Open Access Research Article

Drug Resistant Profile among the Pulmonary Tuberculosis Patients at Waled General Hospital, Cirebon Regency, Indonesia

Desy Syafira Santoso[1*], Dwi Rosa Eka Agustina[2], Nihayatul Amaliyah[3]

1. Faculty of Medicine, Universitas Swadaya Gunung Jati, Indonesia (45132);
2. Department of Pulmonology and Respiratory Medicine, Faculty of Medicine Universitas Swadaya Gunung Jati, Indonesia (45132);
3. Department of Internal Medicine, Faculty of Medicine, Universitas Swadaya Gunung Jati, Indonesia (45132).

***Corresponding author's e-mail**: **desysyafiras17@gmail.com**
DOI: 10.35898/ghmj-831236

ABSTRACT

Background: Tuberculosis (TB) is an infectious bacterial disease caused by Mycobacterium tuberculosis, most commonly affecting the lungs. Drug Resistance Tuberculosis (DR-TB) is a TB disease resistant to one or more anti-tuberculosis drugs. In a global report in 2022, Indonesia ranked 5th for the burden of drug-resistant tuberculosis (DR-TB), and in the tuberculosis information system (SITB) data in West Java is one of the provinces with TB-RO case finding coverage that exceeds the national target with a percentage of 78%.

Aim: To determine the profile of drug-resistant pulmonary tuberculosis patients at Waled General Hospital, Cirebon Regency between 2022 and 2023.

Methods: This study used a retrospective descriptive method. Sampling was done using a total sampling technique, and a sample of 43 respondents was obtained. Data were collected through medical records and tuberculosis information system (SITB) and then analyzed by univariate statistics without comparisons or association tests.

Results: Based on socio-demographic characteristics, the majority of patients aged 46-55 years were 12(27.9%), patients with the most gender were male totaling 29(67.4%), patients with the most recent education were elementary school and high school had the same number of 15(34.9%), most patients' occupations were working at 32(74.4%). The most common classification of DR-TB is MDR-TB, totaling 35(81.4%), the history of previous tuberculosis treatment is mostly new patients at 18(41.3%), and most patients do not have comorbidities totaling 19(44.2%).

Conclusion: The profile of patients with DR-TB based on socio-demographics at Waled General Hospital, Cirebon between 2022 and 2023 is mainly aged 19-59 years with the most gender is male, the last education of elementary and high school has the same number, most patients work. Most patients with previous TB treatment histories were new, and most did not have comorbidities. A comprehensive approach to DR-TB control should incorporate; public education on treatment adherence, enhanced case management and surveillance, and consistent application of molecular diagnostics. Such measures may effectively decrease DR-TB prevalence and associated mortality. This study further highlights the importance of TB awareness and environmental hygiene in Indonesia's ongoing TB elimination efforts.

Keywords: *Drug Resistant Pulmonary Tuberculosis (DR-TB); Patient Profile; MDR-TB prevalence; Comorbidities.*
Received: 22 June 2025 **Reviewed:** 10 July 2025 **Revised:** 06 October 2025 **Accepted:** 28 October 2025.

1. Introduction

Based on the World Health Organization (WHO) definition, Tuberculosis (TB) is an infectious bacterial disease caused by *Mycobacterium tuberculosis,* which most commonly affects the lungs (Almaini & Sutriyanti, 2022). This disease is transmitted from person to person. The symptoms of tuberculosis are cough, chest pain, malaise, weight loss, and sweating at night. The infection often causes no symptoms in healthy people because the immune system responds to block bacteria (Aini & Rufia, 2019).

Drug resistance tuberculosis (DR-TB) is tuberculosis disease resistance to one or more anti-tuberculosis drugs, according to the result of standardized laboratory tests. Mtb resistance arises from spontaneous chromosomal mutations. However, the proportion of Mtb bacteria that have undergone mutation (wild-type resistant mutants) leads to reduced drug accumulation in the bacteria or drug inactivation. Types of drug resistance tuberculosis are monoresistant tuberculosis, polyresistant tuberculosis, multi-drug resistance tuberculosis(MDR-TB), *pre-Extensively Drug Resistant tuberculosis* (preXDR-TB), *Extensively Drug-Resistant tuberculosis* (XDR-TB) (Al Qarni Bayan, 2022; Anderson, et al, 2022; Kementerian kesehatan Indonesia, 2020; Khawbung, Nath & Chakraborty, 2021).

MDR-TB occurs when Mycobacterium tuberculosis becomes resistant to at least two of the most effective first-line anti-TB drugs, isoniazid and rifampicin. Non-adherence to TB treatment dramatically increases the risk of developing MDR-TB, often due to the prolonged treatment duration, leading patients to discontinue their medication prematurely. Patients may also seek treatment from multiple providers due to a perceived lack of progress, and side effects from the medication further discourage adherence. These factors contribute to the widespread resistance of TB to anti-TB drugs, or MDR (Aristiana & Wartono, 2018; Maksum, et al, 2018).

