

# Using timeliness metrics for household contact tracing and TB preventive therapy in the private sector, India

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## SUMMARY

**BACKGROUND:** Although screening of household contacts (HHCs) of TB patients and provision of TB preventive therapy (TPT) is a key intervention to end the TB epidemic, their implementation globally is dismal. We assessed whether introducing a ‘7-1-7’ timeliness metric was workable for implementing HHC screening among index patients with pulmonary TB diagnosed by private providers in Chennai, India, between November 2022 and March 2023.

**METHODS:** This was an explanatory mixed-methods study (quantitative-cohort and qualitative-descriptive).

**RESULTS:** There were 263 index patients with 556 HHCs. In 90% of index patients, HHCs were line-listed within 7 days of anti-TB treatment initiation. Screening outcomes were ascertained in 48% of HHCs within 1 day of line-listing. Start of anti-TB treatment, TPT or a decision to receive neither was achieved in 57% of HHC within 7 days of screening. Overall, 24% of screened HHCs in the ‘7-1-7’ period started TPT compared with 16% in a historical control ( $P < 0.01$ ). Barriers to achieving ‘7-1-7’ included HHC reluctance for evaluation or TPT, refusal of private providers to prescribe TPT and reliance on facility-based screening of HHCs instead of home visits by health workers for screening.

**CONCLUSIONS:** Introduction of a timeliness metric is a workable intervention that adds structure to HHC screening and timely management.

**KEY WORDS:** India; ‘7-1-7’ timeliness metric; household contact screening; TB preventive therapy; private sector;

## SHORT RUNNING TITLE:

Time metrics for household contact screening

The TB epidemic remains out of control,<sup>1</sup> although the UN is still committed to ending TB by 2030. To galvanise momentum, world leaders at the United Nations High-Level Meeting on the Fight against TB in September 2018 committed to successfully treat 40 million people for TB and provide TB preventive therapy (TPT) to at least 30 million people between 2018 and 2022.<sup>2</sup> The TPT target includes 4 million household contacts (HHCs) aged <5 years, 20 million HHCs aged ≥5 years and 6 million people living with HIV.

HHCs of TB patients, especially infants and young children, are at high risk of contracting TB.<sup>3-5</sup> TPT substantially reduces this risk for several years after a course of preventive therapy.<sup>6,7</sup> Based on this evidence, the WHO recommends systematic screening of HHCs for TB,<sup>8</sup> and administration of TPT after excluding active TB.<sup>9</sup> To date, however, global implementation of HHC screening and provision of TPT have been dismal. Over the first 4 years (2018–2021), 1.6 million (40% of target) HHCs aged <5 years and 0.6 million other HHCs (3% of target) received TPT, amounting to 9% of all eligible HHCs.<sup>1</sup> Various challenges hinder the implementation of HHC screening and the provision of TPT.<sup>10,11</sup> Anecdotal and published evidence also suggests that the process can take up to several months,<sup>12</sup> negating its value in breaking household TB transmission. A concerted effort is therefore needed to accelerate and make this intervention more effective.

In July 2021, a new global target of ‘7-1-7’ was proposed to improve early detection and rapid control of health threats arising from suspected infectious disease outbreaks or pandemics.<sup>13</sup> The timeliness metric works as follows: every suspected infectious disease outbreak is detected within 7 days of emergence; the outbreak is reported to public health authorities within 1 day of detection; and early response actions with objective benchmarks are implemented within 7 days of reporting.<sup>14</sup> We adapted the ‘7-1-7’ timeliness metric for the process of HHC screening as follows: First 7 – the index TB patient line-lists potential HHCs within 7 days of treatment initiation; Next 1 – symptom screening outcomes (see below) of line-listed HHCs are ascertained within the next 1 day; Second 7 – eligible HHCs start anti-TB treatment or TPT or the decision to receive no drugs is taken within 7 days of symptom screening.

