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Implementing timeliness metrics for household contact tracing and TB preventive treatment through TB champions in the public sector, India: an explanatory mixed-methods study

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ABSTRACT

Objectives A '7-1-7' timeliness metric, developed for hastening the response to infectious disease outbreaks/pandemics, was adapted to improve screening and managing household contacts (HHCs) of pulmonary tuberculosis (TB) patients. The feasibility, enablers, challenges and utility of implementing this modified metric through TB Champions (TB survivors) for HHC management were assessed.

Design This was an explanatory mixed-methods study with a cohort design (quantitative) followed by a descriptive design with focus group discussions (qualitative).

Setting The study was conducted within routine programmatic settings in public health facilities in six districts from three states of India.

Participants In total, 595 drug-susceptible index pulmonary TB patients registered for treatment in the selected health facilities, and their listed 2108 HHCs were included in the study between December 2022 and August 2023. All 17 TB Champions involved in implementation participated in the focus group discussions.

Primary outcome measures The primary outcome measures were the percentage of eligible participants receiving the desired service within the '7-1-7' timeliness metric and challenges in achieving the timeliness metrics.

Results In 89% of 595 index patients, their HHCs were line-listed within 7 days of initiating anti-TB treatment ('First-7'). In 90% of 2108 HHCs, screening outcomes were ascertained within 1 day of line-listing ('Next-1'). In 42% of 2073 HHCs eligible for further evaluation, anti-TB treatment, TB preventive treatment (TPT) or a decision to not receive medication were made within 7 days of screening ('Second-7'). Barriers to TPT uptake included lack of money and daily wage losses for travelling to clinics, reluctance of asymptomatic contacts to take medication and fear of adverse events. TB Champions felt timeliness metrics improved performance in the systematic and timely management of HHCs.

Conclusions TB Champions found '7-1-7' timeliness metrics were feasible and useful, and national TB programmes should consider their operationalisation.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The study was conducted within routine programmatic settings reflecting the realities of household contact management in the public sector.
⇒ The quantitative findings guided the qualitative discussions, and a combination of the two techniques provided a better understanding of the enablers and barriers in implementing the '7-1-7' metric.
⇒ The study results cannot be generalised throughout the country, given that the districts which were included in the study were supported by a non-governmental organisation and implemented the 'Treat Only' model in India for tuberculosis preventive treatment.
⇒ A quantitative assessment of the impact of '7-1-7' implementation on coverage and timeliness of household contact management could not be done due to the lack of a concurrent or historical cohort.

INTRODUCTION

Tuberculosis (TB) is a major public health concern in the world. The South-East Asia Region (SEAR) contributes 45% to the global TB burden, with an estimated 4.9 million cases and 605 000 deaths reported in 2023.[1] Although the WHO aims to end TB by 2035, progress towards meeting the End TB strategy targets is suboptimal in the SEAR.[2] However, modelling studies from the region have shown that provision of TB preventive treatment (TPT) to high-risk groups has the potential to reduce the overall annual TB

incidence rate by 8.3% relative to 2015.[3 4] Therefore, effective implementation of TPT is crucial for the timely achievement of the End TB targets in this region.

Acknowledging the importance of TPT during the United Nations High-Level Meeting (UNHLM) on the fight against TB in 2018, world leaders committed to providing TPT to 4 million household contacts (HHCs) aged <5 years and 20 million HHCs aged ≥5 years by 2022.[5] In the event, globally, only 2.2 million (55% of the target) HHCs <5 years and only 2 million HHCs aged ≥5 years (10% of the target) received TPT between 2018 and 2022.[6] In SEAR, only 24% of HHCs of bacteriologically confirmed pulmonary TB patients were started on TPT in 2023.[1] Despite this poor progress, the recent UNHLM in September 2023 upheld the commitment to provide TPT to 30 million HHC between 2023 and 2027.[7] This underscores the need to intensify efforts and implement strategies that accelerate progress towards achieving the global target.

Studies have shown that 83% of child HHC with TB infection develop active disease within 90 days of exposure.[8] However, timely provision of TPT can reduce this risk. A recent systematic review of almost 440 000 contacts showed an overall TPT effectiveness of 49% for all ages, rising to 69% in high TB burden settings.[9] Therefore, early provision of TPT is pivotal in averting progression from infection to disease in those with a high risk of exposure, like HHC. However, studies have reported that it may take up to 2 months or longer for eligible HHC to be initiated on TPT, by which time the intervention may be too late to have the desired benefit.[10–12]

Currently, there are no established timeliness metrics applicable to TPT provision. Therefore, we adapted a '7-1-7' timeliness metric, which was primarily developed for hastening the public health response to infectious disease outbreaks, to the context of HHC management.[13 14] The '7-1-7' timeliness metric adapted for the process of HHC management works as follows: First-7—HHCs are line-listed within 7 days of treatment initiation in the index TB patient; Next-1—line-listed HHCs have symptom screening outcomes ascertained within the next 1 day; Second-7—eligible HHCs start anti-TB treatment or TPT or a decision to receive no drugs within 7 days of symptom screening.

We implemented the '7-1-7' timeliness metric in India, which contributes 22% of TB cases globally.[1] Although the National TB Elimination Programme (NTEP) of India recommends TPT for all HHC of pulmonary TB patients after ruling out active TB, TPT implementation has been suboptimal.[11 15 16] In one study, while >90% of HHC were screened for symptoms, only 60% of eligible HHC underwent evaluation for TB infection.[15] In another study, once an index patient was initiated on treatment, it took almost 1 month to screen HHC and more than 2 months to initiate TPT.[11] We therefore assessed whether '7-1-7' was a workable metric for HHC management done by TB survivors (also known as TB Champions (TBCs) in public health facilities in six districts across three states of India.

The specific objectives were to (1) ascertain the proportions of HHC who were screened, investigated and given appropriate interventions in each of the '7-1-7' stages and (2) explore enablers, challenges and benefits of implementing '7-1-7'.

MATERIALS AND METHODS

Study design

This was an explanatory mixed-methods study with a cohort design for the quantitative component and a descriptive design for the qualitative component.

