Annals of R.S.C.B., ISSN: 1583-6258, Vol. 28, Issue 1, 2024, Pages. 266 – 281

Received 30 July 2024; Accepted 15 August 2024.

Tuberculosis treatment outcomes and factors associated with tb regimen and health facilities in Srikakulam, northeast of Andhra Pradesh: A five-year retrospective study

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ABSTRACT

Mycobacterium tuberculosis is the primary cause of tuberculosis (TB), a communicable disease. Active TB Symptoms include fever, night sweats, haemoptysis (coughing up blood), weight loss, and a chronic cough. Diagnosis of TB includes chest x-ray, microscopy and Xpert MTB/RIF assays. The number of deaths has decreased over the years, which is a positive outcome. The regression analysis aimed to explore the relationship between the number of deaths and the number of cured TB cases. While the correlation coefficient (R) indicates a moderate to strong positive relationship, there is no statistical significance in the results. This implies that the number of TB cases that are cured may be significantly influenced by other factors that are not considered by this model. The p-values for both the constant and the number of deaths is above 0.05, suggesting that neither has a significant impact on the number of cured cases in this model. The variability in notifications, cure rates, and death rates over the years highlights ongoing challenges in TB control, including the impact of external factors like the COVID-19 pandemic. The significant decline in cure rates from 43% in 2018-2019 to 23% in 2022 is concerning and indicates a need for enhanced treatment strategies and patient support systems. The fluctuation in mortality rates suggests variability in TB case severity and healthcare quality. The reduction in mortality rates by 2022 is a positive sign, indicating possible improvements in TB care

Keywords

LTBI: Latent TB Infection, NAAT: Nucleic Acid Amplification Tests, MDR TB: Multi Drug Resistant TB, XDRTB: Extensively Resistant TB, IGRA: Interferon Gamma Release Assays, LPA: Line Probe Assay

Introduction

Tuberculosis (TB) is a contagious disease primarily caused by the bacterium Mycobacterium tuberculosis. Although it can spread to other regions of the body such the kidneys, spine, and brain, it mostly affects the lungs. One of the oldest illnesses known to science, tuberculosis (TB) continues to pose a serious global public health threat.

Globally, tuberculosis (TB) is a primary reason of disease and death especially in nations with lower and moderate incomes. According to predictions from WHO, 10 million individuals would have tuberculosis (TB) in 2020, with 1.5 million of those cases ending in death. including 214,000 HIV-positive individuals (WHO, 2021).

The disease burden is highest in regions such as Southeast Asia, Africa, and the Western Pacific. India, Indonesia, China, the Philippines, Pakistan, Nigeria, Bangladesh, and South Africa account for two thirds of the global TB cases.

The main way that TB is transmitted via the air is when someone who has active pulmonary TB coughs, sneezes, or speaks. People with LTBI do not have active disease and cannot transmit the infection. However, if their immune system becomes compromised, they are at risk of developing active TB, especially.

Active TB is characterized by symptoms such as a persistent cough, chest pain, haemoptysis (coughing up blood), night sweats, fever, and weight loss. The risk factors for developing TB include HIV infection, diabetes, malnutrition, tobacco smoking, and living in crowded conditions (CDC, 2020).

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A combination of clinical assessment, a chest radiography, and microbiological examinations, including Microscopy of Sputum Smears, culture, and nucleic acid amplification tests (NAATs), are used to diagnose tuberculosis (TB). A quick test that has improved tuberculosis detection, particularly in environments with limited resources, is the GeneXpert MTB/RIF assay. (WHO, 2013).

A lengthy course of various medicines is necessary for TB treatment in order to completely eradicate the bacteria and stop the emergence of drug resistance. Isoniazid, rifampicin, ethambutol, and pyrazinamide are the usual six-month treatment for drug-susceptible tuberculosis (TB) (CDC, 2020). Treatment regimens for extensively drug-resistant (XDRTB) and multidrug-resistant (MDRTB) tuberculosis (TB) are more complicated, time-consuming, and hazardous.

Effective TB control requires a early detection, prompt treatment, contact tracing, and preventive therapy for those at high risk. Between 2015 and 2030, the WHO's End TB Strategy seeks to reduce tuberculosis fatalities by 90% and new infections by 80%. (WHO, 2015).

Review of literature

Diagnosis and treatment:

Using different methods for identifying the TB. Those are given below

1. Microscopy of Sputum Smears: For decades Microscopy of Sputum Smears has been the cornerstone of TB diagnosis. In this sputum samples under a microscope to detect acid-fast bacilli (AFB). This method is simple, inexpensive, and widely accessible, w its sensitivity is relatively low, particularly in HIV positive patients and in cases of EPTB. (Steingart et al., 2006).
2. Culture Methods: Culture based methods, such as the Löwenstein Jensen medium and the BACTEC system, are considered the benchmark for TB diagnosis due to their high sensitivity. although these culture methods are time-consuming, methods can detect as few as 10100 viable bacilli per millilitre of (Boehme et al., 2010).

Immunological Tests

3. Tuberculin Skin Test (TST): The pure protein derivative (PPD), commonly referred to as the Mantoux test (TST) or tuberculin skin test, involves injecting PPD into the skin and assessing the immunological response. Although widely used, the TST has limitations, including cross-reactivity with environmental mycobacteria and the BCG vaccination, which can lead to false positive results. (Menzies et al., 2007).
4. Interferon Gamma Release Assays (IGRAs): Assays for measuring interferon gamma release in response to particular tuberculosis antigens include the Quanti FERONTB Gold test. Compared to TST, these tests are more specific and unaffected by prior BCG immunisation. IGRAs are particularly useful in diagnosing latent TB infection (LTBI), but their utility in diagnosing active TB is limited (Pai et al., 2014).

