



ORIGINAL ARTICLE TUBERCULOSIS

Prevention Versus Treatment: Barriers to Tuberculosis Prevention and Treatment in Urban Areas

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ABSTRACT

Background and Objective: Tuberculosis preventive treatment (TPT) is thought to be one of the game changers of Tuberculosis (TB) elimination. The success of the TPT program lies in the coverage rate. Anecdotal evidence suggested that there are a few areas in West Bengal where TPT coverage is low. The study aimed to find the barriers to the TPT program in the urban TB units of a district in West Bengal.

Methods: This was a mixed-methods study. Quantitative data were collected and analyzed from the Nikshay portal, which is India's TB information management portal. Qualitative data were collected through interviews with key informants, including doctors, paramedical staff, TB patients, and their household contacts (HHCs).

Results: Among the eligible HHCs, 48% were initiated with TPT. Of those who were initiated with TPT, 85.1% completed the treatment. The major reasons for unsuccessful outcomes were 'lost to follow-up' (58.5%) and 'Not evaluated' (34.5%). Refusal due to long duration of TPT, fear of side effects, lack of awareness, and stigma associated with TB were the main reasons for the poor TPT initiation rate. Poor adherence mechanisms, unaddressed adverse reactions, inadequate knowledge of health care workers, and migration of beneficiaries were the reasons for the poor TPT completion rate.

Conclusion and Implications for Translation: For TPT implementation in urban areas, there are a few unique challenges such as inadequate health workforce and infrastructure, impeding influence of the private sector, and population migration. Long duration of TPT was one of the most significant barriers that can be addressed by the availability of shorter TPT regimens across the age groups.

Keywords: Preventive Medicine, Preventive Health Services, Preventive Programs, Preventive Care, Tuberculosis, Urban Health, Urban Health Services

INTRODUCTION

Tuberculosis (TB) is the leading infectious cause of death worldwide, claiming over a million lives each year.^[1] The primary source of TB infection (TBI) is close contact with an individual suffering from pulmonary TB disease, typically a household contact (HHC). To reduce the risk of developing TB disease among HHCs with TBI, the World Health Organization (WHO) recommends providing tuberculosis preventive treatment (TPT) after confirming that active TB disease is not present.^[2]

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The National Strategic Plan of India for TB elimination (2017–2025) is a bold strategic framework aimed at accelerating progress toward TB elimination, achieving the Sustainable Development Goal, and ending TB targets for the country. It encompasses strategies under four pillars – detect, treat, prevent, and build. Prevention falls under the 3rd pillar.^[3] The TPT program is considered one of the most effective interventions under this pillar.^[4]

There are many challenges to implementing TPT, especially in the Indian subcontinent. Regarding TPT acceptance, adherence, and treatment completion, the initiation and adherence to TPT have been historically poor in India.^[5]

Since 2021, in accordance with the National TB Elimination Program (NTEP), West Bengal, a major state in India, has expanded TPT eligibility to all age groups of HHCs of pulmonary TB patients. However, anecdotal evidence from program data indicates that there are certain areas in West Bengal, especially the urban areas, where the coverage rate for 6H TPT (6 months of isoniazid prophylaxis) is low. This study aimed to find the barriers to the TPT program in the urban tuberculosis units (TUs) of a district in West Bengal. The study also explored probable solutions to the challenges identified to improve TPT implementation in these urban areas of the state.

METHODS

Type of Study

We conducted an explanatory mixed-methods study. For the quantitative part, secondary data analysis was performed on the data obtained from the Nikshay portal, which is a web-based case-based TB surveillance system in India. We included all the HHCs of bacteriologically confirmed pulmonary TB patients (infectious TB patients) notified in the urban TUs of a district in West Bengal from January 2023 to December 2023.

For the qualitative part, we conducted in-depth interviews (IDIs) with the pulmonary TB patients (index cases) and their HHCs (TPT beneficiaries), field workers (Urban Accredited Social Health Activist [ASHA]), and some relevant NTEP staff, including Medical Officers (MOs). The final sample size was determined by the saturation of findings, and we conducted a total of 23 interviews (six TB patients, seven HHCs, four Urban ASHAs, three NTEP staff, and three MOs) to reach the point of saturation.

