efforts with the administration of PPT (Protein Treatment) in cases of Latent Tuberculosis Infection (LTBI). The spread of the disease is driven by infectious agents, both viruses and bacteria, which have a high transmission capacity between individuals, whether through direct or indirect contact. In environments with high HIV prevalence and malnutrition, diagnosis may be more difficult because the disease can present with nonspecific symptoms and signs, and the diagnostic performance of tests may have minimal sensitivity[7] Tuberculosis, as one of the infectious diseases with a significant impact on public health, is currently a major focus of attention in Indonesia. Mycobacterium tuberculosis is the causative agent of tuberculosis, a chronic infectious disease that can be fatal[8]Tuberculosis can affect all organs and systems of the body, caused by the Mycobacterium tuberculosis bacillus. In particular, the bacillus that settles in the lungs and larynx of patients can be transmitted through the respiratory tract. The transmission of this disease is influenced by many factors, and the risk of infection increases in people who have had close contact with an infected individual[9]

Many factors have caused TB treatment coverage to be less than optimal, including trained human resources being transferred to other places (especially in community health centers), monitoring and evaluation being conducted monthly through monthly Zoom meetings, district, provincial, and central level meetings being held offline every semester and attended by program managers, and the commitment of leaders in program supervision not being optimal. the implementation of Tuberculosis Prevention Therapy still faces challenges in terms of public understanding of the importance of TPT, cross-program collaboration is not yet optimal, community involvement in identifying suspected cases and directing them to health services is not yet optimal, and online evaluation of program implementation has never been evaluated [10]

The epidemiological management approach plays a role in managing and controlling TB diseases that pose a risk to the community. This is because 1). The degree of TB transmission is still high and has a negative impact on the welfare of the community, so it needs to be identified and controlled; 2). The quality of life of the community is vulnerable to TB transmission, which requires an epidemiological management approach so that all components are actively involved in control; 3). Effective prevention as a TB management strategy helps reduce the high cost of TB treatment; 4). The economic conditions and welfare of the community improve because control strategies help boost community productivity; 5). Epidemiological management can reduce health disparities between different groups and communities and promote

equity; 6). Epidemiological management increases community trust in the health system, thereby increasing community participation in health programs; 8). Epidemiological management helps anticipate health crises, thereby reducing negative impacts on the community.

This study was conducted to answer these questions through an epidemiological management analysis of the TB control program in Kupang District in an effort to achieve the 2030 TB elimination target. Through this epidemiological management approach, it is hoped that it can help provide the data and information needed to support effective health policies in TB control and help improve the quality of life of patients by identifying patient needs and preferences so that strategies can be developed to improve quality of life.

2. Materials and Methods

The research method used in this study was descriptive research, which is research to create an overview of a situation or event, so this method was used to accumulate basic data[11]This study aimed to describe the implementation of the Tuberculosis (TB) Program from a managerial perspective. The data were sourced from interviews with TB program managers at primary and referral health care facilities. The information gathered included aspects of planning, implementation, resources, cross-sector coordination, monitoring and evaluation, and obstacles to TB program implementation.

3. Results

Table 1. Managerial Aspects in the Implementation of the Tuberculosis Program in Kupang District

Managerial Aspect	Key Findings	Field Conditions
Leadership Commitment & Support	Commitment varies between facilities	Some health center heads actively support TB programs through regular discussions and evaluations, but others have not made TB a top priority.
Program Planning	Not yet fully based on epidemiological analysis	Planning is still routine and annual, without root cause analysis, regional risk mapping, or optimal use of epidemiological data.
Funding	Funding is limited and inflexible	Funding allocations from the BOK/APBD range from 7 to 15 million per year, which is insufficient for active case finding, contact investigation, infection control, and field operations in difficult areas.
Human Resources Role of Cadres & Community	High workload and suboptimal capacity Cadres exist but are not active	Program managers often take on other tasks, and not all of them receive adequate TB training.
Role of Cadres & Communities	Cadres exist	Cadres exist, but are inactive Many TB cadres are inactive because there are no official decrees, incentives, or ongoing support. The involvement of community leaders remains passive.
TB Promotion & Education	Education is not specific or ongoing	Promotional activities are generally combined with integrated health service posts (posyandu/posbindu), so that TB messages are not conveyed in depth and have not reached all levels of society.