Molecular Diagnostic Methods

5. Nucleic Acid Amplification Tests (NAATs): TB diagnostics have been completely transformed by the GeneXpert MTB/RIF assay (NAATs), which can now quickly and accurately identify rifampicin resistance and TB in just a few hours. According to studies, the GeneXpert MTB/RIF assay may identify pulmonary TB with an 88% sensitivity and 99% specificity (Steingart et al., 2014).

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6. Line Probe Assays (LPAs): These tests provide rapid identification of MDRTB and extensively drug resistant TB (XDRTB). Molecular tests known as LPAs are used to identify certain genetic changes linked to medication resistance. The WHO recommends LPAs as a follow-up test for patients diagnosed with TB to guide appropriate treatment regimens (Hillemann et al., 2007).

Emerging Diagnostic Technologies

7. Loop Mediated Isothermal Amplification (LAMP): LAMP offers the potential for rapid, simple, and cost-effective TB diagnosis at the point of care. It is a novel molecular technique that amplifies DNA with high specificity and efficiency under isothermal conditions. Preliminary studies suggest that LAMP has comparable sensitivity and specificity to NAATs (Boone et al., 2015).

8. NextGeneration Sequencing (NGS): NGS technologies are being explored for comprehensive TB diagnostics, including strain identification and drug resistance profiling. NGS offers the advantage of detecting a broad range of genetic mutations associated with drug resistance, but its implementation in routine clinical practice is currently limited by high costs and technical complexity (Meehan et al., 2019).

Treatment

Tuberculosis (TB) effective treatment strategies to combat its high morbidity and mortality rates. This literature review explores the evolution of TB treatment, focusing on the efficacy, challenges, and advancements in therapeutic approaches over recent decades.

Standard Treatment Regimens

The usual treatment approach for drug-susceptible TB recommended by the World Health Organisation (WHO) includes the prescription of first-line anti-TB drugs for a period of six months. This regimen consists of a four-month continuation phase with isoniazid and rifampicin (HR) after an intensive phase of two months with isoniazid, rifampicin, pyrazinamide, and ethambutol (HRZE). Numerous studies have demonstrated the high efficacy of this regimen, with cure rates exceeding 90% in compliant patients (Blumberg et al., 2019).

Challenges in TB Treatment

Despite the effectiveness of the standard regimen, several challenges impede TB control efforts. The lengthy duration of treatment and the emergence of drug resistance. Adverse drug reactions, including peripheral and neuropathy hepatotoxicity, further complicate treatment adherence (Schaberg et al., 1996). Moreover, the coexistence of TB and HIV infection complicates treatment, as rifampicin interacts with antiretroviral drugs, necessitating careful management of drug-drug interactions.

Multidrug Resistant TB (MDRTB)

The emergence of MDRTB is marked by resistance to at least isoniazid and rifampicin, poses a major danger to public health. To treat MDRTB, second-line drugs are required, which are more toxic and less effective. A longer course of therapy is usually required—up to 24 months. The WHO recommended MDRTB regimen includes drugs such as fluoroquinolones (levofloxacin or moxifloxacin), aminoglycosides (amikacin or kanamycin), and newer agents like Bedaquiline and linezolid (WHO, 2019).

Recent studies have shown that shorter MDRTB regimens, lasting 912 months, can be effective in specific populations, particularly those without extensive resistance to second-line drugs. These regimens have shown promising results, with treatment success rates comparable to longer regimens but with fewer adverse effects and improved adherence (Nunn et al., 2019).

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Extensively Drug Resistant TB (XDR-TB) Extensively drug-resistant tuberculosis (XDRTB) is characterised by resistance to fluoroquinolones, second-line injectable drugs, rifampicin, and isoniazid. represents an even greater therapeutic challenge. Treatment options for XDRTB are limited and often involve the use of repurposed drugs such as clofazimine and Delamanid. The introduction of newer drugs, such as Pretomanid, in combination with Bedaquiline and linezolid, has provided hope for more effective XDRTB treatment (Conradie et al., 2020). The NixTB trial demonstrated that this combination regimen could achieve high cure rates in XDRTB patients, marking a significant advancement in TB treatment.

Shorter and Novel Treatment Regimens

Efforts to shorten TB treatment duration have led to the investigation of novel drug combinations and treatment regimens. The STREAM trial evaluated the efficacy of a nine-month MDRTB regimen, demonstrating that it could be as effective as the conventional 20–24month regimen. Additionally, the introduction of Bedaquiline, a novel diarylquinoline, has been a gamechanger in TB treatment, particularly for drug resistant TB. Bedaquiline, when added to existing regimens, has shown to improve treatment outcomes significantly (Diacon et al., 2014).

The TB Alliance's development of Pretomanid, another novel anti TB drug, has further enriched the treatment landscape. Pretomanid has demonstrated encouraging outcomes for treating TB that is very drug-resistant forms when combined with bedaquiline and linezolid (BPaL regimen). The NixTB trial reported a cure rate of over 90% with this regimen, highlighting its potential to revolutionize MDRTB and XDRTB treatment (Conradie et al., 2020).

