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Research Article.

Efficacy and Determinant Factors of Linezolid Containing Regimens in the Treatment of DR - TB Patients at Saint Peter Specialized Hospital, Addis Ababa, Ethiopia, 2023 A Retrospective Study

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Abstract

Background: A synthetic oxazolidinone antimicrobial medication called Linezolid is used to treat patients who are resistant to multiple drugs. Few studies have been done regarding the effectiveness of Linezolid-containing regimens in both developing and developed nations. This study aimed to determine the Efficacy and determinant factors of linezolid-containing regimens in the treatment of DR - TB Patients. Methods: An institution-based cross-sectional study design was conducted using SPSS version 26, and multivariable binary logistic regression analysis was used. Result: out of 345 patients that visited the outpatient clinic, 205 (59.4%) were males, and 126(36.5%) were between 30-39 years. MDR TB Patients' linezolid-containing regimen treatment efficacy success rate is 280(81.2%). MDR TB Patient Previously Treated TB by First Line Drug [AOR= 5.823(3.761-7.341)]. MDR TB Patient Previously Treated TB by First Line and treatment completed [AOR=2.351(1.34-3.214))], the adverse effect [AOR 0.842(0.674-2.431], tolerability of linezolid [AOR =2.543(2.41-4.532)] was significantly associated with linezolid containing regimen treatment efficacy rate. Conclusion: Linezolid-containing regimens have good efficacy and good treatment outcomes for DR-TB patients. The findings showed that Linezolid is a good choice for treating DR-TB, although patients ought to be monitored closely for the incidence of adverse effects.

Keywords

Multidrug Resistance, TB, linezolid, Efficacy, Tolerability Safety, Addis Ababa, Ethiopia

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1. Introduction

The bacterium M. tuberculosis is the cause of TB, an infectious disease that typically affects the lungs. It spreads through the Air when infected people sneeze, cough, or spit. TB is present in all countries and age groups and is curable and preventable. Over 80% of deaths from TB occurred in low—and middle-income countries. [1, 2].

Multidrug resistance emerges when TB medicines are used inappropriately. The most successful TB medications are first-line medications; MDR - TB is a type of TB caused by bacteria that do not react to isoniazid and rifampicin. According to WHO When one or more anti-TB medications fail to eradicate the organism (mycobacterium tuberculosis), TB is deemed drug-resistant (DR). And a lab test known as the drug susceptibility test (DST) can verify this. [3, 4]. Drug-resistant TB continues to be a serious public health issue in many nations and poses a danger to worldwide TB care and prevention. The Global TB Report 2022 estimates that 10.6 million people are estimated to have fallen ill with TB in 2022. [2, 5]. An projected 1.6 million TB fatalities occurred in 2021, with 1.4 million deaths among HIV-negative individuals and 187,000 deaths among HIV-positive individuals. In 2021, MDR/RR-TB was expected to be present in 3.6% of new TB cases and 18% of TB cases that had already received treatment worldwide. It was anticipated that 450,000 incident MDR/RR-TB cases have emerged overall in 2021. [1, 6]

With an expected yearly TB incidence of 119 per 100,000 people and a death rate of 16 per 100,000 people in 2021, Ethiopia is one of the 30 countries with the highest TB and TB-HIV burden. The country has transitioned out of the list of the high burden countries for MDR/RR-TB in 2020. An estimated 1.1% of these new TB cases and 7.5% of previously treated TB cases had drug-resistant TB in 2021 and an estimated 1800 MDR/RR-TB cases emerging in 2021. [2]

As we see in the above context still prevalence of TB, and DR-TB is specially in resource-limited countries in Africa including our country many studies have been done and focus on the determinants of the case still problem continue, in the world researchers trying to dig out or to create crucial main solution for elimination of TB and preventing of DR if possible yet they still lack enough budget to study the drug's efficacy safety and tolerability Since DR-TB drugs are very costly in many African countries get this medication by donors. The DR-TB patients cannot afford the DR drug payment for treatment. [6, 7]

Linezolid is a synthetic oxazolidinone antimicrobial drug. it is indicated for gram-positive infection and approved for the treatment of bacterial pneumonia, skin and skin structure infection, VRE infection, and infections complicated by bacteremia. Linezolid does not have approval for treatment of gram-negative infection or catheter-related bloodstream infection. is one of the drugs currently used for MDR treatment [8, 9] Yet the Linezolid-containing regimens treatment efficacy on MDR patients has not been studied in our country setup. Because of its effectiveness against resistance strains and its distinct mode of action, which is not well known, linezolid has become an essential part of the therapy of DR-TB.

