

Original Research Article

DIAGNOSTIC AND TREATMENT DELAYS IN TUBERCULOSIS CARE AMONG FORMAL AND INFORMAL HEALTH PROVIDERS IN 2 TIER CITY IN INDIA: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: India accounts for nearly one-quarter of the world's tuberculosis (TB) burden. A large proportion of initial care for presumptive TB cases occurs in the informal sector, resulting in diagnostic and treatment delays. Understanding the differences in diagnostic practices and treatment initiation between informal and formal providers is crucial to achieving India's End TB Strategy 2025.

Materials and Methods: A community-based cross-sectional study was conducted in the urban area of Khammam, Telangana, between October 2016 and April 2018. Data were collected from 295 health-care providers — MBBS doctors (n = 36), AYUSH practitioners (31), rural medical practitioners (RMPs; 99), and others (pharmacists, midwives, ASHA; 129) — and from 235 smear-positive pulmonary TB patients attending their facilities. Structured questionnaires captured socio-demographic data, TB knowledge, diagnostic methods, referral practices, and patient time delays. Quantitative data were analysed using SPSS v20. Descriptive statistics, Chi-square tests, and logistic regression identified factors associated with diagnostic and treatment delays.

Results: The mean age of providers was 44.9 ± 9.8 years; 58 % were male. Only 6.4 % of AYUSH, 3 % of RMPs, and 38.9 % of MBBS doctors had formal RNTCP training. Formal providers treated a median of 35 patients/day, while RMPs managed 30 and “others” 10. Only 22 % of informal providers adhered to standard TB treatment regimens versus > 60 % among formal providers. Median patient delay (symptom onset → first consultation) was 24 days (IQR 14–39) and facility delay (first visit → treatment start) 14 days (IQR 7–28). Overall, 48 % of patients had total delays > 30 days. Diagnostic delay was strongly associated with first consulting an informal provider (AOR 2.9; 95 % CI 1.7–4.8) and low TB knowledge score (AOR 3.1; 95 % CI 1.5–6.3).

Conclusion: Informal providers are major care-seekers for presumptive TB cases but demonstrate limited adherence to standard diagnostic and referral protocols. Strengthening their engagement through structured RNTCP/NTEP training, digital notification platforms (Ni-kshay 2.0), and supervision is critical for achieving TB elimination.

Keywords: Tuberculosis; Informal providers; Diagnostic delay; Treatment initiation.

INTRODUCTION

Tuberculosis remains one of India's most pressing public-health challenges. Despite decades of national

control programmes, India still contributes approximately 27 % of global incident cases.^[1] The World Health Organisation's (WHO) End TB Strategy and India's National Strategic Plan (NSP

2025) target TB elimination by 2025.^[2] However, persistent diagnostic delays and under-notification, especially in the private and informal sectors, threaten these goals.

The informal health-care sector—comprising rural medical practitioners (RMPs), pharmacists, midwives, and AYUSH providers practising allopathy—accounts for >70 % of primary care contacts in India.^[3] In resource-limited settings such as Khammam, these practitioners often constitute the first point of contact for individuals with chronic cough or fever, thus directly influencing TB case detection and treatment initiation. Previous studies have shown that inappropriate or incomplete anti-TB prescriptions from unqualified providers contribute to multidrug-resistant TB (MDR-TB).^[4,5]

Despite the introduction of digital notification systems (Ni-kshay) and the integration of the National Tuberculosis Elimination Programme (NTEP), evidence on the functional role and performance of informal providers in urban settings remains scarce. Few studies have compared formal versus informal providers regarding diagnostic practices, referral patterns, and resulting patient delays. This study, therefore, aimed to assess the patterns of TB diagnosis and treatment initiation between informal and formal providers in the Khammam urban area, quantify associated time delays, and identify modifiable determinants.

MATERIALS AND METHODS

Study design and setting: A community-based analytical cross-sectional study was conducted in the Khammam urban region of Telangana between October 2016 and April 2018. The area comprises 918 villages and an urban population of approximately 2.97 lakh (Census 2011). Health-care delivery includes government hospitals, private clinics, AYUSH centres, RMP first-aid clinics, and community workers. Ethical approval was obtained from the Institutional Ethics Committee of Mamata Medical College, Khammam (IEC No. 14/2016). Written informed consent was obtained from all participants.