Challenges and Future Directions

Despite these advancements, TB treatment faces several challenges, including the need for improved diagnostic tools to detect drug resistance early and accurately. Ensuring patient adherence to long treatment regimens remains a critical issue, necessitating the development of more patient friendly treatment options. The integration of digital health technologies, such as video directly observed therapy (VDOT), can enhance treatment adherence and monitoring. In order to combat the rising threat of drug-resistant tuberculosis, ongoing research and development of new medications and treatment plans is also required.

The role of host directed therapies, which target the host immune response rather than the pathogen itself, is also being explored as a potential adjunct to conventional anti TB treatment (Zumla et al., 2015). In conclusion, even though TB therapy has come a long way, more research and creativity are needed to overcome the current obstacles.

The integration of new drugs, shorter regimens, and digital health technologies holds promise for improving TB treatment outcomes and moving closer to the goal of TB elimination.

Materials and methods

Study design: A retrospective study that is cross-sectional centred on a facility was used. Using the five-year patient record charts, data was collected at public health facilities between January 1, 2018, and December 31, 2022.

Study area Period:

This study was carried out in District public health facilities. One of the districts in the southern Indian state of Andhra Pradesh is Srikakulam Town. It is situated 371 kilometres away from Amaravathi in the state of Andhra Pradesh. The Central Statistical Agency estimates that there

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were 23 lakh people living in this town as of 2018. Twelve TB health centres and one hospital serve the town's TB patients, providing them with follow-up monitoring, adherence support, treatment initiation, and diagnosis. The trial ran from January 1, 2018, to December 31, 2022. The TB centre is designed independently from other therapies in these study sites. Referrals from surrounding rural health centres are received by all centres, but particularly by the hospital.

We use the WHO's tuberculosis recommendations for diagnosis and therapy in treatment. methods for diagnosis including microscopy, culture, and Xpert MTB/RIF testing are used to confirm tuberculosis. If the results of bacteriologic procedures are unclear, more testing might be required. It is advised to perform DR screening tests utilising Xpert MTB/RIF and Line Probe Assays. The National TB Program includes DOT. Treatment selection is guided by rapid DST results. Patients who come into touch with DRTB Depending on the DST results from the source case, cases may begin therapy. The same six-month treatment plan is used for EPTB as for PTB. It is essential to obtain a DRTB diagnosis before beginning second line therapy. For some patients, a shorter Bedaquiline-based MDRTB therapy may be an option.

Study populations:

The research comprised diagnosis, patients with treatment, treatment results and legible record in the TB registration book. The research did not include patients who were referred from locations other than the study sites.

Sample size and sampling Procedure:

There are 12 health centres and one general hospital in the Srikakulam district. Patients with tuberculosis were treated at these medical facilities from January 2018 to December 2022. After then, all of these patients whose data had been finished were included, and we also regarded incomplete data as lost to follow-up.

Data Collection Procedure:

A structured data extraction form was created to collect information on demographic traits and clinically pertinent data. To get the data, the TB patient registration record books were utilised. In the TB clinic, data were gathered by research assistants with training. The demographic (gender, age) and clinical (TB diagnosis type, TB type, TB category, features of TB patients, and treatment outcomes) data that was collected contained these details.

Variables:

The dependent variables were TB treatment outcomes, and the independent variables were type of TB, category of TB, presumptive TB Examinations and patient categorization

Data Processing and Data Analysis

The Nikshay site was used to enter each participant's data, which was then extracted as Excel data and exported to SPSS version 21 for analysis. Frequency, percentage, mean, and standard deviation were among the descriptive statistics used to summarise the patients' clinical and sociodemographic characteristics. To assess statistical significance, a p-value of 0.05 with a 95% confidence interval (CI) was employed. However, the P-value is not noteworthy for a number of reasons.

Operational Definitions

The WHO standards for 2021, the National TB Control Program standard definitions, and the TB treatment outcomes reporting system all made use of the following definitions.

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By the national policy

Cured: A person starts therapy with TB regimen and he was proven by microbiology and finished the duration of treatment.

Treatment completed: A person with TB recommended treatment, but the outcomes did not meet the standards for recovery or treatment completed.

Treatment failure: A person with tuberculosis (TB) whose regimen has to be discontinued or permanently changed.

Died: A tuberculosis patient who died for any cause, either while or before to receiving treatment.

Lost to follow-up: A TB person whose treatment has been stopped for eight weeks or more after starting at least four weeks earlier, or who has not started therapy.

Not evaluated: A tuberculosis case with no documented therapy outcome exists. This covers circumstances in which the case has been moved to another treatment institution and circumstances in which the reporting unit is uncertain of the course of treatment.

New patients: Individuals with tuberculosis who are either newly initiating anti-TB medication therapy or have never received TB therapy. New patients may present with disease in any part of the body and with positive or negative bacteriology.

Successful treatment outcome: When tuberculosis patients completed their treatment and were cured that is, when they had a concluding negative smear microscopy at the conclusion for their therapy and on a minimum of one previous subsequent test, they were considered cured.

Unsuccessful treatment outcome: Tuberculosis (TB) patients, who were either ceased regimen medicine for less than six months after registering, underwent therapy but remained smear positive after five months, or had passed away.

