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Research Article

Clinical Features of Pulmonary Tuberculosis Patients Performing Molecular Rapid Test at Jakarta Islamic Hospital Cempaka Putih

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ABSTRACT

Background: Tuberculosis is an infectious disease caused by the bacterium Mycobacterium tuberculosis. This germ has a dormant phase, which causes the healing process to take a long time, thereby increasing the risk of discontinuing drug consumption in TB patients. This has resulted in resistance to several types of anti-tuberculosis drugs, one of which is Rifampicin, a first-line drug in TB treatment. Rifampicin-resistant TB (RR-TB) requires rapid and precise diagnosis and treatment, namely the PCR method using the GeneXpert tool. **Purposes:** To find out the clinical features of pulmonary tuberculosis patients performing TCM GeneXpert at the Jakarta Islamic Hospital Cempaka Putih in January – June 2022. **Methods:** This study employs a descriptive observational method, which describes a clinical feature based on secondary data (medical records) from adult pulmonary TB patients undergoing TCM at RSIJ Cempaka Putih. **Results:** Among patients examined by Molecular Rapid Test, 64 individuals (59.3%) were MTB-detected, and among them, 12 individuals (18.8%) had rifampicin resistance. The highest positivity value from the results of MTB-detected was MTB-Medium Detected, namely 11 people (10.2%). The most common clinical symptom in pulmonary TB patients was cough with phlegm, which was 67 people (62%), and the comorbidity that most patients suffered was diabetes mellitus, which was 21 people (19.4%). **Conclusions:** The frequency distribution of the Molecular Rapid Test (MRT) results showed that 59.3% of the MTB-detected cases were rifampicin-resistant, with 18.8% of the total. Cough with phlegm is the most common clinical symptom experienced by TB patients, namely 62%.

Keywords: clinical feature, TCM, tuberculosis

INTRODUCTION

Tuberculosis (TB), an infectious disease caused by infection of the bacterium *Mycobacterium tuberculosis*, is a significant public health burden in the world. TB germs mostly attack the lung parenchyma (pulmonary TB) but these bacteria also have the ability to infect other organs (extrapulmonary TB) (1).

Tuberculosis patients may show symptoms of coughing up phlegm for ≥ 2 weeks with or without other additional symptoms which include coughing up blood, weakness, shortness of breath, decreased appetite, unintentional weight loss, malaise, sweating at night without physical activity, fever subfebrile more than one month, and chest pain (2,3). Drug Resistant

Tuberculosis (RO-TB) continues to be a public health threat. In 2019, there were approximately 9.96 million TB incidents worldwide, of which 465,000 were Multidrug-Resistant or Rifampicin-Resistant Tuberculosis (MDR/RR TB) (4,5).

The conventional diagnosis for detecting RO-TB is based on time-consuming culture and drug sensitivity tests, as well as specific methods for isolating the bacteria from clinical specimens, identification of the *Mycobacterium tuberculosis* (MTB) complex, and in vitro examination in anti-tuberculosis drug sensitivity tests. During the examination, the patient may receive inappropriate treatment, increasing the chances of developing drug-resistant strains of TB. It is hoped that this can be overcome by the Molecular Rapid Test (MRT) with Xpert MTB/RIF which is fast and can simultaneously detect the presence of resistant MTB and rifampicin, so that treatment initiation can be started and the overall TB incidence rate can be reduced (6–8).

The government continues to make various breakthroughs in order to expand coverage and improve the quality of RO-TB services in Indonesia by appointing hospitals and health centers that treat TB RO patients as stipulated in the Decree of the Minister of Health of the Republic of Indonesia number 350 of 2017 (4). Jakarta Islamic Hospital Cempaka Putih is one of the hospitals designated as a hospital that provides services for RO-TB patients in Indonesia.

Based on the journals that the authors found published within the last 5 years, there has been no data or research related to the clinical features of tuberculosis patients undergoing the MRT. Therefore, this research is expected to be a source of new information regarding the clinical features of tuberculosis patients who undergo the MRT whose results can be used as a basis for further research in efforts to treat tuberculosis patients, especially RR-TB.