This study aimed to assess whether ‘7-1-7’ was a workable timeliness metric for implementing HHC screening among index patients with pulmonary disease (PTB) who were registered and initiated on treatment. We undertook this study in the high TB burden environment of India where the Indian National TB Programme (NTP) recommends TPT for all HHCs after active TB has been ruled out.<sup>15</sup> The study was conducted in the private sector of Chennai, India, where there was already a structure in place for screening and managing HHCs. Specific objectives were to 1) assess the feasibility of implementing ‘7-1-7’ and ascertain the proportions of HHCs who were screened, investigated and given appropriate interventions in each of the ‘7-1-7’ stages; 2) compare total numbers of HHCs screened and started on anti-TB treatment /TPT in the ‘7-1-7’ cohort with a historical cohort (pre-‘7-1-7’) to evaluate if overall TPT uptake improved, and 3) explore enablers and challenges around implementing ‘7-1-7’.

## 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*

The study was conducted in Chennai, India, where the Resource Group for Education and Advocacy for Community Health (REACH) supports the NTP in providing anti-TB treatment for patients diagnosed in the private sector and undertaking screening of their HHCs through a cadre of field staff called TB *Nanbans* (*nanban* is the Tamil word for “friend”).<sup>16</sup> TB Nanbans operate from Nakshatra centres, which are located in private clinics with a high TB burden. In each TB unit (the peripheral administrative unit of the NTP), there are one or two Nakshatra centres. The centres register and provide anti-TB treatment to patients diagnosed and referred by the private providers in the TB unit.

During the ‘7-1-7’ period, TB Nanbans line-listed HHCs of all registered index patients according to the accepted generic HHC definition.<sup>17</sup> They assessed each HHC for symptoms suggestive of TB (cough, fever, weight loss, night sweats and haemoptysis) either at home or at the Nakshatra centre. Those assessed were categorised according to the following symptom screening outcomes: already on anti-TB treatment or TPT; chest symptomatic; asymptomatic <5 years; asymptomatic ≥5 years. All HHCs were further investigated using chest radiography. Those with abnormal chest radiography and/or symptoms suggestive of TB underwent sputum smear microscopy or Xpert<sup>®</sup> MTB/RIF (Cepheid, Sunnyvale, CA, USA) testing, available through the NTP. The TB Nanbans facilitated HHC consultation with the private provider, who would review the investigation reports and decide on further management. Prevalence of latent TB infection is high in HHCs in India;<sup>18</sup> however, testing for this was not included as part of the investigations.

Based on symptom screening, investigations and private provider’s consultations, HHC 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 private provider or HHC not to receive anti-TB treatment or TPT. Dates were recorded as follows: date of treatment initiation in index patient; date of completing line-listing of HHC; date of completion of symptom screening and ascertainment of symptom screening outcome; date of anti-TB treatment initiation, TPT or a decision to receive no treatment.

Data were captured real-time using an EpiCollect5 (v5.1.51, Centre for Genomic Pathogen Surveillance (2023): <https://five.epicollect.net>) mobile-based application. A study coordinator oversaw the work and attended to data quality check reports generated weekly by the team at the Centre for Operational Research (COR), International Union Against Tuberculosis and Lung Disease (The Union), Paris, France.

### *Study population*

Patients with drug-susceptible PTB (index patients) registered for treatment in Nakshatra Centres in eight out of 36 TB Units of Chennai from November 2022 to March 2023 and their listed HHCs were included. These eight high TB burden units contributed 50% of all registered TB patients in Chennai in 2022. A 3-month historical cohort enrolled prior to '7-1-7' implementation was included for comparison. At the conclusion of the '7-1-7' quantitative component, three focus group discussions (FGDs) with TB Nanbans were conducted to document enablers and challenges associated with implementing '7-1-7'.

### *Data variables*

Data variables for the study were collected prospectively for individual index patients and HHCs using a structured proforma embedded within EpiCollect5. PT and DN conducted the FGDs with TB Nanbans using interview guides based on quantitative findings. Findings from quantitative analysis guided our formulation of specific questions for FGDs, aiding in the exploration of enablers and challenges in 7-1-7 implementation. Each discussion lasted 1 hour and was audio-recorded. The recordings were transcribed in the local language and translated into English.