Managerial Aspect	Key Findings	Field Conditions
Cross-Sector Coordination	Not yet integrated and effective	Collaboration with villages, schools, churches, and other sectors is not yet structured in TB program planning and follow-up.
Monitoring Evaluation Managerial	Not routine and lacking focus Key Findings	Monitoring and evaluation activities are often combined with other programs, and specific TB supervision is rarely carried out. Field Conditions.
Aspects & Leadership	Commitment varies between facilities	Some health center heads actively support the TB program through regular discussions and evaluations, but others have not made TB a top priority.
Leadership Commitment & Support	Commitment varies between facilities	Some health center heads actively support the TB program through regular discussions and evaluations, but others have not made TB a top priority.

Based on the Tuberculosis (TB) Program Implementation Table in Health Facilities, it is known that the implementation of the TB program in Kupang District still faces various obstacles in almost all managerial and service components. The commitment and support of health facility leaders vary, with some health center heads actively promoting TB program achievements through routine evaluations and internal discussions, while others have not made the TB program a top priority. From a planning perspective, the TB program is not yet fully based on epidemiological analysis. Planning is still routine and annual in nature, without being supported by root cause analysis, regional risk mapping, or optimal utilization of TB epidemiological data. This situation has an impact on the inaccuracy of priority setting and the implementation of intervention strategies. Funding for the TB program is considered limited and inflexible. Funding allocations from the BOK and APBD range from 7 to 15 million rupiah per year, which is insufficient to support active case finding, contact investigation, infection control, and field operations in areas with geographical challenges. In terms of human resources, the workload of TB program managers is high because they have to juggle several other programs. In addition, not all TB managers have received adequate specialized TB training. TB cadres are actually available in almost all working areas, but most are inactive due to the absence of official decrees, incentives, and ongoing mentoring. TB promotion and education have been carried out, but they are not yet specific and continuous. TB education is generally combined with posyandu or posbindu activities, so the messages conveyed are not in-depth and do not reach all levels of society.

Table 2. Service and Operational Aspects in the Implementation of the Tuberculosis Program in Kupang District

Service & Operational Aspects	Key Findings	Field Conditions
TB Case Detection	Case detection is still dominated by a passive approach	Active case finding efforts are constrained by difficult geographical access, low public awareness, and limited number and capacity of health workers.

Service & Operational Aspects	Key Findings	Field Conditions
Contact Investigation	Contact investigation implementation is not yet optimal	Contact investigation is hampered by geographical conditions, refusal from the patient's family, limited transportation funds, and weak cross-sector coordination.
Tuberculosis Prevention Therapy (TPT)	PMT coverage remains low.	Rejection of TPT occurs because families feel healthy, are concerned about the side effects of the medication, and due to limited availability of TPT medication.
Diagnostic Facilities (TCM)	Access to TB diagnosis services is limited	Most community health centers must refer samples to other facilities, with constraints in terms of distance, transportation, and logistics systems.
TB Infection Control	Infection control is not yet optimal	TB service rooms are still combined with general clinics, patient flow is not yet separated, and the availability of masks and personal protective equipment is still limited.
Recording and Reporting (SITB)	Reporting is not yet done in real time	SITB data entry is often delayed due to limited internet connectivity, resulting in untimely reporting.
Socio-Cultural Factors	Perceptions of risk and stigma surrounding TB remain high.	TB is still considered a common disease or a curse; risky behaviors such as spitting indiscriminately and stopping treatment prematurely are still found.

According to (Pradipta et al., 2025), empowerment refers to an effort to give power or strength to those who tend to be subordinate or weak so that a balance is formed.[12] Meanwhile, the strategy recommended by the WHO for low- to middle-income countries is public-private partnerships that enable communities to play a role in tuberculosis (TB) services while reducing patient care costs and further easing the workload of staff. The Indonesian Ministry of Health envisions fostering an independent community that embraces healthy living through TB control initiatives that actively involve the community. However, the identification of suspected and confirmed TB cases through health facilities is still not optimal, highlighting the need to improve TB case finding programs by increasing community involvement in the region. By involving local communities, effective education on health issues and encouragement of health-related behavioral changes can be implemented, empowering communities with greater independence and knowledge. In the context of community empowerment in TB control, guidelines for the treatment of new TB patients and the prevention of drug-resistant bacteria (DR) are outlined in the TB Guidebook. Furthermore, it is mentioned that it is

important for a PMO (Medication Supervisor) to be able to directly supervise patients in order to achieve a consistent medication schedule and comply with instructions so that drug resistance can be avoided. Dwi Sarwani et al. (Suharyo et al., 2017) add that household contacts can increase motivation and improve treatment consistency for pulmonary TB patients, thereby facilitating recovery and helping to prevent multidrug resistance (MDR). This is in line with the fact that increased motivation and regular treatment can prevent drug-resistant diseases. As one of the case studies on community empowerment in TB control.[13]

