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RESEARCH ARTICLE

RESULTS OF GENEXPERT EXAMINATION IN PATIENTS SUSPECTED OF TUBERCULOSIS AT DR. SOEPRAOEN ARMY HOSPITAL IN 2023 (*HASIL PEMERIKSAAN GENEXPERT PADA PASIEN TERDUGA TUBERKULOSIS DI RUMAH SAKIT TENTARA DR. SOEPRAOEN TAHUN 2023)*

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ABSTRACT

Pulmonary tuberculosis is an infectious disease that continues to be a major public health problem worldwide. It is caused by *Mycobacterium tuberculosis* infection and remains the second leading cause of death from infectious diseases globally. According to the 2023 report from the Malang City Health Office, there were 17,010 suspected tuberculosis cases. Confirmed cases included 565 cases identified at primary health centers, 1,632 at hospitals, and 19 in correctional facilities. This study aimed to describe the GeneXpert examination results among suspected tuberculosis cases at Dr. Soepraoen Army Hospital (RST TK II Dr, Soepraoen), Malang. The study employed a descriptive cross-sectional design using the total sampling method. A total of 2,944 samples were examined. The findings showed that GeneXpert examinations were most frequently conducted among young adults (20–44 years), followed by middle adults (45–64 years). Based on gender, men constituted the majority, accounting for 58% of the study population, while women made up 42% of the cases. Regarding patients' location of residence, Sukun District in Malang City had the highest number of patients who tested positive for tuberculosis by the GeneXpert examination. Overall, positive GeneXpert were most frequently observed among young adult and middle-age adults. In addition, the number of men with positive results was higher than that of women. Sukun District recorded the highest number of positive GeneXpert results at RST TK II Dr. Soepraoen.

Keywords: GeneXpert, *Mycobacterium tuberculosis*, molecular rapid test, pulmonary tuberculosis

ABSTRAK

Tuberkulosis paru merupakan penyakit infeksi yang masih menjadi masalah kesehatan masyarakat global dan termasuk salah satu penyebab utama kematian akibat penyakit menular di dunia. Penyakit ini disebabkan oleh infeksi bakteri Mycobacterium tuberculosis *dan terus menjadi tantangan, khususnya di negara berkembang. Berdasarkan laporan Dinas Kesehatan Kota Malang tahun 2023, tercatat 17.010 kasus suspek tuberkulosis, dengan 565 kasus ditemukan di puskesmas, 1.632 kasus di rumah sakit, dan 19 kasus di lembaga pemasyarakatan. Tingginya angka tersebut menunjukkan pentingnya deteksi dini melalui pemeriksaan yang*

cepat dan akurat. Penelitian ini bertujuan untuk mendeskripsikan secara komprehensif hasil pemeriksaan GeneXpert pada pasien suspek tuberkulosis paru di RST TK II Dr. Soepraoen Malang, serta menganalisis distribusi kasus berdasarkan karakteristik usia, jenis kelamin, dan lokasi tempat tinggal. Penelitian ini menggunakan pendekatan deskriptif dengan menganalisis seluruh sampel yang diperiksa menggunakan metode uji cepat molekuler GeneXpert. Hasil penelitian menunjukkan bahwa pemeriksaan paling banyak dilakukan pada kelompok usia dewasa muda (20–44 tahun), diikuti dewasa madya (45–64 tahun). Berdasarkan jenis kelamin, laki-laki mendominasi sebesar 58%, sedangkan perempuan 42%. Berdasarkan wilayah tempat tinggal, Kecamatan Sukun merupakan daerah dengan jumlah hasil positif terbanyak. Secara keseluruhan, kelompok usia dewasa muda dan dewasa madya merupakan kelompok yang paling sering menunjukkan hasil positif tuberkulosis. Selain itu, proporsi laki-laki dengan hasil positif lebih tinggi dibandingkan perempuan. Temuan ini menegaskan pentingnya skrining aktif dan pemeriksaan molekuler cepat sebagai upaya pengendalian tuberkulosis di wilayah Kota Malang.