### *Analysis and statistics*

Data from EpiCollect5 were downloaded and analysed using STATA<sup>®</sup> v16.0 (StataCorp, College Station, TX, USA). Two analyses were conducted. First, numbers and proportions achieving the activities within each of the '7-1-7' components previously described were analysed. Unadjusted binomial regression was used to assess association of individual-level characteristics with achievement in each of the '7-1-7' components. Crude relative risks (RRs) with 95% confidence intervals (CIs) were used as a measure of association. Second, aggregate data on index TB patients and HHCs screened and managed were compared between the '7-1-7' cohort and the historical cohort.

For the qualitative component, thematic content analysis was done by PT using Atlas-Ti software for Windows (v9.1.70, ATLAS.ti Scientific Software Development, Berlin, Germany, 2021). DN reviewed the analysis and decisions on coding and theme generation was done in consensus. Findings were reported in accordance with Consolidated Criteria for Reporting Qualitative Research (COREQ) guidelines.<sup>19</sup>

### *Ethics*

Ethics approval was obtained from the Ethics Advisory Group, The Union, Paris, France (EAG 04/2022 dated 28 June 2022) and from the Institutional Review Board, REACH, Chennai, India, on 9 November 2022. All index patients, HHCs and TB Nanbans who participated in the study provided informed consent.

## **RESULTS**

### *Implementation of the '7-1-7' metric and characteristics of index patients and HHCs*

There were 263 index patients with 556 HHC line-listed. Implementation of the various steps of the '7-1-7' metric is shown in Figure 1. Line-listing of HHCs was achieved for 237/263 (90%) index patients within 7 days of treatment initiation; symptom screening outcomes were ascertained for 267/556 (48%) HHCs within 1 day after line-listing; and start of anti-TB treatment, TPT or a decision to receive neither was done in 259/454 (57%) HHCs within 7 days of screening. Of 398 HHCs who did not have TB and were potentially eligible for TPT, 110 (28%) started TPT at any time, while 228 (72%) did not start TPT due to a decision made by either the private provider or the HHC. Characteristics of 263 index patients from whom TB Nanbans obtained consent, line-listed HHC and performed this activity within the first 7 days are shown in Table 1. There were no statistically significant differences in age, sex, type of TB or TB Unit at the various process stages.

Characteristics of 556 HHCs who were line-listed, met with TB Nanbans, consented and had their screening outcomes ascertained within the next 1 day are shown in Table 2. There was a significantly higher achievement in the 'Next 1' arm

among those aged  $\geq 30$  years, partners or children or parents of index patients and in TB Units C to H. Characteristics of 454 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 upon within the second 7 days are shown in Table 3. The only significant difference was a better achievement of actions in certain TB units (A, D to H).

#### *Comparison of the '7-1-7' cohort and historical cohorts*

The comparison of the two cohorts ('7-1-7' and historical) is shown in Table 4. The key finding was a significantly higher proportion of HHCs who started TPT during the '7-1-7' (24%) period compared to the historical control (16%,  $P < 0.01$ ).

#### *Enablers and barriers*

Enablers and barriers to achieving the '7-1-7' metric are shown in Figure 2. The major enablers included 1) having Nakshatra centres co-located within the high-burden clinics, thus providing immediate access to most of the index patients; 2) private providers being supportive of HHC tracing and TPT; 3) provision of free chest radiographs; 4) uninterrupted supplies of TPT; and 5) having timelines for completion of each step of contact tracing and further action. The major barriers included 1) HHC reluctance to be evaluated or receive TPT because of high consultation fees, indirect costs or fear of medication-induced side effects; 2) refusal of private providers to prescribe TPT; and 3) reliance on index patients bringing their HHCs to the Nakshatra Centres rather than home visits by TB Nanbans.

Based on their experience, TB Nanbans suggested a time metric of '3-5-9'. In comparison with '7-1-7': having 3 days to line-list HHC would result in line-listing of HHCs in 78% of index patients within the time metric instead of 90%; having 5 days to ascertain screening outcomes would result in 65% of HHCs achieving the outcome within the time metric instead of 48%; and having 9 days to complete decisions and actions would result in 67% of HHCs achieving the outcome instead of 57% (Figure 3).

## **DISCUSSION**

This is the first time a timeliness metric has been applied to the screening and management of HHC of index PTB patients. There were four key findings.