This study aims to thoroughly assess the evidences currently available on DR-TB patients Linezolid containing regimens treatment efficacy and determinant factors on DR-TB patients.

2. Methods

2.1. Study Area and Period

The study was conducted in Addis Ababa the capital city of Ethiopia, covering an area of 210 km^2 with a population of 3,384,569 according to the 2007 census. [10]. At an elevation of 7,546 feet (2,300 meters), Addis Ababa is divided into 10 sub-cities, each of which contains 328 Kebeles and 10–12 Woredas. [1, 4, 6, 11-17].

The study was conducted at the 1953-founded Saint Peter Hospital. Ethiopia's Federal Ministry of Health (FMoH) is in charge of overseeing it. It became the first national hospital in Ethiopia to treat DR-TB in April 2009. It functioned as a center of excellence and training. This facility treats patients who travel from all around the country.

Data collection, entry, and analysis, report writing will be from April to May 2023.

The required sample size can be determined by using a single population formula response of DR-TB patients is 50% taken since no previous study.

Level of significance =0.05

Marginal Error (d) = 5%

n =sample size

Z (α/2) = Z-score at 95% confidence interval=1.96

Q=1-p

Non-response rate =10%

The formula for calculating (n) is

$$n = \frac{(Z\ (\alpha/2)2\ P\ x\ (1-P)}{d^2} = \frac{(1.96) \times (1.96) \times 0.5(1-0.5)}{(0.05)^2} = 384$$

So calculated is n= 384

$$n = \frac{no}{(1+\frac{p}{N})}$$

Where: n is the final sample size, no is calculated value=284, and N is the total population=3500 And the sample size was 262.6 then after adding a 31.6 % contingency rate the final sample size was 345, with the proportional allocation of sample sizes. The sampling interval was calculated based on the total number of patients seen over the study period. In this research, the probability sampling method was used for quantitative data. By using simple random sampling (lottery

method) the patient chart will be selected. Every third patient was questioned until the necessary sample size was reached, and participants were chosen at random from the sampling interval. Data retrieved or collected between November 1, 2015, and February 30, 2023, was selected by a simple random sampling technique.

2.2. Data Collection Procedure

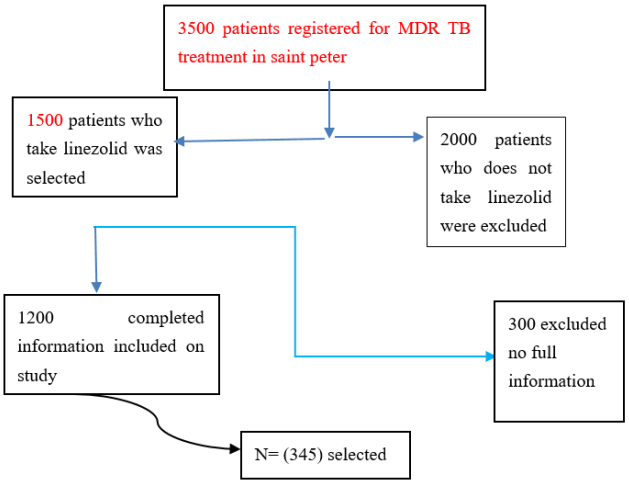

Figure 1. *Shows Data Collection Procedure of MDR TB Patients' linezolid-containing regimen.*

2.3. Eligibility Criteria

2.3.1. Inclusion Criteria

DR-TB Patients Charts from EMR of who are taking or treated by linezolid for DR-TB and complete treatment regimen treated in Saint Peter Specialized Hospital are Included in the study.

