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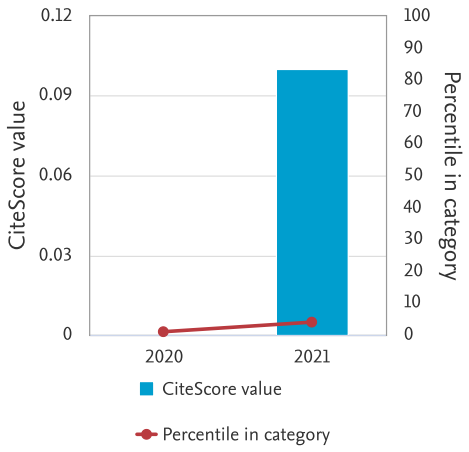

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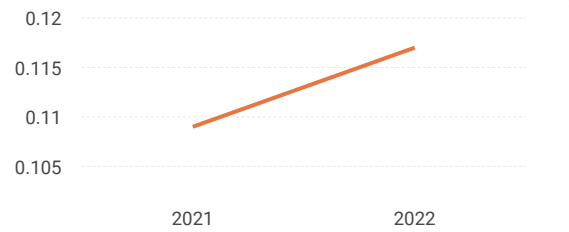

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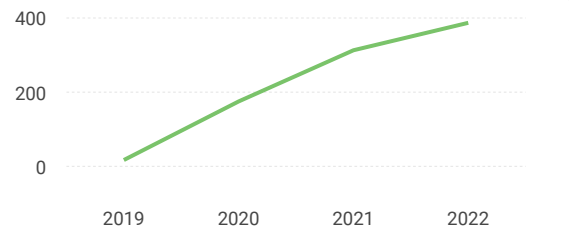

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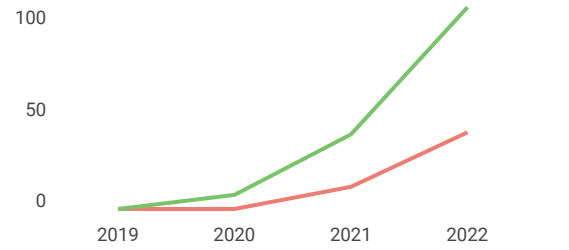

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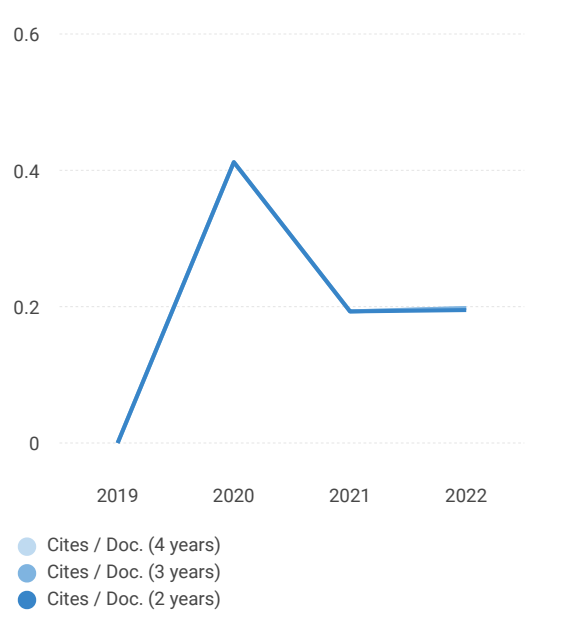

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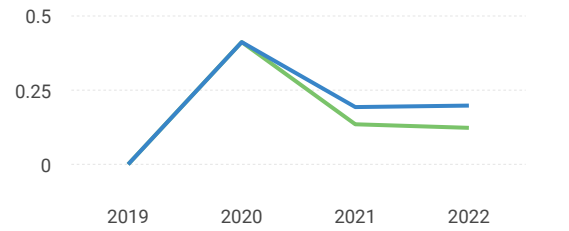

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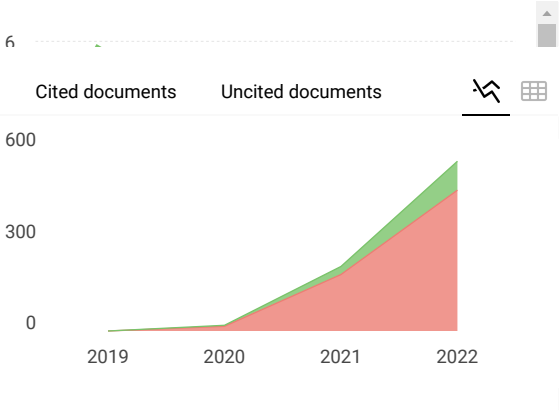