Setting

Organisation of TB care services in the public sector

The key operational units for the delivery of TB care services in the Indian public health system are Tuberculosis Units (TUs). Typically, there is one TU per 150 000 to 250 000 population. Each TU has a medical officer (MO) and senior treatment supervisor (STS) to oversee TB control activities. Each TU is responsible for a group of public health facilities within its catchment area. In these facilities, frontline health workers are involved in the delivery of TB care services.[17]

Process of household contact management

As per NTEP guidelines, the STS or frontline health workers make a home visit to all pulmonary TB patients to line-list their HHC and initiate the process of screening HHC. The HHCs are first evaluated for the presence of active TB disease through symptom screening. If found symptomatic, they are evaluated by an MO to rule out active TB. Those HHC diagnosed with TB are initiated on anti-TB treatment. Those who are asymptomatic or in whom active TB is ruled out are initiated on TPT (daily isoniazid for 6 months–6H regimen) provided they do not have any medical contraindications (the Treat Only Model).[16 18] In some districts (not included in the study), TPT is initiated only in those contacts identified with TB infection based on Interferon-Gamma Release Assays (the Test and Treat Model).[16]

Role of TB survivors

Since 2019, the NTEP has encouraged the engagement of TB Champions (TBCs) as trained role models to support certain TB control activities. TB survivors who are willing to devote time and travel within the district/block to participate in TB response activities and get trained through capacity-building workshops are engaged as TBCs.[19] TBCs undergo a training workshop designed as per the standard training curriculum developed by NTEP. Their roles vary from state to state, and they have been involved in the management of HHC, active case finding and support for treatment adherence, stigma reduction and access to social support schemes.[20]

Non-governmental organisations, such as the Resource Group for Education and Advocacy for Community Health (REACH), assist the NTEP to train TBCs to support TB patients during treatment.[21] Additionally, TBCs are involved in counselling families of TB patients to undergo contact investigation and uptake of TPT in some districts. The TBCs are paid an incentive of about US$8 per index patient for supporting management of their HHC.

Implementation of '7-1-7'

'7-1-7' was implemented in six districts across the states of Bihar, Chhattisgarh and Odisha. These districts were selected because REACH was already supporting TBCs in the districts, and they had a high case load of pulmonary TB. Within each district, two or three TUs with the highest TB notification numbers were selected. Administrative approvals for conducting the study were obtained from the state TB officers in the selected states.

The TBCs in the selected TUs were trained in HHC management in line with the timeliness metrics through a 2-day workshop conducted by the study investigators. On Day 1, the TBCs were oriented on the steps of HHC management, including line-listing, symptom screening and evaluation for ruling out TB disease and initiation of TPT. On Day 2, the process of documenting these steps of HHC management as per the timeliness metrics was discussed using case studies.

During the '7-1-7' implementation period, the TBCs liaised with the STS at the TU on a daily basis and received details of index patients who were initiated on treatment. They then contacted the index patient and set up a face-to-face interview to line-list their HHC. Next, they met each HHC individually in their household or a place convenient for the HHC and assessed them for symptoms suggestive of TB (cough, fever, weight loss, night sweats and haemoptysis). An HHC with any one of these symptoms was considered symptomatic. A symptom screening outcome was ascertained—already on anti-TB treatment or TPT; symptomatic; asymptomatic <5 years and asymptomatic ≥5 years. The TBCs counselled the symptomatic HHC and asymptomatic HHC to visit any nearby health facility for evaluation for TB and eligibility for TPT. They facilitated HHC consultation with the MO, who would evaluate the HHC and decide on further management.

Based on MO consultations, HHCs were classified as: (1) diagnosed with TB and enrolled for anti-TB treatment, (2) eligible for TPT and started on TPT or (3) decision made by either the MO or HHC not to receive anti-TB treatment or TPT.

Thus, the process of HHC management continued to be implemented within routine programmatic settings through personnel designated for this process as per the NTEP guidelines. The TBCs were encouraged to facilitate the completion of the above-mentioned activities within the timelines as per the 7-1-7 timeliness metrics and to document the process. Dates were recorded as follows: date of treatment initiation in the index patient; date of completing line-listing of HHC; date of completing symptom screening and ascertainment of symptom screening outcomes and date of starting anti-TB treatment, TPT or a decision to receive no treatment.

A study coordinator was appointed in each state for supportive supervision of the TBCs.

Study population

All patients with drug-susceptible pulmonary TB (index patients) registered for treatment in health facilities in the selected TUs and their listed HHC were eligible for the study, which was conducted between December 2022 and August 2023. A sample size of 600 index patients was calculated with the assumption that the achievement of the first seven would be 70% with an absolute precision of 4%, 95% confidence and 10% non-response. The assumption of a 70% metric achievement was made empirically, as there have been no prior studies to provide this information. Considering four contacts per patient in India based on studies from programmatic data,[15] 2400 contacts were expected. The first 200 index patients initiated on treatment in the selected TUs in each of the three states were consecutively enrolled. The period of recruitment was between 11 March 2023 and 18 July 2023 in Bihar, 17 January 2023 and 10 June 2023 in Chhattisgarh and 3 December 2022 and 13 July 2023 in Odisha.

At the conclusion of the '7-1-7' quantitative component, focus group discussions (FGDs) were conducted with TBCs to document enablers and challenges associated with implementing the various components of '7-1-7'. Four FGDs were conducted in each state: the first FGD focused on the process of contacting and interviewing the index patients for line-listing HHC; the second FGD on meeting HHC and screening them for symptoms; the third FGD on further evaluation of HHC for active TB, assessing their eligibility for TPT and taking decisions on provision of drugs and the fourth FGD on perceived utility and feasibility of the timeliness metrics. All the TBCs (five to six per state) and the state study coordinator participated in each FGD. Prior to the FGD, participants were informed about the purpose of the scheduled discussion meeting. The FGD was conducted on 21 August 2023 in Bihar, 27 July 2023 in Chhattisgarh and 30 July 2023 in Odisha at the TBCs' workplaces (local REACH office).

Data collection

TBCs entered data for individual index patients and HHC on a structured proforma embedded within the EpiCollect5 mobile-based application (V.5.1.51, Centre for Genomic Pathogen Surveillance (2023):

https://five.epicollect.net) on a real-time basis. The state study coordinator attended to data quality check reports generated weekly by the team at the Centre for Operational Research, The Union.

The FGDs were conducted by PT (male) and DN (female), who are operational research fellows with an MD degree and have undergone formal training in and published on qualitative research. Both PT and DN guided the implementation of this project and led data quality assurance. Cohort study results informed the development of the FGD interview guides (online supplemental file 1). Each discussion lasted for 1 hour and was audio recorded. The recordings were transcribed in the local language and translated to English.

Analysis and statistics

Data from EpiCollect5 were downloaded and analysed using Stata (V.16.0 StataCorp LLC, Texas, USA). Numbers and proportions of individuals achieving each of the '7-1-7' components were analysed. Univariate and multivariate log binomial regression were used to assess associations of individual-level characteristics with achievement in each '7-1-7' component.[22] Crude relative risks (RRs) and adjusted relative risk (aRR) with 95% CIs were used as measures of association and were rounded off to the nearest one decimal point. Findings were reported in accordance with Strengthening the Reporting of Observational Studies in Epidemiology (STROBE), which are provided as online supplemental file 2.[23] For the qualitative component, thematic content analysis was done by PT using Atlas-Ti (V.9.1.7.0, ATLAS.ti Scientific Software Development GmbH (2021): https://atlasti.com/). DN reviewed the analysis and decisions on coding, and theme generation was done by consensus. Findings were reported in accordance with 'Consolidated Criteria for Reporting Qualitative Research' guidelines (COREQ), which are provided as online supplemental file 2.[24] For each component of 7-1-7, we have presented the quantitative study findings followed by a summary of enablers and challenges from qualitative FGDs.

