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IMPROVING PUBLIC KNOWLEDGE OF THE IMPORTANCE OF ROUTINE BLOOD EXAMINATION IN PATIENTS WITH PULMONARY TUBERCULOSIS

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Abstract

Patients with pulmonary tuberculosis (TB) often experience hematological abnormalities, such as anemia, elevated erythrocyte sedimentation rate (ESR), and changes in leukocyte and platelet counts, due to chronic infection or side effects of anti-tuberculosis drugs. However, patients and their families generally know only about sputum examination and do not understand the benefits of routine blood examination. This community service activity aimed to improve TB patients' and families' knowledge of the importance of routine blood examination. The activity was held on 17 January 2025 at Puskesmas 7 Ulu Palembang and involved 40 participants, consisting of 18 pulmonary TB patients and 22 family members or treatment supporters. It included interactive counseling, complete blood count and ESR testing for TB patients, and explanation of the results. Knowledge was measured with a 15-item questionnaire before and after education. ESR was elevated in 13 patients (72.2%), anemia was found in 10 (55.6%), lymphopenia in 6 (33.3%), thrombocytosis in 5 (27.8%), and leukocytosis in 4 (22.2%). Elevated ESR was more frequent in the intensive phase than in the continuation phase (100% vs 50.0%; $p = 0.036$). The mean knowledge score increased from 43.3 ± 18.4 to 79.2 ± 12.3 ($p < 0.001$), with a mean N-gain of 0.65 (moderate). Education combined with routine blood examination improves patients' and families' knowledge and identifies hematological abnormalities that need monitoring during TB treatment.

Keywords: *anemia; erythrocyte sedimentation rate; health education; pulmonary tuberculosis; routine blood examination*

INTRODUCTION

Pulmonary tuberculosis (TB) remains a major health issue in Indonesia, which ranks second globally in terms of the number of TB cases (World Health Organization [WHO], 2024). The government has set a target to eliminate TB by 2030 through case detection, completion of treatment, and patient monitoring throughout the treatment course (President of the Republic of

Indonesia, 2021; Ministry of Health of the Republic of Indonesia, 2020). Treatment success is determined not only by adherence to medication but also by the monitoring of a patient's condition, including through laboratory examinations.

In addition to sputum tests, routine blood tests provide essential information regarding the condition of a TB patient. A prolonged *Mycobacterium tuberculosis* infection triggers chronic inflammation, which can lead to anemia of chronic disease, an elevated erythrocyte sedimentation rate (ESR), and alterations in the counts of leukocytes, lymphocytes, and platelets. Anti-tuberculosis drugs (ATDs) can also cause hematological side effects. Anemia is a common hematological disorder in TB patients and can worsen both their general condition and treatment outcomes (Kurniaji et al., 2023). Research on pulmonary TB patients in Jakarta has also shown that hemoglobin levels and leukocyte counts change over the course of ATD therapy (Permana, 2020). Therefore, routine blood tests are useful for detecting anemia, monitoring inflammation, and identifying drug-related side effects at an early stage.

On the other hand, TB patients and their families are generally familiar only with sputum tests and do not yet understand why blood tests are also necessary. The 7 Ulu Community Health Center (*Puskesmas*) in Palembang serves TB patients from densely populated residential areas in the Seberang Ulu I District. Coordination with the health center's TB program manager revealed that some patients have never undergone routine blood tests during their treatment, and some family members or treatment supervisors (*pengawas menelan obat*—PMO) are not yet aware of the signs of anemia or the potential side effects of ATDs. Therefore, the team from the Bachelor of Applied Science (D4) Program in Medical Laboratory Technology and the Master's Program in Public Health at Universitas Kader Bangsa conducted an educational initiative regarding the importance of routine blood tests for patients with pulmonary tuberculosis (TB). This activity aimed to (1) improve the understanding of patients and their families concerning routine blood tests and their clinical significance, and (2) perform routine blood tests—including the erythrocyte sedimentation rate (ESR)—on TB patients, serving as a practical demonstration of the benefits of such testing and providing data to assist the community health center (puskesmas) in patient monitoring.

METHOD

Time, location, and target audience. The activity took place on Friday, January 17, 2025, at the 7 Ulu Community Health Center (Puskesmas), Seberang Ulu I District, Palembang City. The target participants were pulmonary tuberculosis (TB) patients undergoing treatment at the 7 Ulu Community Health Center, along with their family members or treatment supervisors (known as *Pengawas Menelan Obat* or PMO). Participants were invited through the community health center's TB program coordinator. A total of 40 individuals participated in the full range of activities, consisting of 18 patients and 22 family members/treatment supervisors.

Implementation team and partners. The activity was conducted by faculty members from the Bachelor of Applied Science (D4) program in Medical Laboratory Technology and the Master's program in Public Health at Universitas Kader Bangsa, with assistance from students, in collaboration with the TB program coordinator and laboratory staff at the 7 Ulu Community Health Center.

Activity stages.

