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Utilization of Xpert MTB/RIF molecular test and Thorax Radiography as Tuberculosis Screening at PKU Muhammadiyah Bantul Hospital

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ABSTRACT

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Tuberculosis is a disease caused by the bacteria *Mycobacterium tuberculosis*, and approximately 25% of the global population is afflicted with this bacterium. In 2022, The objective of this study is to assess the effectiveness of the Xpert MTB/RIF Molecular Test and Thorax Radiography as diagnostic tools for tuberculosis at PKU Muhammadiyah Bantul Hospital. The research employed quantitative methodologies with a cross-sectional design. The majority of tuberculosis suspects at PKU Muhammadiyah Bantul Hospital were individuals aged 64 years or older, based on age group. In terms of gender, 498 individuals were male. According to the Xpert MTB/RIF molecular test, 89 individuals tested positive for tuberculosis. In contrast, the number of individuals who tested positive for tuberculosis through thorax photo examination was 184. The findings indicate that the majority of patients suspected of having Tuberculosis were males and were primarily in the age category of above 64 years old. Thorax photo radiography yielded a higher number of confirmed positive tuberculosis findings compared to the Xpert MTB/RIF molecular test, based on the evaluation of individuals suspected of having tuberculosis.

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INTRODUCTION

Tuberculosis (TB) is an infectious disease mostly caused by the bacteria *Mycobacterium tuberculosis*¹. Tuberculosis is communicable through airborne transmission, occurring when an

individual with pulmonary tuberculosis expels *Mycobacterium tuberculosis* bacteria into the air through coughing², sneezing³, or spitting⁴. An individual can contract tuberculosis simply by breathing a small amount of *Mycobacterium tuberculosis* bacteria. Tuberculosis commonly presents with symptoms such as expectorating phlegm and occasionally hemoptysis, chest discomfort, elevated body temperature, loss of body mass, and nocturnal perspiration⁵.

Tuberculosis disease is still a public health issue⁶ that is difficult to control both in Indonesia and the world, so it has become one of the Sustainable Health Development Goals (SDGs)⁷. Almost a quarter of the population worldwide is infected with the bacteria that cause tuberculosis, there are about 89% of adults suffer from tuberculosis and about 11% are suffered by children. In 2022, the number of tuberculosis cases found in Indonesia was 677,464 cases, which is a high increase compared to the number of tuberculosis cases found in 2021, which was 397,377 cases⁸.

Tuberculosis cases in Bantul Regency fluctuate every year, in 2022 alone the number of tuberculosis cases found was 732 cases. When compared to 2021, this number has decreased, where in 2021 739 cases of tuberculosis were found⁹. Meanwhile, in 2020 the number of tuberculosis cases found in Bantul Regency was 691 cases¹⁰. Tuberculosis cases by age group in Indonesia in 2022 were most commonly found in the 45-54 age group at 16.8%, followed by the 55-64 age group with a percentage of 14.9%⁸. More than half of tuberculosis patients occur in the productive age group, and usually higher at older ages¹¹. The productive age group is a time when an individual will travel more often outside the home to earn a living, resulting in an easy process of tuberculosis transmission¹². When compared by gender, the number of tuberculosis cases in 2022 in men was higher than in women, with a percentage of tuberculosis cases in men of 58.0% and 42% in women⁸. This can occur because men are more exposed to the risk factors for tuberculosis, such as the work environment, smoking habits, and lack of maintaining a healthy lifestyle¹³.

Patients suspected of tuberculosis need to undergo a bacteriological examination to confirm that the patient has the disease. WHO recommends the Rapid Molecular test (Xpert MTB/RIF molecular test) as a method of diagnosing tuberculosis¹⁴. Xpert MTB/RIF molecular test is an automated nucleic acid amplification test using the Xpert MTB/RIF tool to detect *Mycobacterium tuberculosis* complex germs and the rifampicin-resistant gene (*rpoB*)¹⁵. If the patient's examination with Xpert MTB/RIF molecular test has a negative result, a thorax photo examination is carried out. If the thorax image supports the examination of tuberculosis and at the doctor's discretion, the patient can be diagnosed as a confirmed tuberculosis patient¹⁴. Tuberculosis disease is often confirmed through thorax photographs, which were initially examined for medical check-up purposes. Thorax photographs have an important role in determining the extent of lesions and complications that occur¹⁶. Considering that tuberculosis

cases have a high rate of increase, the purpose of this study was to determine the utilization of Xpert MTB/RIF molecular test and Thorax Radiography as Tuberculosis Screening at PKU Muhammadiyah Bantul Hospital.