Ethics statement

Ethics approval was obtained from the Ethics Advisory Group, International Union Against Tuberculosis and Lung Disease, Paris, France (EAG 04/2022 on 28 June 2022) and from the Institutional Review Board, REACH, on 9 November 2022. Index TB patients gave verbal informed consent to participate in the study, as the information is collected as part of routine programme implementation. All HHCs gave written informed consent to participate in the study. For HHCs ≤18 years of age, written informed consent was sought from their parents. The TBCs gave written informed consent to participate in the FGDs.

Patient and public involvement

Patients or the public were not involved in the design, conduct, reporting or dissemination plans of our research.

RESULTS

Overview of '7-1-7' implementation

Quantitative findings

There were 595 index patients who were initiated on anti-TB treatment in the 14 selected TUs from three states of India. Of 595 index patients, 588 (99%) were interviewed by TBCs, and 2108 HHC were line-listed (median: 3 contacts, IQR: 2–4 contacts per index patient). Line-listing of HHC was achieved for 527/595 (89%) index patients within 7 days of treatment initiation. Of 2108 line-listed HHC, symptom screening outcomes were ascertained for 2081 (98%) and within 1 day after line-listing in 1896 (90%). Of the 2081 HHC with ascertained screening outcomes, 8 (<1%) were already on TB treatment, and the remaining 2073 were eligible for further evaluation by a MO for decision/action. Of the eligible HHC, only 961 (46%) consulted a MO, and decisions/actions were taken. Of those eligible, the start of anti-TB treatment, TPT or a decision to receive neither was achieved in 874 (42%) HHC within 7 days of screening (figure 1).

Qualitative findings

In FGDs, the TB survivors felt that the metrics improved their performance of HHC management by helping them perform the activities systematically and in a timely manner.

> Because we had these timelines in our minds, we tried to finish these activities in a set time. If the timelines had not been there, we might have been a bit lax with our work. (Male TBC)

Some TBCs who had been supporting HHC management prior to '7-1-7' felt that they were able to deliver TPT in a more timely manner during the '7-1-7' project period.

> Earlier, if they missed starting TPT for contacts during initiation of treatment for the index patient, then TPT could be delayed by 2 months or more… With 7-1-7, we are able to reduce this delay as we are visiting the patient's home. (Male TBC)

Additionally, TBCs felt that the '7-1-7' project brought focus to TPT among NTEP staff and frontline health workers in the study sites.

> Earlier TPT was not given much importance. The focus of home visits was always the patient with TB. But with 7-1-7, we (TBCs) started utilising home visits to counsel the family members regarding TPT. STS started facilitating the provision of TPT and also followed up contacts to ensure they continued to take TPT (Female TBC).

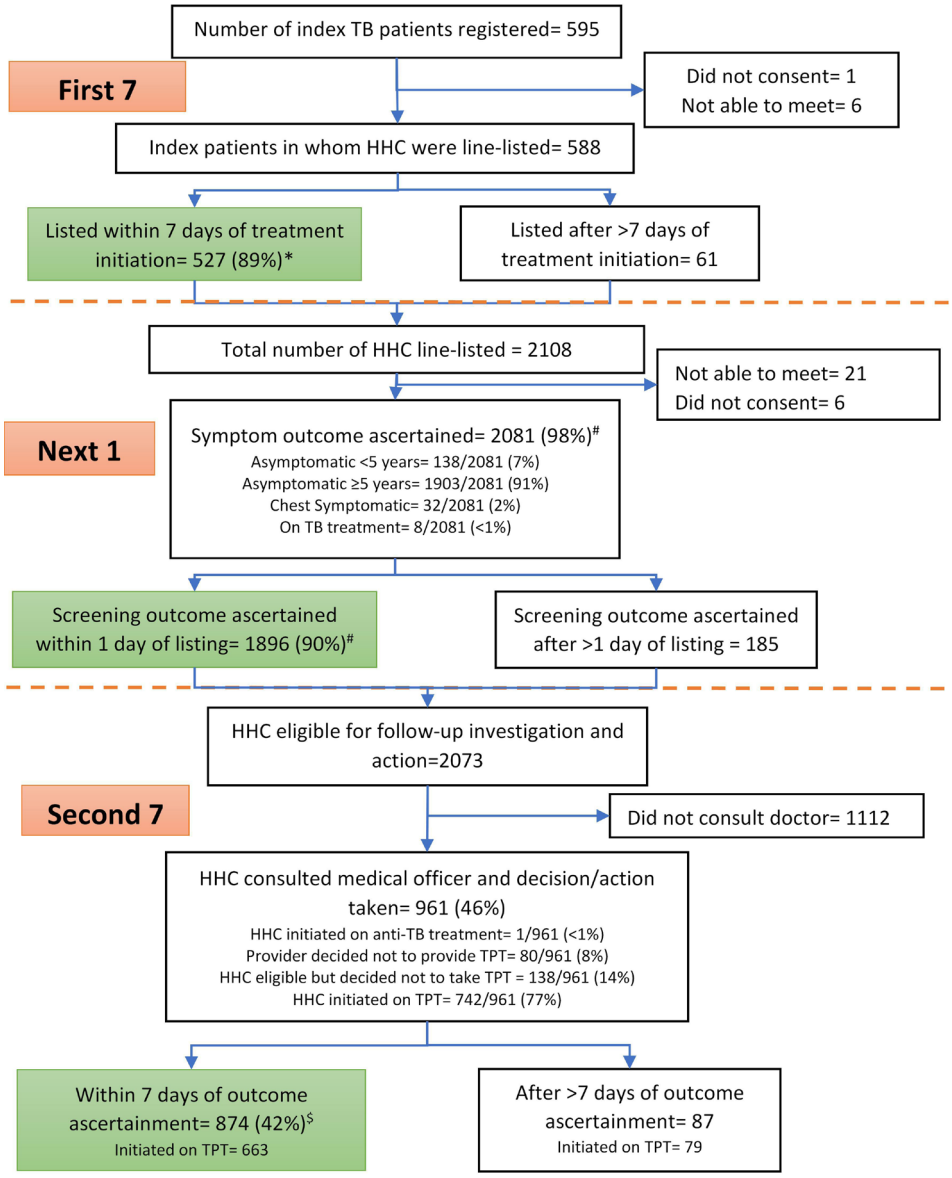

Figure 1 Overview of implementation of '7-1-7' among household contacts of index pulmonary TB patients diagnosed in public health facilities in three states of India: December 2022 to August 2023. *Percentage calculated with total number of index patients registered as the denominator; #Percentage calculated with total number of household contacts listed as denominator; $Percentage calculated with household contacts for whom investigation/action data were available as the denominator. HHCs, household contacts; TB, tuberculosis; TPT, TB preventive treatment.