Kata kunci: GeneXpert, Mycobacterium tuberculosis, *uji cepat molekuler, tuberkulosis paru*

INTRODUCTION

Pulmonary tuberculosis is an infectious disease caused by Mycobacterium tuberculosis (M. tuberculosis), one of the Mycobacterium species that most frequently infects humans. [1] This bacterium is rod-shaped, non-spore-forming, has a thick, fatty wall, is acid-fast (AFB), and is aerobic.[1,2,3] These characteristics enable M. tuberculosis to survive in a body environment with high oxygen levels.[4,6]

Transmission occurs through respiratory droplets expelled from an infected person when they cough or sneeze.[5] Once inhaled, the bacteria multiply in the lungs and can spread to other organs, especially in individuals with compromised immune systems. The bacteria multiply over a period of 2–12 weeks until they reach numbers to stimulate an immune response and become detectable by a tuberculin skin test.[6,7]

Tuberculosis (TB) can affect various organs such as the lungs, lymph nodes, bones, kidneys, and brain, with the lungs being the most commonly affected organ. The main symptoms include a cough lasting more than two weeks, bloody sputum, shortness of breath, persistent fever, weight loss, and night sweats [8,9,10]. To confirm the diagnosis, patients with suspected TB must undergo bacteriological examination. The World Health Organization recommends culture and drug susceptibility testing for rifampicin and isoniazid, using either conventional methods or rapid molecular diagnostic tests.[11] Molecular testing, including detection of Mycobacterium tuberculosis DNA, is now the fastest method and is widely available in Indonesia.

Tuberculosis (TB) is a contagious infectious disease caused by *Mycobacterium tuberculosis*, an acid-fast bacillus transmitted through respiratory droplets when an infected person coughs or sneezes. Bacteriological examination is the primary and mandatory step in establishing a diagnosis in patients suspected of having tuberculosis, given that clinical symptoms and radiological findings are often non-specific. In international guidelines, the World Health Organization recommends culture examination and susceptibility testing for rifampin and isoniazid, both through conventional methods and through rapid molecular diagnostic tests. Molecular tests that detect DNA from Mycobacterium tuberculosis are now the fastest diagnostic method widely available in Indonesia. Molecular diagnostics are able not only to detect the presence of bacteria but also to differentiate between Mycobacterium tuberculosis complex and Non-Tuberculous Mycobacteria (NTM), thus increasing the accuracy of diagnosis in doubtful cases.[12]

In the last decade, GeneXpert has become one of the most revolutionary molecular methods for TB diagnosis. GeneXpert works based on the principle of real-time Polymerase Chain Reaction (RT-PCR), enabling rapid and accurate detection of *Mycobacterium tuberculosis*, including the identification of resistance to rifampicin as an early marker of drug-resistant TB.[13,14,15] GeneXpert's advantages over traditional methods include rapid testing times, simpler procedural standards, and high sensitivity, especially in samples with low bacterial loads. The integration of this molecular technology has reduced diagnostic delays, which have been a major challenge in tuberculosis management for many years.

Globally, tuberculosis remains a leading cause of morbidity and mortality due to infectious diseases. In 2019, there were an estimated 10 million TB cases worldwide, including 5.6 million men, 3.2 million women, and 1.2 million children.[16] Most TB cases are found in adults (≥15 years), accounting for approximately 90% of all cases.[4] This disease is also closely linked to immunocompromised conditions, including HIV infection, with 72% of HIV-associated TB cases occurring in Africa. [4] The global distribution of TB shows that the caseload is concentrated in several countries, including India (27%), China (9%), Indonesia (8%), the Philippines (6%), Nigeria (4%), Bangladesh (4%), and South Africa (3%).[4]

Indonesia is one of the countries with the highest TB burden in the world. In 2024, Indonesia ranked third after India and China in the number of tuberculosis cases.

Epidemiological data indicate that TB cases are more prevalent in men than in women.1[6] Factors influencing this phenomenon include greater mobility among men, exposure to high-risk occupational environments, and a higher prevalence of smoking, which may increase susceptibility to TB infection. On the other hand, women generally pay more attention to their own health and seek healthcare more promptly, thus reducing the risk of developing severe illness.[16]

The high burden of TB in Indonesia underscores the importance of rapid, accurate, and standardized diagnosis. Early detection is a key step recommended by the WHO as a strategy to reduce transmission, prevent further complications, and lower mortality. [5,17] TB management requires accurate initial diagnosis to ensure targeted treatment, given the potential for drug resistance that may complicate the disease management. Therefore, the development of diagnostic technology, including the use of GeneXpert , is essential as part of the TB control system in healthcare facilities.