Study Setting and Population

The study was conducted in a peri-urban district near Kolkata Metro City of Eastern India. The quantitative study population consisted of the HHC of all bacteriologically confirmed pulmonary TB patients of 12 urban TUs who were initiated on TPT (6H). We have included all 2,393 TPT

beneficiaries in our study to avoid any selection biases. The qualitative study population was index TB patients, HHCs, and healthcare providers of these urban TUs.

Data Analysis

Quantitative data, which are the line list of the TPT beneficiaries, were obtained from the Nikshay Portal.^[6] Data fields relevant to the study were analyzed after cleaning and validation. Stata 14.2 (Stata Corp LP, College Station, TX, USA) was used for statistical analysis. Adjusted odds ratios and *p*-values were calculated using a logistic regression model. 95% confidence intervals were obtained from the models. A *p* < 0.05 was considered statistically significant.

Qualitative part

Transcripts were prepared the same day or one day after the interview using mobile phone audio-recording and field notes. Manual descriptive thematic analysis of the transcripts was done by the principal author to identify the codes. The decision on the final coding and theme generation was made using standard procedures and was in consensus with all authors. The findings were reported using the 'Consolidated Criteria for Reporting Qualitative Research' guideline.^[7]

RESULTS

Quantitative Results

TPT care cascade

A total of 5010 HHCs were identified against 2172 index TB patients (sputum-positive pulmonary TB patients). A total of 4987 (99.5%) were eligible for TPT, where 23 (0.5%) HHCs had some contraindications. Among the eligible HHCs, 2393 (48%) were initiated with TPT, and of those who were initiated with TPT, 2036 (85.1%) completed the treatment. 14.9% of the participants experienced an unsuccessful treatment outcome. Loss to follow-up (58.5%) and not evaluated (34.5%) were the two major reasons for the unsuccessful outcome. The care cascade is depicted in Figure 1.

Sociodemographic profile of participants

Mean age of the participants was 32 years, 53.6% were females, and the mean body mass index (BMI) was 20.5 kg/m². The sociodemographic profile is summarized in Table 1.

Sociodemographic factors associated with unsuccessful TPT outcome

There was no independent association of unsuccessful TPT outcome with age, gender, or BMI. The strength of associations is summarized in Table 2.