1. Preparation. The team coordinated with the community health center, developed educational materials and a leaflet titled "Blood Testing: Monitoring TB Treatment," prepared questionnaires, and organized the necessary equipment and supplies for venous blood collection.
2. Pre-test. Participants provided their demographic information and completed a 15-item questionnaire to assess their knowledge.
3. Education. An interactive session lasting approximately 60 minutes covered routine blood tests (hemoglobin, leukocyte count and differential, and platelet count) as well as the erythrocyte sedimentation rate (ESR). The session explained the significance of each parameter for TB patients, signs of anemia, potential side effects of anti-TB medication (OAT) that require attention, the testing schedule throughout the treatment period, and the role of family members/treatment supervisors in supporting patients.
4. Routine blood testing and ESR. Venous blood samples were collected from TB patients by laboratory staff using K3EDTA as an anticoagulant. Routine blood parameters were analyzed using a hematology analyzer (specify the brand and model of the device, as well

as the laboratory where the analysis was performed), and the ESR was determined using the Westergren method.

5. Evaluation and follow-up. Participants completed a post-test. The test results were communicated to the patients and reported to the physician in charge of the TB program for further follow-up.

Outcome criteria. Anemia is defined as a hemoglobin level <13 g/dL in men or <12 g/dL in women. Leukocytosis is defined as a leukocyte count >10,000/µL, thrombocytosis as a platelet count >450,000/µL, and lymphopenia as a lymphocyte count <20%. The erythrocyte sedimentation rate (ESR) is considered elevated if it exceeds 15 mm/hour in men or 20 mm/hour in women.

Data analysis. Data are presented as frequencies, percentages, and means ± standard deviation (SD). Differences in the proportions of abnormalities between the intensive phase and the continuation phase were assessed using Fisher's exact test. Knowledge was measured using a 15-item true-false questionnaire, with scores ranging from 0–100, categorized as good (≥76), fair (56–75), and poor (<56). The difference between pre-test and post-test scores followed a normal distribution (Shapiro–Wilk $p = 0.351$); therefore, it was analyzed using a paired t-test. The effectiveness of the education was evaluated using the N-gain score. Statistical significance was set at $p < 0.05$.

RESULTS AND DISCUSSION

Implementation of activities

The activity lasted for approximately 3 hours and was attended by 40 participants. Patients and their families actively asked questions—most notably regarding why patients often feel weak despite taking their medication regularly, whether red-colored urine caused by the medication is dangerous, and how frequently blood tests should be performed. Prior to the activity, only 5 out of 18 patients (27.8%) had ever undergone routine blood tests during their TB treatment.

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Figure 1. Documentation of Activities

Participant characteristics

Table 1. Participant characteristics (n = 40)

Characteristics	Category	n	%
Status	Pulmonary TB patient	18	45,0
	Family/PMO	22	55,0
Gender	Male	19	47,5
	Female	21	52,5
Age	18–30 years	7	17,5
	31–45 years	14	35,0
	46–60 years	13	32,5
	>60 years	6	15,0
Education	Elementary/Junior High School	15	37,5
	High school/Equivalent	19	47,5
	College	6	15,0
Patient treatment phase (n = 18)	Intensive	8	44,4
	Advanced	10	55,6

Routine blood test results for TB patients

Table 2. Routine blood test and ESR results for pulmonary TB patients (n = 18)

Parameter	Mean ± SD	Abnormality	n (%)
Hemoglobin (g/dL)	11,9 ± 1,5	Anemia	10 (55,6)
Leukosit (×10³/µL)	8,6 ± 2,6	Leukocytosis	4 (22,2)
Limfosit (%)	21 ± 8	Lymphopenia	6 (33,3)
Trombosit (×10³/µL)	382 ± 98	Thrombocytosis	5 (27,8)
LED (mm/h)	46 ± 27	Increase	13 (72,2)

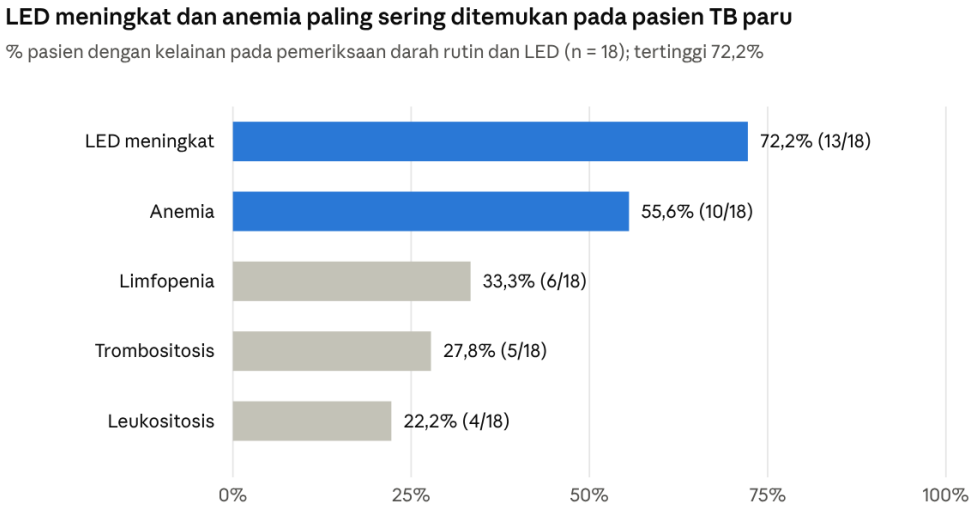


Figure 2. Percentage of pulmonary TB patients with abnormalities in routine blood tests and ESR