Line-listing (First-7) and screening (Next-1) of HHCs

Quantitative findings

Characteristics of 588 index patients recruited for the study are shown in table 1. The achievement of First-7 was significantly higher among index patients in Chhattisgarh (aRR 1.3, 95% CI 1.2 to 1.4) and Odisha (aRR 1.3, 95% CI 1.1 to 1.4) compared with Bihar. There was no significant difference in achievement of First-7 across age groups and gender of index patients.

Characteristics of 2108 HHC who were line-listed are shown in table 2. The achievement of Next-1 was significantly higher among those who were spouses/partners of index patients (aRR 1.1, 95% CI 1.0 to 1.1) compared with parents; HHC of clinically diagnosed index patients (aRR 1.0, 95% CI 1.0 to 1.1) compared with bacteriologically diagnosed patients and HHC of Bihar (aRR 1.2, 95% CI 1.1 to 1.3) and Chhattisgarh (aRR 1.1, 95% CI 1.1 to 1.2) compared with Odisha.

Qualitative findings

Enablers and challenges in line-listing of HHC within 7 days and screening of HHC within the next 1 day, as perceived by the TBCs, are depicted in figure 2.

Some of the enablers are detailed below:

1. Sharing information between NTEP staff and TB survivors

Table 1 Characteristics of index PTB patients initiated on anti-TB treatment in relation to completing line-listing of their household contacts within the first 7 days in public health facilities in three states of India: December 2022 to August 2023

Characteristics of index PTB patients	Total	Patients whose HHC were line-listed		Patients whose HHC were line-listed within 7 days (First 7)		Crude RR (95% CI)*	Adjusted RR (95% CI)*	P value
	n	n	(%)†	n	(%)†			
Total	595	588	(99)	527	(89)	–	–	–
Age (in years)								
≤14	29	29	(100)	27	(93)	1.1 (0.9 to 1.2)	1.1 (1.0 to 1.3)	0.128
15–29	166	165	(99)	143	(86)	1.0 (0.9 to 1.1)	1.0 (0.9 to 1.1)	0.530
30–44	152	150	(99)	138	(91)	1.0 (0.9 to 1.2)	1.0 (0.9 to 1.2)	0.492
45–59	140	137	(98)	126	(90)	1.0 (0.9 to 1.5)	1.0 (0.9 to 1.5)	0.694
≥60	108	107	(99)	93	(86)	Ref	Ref	
Gender								
Male	383	378	(99)	339	(88)	Ref	Ref	
Female	212	210	(99)	188	(89)	1.0 (0.9 to 1.1)	1.0 (0.9 to 1.1)	0.549
Type of PTB								
Bacteriologically confirmed	550	544	(99)	493	(92)	1.2 (1.0 to 1.4)	1.1 (0.9 to 1.3)	0.326
Clinically diagnosed	45	44	(98)	34	(89)	Ref	Ref	
State								
Bihar	178	175	(98)	131	(74)	Ref	Ref	
Chhattisgarh	215	212	(98)	208	(97)	1.3 (1.2 to 1.4)	1.3 (1.2 to 1.4)	<0.001
Odisha	202	201	(99)	188	(93)	1.3 (1.2 to 1.4)	1.3 (1.1 to 1.4)	<0.001

*The relative risk (RR) with 95% CI calculated using univariate and multivariate log binomial regression for achieving the First-7 milestone with total number of index PTB patients in each category as denominator. Not achieving the First-7 includes those in whom HHC were never line-listed and those in whom HHC were line-listed after 7 days.
†Row percentage among total number of index PTB patients approached in each category.
HHC, household contact; PTB, pulmonary tuberculosis; TB, tuberculosis.

TB survivors appreciated the process developed through the '7-1-7' project for timely sharing of index patient details by NTEP staff.

> STS gave details of name, date of diagnosis and contact number of patients initiated on TB treatment. I then followed-up with the index patient on the same day. (Male TBC)

2. Prior appointment for home visit

TBCs mentioned that they fixed the appointment for a home visit based on the availability of the index patient and also most of the HHC. This enabled them to complete the symptom screening of most HHC during the same visit they made for line-listing the contacts.

> Since I used to call beforehand and ask for a suitable time when all the family members would be available, I could complete screening in the same visit. We could plan our field activity well (Male TBC).

3. Counselling by TBCs to overcome stigma

TBCs mentioned that the counselling of index patients and their HHC regarding confidentiality and the importance of line-listing and screening helped to overcome HHC fears of stigma and resistance to a home visit.

> I had to counsel index patients and their contacts about TPT and assure them that I would not disclose their disease status to their neighbours. After repeated counselling they would agree to a home visit. (Female TBC)

4. Accompanying NTEP staff during home visits

TBCs informed that they made home visits along with the NTEP staff for interviewing index TB patients and screening contacts.

> The STS made home visits whenever a patient was started on treatment. I accompanied him and interviewed the patients and their contacts. This was very helpful. (Male TBC)

5. Visit by TBCs during non-working hours

Table 2 Characteristics of household contacts of index PTB patients who were visited by TB champions had their screening outcomes ascertained and completed within 1 day in public health facilities in three states of India: December 2022 to August 2023

