

Research Article

Evaluation of Treatment Outcomes in Shorter and Longer Regimen Treatment in Multi-Drug Resistant Tuberculosis (MDR-TB) Patients in District Etawah: A Longitudinal Study

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A B S T R A C T

Background: Multi-drug resistant tuberculosis is a worldwide problem with a notoriously difficult and challenging treatment. There are two treatment regimens for MDR-TB treatment.

Objectives: To compare the predisposing risk factors and treatment outcomes in two different drug regimens for the treatment of MDR-TB

Material and Methods: A field-based longitudinal study was carried out among 50 microbiologically confirmed MDR-TB patients aged 18 years and above, enrolled from January 2020 to December 2020 of district Etawah. Variables recorded were socio-demographics, clinical profile and treatment outcomes.

Result: The mean age of the participants was 30.70 ± 12.52 years. Most of the participants were female (58%) and belonged to Class II and III of the Modified BG Prasad Classification. Most of the participants (62%) had a BMI of $< 18.5 \text{ kg/m}^2$. About 93% of the study participants in the shorter regimen completed the treatment and were cured. The participants with no prior history of tuberculosis had better treatment outcomes ($p \leq 0.001$).

Conclusion: The present study concludes that successful treatment outcomes are more in the shorter treatment regimen compared to the longer treatment regimen.

Keywords: MDR-TB, Shorter Regimen, Longer Regimen, Treatment Outcomes, NTEP, India

Introduction

Tuberculosis is an infectious disease caused by the bacterium *Mycobacterium tuberculosis*. While it primarily affects the lungs, it can also involve other organs and tissues in the body. It is estimated that one-third of the global population is asymptomatically infected with tuberculosis, with 5–10% progressing to clinical disease over their lifetime.¹

The availability of anti-tubercular drugs (ATDs) has been a significant advancement in the fight against tuberculosis. However, improper treatment regimens, the indiscriminate use of these drugs, and suboptimal adherence have greatly diminished their effectiveness. These factors have contributed to the rise of drug-resistant strains, particularly multi-drug resistant (MDR) tuberculosis.²

Multi-drug resistant tuberculosis (MDR-TB) is caused by a strain of *Mycobacterium tuberculosis* (MTB) that is resistant to both isoniazid and rifampicin. MDR-TB is a persistent and debilitating disease that demands prolonged treatment (often lasting more than 20 months) with a severe regimen of second-line anti-TB drugs, which are less efficacious and carry potential toxicity. MDR-TB is often regarded as “the worst of the worst illnesses,” and its treatment is considered “worse than the disease itself” due to the severe side effects of these drugs, the prolonged duration of therapy, and the challenging nature of managing such a resistant infection, making the treatment process difficult for patients.³

In 2021, the estimated proportion of people with TB who had MDR-TB/ rifampicin resistance-tuberculosis was 3.6% (95% UI: 2.7–4.4%) among new cases and 18% (95% UI: 11–26%) among those previously treated; the figures in 2015 were 3.9% (95% UI: 2.8–5.0%) and 20% (95% UI: 9.5–31%), respectively.⁴

The challenges associated with diagnosing and treating MDR-TB highlight the need to understand the factors that contribute to drug-resistant TB and poor treatment results. It is important to take into consideration factors like age, gender, and health conditions that can influence the disease and treatment outcomes. By focusing on these factors, especially the less resource-intensive ones, we can create better strategies to prevent resistant cases from developing and improve treatment success. This includes reducing relapses, treatment interruptions, and failures.

The standard regimens which are being followed under the National Tuberculosis Elimination Programme (NTEP) for the treatment of MDR-TB are: a) Shorter Regimen and b) longer regimen. The shorter regimen typically lasts for 9 to 12 months and involves a combination of drugs such as kanamycin, moxifloxacin, clofazimine, ethionamide, pyrazinamide, and high-dose isoniazid. It is designed for patients with less complicated forms of MDR-TB. The longer regimen lasts for 18 to 24 months and includes a

more extensive combination of second-line drugs, including injectables like capreomycin or kanamycin, along with moxifloxacin, ethionamide, cycloserine, clofazimine, and pyrazinamide.²

We designed this study to better understand the predisposing risk factors and treatment outcomes of the two different treatment regimens for MDR-TB in the Etawah district.