Diagnosis tools

Year	Notifications	Microscopy	Chest X Ray	CB NAAT	Truenat	Tru nat MT B Rif	others
2018	3041	1173	565	463	5		835
2019	3202	152	756	656	1193	41	404
2020	1788	95	391	420	527	29	328
2021	2810	48	532	288	1166	39	737
2022	3173	25	696	456	999	32	965

Table 1: Different diagnostic tools for identifying the TB Disease

In the laboratory we did the laboratory methods to identify the TB disease

1. chest X ray the most common chest Xray view is the posterior anterior view, which shows your chest from the front and back. This is usually enough for a doctor to identify TB on an Xray. Still, they may also request a lateral Xray, which shows your chest from the side, to help confirm a diagnosis.

2. Sputum Smear Microscopy it is the cornerstone of TB diagnosis. In this sputum samples under a microscope to detect acid-fast bacilli (AFB). This method is simple, inexpensive, and widely accessible, but its sensitivity is relatively low, particularly in HIV positive patients and in cases of EPTB.

Molecular Diagnostic Methods

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5. Nucleic Acid Amplification Tests (NAATs): NAATs, such as the GeneXpert MTB/RIF test, have transformed tuberculosis (TB) diagnostics by offering rifampicin resistance and TB quick and precise identification in a matter of hours. According to studies, the GeneXpert MTB/RIF assay may identify pulmonary TB with an 88% sensitivity and 99% specificity.

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Year	5	4	2018	2022	2020.00	1.581
Notifications	5	1414	1788	3202	2802.80	588.009
Microscopy	5	1148	25	1173	298.60	491.217
chestxray	5	365	391	756	588.00	143.494
CBNAAT	5	368	288	656	456.60	131.878
TrueNAAT	5	1188	5	1193	778.00	507.971
TRNAATMTB RIF	5	41	0	41	28.20	16.514
Valid N (listwise)	5					

Table 2: SPSS Descriptive statistics results for Diagnostic tools

Descriptive Statistics Analysis

The descriptive statistics provided in the second image summarize the key measures for each diagnostic method, confirming our previous calculations. Range Indicates the spread of the data for each diagnostic method. Minimum and Maximum Show the lowest and highest values observed for each method. Mean Provides the average number of cases for each diagnostic method. Standard Deviation Measures the variability or dispersion of the data.

With the new descriptive statistics, we can validate and extend our previous interpretations Notifications Range 1414, Minimum 1788 (in 2020), Maximum 3202 (in 2019), Mean 2802.8, Standard Deviation 588.009. **Variability**: High standard deviations for variables like microscopy and True NAAT suggest significant changes or inconsistencies in the number of tests performed over the years. **Trends**: The mean values provide a central tendency of the data, useful for identifying general trends or patterns in the data. **Range**: A wide range in values indicates a substantial difference between the highest and lowest observations, highlighting variability in test numbers year to year. The descriptive statistics provide a snapshot of the dataset, highlighting central tendencies and variability. This analysis is crucial for understanding the distribution and spread of data, and it serves as a foundation for more complex statistical analyses.

Graphical Representation

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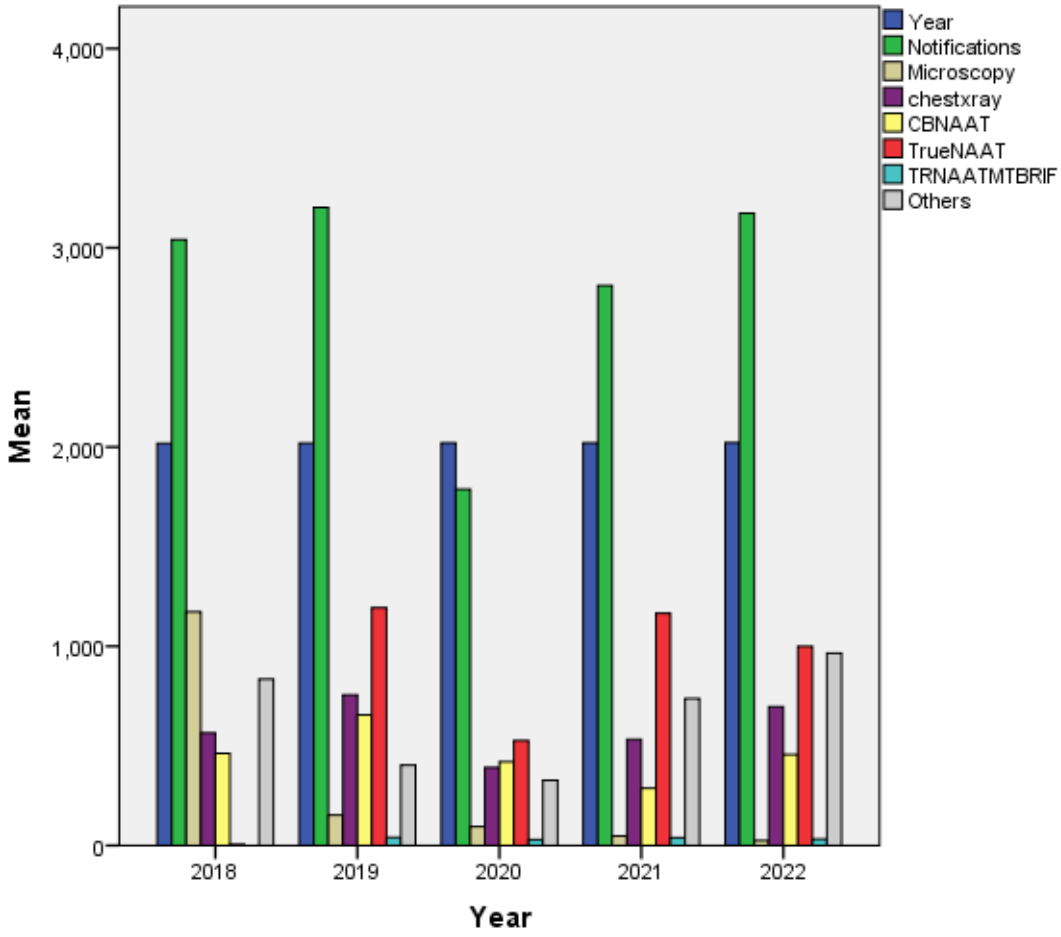