Based on the *World Health Organization* (WHO) estimate, Indonesia ranks 2nd with the highest tuberculosis burden. It was estimated that in 2021, the TB incidence rate would be 354 per 100,000 population, and the incidence rate of Multi Drug Resistant tuberculosis (MDR-TB) would be 10 per 100,000 population (Aini & Rufia, 2019; Bakhtiar, et al, 2021). Based on the 2018 Riskesda Report data, the number of TB cases in Indonesia reached 1.017.290 cases, with the number of cases in West Java province totaling 186.809, then continued with the 2018 West Java Riskesda data, the number of cases based on TB treatment in Cirebon district and city reached 3.758 (Almaini & Sutriyanti, 2022; Sulaiman, et al, 2018).

According to the Global Report 2022, Indonesia is ranked 5th for the burden of drug-resistant tuberculosis (DR-TB) in 2021 with an estimated 28.000 cases of drug resistance tuberculosis (DR-TB), representing 2.4% of all new TB patients and 13% of treated TB patients with a total estimated incidence according to Riskesda 2018, and screening of new bacteriologically confirmed cases for drug resistance tuberculosis (DR-TB) increased from 16% in 2017 to 33% in 2018 (Sulaiman, et al, 2018; Damayanti, et al, 2022; Fachri et al, 2021). Based on data from the tuberculosis information system (SITB) as of March 2023, West Java is one of the provinces with drug resistance tuberculosis (DR-TB) case finding coverage that exceeds the national target with a percentage of 78% (Fachri et al, 2021).

The main reason why researchers want to take this is simply that drug resistance tuberculosis (DR-TB) cases are still increasing in Indonesia, and most cases in Indonesia are MDR-TB cases and there are still few journals that discuss drug resistance tuberculosis (DR-TB) patients, then the high gap in treatment of drug resistance tuberculosis (DR-TB) patients is that the available drug resistance tuberculosis (DR-TB) service health facilities are not proportional to the number of patients, then drug resistance tuberculosis (DR-TB) patients who are not diagnosed or patients die before starting treatment and the lack of information about drug resistance tuberculosis (DR-TB) in the community (Almaini & Sutriyanti, 2022; Sulaiman, et al, 2018). This study discusses the patient profile in terms of age, gender, educational level, and occupation, as well as clinical characteristics including chest X-rays, comorbidities, previous TB treatment history, and TB-RO. The importance of information about drug resistance tuberculosis (DR-TB) to be used as knowledge to the community as a background for the interest researchers to conduct research on the profile of drug-resistant pulmonary tuberculosis patients at Waled General Hospital between 2022 and 2023.

Table 1. Operational Definition

Variables	Definition	Tools	Method	Scale
Socio-demographic characteristics				
Age	Age is the increase in years, months, and dates of birth experienced by all living things since birth, grouped by the Ministry of Health.	Medical Records and SITB	1. 17-25 years old 2. 26-35 years old 3. 36-45 years old 4. 46-55 years old 5. 56-65 years old 6. ≥65 years old	Nominal
Gender	Biological differences that are classified based on differences in form, nature, and function.	Medical Records and SITB	1. Male 2. Female	Nominal
Educational Attainment	The process of changing attitudes based on levels of knowledge. Classification is based on Law No. 20 of 2003 of the Republic of Indonesia.	Medical Records and SITB	1. Not in school 2. Elementary School 3. Junior High School 4. Senior High school 5. College	Ordinal
Occupation	A task performed to be able to fulfill the basic needs and goals of human life.	Medical Records and SITB	1. work 2. not work	Nominal
Types of comorbidities	Comorbidities that have been diagnosed before the diagnosis of TB-RO and can worsen the condition of TB-RO patients based on the results of supporting examinations.	Medical Records and SITB	number of comorbidities 1. no comorbidities 2. 1 comorbidities 3. >1 comorbidities type of comorbidities 1. DM 2. Anemia 3. Hypertension 4. Depression 5. CHD (anterior myocardial infarction, suspected lateral infarction of lead 1, suspected anterior infarction of V2, possible lead 1, ST elevation) 6. Heart Rhythm Abnormalities (CLBBB, AV block, AF) 7. Cardiac morphologic abnormalities (right axis deviation, LAE, RVH, LAH)	Ordinal
Previous TB Treatment History	Records contained in medical records to determine previous TB treatment.	Medical Records and SITB	1. New Case 2. TB cases who received OAT treatment >1 month - Relapse Cases - Treatment Failure Cases - Loss to Follow Up Cases 3. Cases with unknown Treatment History	Nominal
DR-TB	TB patients who are resistant to one or more OAT and there are several classifications that have been diagnosed.	Medical Records and SITB	1. Monoresistant (one type of first-line OAT) 2. Polyresistant (>1 type of OAT other than isoniazid and rifampicin) 3. MDR-TB (isoniazid and rifampicin) 4. PreXDR-TB (isoniazid, rifampicin, fluoroquinolone/second-line OAT) 5. XDR-TB (isoniazid, rifampicin and second-line OAT) Nominal	Nominal

2. Methods

The study design used in this research is retrospective descriptive, with a total sample of 43 respondents taken from medical records as secondary data and the Tuberculosis Information System (SITB) at the pulmonary clinic of Waled General Hospital. The sampling method employed was total sampling. The data collected comprised information on drug-resistant tuberculosis (DR-TB) patients treated at Waled General Hospital from January 2022 to December 2023. Inclusion criteria for this study encompassed medical records and SITB data from patients diagnosed with DR-TB at the pulmonary clinic who were over 17 years old and had confirmed bacteriological results (positive acid-fast bacilli (AFB) and GeneXpert MTB/RIF). Exclusion criteria included samples with incomplete medical records, such as missing patient identification details or insufficient ancillary examination results.