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Bali Medical Journal (*Bali MedJ)* 2023, Volume 12, Number 1: 1152-1157
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The radiologic findings, positivity rate of culture method examinations, correlation with the type of lower respiratory secretion of adult pulmonary Tuberculosis (TB) patients

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ABSTRACT

Background: There are active and latent tuberculosis types, a global public health concern. Test confirmation is required to distinguish between active tuberculosis and nontuberculous mycobacterial infection. This study aims to evaluate the relationship between the type of lower airway secretion specimen, *Mycobacterium tuberculosis* positivity rate of MGIT-LJ, as well as the relationship between the *Mycobacterium tuberculosis* positivity rate in MGIT-LJ and radiological findings.
Methods: This study is cross-sectional with a prospective design. The sample is the result of the examination of the MGIT-LJ method and medical record data of patients suspected of Pulmonary TB at Dr. Soetomo Academic Hospital Surabaya Indonesia that meets the inclusion criteria, analysis of the culture results of MGIT-LJ method and radiological findings were carried out to assess the relationship between the character of sputum, the positivity rate of *Mycobacterium tuberculosis* and radiological findings.
Result: A total of 137 from June 2022 till November 2022 found 88 (64.2%) with spontaneous sputum, 6 (4,4%) aspirate ETT, and 43 (31.4%) BAL. The positivity rate of the MGIT-LJ culture method of the spontaneous sputum specimen to detect *Mycobacterium tuberculosis* was 20.5% higher than ETT or BAL specimens because the implementation of clinical indication to request MGIT-LJ culture method of ETT and BAL specimens is still confusing. The specificity of the chest radiography diagnostic test from all specimens type of 61.86%, with a weak accuracy rate.
Conclusion: In this study, the positivity rate of the MGIT-LJ culture method of the spontaneous sputum specimen to detect *Mycobacterium tuberculosis* was 20.5% higher than ETT or BAL specimens. Chest radiography has a weak accuracy level and must be complemented test with the culture method.

Keywords: *Mycobacterium tuberculosis*, Secretion Specimen Type, Radiological Findings, MGIT-LJ.
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INTRODUCTION

Tuberculosis (TB) is an infectious disease that is one of the leading causes of death worldwide, with *Mycobacterium tuberculosis* (MTB) infecting an estimated quarter of the world's population.[1] Bacillus *Mycobacterium tuberculosis* causes tuberculosis which spreads when a sick person coughs or releases droplets containing bacteria into the air. Tuberculosis can infect the lungs, bones, and other organs. TB primarily affects adults, with an estimated 90% of cases occurring more cases in men rather than women.[2,3] Without treatment, TB disease has a significant mortality rate (about 50%). Approximately 85% of patients can be treated with the currently suggested therapies (4-6 months of anti-TB medications). TB detection on a clinical basis has low specificity and can lead to an incorrect diagnosis of TB and unnecessary treatment.[2,4]

Mycobacterium tuberculosis transmission will be decreased by early TB detection and treatment. An increased risk of TB infection transmission from one person to another and more severe disease symptoms can result from a late identification of the disease. The interval between the development of TB-related symptoms and the patient's first visit to the doctor, as well as the interval between the patient's first visit to the doctor and the diagnosis of TB, are both factors that contribute to diagnosis delays. The absence of cavitation and the position of the main pulmonary lesion outside the upper lobe on the thorax X-ray are two additional features contributing to the doctor's delay in diagnosing.[5,6] Active disease can manifest as either primary TB, which appears quickly after infection, or post-primary TB, which appears after a lengthy latent infection period. Primary tuberculosis is particularly common in young and immunocompromised individuals, and symptoms include lymphadenopathy, lung consolidation, and pleural effusion. Cavitation, consolidation, and centrilobular nodules are all symptoms of post-primary tuberculosis. Miliary TB refers to the disease's more common hematogenous spread in

immunocompromised patients with billions of lung nodules and multiorgan involvement.[7,8] Milliary tuberculosis can develop six weeks after infection in 2-6% of initial infection patients.[9]