2.3.2. Exclusion Criteria

DR-TB patients who are not treated by linezolid due to contraindications during the study period. Incomplete information from DR-TB patients or no follow-up information.

2.4. Study Variables

2.4.1. Dependent Variable

Linezolid containing regimens treatment efficacy.

2.4.2. Independent Variables

Socio-demographic characteristics: Age in year, marital status, educational level, Occupational status, Weight, Height), Complication or Adverse events other drugs comorbid disease patient status or medical condition (DM, HIV, HTN…), and nutritional status.

2.5. Operational Definition

Linezolid: The World Health Organization (WHO) has reclassified it as a Group A medicine for the treatment of extensively drug-resistant tuberculosis (XDR-TB) and multi-drug-resistant tuberculosis (MDR-TB), indicating that it should be part of the regimen for all patients unless there is a contraindication. The ideal dosage and duration of linezolid administration are yet unknown, and there is a significant risk of toxicity. The majority of the evidence included in current guidelines comes from observational non-comparative studies. [18]

According to WHO guidelines [1, 2]

1) Cured: From MDR/RR-TB those who completed treatment within 18 months to over 2 Years, followed by at least two negative sputum cultures
2) Completed treatment -those patients who completed the anti-TB regimen for at least 18 Months
3) Death-patient who died during treatment whatever the cause
4) Failed treatment- smear-positive patients who remained positive at the fifth month of Treatment or smear-negative turning positive
5) Lost to follow-up- treated patients who did not come back to complete chemotherapy and there was no evidence of cure through the sputum result during the fifth month of therapy
6) Successful treatment outcome-patients meeting the definition of cure or treatment completed.
7) Poor treatment outcome- refers to patients meeting the definition of death, lost to follow-up, and treatment failure.
8) Treatment Efficacy of linezolid-containing regimen is measured as Successful treatment outcome and Poor treatment outcome.

2.6. Data Collection Tools, Techniques, Data Management, and Analysis

Before the actual data collection, at ALERT hospital the questionnaire was pre-tested or run through 30 patient charts (5% of the total sample size) to make sure the questions were fair, well-written, and capable of gathering important data. Skilled researchers assessed the modified checklist. The lead investigator verified and reviewed the questionnaire to assess the completeness and consistency of the data.

A pre-tested outcome aids in determining how well the tool gathers the necessary data from research participants.

The principal investigator spent a day training supervisors and data collectors on the study's objectives, interviewing techniques, maintaining information confidentiality, and other fundamental data collection concepts. The tool used to collect the data was created in English. Its consistency was examined.

At the end of each day, supervisors verified that the questionnaire was complete, and the researcher, also known as the

primary investigator, double-checked it. The statistical program SPSS Version 26, which is utilized for all statistical analysis in these investigations, was used to evaluate the quantitative data after it had been entered and cleared using Epi-info version 7.1. An odd ratio with a 95% confidence interval was competing to assess the presence and degree of association between the dependent and independent variables.

A logistic regression model with a p-value <0.05 was considered to identify predictors of linezolid. Significant factors were determined using crude and adjusted odds ratios with 95% confidence intervals. To assess the association between the different predictor variables with the dependent variables, first bivariate relationships between each independent variable and outcome variables will be investigated using a binary logistic regression model. Those independent variables with p-value < 0.02 by Hosmers and Lemeshows rule at the bivariate level were included in a multivariate logistic regression model to control potential confounding factors. After adjusting their effect on the outcome variables, those variables with a p-value < 0.05 with a 95% confidence interval were regarded as significant determinant factors.

3. Results

3.1. Sociodemographic and Baseline Characteristics

205 (59.4%) of the study participants were men out of the total number of responders. With a mean age of 34 +8.1SD years, the participants ranged in age from 20 to 65. Of the responders, 126 (36.5%) were primarily between the ages of 30 and 39, while 23 (7.5%) were older than 50. In terms of the participants' marital status, 167 (48.4%) were married, 65 (18.8%) were single, 80 (23.2%) were divorced, and 33 (9.6%) were widowed. (Table 1).