Measurements

The study variables included socio-demographic characteristics, types of DR-TB, comorbidities, and prior TB treatment history. Data were extracted from medical records and the SITB at the pulmonary clinic of Waled General Hospital, Cirebon city, Indonesia, from January 2022 to December 2023. Data collection involved the retrieval of sociodemographic characteristics, such as age, gender, educational attainment, occupation, types of comorbidities, types of DR-TB, and prior TB treatment history. These were then processed following the inclusion and exclusion criteria established for the study, there was no inferential test because the purpose was descriptive.

Statistical techniques

Data analysis was conducted using univariate analysis to describe the sociodemographic characteristics (age, gender, education level, and occupation), types of TB-RO, comorbid conditions, and prior TB treatment history at Waled General Hospital from January 2022 to december 2023. In this study, there was no inferential test because the purpose was descriptive.

Ethical clearance

This study had received ethical clearance from the Ethics Committee of Waled General Hospital, Cirebon Regency, under reference number 000.9.2/066/KEPK/V/2024. As ethical considerations in this study, the researcher believes that respondents are protected by applying two ethical principles, namely: Confidentiality; maintaining the confidentiality of respondents because this study does not include names, Justice: in this study, the researcher took a total sample so that all samples had the same opportunity to become respondents.

3. *Results*

Respondent characteristics

This study was conducted in 2024 at Waled General Hospital, a government-owned type B regional hospital in Cirebon Regency, West Java. Waled General Hospital provides various services, including outpatient and inpatient care, an emergency department, medical support services, numerous clinics, medical rehabilitation, a pharmacy, and a blood bank. The sample consisted of 43 patients, based on medical records and SITB data from the pulmonary clinic at RSUD Waled. These patients, diagnosed with DR-TB, were over 17 years old and had confirmed bacteriological results (positive BTA and TCM). The analysis captured characteristics such as age, gender, education, and occupation of the patients.

As shown in Table 2, the largest age group of DR-TB patients was 46–55 years (27.9%), representing the early elderly and most economically active population. This indicated that DR-TB primarily affected individuals in their productive years, which might have influenced national workforce productivity. Male patients predominated (67.4%), supporting global evidence that men had higher TB exposure due to occupational and behavioral factors such as smoking or outdoor work. Educationally, both elementary and high-school graduates had the same proportion (34.9%), reflecting limited health literacy that could have affected treatment adherence. Additionally, 74.4% of respondents were employed, which might have contributed to inconsistent medication adherence

because of work-related time constraints. These findings highlighted the demographic segments most vulnerable to DR-TB and suggested targeted interventions through workplace and community education.

Table 2. Frequency Distribution of Socio-demographic Characteristics

Variable	n	%
Age		
17-25	9	20.9
26-35	6	14.0
36-45	7	16.3
46-55	12	27.9
56-65	6	14.0
≥65	3	7.0
Sex		
Male	29	67.4
Female	14	32.6
Education		
Elementary	15	34.9
Middle School	8	18.6
High School	15	34.9
Higher Education	2	4.7
Occupation		
Employed	32	74.4
Unemployed	11	25.6
Total	43	100.0

Notation: n = Total, % = Percentage

At Table 3 below, it shows that 41.3% of patients were new TB cases, followed by those with unknown treatment histories (18.6%) and loss-to-follow-up cases (16.3%). The predominance of new cases suggested a growing trend of primary resistance, in which patients had been infected with drug-resistant strains rather than had developed resistance through poor adherence. This finding implied that there was ongoing community transmission of resistant Mycobacterium tuberculosis strains and emphasized the urgent need for stronger infection control and early detection strategies.

In addition, comorbidity analysis showed that 44.2% of patients had no comorbidities, while 30.2% had one and 25.6% had more than one comorbidity. Among specific comorbidities, anemia (17.8%) was the most prevalent, followed by cardiac morphological abnormalities (14.3%), coronary heart disease (9.0%), and arrhythmia (5.4%). The high rate of anemia indicated possible nutritional deficiencies or adverse effects from anti-TB drugs, both of which might have impaired immune response and delayed recovery. Cardiac-related conditions suggested that DR-TB patients had been at risk for cardiovascular complications, potentially aggravated by second-line drugs such as fluoroquinolones that had prolonged the QT interval. These findings collectively underscored the importance of comprehensive evaluation and close monitoring of comorbidities and treatment histories to prevent interruption of therapy and poor clinical outcomes among DR-TB patients.