Figure 1: clustered bar chart for diagnosis results year wise

The bar chart provided visually confirms the trends observed in the descriptive statistics. It effectively shows the rise and fall in the use of different diagnostic methods over the years.

Treatment and regimen

All Oral Longer MDR TB Regimen (OMDR)IP Only 18-20 Months					
s.no	name of the drug	16-29kg	30-45kg	46-70kg	above 70kg
1	C Clofazimine(Cfz)	50mg	100mg	100mg	200mg
2	C Cyclocerine(Cs)	250mg	500mg	750mg	1000mg
3	L Levofloxacin(Lfx)	250mg	750mg	1000mg	1000mg
4	L Linezolid(Lzd)#	300mg	600mg	600mg	600mg
5	Pyridoxoine(X)	50mg	100mg	100mg	100mg
6	Bedaquiline(Bdq)	First 6 months only (400mg daily for weeks), Remaining 22 weeks 200 md per day like weekly thrice			
#Reduce Lzd to 300mg/day after 6 to 8 months					

All Oral H Mono poly DRTB Regimen

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s.no	name of the drug	16-29kg	30- 45kg	46- 70kg	above 70kg
1	TAB.LEVOFLOXACIN	250MG	750MG	1000MG	1000MG
2	CAR.RIFAMPICIN	300MG	450MG	600MG	600MG
3	TAB.ETHAMBUTOL	400MG	800MG	1200MG	1600MG
4	TAB.PYRAZINAMIDE	750MG	1250MG	1750MG	2000MG
5	TAB.PYRIDOXINE	50MG	100MG	100MG	100MG
DURATION:6 MONTHS					

All oral Longer XDR TB Regimen					
s.no	Name of the drug	16-29kg	30-45kg	46-70kg	above 70kg
1	TAB.MOXIOFLOXACIN Hiht dose(mfx)	40MG	600MG	800MG	800MG
2	TAB.LINEZOLID(Lzd)	300MG	600MG	600MG	600MG
3	CAP.CLOFAZIMINE(Cfz)	50MG	100MG	100MG	200MG
4	CAP.CYCLOSERINE(Cs)	250MG	500MG	750MG	1000MG
5	TAB.PYRIDOXINE(Pdx)	50MG	100MG	100MG	100MG
6	TAB.BEDAQUININ(Bdq)	Week 1&2:Bdq400MG Week 3&4:Bdq 200MG 3 times per week			

Shorter MDR Regimen					
s.no	name of the drug	16-29kg	30- 45kg	46- 70kg	above 70kg
1	TAB.ETHAMBUTOL	400MG	800MG	1200MG	1600MG
2	TAB.PYRAZIAMAIDE	750MG	1250MG	1750MG	2000MG
3	CAP.CLOFAZIMINE	50MG	100MG	100MG	200MG
4	TAB.MOXIFLOXACINE(h)	400MG	600MG	800MG	800MG
5	TAB.PYRIDOXINE	50MG	100MG	100MG	100MG
6	TAB.ETHIONAMIDE	375MG	500MG	750MG	1000MG
7	**INJ AMIKACIN**	**500MG**	750MG	750MG	1000MG
8	TAB.ISONIAZIDE	300MG	600MG	900MG	900MG
IP ----- $- 6 MONTHS (Mfxh KM/Am, Eto ZCfz, Hh E) CP --- 5 MONTHS (Mfxh, Cfz Z, E					

All oral Longer MDR TB Regimen (OMDR)IP Only 18-20 Months					
s.no	name of the drug	16-29kg	30- 45kg	46- 70kg	above 70kg
1	HIGH DOSE ISONIAZIDE(H)	300MG	600MG	900MG	900MG
2	ETHAMBUTOL€	400MG	800MG	1200MG	1600MG
3	PYRAZINAMYDE(Z)	750MG	1250MG	1750MG	2000MG

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4	LEVOFLOXACIN(Lfx)	250MG	750MG	1000MG	1000MG
5	BEDAQUILINE(Bdq)	WEEK 0-2Bdq 400MG DAILY,WEEK 3-24 Bdq 300 MG 3 TIMES PER WEEK			
6	CLOFAZIMINE(Cfz)	50MG	100MG	100MG	200MG
7	**ETHIONAMIDE(Eto)**	**375MG**	500MG	750MG	1000MG
8	PYRIDOXINE(Pdx)	50MG	100MG	100MG	100MG

FOLLOWUPS					
SMEAR	CULTURE				
3,4(5,6)	3,6,9				

Table 3: Treatment regimen for DS TB and DR TB

Tuberculosis (TB) Treatment Regimens

When diagnosed with tuberculosis (TB), it's important to understand the treatment plan to ensure a full recovery and prevent the development of drug resistant TB. Here's a simple explanation of the different TB regimens you might encounter

Follow-up Procedures: Regular follow-ups are essential to monitor your progress and make any necessary adjustments to your treatment. Sputum Smear Microscopy Checking for TB bacteria in your sputum. Sputum Culture Growing the bacteria in a lab to confirm infection and check for drug resistance. Drug Sensitivity Testing (DST) Determining which drugs the TB bacteria are sensitive to. Clinical Evaluation Regular checkups to monitor your health and any side effects. Radiological Examination (Chest Xray) To visualize changes in your lungs and assess the treatment's impact.

