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Original Article

Challenges and strategies of implementing active case finding for tuberculosis: A qualitative study at a high-burden primary healthcare center, Yogyakarta, Indonesia

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Abstract

Tuberculosis (TB) remains a major public health problem in Indonesia, and strengthening active case finding (ACF) is essential to improve early detection and interrupt transmission in high-burden settings. This study aimed to analyze the implementation of TB ACF at Depok II Primary Health Center, Sleman, Indonesia, using the Donabedian framework consisting of input, process and output components, with a focus on implementation processes, challenges, and strategies from a health promotion perspective. A qualitative case study design was employed. Data were collected through in-depth interviews, field observations, and document reviews involving 14 informants, including primary health center staff, district health office representatives, community health cadres, TB patients, a community leader, and a representative from a non-governmental organization. Data were analyzed thematically using the Miles and Huberman framework with support from NVivo version 12. The findings showed that the input component was generally well established, supported by policy commitment, multidisciplinary human resources, adequate basic logistics, program financing, and strong multisectoral partnerships, although challenges remained in village-level budget execution, limited cadre incentives, and dependence on external diagnostic services such as mobile chest X-ray. The process component was generally effective, characterized by structured service delivery, adaptive outreach strategies, strong health education, and patient-centered implementation. However, variation in community responsiveness, internalized stigma, and referral delays remained important barriers. The outcome component was reflected not only in case detection, but also in improved community awareness, acceptance of diagnosis, treatment adherence, and recognition of TB symptoms. Overall, TB ACF at Depok II Primary Health Center was generally effective and supported by strong system readiness and community engagement; however, its sustainability requires strengthened financing, referral access, and health promotion capacity to address remaining operational, behavioral, and social challenges.

Keywords: Tuberculosis, active case finding, health promotion, primary health center, qualitative study

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Introduction

Tuberculosis (TB), caused by *Mycobacterium tuberculosis*, remains a major cause of morbidity and mortality worldwide [1]. Although the World Health Organization (WHO) declared TB a global emergency in 1993, the disease continues to pose a substantial public health threat, particularly in high-burden countries such as Indonesia [2]. In 2023, TB again became the leading

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cause of death from a single infectious agent, with more than 10 million new cases reported globally [3]. Indonesia remains one of the countries contributing the highest number of TB cases, highlighting the need for stronger detection, treatment, and prevention strategies [4]. In response to this burden, Indonesia established the National Tuberculosis Control Strategy 2020–2024. However, progress was disrupted by the coronavirus disease 2019 (COVID-19) pandemic, prompting the development of an acceleration plan for 2025–2026 to support the national target of reducing TB incidence to 65 cases per 100,000 population by 2030 [5]. Despite these efforts, disparities in case detection and treatment outcomes remain evident across regions.

At the local level, Sleman Regency, Yogyakarta Province, reported 450 TB cases across 25 primary health centers in 2024, with Depok II Primary Health Center (PHC) recording the highest number of cases, accounting for 10.89% [6]. This setting is characterized by high population density and considerable mobility due to its proximity to educational institutions, boarding houses, and urban economic centers. Such conditions may increase TB transmission risk and complicate continuity of care, treatment follow-up, and contact investigation. These characteristics make Depok II PHC an important setting for examining TB control implementation.

Because TB is a highly transmissible airborne disease, active case finding (ACF) is essential to identify cases earlier, interrupt transmission, and expand access to treatment. ACF involves proactive screening among populations at risk, including household contacts, people living with HIV, individuals with chronic illnesses, and groups with limited access to health services. Compared with passive case detection, ACF may reduce diagnostic delay and identify undiagnosed cases earlier [7]. In Yogyakarta, this approach has been strengthened through initiatives such as Zero TB, which integrate active screening into broader TB control efforts.

However, ACF implementation remains challenging. Community misconceptions, stigma, limited resources, and operational barriers may reduce participation in screening and delay follow-up [8]. Preventive interventions for close contacts also require sustained monitoring because an initial negative result does not eliminate future risk [9]. In addition, health system constraints, including dependence on referral services and limitations in infrastructure and workforce capacity, may reduce the effectiveness of ACF implementation [10]. Therefore, successful ACF requires not only technical screening activities but also strong service organization and community engagement.

From a health promotion perspective, the effectiveness of ACF depends on its ability to influence health-seeking behavior, improve adherence, reduce stigma, and strengthen community participation in TB prevention and control [11]. Communication strategies, culturally appropriate educational approaches, and collaboration with local stakeholders are therefore central to successful implementation [12,13]. However, limited research has examined how ACF is implemented in a high-burden primary healthcare setting using the Donabedian framework of input, process, and outcome while also incorporating a health promotion perspective.

The aim of this study was to analyze the implementation and its challenges of TB ACF at Depok II PHC, Sleman, using a qualitative case study approach based on the Donabedian framework [14]. The findings are expected to provide practical insights for strengthening ACF implementation in high-burden primary healthcare settings.