TB diagnosis, management, and control rely on accurate and timely laboratory test results. The laboratory is an important component of TB control. Quality specimens are very important in diagnosing TB. Sputum is the most frequently collected specimen for TB testing. Induction of sputum with hypertonic saline is necessary to obtain quality specimens when the patient cannot produce sputum spontaneously, and bronchoscopy can be considered for patients who cannot produce sputum.[5-7] The following procedures can be used to obtain pulmonary secretion: spontaneous sputum, induction sputum, gastric lavage, trans-tracheal aspiration, bronchoscopy, and laryngeal swabbing. Most specimens are sputum, induction sputum, bronchoscopic aspiration, or stomach lavage with spontaneous sputum.[10,11] At the Clinical Microbiology Laboratory of Dr. Soetomo, a tertiary referral hospital providing outpatient and inpatient services, various specimens from lower airway secretions were found, including spontaneous sputum and aspirate sputum taken from endotracheal tube (ETT) and bronchoalveolar lavage (BAL).

Analysis of the relationship of the type of lower airway secretion specimens of pulmonary TB patients, with radiological findings, positivity rate on the Mycobacterium Growth Indicator Tube-Lowenstein Jensen (MGIT – LJ) culture method is still not widely studied. This study is very important to determine the relationship of positivity rate in pulmonary TB with the type of lower airway secretion specimen of pulmonary TB patients and radiological findings. The results of this study are expected to improve the findings of pulmonary TB patients and determine the type of lower respiratory tract secretion specimen with the highest positivity rate in TB patients.

Based on those mentioned above, this study aims to evaluate the relationship between the type of lower airway secretion specimen, *Mycobacterium tuberculosis* positivity rate of MGIT - LJ, and the relationship between the *Mycobacterium tuberculosis* positivity rate in MGIT - LJ and radiological findings.

METHODS

This study is cross-sectional with a prospective design. Sampling is carried out using consecutive sampling techniques from June to November 2022. The participant inclusion criteria included the results of the examination of the Clinical Microbiology Laboratory and the data of the patient's medical record suspected of tuberculosis and age over 18 years. Study exclusion criteria such as the results of the examination of the Clinical Microbiology Laboratory and the patient's medical record data suspect TB with lost, incomplete, or damaged data. The research sample results from examining the clinical microbiology laboratory and medical record data of patients suspected of TB at Dr. Soetomo Academic Hospital Surabaya that meet the inclusion criteria. The culture results of the MGIT - LJ method and radiological findings were analyzed to assess the relationship between the positivity rate of *Mycobacterium tuberculosis* and radiological findings. Statistical analysis was done using bivariate analysis using the Chi-square test, a diagnostic test performed on two variables using SPSS software version 20 for Windows.

RESULTS

Based on the results of the chi-square test in Table 1, between specimen types and with the culture results of the MGIT - LJ method, a p-value of 0.006 was obtained, which means that between the types of specimens with the culture results of the MGIT - LJ method is stated to be statistically meaningful, the chances in spontaneous and non-spontaneous sputum specimens are stated to be different for the culture results of the MGIT - LJ method in detecting MTB.

The MTB positive in spontaneous sputum specimens was 18 with a positivity rate of 20.5%; in spontaneous non-sputum specimens, MTB was positive as much as 2 with a positivity rate of 2%, as seen in Figure 1. Based on the results of the chi-square test in Table 2 between the types of aspirates ETT specimens and the culture results of the MGIT - LJ method, a p-value of 1.000 was obtained, which means that between the types of ETT specimens with the culture results of the MGIT, - LJ method was declared the same.

Table 1. Frequency Distribution of suspect pulmonary TB patients with a positivity rate of MGIT - LJ culture method to detect *Mycobacterium tuberculosis* of spontaneous sputum specimens.

