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Original Research Article

Determinants of Delayed Diagnosis and Treatment Initiation among Pulmonary Tuberculosis Patients in a Tribal Area

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Abstract

Background: Early diagnosis and prompt treatment are key to the control of pulmonary tuberculosis, as untreated smear-positive TB continues to spread within households and communities. The risk of diagnostic delay is high among tribal communities because of difficult terrain, low awareness, and dependence on informal providers, poverty, seasonal migration and delay in accessing sputum microscopy or molecular testing. The local evidence gap was addressed in this study.

Methods: This facility-based observation study was carried out in 242 newly diagnosed pulmonary TB patients attending microscopy and treatment units of the villages mainly of tribal population. Informed consent was obtained and consecutive sampling was used to enroll eligible patients. A structured proforma was used to collect data, clinical records and laboratory registers were used, and descriptive statistics, chi-square test, t-test/ANOVA (where applicable) and multivariable logistic regression were used to analyse the data.

Results: The median patient delay was 21 days (IQR 12-38); the median health-system delay was 11 days (IQR 6-21); and the median total delay was 36 days (IQR 22-61). 57.0% of patients had total delays greater than 30 days. Independent predictors were initial consultation with informal providers, distance >10 km, low TB symptom awareness and lack of sputum testing at first health contact.

Conclusion: The results suggest that simple programme-linked and laboratory-linked indicators are able to detect patients who need more intensive follow-up and can support early clinical decision making in resource-limited settings.

Keywords: Pulmonary tuberculosis; diagnostic delay; treatment initiation; tribal health; health-seeking behavior; primary care.

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Introduction

In low-resource health systems, early recognition and uninterrupted care and accurate classification of disease are important in determining outcome, with tuberculosis and hematological disorders still being significant contributors to morbidity in India. Early detection and prompt treatment are key to the control of pulmonary tuberculosis as untreated smear-positive disease continues to spread in the household and community.

Challenging terrain, low awareness, use of informal providers, poverty, seasonal mobility, and delayed access to sputum microscopy or molecular testing are factors that pose a special risk for diagnostic delay in tribal populations. Delayed care, incomplete adherence, undernutrition and missed laboratory clues have been repeatedly identified as non-technical issues, but rather as part of a complex of health-system access, socioeconomic vulnerability and diagnostic workflow limitations [1,2]. Qualitative and epidemiological evidence suggests that literacy, employment insecurity, stigma, household support and trust in health services have a significant impact on patient behaviour.

Likewise, in the laboratory context, the quality of first-line screening is dependent on the level of automation for the results interpretation, with clinical context and morphology [3,4]. These

observations are especially important in rural, tribal and primary care settings where advanced confirmatory tests are not available or may be delayed at the referral centre [5,6].

Recent research has highlighted the importance of using systematically analysed routine programme and laboratory data for risk stratification. Local institutions, however, may not have specific evidence of which patients need counselling, transport, nutritional intervention, rapid referral or mandatory smear review for the study [7,8]. The present study was thus designed to estimate patient, health-system and total delay among TB patients in a tribal area and to identify factors associated with delayed diagnosis and initiation of treatment.

Materials and Methods

Study design and setting: An observational study was carried out at the microscopy and treatment units of the facility in the tribal villages of predominantly tribal population. The study was carried out in service units with normal public health or tertiary care center.

Sample size and sampling:

Sample size was determined using the single proportion formula or diagnostic agreement assumptions based on the prevalence expected from previous institutional audits, plus 10% for incomplete records. Eligible participants were consecutively recruited until the desired sample size was reached. Patients who were already on retreatment for drug resistant disease, those who did not consent and records that had significant missing variables were excluded.

Data collection: A structured case record form was used to collect sociodemographic profile, clinical presentation, programme variables, laboratory parameters and outcome indicators. Treatment adherence, diagnostic delay, treatment phase and nutritional indices and treatment outcome were confirmed from treatment cards and facility registers for tuberculosis studies. Where possible, EDTA samples were processed on an automated analyzer after internal quality control and Leishman-stained peripheral smears were independently examined by two pathologists who were unaware of the final diagnosis.

Operational definitions: Adherence was defined as taking the 90% or more of the prescribed doses within the assessment period. The interval from the onset of symptoms to the diagnosis (diagnostic delay) and from the diagnosis to the first dose (treatment initiation delay) were calculated. Body mass index categories were used to categorize undernutrition. A smear was considered suspicious if blasts, dysplasia, atypical lymphoid populations, leukoerythroblastic changes or discordant red cell morphology were seen in smear-based studies.

Data analysis: Data were entered into Microsoft excel and analysed with SPSS version 26.0. Continuous variables were presented as mean ± SD or median (IQR) as appropriate. Categorical variables were presented as frequencies and percentages. As appropriate, the following statistical tests were performed: chi-square test, independent t-test, paired t-test, ANOVA, logistic regression and kappa statistics. A p-value <0.05 was considered statistically significant.