Materials and Methods

The present study aimed to assess the treatment outcomes in adult multi-drug resistant TB patients of the Etawah district. The present study was conducted in the Department of Community Medicine, Uttar Pradesh University of Medical Sciences, Saifai, Etawah.

Study Design

A field-based longitudinal study

Study Area

District Etawah

Study Duration

January 2021–July 2022

Study Population and Sample Size

A total of 87 MDR-TB patients who were enrolled in UPUMS, Saifai, Etawah between January 2020 and December 2020 were included in the present study if they fulfilled the inclusion criteria.

Sampling Method

Purposive sampling

Study Tool

Information was collected using a pre-tested, pre-designed, semi-structured questionnaire. A written informed consent was obtained prior to data collection.

Inclusion Criteria

- All diagnosed patients of multi-drug resistant tuberculosis aged 18 years or older, and residing in District Etawah

Exclusion Criteria

- Patients who did not give consent
- Patients who were mentally retarded
- Patients who were unavailable for three consecutive visits

Methodology

There is one District Tuberculosis Centre (DTC), 11 Tuberculosis Units (TUs) and 19 Designated Microscopic Centres (DMCs) functional in district Etawah. All the diagnosed MDR-TB patients of district Etawah are admitted for at least one week in the MDR-TB centre in UPUMS,

Saifai, Etawah. So, the MDR-TB centre in UPUMS, Saifai, Etawah was approached to obtain the necessary permission for conducting the study. The nature and purpose of the study were explained in detail to the head of the MDR-TB centre, and after obtaining the required permission, we procured the list of enrolled MDR-TB patients from January 2020 to December 2020 (Figure 1).

A list of 87 participants was obtained from the MDR-TB centre in UPUMS, among which 50 participants were included in the final study (Figure 2). These participants were then divided into two groups namely shorter regimen

and longer regimen based on the treatment schedule prescribed by the treating physician. Each patient was then approached telephonically to get their full residential address. An interview with the patient was conducted door to door by visiting their house for the required data. Patients were explained in detail about the purpose of the study and written informed consent was obtained from them. A pre-designed, pre-tested, and semi-structured questionnaire consisting of a socio-demographic profile and clinical profile was used for collecting the required information regarding the treatment outcomes of multi-drug resistant tuberculosis.