In terms of services, TB case detection is still dominated by passive detection. Active case finding and contact investigation efforts have not been optimal due to limited personnel, difficult geographical access, resistance from families, and limited transportation funds. The implementation of Tuberculosis Prevention Therapy (TPT) is also not optimal, mainly due to low public understanding, concerns about drug side effects, and limited availability of TPT drugs. Access to TB diagnostic facilities, particularly Rapid Molecular Tests (RMT), is still limited because most community health centers must refer samples to other facilities, which poses distance and logistical challenges. TB infection control in health facilities is also not yet optimal, as evidenced by the lack of dedicated TB rooms, the absence of separate patient flow, and limited personal protective equipment. In terms of recording and reporting, the Tuberculosis Information System (SITB) is not yet filled in in real time due to internet connectivity issues, resulting in delayed reporting. Monitoring and evaluation of the TB program have not been carried out routinely and specifically, and cross-sectoral cooperation is still partial and not integrated into program planning and follow-up. In addition, socio-cultural factors, such as low perception of TB risk and strong stigma against TB patients, also influence the success of TB program implementation in Kupang District.

4. Discussion

1. **Effectiveness of the TB Program**

Findings in the Tuberculosis Program Implementation Table show that the effectiveness of the TB program in Kupang District is still low, as reflected in the suboptimal detection of cases, contact investigation, and implementation of Tuberculosis Prevention Therapy (TPT). This condition is largely constrained by limited resources, planning that is not fully epidemiology-based, and low community involvement. Nevertheless, the provincial government's commitment to regional policies that support efforts to accelerate TB control at the provincial level presents a significant opportunity for optimizing the TB program. This is in line with the findings of Handayani et al. (2020), which indicate that the adequacy of facilities and infrastructure is one of the key elements influencing the success of tuberculosis control program implementation. Each community health center needs to provide adequate facilities and infrastructure, in terms of quality, completeness, and quantity, in order to support the performance of health workers in carrying out their duties optimally. [14]

The policies referred to include: (a) Governor Regulation No. 35 of 2024 concerning the Acceleration of AIDS, Tuberculosis, Malaria (ATM) and Other Infectious Diseases Control; (b) Governor Decree No. 278/Kep/HK/2024 concerning the Task Force for ATM and Other Infectious Diseases Control; (c) East Nusa Tenggara Governor Regulation No. 40 of 2025 concerning the Regional Action Plan for Tuberculosis Control in NTT Province for 2025-2029; (d) Governor Circular Letter on support for the implementation of ATM and other infectious disease control; and (e) Governor Circular Letter on the follow-up to the Central and Regional Coordination Meeting on accelerating TB elimination in NTT Province. The Kupang Regency Government has a Regional Regulation on TB and a Decree on TB Control, but does not yet have a Regional Action Plan (RAD) for TB. The RAD TB document is very important because it contains action plans developed by the local government to control and eliminate TB in the region. The RAD TB is generally developed based on the national TB control strategy and

adapted to the conditions and needs of the region within a certain period of time, usually 5 years. This document serves as a reference for local governments, health organizations, and other stakeholders in controlling TB in the region. The absence of a RAD TB in Kupang Regency means that there are no clear operational guidelines for implementing TB programs at the regency level. TB management should be based on an analysis of the local TB situation, TB control objectives and targets, effective control strategies and actions, performance indicators and targets to be achieved, required resources, and TB program monitoring and evaluation mechanisms. Several factors that affect the effectiveness of the TB program in Kupang Regency include: (a) Limited resources, including an inadequate number of health workers, limited funding, and a lack of TCM equipment; (b) Suboptimal data analysis, in which epidemiological data analysis has not been carried out optimally so that the output achieved does not meet the TB program indicator targets; (c) High community stigma against TB patients, resulting in many undetected cases that do not receive treatment.

