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TREATMENT OUTCOMES OF MULTIDRUG-RESISTANT TUBERCULOSIS UNDER PROGRAMMATIC MANAGEMENT IN RAICHUR DISTRICT: A COMMUNITY-BASED CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Multidrug-resistant tuberculosis (MDR-TB) remains a major public health challenge because of prolonged treatment duration, higher treatment costs, drug-related adverse effects, and comparatively poor treatment outcomes. Continuous evaluation of treatment outcomes under the Programmatic Management of Drug-Resistant Tuberculosis (PMDT) is essential for strengthening tuberculosis control programmes and improving patient care. **Aim:** To assess the treatment outcomes of multidrug-resistant tuberculosis patients managed under the Programmatic Management of Drug-Resistant Tuberculosis (PMDT) in Raichur district.

Materials and Methods: A community-based cross-sectional study was conducted among 60 MDR-TB patients registered under PMDT in Raichur district, Karnataka. Patients were identified through District Tuberculosis Centre records and interviewed using a pre-designed, pre-tested questionnaire. Treatment outcome analysis was performed for 55 patients with documented treatment status. Socio-demographic characteristics, behavioural risk factors, clinical profile, and treatment outcomes were collected from programme records and patient interviews. Data were analysed using SPSS version 26.0. Categorical variables were expressed as frequencies and percentages, while associations were assessed using Chi-square or Fisher's exact test. A p-value <0.05 was considered statistically significant.

Results: The majority of patients belonged to the 30–40-year age group (32.7%), were males (69.1%), rural residents (76.4%), Hindus (83.6%), and belonged to socioeconomic Class IV (56.4%). Histories of smoking, alcohol consumption, tobacco chewing, and comorbidities were reported in 27.3%, 32.7%, 9.1%, and 9.1% of patients, respectively. Treatment success (cured or treatment completed) was observed in 11 (20.0%) patients, while 29 (52.7%) were still receiving treatment and 15 (27.3%) experienced unfavourable outcomes, including treatment interruption, death, or progression to XDR-TB. Individually, 6 (10.9%) patients were cured, 5 (9.1%) completed treatment, 10 (18.2%) had treatment interruption or loss to follow-up, 4 (7.3%) died, and 1 (1.8%) progressed to XDR-TB. No statistically significant association was observed between cured status and age, sex, residence, religion, or socioeconomic status (p>0.05).

Conclusion: MDR-TB in Raichur district predominantly affected economically productive, rural, and socioeconomically disadvantaged individuals. Although one-fifth of patients had achieved treatment success, more than half remained on treatment at the time of assessment, highlighting the need for continued follow-up before final programme outcomes can be determined. Strengthening adherence support, early management of adverse drug reactions, patient counselling, nutritional assistance, and decentralized

PMDT services may improve treatment outcomes and contribute to tuberculosis elimination efforts.
Keywords: Multidrug-resistant tuberculosis. Programmatic Management of Drug-Resistant Tuberculosis (PMDT). Treatment outcomes.

INTRODUCTION

Tuberculosis (TB) remains one of the leading infectious causes of morbidity and mortality worldwide despite the availability of effective chemotherapy. It is caused by Mycobacterium tuberculosis and primarily affects the lungs, although virtually any organ system can be involved. The emergence of drug-resistant tuberculosis has become a major challenge to global TB elimination efforts. Among these, multidrug-resistant tuberculosis (MDR-TB), defined as resistance to at least isoniazid and rifampicin, represents one of the most serious threats because of prolonged treatment duration, increased toxicity, higher treatment costs, and poorer clinical outcomes compared with drug-susceptible TB. The World Health Organization (WHO) has recognized MDR-TB as a major public health concern requiring strengthened surveillance, rapid diagnosis, and effective treatment strategies.[1]

India continues to bear the highest burden of tuberculosis globally and contributes a substantial proportion of MDR/RR-TB cases. Under the National Tuberculosis Elimination Programme (NTEP), formerly the Revised National Tuberculosis Control Programme (RNTCP), programmatic management of drug-resistant tuberculosis (PMDT) has been implemented to improve early diagnosis, universal drug susceptibility testing, standardized treatment regimens, patient monitoring, nutritional support, and treatment adherence. Recent advances such as shorter oral regimens and the introduction of bedaquiline-containing treatment protocols have significantly improved treatment outcomes; however, treatment success remains suboptimal in many regions due to adverse drug reactions, treatment interruption, socioeconomic challenges, comorbidities, and delayed diagnosis.[2]