Types of specimens	Culture results of the MGIT - LJ method		Total	p
	MTB positive N (%)	MTB negative N (%)		
Spontaneous sputum	18 (20.50)	70 (79.50)	88 (100.00)	0.006*
Nonspontaneous sputum	1 (2.00)	48 (98.0)	49 (100.00)	

*Statistically significant if p-value less than 0.05

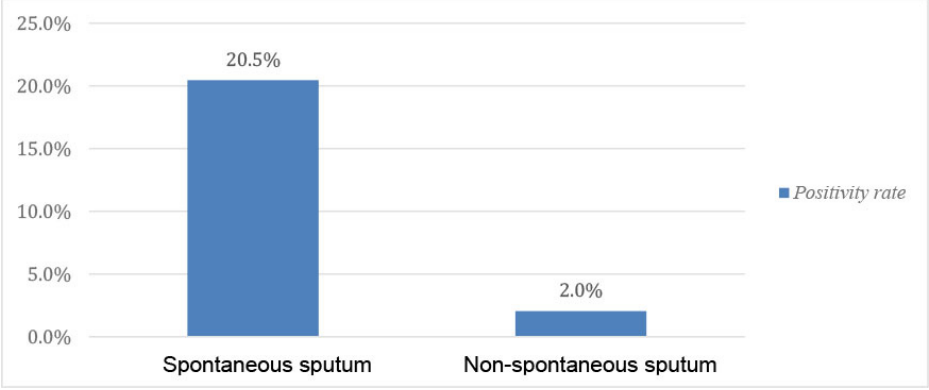

Figure 1. The positivity rate of *Mycobacterium tuberculosis* MGIT - LJ culture method of spontaneous sputum specimens

Table 2. Frequency Distribution of pulmonary TB patients with a positivity rate MGIT – LJ culture method to detect *Mycobacterium tuberculosis* of aspirate specimens.

Types of specimens	Culture results of the MGIT - LJ method		Total	p
	MTB positive N (%)	MTB negative N (%)		
Aspirate ETT	1 (16.70)	5 (83.30)	6 (100.00)	1.000
Non aspirate ETT	18 (13.70)	113 (86.30)	131 (100.00)	

*Statistically significant if p-value less than 0.05

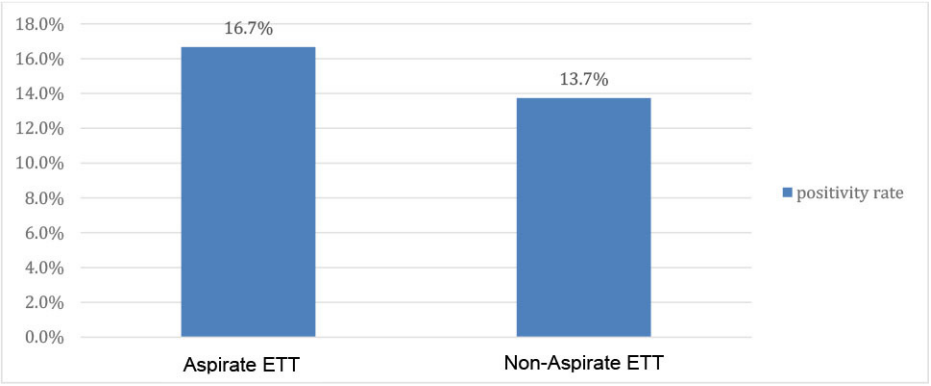

Figure 2. The positivity rate of *Mycobacterium tuberculosis* MGIT - LJ culture method of aspirate ETT specimens.

Table 3. Frequency Distribution of pulmonary TB patients with a positivity rate of MGIT – LJ culture method to detect *Mycobacterium tuberculosis* of BAL specimens.

Types of specimens	Culture results of the MGIT - LJ method		Total	p
	MTB positive N (%)	MTB negative N (%)		
BAL	0 (0.00)	43 (100.00)	43 (100.00)	0.004*
Non-BAL	19 (20.20)	75 (79.80)	94 (68.60)	