To improve the effectiveness of the TB program in Kupang District, improvements need to be made to inputs, processes, outputs, and impacts, such as:

a) Increasing resources by adding more trained health workers, increasing adequate funding allocations, and providing sufficient TCM equipment to meet needs;
b) Improving data analysis capacity through regular training for program managers in analyzing and utilizing epidemiological data for TB program planning and evaluation;
c) Reducing community stigma through increased education and awareness about TB, as well as stigma reduction for TB patients through a community-based approach involving community leaders and health cadres [15]

2. Planning Process

The stages of TB program planning in Kupang District have been carried out in accordance with managerial standards. The TB epidemiological management planning that has been implemented includes: (a) Situation analysis, which involves analyzing the TB situation in the area, including the number of cases, treatment success rates, and available resources; (b) Goal identification, which involves identifying the goals and objectives of the TB program, such as reducing the number of TB cases, improving treatment success rates, and reducing drug resistance; (c) Strategy development, which involves developing strategies to achieve TB program objectives such as increasing public awareness, improving service quality, and reducing drug resistance; (d) Resource 6 8 allocation, which involves allocating available resources to achieve TB program objectives such as health workers, funds, and facilities; and (e) Monitoring and evaluation, which involves monitoring and evaluating TB programs to ensure that program objectives are achieved. The planning process is very important in TB epidemiological management because it can help improve program effectiveness through the establishment of appropriate priorities based on disease burden, optimizing the use of limited resources to be more efficient and have maximum impact, improving the quality of TB services in health facilities, reducing drug resistance through appropriate treatment strategies, and ensuring the achievement of TB elimination goals in line with the set targets [16]

3. Implementation Process

The implementation stages in Kupang Regency are not in line with management concepts, the TB service flow is inconsistent and discontinuous, and has an indirect impact on the environmental conditions and the success of the TB program. This is due to:

a. In the implementation of the plan, the budget used was from the previous year; thus, it did not fully address the needs in the field, namely the success of the program.

b. The results of the study show that although TB cadres are available in most work areas, the inactivity of cadres due to the lack of legality and incentives has an impact on the low level of community involvement in case detection and TB education.
c. Case finding strategies are still dominated by case holding/waiting for new suspected cases to be reported to the locus. This occurs because managers are alone and have limited reach. TB managers at community health centers also have multiple tasks.
d. Public awareness has not yet reached 100% trust in medical treatment. Non-medical treatment (spiritual/traditional medicine) still touches on the self-confidence of TB patients or their families. This is because patients' knowledge about TB is still low, there is stigma towards patients that makes them feel ashamed/anxious, and patients are concerned about the side effects of TB drugs. Patients are more motivated and enthusiastic to recover when they meet a prayer leader than a health worker.

In the implementation of TB epidemiological management, several steps need to be taken, namely:

a. Organization: Organizing available resources, such as health workers, funds, and facilities, to achieve TB program objectives.
b. Direction: Directing TB program activities, such as case finding, treatment, and surveillance, to achieve TB program objectives.
c. Monitoring: Monitoring TB program activities, such as case finding, treatment, and surveillance, to ensure that TB program objectives are achieved.
d. Evaluation: Evaluating the TB program to ensure that TB program objectives are achieved and to identify areas for improvement.

The implementation phase is very important in TB epidemiological management because it can help improve program effectiveness, optimize resources, improve service quality, reduce drug resistance, and increase public awareness about TB.

4. Intervention Strategies

Public health programs have used various strategies to improve compliance at the health system level through financial incentives and to offset the costs of TB treatment and training for health care providers.[17]One of the most commonly used adherence interventions is the DOT strategy, in which health workers, family members, or community members observe patients taking their TB medication. Interventions developed to improve adherence and self-management in TB patients are mostly a combination of several interventions such as health education, psychoeducation, and behavioral therapy. Multicomponent programs include several interventions such as behavior change, social and family support, computer-based therapy and technology, and patient and family counseling.[18]In recent years, video-observed therapy (VOT) has gained attention as an alternative way to provide DOT. Other interventions aimed at supporting adherence through DOT include incentives, which are material or financial rewards given to those who comply with treatment, and availability, which is an intervention that enables patients to overcome economic barriers related to DOT, such as absence from work or direct and indirect costs of accessing TB treatment. Other interventions focus on providing education about TB, its treatment, and prevention to help patients make informed decisions and healthcare teams provide patient-centered care. Patient reminder and tracking systems are designed to help patients keep appointments and take action when they miss appointments. These interventions include reminder letters, phone calls, home visits, and text messaging technology. Psychological interventions aim to provide support through psychological or emotional counseling or social networks for those undergoing TB treatment as a means of improving adherence to TB treatment[19]

