Research Paper

Evaluating Tuberculosis-human Immunodeficiency Virus Co-infection Strategies: A Qualitative Study From Semarang, Indonesia

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ABSTRACT

Background: Tuberculosis (TB) and human immunodeficiency virus (HIV) are global health challenges that exacerbate each other's progression, leading to high mortality rates, particularly in Asia and Africa. This study aimed to evaluate the implementation of the TB-HIV co-infection program and barriers to its implementation in Semarang City, Indonesia, to improve regional responses and patient outcomes.

Methods: This qualitative study used focus group discussions (FGDs) with 20 purposively selected participants from key stakeholder groups in Semarang City. Data were collected over two days, transcribed verbatim, and thematically analyzed using NVivo 15 software, following Braun and Clarke's thematic analysis framework. Triangulation and member-checking enhanced validity.

Results: This study identified three major themes and fifteen sub-themes through thematic analysis of FGD data obtained from stakeholders at different organizational levels. The first theme, TB-HIV prevention programs, includes co-infection screening, household contact tracing, mobile health services, and the provision of TB preventive therapy (TPT). The second, treatment programs, covers adaptation of guidelines, integrated service delivery, mentorship support, and case reporting. The third addresses challenges and barriers, including poor integration, dependence on donor funding, limited outreach to high-risk groups, logistical constraints, low public awareness, and stigma.

Conclusion: While the TB-HIV co-infection program in Semarang City shows promise, particularly in screening and TPT, its effectiveness is limited by systemic fragmentation, stigma, and reliance on donor-funded initiatives. To improve implementation, stronger cross-sector collaboration, stable domestic financing, and context-adapted public education strategies are necessary. These findings underscore the need for reforms prioritizing fully integrated TB-HIV services, empowering community-based interventions, and strengthening supply chains to ensure continuity of care.

Keywords: Human immunodeficiency virus (HIV), Tuberculosis (TB), Coinfection, Qualitative research

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Introduction

Tuberculosis (TB) and human immunodeficiency virus (HIV) are among the world's leading public health threats, particularly in Africa and Asia, and are often classified alongside malaria as the "big three" infectious diseases [1]. World Health Organization (WHO) identifies TB as the most common co-infection in people living with HIV (PLHIV) [2], creating a deadly syndemic in which each disease exacerbates the other [3, 4]. HIV accelerates TB progression, while TB increases HIV viral load, raising the risk of AIDS and death [5, 6] patients with TB.

Indonesia has adopted the 'triple 95' target for HIV control by 2030 and advanced TB control through its National TB Program [7, 8]. However, Semarang City, Indonesia, remains among the top 25 TB burden areas, with high TB-HIV co-infection rates, possibly exceeding levels observed in other parts of Central Java [9, 10]. In response, collaborative TB-HIV programs, featuring mutual screening, preventive therapy, integrated services, and reporting, have been launched under the 2020–2024 national action plan [11]. Despite clear policies and guidelines, local implementation still faces significant challenges.

The 2022 annual TB report showed that only 56% of TB patients in Central Java knew their HIV status and just 25% received antiretroviral treatment (ART) [12]. Although prevention and control programs were implemented by the Semarang City Health Office, the 2023 TB treatment success rate was 85% (target 90%), and the drug-resistant TB case-finding rate was 41% (target 80%) [13]. The cumulative trend of HIV cases in Semarang City has also increased significantly from 2010 to 2023, with 6 deaths reported in 2023 due to AIDS when no deaths were reported in previous years [13].

In addition, data from Semarang City's TB information system (SITB) reported that the TB-HIV incidence rate increased from 2.8 to 3 in 2022-2023, but decreased to 2 per 100,000 population in 2024. Meanwhile, TB-HIV incidence gradually increased from 1.7 in 2022 to 2 in 2024, as reported by Semarang City's HIV information system, highlights the growing challenge of addressing co-infection management in the region. Another study reported that in several lower-middle-income countries, existing programs often operate in silos, leading to a lack of coordinated efforts to address TB-HIV co-infection [14, 15].