Methods

Study design and setting

This study used a qualitative case study design to explore the implementation of ACF for TB at Depok II PHC, Sleman Regency, Indonesia. A case study approach was selected because the research focused on a single primary healthcare setting with a high TB burden and a well-established ACF program. This design allowed an in-depth exploration of program implementation within its real-life context, including organizational, social, cultural, and policy-related factors. The study examined ACF implementation using the Donabedian framework [14], consisting of input, process, and outcome components, and further analyzed the challenges and strategies from a health promotion perspective.

Depok II PHC was selected purposively because it reported the highest number of TB cases in Sleman Regency in 2024 [6] and had actively implemented ACF through multisectoral collaboration. Data collection was conducted from December 2025 to February 2026. The overall research process included preparation of instruments, administrative permission, data collection, data analysis, and report writing.

Participants, criteria and sampling

Participants were selected using purposive sampling based on their roles, involvement, and experience implementing TB ACF. Initial identification of informants was conducted through recommendations from the head of the PHC and the TB program officer, followed by further selection based on the adequacy and relevance of information.

A total of 14 informants participated in this study, consisting of main informants and key informants. Main informants included nine individuals directly involved in or affected by ACF implementation: (1) one TB program officer responsible for TB and ACF activities; (2) four healthcare workers involved in TB case detection, comprising one physician, one laboratory staff member, one health promotion officer, and one epidemiological surveillance officer; (3) two community health volunteers who had actively supported TB activities for at least one year; and (4) two TB patients identified through ACF, consisting of one drug-sensitive TB patient and one drug resistant TB patient. Key informants included five individuals with strategic knowledge and decision-making roles: (1) the head of Depok II PHC; (2) two representatives from the Sleman District Health Office (DHO) responsible for TB policy support, resource allocation, and program monitoring; (3) one community leader within the health center service area; (4) one representative from a TB focused non-governmental organization involved in patient support and community level TB networking.

Informants were eligible if they were directly involved in, affected by, or responsible for TB ACF implementation and were willing to provide informed consent. Individuals were excluded if they declined participation, were unable to complete the interview due to health or communication barriers, or had no direct involvement in the program.

Research focus and operational definitions

This study focused on experiences related to ACF implementation, case identification, multisectoral coordination, community acceptance, treatment provision and follow-up, family and volunteer support, social and cultural barriers, resource availability, and strategies to strengthen program sustainability.

In this study, TB ACF was defined as proactive TB case detection through screening of at-risk populations, contact investigation, and field-based activities conducted by the PHC in collaboration with community volunteers and other sectors. Implementation challenges referred to technical, social, cultural, economic, and health system barriers encountered during screening, diagnosis, treatment, and patient support. Implementation strategies referred to the efforts and innovations undertaken to address these barriers and optimize program performance.

Data collection

The primary research instrument was the researcher, who was responsible for planning the study, collecting data, analyzing findings, and interpreting results. Data collection was supported by semi-structured interview guides and observation sheets developed according to the study objectives and the Donabedian framework.

Data were collected through in-depth semi-structured interviews, non-participant observations, and document review. Interviews were conducted face to face in locations agreed upon by the participants to ensure privacy and comfort. Each interview lasted approximately 30–90 minutes. Some participants, particularly the TB program officer and the head of the PHC, were interviewed more than once to clarify information and deepen the exploration. All interviews were audio-recorded with consent and transcribed verbatim.

Non-participant observation was conducted to examine ACF implementation processes, including interactions among healthcare workers, volunteers, and community members. Document review included ACF activity reports and program performance records to support contextual understanding of the findings.

Data analysis

Data were analyzed thematically using an iterative process that began during data collection. All interviews were transcribed verbatim and reviewed repeatedly to ensure accuracy. Data were then coded using NVivo version 12 software (QSR International, Melbourne, Australia) to facilitate organization and management of qualitative data.

Open coding was conducted to assign initial codes to meaningful data segments related to ACF implementation. Codes were grouped into broader categories and subsequently synthesized into major themes through reflective analysis. Consistent with the Miles and Huberman framework, the analysis was performed through the stages of data reduction, data display, and conclusion drawing. Findings were presented narratively and supported by direct quotations from participants.

Trustworthiness

Trustworthiness was ensured through credibility, dependability, and transferability. Credibility was strengthened through triangulation of data sources and methods, including interviews, observations, and document review, as well as member checking to confirm the accuracy of interpretations with participants. Dependability was maintained through systematic documentation of the research process, including interview guides, field notes, transcripts, coding schemes, and thematic development, forming an audit trail. Regular peer discussions were conducted to enhance analytical rigor. Transferability was supported by providing detailed descriptions of the study context, participant characteristics, and program implementation conditions to enable readers to assess the applicability of findings to similar settings.