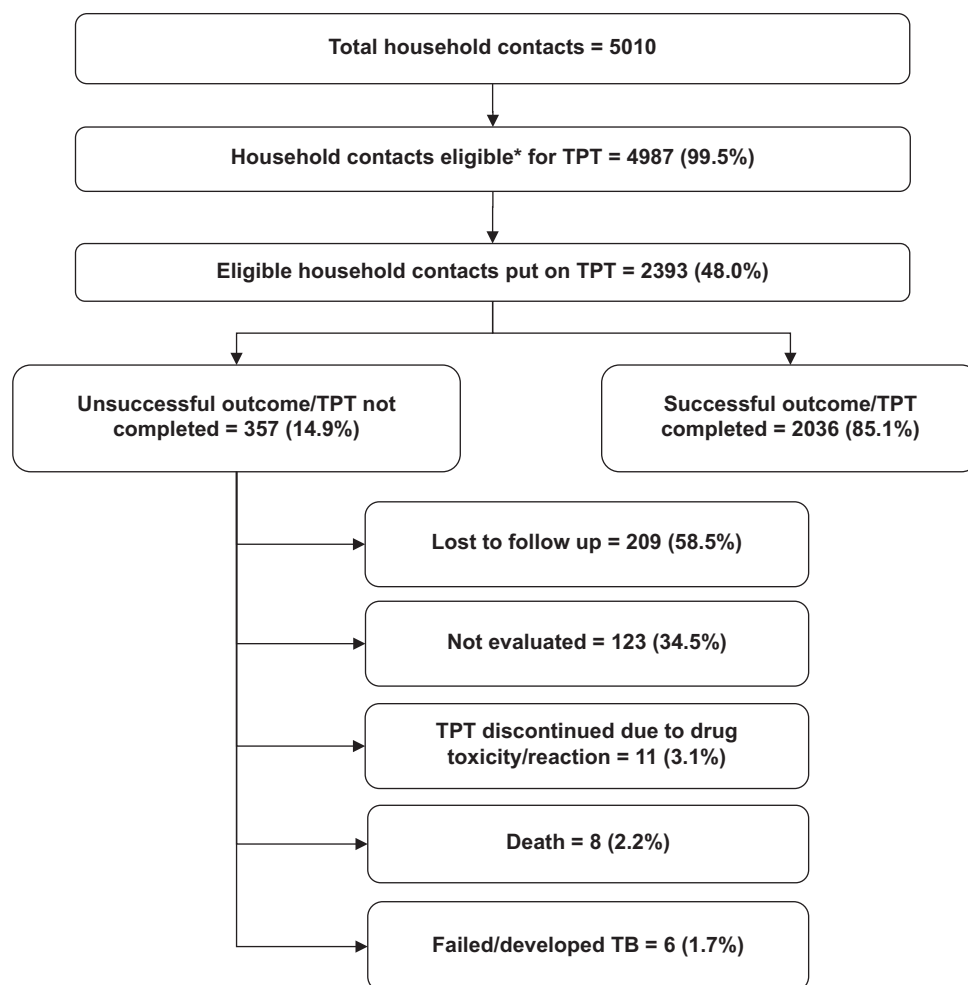


Figure 1: Flowchart depicting the number and percentage of participants at different stages of the TPT care cascade in the urban TUs of a South Bengal district of West Bengal from January 2023 to December 2023. TB: Tuberculosis, TPT: Tuberculosis preventive treatment, TU: Tuberculosis units. *All household contacts of pulmonary TB patients are eligible for TPT under the ‘treat-only policy’, except those having contraindications (active TB, liver disease, peripheral neuropathy, allergy to TPT drugs, heavy alcoholism, and concurrent use of other hepatotoxic drugs).

Qualitative Results

We identified nine codes, which were grouped into two categories, namely ‘Suboptimal TPT initiation rate’ and ‘TPT Completion rate’, under the broad theme ‘TPT implementation challenges’. The codes and categories are depicted in Figure 2.

The five codes were related to ‘suboptimal TPT initiation rate’.

- Stigma associated with TB: Stigma played a significant role in poor TPT acceptance. ‘We had never had TB in our family. My son got it from the hostel. We all are okay. We have nothing to do with TB’ – 49-year-old male (Father of TB patient).
- Lack of adequate field workers in urban settings: Unlike rural areas, most urban ASHAs deal with a population of 3000–4000, which is 3–4 times that of the rural ASHAs.

‘We don’t have plenty of field staff like in rural areas. Our field staff mainly focuses on the BPL population. So, we are unable to reach 100% of the population’. – 32-year-old male (Doctor).

- Wrong message by private doctors due to inadequate sensitization: ‘My husband has been diagnosed and prescribed anti-TB drugs by a renowned physician. He never asked all of us to take medicine for TB. We shouldn’t take any extra medicine’. – 28-year-old female (Wife of TB patient).
- Refusal due to long duration of treatment and fear of side effects: ‘My grandfather has TB and will be taking medicine for 6 months. Now the health worker is asking me to take medicine for 6 months as well. It’s strange! If I need to take medicine for 6 months to prevent TB, then it’s better to take medicine for 6 months after having TB’ – 22-year-old female (Granddaughter of a TB patient).

Table 1: Socioeconomic and clinical profile of the HHCs of pulmonary TB patients who were put on TPT with 6H regimen from January 2023 to December 2023, $n=2393$, $n_1=2036$, $n_2=357$.