Table 1. *Socio-demographic characteristics of the Efficacy and determinant factors of linezolid-containing regimens in the treatment of DR-TB Patients 2023(N=345), 2023.*

Variables	Variables categories	Frequency	Percentage (%)
SEX	Male	205	59.4
	female	140	40.6
AGE	20-29	94	27.2
	30-39	126	36.5
	40-49	99	28.7
	50-65	26	7.5
BODY MASS INDEX	<18.5	223	64.6
	18.5-24.9	86	24.9
	>25	36	10.4
Education	diploma	124	35.9
	degree	49	14.2
	MSC	49	14.2
	Other	123	35.7
Marital Status	single	65	18.8
	married	167	48.4
	widowed	33	9.6
	divorced	80	23.2

3.2. DR-TB Patients Linezolid Containing Regimen Treatment Efficacy on Determinant Factors

According to this study, 97 (28.1%) participants have HIV status of reactive, 66(40.0 %%) are short treatment regimen, 268 (77.7%) participants were previously treated by TB first-line drug, 241 (69.9%) Directly Acquired DR-TB and 186(53.9%) Rifampicin Resistance to drugs profiles. 102(29.6%) Adverse effect, 276(80%) < 5-month time to culture conversion in months. as shown in (Table 2).

Table 2. *The efficacy and determinant factors of linezolid-containing regimens in the treatment of DR-TB Patients 2023 (N=345).*

Variables	Variables categories	Frequency	Percentage (%)
HIV status of the patient	non-reactive	248	71.9
	reactive	97	28.1
Treatment regimen	long	207	60.0
	short	138	40.0
Previously treated by TB first-line drug	Yes	268	77.7%
	No	77	22.3
IF YES (n=268)	Treatment	210	60.9%
	Completed	58	16.8%
	Interrupted		
Directly Acquired MDR	YES	241	69.9%
	NO	104	30.1
Patient resistance to drug profiles	Rifampicin Resistance	186	53.9
	MDR	111	32.2
	HR	21	6.1
	Pre XDR and XDR Patient	27	7.8
Time to culture conversion in months	<5 MONTH	276	80.0
	5-7 MONTH	69	20.0
Adverse effect (AE)	YES	102	29.6
	NO	243	70.4
IF YES(n=102)	Minor side effect	84	24.3%
	Major side effect	18	5.2
Linezolid due to AE	DISCONTINUED	12	3.5
	CONTINUED	70	20.3
	REINITIATED	20	5.8%
If Linezolid Discontinued(N=12)	Permanently	2	0.6%
	Temporarily	10	2.9%
IF YES, Nausea and vomiting(n=102)	Yes	72	20.9%
	no	30	8.7
IF YES, thrombocytopenia SE(n=102)	Yes	30	8.7%
If Yes, Polyneuropathy SE(n=102)	No	72	20.9
IF YES, anemia(n=102)	Yes	31	9.0%

Variables	Variables categories	Frequency	Percentage (%)
nutritional status	No	71	20.6%
	Yes	92	26.7%
	No	10	2.9%
	SAM	122	35.4%
	MAM	163	47.2
	NORMAL	60	17.4

According to this study, 48 (13.9%) After starting DR-TB treatment including linezolid treatment interruption, 150(43.5%) are comorbid disease, 90(26.1%) Taking the additional drug for linezolid AE Treatment, 280 (81.2%) success rate (cured and completed) and 291(84.3%) Well tolerated of linezolid. 139(40.3%) Individualized DR-TB treatment of linezolid treatment as shown in (Table 3).