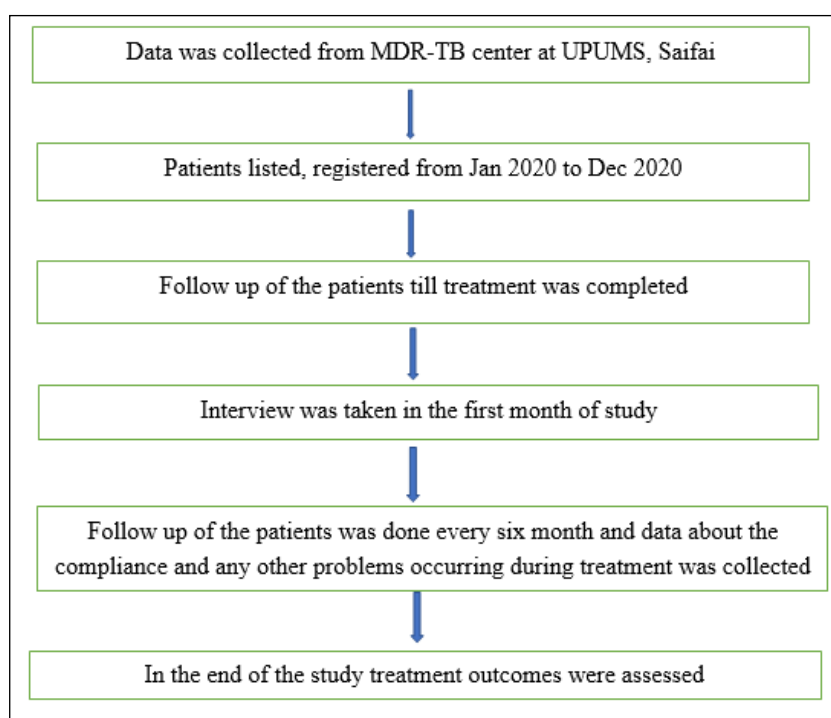


Figure 1.A Flowchart Showing Method of Data Collection and Timing of Interview

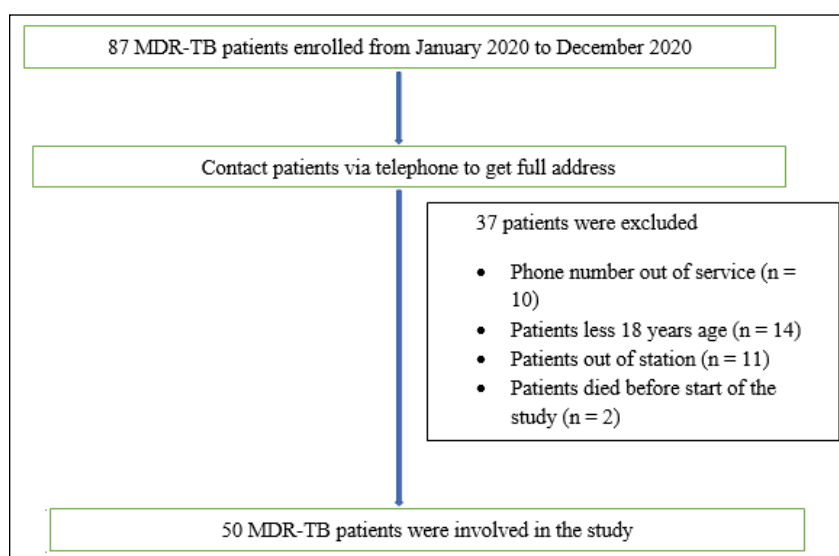


Figure 2.A Flowchart Showing Recruitment of MDR-TB Patients for the Current Study

Statistical Analysis

The data was put into Microsoft Excel version 2022 for Windows, where it was revised and refined. In the event of differences or errors, the appropriate study tool forms were matched and repairs were performed. Statistical Package for Social Sciences (SPSS) Version 24.0, IBM Inc. Chicago, USA software was used to code and analyse the data.

Ethical Clearance

Ethical clearance was obtained from the ethical committee of the Uttar Pradesh University of Medical Sciences (UPUMS), Saifai, Etawah prior to the study (ID-169/2020-21).

Results

Out of the 87 participants registered in the MDR-TB centre in UPUMS, Saifai, 50 participants were included in the final study. Out of these, 30 participants belonged to the shorter regimen and 20 participants belonged to the longer regimen. The proportion of females was higher than that of males in both the treatment groups (shorter regimen: 56.7%; longer regimen: 60.0%). Among all participants, 70% of the study participants belonged to the age group of 18–30 years. Based on educational status, 46% of the study participants had attained an intermediate level of education or higher. In terms of socio-economic status, the majority of participants belonged to the middle class (46%), followed by the upper-middle class (36%) (Table 1).

Among the study participants, 62% had a Body Mass

Index (BMI) of less than 18.5, indicating undernutrition. Additionally, 54% of participants weighed less than 45 kg, while 42% had a weight ranging between 45–60 kg. Newly diagnosed cases accounted for 80% of the participants, and pulmonary tuberculosis was observed in 96% of the study population (Table 2).

In the shorter regimen group, 93.3% (28 out of 30 participants) achieved a cure and successfully completed treatment with no reported cases of default or treatment failure, while death was reported in 6.7% (2 participants), whereas in the longer regimen, 75% (15 out of 20 participants) were cured, and 80% (16 out of 20 participants) successfully completed treatment. The outcomes in the longer regimen also included 2 defaulters (10.0%), 1 case of treatment failure (5.0%), and 2 deaths (10.0%) (Table 3).

Poor treatment outcomes were observed in one male and six female participants. All participants, with an educational qualification of intermediate or higher, achieved successful treatment outcomes, and this difference was statistically significant ($p = 0.021$). Regarding geographical location, 1 out of 25 participants residing in rural areas had a poor treatment outcome (4%), while 6 out of 25 participants in urban areas experienced poor treatment outcomes (24%). Among participants with a previous history of tuberculosis, 7 individuals (50%) had poor treatment outcomes, whereas all participants without a history of tuberculosis achieved successful treatment outcomes, and this difference was statistically significant ($p < 0.001$) (Table 4).