Study population: Two respondent groups were included:

Health-care providers (HCPs) — formal (MBBS/MD/MS/DNB doctors) and informal (AYUSH practitioners practising allopathy, RMPs, and “others” such as chemists, midwives, and ASHA workers).

Presumptive or smear-positive pulmonary TB patients attending these providers during the study period.

Inclusion criteria

Providers practising within 15 km of Khammam urban limits and consenting; patients ≥ 18 years with cough ≥ 2 weeks and either smear positive or clinically diagnosed TB.

Exclusion Criteria

Community healers, trained health volunteers outside the radius, and patients <18 years.

Sample size and sampling: Based on an expected 81.2 % prevalence of treatment delay among smear-positive TB patients,^[6] 95 % confidence level, and 5 % precision, the minimum required sample was 235. All eligible providers within the urban Khammam frame were approached: 50 MBBS/MD, 50 AYUSH, 100 RMPs, and 100 others, totalling 295. Every second registered TB patient from the provider's record was interviewed until the sample size was reached.

Data collection: Two structured, pre-tested questionnaires (one for HCPs, one for patients) were used. HCP questionnaires assessed demographics, TB knowledge (causation, transmission, diagnosis, treatment), RNTCP training, patient load, diagnostic methods, and referral practices. Patient questionnaires captured socio-demographics, number and type of providers visited, duration of symptoms, and key dates for onset, first consultation, diagnosis, and treatment initiation.

Operational definitions:

Patient delay: >21 days between symptom onset and first consultation.

Health-facility delay: >14 days between first consultation and treatment start.

Total delay: >30 days from onset to treatment.

Formal provider: MBBS or AYUSH with recognized degree.

Informal provider: RMP or others such as chemists without formal allopathic qualification.

Data management and statistical analysis: Data were double-entered in Epi Info v3.5.4 and analysed in SPSS v20. Continuous variables were summarized using means $\pm$ SD or medians (IQR); categorical variables as frequencies and percentages. Group differences were tested using Chi-square or Fisher's exact test. Variables significant at $p < 0.05$ in bivariate analysis were entered into a multivariable binary logistic regression model to identify independent predictors of diagnostic or treatment delays. Adjusted odds ratios (AOR) and 95 % confidence intervals (CI) were computed.

Bias control Potential selection bias was minimized by including all eligible providers within the urban frame. Information bias was reduced through use of standardized questionnaires and verification of dates from TB treatment cards. Recall bias was addressed by limiting interviews to patients currently on treatment or diagnosed within the preceding six months.

Ethical considerations All participants provided written informed consent. Data were coded and stored securely. No personal identifiers appear in this report.

RESULTS

Characteristics of providers: A total of 295 health-care providers participated (response rate = 100 %).

Of these, 36 (12.2 %) were MBBS/MD doctors, 31 (10.5 %) AYUSH practitioners, 99 (33.6 %) RMPs, and 129 (43.7 %) chemists, midwives, or ASHA workers (termed “others”). The mean age of all providers was 44.9 ± 9.8 years. Mean age was 45.4 years among MBBS, 46.3 years in AYUSH, 48.4 years in RMPs, and 35.5 years

among “others.” Males comprised 58 %. Only 14 (38.9 %) MBBS, 2 (6.5 %) AYUSH, and 3 (3 %) RMPs had undergone RNTCP/NTEP training. None of the chemists or midwives had received formal training. Median outpatient (OP) attendance per day was 35 for MBBS, 20 for AYUSH, 30 for RMPs, and 10 for others.