Ethical considerations

All participants provided written informed consent after receiving explanations regarding study objectives, procedures, risks, benefits, and their right to withdraw at any time. Confidentiality was maintained by replacing participants' names with codes and ensuring that all personal data were used solely for research purposes. The study adhered to the principles of beneficence, non-maleficence, confidentiality, and respect for participants.

Informed consent

Written informed consent was obtained from all participants prior to data collection. For participants under the age of 18 years, informed consent was obtained from a parent or legal guardian, along with assent from the adolescent participants. All participants were informed about the study objectives, procedures, potential risks, and benefits before participation.

Results

Informants' characteristics

A total of 14 informants participated in this study, consisting of 10 females and 4 males (**Table 1**). Their ages ranged from 26 to 48 years. Most informants had a bachelor's degree, while two had completed senior high school and one held a Diploma IV qualification. The informants represented a range of roles relevant to tuberculosis ACF implementation, including PHC staff such as the TB programmer, laboratory officer, health promotion officer, surveillance officer, head of the PHC, and general practitioner; two community health cadres; two tuberculosis patients, including one drug-susceptible and one drug-resistant case; one community leader; two representatives from the Sleman DHO; and one representative from a tuberculosis-focused non-governmental organization in Sleman.

Table 1. Characteristics of the informants included in the study

Number	Sex	Age (years)	Education level	Position/role
I1	Female	30	Bachelor's degree	TB programmer, Depok II Primary Health Center (PHC)
I2	Female	29	Diploma IV	Laboratory officer
I3	Female	33	Bachelor's degree	Health promotion officer
I4	Female	33	Bachelor's degree	Surveillance officer

Number	Sex	Age (years)	Education level	Position/role
I5	Female	42	Senior High School	Community health cadre
I6	Female	44	Senior High School	Community health cadre
I7	Male	28	Senior High School	Drug-susceptible TB patient
I8	Male	39	Bachelor's degree	Drug-resistant TB patient
I9	Female	48	Bachelor's degree	Head of Depok II PHC
I10	Female	48	Bachelor's degree	General practitioner, Depok II PHC
I11	Male	39	Bachelor's degree	Community leader
I12	Female	29	Bachelor's degree	Representative, Sleman District Health Office (DHO)
I13	Male	37	Bachelor's degree	Representative, Sleman DHO
I14	Female	26	Bachelor's degree	TB NGO representative, Sleman

Implementation of active case findings of TB: Implementation and challenges

Based on in-depth interviews, field observations, and document review, the findings on the implementation of ACF for TB in the working area of Depok II PHC, Sleman, were analyzed using a systems approach. The findings are presented according to the input, process, and outcome components, with emphasis on both implementation and the challenges encountered. Direct quotations from informants are retained to preserve the authenticity of their perspectives.

Input components

The input component of TB ACF implementation at Depok II PHC was generally supported by adequate foundational resources and enabling conditions. These included policy support, human resources, facilities and infrastructure, financing, and multisectoral partnerships, all of which shaped program readiness and implementation capacity. The detailed findings are presented below.

Policy support - well established but constrained by budget execution at the community level

Policy support for TB ACF implementation at Depok II PHC appeared to be well established from the district to the community level. At the Sleman DHO level, TB control was positioned as a comprehensive program encompassing promotive, preventive, curative, and evaluative components, indicating that ACF was implemented as part of a broader TB control system rather than as a standalone activity. This was expressed by a representative from the Sleman DHO, who stated, *"It covers all TB aspects, from promotion, screening, diagnosis, treatment, to evaluation."* (I12)

At the PHC level, policy support was translated into more operational and administrative mechanisms, particularly through the assignment of ACF quotas by the DHO as program performance targets. This suggests that implementation was strongly target-oriented. This was reflected by the head of Depok II PHC, who noted, *"ACF is based on quotas from the Health Office, and those are the targets we must achieve."* (I9)

At the community level, policy support was reflected in the establishment of TB Care Villages (Desa Peduli TB/Desa Siaga TB), which institutionalized community participation in TB control and emphasized collective responsibility for case management. This was expressed by a TB NGO representative, who stated, *"If there is a TB case, it is not only the responsibility of the health center, but a shared responsibility."* (I14)

However, policy implementation at the village level remained constrained by budget execution, as operationalization depended on village financial mechanisms. Despite this challenge, the existence of formal decrees for community health cadres and related training activities indicates ongoing efforts to formalize and sustain community roles in supporting TB ACF.

Human resources - strong community involvement

Human resources involved in TB ACF implementation consisted of healthcare workers, community health cadres, and support from NGOs. At the PHC level, the implementation team included multidisciplinary personnel such as doctors, nurses, laboratory staff, surveillance officers, and health promotion officers, with flexible task distribution according to field needs.