The separation of TB and HIV services highlights structural weaknesses in the health system, as outlined in the WHO health systems framework. Its six interconnected components: service delivery, workforce, information systems, medicines access, financing, and governance, collectively influence system performance [16, 17]. In TB-HIV co-infection, these gaps result in fragmented services, incomplete care, and inefficient resource use [18].

The disconnect between HIV and TB programs reduces the effectiveness of interventions and the provision of comprehensive care [6]. Understanding regional challenges and evidence is key to strengthening national responses and improving patient outcomes [19]. Therefore, this study aimed to evaluate the implementation of the TB-HIV co-infection program in Semarang City, from multiple stakeholder perspectives. The evaluation aimed to identify barriers and opportunities in program implementation and to provide evidence-based feedback to improve the effectiveness of future interventions.

Methods

Study design and setting

This study employed a qualitative research method, utilizing focus group discussions (FGDs), to explore TB-HIV implementation programs in Semarang City.

Selection of study participants

Purposive sampling was employed to recruit participants from two areas in Semarang City identified by the SITB as having the highest and lowest TB–HIV co-infection rates. These areas represented diverse settings, including primary healthcare facilities, regency-level health offices, and urban villages. This approach ensured a balanced representation from high- and low-burden settings. Participants included patients, non-governmental organization (NGO) staff, epidemiologists, health workers, and local government officials, all selected based on their direct involvement or lived experience with TB-HIV programs. Consideration was given to diversity in age, sex, and professional roles, and recruitment continued until data saturation was achieved.

Data collection

This qualitative study was conducted over two consecutive days, November 10–11, 2024, using FGDs as the primary data collection method. FGDs were chosen to promote open dialogue and collective reflection on the complexities related to TB-HIV program implemen-

tation in Semarang City. This two-day design, incorporating repeated engagement with consistent participant groups, aligns with methodological recommendations emphasizing the value of extended sessions over single encounters for enhancing depth, nuance, and data richness—particularly crucial in health research within low-resource settings. Such an approach allows for more nuanced insights and richer dialogue, ultimately improving the quality and comprehensiveness of the findings [20, 21].

A total of twenty participants were purposively selected for their direct involvement or experience with TB-HIV services, encompassing both policy-level actors and community-based stakeholders. This sample size aligns with qualitative research principles that prioritize depth over breadth and was sufficient to reach thematic saturation [22]. To facilitate dynamic yet focused discussions, participants were organized into smaller FGD groups of 6 to 10 individuals, promoting more meaningful interaction and exploration of diverse perspectives.

Before each FGD session, participants received detailed information regarding the study's objectives, the discussion format, and their rights (confidentiality, voluntary participation). Informed consent was obtained before data collection to ensure compliance. All FGDs were conducted in Bahasa Indonesia, facilitated by a trained moderator and assistant, and audio recorded with permission. Field notes were also taken to complement the recordings and capture non-verbal cues or contextual insights.

On the first day, discussions with policymakers and health professionals focused on systemic aspects of TB-HIV service delivery, such as integration, constraints, and intersectoral coordination. The second day involved patients and NGO workers, highlighting personal experiences, care access, adherence, and stigma. This deliberate sequencing enabled this study to explore both top-down (policy and system) and bottom-up (community and individual) perspectives. FGDs concluded upon reaching data saturation, indicated by the absence of new information or themes emerging in the final discussion, confirming adequate coverage of research objectives.

Data analysis

All audio recordings were transcribed verbatim and reviewed for accuracy. Thematic analysis was conducted using NVivo software, version 15 following Braun and Clarke's six-phase framework: Familiarization with the data, generation of initial codes, identification of preliminary themes, review of themes, definition and naming of themes, and reporting [23].

Two researchers independently coded the transcripts to ensure rigor and reduce bias, resolving differences through consensus. This collaborative process enhanced the credibility and dependability of the findings. Themes were organized based on their relevance to the research objectives, allowing for both within- and cross-group analysis. The process aimed to uncover structural issues, institutional responses, and lived experiences shaping TB-HIV program implementation in Semarang City. The final thematic framework offers a comprehensive view of systemic challenges and opportunities for improvement.