Treatment outcome is an important indicator for evaluating the effectiveness of MDR-TB control programmes. The WHO recommends monitoring standardized treatment outcomes including cured, treatment completed, treatment failed, died, lost to follow-up, and not evaluated. Assessment of these outcomes provides valuable information regarding programme performance and identifies gaps that require corrective interventions. Several studies conducted across India have demonstrated variable treatment success rates ranging from approximately 50% to 75%, with mortality and loss to follow-up remaining major concerns. Regional variations in healthcare access, socioeconomic conditions, nutritional status, substance abuse, and associated comorbidities significantly influence treatment outcomes.[3]

Raichur district in Karnataka is recognized as a high TB burden area where MDR-TB poses an important public health challenge. Although PMDT services are available through the District Tuberculosis Centre, limited community-based evidence exists regarding the actual treatment outcomes achieved under routine programmatic conditions. Understanding treatment outcomes at the community level is essential for evaluating programme effectiveness, identifying operational deficiencies, and planning targeted interventions to improve patient survival and treatment completion.[4,5]

Aim

To assess the treatment outcomes of multidrug-resistant tuberculosis patients managed under the Programmatic Management of Drug-Resistant Tuberculosis (PMDT) in Raichur district.

Objectives

1. To determine the treatment outcomes among patients with multidrug-resistant tuberculosis registered under PMDT in Raichur district.
2. To assess the distribution of various treatment outcome categories including cured, treatment completed, treatment failure, death, and loss to follow-up.
3. To identify socio-demographic and clinical factors associated with treatment outcomes among MDR-TB patients.

MATERIALS AND METHODS

Source of Data

The data were obtained from the MDR-TB treatment registers maintained at the District Tuberculosis Centre (DTC), Raichur, along with patient treatment records maintained under the National Tuberculosis Elimination Programme (NTEP). Additional information was collected through interviews conducted during community visits using a pre-designed and pre-tested questionnaire.

Study Design

A community-based cross-sectional study was conducted.

Study Location

The study was conducted in Raichur district, Karnataka. Patients registered for MDR-TB treatment under the District Tuberculosis Centre were traced and interviewed at their respective residences.

Study Duration

The study was conducted over a period of one year.

Sample Size

The study included 60 patients diagnosed with multidrug-resistant tuberculosis and registered under the Programmatic Management of Drug-Resistant Tuberculosis (PMDT) in Raichur district who fulfilled the eligibility criteria.

Inclusion Criteria

- Patients diagnosed with multidrug-resistant tuberculosis and registered under PMDT in Raichur district.
- Patients who had documented treatment outcomes under the programme.
- Patients aged 18 years and above.
- Patients who provided written informed consent.

Exclusion Criteria

- Patients who refused to participate.
- Patients who were transferred out of Raichur district before completion of treatment.
- Patients whose treatment records were incomplete or unavailable.
- Pediatric patients (<18 years).

Procedure and Methodology

Permission to conduct the study was obtained from the District Tuberculosis Officer, Raichur. The list of eligible MDR-TB patients was obtained from the District Tuberculosis Centre. Patients were contacted through the Senior Treatment Supervisors (STS) and visited at their residences. Written informed consent was obtained prior to enrolment.

A structured, pre-tested questionnaire was administered to collect information regarding socio-demographic characteristics, clinical profile, behavioural risk factors, treatment history, and treatment outcomes. Information related to treatment outcome was verified from PMDT treatment records and NTEP registers. Treatment outcomes were categorized according to WHO/NTEP definitions as cured, treatment completed, treatment failed, died, lost to follow-up, or not evaluated.

Anthropometric measurements including height and weight were recorded using standardized techniques whenever required. All collected information was checked for completeness and accuracy before data entry.

Sample Processing

No biological specimens were collected specifically for the present study. Treatment outcome data, microbiological diagnosis, drug susceptibility testing reports, and follow-up information were extracted from the existing PMDT treatment records maintained at the District Tuberculosis Centre. Data were verified with patient treatment cards and programme registers before analysis.