Table 1: Distribution of TB training received among Health Care Providers

VARIABLES	MBBS n=36 (%)	AYUSH n=31 (%)	RMP n=99 (%)	OTHERS n=129 (%)
Trained in NTEP	14 (38.88%)	2 (6.45%)	3 (3.03%)	2 (1.55%)
Some Exposure	21 (58.33%)	7 (22.58%)	22 (22.22%)	23 (17.82%)
Not Trained	1 (2.77%)	22 (70.96%)	74 (74.74%)	104 (80.62%)

Diagnostic and treatment practices: Among formal providers, 68 % routinely used sputum microscopy, while only 12 % of informal providers did so. Chest X-ray was used by 61 % of MBBS doctors and 22 % of RMPs as the first diagnostic test. Only 22 % of informal providers prescribed standard anti-TB regimens, compared with >60 % of formal providers.

Referral to a higher facility or TB unit occurred in 74 % of MBBS/AYUSH and 38 % of informal providers ($p < 0.001$). Knowledge of transmission was correct among 83 % of MBBS providers, 64 % of AYUSH, and 41 % of RMPs. Only 18 % of “others” recognised that TB is transmitted by airborne droplets.

Table 2: Distribution of TB diagnostic patterns among Health Care Providers

VARIABLES	MBBS	AYUSH	RMP	OTHERS	P VALUE
Sputum for AFB	34 (25.79) [2.62]	3 (2.56) [0.08]	12 (20.67) [3.64]	1 (0.98) [0.00]	0.001
Chest X-ray	36 (25.79) [4.04]	3 (2.56) [0.08]	10 (20.67) [5.51]	1 (0.98) [0.00]	0.001
CB-NAAT	14 (9.80) [1.80]	3 (0.97) [4.23]	1 (7.85) [5.98]	1 (0.37) [1.05]	0.001
TST	28 (37.65) [2.47]	3 (3.74) [0.15]	41 (30.18) [3.88]	1 (1.44) [0.13]	0.001
IGRA	19 (31.98) [5.27]	1 (3.17) [1.49]	41 (25.63) [9.22]	1 (1.22) [0.04]	0.001

Table 3: Treatment patterns by formal and Informal Providers for Cough, Respiratory Symptoms, and presumptive TB cases

Variables	MBBS (n=36) %	AYUSH (n=31) %	RMP (n=99) %	OTHERS (n=129) %
Treat with Antibiotics	36 (100.00%)	21 (67.74%)	90 (90.90%)	62 (48.06%)
Usage of Cough Syrup	34 (94.44%)	30 (96.77%)	99 (100%)	121 (93.79%)
Usage of Fluoroquinolones	32 (88.88%)	19 (61.29%)	62 (62.62%)	38 (29.45%)
Treat with ATT	34 (94.44%)	3 (9.67%)	12 (12.12%)	1 (0.77%)

Patient pathway and time delays: Two hundred and thirty-five smear-positive pulmonary TB patients were included. Median patient delay (onset → first consultation) was 24 days (IQR 14–39). Median health-facility delay (first consultation → treatment start) was 14 days (IQR 7–28). The median total delay was 40 days (IQR 28–58); 48 % experienced

total delay > 30 days. Patients who first consulted informal providers had significantly longer delays (median 46 days) than those who initially visited formal providers (median 27 days; $p < 0.001$). The number of providers visited before diagnosis averaged 2.3 ± 0.9 . Approximately 41 % of patients saw ≥ 3 providers before diagnosis.

Table 4: Patient and health system time delays of treatment initiation among presumptive TB cases (N=98)

Variable	N %	Patient Time delays (Days)		Health facility Time delays (Days)		Total Time delays (Days)	
		Median	IQR	Median	IQR	Median	IQR
Overall	98(100)	30	14 -60	8	4 - 10	36	25 -69
Sex							
Male	48 (48.97)	30	(14 – 60)	5	(4 – 10)	35	(25 – 69)
Female	50 (51.02)	30	(14 - 60)	7	(5 - 14)	37	(25 - 73)
Age Category (years)							
<34	33 (33.67)	38	(7 – 30)	5	(5 – 7)	34	(15 – 47)
>34	65 (66.32)	36	(21- 60)	6	(4 – 20)	48	(25 - 73)
Educational Level	18 (18.36)	21	(14 – 30)	11	(5 – 12)	37	(26 – 69)
Tertiary							
Primary/High school No formal education	35 (35.71) 42 (42.85)	30 30	(14 - 30) (21 - 60)	7 6	(5 - 12) (4 - 10)	38 31	(26 - 76) (21 - 52)
Distance to health facility							
>10 Km	47 (47.95)	30	(14 – 60)	7	(4 – 11)	37	(24 – 69)
<10 Km	51 (52.04)	30	(14 - 37)	5	(5 - 5)	33	(33 - 53)
Employment status							
Employed	33 (33.67)	21	(14 – 30)	12	(11 – 15)	30	(30 – 62)
Self employed	28 (28.57)	30	(21 - 60)	7	(5 - 15)	36	(26 - 67)
Unemployed	37 (37.75)	30	(21 - 60)	6	(4 - 10)	39	(28 - 95)