Importance of Adhering to TB Treatment: Complete Cure Ensures all TB bacteria are killed. Prevent Resistance Reduces the risk of developing drug resistant TB. Reduce Spread Decreases the risk of spreading TB to others. Monitor Side Effects Helps manage any side effects from the medications.

Treatment outcome

year	population	Presumptive TB Exams	notifications	cured	Treatment complete	loss to follow up	Treatment failure	died	Treatment regimen change
2018	2319061	14687	3041	1307	1523	156	10	90	42
2019	2329853	19870	3202	1367	1538	50	4	124	29
2020	2339423	37844	1788	603	985	14	9	86	31
2021	2343183	35819	2810	1181	1409	10	6	86	53
2022	2350262	37530	3173	718	934	3	2	62	27

Table 4: Treatment outcome after treatment

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation

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Population	5	2319061	2350262	2336356.40	12153.161
Presumptive TB Examinations	5	14687	37844	29150.00	11017.967
TBNotifications	5	1788	3202	2802.80	588.009
Cured	5	603	1367	1035.20	350.940
Treatmentcomplete	5	934	1538	1277.80	295.369
Losstofollowup	5	3	156	46.60	63.803
TreatmentFailure	5	2	10	6.20	3.347
Died	5	62	124	89.60	22.199
Regimenchange	5	27	53	36.40	10.945
Valid N (listwise)	5				

Table 4: SPSS Treatment outcome descriptive statistics

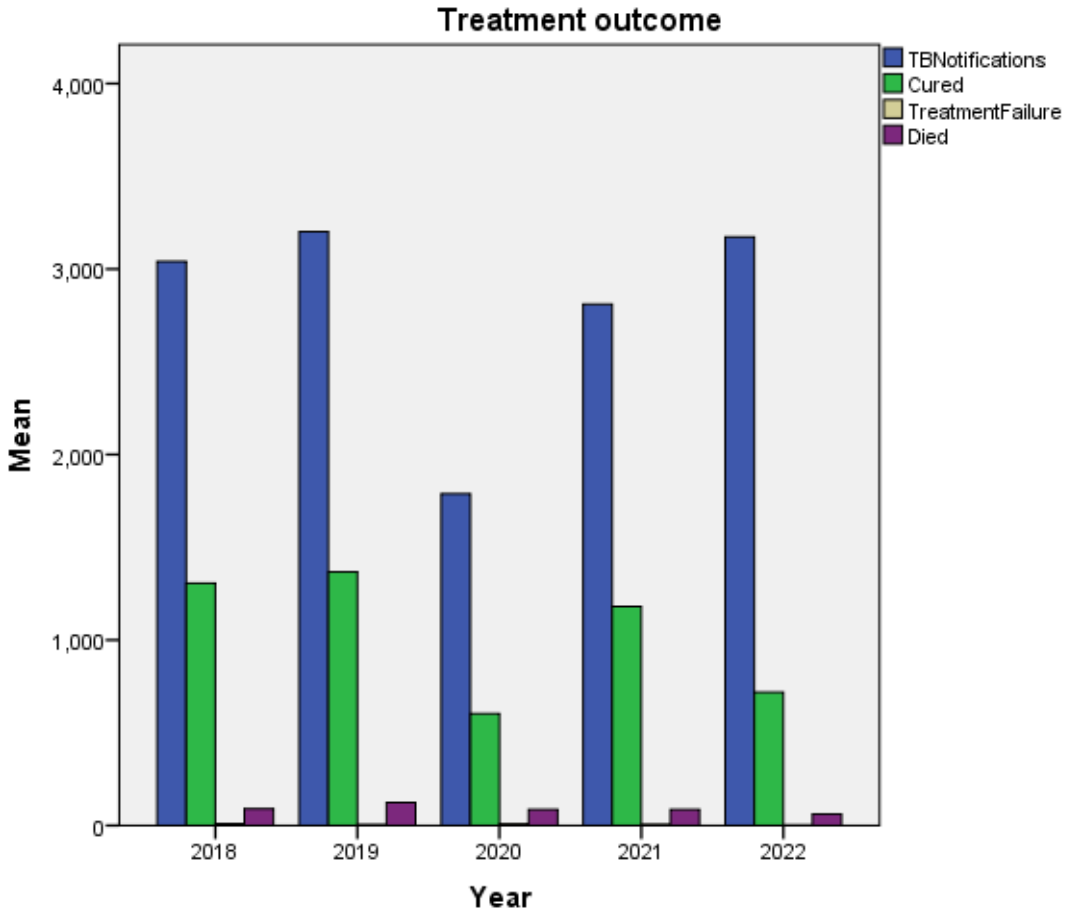

Figure 2: TB Treatment outcome after regimen applied

Descriptive Statistics

Table Interpretation: The table presents key statistical measures for various indicators related to TB treatment outcomes over five years (20182022).