Statistical Methods

The collected data were entered into Microsoft Excel and analysed using Statistical Package for the Social Sciences (SPSS) version 26.0.

Continuous variables were expressed as mean ± standard deviation (SD), whereas categorical variables were presented as frequencies and percentages. Association between categorical variables and treatment outcomes was assessed using the Chi-square test or Fisher's exact test whenever appropriate. Continuous variables were compared using the independent sample t-test. A p-value <0.05 was considered statistically significant with 95% confidence intervals wherever applicable.

Data Collection

Data were collected using a structured and pre-tested questionnaire consisting of:

- Socio-demographic characteristics (age, sex, education, occupation, marital status, socioeconomic status, residence).
- Clinical characteristics (previous TB treatment, comorbidities, BMI, smoking, alcohol use, tobacco use, HIV status, diabetes mellitus).
- Treatment-related information (date of diagnosis, treatment regimen, duration of treatment, adverse drug reactions, adherence).
- Final treatment outcome under PMDT (cured, treatment completed, treatment failure, death, loss to follow-up, transferred out).
- The completed questionnaires were reviewed daily for completeness and consistency before data entry and statistical analysis.

RESULTS

Table 1: Overall profile of MDR-TB patients managed under PMDT in Raichur district (N=55)

Variable	Category	n (%)	Test of significance	95% CI	p-value
Age group	<30 years	14 (25.5)	χ^2=11.73	15.8–38.3%	0.019*
	30–40 years	18 (32.7)		21.8–45.9%	
	40–50 years	14 (25.5)		15.8–38.3%	
	50–60 years	6 (10.9)		5.1–21.8%	
	≥60 years	3 (5.5)		1.9–14.9%	
Sex	Male	38 (69.1)	χ^2=8.02	56.0–80.0%	0.005*
	Female	17 (30.9)		20.0–44.0%	
Residence	Rural	42 (76.4)	χ^2=15.29	63.7–85.6%	<0.001*
	Urban	13 (23.6)		14.4–36.3%	
Religion	Hindu	46 (83.6)	χ^2=24.89	71.7–91.2%	<0.001*
	Muslim	9 (16.4)		8.8–28.3%	
Socioeconomic class	Class II	5 (9.1)	χ^2=18.62	3.9–19.6%	<0.001*
	Class III	19 (34.5)		23.4–47.7%	
	Class IV	31 (56.4)		43.3–68.6%	

History of smoking	Yes	15 (27.3)	χ^2=11.36	17.3–40.2%	0.001*
	No	40 (72.7)		59.8–82.7%	
History of alcohol consumption	Yes	18 (32.7)	χ^2=6.56	21.8–45.9%	0.010*
	No	37 (67.3)		54.1–78.2%	
History of tobacco chewing	Yes	5 (9.1)	χ^2=36.82	3.9–19.6%	<0.001*
	No	50 (90.9)		80.4–96.1%	
Comorbidity present	Yes	5 (9.1)	χ^2=36.82	3.9–19.6%	<0.001*
	No	50 (90.9)		80.4–96.1%	

Table 1 presents the overall profile of 55 patients with multidrug-resistant tuberculosis managed under PMDT in Raichur district. The largest proportion of patients belonged to the 30–40-year age group, comprising 18 (32.7%) participants, followed by those aged <30 years and 40–50 years, with 14 (25.5%) patients in each group. Patients aged 50–60 years accounted for 6 (10.9%), while only 3 (5.5%) were aged ≥60 years. The age-group distribution differed significantly, with a chi-square value of 11.73 and a p-value of 0.019. Males constituted the majority of the study population, with 38 (69.1%) patients compared with 17 (30.9%) females, and this difference was statistically significant (χ^2=8.02, p=0.005). Most participants were from rural areas, accounting for 42 (76.4%), whereas 13 (23.6%) were urban residents; the residential distribution was statistically significant (χ^2=15.29, p<0.001). Hindus constituted 46 (83.6%) of the patients and Muslims 9 (16.4%), showing a significant difference in religious distribution (χ^2=24.89, p<0.001). Regarding socioeconomic status, the majority belonged to Class IV, with 31 (56.4%) patients, followed by Class III with 19 (34.5%) and Class II with 5 (9.1%); this distribution was also significant (χ^2=18.62, p<0.001). A history of smoking was present in 15 (27.3%) patients, while 40 (72.7%) were non-smokers, with a statistically significant difference (χ^2=11.36, p=0.001). Alcohol consumption was reported by 18 (32.7%) patients, whereas 37 (67.3%) had no history of alcohol intake, and this distribution was significant (χ^2=6.56, p=0.010). Tobacco chewing was reported by only 5 (9.1%) patients, while 50 (90.9%) did not chew tobacco, showing a significant difference (χ^2=36.82, p<0.001). Similarly, comorbidities were present in 5 (9.1%) patients and absent in 50 (90.9%), with a statistically significant distribution (χ^2=36.82, p<0.001).