The intervention strategies implemented by Primary Health Care Facilities (FKTP) in Kupang District include several activities. First, TB health education is conducted during community health center (puskesmas) or integrated health service post (posyandu) activities, but its implementation is combined with other program activities, making it less effective and not focused on TB education. Second, individual or community-based TB screening is conducted, but it is still hampered by a lack of community cooperation in participating in screening. Third, notified patients are immediately given treatment, and close contacts or household members are screened and given Tuberculosis Prevention Therapy (TPT). Fourth, social support to encourage patients to undergo examination and intensive treatment is provided by health workers or Drug Adherence Supervisors (PMO). Fifth, Kupang Regency has not maximized the use of digital technology to improve TB case detection and treatment.

In implementing intervention strategies, several important considerations must be taken into account. First, suitability to needs, meaning that intervention strategies must be tailored to the specific needs of the community and the characteristics of TB patients in the area. Second, availability of resources, meaning that intervention strategies must be implementable with available resources and not require unrealistic resources. Third, effectiveness: intervention strategies must be proven effective in increasing case detection and TB treatment success based on scientific evidence. Fourth, usefulness: intervention strategies must provide tangible benefits to the community and TB patients in both the short and long term.

The stages of the intervention strategy are crucial in enhancing the effectiveness of TB programs and achieving the goal of eliminating TB by 2030 in line with the End TB Strategy. Targeted and evidence-based strategies will accelerate the achievement of TB elimination targets.

5. Monitoring and Evaluations and Surveilans

In implementing the national TB elimination strategy, monitoring, evaluation, and reporting are carried out to ensure that indicators are achieved and to determine the progress of TB elimination acceleration activities. Monitoring is carried out routinely and periodically to quickly detect problems during program implementation so that corrective action can be taken immediately. Evaluation is carried out to assess the extent to which the objectives, indicators, and targets that have been set have been achieved. Evaluations are conducted over a longer period of time, usually every 6 months to 1 year. [20]However, in practice, the monitoring and evaluation (M&E) stages are not carried out routinely by the Health Office at the district or provincial level. After the COVID-19 pandemic, M&E was conducted online via the Zoom platform. This method is considered ineffective because it does not reflect the actual conditions in the field. In addition, not all community health centers have internet access that supports Zoom, and the opportunity to explain or describe the actual conditions is limited or even non-existent due to time constraints and the large number of participants. Surveillance includes passive and active surveillance, but is dominated by a case management approach where officers more often wait for reports of suspected cases at health centers. The community is also involved in surveillance activities, such as schools, churches, places of worship, youth groups, and markets, but this involvement is not yet well organized and sustainable. Monitoring, evaluation, and surveillance can be carried out in several more effective ways. First, data collection, which involves the systematic collection of data on TB program performance, such as the number of cases found, treatment coverage, and treatment outcomes. Second, data analysis, which involves conducting periodic data analysis to identify the weaknesses and strengths of TB programs and TB epidemiological trends in the region. Third, program evaluation involves periodic evaluation of TB programs to determine whether program objectives have been achieved and to identify obstacles that need to be overcome. Fourth, reporting involves reporting the results of monitoring and supervision to stakeholders in a timely manner to support data-driven decision-making.

5. Conclusions

a. The stages of the TB program planning process are appropriate/epidemiology-based and directly related to the effectiveness of the TB program.
b. The stages of the TB program implementation process in the field based on the concepts of management, health services, and environment are not appropriate, not sustainable, and do not have a direct impact on the effectiveness of the TB program. The bivariate test shows that the concepts of management and environment are significant, or directly related to the effectiveness of the TB program; however, the concept of health services is not significant.
c. The stages of the TB program intervention strategy are appropriate/epidemiology-based and directly related to the effectiveness of the TB program.
d. The stages of the TB program monitoring, supervision, evaluation, and surveillance processes are appropriate/epidemiology-based and directly related to the effectiveness of the TB program.

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7. Conflicts of Interest

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