METHODS

The type and design of this study employed a descriptive observational method, explicitly describing the clinical features based on secondary data (medical records) of adult pulmonary tuberculosis patients who underwent the Molecular Rapid Test (MRT) at the Jakarta Islamic Hospital Cempaka Putih.

The sample in this study consisted of adult patients with pulmonary tuberculosis who underwent the MRT at the Jakarta Islamic Hospital Cempaka Putih from January to June 2022. The sampling technique used in this study was simple random sampling, which involves selecting a sample by taking all members of the population as respondents. It must meet predetermined inclusion and exclusion criteria.

The inclusion criteria include patients diagnosed with pulmonary TB who are undergoing MRT at the Jakarta Islamic Hospital Cempaka Putih, as well as patients in the adult category, according to the 2009 guidelines of the Republic of Indonesia's Ministry of Health. The exclusion criteria include adult pulmonary TB patients with incomplete data recorded in the medical record of the Jakarta Islamic Hospital Cempaka Putih and patients with indeterminate MRT results.

A computer will then process data obtained secondarily to analyze it. The research results are presented in the form of descriptive statistical data in tables. Data processing utilizes IBM SPSS (Statistical Package for the Social Sciences) version 29.

To conduct this research, the researcher submitted an ethical test to the Health Research Ethics Commission of the Faculty of Medicine and Health, Muhammadiyah University of

Jakarta, and was declared to be ethically appropriate by seven WHO 2011 standards with the pass number 358/PE/KE/FKK-UMJ/XII/2022.

RESULTS

Regarding the clinical features of adult pulmonary tuberculosis patients who underwent Molecular Rapid Test (MRT) at the Jakarta Islamic Hospital Cempaka Putih for the period January-June 2022, a total of 377 patients were obtained and 108 samples were obtained that met the inclusion and exclusion criteria.

Table 1. Characteristics of Adult Pulmonary TB Patients

Age (years old)	F / M	Occupation									Total
		No data (person)	Civil servant (person)	Entrepre-neur (person)	Private employ-yee (person)	Student (person)	Laborer/ farmer (person)	Retired (person)	House-wife (person)	Unem-ployed (person)	
18-25	M	3 (2.8%)	0	0	1 (0.9%)	3 (2.8%)	0	0	0	0	4 (3.7%)
	F	2 (1.9%)	0	0	0	1 (0.9%)	0	0	0	0	2 (1.9%)
26-35	M	5 (4.6%)	0	0	2 (1.9%)	1 (0.9%)	1 (0.9%)	0	0	0	5 (4.6%)
	F	4 (3.7%)	1 (0.9%)	1 (0.9%)	2 (1.9%)	0	0	0		0	6 (5.6%)
36-45	M	5 (4.6%)	0	1 (0.9%)	5 (4.6%)	0	0	1 (0.9%)	0	0	11 (10.2%)
	F	9 (8.3%)	1 (0.9%)	0	4 (3.7%)	0	0	0	4 (3.7%)	0	11 (10.2%)
46-55	M	8 (7.4%)	2 (1.9%)	1 (0.9%)	4 (3.7%)	0	2 (1.9%)	0	0	1 (0.9%)	16 (14.8%)
	F	6 (5.6%)	2 (1.9%)	1 (0.9%)	2 (1.9%)	0	0	0	4 (3.7%)	0	10 (9.3%)
56-65	M	8 (7.4%)	0	1 (0.9%)	5 (4.6%)	0	0	3 (2.8%)	0	2 (1.9%)	14 (13%)
	F	6 (5.6%)	0	0	4 (3.7%)	0	0	3 (2.8%)	2 (1.9%)	0	12 (11.1%)
≥65	M	4 (3.7%)	0	0	4 (3.7%)	0	0	4 (3.7%)	0	0	10 (9.3%)
	F	6 (5.6%)	0	0	1 (0.9%)	0	0	0	3 (2.8%)	3 (2.8%)	7 (6.5%)
Total	M	33 (30.6%)	2 (1.9%)	3 (2.8%)	21 (19.4%)	4 (3.7%)	3 (2.8%)	8 (7.4%)	0	3 (2.8%)	60 (55.6%)
	F	33 (30.6%)	4 (3.7%)	2 (1.9%)	13 (12%)	1 (0.9%)	0	3 (2.8%)	13 (12%)	3 (2.8%)	48 (44.4%)
Total		66 (61.1%)	6 (5.6%)	5 (4.6%)	34 (31.5%)	5 (4.6%)	3 (2.8%)	11 (10.2%)	13 (12%)	6 (5.6%)	108 (100%)