Characteristics of household contacts	Total	Met by TB champions		Screening outcomes ascertained		Screening outcomes ascertained within 1 day (Next-1)		Crude RR (95% CI)*	Adjusted RR (95% CI)*	P value
	n	n	(%)†	n	(%)†	n	(%)†			
Total	2108	2087	(99)	2081	(99)	1896	(90)			
HHC age (in years)										
≤14	552	551	(99)	551	(99)	510	(92)	1.1 (1.0 to 1.2)	1.1 (1.0 to 1.2)	0.107
15–29	641	630	(98)	627	(98)	593	(92)	1.1 (1.0 to 1.2)	1.1 (1.0 to 1.2)	0.073
30–44	453	448	(99)	445	(98)	387	(85)	1.0 (0.9 to 1.1)	1.0 (0.9 to 1.1)	0.957
45–59	316	315	(99)	315	(99)	285	(90)	1.1 (1.0 to 1.2)	1.1 (1.0 to 1.2)	0.085
≥60	146	143	(98)	143	(98)	121	(83)	Ref	Ref	
HHC gender										
Male	1046	1030	(98)	1026	(98)	937	(90)	Ref	Ref	
Female	1061	1056	(99)	1054	(99)	958	(90)	1.0 (0.9 to 1.0)	1.0 (0.9 to 1.0)	0.232
Other	1	1	(100)	1	(100)	1	(100)	–	–	–
Relationship with index PTB patient										
Partner	332	329	(99)	328	(99)	298	(90)	1.0 (0.9 to 1.1)	1.1 (1.0 to 1.1)	0.029
Child	825	810	(98)	808	(98)	740	(90)	1.0 (0.9 to 1.1)	1.0 (0.9 to 1.1)	0.423
Parent	361	360	(99)	360	(99)	309	(86)	Ref	Ref	
Siblings	257	256	(99)	256	(99)	239	(93)	1.1 (1.0 to 1.1)	1.0 (0.9 to 1.1)	0.295
Other	333	332	(99)	329	(99)	310	(93)	1.1 (1.0 to 1.1)	1.0 (0.9 to 1.1)	0.996
Type of PTB in index patient										
Bacteriologically confirmed	1917	1897	(99)	1891	(99)	1711	(89)	Ref	Ref	
Clinically diagnosed	191	190	(99)	190	(99)	185	(97)	1.1 (1.0 to 1.1)	1.1 (1.0 to 1.1)	0.014
State										
Bihar	815	815	(100)	809	(99)	795	(97)	1.2 (1.1 to 1.3)	1.2 (1.1 to 1.3)	<0.001
Chhattisgarh	740	721	(97)	721	(97)	664	(89)	1.1 (1.1 to 1.2)	1.1 (1.1 to 1.2)	<0.001
Odisha	553	551	(99)	551	(99)	437	(79)	Ref	Ref	

*The relative risk (RR) with 95% CI calculated using univariate and multivariate log binomial regression for achieving the Next-1 milestone, with the total number of household contacts in each category as the denominator. Not achieving the Next-1 includes those HHC in whom screening was never done and those in whom screening was done after 1 day.
†Row percentage calculated among total number of household contacts in each category.
HHC, household contact; PTB, pulmonary tuberculosis; TB, tuberculosis.

TBCs mentioned that house visits outside of routine working hours helped in seeing most of the HHC, especially students and the adult working class.

> Usually the patient would suggest that we visit either early in the morning before their family members went to work or in the evening after they returned from work. We used to meet them accordingly. (Male TBC)

The challenges included:

1. Non-availability of index patients and HHC during home visits

TBCs informed that despite making a prior appointment, some index patients and HHC were not available during the home visit, requiring multiple visits to the homestead.

> When we speak to them by phone, the patients would ask us to come on a particular day. But they would not be available on that day, especially school-going children and those who were at work. We would have to visit multiple times… (Male TBC).

2. Stigma for home visits, especially by TBCs

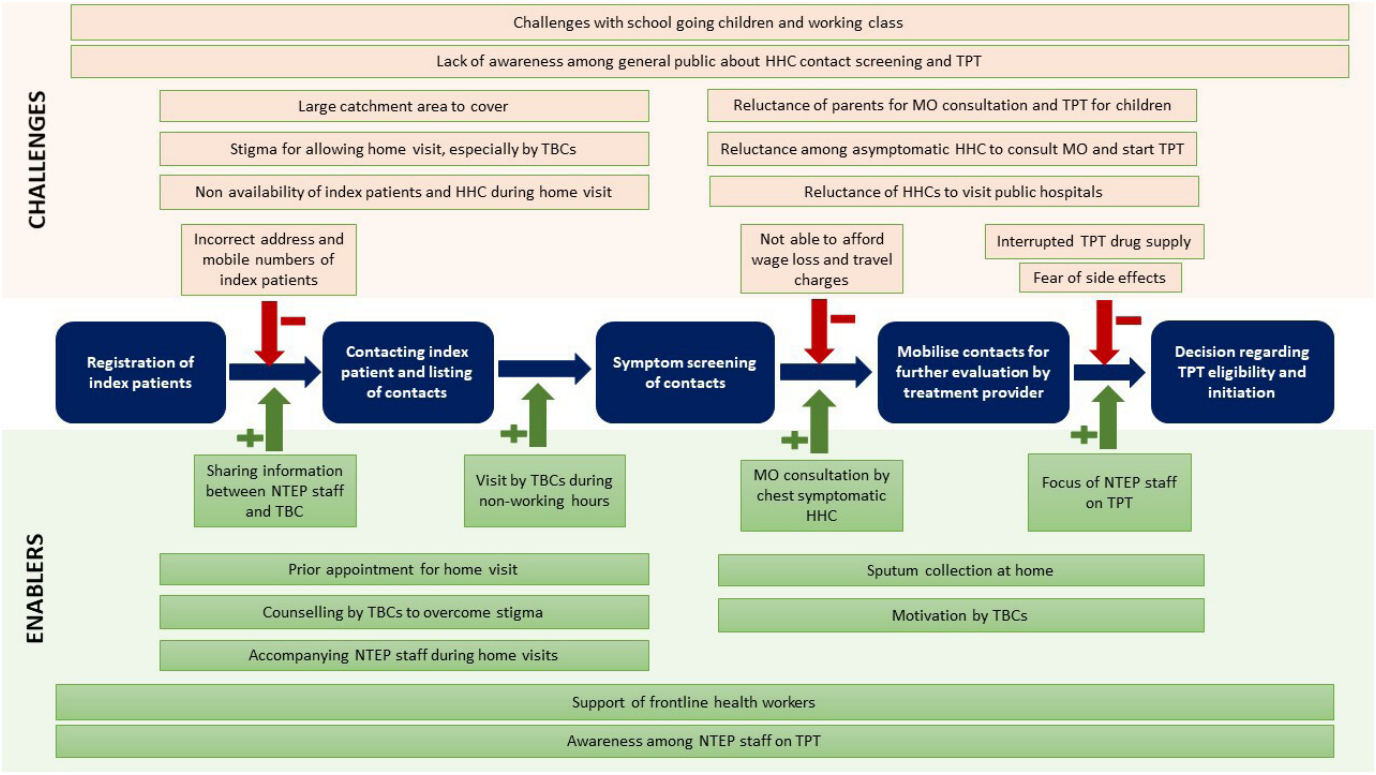

Figure 2 Facilitators (+) and barriers (-) at the various stages of implementing '7-1-7' for index patients with PTB and their household contacts: Public health facilities in three states of India, December 2022 to August 2023. HHCs, household contacts; MO, medical officer; NTEP, National TB Elimination Programme; PTB, pulmonary tuberculosis; TBCs, tuberculosis champions; TPT, tuberculosis preventive treatment.

TBCs mentioned that some index patients and HHC feared home visits due to stigma and worries that their disease status would become known to the neighbours if TBCs visited their homes.