Table 3. *The efficacy and determinant factors of linezolid-containing regimens in the treatment of DR TB Patients 2023 (N=345).*

Variables	Variables categories	Frequency	Percentage (%)
After starting MDR treatment including linezolid treatment interruption	Yes	48	13.9
	no	297	86.1
comorbid disease	Yes	150	43.5%
	no	195	56.5
If yes	DM	39	11.3%
	HTN	28	8.1%
	HIV	66	19.1%
	CARDIA DISEASE	17	4.9%
Taking the additional drug for linezolid AE Treatment	Yes	90	26.1
	no	60	17.4
Treatment outcome with linezolid AND OTHER MDR DRUGS	CURED	195	56.5%
	COMPLETED	84	24.3%
	FAILED	26	7.5%%
	DEATH2	18	5.2%%
	lost follow up	22	6.4%%
Linezolid related death	no	345	100
linezolid efficacy	success rate (cured and completed)	280	81.2
	poor treatment outcome (failed, death, and lost follow-up)	65	18.8
Tolerability of linezolid	well, tolerated	291	84.3
	not welltolerated	54	15.7
dosing and Duration of linezolid treatment	Short regimen	192	55.7
	Individualized MDR TB treatment	139	40.3

Variables	Variables categories	Frequency	Percentage (%)
	Long MDR TB treatment	14	4.1

3.3. Prevalence of DR-TB Patients' Linezolid-Containing Regimen Efficacy

The prevalence of DR-TB patients' linezolid-containing regimen efficacy among the total study participants was (81.2%). (Figure 2).

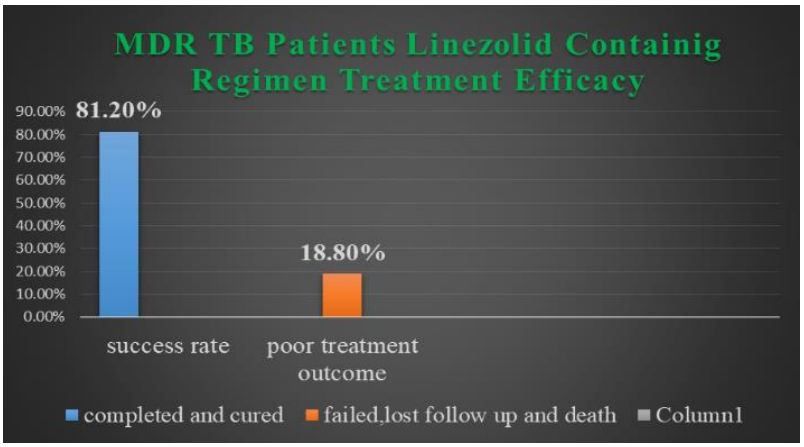

Figure 2. *The Efficacy and determinant factors of linezolid-containing regimens in the treatment of DR-TB Patients 2023.*

3.4. *Socio*-demographic Correlation with DR-TB Patients Linezolid Efficacy Success Rate

Table 4. *Shows a relationship between the socio-demographic status of DR-TB Patient's Linezolid efficacy Success Rate in Addis Ababa Ethiopia 2023 (N=345).*

Variables	Variables categories	Linezolid Efficacy Success Rate		Total
		RT success rate (cured and completed)	poor treatment outcome (failed, death, and lost follow-up)	
SEX	Male	182	23	205
	female	98	42	140
AGE	20-29	70	24	94
	30-39	109	17	126
	40-49	82	17	99
	50-65	19	7	26
BODY MASS INDEX	<18.5	182	41	223
	18.5-24.9	69	17	86
	>25	29	7	36
Education	diploma	101	23	124
	degree	40	9	49
	MSC	39	10	49
	Other	100	23	123

Variables	Variables categories	Linezolid Efficacy Success Rate		Total
		RT success rate (cured and completed)	poor treatment outcome (failed, death, and lost follow-up)	
Marital Status	single	52	13	65
	married	137	30	167
	widowed	27	6	33
	divorced	64	16	80

3.5. Linezolid Efficacy Success Rate with Independent Variables Correlation

Table 5. *Shows a relationship between Linezolid efficacy Success Rate or status of DR-TB Patients linezolid containing regimen treatment efficacy in Addis Ababa Ethiopia 2023 (N=345).*