This was expressed by a health promotion officer, who stated, *"We are not strictly divided… everyone can be involved in both education and ACF activities."* (I3)

Community health cadres played a strategic role as a bridge between the PHC and the community, particularly in mobilizing participants, assisting during screening, conducting contact tracing, and supporting treatment adherence. This was reflected by a general practitioner at Depok II PHC, who noted, *"If someone does not attend, cadres can follow up or remind them."* (I10)

The cadre system was further strengthened through formal village decrees, with cadre deployment extending to the hamlet level and thereby broadening community-based service coverage. Human resource capacity was supported through formal training and on-the-job training, including technical skills such as Mantoux testing and chest X-ray interpretation, as well as communication and community engagement approaches. In addition, NGO involvement further reinforced human resources through patient support, particularly for drug-resistant TB cases and individuals at risk of treatment default.

Facilities and infrastructure - sufficient but limited by dependence on external services

The findings indicate that facilities and infrastructure for TB ACF implementation were generally adequate at the district, PHC, and community levels. The Sleman DHO played an important role in providing logistics required for screening and diagnostic activities. This was reflected by a representative from the Sleman DHO and a community leader. A representative from the Sleman DHO stated, *"Logistics are provided by the Health Office, including sputum containers and TCM supplies."* (I12) A community leader also noted, *"We usually receive supplies such as masks, tuberculin, and other screening tools from the district."* (I11)

At the PHC level, infrastructure management was focused on maintaining service continuity, particularly through the availability of TB medications and diagnostic tools. This was expressed by a laboratory officer and a community health cadre. A laboratory officer stated, *"We try to ensure that TB drugs are always available, so treatment is not interrupted."* (I2) A community health cadre added, *"If there is a shortage, we try to procure or coordinate quickly."* (I6)

Despite these supports, implementation remained constrained by dependence on external diagnostic services, particularly mobile chest X-ray. This was highlighted by a drug-resistant TB patient, the head of the PHC, and a community health cadre. A drug-resistant TB patient stated, *"We depend on the mobile X-ray schedule from the hospital."* (I8) The head of Depok II PHC added, *"Sometimes the schedule does not match with our field plan."* (I9) A community health cadre further noted, *"If the X-ray is not available, screening becomes less optimal."* (I5)

At the community level, infrastructure support was also reflected in the provision of venues and local resources to facilitate ACF activities. This was described by a TB NGO representative and a representative from the Sleman DHO. A TB NGO representative stated, *"We usually use the village hall or community office for screening."* (I14) A representative from the Sleman DHO added, *"The village helps prepare the place and sometimes basic needs."* (I13)

Accessibility was further supported through communication channels between patients and health providers, which facilitated follow-up and service responsiveness. This was expressed by the TB programmer and a surveillance officer. The TB programmer stated, *"Patients can directly contact us if they have complaints or need help."* (I1) A surveillance officer added, *"Communication via phone or WhatsApp makes follow-up easier."* (I4)

Program financing - available but constrained by budget cycle and limited incentives

Funding for TB ACF implementation at Depok II PHC was primarily derived from the Regional Government Budget, with additional support from the National Budget and NGOs. The findings suggest that financing for ACF had been incorporated into routine annual planning. This was reflected by a representative from the Sleman DHO and a community leader. A representative from the Sleman DHO stated, *"ACF funding has been allocated since the previous year."* (I12) A community leader also noted, *"The budget is already planned in the annual program."* (I11)

Despite this availability, financing remained constrained by the administrative structure of the budget cycle, which affected the continuity of field activities. This was expressed by a drug-susceptible TB patient and a community health cadre. A drug-susceptible TB patient stated, *"At*

the end of the year, activities usually stop because of budget closing." (I7) A community health cadre added, *"We cannot conduct activities if the budget has not been disbursed."* (I6)

Another challenge was the absence of external donor support, particularly from the Global Fund, which had previously contributed to program implementation. This was described by a representative from the Sleman DHO and a general practitioner at Depok II PHC. A representative from the Sleman DHO stated, *"Previously there was support from the Global Fund, but now it is no longer available."* (I12) A general practitioner at Depok II PHC added, *"Without external funding, some activities become limited."* (I10)

Available funding was used for logistics, training, and operational implementation, with additional support from local government structures. This was reflected by a representative from the Sleman DHO and a health promotion officer. A representative from the Sleman DHO stated, *"The village sometimes helps with consumption during activities."* (I13) A health promotion officer added, *"Funding is also used for training and operational needs."* (I3)

However, limited financial incentives for community health cadres remained an important constraint. This was emphasized by the head of the PHC and a TB NGO representative. The head of Depok II PHC stated, *"Cadres do not receive direct incentives from the health center."* (I9) A TB NGO representative also noted, *"Their support depends on village policies."* (I14)

At the same time, NGOs and community organizations contributed by providing financial support for patients, particularly those with drug-resistant TB, to help sustain treatment adherence. This was expressed by a laboratory officer and a community health cadre. A laboratory officer stated, *"NGOs help support patients who need additional assistance."* (I2) A community health cadre added, *"For MDR-TB patients, there is sometimes financial support to ensure treatment adherence."* (I5)

Networking and partnership - strong and multi-sectoral

TB ACF implementation at Depok II PHC was supported by strong and multisectoral partnerships involving formal health services, community structures, local government, and civil society. These partnerships contributed to participant mobilization, diagnostic access, communication, and patient support.