*Statistically significant if p-value less than 0.05

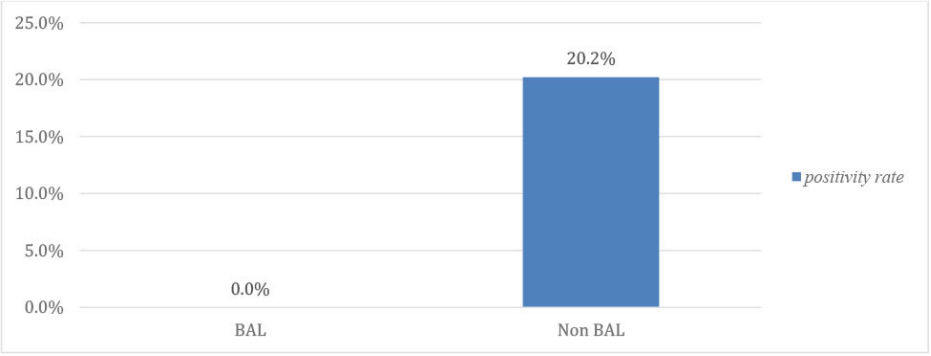

Figure 3. The positivity rate of *Mycobacterium tuberculosis* MGIT - LJ culture method of BAL specimens. No *Mycobacterium tuberculosis* was found from BAL specimens in the MGIT - LJ culture method, and 19 non-BAL specimens were found with a positivity rate of *Mycobacterium tuberculosis* of 20.2%.

Figure 2 shows the positivity rate of *Mycobacterium tuberculosis* MGIT - LJ culture method of aspirate ETT specimens. Positive MTB in ETT aspirate specimens was one specimen with a positivity rate of 16.70%. In non-aspirate specimens, ETT MTB was positive in as many as 18 specimens with a positivity rate of 13.70%.

Based on the chi-square test results in Table 3 between specimen types and with the culture results of the MGIT - LJ method, a p-value of 0.004 was obtained, which means that between specimen types with culture results of the MGIT - LJ method is stated to be statistically meaningful, in BAL and non-BAL specimens are stated to be different to detect MTB with the MGIT - LJ culture method.

Figure 3 shows the positivity rate of *Mycobacterium tuberculosis* MGIT - LJ culture method of BAL specimens. No *Mycobacterium tuberculosis* was found from BAL specimens in the MGIT - LJ culture method, and 19 non-BAL specimens were found with a positivity rate of *Mycobacterium tuberculosis* of 20.2%. Based on the chi-square test results in Table 4 between chest radiography results and culture results of the MGIT - LJ method, a p-value of 0.022 was obtained.

Table 5 shows the analysis of chest radiography diagnostic tests with the gold standard culture MGIT - LJ method. The sensitivity was 68.42%, the specificity 61.86%, and the accuracy was 62.77%. Based on Figure 4, we can see the positivity rate based on the chest radiography result. Chest radiograph with pulmonary TB has a 22.40% positivity rate, while non-pulmonary TB has a 7.60% positivity rate.

Based on the chi-square test results between chest radiography results and culture results of the MGIT - LJ method based on spontaneous sputum specimens, a p-value of 0.062 was obtained, as seen in Table 6. The diagnostic value of chest radiograph results with culture results of MGIT - LJ method of spontaneous sputum specimens can be seen in Table 7.

Table 8 shows the relationship of chest radiography with the culture results of the MGIT - LJ method of aspirate ETT specimens. The relationship was not statistically significant, with a p-value of 1.00. The diagnostic value also showed 0% sensitivity and 60.00% specificity, as seen in Table 9. While Figure 5 shows the positivity rate of *Mycobacterium tuberculosis* MGIT - LJ culture method of ETT aspirate specimens and radiological findings.

Table 10 shows the bivariate analysis of chest radiography with the culture results of the MGIT - LJ method of

Table 4. **Analysis of the relationship of *chest radiography* with the culture results of the MGIT - LJ method from all specimens of lower airway secretion.**

Chest radiography results	Culture results of the MGIT - LJ method		Total	p
	MTB positive N (%)	MTB negative N (%)		
Pulmonary TB	13 (22.40)	45 (77.60)	58 (100.00)	0.022*
Non-pulmonary TB	6 (7.60)	73 (92.40)	79 (100.00)	

*Statistically significant if p-value less than 0.05

Table 5. **Analysis of chest radiography diagnostic tests with gold standard culture MGIT - LJ method.**

Diagnostic test	Diagnostic value
Sensitivity	68.42%
Specificity	61.86%
AUC	0.651
Positive Predictive Value	22.41%
Negative Predictive Value	92.41%
Accuracy	62.77%