Table 4 indicated that MDR-TB was overwhelmingly the most common form (81.4%), whereas Pre-XDR and XDR-TB each accounted for 4.7% of cases, and mono-resistant TB accounted for 9.3%. The dominance of MDR-TB reflected persistent issues in treatment adherence and inadequate surveillance systems at the community level. This distribution was consistent with WHO reports, which had noted MDR-TB as the most prevalent resistance pattern globally and nationally. The small but concerning proportions of Pre-XDR and XDR-TB suggested a potential escalation of resistance to second-line drugs if proper control measures had not been implemented. These results reinforced the necessity of strengthening molecular diagnostic coverage and ensuring an uninterrupted drug supply to prevented further evolution of resistant TB strains.

Table 3. Frequency Distribution of Previous TB History and Comorbidities among DR-TB Patients

Variable	Category	n	%
Previous TB History	New Case	18	41.3
	TB Cases Treated with Anti-TB Drug >1 month		
	Relapsed	5	11.6
	Treatment Failure	5	11.6
	Loss to Follow-Up	7	16.3
	TB Cases with Unknown Treatment History	8	18.6
Comorbidities	No Comorbidities	19	44.2
	1 Comorbid	13	30.2
	>1 Comorbid	11	25.6
Types of Comorbidities	DM	4	7.1
	Anemia	10	17.8
	Hypertension	4	7.1
	Depression	3	5.4
	Coronary Heart Disease/CHD (Anterior Myocardial Infarction, Susp. Lateral Infarction (Lead I), Susp. Anterior Infarction (V2), Possible Inferior Infarction Lead 1, ST Elevation)	4	9.0
	Cardiac Arrhythmias (CLBBB/Complete left bundle branch block, AF/ Atrial Fibrillation, AV Block	3	5.4
	Cardiac Morphological/Structural Abnormalities (Right Axis Deviation, LAE/Left Atrial Enlargement, RVH/Right Ventricular Hypertrophy, LAH/Left Atrial Hypertrophy)	8	14.3
Total		43	100%

Table 4. Frequency Distribution of Types of DR-TB in Patients

Type TB-RO	**n**	**%**
Monoresistant TB	4	9.3
MDR-TB	35	81.4
PreXDR-TB	2	4.7
XDR-TB	2	4.7
Total	43	100.0

4. Discussion

This study revealed that the largest age group was between 46-55 years, comprising 12 individuals (27.9%), with only 3 patients (7.0%) over 65. The World Health Organization (WHO) estimates that approximately one-third of the global population has been infected with *Mycobacterium tuberculosis*. Around 75% of TB cases occur in the most economically productive age group (15-50 years) (Sulaiman et al., 2018). Working-age individuals are at higher risk of contracting tuberculosis (Reviono et al., 2014). The results of this study are consistent with the theory that in developing countries, TB infection predominantly affects those under 50 years of age. In contrast, in developed countries, TB prevalence is higher among older adults. This is partly due to the non-specific symptoms of TB in older adults, making it more challenging to diagnose, as well as the reactivation of dormant TB foci. Moreover, comorbid conditions that weaken cell-mediated immunity, such as malignancies, immunosuppressive drug use, and age-related immune decline, contribute to the increased TB prevalence in this demographic. Age is a predisposing factor

linked to behavioral changes associated with physical and psychological maturity in pulmonary TB patients (Fachri et al., 2021). The 15-59 year age group faces 5-6-fold greater pulmonary TB risk due to: (1) increased *M. tuberculosis* exposure through adult activities, and (2) high bacterial reactivation potential during peak productive years (Bakhtiar et al., 2021; Damayanti & Widada., 2022; Anderson et al., 2022).

The study found that the majority of patients were male, accounting for 29 individuals (67.4%), while females made up only 14 (32.6%). This finding aligns with a study conducted at Ulin Hospital in Banjarmasin between December 2015 and May 2016, which found that male patients outnumbered female patients by 5.3 times, with similar results for DR-TB cases (Al Qarni Bayan, 2022)**.** WHO report also indicates that the prevalence of tuberculosis was 1.7 times higher in men than in women. Beyond biological and sociocultural factors, men tend to have more exposure to external environments, which may increase their TB risk. Additionally, cigarette smoke can increase airway resistance and cause damage to the lungs, impairing macrophages, which play a crucial role in fighting bacteria. As the number of TB patients rises, there is a corresponding increase in the number of DR-TB cases (Al Qarni Bayan, 2022).

In terms of education, the study found that patients with elementary and high school education had the exact representation, with 15 individuals (34.9%) each. Patients with middle school education comprised 8 individuals (25.5%), while those with higher education had the lowest representation, at just 2 individuals (4.7%). Education empowers individuals to develop their potential in various domains, including spirituality, self-control, personality, intelligence, and skills, preparing them for active societal participation. Educational attainment influences the likelihood of contracting tuberculosis; the higher one's level of education, the greater the knowledge acquired, especially concerning preventive health measures. Individuals with higher education are more likely to engage actively with health-related information and maintain better health practices. Education enhances their ability to understand health topics and informs their attitudes and behaviors, shaped by factors such as experience, access to facilities, and education itself (Muhammad, 2019).