Table 1. Distribution of Study Participants According to Their Socio-Demographic Profile

N = 50

Variables	Sub-Groups	Total n (%)	Shorter Regimen Treatment (N = 30) n (%)	Longer Regimen Treatment (N = 20) n (%)	p Value
Gender	Male	21 (42.0)	13 (43.3)	8 (40.0)	0.815
	Female	29 (58.0)	17 (56.7)	12 (60.0)	
Age (years)	18–30	35 (70.0)	20 (66.7)	15 (75.0)	0.598
	31–50	11 (22.0)	8 (26.7)	3 (15.0)	
	≥ 51	4 (8.0)	2 (6.7)	2 (10.0)	
Religion	Hindu	43 (86.0)	24 (80.0)	19 (95.0)	0.219 [#]
	Muslim	7 (14.0)	6 (20.0)	1 (5.0)	
Educational status	Illiterate	10 (20.0)	6 (20.0)	4 (20.0)	0.801
	Primary school	3 (6.0)	2 (6.7)	1 (5.0)	
	Junior high school	5 (10.0)	4 (13.3)	1 (5.0)	
	High school	9 (18.0)	6 (20.0)	3 (15.0)	
	Intermediate & above	23 (46.0)	12 (40.0)	11 (55.0)	

Type of family	Nuclear	24 (48.0)	15 (50.0)	9 (45.0)	0.917
	Joint	24 (48.0)	14 (46.7)	10 (50.0)	
	Three generation	2 (4.0)	1 (3.3)	1 (5.0)	
Marital status	Unmarried	14 (28.0)	7 (23.3)	7 (35.0)	0.504
	Married	35 (70.0)	22 (73.3)	13 (65.0)	
	Others	1 (2.0)	1 (3.3)	0 (0.0)	
Socio-economic status of the family as per revised BG Prasad scale	Upper class	3 (6.0)	0 (0.0)	3 (15.0)	0.087
	Upper-middle class	18 (36.0)	11 (36.7)	7 (35.0)	
	Middle class	23 (46.0)	17 (56.7)	6 (30.0)	
	Lower-middle class	3 (6.0)	1 (3.3)	2 (10.0)	
	Lower class	3 (6.0)	1 (3.3)	2 (10.0)	

#Fisher's Exact test

Table 2. Distribution of the Study Participants According to Their Clinical Profile

N = 50

Variables	Sub-Groups	Shorter Regimen Treatment n (%)	Longer Regimen Treatment n (%)	Total n (%)	p Value
BMI (in kg/m ²)	< 18.5	19 (63.3)	12 (60.0)	31 (62)	0.812
	18.5–24.9	11 (36.7)	08 (40.0)	19 (38)	
	> 25	0 (0.0)	0 (0.0)	0 (0.0)	
Weight (kg) (at the time of admission)	< 45	18 (60.0)	09 (45.0)	27 (54)	0.579
	45–60	11 (36.7)	10 (50.0)	21 (42)	
	> 60	1 (3.3)	1 (5.0)	2 (4)	
Type of patients	New case	24 (80.0)	16 (80.0)	40 (80)	0.108
	Relapse case	2 (6.7)	4 (20.0)	6 (12)	
	Treatment after Loss to Follow-up	4 (13.3)	0 (0.0)	4 (8)	
	Treatment after failure	0 (0.0)	0 (0.0)	0 (0.0)	
Type of TB	Pulmonary	29 (96.7)	19 (95.0)	48 (96)	1.000 [#]
	Extra-pulmonary	1 (3.3)	1 (5.0)	2 (4)	

#Fisher's Exact test

Table 3. Distribution of Study Participants According to Their Treatment Outcomes in Shorter and Longer Regimens

N = 50

Variables	Response	Shorter Regimen Treatment n (%)	Longer Regimen Treatment n (%)	Total n (%)	p Value
Treatment outcome (successful)					
Cured	Yes	28 (93.3)	15 (75.0)	43 (86.0)	0.100 [#]
	No	2 (6.7)	5 (25.0)	7 (14.0)	
Treatment completed	Yes	28 (93.3)	16 (80.0)	44 (88.0)	0.202 [#]
	No	2 (6.7)	4 (20.0)	6 (12.0)	

Treatment outcome (poor)				
Defaulter	Yes	0 (0.0)	2 (10.0)	2 (4.0)
	No	30 (100.0)	18 (90.0)	48 (96.0)
Failure	Yes	0 (0.0)	1 (5.0)	1 (2.0)
	No	30 (100.0)	19 (95.0)	49 (98)
Died	Yes	2 (6.7)	2 (10.0)	4 (8.0)
	No	28 (93.3)	18 (90.0)	46 (92.0)

#Fisher's Exact test

Table 4. Association of Study Participants According to Their Socio-Demographic Variables and Clinical Status with Treatment Outcomes