Results

Table 1 outlines the codes assigned to each participant group, which were used throughout the analysis to protect confidentiality and to provide a clear overview of each participant's perspective.

Table 1. FGD participant categories

Participant's Categories	Participants in FGD	Identification Code
Epidemiologist	1	EPI
Healthcare worker	5	HCW
Local government	3	LG
PLHIV with TB coinfection	4	PLHIV
NGO	6	NGO
Total	20	

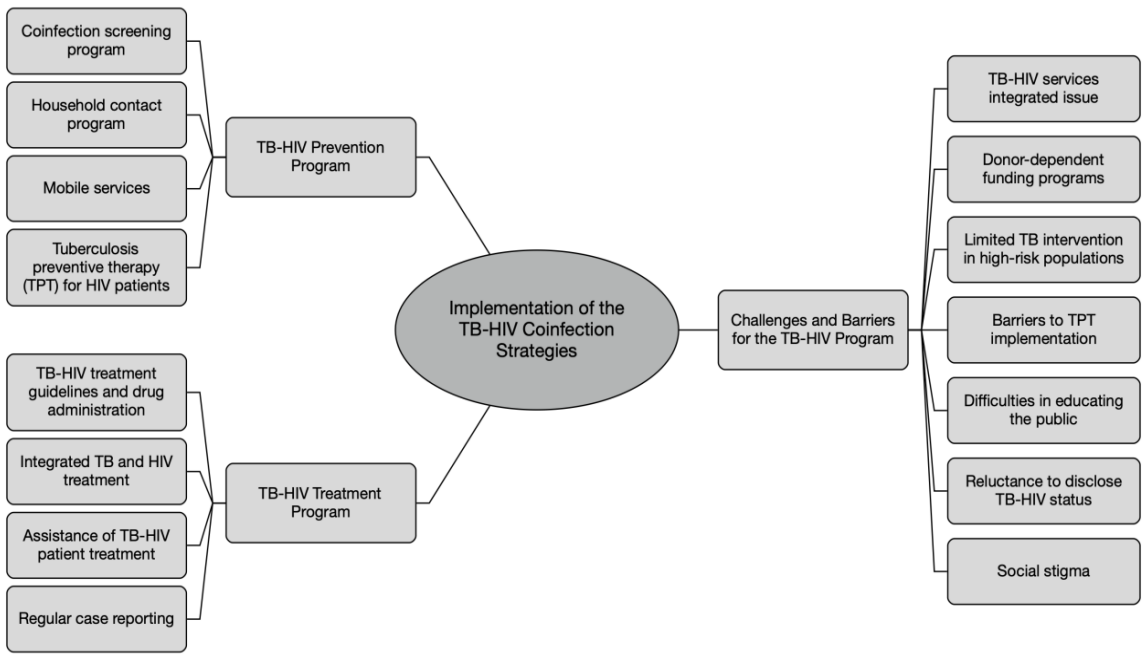

Figure 1. Thematic map of implementation of the TB-human immunodeficiency virus co-infection program in Semarang City, Indonesia, NVivo Analysis 2025

Through qualitative data analysis employing thematic analysis, three major themes were identified, representing consistent patterns of meaning across the participants' narratives and reflecting systemic and community-level responses to TB-HIV co-infection strategies: Prevention programs, treatment pro-grams, and challenges and barriers (Figure 1). In addition, fifteen sub-themes emerged, offering more nuanced insights into participants' experiences, per-ceptions, and interpretations of the implementation and effectiveness of TB-HIV integration efforts.

These 15 subthemes offered nuanced insights into participants' experiences, perceptions, and interpretations of TB–HIV co-infection management. The prevention programs theme highlighted proactive efforts, such as integrated TB–HIV screening, household contact tracing, mobile outreach services, and the provision of TB preventive therapy (TPT). The treatment programs theme underscored integrated, patient-centered management, encompassing clinical guidelines, drug availability, service integration, adherence support, and routine case reporting. The challenges and barriers theme revealed structural and sociocultural impediments, including limited service integration, donor-dependent financing, inadequate outreach to high-risk populations, logistical challenges in TPT implementation, low public awareness, nondisclosure of TB–HIV status, and persistent stigma.