Abbreviation: F=Female, M=Male

From table 1 which divides characteristics based on age, gender, and occupation, it can be seen that the majority of patients are in the age range of 46-55 years and 56-65 years, namely 26 people each (24.1%). More than half of the patients were male, namely 60 people (55.6%). In the employment data recorded in medical records, the highest number was private employees, namely 34 people (31.5%) and the lowest were laborers/farmers, namely 3 people (2.8%).

From table 2, the results of the MRT, consist of 2 tests, namely detection of MTB and detection of resistant rifampicin. In the MRT MTB examination, there were 64 people (59.3%) detected MTB with Moderate Detected MTB occupying the highest positive value, that is 25 people (23.1%). Among the 64 people who detected MTB, there were 22 people (34.4%) who experienced rifampicin resistance. The age group with the most detection of rifampicin resistance was the 56-65 years age group, namely 6 people (9.4%). The number of male patients who were detected to be resistant to rifampicin was more, namely 12 people (18.8%) compared to women, which were 10 people (15.6%).

Table 2. Molecular Rapid Test Results in Adult Pulmonary TB Patients based on Age and Gender Demographics

Age (years old)	F/M	MRT MTB					Total	MRT Rifampicin Resistance		Total
		MTB Undetected (person)	MTB Very low-Detected (person)	MTB Low-Detected (person)	MTB Medium-Detected (person)	MTB High-Detected (person)		Undetected (person)	Detected (person)	
18-25	M	0	1 (0.9%)	1 (0.9%)	2 (1.9%)	0	4 (3.7%)	2 (3.1%)	2 (3.1%)	4 (6.3%)
	F	2 (1.9%)	0	0	0	0	2 (1.9%)	2 (3.1%)	0	2 (3.1%)
26-35	M	1 (0.9%)	0	1 (0.9%)	1 (0.9%)	2 (1.9%)	5 (4.6%)	4 (6.3%)	1 (1.6%)	5 (7.8%)
	F	1 (0.9%)	1 (0.9%)	2 (1.9%)	1 (0.9%)	1 (0.9%)	6 (5.6%)	2 (3.1%)	4 (6.3%)	6 (9.4%)
36-45	M	2 (1.9%)	0	2 (1.9%)	3 (2.8%)	4 (3.7%)	11 (10.2%)	8 (12.5%)	3 (4.7%)	11 (17.2%)
	F	3 (2.8%)	0	3 (2.8%)	4 (3.7%)	1 (0.9%)	11 (10.2%)	9 (14.1%)	2 (3.1%)	11 (17.2%)
46-55	M	10 (9.3%)	1 (0.9%)	2 (1.9%)	1 (0.9%)	2 (1.9%)	16 (14.8%)	5 (7.8%)	2 (3.1%)	7 (10.9%)
	F	4 (3.7%)	0	1 (0.9%)	5 (4.6%)	0	10 (9.3%)	2 (3.1%)	0	2 (3.1%)
56-65	M	8 (7.4%)	1 (0.9%)	0	3 (2.8%)	2 (1.9%)	14 (13%)	4 (6.3%)	3 (4.7%)	7 (10.9%)
	F	2 (1.9%)	2 (1.9%)	3 (2.8%)	3 (2.8%)	2 (1.9%)	12 (11.1%)	1 (1.6%)	3 (4.7%)	4 (6.3%)
≥65	M	5 (4.6%)	1 (0.9%)	0	1 (0.9%)	3 (2.8%)	10 (9.3%)	3 (4.7%)	1 (1.6%)	4 (6.3%)
	F	6 (5.6%)	0	0	1 (0.9%)	0	7 (6.5%)	0	1 (1.6%)	1 (1.6%)
Total	M	26 (24.1%)	4 (3.7%)	6 (5.6%)	11 (10.2%)	13 (12%)	60 (55.6%)	26 (40.6%)	12 (18.8%)	38 (59.4%)
	F	18 (16.7%)	3 (2.8%)	9 (8.3%)	14 (13%)	4 (3.7%)	48 (44 %)	16 (25%)	10 (15.6%)	26 (40.6%)
Total		44 (40.7%)	7 (6.5%)	15 (13.9%)	25 (23.1%)	17 (15.7%)	108 (100%)	42 (65.6%)	22 (34.4%)	64 (100%)