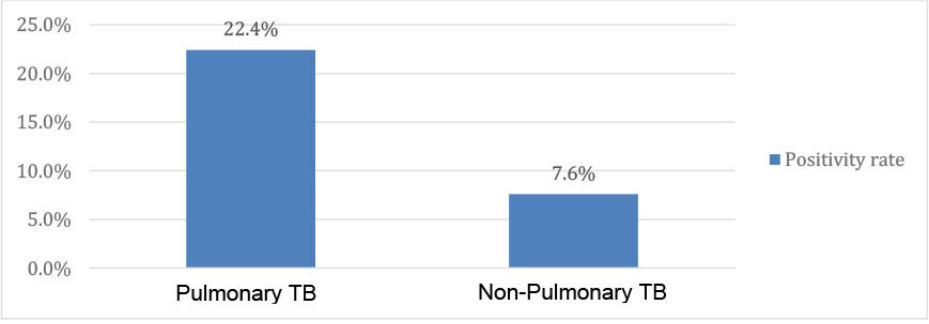

Figure 4. The positivity rate of *Mycobacterium tuberculosis* MGIT - LJ culture method and radiological findings.

Table 6. **Analysis of the relationship of chest radiography and the culture results of the MGIT – LJ method of spontaneous sputum specimens.**

Chest radiography results	Culture results of the MGIT – LJ method		Total	p
	MTB positive N (%)	MTB negative N (%)		
Pulmonary TB	13 (29.50)	31 (70.50)	44 (100.00)	0.062
Non-pulmonary TB	5 (11.40)	39 (88.60)	44 (100.00)	

*Statistically significant if p-value less than 0.05

Table 7. **Analysis of chest radiography diagnostic test with culture results of MGIT - LJ method of spontaneous sputum specimens.**

Diagnostic test	Diagnostic value
Sensitivity	72.2%
Specificity	55.7%
AUC	0.64
Positive Predictive Value	29.5%
Negative Predictive Value	88.6%
Accuracy	59.1%

BAL specimens. Pulmonary and non-pulmonary TB based on chest radiograph results were MTB negative.

DISCUSSION

The sample of this study was 137 results of the examination of lower respiratory tract secretion specimens of patients suspected of pulmonary TB in June – November 2022 at the Clinical Microbiology Laboratory of Dr. Soetomo Academic Hospital Surabaya. Spontaneous sputum specimens in this study had an MTB positivity rate of 20.5%, higher than other specimens by 2%. Another study that studied the characteristics of sputum and TB positivity rate found the positivity rate on sputum was 34.2%. Not in line with other studies which found BAL was 63.4% more sensitive than 43.5% sputum.[11,12]

The diagnosis of pulmonary TB in the ICU has its challenges, especially in obtaining fast and reliable microbiological confirmation. Microbiological sampling of patients with mechanical ventilation will require endotracheal aspirate (ETA), non-directed bronchial lavage, or bronchoalveolar lavage (BAL). ETA is an easy-to-do, inexpensive and non-invasive method, but it has some limitations, such as low specificity and high false positives for diagnosing other lung infections. The positivity rate of MTB in aspirate ETT specimens was 16.7% in this study. In line with other studies identified MTB in critical patient ETT aspirate specimens in the ICU as much as 14%.[10]

Bronchoscopy is a semi-invasive, expensive procedure and is not always present in every health service. A number of studies report diagnostic results of respiratory specimens obtained with flexible bronchoscopy, using positive MTB cultures or evidence of therapeutic responses as criteria for the diagnosis of pulmonary TB. Bronchoscopic sampling has diagnostic results of 50% - 100% when based on cultures of patients suspected of pulmonary TB in HIV infection, with bronchoscopy leading to suspect TB in 34% - 48% of HIV-infected patients, according to two studies.[7,13] Another study found BAL was 63.4% more sensitive than 43.5% sputum. Not in line with this study, in BAL specimens with MGIT - LJ culture, there is no MTB growth. It is important to know

Table 8. **Analysis of the relationship of chest radiography with the culture results of the MGIT - LJ method of aspirate ETT specimens.**

Chest radiography results	Culture results of the MGIT - LJ method		Total	p
	MTB positive N (%)	MTB negative N (%)		
Pulmonary TB	0 (0.00)	2 (100.00)	2 (100.00)	1.000
Non-pulmonary TB	1 (25.00)	3 (75.00)	4 (100.00)	

*Statistically significant if p-value less than 0.05

Table 9. **Analysis of chest radiography diagnostic test with culture results of MGIT - LJ method of aspirate ETT specimens.**