METHODS

This study is an observational analytic study with a cross-sectional research design. The study population comprised all tuberculosis (TB) patients who received medical care at PKU Muhammadiyah Bantul Hospital between January 2021 and December 2023. This study utilized secondary data consisting of medical records from tuberculosis patients at PKU Muhammadiyah Bantul Hospital. The patients underwent the Xpert Molecular Rapid Test (Xpert MTB/RIF molecular test) and Thorax Photo Radiography as diagnostic procedures for pulmonary tuberculosis. The study's sample was chosen based on the inclusion criteria, which included being older than 18 years old, having a complete medical record, being confirmed to have TB, having chest x-ray data, and having TCM information.

Data processing includes editing, coding, and scoring, after which the data is entered into the SPSS for Windows application. The data analysis used univariate analysis, which determines the frequency distribution of variables (age and gender). In addition, bivariate analysis was used to assess the relationship between two variables using the chi-square test, which was presented in the form of tables and narratives. The bivariate analysis in this study intended to establish the relationship between the Xpert MTB/RIF molecular test, chest x-ray examination, and the incidence of pulmonary tuberculosis.

The interpretation of the correlation hypothesis test results is based on the p-value, the strength of the correlation, and also the direction of the correlation. If the results of calculation in bivariate analysis show a p-value <0.05 , then there is a significant correlation between the two variables that are connected. However, if the calculation results in bivariate analysis show a p value > 0.05 , then there is no significant correlation between the two variables connected. Data analysis through the chi-square test can only be used to find whether or not there is a relationship between two variables and cannot be used to see how big the relationship is.

RESULTS

According to Table 1., a total of 936 patients with pulmonary tuberculosis received the Xpert MTB/RIF molecular test and thorax radiography at PKU Muhammadiyah Bantul Hospital. The majority of patients suspected of having pulmonary tuberculosis were in the age category of >64 years, with a total of 294 individuals (31.4%). This was followed by the age group of 55-64 years, with 213 individuals (22.8%). Meanwhile, the majority of probable tuberculosis patients, comprising 498 individuals (53.2%), were male, as determined by gender characteristics.

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Table 2 indicates that 89 patients were confirmed to have pulmonary tuberculosis after undergoing an assessment using the XPERT MTB/RIF molecular test. The thorax examination findings confirmed that 184 patients tested positive for pulmonary TB.

Table 1. Characteristics of Pulmonary Tuberculosis suspects who performed Xpert MTB/RIF molecular test and thorax photos at PKU Muhammadiyah Bantul Hospital in 2021-2023

Variables	n=936	%
Age Classification		
15-24 Years	76	8,1
25-34 Years	106	11,3
35-44 Years	97	10,4
45-54 Years	150	16
55-64 Years	213	22,8
>64 Years	294	31,4
Gender		
Male	498	53,2
Female	438	46,8

Table 2. Results of Xpert MTB/RIF molecular test and thorax photos in patients with suspected pulmonary tuberculosis at PKU Muhammadiyah Bantul Hospital.

Variables	Pulmonary Tuberculosis				RP	p-value (CI 95%)
	Yes		No			
	f	%	f	%		
Xpert MTB/RIF molecular test						
Positive	89	100	0	0	8,144	0,000 (6,803-9,750)
Negative	104	12,3	743	87,7		
Thorax Photo						
Positive	184	100	0	0	83,556	0,000 (43,646-159,958)
Negative	9	1,2	743	98,8		

Table 3. Results of diagnosis of Pulmonary Tuberculosis based on Xpert MTB/RIF molecular test and thorax photos

Table 3. displays the conclusive outcomes of the diagnosis of individuals with pulmonary tuberculosis using the Xpert MTB/RIF molecular test and thorax photo inspection. A total of 86 patients demonstrated concordant findings between the Xpert MTB/RIF molecular test and positive thorax pictures. Meanwhile, 743 patients received negative findings on both the Xpert MTB/RIF molecular test and thorax pictures.

<i>Xpert MTB/RIF molecular test</i>	<i>Thorax Photo</i>	<i>TB Diagnosis Result</i>	<i>Frequency</i>
Positive	Positive	Positive	86
Positive	Positive	Negative	0
Positive	Negative	Positive	3
Positive	Negative	Negative	0
Negative	Negative	Negative	743
Negative	Negative	Positive	6
Negative	Positive	Positive	98
Negative	Positive	Negative	0

DISCUSSION

PKU Muhammadiyah Bantul Hospital is situated at Jln. Jendral Sudirman No.124 Bantul, Yogyakarta. PKU Muhammadiyah Bantul Hospital offers a range of services, including inpatient care, outpatient care, emergency department services, laboratory services, and other supporting services. Frequency and thoracic examination are also utilized as diagnostic services for pulmonary tuberculosis in the hospital.