First, it was feasible to implement the '7-1-7' timeliness metric, which in turn gave valuable insights into each stage of the screening and management process. The most difficult aspect was ascertaining screening outcomes within 1 day. This was mainly because HHC were not always present when TB Nanbans visited the home, thus requiring repeat visits on another day. This finding is in line with other reports,<sup>20</sup> supporting the sensible suggestion by TB Nanbans to change the time metrics and have this component completed within 5 days.

Second, the improved coverage of symptom screening in the historical cohort was attributed to index patients informing TB Nanbans about their HHCs' symptoms (proxy screening). In contrast, during '7-1-7,' each HHC was independently met and screened, which was in accordance with NTP recommendations for individual screening. It is essential to interpret the lower coverage in '7-1-7' compared to the historical cohort cautiously, considering the change in the screening approach from proxy screening to the more effective practice of individually screening each HHC.

Third, although not all HHCs started TPT within 7 days of knowing their screening outcome, there was a better overall uptake of TPT in '7-1-7' compared with the historical cohort and compared with previous observational studies conducted in Africa and Asia.<sup>21-24</sup> The TB Nanbans mentioned during the FGDs that introduction of the timeliness metric brought structure and focus into HHC care provision and thus improved performance. This bodes well for reducing TB household transmission.

Fourth, screening and actions worked better in older HHCs and in those who were partners or parents and there was better performance in some TB units compared with others. Similar observations about HHC screening and management have been reported previously.<sup>24</sup> The FGDs offered valuable insights into the factors that either support or impede the entire process of screening and managing HHC interventions. Common themes included private providers' negative perceptions about the value and safety of TPT, challenges in administrative logistics, and the reluctance of healthy HHCs to take preventive medication.<sup>25-27</sup> These issues must be addressed if progress is to be made.

The study had several strengths. It was conducted within the routine setting of the private sector in Chennai, the data were checked weekly and, more frequently if needed, and the conduct and reporting of the quantitative and qualitative components of the study followed STROBE and COREQ guidelines, respectively.<sup>19,28</sup> The main limitations were the lack of a concurrent control group for comparison and inability to conduct qualitative interviews among HHCs and private providers due to funding constraints. Furthermore, the achievements of the 'First 7' and 'Next 1' arms were underestimated as those who did not provide informed consent were considered to have failed the timeliness metrics, irrespective of receipt of services. As time taken to complete the various steps of contact screening and management was

unavailable for the historical cohort, we were not able to compare the impact of the introduction of time metrics on timeliness.

The '7-1-7' framework described in this paper provides a workable structure to deliver on treating and preventing TB within this high-risk environment, and, most importantly, inserts a timeliness metric into the intervention. The framework clearly shows that opportunities to prevent TB are not taken up, because of either health worker and/or HHC reluctance. Persons who contract TB and successfully complete TB treatment are often left disabled, with a poor quality of life,<sup>29</sup> and they are at much higher risk of death compared with those who have never had TB.<sup>30</sup> Much more needs to be done to convince people that TB prevention is better than cure.

Moving forwards, we will assess whether the TB Nanban suggestion of a '3-5-9' metric works better in the private sector in Chennai. We are already conducting assessments of '7-1-7' in other countries and in other settings and hope to report on these later in the year.

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Conflicts of interest: none declared.

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**Table 1.** Characteristics of index PTB patients initiated on anti-TB treatment in relation to line-listing their HHCs and completing line-listing within the first 7 days in the private sector, Chennai, India, November 2022–March 2023