Within the healthcare system, collaboration with hospitals and other healthcare facilities was established through formal service agreements to support referral pathways and diagnostic services. This was reflected by a representative from the Sleman DHO and a drug-resistant TB patient. A representative from the Sleman DHO stated, *"We collaborate with all healthcare facilities that have TB service agreements."* (I12) A drug-resistant TB patient also noted, *"Referral and diagnostic services are coordinated with partner hospitals."* (I8)

Hospitals also played an important role in providing diagnostic support, particularly for GeneXpert and chest X-ray examinations, including mobile chest X-ray services. This was described by a community health cadre and the head of the PHC. A community health cadre explained, *"We rely on hospitals for X-ray and TCM examinations."* (I5) The head of Depok II PHC added, *"Mobile X-ray services are also coordinated with hospital partners."* (I9)

At the local level, partnerships with village authorities and community leaders were important for mobilizing participants and facilitating screening activities. This was emphasized by a representative from the Sleman DHO and a TB NGO representative. A representative from the Sleman DHO stated, *"The village helps gather participants for screening."* (I13) A TB NGO representative added, *"Community leaders play a role in encouraging people to attend."* (I14)

Collaboration also extended to local security and administrative actors to reach populations that were more difficult to engage. This was expressed by a general practitioner at Depok II PHC, who stated, *"Sometimes Babinsa and Bhabinkamtibmas help us approach the community."* (I10)

Cross-sector collaboration further involved governmental and non-governmental institutions that supported both service delivery and communication activities. This was described by a community leader and a representative from the Sleman DHO. A community leader explained, *"We work with social services and religious institutions."* (I11) A representative from the Sleman DHO added, *"Information dissemination is also supported by communication offices."* (I12)

NGOs and private sector actors also contributed through patient support and service innovation. This was expressed by a laboratory officer and a community health cadre. A laboratory officer stated, *"NGOs assist in patient mentoring and monitoring."* (I2) A community health cadre also noted, *"Some private clinics provide free X-ray services through CSR."* (I6)

At the community level, cadres emerged as the main link between the PHC and the community. This was emphasized by a health promotion officer and the head of the PHC. A health promotion officer stated, *"Cadres are the key to reaching the community."* (I3) The head of Depok II PHC further stated, *"Without cadres, it would be difficult to mobilize participants."* (I9)

Process components

The process component of TB ACF implementation at Depok II PHC appeared to be generally effective, supported by structured service delivery, adaptive community engagement, and consistent health education. Nevertheless, challenges remained, particularly in referral delays and variations in community responsiveness. The detailed findings are presented below.

Characteristics of the target population - varied responsiveness

The target population for TB ACF included household contacts, close contacts, and vulnerable groups such as people living with HIV, older adults, people with disabilities, and individuals with mental health conditions. These groups were considered appropriate targets because of their increased risk of TB exposure and transmission. However, responsiveness to screening varied, particularly during the initial approach. This was reflected by a community health cadre and another informant, who described hesitation among some residents. A community health cadre stated, *"At first, some residents refused because they were afraid, but after we explained patiently, they agreed to be screened."* (I6) Another community health cadre also noted, *"Some people think they are healthy, so they do not feel the need to be examined."* (I5)

Differences in responsiveness were also observed across population groups, particularly between local residents and migrants. This was expressed by a health promotion officer and a drug-resistant TB patient. A health promotion officer stated, *"Local residents are usually easier to approach. Migrants sometimes need more intensive communication."* (I3) A drug-resistant TB patient added, *"Migrants tend to be more difficult to reach because they are not always present during activities."* (I8)

Overall, these findings suggest that although the target population was appropriately identified, varied responsiveness required adaptive and context-specific communication strategies.

Intention gap - reduced through effective health promotion

The gap between awareness and participation appeared to be reduced through health promotion activities, particularly community socialization. Informants consistently described improved willingness to attend screening after receiving education and direct explanation. This was reflected by a health promotion officer and two community health cadres. A health promotion officer stated, *"After socialization, the number of people coming for screening increased significantly."* (I3) A community health cadre added, *"Before education, many people were hesitant, but after that, they became more willing."* (I6) Another community health cadre also noted, *"People need to be approached first; once they understand, they usually agree."* (I5)

These findings indicate that health promotion played an important role in translating awareness into screening participation.