> Two patients firmly told me not to visit their house and to take all information that I needed from the hospital. In this area, there is a lot of stigma around TB… We (TBCs) are not residents of the village, so when we visit any house, the neighbours ask the patient why an outsider visited their house. (Male TBC)

Further evaluation (Second-7) of HHCs

Quantitative findings

Characteristics of 2073 HHCs who were eligible for follow-up investigation and were started on anti-TB treatment or TPT or had a decision for no drugs and had these acted on within the second 7 days are shown in table 3. A significantly higher achievement in the Second-7 was seen in Chhattisgarh (aRR 11.9, 95% CI 8.1 to 17.3) and Odisha (aRR 17.3, 95% CI 11.9 to 25.1) compared with Bihar. The achievement of the Second-7 was 66% with Bihar excluded, the latter having only 4% achievement.

Qualitative findings

The enablers and challenges in achieving the Second-7 as perceived by the TBCs are depicted in figure 2.

The important enablers included:

1. Sputum collection at home

TBCs mentioned that, as some of the symptomatic contacts were not willing to visit the healthcare facilities, TBCs collected and transported sputum samples for investigation. This improved the uptake of TB evaluation and reduced the time for TB diagnosis.

> For symptomatic contacts, we carried sputum cups with us and collected sputum samples from them. (Female TBC)

2. Focus of NTEP staff on TPT

In some districts, NTEP staff were proactive and ensured that assessment of contacts and provision of TPT were carried out soon after the index patient was diagnosed.

> As soon as a person was diagnosed as sputum positive, the STS ensured that their family members received TPT. The STS makes a home visit or collects details about family members from the patient, ie, number of children and adults. Accordingly, the STS would issue TPT drugs to the index patient or available members for all the listed contacts. (Female TBC)

The challenges included:

1. HHC not being able to afford wage loss and travel charges

TBCs mentioned that HHC did not visit health facilities for further evaluation after symptom screening, as they were not able to afford travel charges to the health facility. Also, some HHC who were daily wage workers

Table 3 Characteristics of household contacts of index PTB patients with screening outcomes ascertained in whom decisions and action were taken within 7 days in public health facilities in three states of India: December 2022 to August 2023

Characteristics of household contacts	Total	Decisions and action taken						Decisions and action taken within 7 days (Second 7)		Crude RR (95% CI)*	Adjusted RR (95% CI)*	P value
		Total		ATT	TPT	Medical officer did not prescribe TPT	Eligible for TPT but HHC refused					
	n	n	(%)†	N	N	N	n	n	(%)†			
Total	2073	961	(46)	1	742	80	138	874	(42)			
HHC age (in years)												
≤14	549	222	(40)	0	161	28	33	203	(37)	Ref	Ref	
15–29	625	271	(43)	0	213	19	39	249	(40)	1.1(0.9 to 1.2)	1.0 (0.8 to 1.1)	0.729
30–44	442	233	(53)	0	184	19	30	212	(48)	1.3 (1.1 to 1.5)	1.2 (1.0 to 1.4)	0.079
45–59	314	158	(50)	1	129	10	18	139	(44)	1.2 (1.0 to 1.4)	0.8 (0.7 to 1.1)	0.187
≥60	143	77	(54)	0	55	4	18	71	(50)	1.3 (1.1 to 1.6)	1.0 (0.8 to 1.4)	0.877
HHC gender												
Male	1020	463	(45)	1	357	40	65	420	(41)	Ref	Ref	
Female	1052	498	(47)	0	385	40	73	454	(43)	1.0 (0.9 to 1.2)	1.0 (0.9 to 1.1)	0.576
Other	1	0	(0)	0	0	0	0	0	(0)	–	–	
Relationship with index patient												
Partner	327	187	(57)	1	153	17	17	156	(48)	3.1 (2.3 to 4.2)	1.0 (0.8 to 1.3)	0.806
Child	807	428	(53)	0	330	42	56	394	(49)	3.2 (2.5 to 4.2)	1.0 (0.8 to 1.2)	0.840
Parent	358	186	(52)	0	144	11	30	173	(48)	3.2 (2.4 to 4.2)	1.2 (0.9 to 1.6)	0.118
Siblings	252	108	(43)	0	81	9	18	101	(40)	2.6 (1.9 to 3.5)	1.2 (0.9 to 1.6)	0.149
Other	329	52	(16)	0	34	1	17	50	(15)	Ref	Ref	
Type of TB in index patient												
Bacteriologically confirmed	1883	923	(49)	†	725	65	132	836	(44)	2.2 (1.6 to 2.9)	0.9 (0.7 to 1.2)	0.484
Clinically diagnosed	190	38	(20)	0	17	15	6	38	(20)	Ref	Ref	
Symptom screening outcome												
Asymptomatic <5 years	138	43	(31)	0	31	5	7	43	(31)	Ref	Ref	
Asymptomatic ≥5 years	1903	898	(47)	0	697	72	129	816	(43)	1.4 (1.1 to 1.8)	1.2 (0.9 to 1.8)	0.201
Symptomatic	32	20	(63)	1	14	3	2	15	(47)	1.5 (0.9 to 2.3)	1.3 (0.8 to 2.2)	0.305

Continued

Table 3 Continued

Characteristics of household contacts	Total	Decisions and action taken						Decisions and action taken within 7 days (Second 7)		Crude RR (95% CI)*	Adjusted RR (95% CI)*	P value
		Total		ATT	TPT	Medical officer did not prescribe TPT	Eligible for TPT but HHC refused					
	n	n	(%)†	N	N	N	n	n	(%)†			
State												
Bihar	805	39	(5)	0	27	0	12	32	(4)	Ref	Ref	
Chhattisgarh	718	498	(69)	1	346	80	71	490	(68)	17.2 (12.2 to 24.2)	11.8 (8.1 to 17.3)	<0.001
Odisha	550	424	(77)	0	369	0	55	352	(64)	16.1 (11.4 to 22.7)	17.3(11.9 to 25.1)	<0.001

*The relative risk (RR) with 95% CI calculated using univariate and multivariate log binomial regression for achieving the Second-7 milestone, with the total number of household contacts whose screening outcomes were ascertained in each category as the denominator. Not achieving the Second-7 includes HHC in whom decisions and/or actions were never taken and HHC in whom decisions and/or actions were taken after 7 days.
†Row percentage calculated among total number of household contacts whose screening outcomes were ascertained.
.ATT, anti-TB treatment; HHC, household contact; PTB, pulmonary tuberculosis; TB, tuberculosis; TPT, tuberculosis preventive treatment.

were not willing to give up their day's wage in order to visit the health facility.

> They said that they are busy at work or that they are not able to afford the transport charges to visit the health facility. (Male TBC)

2. Reluctance among asymptomatic contacts to consult the MO

TBCs mentioned that HHC who were asymptomatic felt they were healthy and did not feel the need to get evaluated by a doctor or take any medication (TPT).