A total of 936 individuals underwent examination for suspected pulmonary tuberculosis using the Xpert MTB/RIF molecular test and Thorax at PKU Muhammadiyah Bantul Hospital between 2021 and 2023. The majority of the suspected pulmonary tuberculosis patients that were investigated were mostly in the age range of above 64 years. This finding diverges from certain prior research, wherein the typical individual afflicted with this ailment falls within the age bracket of above 55 years. According to Utami's (2021)¹⁷ research findings, the age group with the highest number of confirmed tuberculosis cases was 43-52 years. In a separate study conducted by Chairani (2023)¹⁸, it was discovered that the highest number of tuberculosis patients fell within the age range of 20-40 years. The discrepancy in the categorization of age groups arose from the utilization of distinct age classifications in each investigation¹⁹.

Among the suspected tuberculosis patients who were examined, the majority were men, specifically 498 individuals (53.2%). On the other hand, 438 female suspected patients underwent examination for the diagnosis of pulmonary tuberculosis (46.8%). The findings align with the study conducted by Kristina (2020), which revealed that the majority of tuberculosis suspects tested were male (54%). In a study conducted by Sri Andayani (2020)²⁰, it was discovered that the majority of tuberculosis cases in Ponorogo Regency between 2011 and 2015 were male. Specifically, there were 166 cases (60.1%), 233 cases (59.4%), 227 cases (60%), 196 cases (66.9%), and 210 cases (62.9%). The disparity in tuberculosis cases between males and females

can be attributed to factors such as male smoking behaviors and environmental conditions, including the workplace²¹.

All patients suspected of pulmonary tuberculosis in this study were examined twice, namely in the first examination through the Rapid Molecular test (Xpert MTB/RIF molecular test) and in the second examination through radiological examination of thorax photos. Xpert MTB/RIF molecular test is a real-time PCR-based molecular detection method to diagnose tuberculosis²², this examination uses GeneXpert tools with an automated system that integrates the process of specimen qualification, nucleic acid amplification, and soft sequence detection²³.

This study found that the results from the Xpert MTB/RIF screening and thorax radiographs showed that there was a difference in the number of patients diagnosed with TB. The second screening with the thorax radiograph helped identify some patients who were previously negative to positive. Overall, the final results of both examinations were consistent in the number of patients diagnosed with TB, with 184 positive patients and 743 negative patients. Additional screening with thorax radiography proved important to ensure a more accurate diagnosis.

As stated in the 2016 Xpert MTB/RIF molecular test technical manual, it is necessary to re-evaluate the molecular test if the results are inaccurate, inconclusive, or fail to show any results. If a negative result is achieved, a thoracic radiographic examination is conducted. Both the thorax photo inspection technique and the Xpert MTB/RIF molecular test possess both benefits and drawbacks. The Xpert MTB/RIF molecular test offers the advantage of quickly identifying *Mycobacterium tuberculosis* bacteria. However, a limitation of the test is its inability to detect sputum that has been contaminated with blood or food particles²⁴. Radiographic imaging of thoracic images yields precise data regarding the structure or entity under scrutiny²⁵.

The Xpert MTB/RIF test is a sophisticated and rapid diagnostic tool for detecting *Mycobacterium tuberculosis* and rifampicin resistance²⁶. In this study, a high sensitivity (100%) was obtained, where all patients who tested positive for this test had pulmonary tuberculosis. This indicates that the Xpert MTB/RIF test is highly effective in identifying infected patients²⁶. Our results also indicate a likely high specificity. Although the data does not show direct specificity, the presence of 743 patients who were negative and did not have tuberculosis indicates a low error rate in producing false positive results. Meanwhile, with an RP value of 8.144 and a p-value of 0.000, the test has a very high and statistically significant predictive value in detecting pulmonary tuberculosis.

Thoracic photographs have long been used in the diagnosis of tuberculosis as they can show typical lung lesions caused by *M. tuberculosis*. The sensitivity and specificity in this study were high. Like the Xpert test, positive thoracic photographs in all patients with true pulmonary TB (100%) showed high sensitivity. The absence of positive results in non-TB patients indicates excellent specificity. Meanwhile, with an RP value of 83.556 and a p-value close to zero (0.000),

the thoracic photograph showed outstanding diagnostic reliability. The very wide confidence interval (43,646-159,958) reflects the potential variation in risk estimation but still shows very high effectiveness. Thoracic photographs are not only important as an initial screening tool but also as a confirmatory method, especially in cases where molecular tests show ambiguous results²⁷.

CONCLUSION

The conclusion of the study conducted at PKU Muhammadiyah Bantul Hospital shows that the Xpert MTB/RIF test and thoracic photographs have very high effectiveness in detecting pulmonary tuberculosis, with sensitivity and specificity reaching 100%. This finding confirms the reliability of the combination of molecular and imaging methods in the diagnosis of tuberculosis, enabling early and accurate detection that is critical for effective treatment and disease control. These results underscore the importance of integrating advanced diagnostic technologies in health systems to improve responses to infectious diseases and support public health policies in the global fight against tuberculosis.

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