Abbreviation: F=Female, M=Male

From table 3 frequency distribution of clinical symptoms in adult pulmonary TB patients, the most clinical symptom experienced by patients was coughing up phlegm, namely 67 people (62%), while the least symptom experienced by patients was coughing up blood, namely 26 people (24.1%) and chest pain in 27 people (25%). Nearly half of the patients with insignificant differences experienced symptoms of weakness, decreased appetite, and subfebrile fever, namely 49 people (45.4%), 46 people (42.6%), and 44 people (40.7%).

Table 3. Clinical Symptoms in Adult Pulmonary TB Patients based on Age and Gender Demographics

Age (years old)	F/M	Clinical Symptoms								
		Cough with phlegm (person)	Hemo-ptysis (person)	Dyspnea (person)	Malaise (person)	Appetite loss (person)	Weight loss (person)	Sweating (person)	Subfebrile fever (person)	Chest pain (person)
18-25	M	1 (0.9%)	1 (0.9%)	1 (0.9%)	1 (0.9%)	0	1 (0.9%)	0	1 (0.9%)	1 (0.9%)
	F	1 (0.9%)	0	0	0	0	1 (0.9%)	0	0	0
26-35	M	4 (3.7%)	2 (1.9%)	0	0	0	1 (0.9%)	1 (0.9%)	1 (0.9%)	2 (1.9%)
	F	5 (4.6%)	1 (0.9%)	0	0	1 (0.9%)	1 (0.9%)	1 (0.9%)	0	1 (0.9%)
36-45	M	5 (4.6%)	2 (1.9%)	4 (3.7%)	5 (4.6%)	4 (3.7%)	3 (2.8%)	4 (3.7%)	4 (3.7%)	4 (3.7%)
	F	6 (5.6%)	3 (2.8%)	2 (1.9%)	5 (4.6%)	4 (3.7%)	2 (1.9%)	3 (2.8%)	3 (2.8%)	3 (2.8%)
46-55	M	11 (10.2%)	4 (3.7%)	5 (4.6%)	7 (6.5%)	6 (5.6%)	4 (3.7%)	4 (3.7%)	6 (5.6%)	5 (4.6%)
	F	5 (4.6%)	1 (0.9%)	3 (2.8%)	7 (6.5%)	7 (6.5%)	2 (1.9%)	3 (2.8%)	5 (4.6%)	5 (4.6%)
56-65	M	8 (7.4%)	4 (3.7%)	4 (3.7%)	7 (6.5%)	8 (7.4%)	4 (3.7%)	1 (0.9%)	7 (6.5%)	2 (1.9%)
	F	10 (9.3%)	3 (2.8%)	4 (3.7%)	8 (7.4%)	8 (7.4%)	3 (2.8%)	5 (4.6%)	9 (8.3%)	1 (0.9%)
≥65	M	7 (6.5%)	1 (0.9%)	3 (2.8%)	6 (5.6%)	5 (4.6%)	5 (4.6%)	3 (2.8%)	3 (2.8%)	2 (1.9%)
	F	4 (3.7%)	4 (3.7%)	4 (3.7%)	3 (2.8%)	3 (2.8%)	2 (1.9%)	4 (3.7%)	5 (4.6%)	1 (0.9%)
Total	M	36 (33.3%)	14 (13%)	17 (15.7%)	26 (24.1%)	23 (21.3%)	18 (16.7%)	13 (12%)	22 (20.4%)	16 (14.8%)
	F	31 (28.7%)	12 (11.1%)	13 (12%)	23 (21.3%)	23 (21.3%)	11 (10.2%)	16 (14.8%)	22 (20.4%)	11 (10.2%)
Total		67 (62%)	26 (24.1%)	30 (27.8%)	49 (45.4%)	46 (42.6%)	29 (26.9%)	29 (26.9%)	44 (40.7%)	27 (25%)