Stigma - subtle and internalized rather than overt

Stigma was not generally expressed in overt forms such as direct discrimination, but rather appeared as internalized stigma that influenced patients' behavior and social interactions. This was reflected by both drug-susceptible and drug-resistant TB patients. A drug-susceptible TB patient stated, *"My neighbors did not discriminate against me, but I limited my interactions because I was afraid of transmitting the disease."* (I7) A drug-resistant TB patient also noted, *"I was worried that people would avoid me, so I preferred to stay at home."* (I8) The same drug-susceptible TB patient further stated, *"Even though no one said anything, I felt uncomfortable meeting others."* (I7)

These findings suggest that stigma remained present in subtle and internalized forms, with potential implications for psychosocial well-being and social participation.

Innovative outreach strategies - effective and contextually adaptive

The implementation of TB ACF was supported by several innovative outreach strategies, particularly through active community engagement and flexible service delivery. These strategies were designed to improve participation by adapting to the needs and circumstances of the target population.

Volunteer involvement emerged as a key component of outreach, particularly in assisting residents who were hesitant or unable to attend screening activities independently. This was reflected by community health cadres, who described direct and personalized follow-up efforts. A community health cadre stated, *"Sometimes we pick them up and accompany them directly to the screening location."* (I6) Another community health cadre added, *"If they do not come, we visit their house and remind them again."* (I5) The same cadre further noted, *"We try to approach them personally so they feel more comfortable."* (I6)

Digital communication also played an important role in outreach. This was expressed by a health promotion officer and a drug-resistant TB patient, who highlighted the use and effectiveness of WhatsApp-based reminders. A health promotion officer stated, *"We use WhatsApp groups to share information and remind residents about screening schedules."* (I3) A drug-resistant TB patient also noted, *"Reminders through WhatsApp are quite effective because most people use it."* (I8)

In addition, simple incentives were used to increase community participation in screening activities. This was described by community health cadres, who emphasized that small material support could encourage attendance. A community health cadre stated, *"Providing snacks or small souvenirs makes residents more enthusiastic to attend."* (I6) Another cadre added, *"Sometimes small things like food can attract people to come."* (I5)

Overall, these findings indicate that TB ACF implementation incorporated contextually adaptive strategies that combined personal outreach, digital communication, and simple incentives to improve screening participation.

Implementation strategy - systematic and patient-centered

The implementation of TB ACF followed a systematic and structured flow, from registration to follow-up examination, with clear prioritization of high-risk groups. This was reflected by the head of the PHC and a general practitioner at Depok II PHC. The head of Depok II PHC stated, *"We prioritize household contacts of bacteriologically confirmed TB cases."* (I9) A general practitioner added, *"Screening is conducted step by step, starting from identification to examination."* (I10)

Preventive interventions were also integrated into the implementation process, particularly for household contacts at increased risk of developing TB. This was described by a health promotion officer and the head of the PHC. A health promotion officer stated, *"We provide preventive therapy, especially for children under five who are household contacts."* (I3) The head of Depok II PHC added, *"Preventive treatment is important to break the transmission chain."* (I9)

In addition, flexibility in service delivery supported treatment continuity and adherence. This was expressed by both drug-susceptible and drug-resistant TB patients. A drug-susceptible TB patient stated, *"If I cannot come on the scheduled day, the staff allow me to pick up the medication on another day."* (I7) A drug-resistant TB patient also noted, *"The schedule is quite flexible, so it helps us continue treatment."* (I8)

Overall, these findings indicate that TB ACF implementation was not only systematic in its operational flow but also patient-centered in its efforts to integrate prevention and accommodate patients' needs during treatment.

Referral and service network - functional but limited by waiting time

Referral for drug-resistant TB cases was conducted through an established service network, particularly with RSUP Dr. Sardjito Hospital. Although this referral pathway was functional, accessibility remained constrained by long waiting times for further examination. This was

expressed by a health promotion officer and the head of the PHC. A health promotion officer stated, *"The service is good, but the queue can be long, and that sometimes discourages patients."* (I3) The head of Depok II PHC also noted, *"Sometimes patients have to wait quite a long time for further examination."* (I9)

These findings indicate that, despite an established referral system, delays in service access may reduce patient motivation and potentially hinder continuity of care.

Health education - strong and consistently delivered

Health education was consistently delivered as part of TB ACF implementation and focused primarily on disease transmission, treatment adherence, and follow-up care. This was reflected by a health promotion officer and a general practitioner at Depok II PHC. A health promotion officer stated, *"We always educate patients about how TB is transmitted and why they must complete the full course of treatment."* (I3) A general practitioner also emphasized, *"Education is important so patients understand and do not stop treatment midway."* (I10)

Improved knowledge was also reflected in patient awareness of TB symptoms. This was expressed by a drug-susceptible TB patient, who stated, *"A cough is not normal if it lasts more than two weeks."* (I7)

Outcome components

The outcome component of TB ACF implementation at Depok II PHC was reflected not only in case detection, but also in improved community awareness, acceptance of diagnosis, treatment adherence, and recognition of TB symptoms. These findings indicate that the effects of ACF extended beyond screening outcomes alone. The detailed findings are presented below.