Characteristics of index PTB patients	Total <i>n</i>	Patients whose HHCs were line-listed <i>n</i> (%)*	Patients whose HHCs were line-listed within 7 days ('First 7') <i>n</i> (%)*	Crude RR (95% CI)†	<i>P</i> value
Total	263	257 (98)	237 (90)	—	—
Age, years					
≤14	9	9 (100)	7 (78)	0.8 (0.6–1.3)	0.51
15–29	59	58 (98)	53 (90)	1.0 (0.9–1.2)	0.74
30–44	57	55 (96)	51 (89)	1.0 (0.9–1.1)	0.79
45–59	80	79 (99)	75 (94)	1.1 (0.9–1.2)	0.26
≥60	58	56 (96)	51 (88)	Reference	
Sex					
Male	156	152 (97)	140 (90)	Reference	
Female	107	105 (98)	97 (91)	1.0 (0.9–1.1)	0.81
Type of PTB					
Bacteriologically confirmed	174	169 (97)	155 (89)	Reference	
Clinically diagnosed	89	88 (99)	82 (92)	1.0 (0.9–1.1)	0.41
TB Unit in Chennai					
A	50	46 (92)	43 (86)	1.1 (0.8–1.5)	0.49
B	13	13 (100)	10 (78)	Reference	
C	30	30 (100)	26 (87)	1.1 (0.8–1.6)	0.47
D	46	46 (100)	46 (100)	1.3 (0.9–1.7)	0.08
E	48	47 (98)	43 (90)	1.2 (0.8–1.6)	0.34
F	42	42 (100)	37 (88)	1.1 (0.8–1.6)	0.40
G	20	20 (100)	19 (95)	1.2 (0.9–1.7)	0.18
H	14	13 (93)	13 (93)	1.2 (0.9–1.7)	0.26

\* Row percentage among total number of index PTB patients approached in each category.

† The RR with 95% CIs 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 HHCs were never listed and those in whom HHCs were listed after 7 days.

HHC = household contact; PTB = pulmonary TB; RR = relative risk; CI = confidence interval.

**Table 2.** Characteristics of household contacts of index PTB patients who were visited by TB *nanbans*, had their screening outcomes ascertained and completed outcome ascertainment within 1 day in the private sector, Chennai, India, November 2022–March 2023

Characteristics of household contacts	Total <i>n</i>	Met by TB <i>nanbans</i> <i>n</i> (%) <sup>*</sup>	Screening outcomes ascertained <i>n</i> (%) <sup>*</sup>	Screening outcomes ascertained within 1 day ('Next 1') <i>n</i> (%) <sup>*</sup>	Crude RR (95% CI) <sup>†</sup>	<i>P</i> value
Total	556	526 (95)	454 (82)	267 (48)		
HHC age, years						
≤14	98	96 (98)	88 (90)	43 (44)	1.2 (0.9–1.7)	0.19
15–29	154	139 (90)	113 (73)	55 (36)	Reference	
30–44	128	124 (97)	108 (84)	71 (55)	1.5 (1.2–2.0)	0.001
45–59	125	125 (94)	111 (83)	75 (56)	1.6 (1.2–2.0)	0.001
≥60	42	42 (98)	34 (79)	23 (53)	1.5 (1.0–2.1)	0.02
HHC sex						
Male	247	231 (94)	199 (81)	116 (47)	Reference	
Female	309	295 (95)	255 (82)	151 (49)	1.0 (0.8–1.2)	0.65
Relationship with index PTB patient						
Partner	139	134 (96)	115 (83)	81 (58)	1.8 (1.2–2.8)	0.006
Child	189	180 (95)	159 (84)	89 (47)	1.5 (1.0–2.3)	0.08
Parent	109	106 (97)	89 (82)	57 (52)	1.6 (1.1–2.5)	0.03
Siblings	50	46 (92)	39 (78)	16 (32)	Reference	
Others	69	60 (87)	52 (75)	24 (35)	1.1 (0.6–1.8)	0.75
Type of PTB in index patient						
Bacteriologically confirmed	375	360 (96)	300 (80)	175 (47)	Reference	
Clinically diagnosed	181	166 (92)	154 (85)	92 (51)	1.1 (0.9–1.3)	0.35
TB Unit						
A	103	92 (89)	46 (45)	29 (28)	Reference	
B	25	25 (100)	25 (100)	6 (24)	0.9 (0.4–1.8)	0.68
C	58	58 (100)	54 (93)	28 (48)	1.7 (1.1–2.6)	0.01
D	99	97 (98)	91 (92)	42 (42)	1.5 (1.0–2.2)	0.04
E	109	99 (91)	97 (89)	56 (51)	1.8 (1.3–2.6)	<0.001
F	89	87 (98)	80 (90)	60 (67)	2.4 (1.7–3.4)	<0.001
G	43	38 (88)	37 (86)	26 (60)	2.1 (1.5–3.2)	<0.001
H	30	30 (100)	24 (80)	20 (67)	2.4 (1.6–3.5)	<0.001

<sup>\*</sup> Row percentage calculated among total number of household contacts in each category.

