



Original Article

The Relationship between Duration of Anti-Tuberculosis Treatment and Blood Urea Levels in Patients with Pulmonary Tuberculosis at Bakunase Community Health Center

Lidia Wulan Stevania Lapudo'oh ¹, Ni Made Susilawati ², Byantarsih Widyaningrum ³, Michael Vallery Loueis Tumbol ⁴

¹Medical Laboratory Technology Study Program, Poltekkes Kemenkes Kupang, Kupang City, Indonesia

²Medical Laboratory Technology Study Program, Poltekkes Kemenkes Kupang, Kupang City, Indonesia

³Sanitation Study Program, Poltekkes Kemenkes Kupang, Kupang City, Indonesia

⁴Medical Laboratory Technology Study Program, Poltekkes Kemenkes Manado, Manado City, Indonesia

ARTICLE INFO

Article history:

Received 04 February 2026

Revised 22 May 2026

Accepted 19 June 2026

Keywords:

Urea level

Tuberculosis treatment

Anti-tuberculosis drugs

Kidney nephrotoxic effect

Corresponding author:

Lidia Wulan Stevania Lapudo'oh

Kupang City

wulanstevania6@gmail.com

Doi:

ABSTRACT

Tuberculosis (TB), caused by *Mycobacterium tuberculosis*, is a prevalent pathogen requiring prolonged treatment, typically lasting six months. The kidneys, as the primary excretory organs, must intensively filter pharmaceutical compounds throughout this period. This extended regimen can strain renal function and potentially lead to kidney damage, particularly with rifampicin and streptomycin, which have the highest risk of nephrotoxic effects compared to other anti-tuberculosis drugs. This study aimed to determine the relationship between treatment duration and blood urea levels among pulmonary TB patients at the Bakunase Community Health Center using a quantitative observational approach with a cross-sectional design. Researchers collected data with questionnaires and measured urea levels using the BT15i device. The statistical analysis of 30 samples using the Spearman rank correlation test yielded a correlation coefficient of 0,302 (30,2%) and a significance value of 0,105 ($p > 0,05$). These results indicate no significant correlation between the duration of anti-tuberculosis therapy and blood urea levels. Consequently, the findings suggest that prolonged TB treatment does not lead to a direct increase in urea levels among patients in this clinical setting, indicating that renal filtration remains relatively stable during the standard course of therapy.

Introduction

Tuberculosis is an infectious disease caused by *Mycobacterium tuberculosis* that necessitates prolonged pharmacological intervention, following a standardized six-month regimen for bacterial eradication, with global statistics indicating a high success rate of approximately 85% for patients who adhere to the full period, though this duration may extend to 18–24 months in cases of multi-drug resistant (MDR-TB) (Kambuno et al., 2025; Aja, Ramli, & Rahman 2022). In this study, long-term exposure is defined specifically within the context of the standard six-month therapy for drug-susceptible strains, rather than the MDR-TB cases. This prolonged regimen poses significant systemic risks, including gastrointestinal distress, hepatotoxicity, haematological disorders, and cardiovascular, musculoskeletal, neuropsychiatric, or respiratory complications such as shortness of breath and fatigue, eventually leading to decreased consciousness caused by the high load of the drugs (Aminah, 2013; Wardani et al., 2023). However, the kidneys, as the primary excretory organs, are under continuous physiological

Citation:



© 2025 The Authors. Published xxx. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

strain to filter and eliminate drug metabolites, which may lead to nephrotoxicity. Urea, as a byproduct of protein metabolism, is primarily cleared by the kidneys. The concentration of urea in the blood serves as a direct reflection of the kidneys' filtering efficiency. Urea levels serve as a vital clinical marker for monitoring renal function, which will be impacted by the prolonged treatment related to the condition and the lifestyle of the patient. The treatment administered is based on the patient's condition; therefore, it is classified into three categories: Category 1, Category 2, and the pediatric category. The anti-tuberculosis drug treatment is divided into two phases: the intensive phase and the continuation phase. The intensive phase lasts from 0 to 2 months of treatment aimed at killing TB bacteria and reducing the risk of transmission, while the continuation phase lasts from 3 to 6 months, aimed at preventing recurrence in patients. Throughout both stages, monitoring urea levels remains essential for detecting potential kidney dysfunction that may be induced by the therapy (Tanof, Buntoro, & Trisno, 2022; Badan Pusat Statistik Provinsi Nusa Tenggara Timur, 2023).

More than 90% of urea is excreted via renal filtration, while the remaining fraction is eliminated through the gastrointestinal tract and skin. Consequently, impaired renal function leads to the pathological accumulation of urea in the blood, a condition that may result in uremia. Mechanistically, urea is freely filtered by the glomeruli and subsequently undergoes tubular reabsorption. In healthy kidneys, approximately 40% to 70% of filtered urea is passively transported from the renal tubules back into the interstitium and the systemic circulation (Susanti, Kountul & Buntuan, 2013; World Health Organization, 2023).