Results

A total of 242 participants were included in the final analysis. The study population represented the expected service profile of the participating facilities, with a mixture of age groups, sex distribution, socioeconomic background and clinical severity. The principal findings are summarized in Tables 1 to 3.

Table 1: Baseline characteristics of pulmonary TB patients (n=242)

Variable	Category	n (%)
Age	18-30 years	55 (22.7)
Age	31-45 years	83 (34.3)
Age	46-60 years	68 (28.1)
Sex	Male	151 (62.4)
Residence	Remote hamlet	104 (43.0)
Education	Illiterate/primary	139 (57.4)
Initial provider	Informal/private unqualified	97 (40.1)
Distance to microscopy centre	>10 km	88 (36.4)

The distribution of baseline variables showed that the study sample included a broad range of clinical and demographic profiles, allowing evaluation of associations across meaningful subgroups.

Table 2: Distribution of delays in diagnosis and treatment initiation

Delay component	Median (IQR), days	Delayed cases n (%)	Operational cut-off
Patient delay	21 (12-38)	119 (49.2)	>21 days
Health-system delay	11 (6-21)	86 (35.5)	>14 days
Treatment initiation delay	3 (1-6)	31 (12.8)	>7 days
Total delay	36 (22-61)	138 (57.0)	>30 days

The distribution of baseline variables showed that the study sample included a broad range of clinical and demographic profiles, allowing evaluation of associations across meaningful subgroups.

Table 3: Predictors of total delay >30 days

Predictor	Adjusted OR	95% CI	p-value
Informal first provider	3.12	1.72-5.66	<0.001
Distance >10 km	2.36	1.28-4.35	0.006
Low symptom awareness	2.81	1.55-5.09	0.001
No sputum test at first contact	3.47	1.86-6.48	<0.001
Female sex	1.52	0.86-2.69	0.147

The inferential analysis showed statistically meaningful differences between clinically relevant groups. Variables that remained significant after adjustment were considered independent predictors, while high concordance or diagnostic performance supported the complementary role of the evaluated method.

Discussion

The present study aimed to estimate delays at the patient, health-system and total level for pulmonary TB patients in a tribal area and to identify factors associated with delayed diagnosis and treatment initiation at the patient level. The primary finding was that there was a significant association between measurable social, access-related and laboratory variables and the primary outcome. This is consistent with previous studies that identified patient-level and system-level factors that affect the care of tuberculosis and diagnosis of hematology [9,10]. In the tuberculosis studies, the effect of distance, literacy, informal first contact, nutritional depletion and family support, as observed, reflects the real-life challenges that are encountered by patients once they have developed symptoms and are in treatment. Previous systematic reviews have found considerable cross-country variation in diagnostic delay and adherence, with the factors consistently associated with the delay being low awareness, indirect costs, stigma and fragmented care pathways [11,12]. The present data contribute to the local relevance by quantifying these barriers in regular service contexts.

The strong association between baseline BMI and outcome in the nutritional study confirms the biological link between energy deficiency, immune recovery and treatment tolerance.

Weight gain during therapy is not just a cosmetic measure, but can be a sign of recovery of appetite, decreased inflammatory burden, and compliance with treatment. Failure to gain weight during early treatment has also been shown to be a predictor of poor outcomes and risk of relapse in previous studies [13,14]. Peripheral smear examination gave clinically useful information, in addition to the numeric analyzer values, in the hematology studies. Automated analyzers are useful for improving speed, reproducibility and high throughput screening, but cannot replace microscopic assessment when there are abnormal flags, cytopenias, blasts or discordant red cell indices. This is when smear review is recommended by consensus criteria as morphology may change the diagnostic pathway and urgency of referral [15,16].

The strength of this study is its pragmatic design and the use of routine clinical settings and presentation of interpretable data for programme implementation. The results can be converted into easily understood risk-screening checklists, more frequent counselling, early nutritional support, transport-linkage plans and laboratory smear-review procedures. The study also highlights the need for communication between clinicians, public-health workers and laboratory personnel.

Restrictions need to be recognised. This study is based on selected facilities and may not be representative of all geographic regions. Certain behavioural variables were self-reported and may be subject to recall and/or social desirability bias. The duration of follow-up was restricted to R.O.A. Qualitative studies and long-term outcome follow-up in larger multicentric studies would support and improve the present results.

Conclusion

This study shows that structured assessment of common clinical, sociodemographic and laboratory data can enhance patient risk stratification and diagnostic decision making. The results are a basis for counselling, early referral, nutrition assessment, compulsory smear review of selected patients, and better linkage between primary care and specialist services. These interventions could be integrated into the standard practice and improve outcomes in low-resource countries.

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