<sup>†</sup> The RR with 95% CIs for achieving the 'next 1' milestone with total number of household contacts in each category as denominator. Not achieving the 'next 1' includes those HHC in whom screening was never done and those in whom screening was done within 1 day. PTB= pulmonary TB; HHC = household contact; RR = relative risk; CI = confidence interval.

**Table 3.** Characteristics of household contacts of index PTB patients with screening outcomes ascertained in whom decisions were made and action taken within 7 days in the private sector, Chennai, India, November 2022–March 2023

Characteristics of household contacts	Decisions and action taken					Eligible but HHC did not take TPT <i>n</i>	Decisions and action taken within 7 days ('Second 7') <i>n</i> (%)*	Crude RR (95% CI)†	<i>P</i> value
	Total <i>n</i>	Total <i>n</i> (%)*	ATT <i>n</i>	TPT <i>n</i>	Doctor did not prescribe TPT <i>n</i>				
Total	454	401 (88)	3	110	176	112	259 (57)		
HHC age, years									
≤14	88	77 (88)	1	25	34	17	53 (60)	1.1 (0.8–1.5)	0.67
15–29	113	96 (85)	0	29	36	31	66 (58)	1.0 (0.7–1.5)	0.80
30–44	108	100 (93)	1	21	46	32	66 (61)	1.1 (0.8–1.5)	0.60
45–59	111	97 (87)	0	24	50	23	55 (50)	0.9 (0.6–1.3)	0.50
≥60	34	31 (91)	1	11	10	9	19 (56)	Reference	
HHC sex									
Male	199	172 (86)	3	47	71	51	115 (58)	Reference	
Female	255	229 (90)	0	63	105	61	144 (56)	1.0 (0.8–1.1)	0.78
Relationship with index patient									
Partner	115	105 (91)	0	29	48	28	69 (60)	1.2 (0.9–1.6)	0.36
Child	159	136 (86)	1	38	57	40	86 (54)	1.0 (0.8–1.4)	0.80
Parent	89	82 (92)	2	24	38	18	52 (58)	1.1 (0.8–1.5)	0.47
Siblings	39	35 (90)	0	6	15	14	26 (67)	1.3 (0.9–1.8)	0.16
Others	52	43 (83)	0	13	18	12	26 (50)	Reference	
Type of TB in index patient									
Bacteriologically confirmed	300	282 (94)	1	73	124	84	179 (60)	1.1 (0.9–1.4)	0.12
Clinically diagnosed	154	119 (77)	2	37	52	28	80 (52)	Reference	
Symptom screening outcome									
Asymptomatic <5 years	13	10 (77)	0	4	3	3	6 (46)	0.8 (0.4–1.5)	0.48
Asymptomatic ≥5 years	408	358 (88)	2	93	159	104	233 (57)	Reference	
Chest symptomatic	33	33 (100)	1	13	14	5	20 (61)	1.1 (0.8–1.4)	0.69
TB Unit									
A	46	44 (96)	0	7	4	33	37 (80)	3.1 (1.9–5.0)	<0.001
B	25	10 (40)	0	0	9	1	6 (24)	0.9 (0.4–2.1)	0.86
C	54	48 (89)	0	10	15	23	14 (26)	Reference	
D	91	78 (86)	0	30	24	24	50 (55)	2.1 (1.3–3.5)	<0.001
E	97	92 (95)	1	3	78	10	57 (59)	2.3 (1.4–3.7)	<0.001
F	80	69 (86)	2	48	0	19	60 (75)	2.9 (1.8–4.6)	<0.001
G	37	37 (100)	0	1	36	0	19 (51)	2.0 (1.1–3.4)	0.02
H	24	23 (96)	0	11	10	2	16 (67)	2.6 (1.5–4.4)	<0.001

\* Row percentage calculated among total number of HHCs whose screening outcomes were ascertained.

† The RR with 95% CIs for achieving the 'second 7' milestone with total number of household contacts whose screening outcomes were ascertained in each category as denominator. Not achieving the 'second 7' includes those HHC in whom decisions and/or actions were never taken and those in whom decisions and/or actions were taken after 7 days.