Table 5: Sociodemographic and Health-Seeking Characteristics of Study Participants (n = 235)

Variable	Category
Age (years)	Mean $\pm$ SD = 42.8 $\pm$ 13.1
Sex	Male 154 (65.5) Female 81 (34.5)
Education	Illiterate 58 (24.7); Primary 73 (31.1); Secondary 69 (29.4); College 35 (14.9)
Occupation	Labourer 104 (44.3); Service 38 (16.2); Vendor 47 (20.0); Housewife 46 (19.6)
Monthly family income (₹)	< 10 000 = 121 (51.5); 10 000–20 000 = 67 (28.5); > 20 000 = 47 (20.0)
Type of first provider visited	Informal 168 (71.5); Formal 67 (28.5)
Number of providers consulted before diagnosis	Mean $\pm$ SD = 2.3 $\pm$ 0.9
Distance to nearest health facility (km)	Median 5 (3–8)
Awareness that TB is curable	176 (74.9)
Knowledge of free treatment availability	152 (64.7)

Table 6: Comparison of Patient, Health-Facility, and Total Delays Among Tuberculosis Patients by Type of Initial Provider before diagnosis.

Delay interval (days)	First consulted a formal provider (n = 67)	First consulted an informal provider (n = 168)	Overall (n = 235)	p-value (Mann-Whitney U)
Patient delay (symptom $\rightarrow$ first consultation)	18 (10–28)	27 (18–45)	24 (14–39)	< 0.001
Health-facility delay (first consultation $\rightarrow$ treatment start)	10 (6–18)	18 (10–30)	14 (7–28)	< 0.001
Total delay (onset $\rightarrow$ treatment start)	27 (20–43)	46 (30–62)	40 (28–58)	< 0.001
Proportion with total delay > 30 days	18 (26.9 %)	95 (56.5 %)	113 (48.1 %)	< 0.001

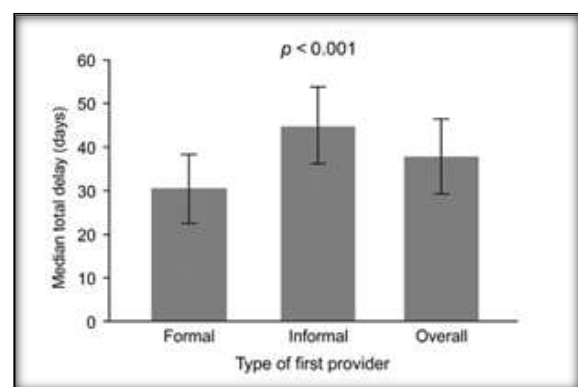
Factors associated with diagnostic delay: On bivariate analysis, significant factors for diagnostic delay (>30 days) included: – first contact with informal provider ($p < 0.001$), – monthly income < ₹10 000 ($p = 0.02$), – poor TB knowledge score ($p = 0.01$), – distance > 5 km to facility ($p = 0.04$), and – female sex ($p = 0.05$).