Regarding occupation, the study found that most patients were employed, with 32 individuals (74.4%) working, while 11 (25.6%) were unemployed. This finding is consistent with research by Bayan et al., which found that the majority of DR-TB patients were employed. Similarly, a study conducted at Urin Banjarmasin General Hospital showed that most pulmonary TB-DR patients were private-sector employees. Employment is closely related to income levels, and an individual's occupation can significantly impact their daily life, including access to nutritious food and healthcare. Individuals with lower incomes often struggle to meet their nutritional needs, making them more susceptible to contracting DR-TB (Al Qarni Bayan, 2022).

Types of DR-TB

The study reported that most patients (35 or 81.4%) were diagnosed with MDR-TB (Multidrug-Resistant Tuberculosis), a significant global challenge in TB eradication. According to the World Health Organization's (WHO) 2019 report, an estimated 9.96 million TB cases were recorded globally, with 465,000 of these classified as DR-TB. Of the estimated DR-TB cases, only 206,030 were identified, and 177,099 (86%) were treated, with a global treatment success rate of 57%. In the same year, it was estimated that 3.3% of new TB cases and 17.7% of previously treated TB cases were DR-TB (World Health Organization, 2018).

The prevalence of MDR-TB among new and previously treated cases in 2017 was 1.6% and 29%, respectively, in the Southeast Asia region. MDR-TB is particularly challenging to treat, requiring longer treatment durations, extended hospital stays, and less effective, more expensive drugs that often come with severe side effects (World Health Organization, 2018).

The dominance of multidrug-resistant tuberculosis (MDR-TB) observed in this study reflected similar patterns reported across Indonesia, indicating persistent challenges in treatment adherence and surveillance systems. These findings were consistent with the research of Marfuati et al. (2024), who found that patient knowledge and adherence behavior strongly influenced treatment outcomes among pulmonary TB patients in Cirebon, West Java. According to their study, poor understanding of medication schedules and fear of side effects had contributed to irregular drug intake, leading to acquired resistance.

In addition, genetic factors might have played a role in the emergence of drug resistance. A molecular study conducted in Cirebon by Oktaviyati, Pratamawati, and Nauphar (2025) reported that the TNF-α −308 G/A

polymorphism was associated with increased susceptibility to pulmonary TB infection, suggesting that host genetic variability could influence immune response to Mycobacterium tuberculosis. Their findings supported the need for personalized monitoring and host-directed therapy approaches in future DR-TB management.

Epidemiologically, the high proportion of new DR-TB cases in this study indicated active community transmission rather than resistance caused by poor adherence. This pattern aligned with the spatial analysis conducted by Puspita et al. (2022), who found that West Java province had one of the highest TB risk ratios in Indonesia between 2010 and 2019. The authors emphasized that population density and healthcare access disparities had contributed to the spread of resistant strains, reinforcing the importance of strengthening TB surveillance and preventive interventions in high-burden areas.

Comorbidity also played a crucial role in treatment outcomes. A study by Fatihah, Latief, and Herdwiyanti (2025) showed that diabetic TB patients at Waled Hospital did not present significant differences in chest lesion area compared to non-diabetic patients, implying that metabolic diseases might not change radiologic severity but could complicate clinical recovery. Likewise, Ayudhipasha, Herdwiyanti, and Sedayu (2025) demonstrated a positive correlation between antiretroviral therapy duration and renal function among HIV-positive patients in Cirebon, underscoring the importance of integrating HIV and DR-TB management programs to improve patient survival and reduce complications.

Socio-demographic factors also remained significant in shaping the epidemiological profile of DR-TB. Sulistyawati and Ramadhan (2021) identified male gender, smoking behavior, and low education as strong determinants of TB risk in urban Indonesia. These characteristics closely matched the demographic distribution observed in this study, where most DR-TB patients were working-age males with limited formal education. This similarity highlighted that socioeconomic status and health literacy continued to influence treatment adherence and clinical outcomes.

Overall, the present findings underscored the complexity of DR-TB epidemiology, where behavioral, genetic, and comorbid factors interacted to sustain transmission. Strengthening molecular diagnostic coverage, integrating TB–HIV–DM care, and improving public education and adherence support remained essential strategies to curb the progression of resistant TB strains at Waled Hospital and beyond.

Previous TB History in DR-TB Patients

In this study, the majority of DR-TB patients (18 or 41.3%) were classified as new TB cases. This finding aligns with Kusumandari et al.'s 2023 study, which reported that new cases were the most significant contributors to DR-TB. New DR-TB cases are classified as those newly diagnosed with TB and who have not been previously treated with anti-TB drugs or have been treated for less than one month. These patients are infected with drug-resistant strains of M. tuberculosis, referred to as primary resistance. Transmission from individuals with drug-resistant TB leads to new cases of primary resistance, ultimately driving the increase in MDR-TB cases (Kusumandari & Nawangsari., 2023).

Based on the treatment history, resistance to anti-tuberculosis drugs can occur due to improper use or management of the medication. Patients fail to complete the treatment as advised. Healthcare workers may prescribe inappropriate treatments in terms of dosage or duration of therapy. The unavailability of appropriate therapy drugs, irregular drug use by patients, repeated use of the same medication, and the lengthy treatment period often result in low patient compliance. Consequently, drug-resistant strains emerge. Additionally, factors such as patients' and families' knowledge about TB contribute to the rise in new cases of drug-resistant tuberculosis (DR-TB) (Aini & Rufia, 2019).