Population The number of people considered for the study each year. Mean 2,336,356.40, Standard Deviation 12,153.16, Indicates a fairly stable population size with slight year to year variations.

Presumptive TB Examinations The number of people examined annually for TB, mean

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29,150, Standard Deviation 11,017.97, Shows an increasing trend, indicating more screenings over time.
TB Notifications The number of TB cases notified each year. Mean 2,802.80, Standard Deviation 588.00 Reflects variations with peaks in 2019 and 2022.
Cured Number of patients cured each year. Mean 1,035.20, Standard Deviation 350.94, Indicates a decrease over the years, with a significant drop in 2022.
Treatment Complete Number of patients who completed their treatment. Mean 1,277.80, Standard Deviation 295.36, Also shows a decreasing trend, with the lowest in 2022.
Loss to Follow-up Number of patients lost to follow-up. Mean 46.60, Standard Deviation 56.98, Shows a decrease, indicating better follow-up in recent years.
Treatment Failure Number of treatment failures. Mean 6.40, Standard Deviation 3.34, Relatively stable with slight variations.
Died Number of deaths during treatment. Mean 89.60, Standard Deviation 22.19, Indicates a decline in deaths over the years.
Regimen Change Number of treatment regimen changes. Mean 36.40, Standard Deviation 10.95, Shows some fluctuations, but generally stable.

Graph Interpretation
TB Notifications The blue bars show fluctuations, with a noticeable dip in 2020 likely due to the COVID19 pandemic. Cured The green bars show a decreasing trend, with a significant drop in 2022. Treatment Failure The purple bars remain relatively low and stable. Died The red bars indicate a decline in deaths over the years.

Regression analysis

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.629[a]	.396	.195	314.940

a. Predictors (Constant), TB Notifications

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	195075.576	1	195075.576	1.967	.255[b]
	Residual	297561.224	3	99187.075		
	Total	492636.800	4			

a. Dependent Variable Cured
b. Predictors (Constant), TB Notifications

Table 5: SPSS Regression analysis for treatment outcomes

Regression Analysis
The provided SPSS output contains results from a linear regression analysis examining the connection between number of deaths (independent variable) and the number of cured TB cases (dependent variable).
This indicates that the independent variable is "Died," and the dependent variable is "Cured."
Model Summary: R 0.684, R Square (R^2) 0.468, Adjusted R Square 0.290, Standard Error of the Estimate 295.689

Annals of R.S.C.B., ISSN: 1583-6258, Vol. 28, Issue 1, 2024, Pages. 266 – 281

Received 30 July 2024; Accepted 15 August 2024.

Interpretation There is a moderate to strong positive connection (R = 0.684) between the number of healed patients and the number of fatalities. With a coefficient of determination (R2) of 0.468, the number of deaths accounts for around 46.8% of the variation in the number of healed cases.
Adjusted R Square 0.290 adjusts the R^2 value for the number of predictors in the model, suggesting that the model explains about 29.0% of the variance in cured cases, after accounting for the number of predictors.
ANOVA (Analysis of Variance) Sum of Squares (Regression) 230,340.864, Sum of Squares (Residual) 262,295.936, Sum of Squares (Total) 492,636.800, Degrees of Freedom (df) 1 for regression, 3 for residual
Mean Square (Regression) 230,340.864, Mean Square (Residual) 87,431.979, F value 2.635, Significance (p value) 0.203
According to the p value of 0.203 and the F value of 2.635, the model is not statistically significant at the 0.05 level. This means we cannot confidently say that the number of deaths has a significant effect on the number of cured cases based on this data.
Coefficients: Unstandardized Coefficients (B) Constant 66.636, Died 10.810, Standard Error, Constant 611.206, Died 6.660, Standardized Coefficients (Beta), Died 0.684, t value, Constant 0.109, Died 1.623, Significance (p value), Constant 0.920, Died 0.203
Constant The value 66.636 indicates the expected number of cured cases when the number of deaths is zero. However, its high p value (0.920) suggests it is not statistically significant.
Died The coefficient 10.810 suggests that for each additional death, the number of cured cases is expected to increase by 10.810, but this relationship is not statistically significant (p-value = 0.203). As the p – value is more than 0.05, the deviation from null hypothesis is not significant, which the null hypothesis is not rejected. As per the collected data there is 20% probability due to loss of data at the time of COVID-19.

Results and Discussion

The analysis reveals significant insights into the diagnostic methods used over the years
Shift from Microscopy The decline in microscopy usage suggests a shift towards more advanced diagnostic methods, reflecting improvements in diagnostic technology.
Pandemic Impact The dip in notifications in 2020 underscores the impact of the COVID19 pandemic on diagnostic activities.
Adoption of Advanced Methods The increase in the use of Truenat MTB indicates a growing preference for advanced diagnostic tools.
Variable Usage of Other Methods The variability in the "Others" category suggests a dynamic diagnostic landscape, adapting to different needs and conditions.
1. Trends in TB Notifications and Examinations: There is an increasing trend in presumptive TB examinations, reflecting improved screening efforts.
TB notifications fluctuate, with a notable decrease in 2020, likely impacted by the pandemic.
2. Treatment Outcomes: Both the number of cured patients and those completing treatment show a declining trend. This could be due to various factors such as increased treatment complexity, drug resistance, or patient adherence issues. The number of patients lost to follow-up has decreased, indicating better patient tracking and follow-up mechanisms. Treatment failures remain low, suggesting effective treatment regimens for most patients.
3. Mortality The number of deaths has decreased over the years, which is a positive outcome. This might be due to better treatment protocols, improved healthcare services, or early detection and management.
4. Regimen Changes: The number of regimen changes has remained relatively stable,

Annals of R.S.C.B., ISSN: 1583-6258, Vol. 28, Issue 1, 2024, Pages. 266 – 281

Received 30 July 2024; Accepted 15 August 2024.

indicating that most patients are likely receiving appropriate initial treatments.