Variables	Variables categories	Linezolid Efficacy Success Rate		Total
		RT success rate (cured and completed)	poor treatment outcome (failed, death, and lost follow-up)	
HIV status of the patient E	Male	182	23	205
	female	98	42	140
Treatment Regimen	<18.5	182	41	223
	18.5-24.9	69	17	86
	>25	29	7	36
Previously Treated TB By First Line Drug	diploma	101	23	124
	degree	40	9	49
	MSC	39	10	49
	Other	100	23	123
IF YES(N=268)	single	52	13	65
	married	137	30	167
	widowed	27	6	33
	divorced	64	16	80
Directly Acquired MDR	YES	195	46	241
	NO	85	19	104
Patient Resistance To Drugs Profiles	Rifampicin Resistance	148	38	186
	MDR	92	19	111
	HR	17	4	21
	Pre XDR and XDR Patient	23	4	27
Time To Culture Conversion In Months	<5 Month	222	54	27
	5-7 Month	58	11	69
Adverse Effect(AE)	Yes	71	31	10
	no	209	34	24

Variables	Variables categories	Linezolid Efficacy Success Rate		Total
		RT success rate (cured and completed)	poor treatment outcome (failed, death, and lost follow-up)	
If Yes	Minor sideefect	70	14	84
	Majorside effect	14	4	18
IF YES, Nausea and vomiting	Yes	60	12	72
	No	24	6	30
IF YES, thrombocytopenia SE	Yes	25	5	30
	No	59	13	72
If yes, Polyneuropathy SE	Yes	25	6	31
	No	59	12	71
IF YES, anemia	Yes	75	17	92
	No	9	1	10
Linezolid Due To AE	Discontinued	10	2	12
	Continued	58	12	70
	Reinitiated	16	14	20
If Linezolid Discontinued(N=12)	Permanently	2	0	2
	temporarly	8	2	10
Nutritional Status	Sam	98	24	122
	Mam	133	30	163
	Normal	49	11	60

3.6. Linezolid Efficacy Success Rate with Independent Variables Correlation with Treatment Outcome

Table 6. *Shows a relationship between Linezolid efficacy Success Rate or status of DR-TB Patients linezolid containing regimen treatment efficacy in Addis Ababa Ethiopia 2023 (N=345).*

Variables	Variables categories	Linezolid Efficacy Success Rate		Total
		RT success rate (cured and completed)	poor treatment outcome (failed, death, and lost follow-up)	
Side effect (SE)	Yes	71	31	102
	No	209	34	243
After starting MDR treatment including linezolid treatment interruption	Yes	38	10	48
	No	242	55	297
COMORBID DISEASE	Yes	121	29	150
	No	159	36	195
If yes	DM	32	7	39
	HTN	23	5	28
	HIV	55	11	66

Variables	Variables categories	Linezolid Efficacy Success Rate		Total
		RT success rate (cured and completed)	poor treatment outcome (failed, death, and lost follow-up)	
Taking the additional drug for linezolid AE treatment	CARDIAC DISEASE	13	4	17
	Yes	74	16	90
	no	49	11	60
Treatment outcome with linezolid and other MDR drugs	cured	160	35	195
	completed	67	17	84
	failed	21	5	26
	death	15	3	18
	lost follow up	17	5	22
linezolid related death	no	0	0	0
Tolerability of linezolid	well tolerated	252	39	291
	not well tolerated	28	26	54
dosing and Duration of linezolid treatment	Short regimen	170	22	192
	Individualized MDR TB treatment	97	42	139
	Long MDR TB treatment	13	1	14

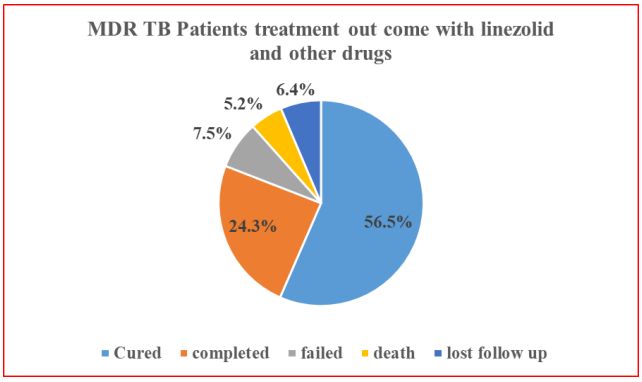

Figure 3. *DR-TB treatment outcome with DR-TB patient's linezolid containing regimen treatment efficacy on Addis Ababa Ethiopia 2023.*