The increasing number of new multidrug-resistant tuberculosis (MDR-TB) cases serves as a warning because it will become dangerous if MDR-TB cases are dominated by new TB cases, indicating that more TB bacteria are becoming resistant. Resistant TB bacteria, with a higher risk of transmission, will pose a significant problem as they could lead to a sharp increase in MDR-TB cases. Furthermore, the morbidity and mortality rates among pulmonary TB patients will escalate as MDR-TB has more severe consequences compared to regular pulmonary TB. New patients are at a higher risk of developing MDR-TB, likely due to frequent close contact with MDR-TB patients, combined with a lack of understanding about transmission through shared items between individuals and patients. If both individuals and healthcare workers do not adequately control this transmission, it will significantly impact the increase in new MDR-TB cases (Purnamaningsih et al., 2018; Almaini & Sutriyanti, 2022).

Comorbidities in patients with drug-resistant tuberculosis (DR-TB)

In this study, based on the number of comorbidities, the majority of patients (19 individuals or 44.2%) had no comorbidities, while 13 patients (30.2%) had one comorbidity. Among the comorbidities, anemia was the most common, affecting 10 patients (17.8%).

Anemia is a significant public health concern that can make individuals more susceptible to various infectious diseases, including TB (Gelaw et al., 2021; Baluku et al., 2021; Adejumo et al., 2020). Several factors can cause anemia, including blood loss, impaired red blood cell production, and destruction of red blood cells. Anemia caused by the destruction of red blood cells is known as hemolytic anemia. Hemolytic anemia can be divided into two categories: anemia caused by factors within the red blood cells themselves and anemia caused by external factors. One of the external factors causing hemolytic anemia is drug-induced. Each anti-tuberculosis drug has side effects that can lead to toxic effects on the body. Isoniazid and rifampicin can cause hemolytic anemia through an immune-complex mechanism, where drug-antibody complexes bind to the red blood cell membrane, triggering complement activation and destroying red blood cells or hemolysis. These toxic effects can work synergistically to cause blood disorders, specifically anemia, in pulmonary TB patients (Thuraidah et al., 2017).

In treating drug-resistant tuberculosis (DR-TB), levofloxacin, which belongs to the fluoroquinolone class of antibiotics, is used. This drug has side effects on the heart's electrocardiogram (ECG), particularly by prolonging the QT interval and potentially inducing HERG inhibition. This can result in arrhythmias and myocardial infarction (heart attack). Arrhythmias, in this context, fall under the category of coronary heart disease (CHD) comorbidities. Fluoroquinolones are associated with prolonged ECG-derived corrected QT (QTc) intervals. The drug's effects on myocardial tissue are closely linked to the human ether-a-go-go-go-related gene (HERG), which codes for the heart's rapidly activating delayed rectifier potassium channel (IKr). Fluoroquinolones induce HERG/IKr inhibition and may cause QTc interval prolongation, potentially leading to arrhythmias and heart attacks. Studies on HERG inhibition by fluoroquinolones have shown that all types of fluoroquinolones have the potential to cause dose-dependent HERG blockade. Moxifloxacin poses the highest risk of causing QTc interval prolongation compared to gemifloxacin, ofloxacin, and levofloxacin, while ciprofloxacin presents the lowest risk (Raini, 2015; Mansur et al., 2021).

This research process has limitations and is not yet fully adequate, as several aspects require further improvement in future studies. The limitations of this study include its scope being limited to a single institution, a small sample size, the absence of outcome data, insufficient supporting data on factors influencing patient recovery, such as patient adherence to medication, family history of pulmonary tuberculosis, and the lack of data on nutritional status, lifestyle, and dietary patterns, which may provide a better explanation of patients' clinical conditions.

5. Conclusion

Based on socio-demographic characteristics, the majority of patients aged 46-55 years, patients with the most gender were male, patients with the most recent education were elementary school, and high school had the same number, and most patients' occupations were working. The most common classification of DR-TB is MDR-TB; the history of previous tuberculosis treatment is mostly new patients, and most patients do not have comorbidities. A comprehensive approach to DR-TB control should incorporate; public education on treatment adherence, enhanced case management and surveillance, and consistent application of molecular diagnostics. Such measures may effectively decrease DR-TB prevalence and associated mortality. This study highlights the importance of TB awareness and environmental hygiene in Indonesia's ongoing TB elimination efforts. Ubsequent studies may build upon this research through; adoption of distinct methodological approaches (such as case-control designs), incorporation of novel variables or analytical techniques, and mitigation of the limitations noted herein.

Conflict of Interest

The authors declare no conflicts of interest in the results.