At the local level, tuberculosis is also a significant health problem in Malang City. According to a 2023 report from the Malang City Health Office, there were 17,010 people categorized as suspected tuberculosis. Of these, confirmed cases identified through healthcare facilities 565 cases reported by community health centers, 1,632 cases diagnosed in hospitals, and 19 cases identified in correctional institutions.[18,19] The high number of confirmed cases indicates that Malang City has a significant TB burden, thus requiring an effective and sensitive diagnostic approach.

Considering the high number of TB at the global, national, and local levels, and the importance of early detection through molecular testing, this study was conducted to analyze the results of GeneXpert tests in patients suspected of having tuberculosis at Dr. Soepraoen Hospital, Malang. This study is expected to provide additional information regarding the distribution patterns of cases based on patient demographic characteristics, as well as an overview of the frequency of positive GeneXpert results in tertiary healthcare facilities.

MATERIALS AND METHODS

The study employed a descriptive cross-sectional design to describe the *GeneXpert* test results among patients suspected of having tuberculosis at Dr. Soepraoen Hospital. The study used a total sampling method. Based on data from Dr. Soepraoen Class II Hospital, a total of 2,944 GeneXpert examination results were recorded from January to December 2023. Data were collected from secondary sources in the form of medical records of patients

suspected of tuberculosis (TB) who met the criteria. This study began with an observation phase at the Laboratory of Dr. Soepraoen Class II Hospital, followed by obtaining ethial approval and permission for data collection. The data collected consisted of GeneXpert examination results obtained from the medical records of patients with suspected tuberculosis.

The GeneXpert examination is based on the detection of *Mycobacterium tuberculosis* DNA using an automated PCR method in a closed-cartridge system and is able to identify rifampicin resistance. The sample used is generally sputum, the standard specimen for pulmonary TB examination. Patients presented to the hospital either through a referral from a community health centers, other health facilities, or coming in person. Following clinical examination by a phsycian, sputum samples were collected and processed in the laboratory using the GeneXpert, and the examination results were used to confirm the diagnosis of tuberculosis. The GeneXpert examination detecs *Mycobacterium tuberculosis* DNA using an automated PCR method in a closed cartridge, with the sputum serving as the primary specimen. The diagnostic process begins when patients present to the hospital, patients with a percentage of 19.5%. This is illustrated in Table 1. Which is explained below:

either through a referral or by self-resentation. Patients are then examined by a physician, after which a sputum sample is collected, and processed in the laboratory using GeneXpert. The examination results are subsequently used to support the diagnosis of TB.

RESULTS AND DISCUSSION

This study involved 2,944 samples. The distribution of GeneXpert examination results according to age, based on the World Health Organization (WHO) age classification, is presented in Table 1. Among infants (0-1 years) 2 patients tested positive(0.6 %), while 14 negative infants with a percentage of 0.5%. No positive cases were identified among toddlers (1-5 years), whereas 54 patients tested negative (1.8 %). Among children (6-12 years), 1 patient tested positive (0.3%), while 132 tested negative (2.1%). In adolescents (13-19 years), 32 patients tested positive (9.5%), whereas 190 tested negative (6.5%).

Among young adults (20-44 years), 133 tested positive (39%), while 760 tested negative (29%). Similarly, among middle-aged adults (45-64 years old), 130 patients tested positive (38.4%), while 948 tested negative(36%). In the elderly group (>65 years), 40 patients tested positive (11.8%), while the remining tested negative.