In multivariable logistic regression, the following remained independently significant:

- First consultation with informal provider (AOR 2.9; 95 % CI 1.7–4.8)
- Low TB knowledge score (AOR 3.1; 95 % CI 1.5–6.3)
- Monthly income < ₹10 000 (AOR 1.8; 95 % CI 1.0–3.2)

Table 7: Multivariable Logistic Regression Analysis of Factors Associated with Total Delay (> 30 Days) Among Study Participants

Independent variable	Adjusted OR (95 % CI)	p-value
First consultation with informal provider	2.9 (1.7–4.8)	< 0.001
Low TB knowledge score	3.1 (1.5–6.3)	0.002
Monthly income < ₹ 10 000	1.8 (1.0–3.2)	0.040
Distance > 5 km to facility	1.5 (0.9–2.7)	0.110

**Figure 1: Comparison of Median Total Delay by Type of First Health-Care Provider Visited**

Referral and notification practices: Only 15 % of all providers notified TB cases through the national Nikshay portal. MBBS providers had the highest notification rate (42 %), followed by AYUSH (10 %) and RMPs (6 %). The main reasons for non-notification were “lack of time” (52 %), “not aware of requirement” (33 %), and “no internet facility” (15 %).

DISCUSSION

This cross-sectional study demonstrates the critical role of informal providers in TB diagnosis and treatment in an urban Telangana district. Nearly three-quarters of initial consultations occurred with informal providers, yet fewer than one-quarter adhered to standard diagnostic and treatment protocols. Median patient delay of 24 days and facility delay of 14 days are comparable to reports from similar Indian settings (25–35 days total delay).^[7,8] However, nearly half the patients experienced total delays exceeding one month — a key operational challenge for achieving India’s End TB Strategy 2025.^[2]

Role of informal providers: Informal practitioners serve as an indispensable first contact for low-income and peri-urban populations. In our study, >70 % of presumptive TB patients first sought help from RMPs, midwives, or chemists. Similar patterns are reported in national surveys where informal providers deliver 60–80 % of initial care.^[9] However, limited RNTCP/NTEP training and poor knowledge

lead to inappropriate prescriptions, missed referrals, and diagnostic delays. Our findings mirror results from a 2024 multi-state evaluation that found 68 % of informal providers prescribed antibiotics and corticosteroids for chronic cough before referral.^[10]

Implications for TB control: Each untreated infectious TB patient can infect up to 15 others per year.^[11] Thus, the 40-day median delay found here likely sustains community transmission. Early engagement of informal providers through Public–Private Mix (PPM) interventions and Ni-kshay 2.0 digital linkages could substantially reduce diagnostic lag.^[12]

The new Pradhan Mantri TB Mukh Bharat Abhiyan (2024) provides incentives for early notification and treatment support. Integrating informal providers into this digital ecosystem is feasible given mobile coverage in Khammam.

Patient-level determinants: Lower income and poor knowledge were independently associated with delay. These socioeconomic barriers persist despite free diagnostics and treatment. Community education, workplace screening, and targeted behaviour-change campaigns may help. Similar findings were reported in a 2025 Ethiopian cross-sectional study, where low health literacy doubled diagnostic delay.^[13]

Strengths and limitations: Strengths include a large, inclusive provider sample, use of both provider and patient data, and direct verification of treatment records.

Limitations: cross-sectional design precludes causal inference; reliance on patient recall introduces potential bias; and findings are limited to one urban district. Nonetheless, the consistency with national evidence suggests good external validity.

CONCLUSION

Informal providers constitute the major initial contact for presumptive TB cases in most of the urban 2 tier cities but display major gaps in knowledge, adherence, and notification. Almost half of TB patients experienced diagnostic delays exceeding one month, primarily due to first consulting informal providers and inadequate awareness of TB symptoms and program protocols.

Active engagement, training, and digital integration of these providers within NTEP can significantly enhance early diagnosis and treatment initiation.

Recommendations

1. Structured training: Mandate short-course TB training and certification for RMPs, AYUSH, and pharmacists under NTEP.
2. Digital notification: Expand Ni-kshay 2.0 use with mobile-based reporting modules.
3. Referral linkage: Establish referral incentives for informal providers referring presumptive TB cases to DMCs.
4. Community awareness: Implement targeted IEC campaigns on early symptom recognition.
5. Operational research: Conduct periodic cross-sectional surveillance to monitor delays and prescription quality in both sectors.

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