These themes consistently emerged across multiple informants, reflecting the full spectrum of program implementation, from prevention and treatment to structural and social challenges. Information validation involved document review and triangulation using key informants from the Semarang City Health Office. The member-checking process was also conducted on the informants to ensure that the data interpretations from the FGD accurately reflected their understanding and experience.

Theme 1: TB-human immunodeficiency virus (TB-HIV) prevention program

Sub-theme 1) Co-infection screening program

Discussions with participants who had experience with the TB-HIV program revealed that several NGOs have combined TB and HIV screening as early detection measures, ensuring that TB patients are aware of their HIV status, and vice versa, allowing co-infected patients to receive appropriate treatment promptly.

"If patients are screened positive for TB, we also direct them to treatment so they can recover." (NGO-04); "…. in a patient assistance program run by an NGO managing the TB program, there is a target for patients with TB to know their HIV status. Similarly, in an NGO handling the HIV program, every HIV patient undergoes TB screening." (EPI)

A structured patient tracking system is already in place. Patients with a cough lasting more than two weeks undergo a sputum test or rapid molecular test (RMT). If the result is positive, they are immediately contacted for HIV and blood sugar test results. "….At community health centers, anyone with a cough lasting more than two weeks undergoes a RMT. If the result is positive, they are promptly contacted and tested for HIV infection and blood sugar levels. That is a standard procedure" (HCW-01).

Sub-theme 2) Household contact program

Screening is also extended to household contacts of TB patients to ensure early detection and treatment of potential infections. This proactive approach helps to identify individuals who may have been exposed to bacteria, allowing for timely medical intervention. This also reduces the risk of further transmission within the household.

"Household contacts are also screened immediately. Community health workers and cadres actively visit patients to screen their contacts" (HCW-03).

Sub-theme 3) Mobile services

This program also involves collaboration between community health centers, health departments, and local communities to expand the coverage of detection and treatment, including mobile services for TB, HIV, and other diseases.

"The program was conducted in collaboration with the community health center and Semarang City Health Office in Semarang City. Examinations during mobile visits are not only HIV tests but also blood sugar, blood pressure, sexually transmitted infections, and TB tests" (NGO-02).

Sub-theme 4) TPT for HIV Patients

The TB-HIV prevention and treatment program involves various institutions to ensure that HIV patients receive TPT and appropriate care. TPT is provided to close contacts of TB patients and at-risk populations, such as PLHIV and healthcare workers.

"A NGO responsible for implementing the TB program also has a set of target for assisting a specific number of HIV patients in receiving TPT. Therefore, there is still collaboration between TB and HIV in each program" (EPI).

"The available TPTs are for close contacts and at-risk populations, such as PLHIV and health workers. There are three varieties of TPT: one taken daily for 6 months, one daily for 3 months, and one weekly for 3 months" (EPI).

Theme 2: TB-HIV treatment program

Sub-theme 1) TB-HIV treatment guidelines and drug administration

In healthcare facilities, the treatment of patients with TB-HIV is adjusted according to the order of diagnosis. TB patients receive TB treatment for two weeks before starting antiretroviral therapy, while HIV patients begin ART before initiating TB treatment. Both sets of medications are administered at regular intervals to ensure therapeutic effectiveness.

"At the community health center, treatment is based on diagnosis… TB-first patients receive TB drugs for two weeks before starting antiretrovirals, while HIV-first patients get antiretrovirals first, followed by TB treatment. If both are diagnosed together, both treatments are given immediately" (HCW-04).

"ART and TB medications should not be taken together; they should be separated by at least 1 hour. … this is to prevent resistance in the body and to identify which drugs cause side effects" (PLHIV-01).

Sub-theme 2) Integrated TB and HIV treatment

Patients diagnosed with both TB and HIV undergo simultaneous treatment to manage both infections and effectively improve their overall health outcomes.

"...we (as a PLHIV with TB co-infection) received simultaneous treatment for both (HIV and TB)" (PLHIV-04).