N = 50

Variables	Sub-Groups	Successful Treatment n (%)	Poor Treatment n (%)	p Value
Gender	Male	20 (95.2)	1 (4.8)	0.215 [#]
	Female	23 (79.3)	6 (20.7)	
Age (years)	18–30	32 (91.4)	3 (8.6)	0.070
	31–50	9 (81.8)	2 (18.2)	
	≥ 51	2 (50.0)	2 (50.0)	
Religion	Hindu	38 (88.4)	5 (11.6)	0.250 [#]
	Muslim	5 (71.4)	2 (28.6)	
Educational status	Illiterate	6 (60.0)	4 (40.0)	0.021 [*]
	Primary school	2 (66.7)	1 (33.3)	
	Junior high school	5 (100.0)	0 (0.0)	
	High school	7 (77.8)	2 (22.2)	
	Intermediate & above	23 (100.0)	0 (0.0)	
Residence	Rural	24 (96.0)	1 (4.0)	0.098 [#]
	Urban	19 (76.0)	6 (24.0)	
Type of family	Nuclear	22 (91.7)	2 (8.3)	0.387
	Joint	19 (79.2)	5 (20.8)	
	Three generation	2 (100.0)	0 (0.0)	
Marital status	Unmarried	13 (92.9)	1 (7.1)	0.608
	Married	29 (82.9)	6 (17.1)	
	Others	1 (100.0)	0 (0.0)	
Socio-economic status of the family as per the revised BG Prasad scale	Upper class	3 (100.0)	0 (0.0)	0.256
	Upper-middle class	17 (94.4)	1 (5.6)	
	Middle class	17 (73.9)	6 (26.1)	
	Lower-middle class	3 (100.0)	0 (0.0)	
	Lower class	3 (100.0)	0 (0.0)	
Past history of tuberculosis	Yes	7 (50.0)	7 (50.0)	0.001 [*]
	No	36 (100.0)	0 (0.0)	

BMI of the patient	≤ 18.5	27 (87.1)	4 (12.9)	1.000 [#]
	18.5–24.9	16 (84.2)	3 (15.8)	
	≥ 25	0 (0.0)	0 (0.0)	
Type of the patient	New case	35 (87.5)	5 (12.5)	0.274
	Relapse case	04 (66.7)	2 (33.3)	
	Treatment after Loss to Follow-up	4 (100.0)	0 (0.0)	
	Treatment after failure	0 (0.0)	0 (0.0)	

*Significant (p value < 0.05), [#]Fisher's Exact test

Discussion

This study aimed to evaluate the treatment outcomes in patients undergoing shorter and longer regimens for MDR-TB in District Etawah. The findings revealed notable differences in treatment outcomes between the two regimens, reflecting the potential advantages of the shorter regimen over the longer regimen in certain specific contexts.

Among the participants in the shorter regimen group, 93.3% (28 out of 30) achieved a cure and successfully completed treatment without any cases of default or failure, while mortality due to the disease was reported in 6.7% (2 participants). In contrast, the longer regimen group demonstrated relatively less favourable outcomes, with 75% (15 out of 20) achieving cure, 80% (16 out of 20) completing treatment, 10.0% (2 participants) defaulting, 5.0% (1 participant) experiencing treatment failure, and 10.0% (2 participants) succumbing to the disease. The results of our study are consistent with another study conducted by Zhdanova et al., where 56.1% of participants in the shorter regimen group were cured, 27.3% completed their treatment, 13.6% defaulted, 3% experienced treatment failure, and no deaths were reported. In comparison, the longer regimen in their study showed a lower cure rate (32.5%) and higher rates of default (33.9%) and mortality (13.1%).⁵ The lower rates of cure in their study can be attributed to different treatment protocols and population demographics.

Among participants with a BMI ≤ 18.5, 87.1% achieved successful treatment outcomes, while 12.9% experienced poor outcomes. In a study conducted by Nair et al., 42% of participants with a BMI < 18.5 kg/m² had unfavourable treatment outcomes.⁶ Similarly, a study by Dash and Behera reported poor treatment outcomes in 31.25% of participants with a BMI below 18.5 kg/m².⁷ The discordance in results may be attributed to differences in geographical regions.