> They felt that they were fine and had no symptoms and so they refused to visit the medical officer or take any medicines. There was a contact who stayed close to the hospital but he said that nothing was wrong with him and he was fit. He did not visit the hospital. (Female TBC)

3. Reluctance of parents for MO consultation and TPT for children

TBCs felt that parents were reluctant to take their children for further evaluation. The parents cited reasons that included unwillingness to allow children to undergo investigations, the apparently healthy status of children and/or fear of side effects of TPT.

> If the contact was a child less than five years, the family members would say that the child would not be able to give sputum specimens or undergo any investigation. They said the child was healthy and so did not want to take the child to the hospital. (Male TBC)

4. Fear of side effects

TBCs felt that there was a fear of side effects of TPT, which prevented healthcare providers from prescribing TPT and HHC from taking the drugs.

> In this TU, the STS was not willing to provide TPT to contacts of clinically diagnosed PTB cases. He felt they would have side effects. (Male TBC)

> The family members are scared of taking TPT… They say "we do not have any disease. Why should we take drugs? We may end up with some other problem if we take drugs unnecessarily. (Male TBC)

5. Interruptions in TPT drug supply

There were interruptions in the TPT drug supply for a short period during the study, which was cited as a reason for the delay in initiation of TPT.

> TPT drugs were not available for one month. Programme staff had informed us not to counsel or motivate family members to visit the health facility during that period. They were worried that if people turned up at the health facility, they would not be able to provide them with the TPT drugs. (Female TBC)

Alternate timeliness metrics

Based on their experience, TBCs suggested a time metric of '3-5-7'. In comparison with '7-1-7', having 3 days to

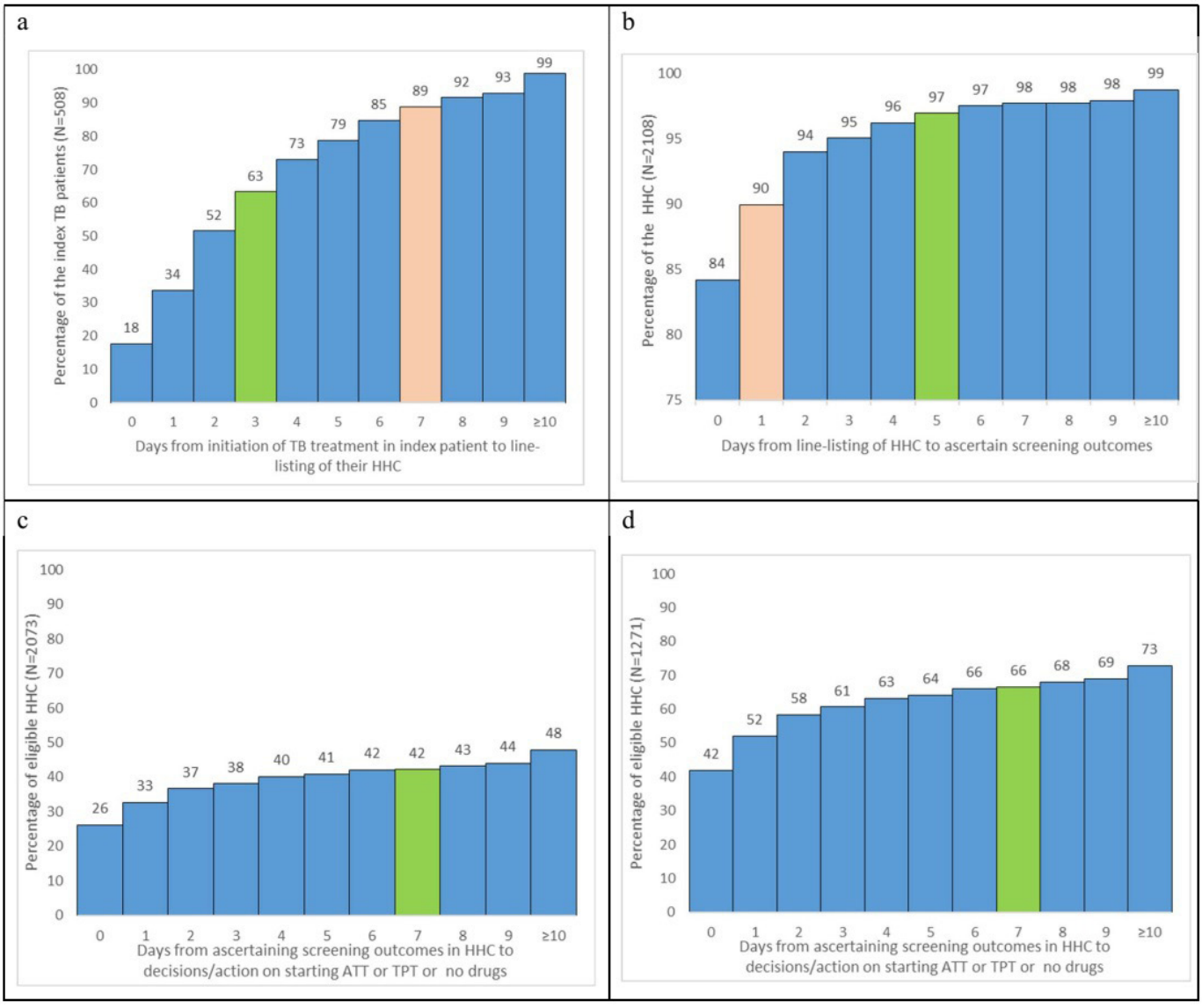

Figure 3 Daily cumulative achievement of outcomes for line-listing of household contacts of pulmonary TB patients, ascertainment of household contact screening outcomes and decisions/actions on anti-TB treatment, TPT or no drugs according to '7-1-7' or '3-5-7' time metrics: Public health facilities in three states of India, December 2022 to August 2023. ATT, anti-TB treatment; HHC, household contacts; TB, tuberculosis; TPT, tuberculosis preventive treatment. Note: a, line-listing of household contacts; b, screening of line-listed household contacts; c, decision or action on starting anti-TB treatment or TPT or no drugs in three study states; d, decision or action on starting anti-TB treatment or TPT or no drugs in two study states (Chhattisgarh and Odisha); in a and b, green indicates the '3-5-7' timeliness metric proposed by the TB champions; peach indicates the '7-1-7' timeliness metric; in c and d, the green with 42% and 66% achievement on day 7, respectively, applies to both the '3-5-7' and '7-1-7' timeliness metrics.

line-list HHC would result in line-listing of HHC in 63% of index patients within the time metric instead of 89% and having 5 days to ascertain screening outcomes would result in 97% of HHC achieving the outcome within the time metric instead of 90% (figure 3).