Variables	Total <i>n</i> (%)	Successful outcome <i>n</i> 1 (%)	Unsuccessful outcome <i>n</i> 2 (%)	<i>p</i> -value
Age group				
0–5 years	112 (4.7)	91 (81.3)	21 (18.7)	0.839
6–10 years	179 (7.5)	152 (84.9)	27 (15.1)	
11–20 years	438 (18.3)	375 (85.6)	63 (14.4)	
21–30 years	502 (21)	429 (85.5)	73 (14.5)	
31–60 years	990 (41.4)	846 (85.4)	144 (14.6)	
>60 years	172 (7.2)	143 (83.1)	29 (16.9)	
Gender				
Male	1111 (46.4)	943 (84.8)	168 (15.2)	0.795
Female	1282 (53.6)	1093 (85.2)	189 (14.8)	
BMI category				
Severely	512 (21.4)	434 (84.8)	78 (15.2)	0.283
Under weight	374 (15.6)	310 (82.8)	64 (17.2)	
Normal	1133 (47.3)	966 (85.2)	167 (14.8)	
Overweight	277 (11.6)	246 (88.8)	31 (11.2)	
Obese	97 (4.1)	80 (82.4)	17 (17.6)	
Total	2393	2036 (85.08)	357 (14.92)	

#Column percentage; *Row percentage. HHC: Household contacts, TB: Tuberculosis, TPT: Tuberculosis preventive treatment, 6H: Course of isoniazid for 6 months, BMI: Body mass index.

Table 2: Sociodemographic factors associated with unsuccessful TPT outcome among the HHCs of pulmonary TB patients who were put on TPT with the 6H regimen from January 2023 to December 2023. $n=2393$, $n_2=357$.

Characteristics	Total HHC, n (%)	Unsuccessful Outcome n_2 (%)	aOR (95% CI) ^α	p -value ^α
Age groups				
0–5 years	112 (4.7)	21 (5.9)	1 (base)	0.433
6–10 years	179 (7.5)	27 (7.6)	0.8 (0.4–1.5)	
11–20 years	438 (18.3)	63 (17.6)	0.7 (0.4–1.3)	0.249
21–30 years	502 (21)	73 (20.4)	0.7 (0.4–1.3)	0.312
31–60 years	990 (41.4)	144 (40.3)	0.8 (0.4–1.3)	0.311
>60 years	172 (7.2)	29 (8.1)	0.9 (0.5–1.7)	0.705
Gender				
Male	1111 (46.4)	168 (47.1)	1 (0.8–1.3)	0.763
Female	1282 (53.6)	189 (52.9)	1 (base)	
BMI category				
Severely underweight	512 (21.4)	78 (21.8)	1 (0.7–1.4)	0.998
Underweight	374 (15.6)	64 (17.9)	1.2 (0.9–1.6)	0.275
Normal BMI	1133 (47.3)	167 (46.8)	1 (base)	0.118
Overweight	277 (11.6)	31 (8.7)	0.7 (0.5–1.1)	
Obese	97 (4.1)	17 (4.8)	1.2 (0.7–2.1)	

*=column percentage within the category; α =odds ratio adjusted (with other independent factors) using a logistic regression model to derive the p -values and 95% CI. HHC: Household contacts, TB: Tuberculosis, TPT: Tuberculosis preventive treatment, 6H: Course of isoniazid for 6 months, BMI: Body mass index, aOR: Adjusted odds ratio, 95% CI: 95% confidence interval.