Note: F=Female, M=Male

From table 4 distribution of the frequency of comorbidities, the most common comorbidity that patients have is diabetes mellitus, namely 21 people (19.4%) and the least comorbid disease is kidney failure, namely 1 person (0.9%). Based on age group, the group that had the most comorbidities was the age group 46-55 years and 56-65 years, namely 26 people.

Table 4. Comorbidities in Adult Pulmonary TB Patients based on Age and Gender Demographics

Age (years old)	F/M	Comorbidities						Total
		No comor-biddities (person)	Hyperten-sion (person)	CHD (person)	DM (person)	Kidney failure (person)	Other respiratory disease (person)	
18-25	M	3 (2.8%)	0	0	0	0	1 (0.9%)	4 (3.7%)
	F	2 (1.9%)	0	0	0	0	0	2 (1.9%)
26-35	M	5 (4.6%)	0	0	0	0	0	5 (4.6%)
	F	4 (3.7%)	0	0	1 (0.9%)	0	1 (0.9%)	6 (5.6%)
36-45	M	5 (4.6%)	1 (0.9%)	0	4 (3.7%)	0	1 (0.9%)	11 (10.2%)
	F	9 (8.3%)	1 (0.9%)	0	1 (0.9%)	0	0	11 (10.2%)
46-55	M	8 (7.4%)	0	1 (0.9%)	4 (3.7%)	0	2 (1.9%)	16 (14.8%)
	F	6 (5.6%)	1 (0.9%)	0	2 (1.9%)	0	1 (0.9%)	10 (9.3%)
56-65	M	8 (7.4%)	0	1 (0.9%)	4 (3.7%)	1 (0.9%)	1 (0.9%)	14 (13%)
	F	6 (5.6%)	1 (0.9%)	1 (0.9%)	4 (3.7%)	0	0	12 (11.1%)
≥65	M	4 (3.7%)	2 (1.9%)	0	1 (0.9%)	0	3 (2.8%)	10 (9.3%)
	F	6 (5.6%)	1 (0.9%)	0	0	0	0	7 (6.5%)
Total	M	33 (30.6%)	3 (2.8%)	2 (1.9%)	13 (12%)	1 (0.9%)	8 (7.4%)	60 (55.6%)
	F	33 (30.6%)	4 (3.7%)	1 (0.9%)	8 (7.4%)	0	2 (1.9%)	48 (44.4%)
Total		66 (61.1%)	7 (6.5%)	3 (2 %)	21 (19.4%)	1 (0.9%)	10 (9.3%)	108 (100%)

Note: F=Female, M=Male

DISCUSSION

Based on the results of the study, the frequency of adult pulmonary TB patients who took the Molecular Rapid Test (MRT) at the Jakarta Islamic Hospital Cempaka Putih for the period January-June 2022 was based on age characteristics, the highest rates were found in the age group 46-55 years and 56-65 years. The results of this study show conformity with the results of a study conducted by Pauline Caraux-Paz (2021) which stated that the group with the largest percentage of TB cases was in the age range of 25-54 years. TB cases in this age group are more susceptible to new TB infections and are at high risk of reactivation of latent lesions (9–11). Activation of these lesions can be caused by changes in the immune system that occur with age (12,13).