Sub-theme 3) Assistance of TB-HIV patient treatment

An HIV mentor supports patients by monitoring their treatment and ensuring adherence.

"The HIV mentor's task include monitoring patients, ensuring they adhere to treatment, and helping them maintain their healthy to remain productive PLHIV" (NGO-04).

Sub-theme 4) Regular case reporting

For TB-HIV cases, routine reports consistently included only the total number of cases to maintain patient confidentiality and streamlined data reporting.

"For TB-HIV cases, during cross-sector meetings, we always report only the total number of cases" (HCW-02).

".... TB and HIV are considered sensitive issues, and only authorized parties can access such information… we (sub-district government and local health cadres) receive information from the community health center, but we are typically notified only when a specific case arises.." (LG-02).

Theme 3: Challenges and barriers for the TB-HIV programs

Sub-theme 1) TB-HIV services integrated issue

TB and HIV programs still operate separately, preventing fieldworkers from collaborating effectively. This limits the service coordination in detecting and managing cases in an integrated manner.

"...TB and HIV programs are still running separately, rather than as an integrated system..." (NGO-01).

"Unfortunately, HIV and TB outreach workers have been unable to collaborate. If collaboration were possible, we could find cases together; TB-positive patients would be tested for HIV, and HIV-positive patients would be tested for TB simultaneously" (NGO-03).

Sub-theme 2) Donor-dependent funding programs

A significant barrier is the heavy reliance on donor funding, primarily from the Global Fund, which follows a top-down approach. This funding structure often results in NGOs implementing TB and HIV programs independently, with minimal collaboration, making comprehensive service integration difficult.

"Therefore, TB and HIV programs in NGOs remain donor-dependent, mainly on the Global Fund. ....the top-down funding scheme limits flexibility, as activities are predetermined. For example, TB-focused NGOs handle outreach, case-finding, and mentoring, while others concentrate on HIV programs" (EPI).

Sub-theme 3) limited TB intervention in high-risk populations

Another challenge arises in high-risk communities where drug users share smoking devices, which increases the risk of TB transmission. However, healthcare programs in these settings primarily focus on HIV, while TB remains a low priority.

"Since 2019, we (as NGOs) have assisted HIV-positive drug users, including those in prisons. We encountered methamphetamine users and several cases were diagnosed with TB. This is due to sharing the same smoking paraphernalia among 4-5 people. However, TB is not yet a priority health programme…" (NGO-06).

Sub-theme 4) Barriers to TPT implementation

Implementing TPT faces obstacles, including patient and family refusal, and logistical shortages in some healthcare facilities.

"...there are still many patient families who refuse to use it (TPT). Some patients are willing to undergo screening, but lack of time is a barrier" (HCW-02).

"Some of my PLHIV friends have been on ARV therapy for several months but have not received any TPT services at all due to the inadequate TPT logistical support" (PLHIV-02).

Sub-theme 5) difficulties in educating the public

The lack of education regarding TB and HIV also hinders the program's effectiveness. Public awareness remains low, particularly in certain groups and slum areas.

"...not all the general public welcomes TB information. Groups at risk of carrying the disease are often unreceptive and resistant to testing. Proper education is needed, especially in slum areas" (NGO-05).

Sub-theme 6) reluctance to disclose TB-HIV status

Many patients with TB do not disclose their HIV status, making it difficult for support teams to provide appropriate care. Some families refuse home visits due to embarrassment, whereas healthcare facilities often maintain patients' data confidentiality.

"... few patients admit that they (TB patients) are also HIV positive. This poses a challenge for us, as the TB outreach and mentoring team lacks access to information regarding the patient's HIV status" (NGO-05).

"The main challenge in HIV cases is that most patients have not yet disclosed their status. Therefore, when we need to conduct tracing, it must be done internally—we cannot involve health cadres" (HCW-05).

Sub-theme 7) Social stigma

Social stigma remains a significant challenge in HIV programmes, making it difficult to track patients who have lost contact.

"We have conducted education and awareness campaigns to eliminate HIV stigma in society, but in reality, the stigma remains high" (LG-03).