References

Adejumo, O. A., Olusola-Faleye, B., Adepoju, V. A., Gidado, M., Onoh, M. O., Adegboye, O., Abdur-Razzaq, H., Moronfolu, O. & Shogbamimu, Y. (2020). The pattern of comorbidity and its prevalence among drug-resistant tuberculosis patients at treatment initiation in Lagos, Nigeria. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, *114*(6), 415-423. https://doi.org/10.1093/trstmh/trz126

Aini, Z. M., & Rufia, N. M. (2019). Karakteristik Penderita Tuberculosis Multidrug Resistant (TB MDR) di Sulawesi Tenggara Tahun 2014-2017. *Universitas Halu Oleo*. https://dx.doi.org/10.52689/higea.v13i2.388

Al Qarni Bayan, U. (2022). Karakteristik Pasien Tuberkulosis Resistan Obat Di RSUD Dr. H. Chasan Boesoirie. *Kieraha Medical Journal*, 4(2), 116–123. https://doi.org/10.33387/kmj.v4i2.4651

Almaini, A., & Sutriyanti, Y. (2022). Studi Kualitatif Perilaku Pengobatan Pasien Tb Resisten Terhadap Obat Di Kabupaten Rejang Lebong. *Journal Of Nursing and Public Health*, *10*(2), 77-87. https://doi.org/10.37676/jnph.v10i2.3137

Anderson, K., Pietersen, E., Shepherd, B. E., Bian, A., Dheda, K., Warren, R., Sterling, T. R. & van der Heijden, Y. F. (2022). High mortality among patients hospitalized for drug-resistant tuberculosis with acquired second-line drug resistance and high HIV prevalence. *HIV medicine*, *23*(10), 1085-1097.. https://doi.org/10.1111/hiv.13318

Aristiana, C. D., & Wartono, M. (2018). Faktor-faktor yang mempengaruhi terjadinya Multi Drug Resistance Tuberkulosis (MDR-TB). *Jurnal Biomedika Dan Kesehatan*, 1(1). https://doi.org/10.18051/JBiomedKes.2018

Ayudhipasha, T. S., Herdwiyanti, M., & Sedayu, S. (2025). Correlation between Duration of Antiretroviral Therapy and Glomerular Filtration Rate in People Living with HIV/AIDS: A Cross-sectional Study in Cirebon, West Java, Indonesia. *GHMJ (Global Health Management Journal)*, 8(1s), 95–101. https://doi.org/10.35898/ghmj-81s1182

Bakhtiar, M. I., Wiedyaningsih, C., Yasin, N. M., & Kristina, S. A. (2021). Hubungan karakteristik, kepatuhan, dan outcome klinis pasien tuberkulosis paru di puskesmas Kabupaten Bantul. *Majalah Farmaseutik*, *17*(2), 256-269.. https://doi.org/10.22146/farmaseutik.v17i2.60681

Baluku, J. B., Nakazibwe, B., Naloka, J., Nabwana, M., Mwanja, S., Mulwana, R., Sempiira, M., Nassozi, S., Babirye, F., Namugenyi, C. Ntambi, S, Namiiro, S., Bongomin, F., Katuramu, R., Andia-Biraro, I., & Worodria, W. (2021). Treatment outcomes of drug resistant tuberculosis patients with multiple poor prognostic indicators in Uganda: a countrywide 5-year retrospective study. *Journal of clinical tuberculosis and other mycobacterial diseases*, *23*, 100221. https://doi.org/10.1016/j.jctube.2021.100221

Damayanti, L., Widada, W., & Adi, G. S. (2022). Status Pengobatan Berhubungan Dengan Kejadian Tuberkulosis Resistan Obat Pada Usia Produktif. *PROFESSIONAL HEALTH JOURNAL*, *3*(2), 138-148. https://doi.org/10.54832/phj.v3i2.197

Fachri, M., Fauzi, R. A., & Akaputra, R. (2021). Gambaran Radiologi Foto Toraks Pasien TB Paru Resistan Obat dengan dan Tanpa DM Tipe 2 di Rumah Sakit Islam Jakarta Sukapura. *Jurnal Kedokteran Dan Kesehatan*, *17*(2), 177-186. https://doi.org/10.24853/jkk.17.2.177-186

Fatihah, H. B., Latief, M. A., & Herdwiyanti, M. (2025). Comparing Chest Radiograph Lesion Areas in Pulmonary Tuberculosis Patients with and without Diabetes Mellitus: A 2023 Study at Waled Hospital, Cirebon, Indonesia. *GHMJ (Global Health Management Journal)*, 8(2), 166–171. https://doi.org/10.35898/ghmj-821161

Gelaw, Y., Getaneh, Z., & Melku, M. (2021). Anemia as a risk factor for tuberculosis: a systematic review and meta-analysis. *Environmental health and preventive medicine*, *26*(1), 13. https://doi.org/10.1186/s12199-020-00931-z

Kementerian Kesehatan Indonesia. (2020). P. Petunjuk Teknis Penatalaksanaan Tuberkulosis Resistan Obat Di Indonesia. https://tbindonesia.or.id/wp-content/uploads/2021/06/TBRO_Buku-Juknis-Tuberkulosis-2020-Website.pdf

Khawbung, J. L., Nath, D., & Chakraborty, S. (2021). Drug resistant Tuberculosis: A review. *Comparative immunology, microbiology and infectious diseases*, *74*, 101574. https://doi.org/10.1016/j.cimid.2020.101574

Kusumandari, V. P., Sunarti, S., & Nawangsari, D. (2023). Pengaruh Riwayat Pengobatan Pasien TB Terhadap Kejadian TB MDR di RSUD Prof. Dr. Margono Soekarjo. *Pharmacy Genius*, *2*(3), 176-188. https://doi.org/10.56359/pharmgen.v2i3.294

