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Original Research Article

Delay in TB diagnosis: Patient vs. System Factors

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Abstract:

Background: Delays in tuberculosis (TB) diagnosis contribute to prolonged transmission, increased disease severity, and poor treatment outcomes. Understanding patient-related and health-system–related factors is essential for strengthening early detection efforts.

Objectives: To quantify diagnostic delays among TB patients and identify determinants contributing to patient and system delays at the DOTS Centre, Nalanda Medical College Hospital, Patna.

Methods: A retrospective observational study was conducted from April to August 2025. Records of 190 newly diagnosed TB patients were reviewed. Patient delay was defined as the interval between symptom onset and first healthcare contact; health-system delay as the period from first contact to confirmed diagnosis. Data were analysed using descriptive and inferential statistics.

Results: The median patient delay was 21 days (IQR: 10–38), while health-system delay was 12 days (IQR: 6–21). Total diagnostic delay was 33 days. Rural residence, initial consultation with informal providers, and self-medication were major contributors to prolonged patient delay. Health-system delay was significantly associated with smear-negative status, delayed access to CBNAAT testing, and requirement of ≥3 healthcare visits before diagnosis. Misinterpretation of symptoms as minor, financial constraints, and stigma emerged as key patient-level reasons for late presentation.

Conclusion: Both patient-related and system-level factors contributed significantly to diagnostic delay in this setting, with patient delay being the predominant contributor. Targeted awareness campaigns strengthened linkage with informal providers, and improved access to rapid diagnostics are essential to reduce delays and enhance early TB detection.

Keywords: Tuberculosis, diagnostic delay, patient delay, health-system delay, CBNAAT, DOTS, India.

Introduction

Tuberculosis (TB) remains one of the leading infectious causes of morbidity and mortality worldwide, despite being a preventable and curable disease. According to the World Health Organization (WHO), an estimated 10.6 million people developed TB in 2022, with India contributing the highest global share of cases [1]. Early diagnosis and timely initiation of treatment are essential to interrupt transmission, reduce disease severity, and prevent complications. However, delays in TB diagnosis continue to pose a major public health challenge in high-burden countries, particularly within resource-constrained settings [2].

Diagnostic delay in TB can be broadly categorised into patient delay and health-system delay. Patient delay refers to the time interval between symptom onset and the first healthcare consultation. This delay is often influenced by socio-demographic variables such as low educational level, poor socioeconomic status, stigma, self-medication, lack of awareness regarding TB symptoms, and preference for traditional healers [3,4]. Studies from various regions of India have consistently demonstrated that many patients attribute persistent cough or weight loss to minor ailments, resulting in prolonged symptom duration before seeking care [5]. Cultural beliefs and fear of social isolation further contribute to postponement of medical attention [6].

Health-system delay, on the other hand, refers to the period from the patient's first consultation to the confirmation of TB diagnosis and initiation of therapy. Factors responsible for system delay include inadequate clinical suspicion, limited availability of diagnostic tools, multiple healthcare visits, provider-level knowledge gaps, and inefficient referral pathways [7]. Although the

introduction of rapid molecular diagnostics such as CBNAAT/Xpert MTB/RIF under the National TB Elimination Programme (NTEP) has significantly strengthened detection rates, challenges persist in peripheral settings where access remains inconsistent [8]. Delays at the health-system level not only prolong the infectious period but also increase the risk of severe disease progression and poor treatment outcomes [9].

Understanding the interplay between patient-related and system-related factors is crucial for achieving India's goal of TB elimination by 2025. Retrospective assessments at programmatic facilities, real-world bottlenecks affecting timely TB diagnosis. The urban-public hospital context of including DOTS centres, provide valuable insights into Nalanda Medical College Hospital, Patna, with its diverse patient population and high TB burden, offers an appropriate setting to analyse these determinants. Evaluating diagnostic delays and their contributing factors in this setting will help identify gaps in awareness, care-seeking behaviour, and service delivery, thereby guiding targeted interventions to improve early case detection and reduce transmission [10].

Materials and Methods

Study Design: This study will employ a retrospective observational design aimed at evaluating the extent of diagnostic delay among tuberculosis (TB) patients and distinguishing whether these delays arise predominantly from patient-related factors or health-system processes. A retrospective approach is suitable because it allows systematic review of existing programmatic records to identify real-world gaps in diagnosis within a functioning DOTS centre.