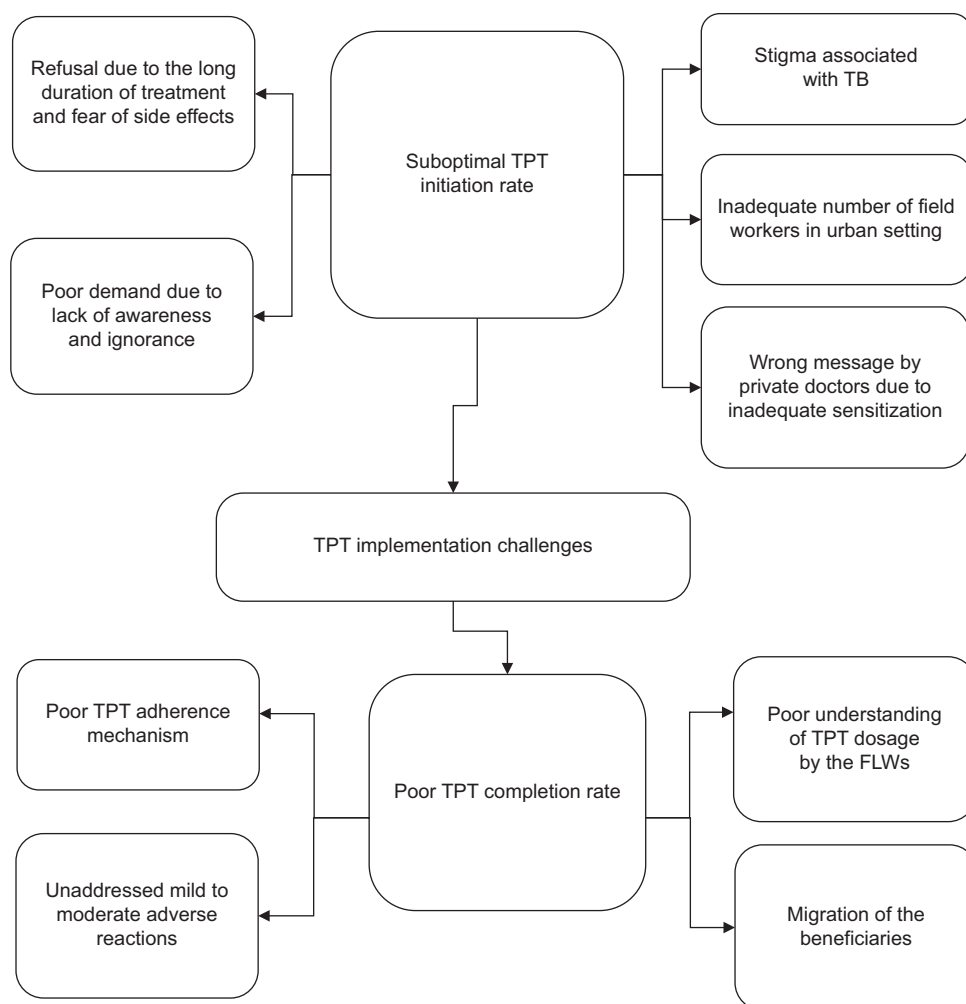


Figure 2: The reasons for low TPT coverage in the urban TUs of a south Bengal district from January 2023 to December 2023. TPT: Tuberculosis preventive treatment, TB: Tuberculosis, FLW: Frontline workers, TU: Tuberculosis units.

- e) Poor demand due to the lack of awareness and ignorance: 'I've never heard any such thing that a medicine can prevent TB. I don't believe it'. – 55-year-old male (Close Contact of TB patient).

The four codes were related to 'Poor TPT completion rate'.

- a) Poor TPT adherence mechanism: 'Digital adherence is not feasible as sleeves are not available for INH strips. Such a huge number of beneficiaries, who will monitor them physically? Not possible'. – 51-year-old male (NTEP Staff).
- b) Unaddressed mild-to-moderate adverse reactions: 'Please don't ask me to take any medicine. I was about to die that day when I developed severe abdominal pain, vomiting due to the medicine. Nobody helped me'. – 27-year-old female (Close contact of TB patient).
- c) Poor understanding and TPT dosage by the front-line workers (FLWs): 'She gave the medicines for all of us in the

same packet. Now all are mixed. We don't know who will take what and how many tablets. In this situation, I've asked my family member not to take any medicine'. – 27-year-old male (Close contact with TB patient).

- d) Migration of the beneficiaries: 'I've visited his house at least four times, but I could never meet him (HHC)'. – 39-year-old female (FLW).

DISCUSSION

This is one of the first mixed-methods studies in India that explored the root causes of low TPT initiation and completion rates in urban areas.

Discussion on Key Findings

First, fear of adverse effects due to the long duration of the TPT course (6H) was one of the main reasons for refusal.