Table 2: Summary of treatment outcomes among MDR-TB patients registered under PMDT in Raichur district (N=55)

Treatment-outcome group	n (%)	Test of significance	95% CI	p-value
Treatment success: cured or treatment completed	11 (20.0)	Exact binomial test	11.6–32.4%	<0.001*
Currently on treatment	29 (52.7)		39.8–65.3%	
Unfavourable outcome: death, interruption or XDR-TB	15 (27.3)		17.3–40.2%	
Total	**55 (100.0)**			

Table 2 summarizes the treatment outcomes among the 55 MDR-TB patients registered under PMDT. Treatment success, defined as either cure or treatment completion, was observed in 11 (20.0%) patients, with a 95% confidence interval of 11.6%–32.4%. More than half of the patients, 29 (52.7%), were still receiving treatment at the time of assessment, with a 95% confidence interval of 39.8%–65.3%. Unfavourable outcomes, including death, treatment interruption, or progression to XDR-TB, were recorded in 15 (27.3%) patients, with a 95% confidence interval of 17.3%–40.2%. The exact binomial test showed that the observed treatment-success proportion was significantly below 50% (p<0.001). However, this finding should be interpreted cautiously because 52.7% of the participants were still undergoing treatment and had therefore not yet reached a final outcome. Consequently, the 20.0% treatment-success proportion represents the status at the time of the study rather than the final programme-level treatment success rate.

Table 3: Distribution of individual treatment-outcome categories among MDR-TB patients (N=55)

Treatment outcome	n (%)	Test of significance	95% CI	p-value
Cured	6 (10.9)	χ^2=56.16	5.1–21.8%	<0.001*
Treatment completed	5 (9.1)		3.9–19.6%	
On treatment	29 (52.7)		39.8–65.3%	
Treatment interruption/lost to follow-up	10 (18.2)		10.2–30.3%	
Death	4 (7.3)		2.9–17.3%	
Progression to XDR-TB/treatment failure	1 (1.8)		0.3–9.6%	
Total	**55 (100.0)**			

Table 3 shows the distribution of individual treatment-outcome categories among MDR-TB patients. The most common outcome category was "on treatment," reported in 29 (52.7%) patients, with a 95% confidence interval of 39.8%–65.3%. Treatment interruption or loss to follow-up was the second most frequent outcome, occurring in 10 (18.2%) patients, with a 95% confidence interval of 10.2%–30.3%. Six (10.9%) patients were cured, while 5 (9.1%) had completed treatment, giving a

combined treatment-success proportion of 20.0%. Death occurred in 4 (7.3%) patients, with a 95% confidence interval of 2.9%–17.3%. Only 1 (1.8%) patient progressed to XDR-TB or experienced treatment failure, with a 95% confidence interval of 0.3%–9.6%. The observed distribution across the six outcome categories was statistically significant (χ^2=56.16, p<0.001), indicating that the outcomes were not evenly distributed. The predominance of patients still on treatment reflects the cross-sectional timing of the assessment, while the relatively high proportion of treatment interruption highlights an important programme-related concern requiring enhanced adherence counselling, active follow-up, and patient support.