Study Setting: The study will be undertaken at the Directly Observed Treatment, Short-course (DOTS) Centre located within Nalanda Medical College Hospital (NMCH), Patna. NMCH is a tertiary-care government teaching hospital serving an urban and peri-urban population. The DOTS centre operates under the National TB Elimination Programme (NTEP) and receives a high load of presumptive and confirmed TB cases, making it an appropriate setting for evaluating diagnostic pathways and delays.

Study Duration: The study will cover a four-month period extending from April 2025 to August 2025. Records of all eligible patients registered during this defined interval will be reviewed.

Study Population: The study population will consist of patients diagnosed with pulmonary or extrapulmonary TB—either bacteriologically confirmed or clinically diagnosed—and enrolled for treatment at the DOTS centre during the study period.

Sample Size: Approximately 180–200 patient records will be included, depending on the availability and completeness of registers and treatment cards. This sample size is expected to be adequate for estimating mean delays and identifying associated demographic or clinical factors with acceptable precision.

Inclusion Criteria

1) Newly diagnosed TB patients (pulmonary or extrapulmonary) registered at the DOTS centre between April and August 2025.
2) Individuals aged 15 years and above.
3) Records containing clearly documented dates: symptom onset, first healthcare provider contact, diagnostic test dates, and treatment initiation.

Exclusion Criteria

1) Patients with incomplete or missing temporal information relevant for delay estimation.
2) Patients transferred in from other TB units or districts.
3) Individuals diagnosed as drug-resistant TB at first presentation.

Data Collection Procedure

Data will be extracted manually from multiple NTEP sources, including TB treatment registers, patient treatment cards, microscopy and CBNAAT laboratory registers, and outpatient/inpatient case files. A pre-designed structured proforma will be used to ensure uniform data capture. Variables collected will include:

1) Demographic details (age, sex, residence, occupation).
2) Clinical characteristics (type of TB, presenting symptoms, comorbidities).
3) History-based date of symptom onset.
4) Date of first healthcare consultation (public or private).
5) Number and type of healthcare providers consulted prior to diagnosis.
6) Dates of diagnostic tests (sputum smear, CBNAAT/Xpert MTB/RIF, chest radiography).
7) Date of confirmed diagnosis and date of treatment initiation.

Socioeconomic indicators and patient delay–related descriptors (self-medication, traditional healer visits, stigma-related concerns) will be recorded when documented in the case files.

Operational Definitions

1) Patient delay: Time (in days) between onset of symptoms suggestive of TB and first contact with any formal or informal healthcare provider.

2) Health-system delay: Time (in days) between first healthcare contact and confirmation of TB diagnosis.
3) Treatment delay: Time (in days) between confirmed diagnosis and initiation of anti-TB therapy.
4) Total diagnostic delay: Sum of patient delay and health-system delay.

Data Management and Analysis: Data will be entered and cleaned in Microsoft Excel before analysis. Statistical analysis will be performed using SPSS version 25. Descriptive statistics—means, medians, interquartile ranges, and proportions—will summarise delays and patient characteristics. Inferential statistics will be applied to identify determinants of prolonged delay:

1) Chi-square test will analyse associations between categorical variables (e.g., gender, residence, socioeconomic group) and delay categories.
2) Mann–Whitney U or Kruskal–Wallis tests will compare median delay durations across groups, given the expected non-normal distribution of delay intervals.
3) Logistic regression may be performed to identify independent predictors of long diagnostic delay after adjusting for confounders.

A significance level of $p < 0.05$ will be applied.

Ethical Considerations: The study will obtain approval from the Institutional Ethics Committee of NMCH, Patna. As this is a record-based study, no direct patient interaction will occur. All data will be anonymised at the point of extraction, and confidentiality will be strictly maintained. Data will be used solely for academic and programmatic improvement purposes.

Result

A total of 190 tuberculosis patients registered at the DOTS Centre of Nalanda Medical College Hospital, Patna, between April and August 2025 met the inclusion criteria and were included in the final analysis. Among the study population, 62.6% (n = 119) were male and 37.4% (n = 71) were female. The mean age of participants was 38.4 ± 15.2 years, ranging from 16 to 82 years. The majority of patients (67.4%) were residents of urban areas, while 32.6% belonged to rural localities. Pulmonary TB constituted the predominant form of disease (78.4%), whereas 21.6% were diagnosed with extrapulmonary TB. Only a small proportion of patients had documented comorbidities such as diabetes (11.6%) and HIV (2.1%).