A recent study in India conducted among healthcare workers reported similar findings.^[8] Studies conducted in India as well as abroad reported that fear of TPT side effects may prevent eligible contacts from accepting and completing TPT.^[8,9]

Second, the wrong message from private doctors was a challenge – an Indian study reported that the participation of private practitioners (PPs) has been inconsistent in TB prevention and care, and distrust exists between the public and private sectors.^[10]

Third, stigma significantly hinders the successful implementation of TPT, as many individuals are hesitant to disclose their TBI or latent TB status due to fear of discrimination and social exclusion. Studies show that the stigma associated with TB can discourage people from seeking diagnoses and completing their treatment. This is especially troubling regarding TPT.^[9,11,12]

Fourth, ineffective adherence mechanisms significantly hinder the successful implementation of TPT. A study in South Africa showed that the implementation of the TPT program was suboptimal, with inadequate monitoring even in health districts with well-functioning TB services.^[13]

Fifth, inadequate awareness and ignorance contribute to low demand, which hampers the effective implementation of TPT. Studies indicate that misunderstandings of TPT's preventive role among HCWs, including doctors and contacts of persons with TB, can affect its acceptance and completion.^[8,9,14]

Strengths and limitations of the study

Strengths: (i) It was conducted under programmatic settings, reflecting field realities. (ii) We used a mixed methods design, which provided valuable insights into the challenges of implementing TPT and helped interpret the quantitative results. (iii) The study had a relatively large sample size, with no selection bias, as we included all the TPT beneficiaries of 2023 in the district.

Weakness: (i) We failed to capture data and adjust our model for potential confounders such as socioeconomic status, occupation, education level, and marital status. Thus, the factors associated with 'Unsuccessful TPT outcome' must be interpreted with caution. (ii) The qualitative interviews were limited to patients, HHC, and healthcare staff within one district. Thus, we failed to capture the experiences of program managers and policymakers at the district and State levels.

Recommendations Based on the Findings

Shorter TPT regimens: Efforts should be made to promote and implement shorter, more tolerable regimens to improve patient compliance and reduce dropouts. Shorter TPT regimens should be made available for pediatric patients.

Engagement of PPs: Collaborate more effectively with private healthcare providers to enhance accurate communication and encourage participation in TPT programs. The Swasth e-gurukul platform should be promoted among busy practitioners for self-paced learning.^[15]

Issues with urban health setup: There are many identified key issues in the urban health sector of West Bengal that need urgent attention. Key issues include a lack of uniform healthcare infrastructure, inadequate health workforce, an overstretched public health system due to population pressure, overlapping service delivery by various health programs at the local level, disparities in human resource availability, and a lack of coordination between different administrative bodies.^[16]

CONCLUSION AND IMPLICATIONS FOR TRANSLATION

For TPT implementation in urban areas, there are several unique challenges, such as inadequate health workforce; impeding influence of huge, heterogeneous, and unorganized private sector; population migration; and lack of primary healthcare infrastructure. The long duration of TPT has been one of the most significant barriers, which can be addressed by providing shorter TPT courses, like 3HP/1HP, for all age groups.

Key messages

1) Tuberculosis preventive treatment (TPT) is considered the most effective strategy to prevent tuberculosis, but the TPT coverage in many urban areas remains sub-optimal. 2) A longer duration of the TPT course has emerged as one of the main barriers to achieving optimal TPT coverage and compliance. The availability of a shorter TPT regimen for all eligible beneficiaries, including children, is urgently needed. 3) Urban areas of West Bengal face unique challenges different from those in rural areas. These issues should be addressed separately to achieve tuberculosis elimination targets.

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COMPLIANCE WITH ETHICAL STANDARDS

Conflicts of Interest: The authors declare no competing interests. **Financial Disclosure:** Nothing to declare. **Funding/Support:** There was no funding for this study. **Ethics Approval:** The research/study was approved by the Institutional Review Board at Malda Medical College and Hospital, number P/MLD-MC/IEC-24/01, dated March 13, 2024. **Declaration of Patient Consent:** Written informed consent was taken before the interviews and audio-recordings. Patient anonymity is maintained strictly. Good clinical care guidelines and guidelines as per the

Declaration of Helsinki were followed throughout the study. **Use of Artificial Intelligence (AI)-Assisted Technology for Manuscript Preparation:** The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript, and no images were manipulated using AI. **Disclaimer:** None.

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