Diagnostic test	Diagnostic value
Sensitivity	0.00%
Specificity	60.00%
AUC	0.3
Positive Predictive Value	0.00%
Negative Predictive Value	75.00%
Accuracy	50.00%

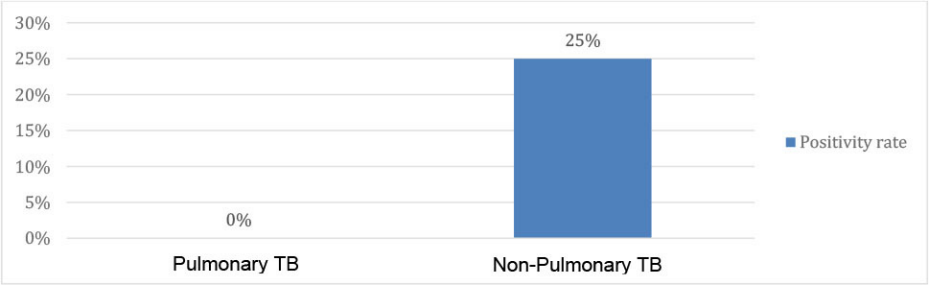

Figure 5. The positivity rate of *Mycobacterium tuberculosis* MGIT - LJ culture method of ETT aspirate specimens and radiological findings.

Table 10. **Analysis of the relationship of chest radiography with the culture results of the MGIT - LJ method of BAL specimens.**

Chest radiography results	Culture results of the MGIT - LJ method		Total
	MTB positive N (%)	MTB negative N (%)	
Pulmonary TB	0 (0.00)	12 (100.00)	12 (100.00)
Non-Pulmonary TB	0 (0.00)	31 (100.00)	31 (100.00)

whether the specimens sent are true from patients who suspect pulmonary TB or are examined only as screening for diseases of the pulmonary parenchyma, such as malignancy in the lungs related to the epidemiology of TB endemic country.[11] TB screening can be done in populations with a minimum TB prevalence of 100/100,000. Systematic screening is carried out on people with TB risk factors to be treated or are under treatment. The number of cases in Indonesia in 2021 was 443,235. The number of mid-year Indonesians in 2022 is 275,773,800 inhabitants[14], so the prevalence of TB in Indonesia is obtained > 100/100,000 people.[14,15]

The diagnostic test in this study has two variables, namely chest radiography as a predictor and MGIT-LJ culture as the gold standard variable. Chest radiography is important to TB diagnosis, especially as an adjuvant test in negative smear TB diagnostic algorithms. Low-specificity chest radiography is often associated with excessive tb diagnosis, resulting in unnecessary TB treatment, waste of resources, and unnecessary toxicity.[8,16] In line with this study, it found that the specificity of the chest radiography diagnostic test from all specimens of lower airway secretion of 61.86% with a weak accuracy rate, based on spontaneous sputum specimens obtained a specificity of 55.7% with a weak accuracy level, based on ETT aspirate specimens obtained specificity of 60% with a very weak accuracy level while diagnostic tests on BAL specimens could not be assessed as caused by the absence of MTB positive. This can be caused by screening to distinguish MTB from pulmonary disease so that the specimens sent are not only from suspected pulmonary TB patients, and the implementation of clinical indication to request MGIT – LJ culture method of ETT and BAL specimens is still confusing.[17-19] The limitation of this study is many factors can influence culture results and radiological findings, but this study did not examine these factors and need future prospective studies to explain the accuracy of the type of sputum specimens.

CONCLUSION

This study showed that the positivity rate of the spontaneous sputum specimen's MGIT – LJ culture method to detect *Mycobacterium tuberculosis* was 20.5% higher than ETT or BAL specimens. Chest radiography findings revealed obtained weak level of accuracy, based on spontaneous sputum specimens obtained a weak level of accuracy, based on ETT aspirate specimens obtained a very weak accuracy level. Chest radiography must be complemented test with the culture method.

CONFLICT OF INTEREST

The author reports no conflicts of interest in this work.

ETHICAL CONSIDERATION

This research was conducted based on the ethical conduct of research from the Ethics Committee of the Medical Faculty, Universitas Airlangga, Dr. Soetomo Hospital, Surabaya.

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AUTHOR CONTRIBUTION

All authors have contributed equally from the conceptual framework, data

acquisition, and data analysis until the study results are reported through publication.

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