The regression analysis aimed to explore the relationship between the number of deaths and the number of cured TB cases. While the correlation coefficient (R) indicates a moderate to strong positive relationship, the results are not statistically significant. This suggests that other factors not included in this model may play a significant role in influencing the number of cured TB cases.

Moderate to Strong Positive Correlation There is a moderate to strong positive correlation between the number of deaths and cured cases, but it is not strong enough to be statistically significant.

Moderate Explained Variance The model explains about 29.0% of the variance in cured cases, indicating that other variables might be influencing the outcome.

Nonsignificant Predictors The p-values for both the constant and the number of deaths is above 0.05, suggesting that neither has a significant impact on the number of cured cases in this model.

Interpretation

Notifications: The number of TB notifications peaks in 2019 (3202) and 2022 (3173). This trend because of associated with enhanced surveillance and better diagnostic methods during these years, leading to more detected and reported cases. The decreased cases in 2020 (1788) due to the impact of the COVID-19 pandemic, which strained healthcare resources and disrupted TB services globally.

Cure Rate: The cure rate is consistent at 43% in 2018 and 2019, suggesting effective TB management during these years. However, there is a notable decline in the cure rate to 34% in 2020 and further to 23% in 2022. This decline cure rates indicates COVID-19 pandemic and the potential challenges in treatment adherence, drug resistance, or health service disruptions.

Mortality Rate: The number of deaths fluctuates, with the highest mortality in 2019 (124) and the lowest in 2022 (62). The mortality rate peaks at 5% in 2020, likely due to the compounded effects of the COVID-19 pandemic on TB patients. The decrease in the death rate to 2% in 2022 suggests improvements in TB management and possibly the adaptation of health services to post-pandemic conditions.

Population Impact: Despite the increasing population, the TB notification rates and cure rates reflect the health system's performance and TB control measures' effectiveness. The data suggests that while the population grows, TB control efforts need to adapt continuously to meet new challenges.

Conclusion

The data analysis provides valuable insights into the evolving diagnostic practices. The shift towards advanced diagnostic methods and the impact of external factors like the pandemic are clearly evident. These insights can inform future strategies for improving diagnostic approaches and healthcare planning.

TB treatment requires patience and strict adherence to the prescribed regimen. Regular follow-ups with your healthcare provider are crucial for a successful recovery. If you have any questions or experience any side effects, contact your healthcare provider immediately.

The analysis of TB treatment outcomes from 2018 to 2022 highlights several key points

Improved Screening There has been a significant increase in the number of presumptive TB examinations, reflecting enhanced screening and detection efforts.

Fluctuating Notifications TB notifications have varied over the years, with a noticeable impact from the COVID19 pandemic.

Decreasing Cure and Completion Rates The decline in the number of cured patients and those completing treatment is concerning and may require further investigation into underlying causes.
Better Follow-up The reduction in loss to follow-up cases suggests improved patient management and tracking systems.
Stable Treatment Failures and Mortality Low treatment failure rates and decreasing mortality indicate effective treatment regimens and healthcare services.
These findings can guide healthcare providers and policymakers in enhancing TB treatment strategies, improving patient adherence, and addressing any barriers to successful treatment outcomes.
The regression analysis reveals that while there is a moderate to strong positive correlation between the number of deaths and the number of cured cases, this relationship is not statistically significant. This implies that other factors, potentially including patient adherence to treatment, quality of healthcare services, or socioeconomic factors, may significantly influence treatment outcomes.

1. TB Control Challenges: The variability in notifications, cure rates, and death rates over the years highlights ongoing challenges in TB control, including the impact of external factors like the COVID-19 pandemic.
2. Declining Cure Rates: The significant decline in cure rates from 43% in 2018-2019 to 23% in 2022 is concerning and indicates a need for enhanced treatment strategies and patient support systems.
3. Mortality Trends: The fluctuation in mortality rates suggests variability in TB case severity and healthcare quality. The reduction in mortality rates by 2022 is a positive sign, indicating possible improvements in TB care.
4. Future Directions: Strengthening Healthcare Systems: Continuous investment in healthcare infrastructure and human resources is essential to manage TB effectively, especially in the face of external disruptions.
Enhancing Treatment Adherence: Strategies to improve treatment adherence and manage drug resistance are crucial to improving cure rates.
Integrated Health Approaches: Integrating TB control programs with other healthcare services can ensure a more resilient health system capable of handling multiple public health threats.
In conclusion, while there have been some positive trends, such as decreasing mortality rates, the overall decline in cure rates and fluctuating notification rates call for sustained and adaptive TB control efforts. Enhanced diagnostics, improved treatment protocols, and robust healthcare infrastructure are essential to achieve better TB outcomes in the future.

Acknowledgments: Our sincere gratitude towards the staff, Department of Tuberculosis, RIMS Hospital, Srikakulam.

- **No conflicts of interest**

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