Table 1 Characteristics of GeneXpert Examination Results in Patients Suspected of Having TB Based on Age

Variable (Age)	GeneXpert Positive (N)	% Positive	GeneXpert Negative (N)	% Negative
0–1 years	2	0.6%	–	0.5%
1–5 years	–	–	54	1.8%
6–12 years	1	0.3%	132	2.1%
13–19 years	32	9.5%	190	6.5%
20–44 years	133	39%	760	29%
45–64 years	130	38.4%	948	36%
> 65 years	40	11.8%	508	19.5%
Total	**338**	**100%**	**2,606**	**100%**

The data shows that GeneXpert examinations at RST TK II Dr. Soepraoen in 2023 were most frequently performed among the young adult age group (20-44 years), followed by the middle adult age group (45-64 years). These findings are in accordance with those reported by Sihotang et al. (2012), who found that 58 (48.2%) TB patients were aged 25-49 years, of whom 56.9% were male and 43.1% were female. [20] Similarly, Munoz et al. (2013) reported that among 50 patients with pulmonary TB in Barcelona, the largest proportion (49.3%) was aged 20-49 years, 35 (70%) male patients and 15 (30%) female patients.[8]

The high number of TB cases among individuals of productive age is thought to be closely related to their greater likelihood of exposure to *M. Tuberculosis* through contact with infected individuals.[2] Furthermore, demographic changes have led to a higher life expectancy among older adults. However, it is also possible for older adults or other non-productive age groups to be infected with pulmonary TB because immune function declines with advancing age, , making them more susceptible to various diseases, including pulmonary TB. [16,2]

Table 2 Characteristics of GeneXpert examination results in patients suspected of having TB based on gender

Variables	GeneXpert Positive (N / %)	GeneXpert Negative (N / %)
Man	196 (58%)	1,246 (47.8 %)
Woman	142 (42%)	1,360 (52.2 %)
Total	**338 (100%)**	**2,606 (100%)**

Table 2 shows that based on gender, 196 male patients (58%) tested positive, while 1,246 (47.8%) tested negative . Among female patients, 142 tested positive (42%), while 1,360 (52.2%) tested negative These data indicate that GeneXpert testings at RST Class II Dr. Soepraoen in 2023 were frequently performed among male patients.

These findings are consistent with those of Andina et al. (2012). In that study, 36 smear-negative pulmonary TB samples from Adam Malik General Hospital, Pirngadi Hospital, and the Medan BPPP were examined using the PCR method. Of the samples confirmed positive by PCR, the majority were from male patients (25 cases; 69.5 %), while 11 cases (30.5%) were from female pateints [22]

The higher number of TB cases among men is thought to be related to their greater occupational and social activities, which may increase their exposure to *M. tuberculosis* through contact with infected individuals. In addition, behavioral differences between men and women may contribute to this disparity, as smoking is more prevalent among men (96.3%) than among women (3.7%). Furthermore, men are more likely to work in high-risk occupational environments ans spend more time outside the home. [21,22]

Table 3 Characteristics of GeneXpert Examination Results in Patients Suspected of Having TB Based on the Sub-district of Residence

Variable (Sub-district)	GeneXpert Positive (N / %)	GeneXpert Negative (N / %)
Breadfruit	159 (47%)	1,442 (55.3 %)
Kedung Sometimes	38 (11.2 %)	181 (6.9 %)
Wagir	30 (8.9 %)	183 (7%)
Starfruit	25 (7.4 %)	154 (5.9 %)
Pakisaji	18 (5.3 %)	71 (2.7 %)

Based on Table 3, Sukun District recorded the highest number of patients with positive tuberculosis results, with 159 patients (47%), while 1,442 patients (55.3%) tested negative . Kedung Kandang District ranked second, with 38 positive patients (11.2 %) and 181 negative patients (6.9%). This was followed by Wagir District, with 30 positive patients (8.9 %) and 183 negative patients (7%). Blimbing District recorded 25 positive patients (7.4 %) and 154 negative patients (5.9%), while Pakisaji District had 18 positive patients (5.3 %) and 71 negative patients (2.7%). Klojen District had 17 positive patients (5%) and 162 negative patients (6.2%). Meanwhile, Lowokwaru District and Dau District each recorder 5 positive patients

(1.5%). Lowokwaru had 66 negative patients (2.5%), while Dau recorded 42 negative patients (1.6%).

The high number of positive cases in Sukun District may be influenced by various risk factors. This district is one of the most densely populated areas; the potential for airborne transmission is greater, especially in densely populated residential areas with suboptimal ventilation. Furthermore, some residents work in the informal sector, which often involves high mobility, and may increase opportunities for contact with individuals infected with TB. Smoking habits, inadequate environmental sanitation, and limited public awareness of TB symptoms and prevention may also contribute to an increased risk of transmission. Collectively, these factors may partially explain the higher n umber of positive cases in Sukun District compared with other districts.