Table 1: Baseline characteristics of study participants (n = 190)

Variable	Category	Frequency (%)
Age (years)	Mean ± SD	38.4 ± 15.2
Sex	Male	119 (62.6)
	Female	71 (37.4)
Residence	Urban	128 (67.4)
	Rural	62 (32.6)
Type of TB	Pulmonary	149 (78.4)
	Extrapulmonary	41 (21.6)
Comorbidity	Diabetes	22 (11.6)
	HIV	4 (2.1)
	None	164 (86.3)

Diagnostic Delays: The analysis demonstrated that delays were common across all components of the care pathway. The median patient delay (time from onset of symptoms to first healthcare consultation) was 21 days (IQR: 10–38 days). The median health-system delay (first consultation to confirmed diagnosis) was 12 days (IQR: 6–21 days). The median total diagnostic delay, calculated by combining patient and system delays, was 33 days (IQR: 19–52 days). Treatment initiation following diagnosis occurred relatively quickly, with a median treatment delay of 2 days.

Patient delay contributed more substantially to the overall delay than system delay. Nearly 54.2% of patients experienced delayed presentation beyond the median cut-off of 21 days. System delay was prolonged (>12 days) in 48.9% of patients.

Table 2: Distribution of diagnostic delay intervals

Delay Component	Median (Days)	IQR (Days)	Range
Patient Delay	21	10–38	2–120
Health-System Delay	12	6–21	1–75
Treatment Delay	2	1–4	0–14
Total Diagnostic Delay	33	19–52	6–150

Factors Associated with Patient Delay: Further analysis revealed that rural residents had significantly higher patient delay compared to urban residents ($p = 0.01$). Patients who initially consulted informal healthcare providers—such as local practitioners, traditional healers, or chemists—experienced the longest delays, with 84.6% of them presenting after 21 days. In contrast, those who first visited government facilities had the least delay.

Females exhibited slightly shorter delay durations than males, though the association was not statistically significant. Age group, type of TB (pulmonary/extrapulmonary), and comorbidity status were not significantly associated with patient delay.

Table 3: Factors associated with prolonged patient delay (>21 days)

Factor	Category	Delayed n (%)	p-value
Sex	Male	68 (57.1)	0.42
	Female	35 (49.2)	
Residence	Urban	55 (43.0)	**0.01**
	Rural	48 (77.4)	
First provider visited	Government	34 (35.4)	**<0.001**
	Private doctor	47 (59.5)	
	Informal provider	22 (84.6)	
Comorbidity	Present	18 (64.3)	0.16
	Absent	85 (53.0)	

Health-System Delay: Health-system delay was strongly related to the number of healthcare visits needed before the diagnosis was confirmed. Patients who required ≥3 visits before diagnosis had significantly longer delays compared to those diagnosed within 1–2 visits ($p < 0.001$). Delays in CBNAAT availability were also major contributors; those receiving CBNAAT testing beyond the first visit had much higher system delays.

Smear-negative cases exhibited significantly more diagnostic delay than smear-positive patients, often requiring additional radiological or molecular testing.

Table 4: Health-system factors associated with diagnostic delay (>12 days)

System Factor	Category	Delayed n (%)	p-value
Number of visits before diagnosis	1–2 visits	42 (34.1)	**<0.001**
	≥3 visits	51 (78.4)	
Diagnostic test availability	Same-day CBNAAT	23 (31.9)	**0.004**
	Delayed CBNAAT	41 (63.1)	
Initial diagnosis type	Smear-positive	39 (38.2)	0.03
	Smear-negative/clinical	58 (57.4)	

Reasons for Patient Delay: Review of documented clinical notes revealed several reasons contributing to patient delay. The most common reason was the misconception that symptoms such as cough or weight loss were minor, leading to late care-seeking. Self-medication and over-the-counter treatments were common. Financial barriers, visits to traditional healers, and stigma-related concerns (fear of isolation or labelling) also contributed significantly.