Community response - positive with increased awareness and acceptance

The findings suggest that ACF contributed to improved community awareness and engagement. This was reflected by a health promotion officer and a community health cadre, who described greater community understanding and willingness to participate in screening. A health promotion officer stated, *"When we provide health education, their questions are already quite in depth, which shows they are starting to understand."* (I3) A community health cadre also noted, *"People are now more aware and willing to participate in screening."* (I6)

Patients generally showed acceptance toward diagnosis, although their emotional responses varied. This was expressed by both drug-susceptible and drug-resistant TB patients. A drug-susceptible TB patient stated, *"To be honest, I was a little worried, but not panicked. I felt fine."* (I7) A drug-resistant TB patient also noted, *"I accepted it because I knew it could be treated."* (I8)

Among patients with drug-resistant TB, diagnosis was also associated with mixed feelings of shock and relief. This was reflected by a drug-resistant TB patient, who stated, *"I was a bit shocked, but at the same time relieved to finally know what illness I had."* (I8)

Improved symptom recognition was also evident among participants. This was expressed by a drug-susceptible TB patient, who stated, *"A cough is not normal if it lasts more than two weeks."* (I7)

Overall, these findings indicate that TB ACF contributed to positive community responses, greater awareness, and broader acceptance of screening and diagnosis.

Drug side effects and adherence - strong adherence despite side effects

The findings indicate that patients with drug-resistant TB experienced noticeable side effects during treatment. This was reflected by a drug-resistant TB patient, who described both the physical burden and the effort required to continue treatment. A drug-resistant TB patient stated, *"After a few days, I felt nauseous and dizzy, then rashes appeared all over my body."* (I8) The same patient also noted, *"At the beginning, it was quite heavy, but I tried to continue."* (I8)

Despite these challenges, adherence remained strong among patients. This was expressed by both drug-susceptible and drug-resistant TB patients. A drug-susceptible TB patient stated, *"I take it regularly. I really want to recover quickly."* (I7) A drug-resistant TB patient also noted, *"I never miss taking my medication."* (I8)

The findings further suggest that motivation for adherence gradually shifted from external support to internal commitment. This was reflected by a health promotion officer and a drug-susceptible TB patient. A health promotion officer stated, *"Follow up reminders initially supported adherence, which later developed into personal initiative."* (I3) A drug-susceptible TB patient added, *"It really comes from within yourself. Awareness."* (I7)

Overall, these findings indicate that although treatment side effects were substantial, adherence remained strong, supported initially by follow-up and subsequently by patients' internal motivation to recover.

Discussion

The findings indicate that the input components of ACF implementation at Depok II PHC were generally strong and complementary, particularly in relation to policy support, human resources, facilities and infrastructure, financing, and partnerships. Hierarchical policy support from the district to the community level provided a clear structural foundation for program implementation [15,16]. In addition, the comprehensive TB policy, which covered both drug-susceptible and drug-resistant TB, strengthened governance and accountability. However, the quota system established by the DHO, although functioning as a performance control mechanism, may reduce implementation flexibility in urban settings with high population mobility, such as Depok, where students and migrant workers make up a substantial proportion of the population. At the community level, the establishment of TB Care Villages reflected a policy innovation that extended beyond formal regulation into collective social responsibility. This model resembled community-based initiatives developed during the COVID-19 pandemic and underscored the importance of local adaptability for the success of health programs [16]. Institutionalized TB cadres also served as an important bridge between health services and the community [17]. Nevertheless, limited financial support for cadres posed sustainability challenges and may have affected their long-term motivation and quality of engagement [18]. Although infrastructure and logistics were generally adequate, dependence on referral hospitals for mobile chest X-ray services remained a major constraint. This finding suggests that the effectiveness of ACF depends not only on primary care readiness, but also on the capacity of the broader health system [19]. Diverse funding sources from local government, the national budget, and NGOs reflect a degree of financial resilience, although long-term sustainability and responsiveness to field needs remain important concerns [20]. Strong multisectoral partnerships, including collaboration with hospitals, laboratories, village authorities, NGOs, and private clinics through corporate social responsibility initiatives, further strengthened program input and were consistent with WHO recommendations on cross-sectoral integration [21].