The most frequently observed abnormalities are an elevated erythrocyte sedimentation rate (ESR) (72.2%) and anemia (55.6%). The ESR increases because chronic inflammation raises the levels of fibrinogen and globulins in the plasma, which facilitates the formation of "rouleaux" (stacks of red blood cells) and causes them to settle more rapidly. Anemia in tuberculosis (TB) patients is typically classified as anemia of chronic disease, as inflammatory cytokines inhibit iron utilization and the production of red blood cells. This condition can be exacerbated by poor nutritional intake and the side effects of anti-tuberculosis drugs (Kurniaji et al., 2023).

Thrombocytosis and leukocytosis also reflect an inflammatory response, while lymphopenia may indicate a diminished cellular immune response.

Table 3. Hematologic abnormalities according to treatment phase (n = 18)

Abnormality	Intensive phase (n = 8)	Follow-up phase (n = 10)	p (Fisher)
Anemia, n (%)	6 (75,0)	4 (40,0)	0,188
LED increased, n (%)	8 (100,0)	5 (50,0)	0,036

An elevated erythrocyte sedimentation rate (ESR) was observed in all patients during the intensive phase and in half of the patients during the continuation phase (p = 0.036). Anemia was also more frequent during the intensive phase (75.0% vs. 40.0%), though the difference was not statistically significant, likely due to the small sample size. This pattern reflects a reduction in inflammation as treatment progresses successfully, and it aligns with findings by Permana (2020), who reported changes in hemoglobin and leukocyte levels in relation to the duration of anti-tuberculosis (TB) therapy. Consequently, periodic routine blood tests and ESR measurements can be useful for monitoring treatment response and identifying issues that require intervention—such as anemia, which may necessitate nutritional improvement.

Changes in participants' knowledge

Table 4. Knowledge scores and categories before and after education (n = 40)

Parameter	*Pre-test*	*Post-test*
Mean ± SD	43,3 ± 18,4	79,2 ± 12,3
Median (min–maks)	40,0 (13,3–80,0)	80,0 (53,3–100)
Good, n (%)	3 (7,5)	23 (57,5)
Enough, n (%)	7 (17,5)	15 (37,5)
Not Enough, n (%)	30 (75,0)	2 (5,0)
Mean difference (95% CI)	35,8 (31,4–40,2)	
Paired t test	t = 16,51; p < 0,001	
Average N-gain	0,65 (moderate)	
Score increased/remained the same/decreased	40/0/0	

The mean knowledge score increased by 35.8 points following the educational intervention (p < 0.001), with improvements observed in the scores of all participants. The proportion of participants with a low level of knowledge decreased from 75.0% to 5.0%. Prior to the education, most participants were unaware that blood tests could detect anemia and adverse drug reactions. Following the education, participants understood that symptoms such as weakness, pallor, or

easy fatigability during treatment should be reported to healthcare providers and can be evaluated through blood tests. Explaining the patients' own test results directly made the material easier to comprehend. The involvement of family members and treatment supporters (PMO) is crucial, as they accompany patients daily and are well-positioned to identify symptoms at an early stage.

Limitations

The number of patients examined was small, and assessments were conducted only once; therefore, changes in hematological parameters during treatment could not be evaluated. The specific type of anemia was not distinguished, as erythrocyte indices and iron status—such as ferritin levels—were not analyzed. Furthermore, the evaluation of knowledge was carried out immediately following the educational intervention, using a single-group design without a comparison group.

CONCLUSIONS AND SUGGESTIONS

Conclusion. Education regarding the importance of routine blood tests significantly improved the knowledge of pulmonary TB patients and their families (increasing from 43.3 to 79.2; $p < 0.001$; N-gain 0.65). Routine blood tests and erythrocyte sedimentation rate (ESR) measurements in 18 patients revealed an elevated ESR in 72.2% of cases and anemia in 55.6%; elevated ESR was more frequently observed during the intensive phase of treatment. These findings indicate that routine blood tests are useful for monitoring a patient's condition during TB treatment.

Recommendations.

1. For the 7 Ulu Community Health Center (Puskesmas): Schedule routine blood tests and ESR measurements at the start of treatment, at the end of the intensive phase, and at the conclusion of treatment; also, provide nutritional counseling for patients diagnosed with anemia.
2. For patients and their families/treatment supporters (PMO): Report any symptoms such as weakness, pallor, or easy fatigability—as well as any potential medication side effects—to healthcare personnel, and adhere to the scheduled laboratory testing timeline.
3. For future initiatives: Include assessments of erythrocyte indices and iron status, evaluate changes in hematological parameters before and after treatment, and involve a larger number of patients.

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