3.7. Factors Associated Linezolid Containing Regimen Treatment Efficacy

In the bivariate analysis, the association between baseline variables and factors of DR-TB patient linezolid-containing regimens treatment efficacy was analyzed using a logistic regression model. In the bi-variable logistic regression model; Sex Tolerability of Linezolid, Treatment Regimen, Previously Treated TB by First Line drug, and Adverse Effect of Those variables with P-value < 0.25 in Bi-variable were included in multivariable logistic regression analysis. In the multivariable logistic regression model, four variables; i.e. DR-TB Patient Previously Treated TB by First Line drug, DR-TB Patient Previously Treated TB by First Line drug and treatment completed, adverse effect, tolerability of linezolid were significantly associated with DR-TB patient linezolid containing regimens treatment efficacy (< 0.05). The result of the multivariable analysis revealed that the odds of patients who were Previously Treated TB by First Line drug had 5.823 times more likely higher Linezolid efficacy Success Rate [AOR= 5.823(3.761-7.341)]. The odds of patients who were DR-TB patients previously Treated TB by First Line drug and treatment completed efficacy had 2.351 times more likely higher Linezolid efficacy Success Rate 2.351 (1.34-3.214))].

The odds of DR-TB patient who harmed linezolid-containing regimens before the first TB case had 84% less likely Linezolid efficacy Success Rate as compared to other DR-TB patients who had no adverse effects or DR-TB patients who had adverse effects had there is a potential increased risk of negative outcome compared to patients on other treatment regimen [AOR 0.842 (0.674-2.431]. The odds of DR-TB patient linezolid containing regimens treatment efficacy who tolerability linezolid had 2.543 times more likely to increase Linezolid efficacy Success Rate as compared to DR-TB patients who had [AOR =2.543

(2.41-4.532)].

Table 7. *Shows Multivariable analysis of factors affecting MDR Tb patient linezolid containing regimens treatment efficacy and determinant factors at saint peter specialized hospitals Addis Ababa, Ethiopia 2023.*

Variables	Variable Categories	Linezolid Efficacy		COR (95%CI)	AOR(95%CI)	p-value
		Success Rate	Poor Treatment Outcome			
Previously Treated TB By First Line	Yes	168	39	3.268(1.829-5.840) *	5.823(3.761-7.341) **	0.000
	No	112	26			
If yes	treatment completed	230	38	1.000(.576-1.735) *	2.351(1.34-3.214) **	0.000
	Interrupted	50	27			
Adverse Effect	Yes	71	31	0.373(0.214-0.650) *	0.842(0.674-2.431) **	0.000
	No	209	34			
Tolerability of linezolid	Well tolerated	252	39	1.670(1.287-2.168) *	2.543(2.41-4.532) **	0.000
	Not well tolerated	28	26			

Note: ** statistically significant

4. Discussion

This study evaluates the efficacy of linezolid-containing regimens for treating drug-resistant tuberculosis (DR-TB) among adults aged 18 and older in public hospitals in Addis Ababa. An analysis of 403 patient charts revealed a non-response rate of only 4%, with an overall treatment efficacy of 81.2% (280 patients). These findings suggest that linezolid is not only effective but also generally safe and well-tolerated for short-term use. [19].

The results align with previous research, such as a study conducted by the FDA, which make linezolid to be the first member of a novel class of oxazolidinone-based antibacterial drugs. Furthermore, a study in West China reported a clinical success rate of 280 (82.2%). [20] Among intensive care unit patients, reinforcing the positive outcomes associated with linezolid treatment. Conversely, a systematic review and meta-analysis indicated a lower treatment success rate of 77.36% [18]. Highlight how variations in study design and methodology can significantly impact results.