Maksum, I. P., Suhaili, S., Amalia, R., Kamara, D. S., Rachman, S. D., & Rachman, R. W. (2018). PCR Multipleks untuk identifikasi Mycobacterium tuberculosis resisten terhadap isoniazid dan rifampisin pada galur lokal Balai Laboratorium Kesehatan Provinsi Jawa Barat. *Jurnal Kimia Valensi*, *4*(2), 107-118. https://doi.org/10.15408/jkv.v4i2.7226

Mansur, M., Suprapti, B., Hidayati, M., Fatmawati, U. (2021). Gambaran Pemanjangan Interval Qtc Pada Terapi Jangka Pendek Pasien Tb Mdr. Studi Magister Farmasi Klinik. Surabaya. *JURNAL MEDIA KESEHATAN*, *14*(1), 8–17. https://doi.org/10.33088/jmk.v14i1.581

Marfuati, S., Fitriani, H., Weni, M., & Riawan, F. P. (2024). Improving Pulmonary Tuberculosis Treatment Adherence: The role of patient knowledge in Cirebon, West Java, Indonesia. *GHMJ (Global Health Management Journal)*, 7(2), 103–108. https://doi.org/10.35898/ghmj-72987

Muhammad, E. Y. (2019). Hubungan tingkat pendidikan terhadap kejadian tuberkulosis paru. *Jurnal Ilmiah Kesehatan Sandi Husada*, *8*(2), 288-291. https://jurnalsandihusada.polsaka.ac.id/JIKSH/article/download/173/147

Muhammad, M., & Fadli, F. (2019). Analisis Faktor Penyebab Multi-Drug Resistance (Mdr) Pada Penderita Tuberkulosis. *Jurnal Publikasi Kesehatan Masyarakat Indonesia*, *6*(2), 62-67. https://doi.org/10.20527/jpkmi.v6i2.7454

Oktaviyati, N., Pratamawati, T. M., & Nauphar, D. (2025). TNF-α −308 G/A Gene Polymorphism as a Risk Factor for Pulmonary Tuberculosis in Cirebon, Indonesia. *GHMJ (Global Health Management Journal)*, 8(1s), 121–126. https://doi.org/10.35898/ghmj-81s1159

Purnamaningsih, I., Martini, M., Adi, M. S., & Saraswati, L. D. (2018). Hubungan Status Riwayat Kontak Bta+ Terhadapkejadian Tb Anak (Studi Di Balai Kesehatan Masyarakat Wilayah Semarang). *Jurnal Kesehatan Masyarakat*, *6*(1), 273-278. https://doi.org/10.14710/jkm.v6i1.19881

Puspita, T., Suryatma, A., Simarmata, O. S., Veridona, G., Lestary, H., & Anwar, A. (2022). Spatial variation of tuberculosis risk in Indonesia 2010–2019. *Health Science Journal of Indonesia*, 12(2). https://doi.org/10.22435/hsji.v12i2.5467

Raini, M. (2016). *Antibiotik golongan fluorokuinolon: Manfaat dan kerugian*. Media Litbangkes, Vol. 26 No. 3, September 2016, 163-174. https://doi.org/10.22435/mpk.v26i3.4449.163-174

Reviono, Kusnanto, P., Eko, V., Pakiding, H., & Nurwidiasih, D. (2014). Multidrug resistant tuberculosis (MDR-TB): tinjauan epidemiologi dan faktor risiko efek samping obat anti tuberkulosis. *Majalah Kedokteran Bandung*, *46*(4), 189-196. http://dx.doi.org/10.15395/mkb.v46n4.336

Sulaiman, S. C., Handayani, L., Suwandi, M. Y. S., & Soedarsono, S. (2018). Gambaran Radiografi Tuberkulosis Paru Multidrug-Resistant: Studi Retrospektif di Rumah Sakit Umum Dr. Soetomo Surabaya. *Jurnal Respirasi*, *4*(3). https://doi.org/10.20473/jr.v4-I.3.2018.71-75

Sulistyawati, S., & Ramadhan, A. W. (2021). Risk Factors for Tuberculosis in an Urban Setting in Indonesia: A Case-control Study in Umbulharjo I, Yogyakarta. *Journal of UOEH*, 43(2), 165–171. https://doi.org/10.7888/juoeh.43.165

Thuraidah, A., Widya Astuti, R. A., & Rakhmina, D. (2017). Anemia dan Lama Konsumsi Obat Anti Tuberculosis. *Medical Laboratory Technology Journal*, *3*(2), 42–46. https://doi.org/10.31964/mltj.v3i2.157

World Health Organization. (2018). Global Tuberculosis Report 2018. WHO. https://www.who.int/publications/i/item/9789241565646

Cite this article as:

Santoso, D. S., Agustina, D. R. E., & Amaliyah, N. (2025). Drug Resistant Profile among the Pulmonary Tuberculosis Patients at Waled General Hospital, Cirebon Regency, Indonesia. *GHMJ (Global Health Management Journal)*, *8*(3), 392–402. https://doi.org/10.35898/ghmj-831236