Table 4: Association of socio-demographic factors with cured status among MDR-TB patients (N=55)

Factor	Category	Cured n (%)	Not cured/currently on treatment n (%)	95% CI for cured proportion	Test of significance	p-value
Age group	<30 years	1 (7.1)	13 (92.9)	1.3–31.5%	χ^2=2.17	0.705
	30–40 years	2 (11.1)	16 (88.9)	3.1–32.8%		
	40–50 years	1 (7.1)	13 (92.9)	1.3–31.5%		
	50–60 years	1 (16.7)	5 (83.3)	3.0–56.4%		
	≥60 years	1 (33.3)	2 (66.7)	6.1–79.2%		
Sex	Male	5 (13.2)	33 (86.8)	5.8–27.3%	Fisher's exact test	0.654
	Female	1 (5.9)	16 (94.1)	1.0–27.0%		
Residence	Rural	5 (11.9)	37 (88.1)	5.2–25.0%	Fisher's exact test	1.000
	Urban	1 (7.7)	12 (92.3)	1.4–33.3%		
Religion	Hindu	5 (10.9)	41 (89.1)	4.7–23.0%	Fisher's exact test	1.000
	Muslim	1 (11.1)	8 (88.9)	2.0–43.5%		
Socioeconomic class	Class II	0 (0.0)	5 (100.0)	0.0–43.4%	χ^2=3.26	0.196
	Class III	4 (21.1)	15 (78.9)	8.5–43.3%		
	Class IV	2 (6.5)	29 (93.5)	1.8–20.7%		

Table 4 presents the association between socio-demographic factors and cured status among the 55 MDR-TB patients. Cure was observed in 1 (7.1%) patient aged <30 years, 2 (11.1%) patients aged 30–40 years, 1 (7.1%) patient aged 40–50 years, 1 (16.7%) patient aged 50–60 years, and 1 (33.3%) patient aged ≥60 years. Although the highest cure proportion was noted among patients aged ≥60 years, the confidence interval was wide because of the small number of patients in this category, and the association between age group and cure was not statistically significant (χ^2=2.17, p=0.705). Among males, 5 of 38 patients (13.2%) were cured compared with 1 of 17 females (5.9%); however, the association between sex and cured status was not significant (Fisher's exact test, p=0.654). Cure was recorded in 5 of 42 rural patients (11.9%) and 1 of 13 urban patients (7.7%), with no statistically significant association between residence and cure (p=1.000). Similarly, 5 of 46 Hindu patients (10.9%) and 1 of 9 Muslim patients (11.1%) were cured, showing virtually identical cure proportions and no significant association with religion (p=1.000). Regarding socioeconomic status, no patient from Class II was cured, whereas cure occurred in 4 of 19 patients (21.1%) from Class III and 2 of 31 patients (6.5%) from Class IV. Although cure appeared more frequent among patients in socioeconomic Class III, the association was not statistically significant (χ^2=3.26, p=0.196).

DISCUSSION

The present community-based study described the profile and treatment status of 55 patients with multidrug-resistant tuberculosis managed under PMDT in Raichur district. The findings demonstrated that MDR-TB predominantly affected economically productive adults, males, rural residents and patients from lower socioeconomic groups. At the time of assessment, 20.0% had achieved treatment success, 52.7% were still receiving treatment and 27.3% had experienced an unfavourable event. These results should be interpreted in the context of the cross-sectional design because most patients had not completed their prescribed treatment course.

Socio-demographic and clinical profile

In the present study, 83.7% of patients were younger than 50 years, and the largest proportion belonged to the 30–40-year age group. The age distribution was statistically unequal (χ^2=11.73, p=0.019). Sharma et al. (2020),[1] in their record-based study from Delhi, similarly reported that MDR-TB predominantly affected young and middle-aged adults. Fatima et al. (2021),[2] reported a mean age of approximately 31 years among 3,580 MDR-TB patients in Uttar Pradesh. The concentration of disease among working-age adults is epidemiologically important because prolonged treatment, repeated healthcare visits and treatment-related toxicity may adversely affect employment, household income and social

participation. However, the goodness-of-fit p-value in the present table indicates only that patients were not distributed equally across age categories; it does not establish that age caused MDR-TB or influenced its outcome.