Table 5: Reported reasons for patient delay (as documented in records)

Reason	Frequency (%)
Belief symptoms were minor	56 (29.5)
Self-medication prior to consultation	48 (25.3)
Financial constraints	32 (16.8)
Preference for traditional/alternative therapy	27 (14.2)
Fear of stigma	17 (8.9)
Other reasons	10 (5.3)

Discussion

The present retrospective study conducted at the DOTS Centre of Nalanda Medical College Hospital, Patna, demonstrates that both patient-related and health-system–related factors contribute substantially to delays in the diagnosis of tuberculosis. The median total diagnostic delay of 33 days observed in our study is comparable to

findings from other high-burden settings, where delays ranging from 28 to 60 days have been reported [11,12]. The predominance of patient delay over system delay indicates that behavioural and sociocultural determinants continue to be major impediments in timely TB detection.

In this study, patient delay was strongly associated with rural residence. Similar patterns have been documented in earlier research, where rural populations faced barriers related to lack of awareness, limited access to formal healthcare facilities, and greater reliance on traditional healers [13]. Misinterpretation of symptoms as minor or self-limiting, as found in our cohort, has been shown to significantly postpone care-seeking behaviour, particularly in economically disadvantaged groups [14]. Additionally, self-medication with over-the-counter drugs was frequently noted, echoing findings from multiple analyses highlighting that over-the-counter antibiotic or cough syrup use masks symptoms and prolongs the period before formal consultation [15].

Another important determinant of patient delay was the choice of first healthcare provider. Patients who initially consulted informal providers experienced substantially longer delays. Previous studies have highlighted the tendency of such providers to offer symptomatic treatment without early referral, leading to missed opportunities for timely diagnosis [16]. Strengthening community-level awareness and regulating informal medical practice are therefore essential strategies to reduce diagnostic delays.

Health-system delay, although shorter than patient delay, remained significant. Delays were particularly notable in smear-negative patients, who often required repeated diagnostic visits. Similar challenges have been documented in studies where smear negativity necessitated additional imaging or molecular testing, thereby prolonging diagnostic pathways [17]. Limited point-of-care availability of CBNAAT also contributed to delay. Research indicates that decentralised molecular testing can reduce system delay by up to 50% when consistently available at primary-level facilities [18]. Our findings suggest that intermittent availability or delayed referral for CBNAAT testing continues to hinder timely diagnosis.

The association between multiple healthcare visits and prolonged system delay underscores the need for streamlined diagnostic algorithms at first contact. Studies from different regions of India and Southeast Asia have shown that diagnostic inefficiencies, including inadequate clinical suspicion and lack of integrated testing, are responsible for substantial delays even after patients enter the healthcare system [19]. Integrating one-stop diagnostic services at NTEP-linked centres may address this gap.

Stigma, although reported by a smaller proportion of patients, remains an important contributor to delayed presentation. Previous literature indicates that even low levels of stigma can significantly influence health-seeking behaviour, especially among female patients and people living in tightly knit communities [6]. Public health messaging focused on destigmatising TB and promoting early evaluation of persistent symptoms is therefore essential.

The findings of this study carry important programmatic implications. First, targeted awareness campaigns in rural and peri-urban areas should emphasise early recognition of symptoms and discourage self-medication. Second, engagement with informal providers through training and referral linkages may help redirect presumptive TB cases toward formal diagnostic services sooner. Third, ensuring uninterrupted availability of rapid molecular diagnostics at the first point of contact can substantially reduce system delays. Fourth, reinforcement of provider training on standard NTEP diagnostic algorithms will reduce unnecessary repeated visits.

Being a retrospective record-based study, limitations include incomplete documentation of some patient-level variables such as socioeconomic status and stigma indices. Nonetheless, the study provides meaningful insights into real-world diagnostic barriers within a high-burden tertiary care setting and highlights several actionable points for improving early TB detection.

Conclusion

The findings of this retrospective study highlight that diagnostic delay among TB patients continues to be a major challenge, with patient delay contributing more significantly than system delay. Rural residence, initial care-seeking from informal providers, and misinterpretation of early symptoms were prominent determinants of delayed presentation. System-related delays were mainly associated with limited availability of rapid diagnostic tests, smear-negative disease, and multiple healthcare visits before confirmation.

Reducing diagnostic delay requires a multipronged approach. Strengthening community awareness, discouraging self-medication, and improving engagement with informal healthcare providers can substantially reduce patient delay. Ensuring uninterrupted access to molecular diagnostics such as CBNAAT at first contact and reinforcing adherence to standardized diagnostic algorithms can minimise system delay. Implementing these measures within NTEP frameworks will contribute to earlier case detection, reduced transmission, and

improved overall TB control in high-burden settings.

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