PTB = pulmonary TB; HHC = household contact; ATT = anti-TB treatment; TPT = TB preventive treatment; RR = relative risk; CI = confidence interval.



**Table 4.** Comparison of key characteristics and activities before and after implementation of '7-1-7' for HHC tracing of PTB patients initiated on treatment: the private sector, Chennai, India

Characteristics and activities	Before '7-1-7'*	During '7-1-7'	P value
	July–September 2022	November 2022–March 2023	
	<i>n</i> (%)	<i>n</i> (%)	
Index PTB patients registered, <i>n</i>	170	263	
HHCs line-listed, <i>n</i>	385	556	
HHCs screened at any time	381 (99) <sup>†</sup>	454 (82) <sup>†</sup>	<0.001
HHCs started on ATT at any time	3 (<1) <sup>‡</sup>	3 (<1) <sup>‡</sup>	0.83
HHCs started on TPT at any time	62 (16) <sup>‡</sup>	110 (24) <sup>‡</sup>	<0.01

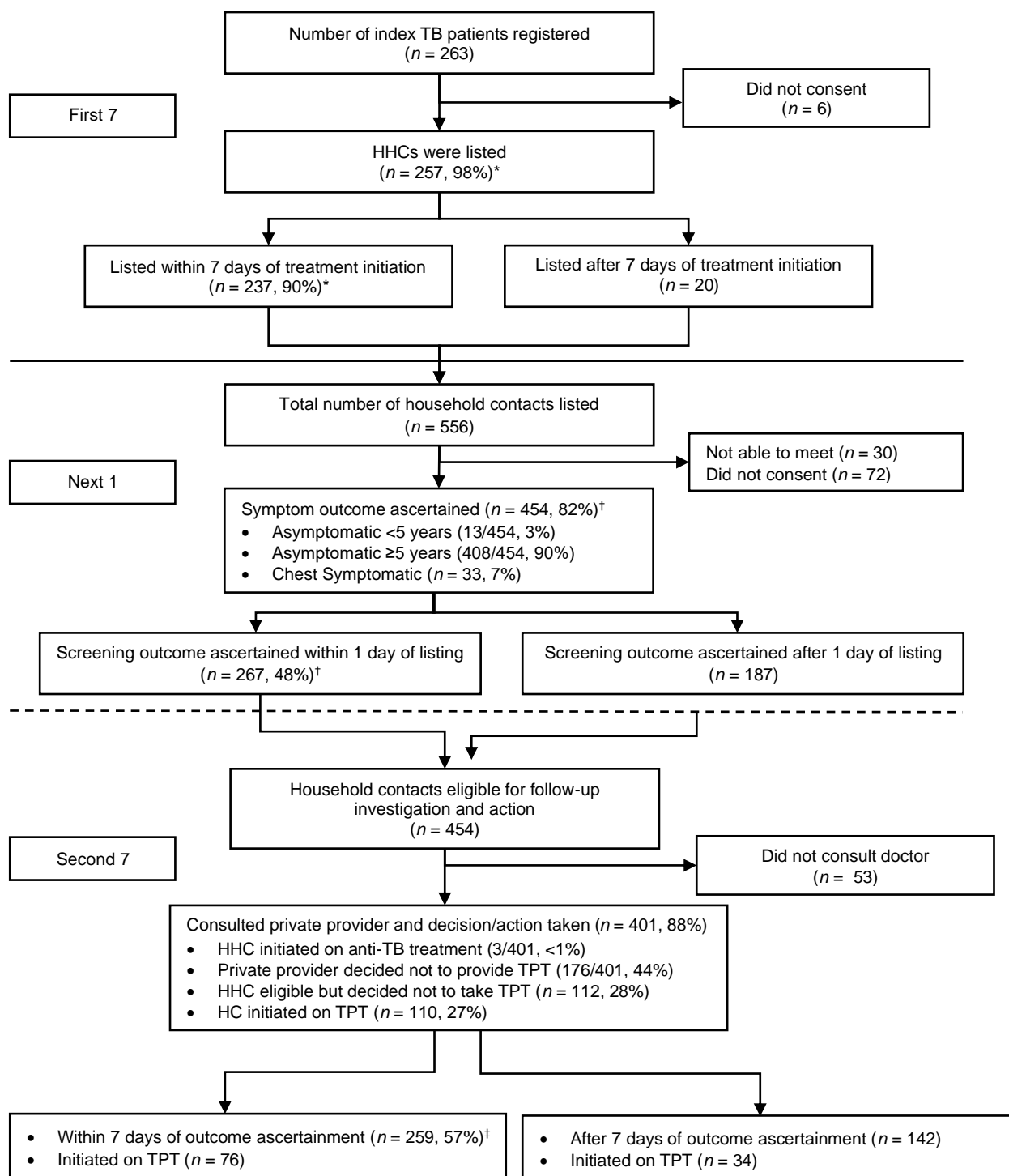
\*Before '7-1-7', screening was defined as the index PTB patient just providing details of household contacts. After '7-1-7', screening was defined as TB Nanbans meeting with household contacts at their home or at the private provider clinic.