The findings also suggest that ACF implementation followed a structured yet adaptive strategy to address heterogeneous target groups, including local residents, migrants, students, and other vulnerable populations. Differences in acceptance between local and migrant populations highlight the importance of sociocultural considerations in program delivery. This is consistent with the socioecological model, which emphasizes that health behavior is shaped by interactions across individual, interpersonal, community, and broader social contexts [22]. In addition, the identified intention–behavior gap, reflected in verbal agreement without actual attendance, suggests that socialization alone is insufficient to produce behavioral change. Screening uptake is likely influenced by perceived susceptibility, perceived benefits, and perceived barriers [23]. TB stigma in this study also appeared to be largely implicit, shifting from overt discrimination toward internalized self-stigma, which indicates the need for more tailored psychosocial approaches [24]. Innovative outreach strategies, including home pick-up by cadres, WhatsApp groups, surveillance mapping, and the use of public digital spaces, reflected adaptive urban approaches that emphasized reach and accessibility [25]. In addition, the structured service flow and involvement of physicians suggest efforts to maintain both efficiency and quality. The shift toward risk-based targeting of close contacts further indicates improved process quality within the Donabedian framework, particularly in terms of accuracy and efficiency [26]. Although the referral system was structurally integrated, operational challenges remained, including loss to follow-up across administrative boundaries. Post-ACF follow-up mechanisms that combined digital systems with community-based approaches appeared to strengthen continuity of care.

However, high workload and limited human resources affected real-time reporting, indicating structural weaknesses that may compromise process quality despite the existence of technical system integration [27]. Overall, these multidimensional barriers suggest that ACF is a complex intervention that requires systemic and collaborative solutions.

The outcomes of ACF extended beyond screening numbers and case detection to include changes in awareness, patient responses, and treatment adherence. Variations in emotional responses, ranging from mild concern to relief after diagnosis, suggest that ACF may reduce uncertainty and facilitate earlier access to treatment. In addition, treatment adherence appeared to be largely driven by intrinsic motivation, underscoring the importance of fostering internal awareness rather than relying solely on external supervision [28]. At the outcome level, the increase in case detection between 2022 and 2024 suggests that ACF contributed to strengthened TB detection in Sleman. This local pattern is consistent with global evidence supporting the effectiveness of systematic case-finding strategies. The World Health Organization has emphasized that organized and large-scale ACF can reduce diagnostic delay, accelerate treatment initiation, and ultimately decrease transmission within communities [29]. Preventive outcomes were also evident through the provision of tuberculosis preventive therapy. The implementation of tuberculosis preventive treatment among household contacts indicates that the ACF strategy extended beyond curative efforts toward a stronger preventive orientation. In addition, behavioral changes, such as self-limitation of social interaction to avoid transmission, further reflect meaningful preventive outcomes.

This study has several limitations. It was conducted in a single high-burden primary health center, which may limit the transferability of the findings to other settings. As a qualitative case study, the findings were based on participants' perceptions and experiences and may therefore be influenced by recall bias or social desirability bias. Although multiple data sources were used, the number of informants was limited, and the sample may not have fully captured all relevant stakeholder perspectives. In addition, this study focused on implementation experiences and perceived outcomes rather than quantitatively assessing the effectiveness of ACF. Nevertheless, it provides in-depth contextual insights into the implementation, challenges, and strategies of TB ACF in a high-burden primary healthcare setting.

Conclusion

The implementation of ACF for tuberculosis at Depok II PHC, Sleman, was generally effective and supported by strong policy commitment, multidisciplinary human resources, adequate basic facilities, program financing, and multisectoral partnerships. The integration of input, process, and outcome components contributed to the overall implementation of ACF in this high-burden primary healthcare setting. However, several constraints remained, particularly limited budget flexibility, dependence on external diagnostic services, referral delays, and variation in community responsiveness. At the process level, ACF was implemented through structured and patient-centered service delivery, supported by adaptive outreach strategies, consistent health education, and collaboration with community cadres and local leaders. These approaches helped improve participation, reduce hesitation toward screening, and strengthen treatment continuity. At the outcome level, ACF contributed not only to case detection and screening coverage, but also to improved community awareness, acceptance of diagnosis, adherence to treatment, and recognition of TB symptoms. The program also showed strong performance indicators, including high presumptive case identification, an 80% case detection rate, and an 87.8% treatment success rate, indicating effectiveness in both early detection and continuity of care. Overall, the findings indicate that ACF functioned not only as an early case detection strategy, but also as a community-engaged health promotion approach that addressed behavioral and social aspects of TB control. Strengthening sustainable financing, referral access, and health promotion capacity will be important to support the long-term effectiveness and sustainability of ACF implementation.

Ethics approval

Ethical approval was obtained from the Medical and Health Research Ethics Committee of Universitas Gadjah Mada with reference number KE-FK-1848-EC-2025. Research permission

was subsequently obtained from the Sleman District Health Office and Depok II Primary Health Center.

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Competing interests

All the authors declare that there are no conflicts of interest.

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Underlying data

Derived data supporting the findings of this study are available from the corresponding author on request.

Declaration of artificial intelligence use

This study used artificial intelligence (AI), ChatGPT, for language refinement (improving grammar, sentence structure, and readability of the manuscript). We confirm that all AI assisted processes were critically reviewed by the authors to ensure the integrity and reliability of the results. The final decisions and interpretations presented in this article were solely made by the authors.

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