Males constituted 69.1% of the study population, and the male predominance was statistically significant (χ^2=8.02, p=0.005). Similar findings were reported by Fatima et al. (2021),[2] who observed that 67% of MDR-TB patients were male. In a study of patients treated with a bedaquiline-containing regimen in Punjab, Kumari et al. (2024),[3] also documented a predominance of male patients. The greater representation of men may reflect higher exposure to smoking, alcohol use, occupational dust, crowded workplaces and delayed healthcare-seeking. Gender differences in access to diagnostic and treatment services may additionally contribute to under-notification among women. Nevertheless, the male predominance in an enrolled treatment cohort should not be interpreted as an independent biological association without population-based comparison data.

Three-fourths of the participants were rural residents. This was comparable with the study by Vasavi et al. (2021),[4] in which 123 of 211 MDR-TB patients were from rural areas. That study also reported a statistically significant relationship between geographical residence and treatment outcome. Rural predominance in the present study may reflect the population distribution of Raichur district, but it may also indicate barriers such as long travel distances, fewer diagnostic facilities, transportation costs and loss of daily wages. Wrohan et al. (2022),[5] emphasized that treatment accessibility and continuity of care influence MDR-TB outcomes, while Watumo et al. (2022),[6] found that travelling longer distances to healthcare facilities substantially increased the likelihood of loss to follow-up among patients receiving TB treatment. These observations support decentralised drug-resistant TB services, home-based adherence support and active follow-up through community health workers.

Most patients were Hindu, reflecting the underlying demographic composition of the study area rather than a disease-specific relationship. Religion was therefore more appropriately regarded as a descriptive variable and not an etiological factor. The significant goodness-of-fit result for religion (χ^2=24.89, p<0.001) showed an unequal distribution between the categories but did not demonstrate that religious affiliation affected susceptibility or treatment response.

More than half of the patients belonged to socioeconomic Class IV and approximately one-third belonged to Class III. This finding indicated that MDR-TB was concentrated among socioeconomically disadvantaged households. Sharma et al. (2020),[1] highlighted the operational difficulties associated with MDR-TB treatment in socially and economically vulnerable populations. Barriers may include inadequate nutrition, unstable employment, overcrowding, inability to meet transportation costs and interruption of treatment because of migration. India's programme guidelines recognise nutritional, social and adherence support as important components of drug-resistant TB management.[7] The predominance of lower socioeconomic groups in the present study therefore reinforces the need for timely nutritional assistance, direct-benefit transfers, counselling and social protection.

A history of smoking was reported by 27.3%, alcohol consumption by 32.7% and tobacco chewing by 9.1% of participants. Substance use may impair adherence, worsen nutritional status, increase hepatotoxicity risk and coexist with other social vulnerabilities. Belachew et al. (2022),[8] found that clinical and behavioural characteristics were important considerations in MDR/RR-TB outcomes, while Akalu et al. (2024),[9] identified several patient-level and clinical factors associated with poor outcomes among patients with drug-resistant TB. The proportion of smokers and alcohol users in Raichur was clinically relevant even though the goodness-of-fit tests in Table 1 compared the frequencies of users and non-users rather than evaluating their relationship with treatment success. A valid assessment of their prognostic effect would require outcome-stratified analysis and preferably multivariable regression.

Only 9.1% of participants were recorded as having comorbidities. This proportion was lower than that reported in several contemporary MDR-TB cohorts, where diabetes mellitus, HIV infection, anaemia and chronic pulmonary disease were commonly encountered. Vadakunnel et al. (2025),[10] reported that clinical comorbidities and indicators of disease severity were associated with unfavourable outcomes among MDR/RR-TB patients. Getahun et al. (2023),[11] also found that older age and adverse clinical factors increased mortality risk. The low comorbidity prevalence in the present study may reflect the small sample, relatively young population, incomplete screening or reliance on existing records rather than systematic biochemical assessment.

Overall treatment status

Treatment success, defined as cure or treatment completion, was recorded in 11 patients, giving an observed proportion of 20.0%. This proportion was significantly below the 50% reference value used in the exact binomial test (p<0.001). However, 29 patients, representing 52.7% of the sample, were still receiving treatment. Therefore, the observed 20.0% must not be interpreted as the final treatment-success rate of the Raichur PMDT programme. It represented an interim status measure in a cross-sectional cohort in which more than half of the participants were not yet eligible for assignment of a final outcome.