In our study, 92(26.7%) of patients developed anemia, consistent with findings from a global review that ranked anemia as the most common side effect of linezolid treatment, affecting 23(44.2%) of patients in sub-Saharan Africa. [5]. This similarity may stem from comparable methodologies and patient populations. Moreover, out of the 102 patients (29.6%) who experienced side effects, only 12(0.6%) had to permanently discontinue treatment. This is notably lower than the 21% discontinuation rate reported in a South African study [19]. Which attributed toxicity as a significant factor. The lack of correlation between HIV co-infection and linezolid toxicity in our study suggests differences in patient demographics and methodologies.

Crucially, our results show that the likelihood of a successful course of treatment is 2.54 times higher for patients who tolerate linezolid. The safety and effectiveness of linezolid in treating DR-TB are further supported by a research conducted in Vietnam. [21, 22]. In conclusion, this study highlights the promising role of linezolid in treating DR-TB, while also emphasizing the need for careful monitoring of side effects to optimize patient outcomes. The evidence suggests that with appropriate management, linezolid can be a valuable tool in the battle against multidrug-resistant tuberculosis.

Limitation

The absence of prior studies in the field is one of the limitation and linezolid concentration and volume of distribution on plasma or plasma samples not collected and recorded on the EMR tracker (patient chart).

5. Conclusion

This study overall DR-TB patient linezolid-containing regimens treatment efficacy was very high and The findings from the multivariable logistic regression analysis highlight critical factors influencing the efficacy of linezolid-containing regimens in DR-TB patients. Notably, a history of prior treatment with first-line TB drugs significantly increases the likelihood of treatment success. Conversely, the presence of

adverse effects reduces the efficacy of linezolid, indicating a need for careful patient monitoring. Additionally, improving tolerability can further enhance treatment outcomes. These insights underscore the importance of personalized treatment strategies and the need for ongoing support for patients undergoing DR-TB treatment. Implementing the recommendations outlined above can contribute to improved patient care and outcomes in this challenging population.

Abbreviations

AAHB	Addis Ababa Health Bureau.
ACCR	Addis Ababa Cancer Registry
CCM	Critical Care Medicine
DM	Diabetes Mellitus
EMR	Electronic Medical Record
GDP	Gross Domestic Products
HAIs	hospital-acquired Infections
ICU	Intensive Care Unit (ICU)
MDR	Multiple Drug Resistance
MOH	Ministry of Health
OPD	Out Patient Department
PI	Principal Investigator
SPSS	Statically Package for Social Science
TB	Tuberculosis
U.S.A	United States of America
WHO	World Health Organization

Declarations

Ethics Approval and Consent

Saint Peter Specialized Hospital's institutional review committee granted ethical clearance. A formal letter was sent to the hospital's IRB, and secrecy was guaranteed. By leaving out, Strict Confidentiality was preserved. making use of non-identifiable data and restricting access to it to authorized personnel only. The study did not impact participants in accordance with institutional and national rules, safeguarding patient anonymity and care quality. The research design prevented participants from experiencing any negative effects or additional risks.

Consent for Publication

Not relevant.

Author Contributions

The study was developed and designed by Abdurehman Seid Mohammed, who also wrote a review and edited the first draft, created the study design, checked the quality of the data, conducted the statistical analysis, and authored the first draft of the article Chekole Sileshi Menbere and Abdurehman Seid Mohammed helped with the paper revision, statistical analysis, conceptualization, and literature review. The original document was examined and edited, and the text was rewritten by Dr. Mustofa Hassen Yesuf, Chekole Sileshi Menbere, and Getachew Mekete Diress, who also helped with the conception and research design. Dr. Mustofa Hassen Yesuf, Getachew Mekete and Abdurehman Seid helped with the idea, updated the data extraction sheet, gathered patient information, examined and analyzed the information, and made revisions to the text.

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Data Availability Statement

The corresponding author can provide the datasets used and analyzed in this study upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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