Based on gender characteristics, patients with pulmonary tuberculosis had the highest rate in patients with male gender, namely 60 people (55.6%). These results also show compatibility with research conducted by Sunarmi (2021) at KWP TB Care Aisyiyah which states that there is a predominance in the number of pulmonary TB cases in men (63.6%) compared to women (36.4%) (14). A number of factors have been suggested for the increased vulnerability in men. In most countries, men smoke more than women. This is associated with

toxic lung damage and decreased immune cell function which makes it more susceptible to infection (15,16).

Based on occupational characteristics, most adult pulmonary TB patients who carried out the Molecular Rapid Test (MRT) at the Jakarta Islamic Hospital Cempaka Putih for the January-June 2022 period were most often found working as private employees. The results of this study are in line with previous research by Adinda R. S. (2018) in Badung Regency which stated that the distribution of pulmonary TB sufferers based on work was most experienced by private employees, namely 44.4% (16). The results of this study are possible because private sector workers are jobs that must interact with many people for a long time, so the risk of contracting Mycobacterium Tuberculosis also increases.

The results of the Molecular Rapid Test (MRT) in pulmonary TB patients showed that out of 108 patients who underwent TCM, 64 people (59.3%) were detected with MTB with the highest gradation of positivity in moderate TB with 25 people (23.1%). These results are in accordance with research conducted by Sheila G. D. (2021) which showed that the highest positivity rate was also found in moderately detected MTB, namely 11 people (32.4%). Based on the rifampicin-resistant test, there were 22 people (20.4%) who had resistance to rifampicin. The results of this study show a line with research conducted by Adejumo (2018) which stated that 220 people (23.4%) were detected with rifampicin resistance out of 942 patients who were detected with MTB. Among patients whose rifampicin resistance was detected, the largest age group was in the 56-65 years age group, namely 6 people (9.4%). Elderly patients have repeatedly been reported to have lower levels of medication adherence and are less aware of their health than younger patients, so the risk of developing resistance to treatment will increase (17,18).

The clinical features which was divided into clinical symptoms and accompanying diseases showed that the most clinical symptom experienced by patients was cough ≥2 weeks, namely 67 people (62%). These results are in line with previous research by Anak A. (2020) which found that most patients had cough as the main symptom that brought them to the nearest health facility (19).

Based on co-morbidities, of the 42 patients who had co-morbidities, the most common disease experienced by patients was diabetes mellitus, namely 21 people (19.4%) or half of the patients who had co-morbidities. It is said that there is an impaired immune response in diabetes. Numerous studies have been conducted to determine the diabetes-related mechanisms that undermine the host's defenses against pathogens. These mechanisms involve suppression of cytokine production, defects in phagocytosis, immune cell dysfunction, and failure to eliminate microbes. Several studies have reported an increased risk of lower respiratory tract infections such as pulmonary tuberculosis and pneumonia in patients with diabetes mellitus (20).

CONCLUSION

Based on the results of a study conducted on 108 patients regarding the clinical features of adult pulmonary TB patients who underwent a Rapid Molecular Test at the Jakarta Islamic Hospital Cempaka Putih for the period January-June 2022, it can be concluded that the characteristics of the patients were mostly in the age group 46-55 years and 56-65 years

(24.1%), male sex (55.6%), and works as a private employee (31.5%). TCM results showed that there were 64 people (59.3%) who had MTB detected and 22 people (20.4%) had rifampicin resistance. The most clinical symptom experienced by patients was cough ≥2 weeks (62%). The comorbid disease that most patients suffer from is diabetes mellitus, which is as many as 21 people (19.4%).

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CONFLICT OF INTEREST

The researcher has no conflict of interest, and has no affiliation or connection with or with any entity or organization that may raise biased questions in the discussion and conclusion of the manuscript.