Discussion

This study examined the perspectives of relevant stakeholders, including healthcare workers, NGOs, and patients, to identify the various challenges and opportunities associated with implementing the TB-HIV program in Semarang City, Indonesia. Efforts to integrate TB and HIV services in Semarang City have begun through collaboration between healthcare facilities, NGOs, and communities. Outreaching at-risk populations is achieved by initiating integrated TB and HIV screening, which enables early detection and faster intervention.

In a study of African countries, a community-based approach was proven effective in expanding access to healthcare services, especially in areas with limited facilities. The active role of health center staff and cadres in screening and supporting patients in their communities is crucial. Integrating HIV testing in TB household contact screening helps identify PLHIV at high risk for TB who may be unaware of their HIV status [24]. Early detection of PLHIV is vital for preventing further transmission; this involves educating patients to report TB symptoms to their close contacts and involving healthcare professionals in referring them for TB testing and treatment [25].

Semarang City has made notable progress in addressing TB-HIV co-infection through innovative community-based initiatives. A particularly noteworthy practice is the HIV treatment mentorship program, which offers direct patient support. This program aims to improve adherence, provide psychosocial assistance, and guide patients through the healthcare system, helping to prevent treatment discontinuation, drug resistance, and maintaining the overall well-being of patients throughout long-term care [26]. Additionally, Semarang City has introduced mobile health services through collaboration with health centers and local stakeholders, improving access for underserved populations, which is a collaborative effort involving community health centers, the Municipal Health Office, and local stakeholders. The success of these initiatives relies on sustained implementation, capacity building of health personnel, and strong feedback mechanisms, reinforcing participatory primary health care in managing chronic infectious diseases [27].

While TB and HIV programs in Semarang City have advanced in management-level collaboration, the HIV control program for TB coinfection largely operates in isolation. This fragmentation is evident in the diverse service delivery models and limited point-of-care coordination. Furthermore, the underutilization of targeted TB therapies among high-risk groups, particularly drug users, indicates persistent shortcomings in the public health approach [28].

Primary issues within Semarang City's TB-HIV program include inadequate funding and suboptimal medicine distribution. This program heavily relies on donor funding, especially from the Global Fund, whose hierarchical and frequently constrains the adaptability of field program execution. Consequently, NGOs addressing TB and HIV typically operate independently, exhibiting a deficiency in collaboration for integrated services. Furthermore, patients and healthcare professionals have reported logistical challenges, including delays or shortages of TPT and antiretroviral drugs, which adversely affect patients' capacity to maintain treatment regimen.

These challenges can be critically analyzed using the WHO health systems framework, which delineates six core, interrelated building blocks: service delivery, health workforce, health information systems, access to essential medicines, health financing, and leadership/governance. The recurrent stock-outs of ART in some health facilities underscore weaknesses in the service delivery and essential medicines components, contributing to treatment delays and increased risk of opportunistic infections.

These systemic deficiencies have direct consequences on patient outcomes. Globally, studies have shown that the absence of integrated services contributes to a higher rate of treatment interruption, estimated at up to 21% in some high-burden settings, significantly increasing the risk of drug resistance and poor clinical prognosis [29]. Moreover, lack of integrated management has been associated with elevated mortality rates among coinfected patients, reaching 25–30% in certain contexts, particularly during the intensive phase of TB treatment [30].

Accordingly, the WHO has introduced a strategic framework recommending a fully integrated care model—where both TB and HIV services are provided at the same facility by the same provider—to combat TB-HIV through improved diagnosis, treatment, and patient outcomes. While full integration benefits both patients and health systems, most high-burden countries still adopt a partial integration model, involving patients referrals between TB and HIV services. This model is prevalent in countries with high TB-HIV prevalence [18], is easier to apply in resource-limited settings, but often leads to care discontinuity, higher loss to follow-up, and weaker chronic disease management. From a systems theory view, this reflects poor coordination and limited health system responsiveness to complex conditions.