The observed proportion was consequently lower than the final outcomes reported in completed

cohorts. Fatima et al. (2021),[2] reported 30.4% cured and 25.5% treatment completed, producing an overall success rate of approximately 55.9%. Sharma et al. (2020),[1] noted gradual improvement in MDR-TB outcomes under programmatic conditions in Delhi, although mortality and loss to follow-up remained substantial. Kumari et al. (2024),[3] reported that 52.9% of patients receiving bedaquiline-containing treatment were cured and 20.0% completed treatment, amounting to a success rate of approximately 72.9%. Similarly, Lecai et al. (2023),[12] documented 71.1% treatment success among MDR-TB patients receiving ambulatory care in Shenzhen, while Belachew et al. (2022),[8] reported a success rate of 77.1%.

WHO reported that the global treatment-success rate among the 2021 MDR/RR-TB treatment cohort was 68%, an improvement from 64% in 2020 and 60% in 2019.[13] The Indian national drug-resistant TB guidelines reported that MDR-TB treatment success in India improved from 49% in the 2017 cohort to 75% in the 2021 cohort.[7] These rates cannot be directly compared with the 20.0% in the present study because national and international estimates were based on cohorts with final evaluated outcomes, whereas the Raichur study included 52.7% who remained on treatment.

Distribution of individual outcomes

Among individual treatment categories, 52.7% remained on treatment, 18.2% had treatment interruption or loss to follow-up, 10.9% were cured, 9.1% completed treatment, 7.3% died and 1.8% progressed to XDR-TB or experienced treatment failure. The significant goodness-of-fit result (χ^2=56.16, p<0.001) showed that the six categories were not equally represented, primarily because more than half were still undergoing treatment.

Treatment interruption in 18.2% of patients was an important programmatic concern. It was higher than the default proportion of 8.5% reported by Vasavi et al. (2021),[4] and the 11.6% reported by Kumari et al. (2024),[3] but was closer to the substantial levels of loss to follow-up reported in older programmatic cohorts. Fatima et al. (2021),[2] observed a default rate of 12.5%. Differences between studies may be attributable to treatment duration, regimen tolerability, distance from treatment facilities, socioeconomic support and intensity of patient tracking.

The longer MDR-TB regimens historically required prolonged exposure to multiple drugs and were associated with substantial toxicity and treatment fatigue. Gupta and Chopra (2020),[14] noted that the transition from RNTCP to NTEP included the introduction of newer drugs and all-oral regimens intended to improve tolerability and outcomes. WHO now prioritises six-month BPaLM or BPaL regimens for eligible patients, followed by nine-month all-oral regimens, while longer regimens are reserved for patients who are not eligible for shorter treatment.[13,15] Wider use of shorter, injection-free regimens may reduce treatment interruption by decreasing treatment duration, pill burden and injectable-drug toxicity.

The mortality proportion of 7.3% was lower than the 21.4% reported by Fatima et al. (2021),[2] the 26.0% reported by Vasavi et al. (2021)[4] and the 14.2% reported by Kumari et al. (2024).[3] However, because 52.7% of the Raichur cohort was still on treatment, additional deaths could have occurred after the study assessment. The mortality proportion was therefore an interim cumulative measure rather than a final case-fatality estimate. Bofe et al. (2022),[16] and Getahun et al. (2023),[11] identified advanced age, severe disease, delayed culture conversion and comorbid conditions as important predictors of mortality among MDR-TB patients.

Only one patient progressed to XDR-TB or treatment failure. This was comparable with the low treatment-failure proportions reported by Fatima et al. (2021),[2] and Kumari et al. (2024).[3] Nevertheless, even a single instance of amplification of resistance is epidemiologically important because it may reflect inadequate drug exposure, poor adherence, baseline resistance not detected by available tests or suboptimal regimen effectiveness. Farhat et al. (2024),[17] emphasised that drug-resistant TB remains a persistent global threat despite the availability of newer all-oral regimens.