REFERENCES

1. Kementerian Kesehatan Republik Indonesia. Keputusan Menteri Kesehatan Nomor HK.01.07/MENKES/755/2019 Tentang Pedoman Nasional Pelayanan Kedokteran Tata Laksana Tuberkulosis. Jakarta; 2019.
2. Centers for Disease Control and Prevention. Basic TB Facts: Signs & Symptoms. 2022 [cited 2022 Oct 24]. Available from: https://www.cdc.gov/tb/topic/basics/signsandsymptoms.htm
3. Persatuan Dokter Paru Indonesia. Tuberkulosis: Pedoman Diagnosis dan Penatalaksanaan di Indonesia. Jakarta; 2021.
4. Kementerian Kesehatan Republik Indonesia. Petunjuk Teknis Penatalaksaan Tuberkulosis Resistan Obat di Indonesia. Jakarta; 2020.
5. World Health Organization (WHO). Global Tuberculosis Report 2020. Geneva; 2020.
6. Kementerian Kesehatan Republik Indonesia. Petunjuk Teknis Pemeriksaan TB Menggunakan Tes Cepat Molekuler. Jakarta; 2017.
7. Centers for Disease Control and Prevention (CDC). A New Tool to Diagnose Tuberculosis: The Xpert MTB/RIF Assay. 2016 [cited 2023 Jan 15]. Available from: https://www.cdc.gov/tb/publications/factsheets/testing/xpert_mtb-rif.htm
8. Kementerian Kesehatan Republik Indonesia. RR/MDR TB Enrollment Rate. 2022 [cited 2022 Oct 24]. Available from: https://tbindonesia.or.id/pustaka-tbc/dashboard-tb/#tab-634ba7237cd46-7
9. Di Gennaro F, Vittozzi P, Gualano G, Musso M, Mosti S, Mencarini P, et al. Active pulmonary tuberculosis in elderly patients: a 2016–2019 retrospective analysis from an Italian Referral Hospital. Antibiotics. 2020;9(8):489.
10. Centers for Disease Control and Prevention (CDC). Diagnosing Latent TB Infection & TB Disease. 2016 [cited 2022 Oct 24]. Available from: https://www.cdc.gov/tb/topic/testing/diagnosingltbi.htm
11. Centers for Disease Control and Prevention (CDC). Latent TB Infection and TB Disease.

2020 [cited 2022 Oct 24]. Available from: https://www.cdc.gov/tb/topic/basics/tbinfectiondisease.htm

12. Caraux-Paz P, Diamantis S, de Wazières B, Gallien S. Tuberculosis in the Elderly. J Clin Med. 2021 Dec;10(24).
13. Centers for Disease Control and Prevention, National Center for HIV/AIDS, Viral Hepatitis, STD and TPD of TE. Core Curriculum on Tuberculosis: What the Clinician Should Know. 2021.
14. Sunarmi S, Kurniawaty K. hubungan karakteristik pasien TB Paru dengan kejadian tuberkulosis. Jurnal'Aisyiyah Med. 2022;7(2).
15. Centers for Disease Control and Prevention (CDC). TB risk factors. 2016 [cited 2022 Oct 24]. Available from: https://www.cdc.gov/tb/topic/basics/risk.htm
16. Miller PB, Zalwango S, Galiwango R, Kakaire R, Sekandi J, Steinbaum L, et al. Association between tuberculosis in men and social network structure in Kampala, Uganda. BMC Infect Dis. 2021;21(1):1023.
17. Savitri AR, Muliani Y, Yuliana Y. Karakteristik penderita tuberkulosis paru dengan diabetes melitus di kabupaten badung tahun 2017-2018. E-Jurnal Med Udayana. 2021;10(1):60–4.
18. An Q, Song W, Liu J, Tao N, Liu Y, Zhang Q, et al. Primary drug-resistance pattern and trend in elderly tuberculosis patients in Shandong, China, from 2004 to 2019. Infect Drug Resist. 2020;4133–45.
19. Dewi A, Andrika P, Artana IB, Kunci K. Gambaran karakteristik pasien tuberculosis di poliklinik paru RSUP Sanglah Denpasar. J Med Udayana. 2020;9(6):9.
20. Berbudi A, Rahmadika N, Tjahjadi AI, Ruslami R. Type 2 diabetes and its impact on the immune system. Curr Diabetes Rev. 2020;16(5):442–9.