Among participants with a previous history of tuberculosis, 50% experienced poor treatment outcomes, whereas those with no history of tuberculosis achieved a 100% success rate in treatment outcomes. In a study conducted by

Johnson et al., it was observed that 94.9% of participants with no history of tuberculosis had unsuccessful treatment outcomes, and 89.5% of re-treated participants also faced unsuccessful outcomes.⁸ Similarly, a study by Khaliukin et al. reported that 71% of participants with a history of tuberculosis had unsuccessful treatment outcomes.⁹

The discordance between the findings of the present study and those reported in the literature may be attributed to differences in the study populations. The present study exclusively included MDR-TB patients, whereas the studies by Johnson et al. and Khaliukin et al. encompassed participants with various forms of tuberculosis, including non-MDR, XDR, and HIV-positive cases.^{8,9} These variations in inclusion criteria likely influenced the treatment outcomes, highlighting the importance of stratifying participants based on TB type and comorbidities when comparing treatment effectiveness across studies.

This study had certain limitations. Comorbid conditions like HIV status, diabetes mellitus and radiological findings could have been included for the better assessment of treatment outcomes among MDR-TB patients. Due to the COVID pandemic situation delaying the current study and lengthening the retrospective period, potentially introducing recall bias among the study participants. This study was conducted in rural and urban areas of District Etawah. The findings of this study cannot be generalised to a larger demographic area and therefore may not be applicable to every other district or state in India or abroad owing to differences in socio-economic status, culture, and access to and use of health services for different health needs.

Conclusion

The present study contributes to the literature investigating the assessment of treatment outcomes and adverse drug reactions in adult MDR-TB patients in district Etawah. The study highlights that the shorter regimen for MDR-TB is associated with better treatment outcomes compared to the longer regimen. Factors such as higher education levels, and not having a history of tuberculosis are important predictors of successful treatment. These findings also

suggest that addressing socio-demographic factors and opting for the shorter regimen may improve treatment success in MDR-TB patients.

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Authors' Contribution: All the authors contributed equally.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process: None

References

1. Data on development of clinical tuberculosis available at/K. Park/25th edition/page no. 188 [cited 2021 Oct 19]. Available from: M/S Banarsidas Bhanot. Retrieved from <http://bhanot.in>
2. Data on treatment of MDR-TB patients [Internet]; [cited 2021 Oct 19]. Available from: <https://tbcindia-wp.azurewebsites.net/wp-content/uploads/2023/05/NTEPTTrainingModules1to4.pdf>
3. Jaber AA, Ibrahim B. Health-related quality of life of patients with multidrug-resistant tuberculosis in Yemen: prospective study. Health and quality of life outcomes. 2019 Dec;17:1-4., <https://doi.org/10.1186/s12955-019-1211>
4. Data on TB burden in India [Internet]; [cited 2022 Oct 19]. Available from: <https://tbcindia.mohfw.gov.in/wp-content/uploads/2023/05/TBAnnauReport2022.pdf>
5. Zhdanova E, Goncharova O, Davtyan H, Alaverdyan S, Sargsyan A, Harries AD, Maykanaev B. 9-12 months short treatment for patients with MDR-TB increases treatment success in Kyrgyzstan. J Infect Dev Ctries. 2021 Sep 29;15(9.1):66S-74S. [PubMed] [Google Scholar]
6. Nair D, Velayutham B, Kannan T, Tripathy JP, Harries AD, Natrajan M, Swaminathan S. Predictors of unfavourable treatment outcome in patients with multidrug-resistant tuberculosis in India. Public Health Action. 2017 Mar 21;7(1):32-8. [PubMed] [Google Scholar]
7. Dash M, Behera BP. Socio-epidemiological status and clinical outcome of MDR TB patients in a tertiary medical college in Southern Odisha. J Family Med Prim Care. 2022 Apr;11(4):1275. [PubMed] [Google Scholar]
8. Johnson JM, Mohapatra AK, Velladath SU, Shettigar KS. Predictors of treatment outcomes in drug resistant tuberculosis-observational retrospective study. Int J Mycobacteriol. 2022 Jan;11(1):38. [PubMed] [Google Scholar]
9. Khaliaukin A, Kumar AM, Skrahina A, Hurevich H, Rusovich V, Gadoev J, Falzon D, Khogali M, de Colombani P. Poor treatment outcomes among multidrug-resistant

tuberculosis patients in Gomel Region, Republic of Belarus. Public Health Action. 2014 Oct 21;4(Suppl 2):S24-8. [PubMed] [Google Scholar]