Factors associated with cured status

None of the examined socio-demographic factors showed a statistically significant association with cured status. Cure proportions were 7.1% among patients aged <30 years, 11.1% among those aged 30–40 years, 7.1% among those aged 40–50 years, 16.7% among those aged 50–60 years and 33.3% among those aged ≥60 years (p=0.705). Although the highest proportion appeared among older patients, this category contained only three participants and had a very wide confidence interval. The apparent age gradient was therefore unstable and should not be regarded as evidence of a beneficial effect of older age. In contrast, Belachew et al. (2022),[8] found older age to be associated with unsuccessful treatment, and Getahun et al. (2023),[11] reported markedly elevated mortality among older MDR-TB patients.

The cure proportion was higher among males than females, but the difference was not significant (13.2% versus 5.9%, p=0.654). Wrohan et al. (2022),[5] reported that treatment outcome was shaped by a combination of demographic and clinical factors rather than sex alone. The small number of cured patients in the present study substantially limited the ability to detect gender differences.

Rural and urban patients had similar cure proportions, and residence was not significantly associated with cure (p=1.000). This differed from Vasavi et al. (2021),[4] who reported a significant association between geographical distribution and treatment outcome. Differences may have resulted from sample size, local availability of treatment services and classification of outcomes. The lack of

association in Raichur should not be interpreted as evidence that geographical accessibility was unimportant because the study included only six cured patients.

Religion was not associated with cure, with almost identical proportions among Hindu and Muslim patients. This supported the interpretation that religion primarily reflected the background population distribution and was not an independent clinical predictor.

Patients from Class III had a numerically higher cure proportion than those from Classes II and IV, but the association was not statistically significant (p=0.196). Socioeconomic disadvantage may influence adherence and access to care, but its effect is often mediated through nutrition, employment, distance, housing and social support. A larger cohort with multivariable analysis would be required to separate these effects.

Importantly, the comparison category in Table 4 combined patients who were still receiving treatment with those who had experienced an unfavourable outcome. Patients currently on treatment had not failed treatment and could subsequently be cured or complete therapy. Therefore, the analysis evaluated "documented cure at the time of assessment" rather than predictors of final successful versus unsuccessful outcome. This outcome misclassification, together with only six cured cases, wide confidence intervals and multiple cells with low expected frequencies, limited statistical power. Future studies should follow every patient until a final WHO-defined outcome and analyse treatment success against death, failure and loss to follow-up using multivariable logistic regression or time-to-event methods.

CONCLUSION

The present community-based cross-sectional study evaluated the treatment outcomes of multidrug-resistant tuberculosis (MDR-TB) patients managed under the Programmatic Management of Drug-Resistant Tuberculosis (PMDT) in Raichur district. The study found that MDR-TB predominantly affected young and middle-aged adults, males, rural residents, and individuals belonging to lower socioeconomic classes. At the time of assessment, one-fifth of the patients had achieved treatment success (cured or treatment completed), while more than half were still undergoing treatment and approximately one-fourth had experienced unfavourable outcomes, including treatment interruption, death, or progression to XDR-TB. None of the evaluated socio-demographic factors showed a statistically significant association with cured status, suggesting that treatment outcome is likely influenced by multiple clinical, behavioural, and programmatic factors beyond baseline demographic characteristics. The findings highlight the importance of sustained treatment adherence, regular follow-up, early management of adverse drug reactions, strengthened patient counselling, nutritional and social support, and timely monitoring under PMDT. Continued implementation of patient-centred care and wider adoption of shorter all-oral regimens may further improve treatment outcomes and contribute towards achieving the goals of the National Tuberculosis Elimination Programme.

Limitations of the Study

1. The cross-sectional study design captured treatment status at a single point in time and therefore could not determine the final treatment outcomes for patients who were still undergoing therapy.
2. The study was conducted in a single district with a relatively small sample size (55 patients with documented treatment outcomes), which limits the generalizability of the findings.
3. Treatment outcome assessment relied primarily on programme records, making the study susceptible to incomplete documentation and information bias.
4. Important clinical variables such as bacteriological conversion, radiological findings, nutritional status, drug susceptibility patterns, and severity of disease were not evaluated in detail.
5. Multivariable analysis could not be performed because of the limited number of cured patients, thereby restricting the identification of independent predictors of treatment success.
6. Behavioural risk factors such as smoking and alcohol consumption were self-reported and may have been affected by recall or social desirability bias.

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