Based on the research results, Sukun District in Malang City recorded the highest number of positive GeneXpert results for tuberculosis. These findings are consistent with TB case detection reports from the Malang City Health Office, which also identified Sukun District as the area with the highest number of TB cases. According to the report, seven TB cases were identified and treated, consisting of six men and one woman. Furthermore, 143 individuals with suspected TB cases received standard care, comprising 79 men and 64 women.

The high number of TB cases in Sukun District may be influenced by several risk factors. Poor environmental hygiene is one contributing factor, particularly living in crowded environments with inadequate ventilation, which may facilitate TB transmission. Certain occupations, particularly those involving exposure to dust or work in enclosed spaces, may also also increase the risk of TB infection. Furthermore, unhealthy habits

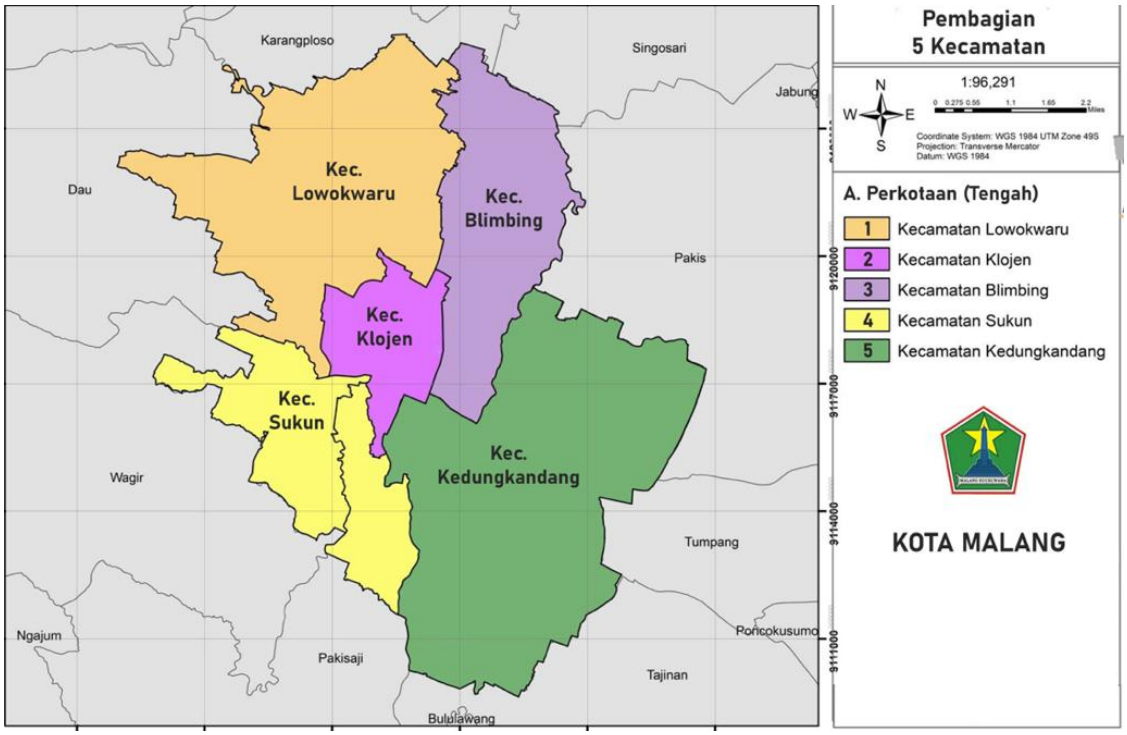

Figure 1 Location Map of Sukun District, Malang.
Quoted from: Malang City Health Office.[18]

CONCLUSION

The results of this study showed that tuberculosis was most frequently identified among the young to middle-age population, a group generally characterized by high levels of social activity and mobility. GeneXpert testing also showed that positive cases were more common in men, supporting previous findings that men are at greater risk of TB exposure due to occupational factors, smoking habits, and increased social and workplace interactions. Furthermore, the majority of patients who underwent GeneXpert testing were from Sukun District, an area reported to have the highest number of TB cases in Malang City. This pattern suggests that environmental factors and population density may contribute to an increased risk of TB transmission in the district.

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