<sup>†</sup> Denominator = number of HHCs line-listed.

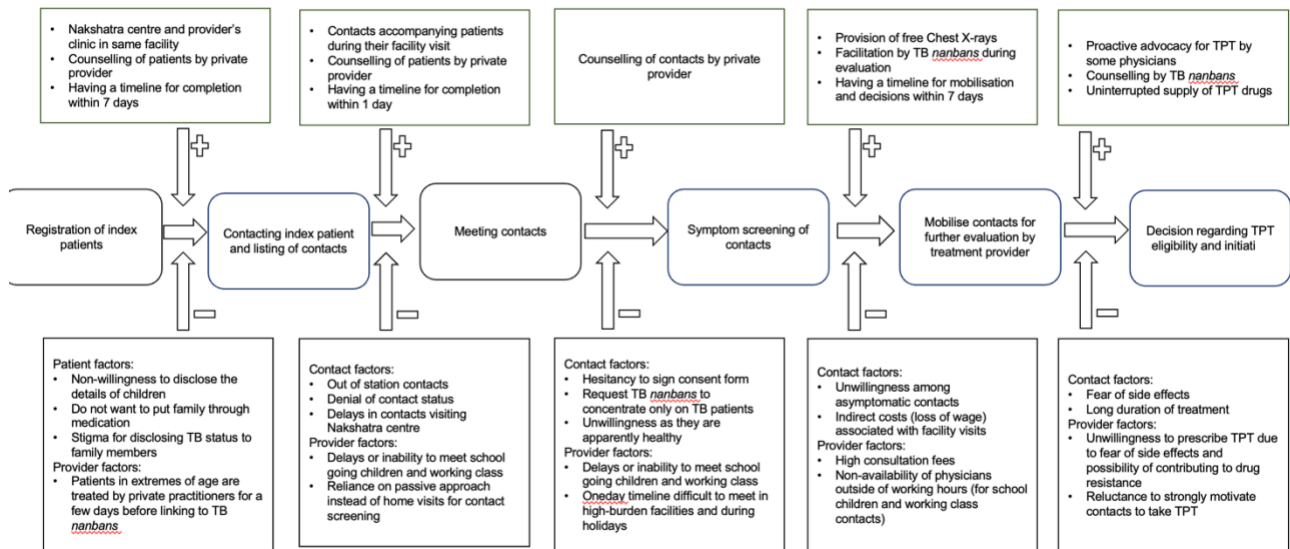
<sup>‡</sup> Denominator = number of HHCs screened at any time.

HHC = household contact; PTB = pulmonary TB; ATT = anti-TB treatment; TPT = TB preventive therapy.

**Figure 1.** Overview of implementation of '7-1-7' among household contacts of index pulmonary TB patients diagnosed in private facilities of Chennai, India, November 2022–March 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 was available as the denominator. HHC = household contact; TPT = TB preventive therapy.



**Figure 2.** Facilitators (+) and barriers (-) at the various stages of implementing '7-1-7' for index patients with PTB and their household contacts: the private sector, Chennai, India, November 2022–March 2023.



**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 “3-5-9” time metrics: the private sector, Chennai, India, November 2022–March 2023. \* (black) = the ‘3-5-9’ timeliness metric proposed by the TB *nanbans*; † (grey) = the ‘7-1-7’ timeliness metric. ATT = anti-TB treatment; TPT = TB preventive treatment.