DISCUSSION

This is the first study of which we are aware to assess the feasibility of implementing timeliness metrics for HHC management through TBCs in public health facilities of India. The key findings were: (1) it was feasible to implement '7-1-7' timeliness metrics with high achievement of the First-7 and Next-1; (2) achievement of the Second-7 was low due to poor TPT uptake that included lack of money and daily wage losses for HHC travelling to clinics, reluctance of asymptomatic contacts to take medication and fear of adverse events; (3) the timeliness metrics were perceived as useful by TBCs and iv) '3-5-7' was proposed as an alternate metric for HHC management by TBCs.

The study had several strengths. First, it was conducted within routine programmatic settings reflecting the

realities of HHC management in the public sector. Second, the data were quality checked on a weekly basis and more frequently if needed. Third, the quantitative findings guided the qualitative discussions, and a combination of the two techniques provided a better understanding of the enablers and barriers in implementing the '7-1-7' metric. Fourth, the conduct and reporting of the quantitative and qualitative components of the study followed STROBE and COREQ guidelines, respectively.[23 24]

The main limitations were that the study results cannot be generalised throughout the country, given that the districts which were included in the study were supported by REACH and implemented the 'Treat Only' model for TPT; that is, all HHC without active TB were considered eligible for TPT without testing for TB infection. Also, the TUs were conveniently sampled based on the availability of higher numbers of TB patients. We were unable to compare TPT uptake of the '7-1-7' cohort with a concurrent or historical cohort due to restrictions on accessing the NTEP database and discrepancies in the database, which have been described elsewhere.[15] Therefore, we are not able to assess the impact of '7-1-7 implementation on coverage and timeliness of HHC management quantitatively. We did not conduct qualitative interviews among index patients and their HHC due to funding constraints.

As seen in other settings,[25–27] it was feasible to implement '7-1-7' timeliness metrics with First-7 and Next-1 achieved in 89% and 90%, respectively. The onus of completing the First-7 and Next-1 was largely due to the TBC. Motivated TBCs liaised well with the NTEP and planned their field activities, such that they were able to complete these tasks within the set timelines. Although there were challenges due to fear of stigma as reported in other settings,[15 25 28] the TBCs were able to overcome these through effective counselling and support from frontline health workers. To mitigate challenges in screening of HHC who were working or attending school, the TBCs visited the households either during non-working hours or at weekends.

Achievement of the Second-7 was low in 42% of the eligible HHC. The HHC not consulting MOs for further evaluation at health facilities was the major reason for suboptimal achievement in the Second-7. Asymptomatic HHCs were especially not willing to be further evaluated or take TPT drugs, as they believed this to be unnecessary. Lack of perceived need for TPT among asymptomatic HHC has been reported in other settings.[15 26 27 29] Programmes implementing TPT should consider mass media awareness campaigns to educate the community about the susceptibility of HHC to TB infection and the utility of TPT in preventing TB disease. This would enable asymptomatic HHC to understand the threat of TB disease, and it might help to allay their fear of side effects from TPT.

Even in those HHC who are willing to get evaluated, financial constraints prevent them from travelling to a health facility for further evaluation. This challenge has been reported from other resource-constrained settings.[25 28] Programmes can assess the effectiveness of interventions like the provision of social support for covering costs of travel and loss of daily earnings and introducing outreach services through the use of mobile vans equipped with point-of-care diagnostic devices for further evaluation and action.

Interruptions in TPT drug supplies also contributed to the low achievement of the Second-7. During these interruptions, NTEP staff discouraged TBCs from mobilising HHC to health facilities, as it would not have been possible to provide TPT. Such issues with drug logistics have been reported as a bottleneck for effective HHC management elsewhere.[25 29 30] Therefore, National TB Programmes must ensure uninterrupted supplies of TPT drugs by adopting methods for appropriate quantification and timely requisition and distribution.

TBCs felt the timeliness metrics were useful in carrying out HHC management. As the metrics provided a structured breakdown for the activities and specified timelines for each step, the TBCs felt the introduction of metrics made the activity more systematic. Therefore, TBCs were able to complete activities in a timely manner compared with how they had done these previously. The metrics also brought focus on TPT among the NTEP staff, and they tried to help TBCs in the process of HHC management. Similar feedback was shared by the staff involved in implementing the same metrics in Pakistan, Kenya and in the private sector in India.[25–27]

However, as in other settings, TBCs felt the '3-5-7' timeliness metrics to be more appropriate for HHC management compared with '7-1-7'. Although restricting First-7 to 3 days resulted in a decline in achievement from 89% to 63% in our model, the TBCs felt that if a 3-day timeline had been set from the beginning, they would have been able to meet it. Although the TBCs had managed to meet and symptom screen 90% of the HHC within 1 day (Next-1), often working beyond their usual working hours, they felt it would not be feasible and sustainable in the long run. Therefore, they suggested reducing the First-7 to 3 days and increasing the Next-1 to 5 days. TBCs felt that the second 7 days would be sufficient for further evaluation and action after screening, providing the challenges of mobilising HHC to health facilities and shortages of TPT drugs could be addressed.

To our knowledge, this is the first time that engagement of TBCs in HHC management has been documented. In resource-limited settings such as these, available programme staff have their hands full with multiple tasks related to the detection and management of TB patients. Therefore, timely HHC management could take a back seat.[15 28 31] As the experience from this study demonstrates, TBCs can effectively facilitate delivery of TB preventive services, and programmes should consider training and involving such personnel in HHC management. A recently published WHO investment case outlines the health and economic rationale for TB screening and TPT, arguing that these interventions can substantially reduce TB incidence and mortality and contribute to ending TB by 2035.[32]

Studies from resource-constrained settings and WHO guidance endorse engagement of TB survivors for effective TB care provision in different roles, like treatment supervisors, implementers of behaviour change communication, etc.[33–35] In this study, TBCs who were already active within the NTEP were up-skilled through a 2-day training workshop with a focus on timeliness and documentation, to catalyse the implementation of HHC management. Though we have not conducted a formal costing analysis, as these timeliness metrics were instituted in the existing workflow, we believe this is a low-cost and sustainable strategy. The credibility, access and trust that these TB survivors have in the community can be leveraged to improve listing and screening of HHC, which is the first step in HHC management. By establishing a one-on-one rapport with the HHC, TB survivors can also facilitate prompt referral for testing or preventive therapy. Adding timeliness metrics brings structure and urgency to the whole process, which is crucial to TB prevention. We recommend that workable timeliness metrics for HHC management should be developed at the national level. Further, these metrics should be implemented through trained community volunteers like TB survivors. Achievement of these metrics should be integrated as indicators into the programme monitoring framework so that HHC screening and TPT are done well and in a timely manner.

CONCLUSIONS

In conclusion, we found that by using TBCs, it was feasible to implement '7-1-7' timeliness metrics for TPT in public health facilities in three states of India with high achievement of the First-7 and Next-1 but suboptimal achievement of the Second-7. The TBCs felt the timeliness metrics were useful in timely HHC management, as they brought structure and a sense of urgency to the activity.

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