Previous studies highlight the crucial role of integrating and expanding TB and HIV services for effectively addressing both diseases [31]. This integration involves coordinated planning, unified funding, and a streamlined service system to improve control efforts. Given that HIV infection markedly increases the risk of TB progression and worsens clinical severity, TB-HIV co-infection requires a differentiated, integrated response [32]. Collaborative efforts are vital for optimal screening, better access to preventive therapy, and more effective treatment to reduce TB-HIV co-infection [33]. Strengthening the healthcare system with sustainable funding and improved resource allocation is essential for ensuring continuous, equitable care for co-infected patients [34].

To strengthen TB-HIV prevention and control, a fully integrated national program is needed. This should include a unified recording and reporting system that captures data from both TB and HIV registries, along with behavioral and environmental risk factors to guide targeted interventions. Successful implementation requires widespread training and dissemination to ensure healthcare workers at all levels can access and use the system effectively. Without such integration, efforts to manage TB-HIV co-infection will remain suboptimal.

Semarang City's TB prevention and treatment program for PLHIV includes TPT provision, which has proven effective in reducing the risk of active TB in PLHIV, especially those undergoing ART. Studies have shown that 12 months of TPT with isoniazid in PLHIV on ART can reduce this risk by up to 37%. The WHO recommends a minimum of 6 months of TPT for all adults and adolescents with HIV as well as for children at high risk in areas with high TB prevalence [25].

However, a crucial finding of this study is the limited availability of TPT for PLHIV, despite WHO recommendations. In Semarang City, implementation is hindered by unstable drug supplies, poor coordination, and a lack of facility preparedness. Strengthening pharmaceutical supply chains and logistics is crucial, as delays in TPT use increase the risk of TB-HIV co-infections and related mortality [35]. Key solutions include community empowerment, financial support, and effective monitoring systems with evidence-based strategies for implementation optimization [36].

In addition to system-level barriers, individual and social barriers hinder successful TB-HIV treatment and control. This study identified refusal from family and communities, lack of treatment seeking, and stigma as underlying barriers to TB and HIV control activities, including education, care, and treatment adherence. Patients and their close contacts often have limited knowledge of TB-HIV co-infections. Lack of knowledge about TB increases stigma, potentially affecting health-seeking behaviour [37]. Stigma can hinder treatment by causing delays in care initiating and maintaining, especially in areas with a high prevalence of TB and HIV [38].

The prolonged and complex treatment of TB-HIV often leads to poor adherence, highlighting the need for support systems, such as regular follow-ups and counselling [39]. Therefore, community-based interventions are vital for reducing stigma, supporting mental health, and improving quality of life through peer involvement [40]. In Semarang, the health office collaborates with NGOs and community cadres to assist TB-HIV patients in ongoing prevention and treatment. Strengthening education can improve patients' understanding and disease management [41]. A theory- and evidence-based, stakeholder-informed approach is essential for designing practical, multicomponent interventions that address adherence challenges by leveraging local service resources [42].

Additionally, this study utilized a qualitative approach, including FGDs, to gain an in-depth understanding from various stakeholders. The participation of health workers, NGOs, policymakers, and patients provides a comprehensive perspective. However, the small sample size may limit the generalizability of the results. Furthermore, the qualitative nature of the study precludes quantifying the results or establishing causal relationships.

Conclusion

The TB-HIV co-infection program in Semarang City has significant potential to improve the detection and treatment of co-infected patients, incorporating TB and HIV screening as well as simultaneous TBT for HIV patients. However, this study identified implementation challenges, such as the lack of integration between TB and HIV services, reliance on donor funding, and high social stigma, that hinder the effectiveness of the program. This issue requires addressing at individual, social, and system levels. Therefore, strengthening health systems through sustained financial support and improved resource allocation is crucial. Fostering stronger collaboration among health institutions, NGOs, and communities, coupled with enhanced public education, will ensure comprehensive and sustainable care for TB-HIV patients.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of Diponegoro University, Semarang, Indonesia (Code: 503/EA/KEPK-FKM/2024).

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Authors' contributions

All authors contributed equally to the conception and design of the study, data collection and analysis, interpretation of the results, and drafting of the manuscript. Each author approved the final version of the manuscript for submission.

Conflict of interest

The authors declared no conflicts of interest.

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