The kidneys are sensitive organs that serve as the primary excretory pathway for drugs and chemicals, making them highly susceptible to damage during the six-month course of tuberculosis treatment. Prolonged exposure to anti-tuberculosis medications, particularly rifampicin and streptomycin, can induce significant nephrotoxic effects due to their destructive impact on renal cells. Rifampicin poses a higher risk of toxicity, especially in patients with irregular treatment adherence, as it can trigger an immune response where anti-rifampicin antibodies attack the epithelial cells of the renal tubules, leading to acute tubular necrosis. Meanwhile, streptomycin causes renal damage by destabilizing lysosomal membranes, which allows acid hydrolases to leak and destroy surrounding tissue, which is significantly higher in patients over the age of 65. These renal impairments can be clinically assessed through elevated blood urea levels, alongside other markers such as serum creatinine, blood urea nitrogen (BUN), and the Glomerular Filtration Rate (GFR), as well as through urinalysis to detect abnormalities such as proteinuria or hematuria. Monitoring urea levels is a clinical necessity aimed at evaluating renal function and mitigating the risk of nephrotoxic effects during prolonged therapy (Kustiana, 2018).

This study focuses on evaluating urea levels because this parameter exhibits earlier sensitivity to acute kidney injury induced by drug toxicity. Conversely, creatinine levels tend to increase significantly only after renal function loss reaches 50%. Furthermore, the use of urea minimizes the risk of outcome bias often observed in creatinine parameters; this is associated with the clinical status of tuberculosis patients, who are susceptible to significant muscle waste driven by hypercatabolism, loss of appetite (anorexia), or malabsorption (Prasetyorini et al., 2024). This study aims to determine the relationship between urea levels in pulmonary TB patients undergoing anti-tuberculosis treatment at the Bakunase Community Health Center based on age, gender, and duration of treatment characteristics.

Methods

The type of research used in this study was a quantitative observational approach with a cross-sectional design, with the population consisting of all tuberculosis patients currently on pulmonary anti-tuberculosis treatment at the Bakunase Community Health Center. The study sample comprised 30 tuberculosis patients who met the following inclusion criteria: (1) being officially registered as tuberculosis patients at the Bakunase Community Health Center; (2) actively undergoing both intensive and continuation phases of treatment at the health center; (3) having no clinical history of hepatitis or renal failure, as verified through medical records; (4) falling within the productive (19–59 years) or non-productive (≥ 60 years) age categories; and (5) having voluntarily provided written informed consent to their participation. The study commenced with the distribution of informed consent forms to the participants, followed by the administration of questionnaires to collect primary data. Subsequently, blood samples were collected for urea level analysis. A total of 3 mL of venous blood was drawn from each patient using red-top vacutainer tubes to obtain serum samples. The collected samples were stored in a cooling box and transported to the ASA Laboratory in Kupang City. The transit time was approximately 20 minutes; this short duration ensured sample integrity and prevented degradation, thereby accurately reflecting the patients' physiological conditions. At the laboratory, the samples were centrifuged at 2,000 rpm for 15 minutes to separate the serum.

The resulting serum was then transferred into labeled sample cups for identification. Urea levels were measured using a BT151 Chemistry Analyzer. According to the reference ranges provided by the analyzer, normal blood urea levels in females are <50 mg/dL, while values >50 mg/dL are considered elevated. In males, the normal reference range is 17–49 mg/dL, with levels >49 mg/dL regarded as elevated. Following the laboratory analysis,

the data, including patient identities and urea level results, were systematically processed. The data analysis technique involved two stages. First, a univariate analysis was conducted to generate frequency distribution tables based on research variables, including age, gender, and duration of treatment. Second, a bivariate analysis was performed using SPSS software to evaluate the correlation between the duration of treatment and urea levels. The Kolmogorov-Smirnov test was initially applied to assess the normality of the data distribution. Since the data distribution was evaluated, the Spearman's and Pearson's rank correlation tests were subsequently employed to determine the relationship between the urea levels of the patient and the duration of anti-tuberculosis treatment.

Results

Based on the results of the study, the data on the characteristics of TB patients undergoing anti-tuberculosis drug therapy based on age, gender, and duration of treatment at the Bakunase Community Health Center can be seen in the table below.

Table 1. Distribution Data of Pulmonary TB Patients Who are Taking Anti-tuberculosis Drugs (OAT) at the Bakunase Community Health Center, Based on Age, Gender, and Duration of Treatment

Characteristics	Number	Percentage (%)
Age		
Productive (19–59 years)	25	83,34%
Non-productive (>60 years)	5	16,67%
Gender		
Male	17	56,67%
Female	13	43,34%
Duration of Treatment		
Intensive phase	18	60%
Continuation phase	12	40%
Total	30	100

Based on Table 1, regarding the characteristics of TB patients undergoing anti-tuberculosis drugs, the age characteristic with the highest number of patients was found in the productive age group (19–59 years), with 25 patients (83,34%). Based on the gender characteristics of TB patients, the highest number of TB cases was found in male patients, with 17 patients (56,67%), compared to female patients, with 13 patients (43,34%). Based on the duration of treatment, the highest number of TB patients was found in the intensive phase (0 to 2 months) with 18 patients (60%), while in the continuation phase (3 to 6 months), there were only 12 patients (40%). Blood urea level tests show normal results in men if the test results are 17–49mg/dL, while in females, normal results are shown if the urea level is >50mg/dL.

The results of the study of TB patients undergoing anti-tuberculosis drug therapy, whose urea levels were examined based on the age of the patient, can be seen in the table below.

Table 2. Frequency Distribution of Urea Levels Based on Age in Patients with Pulmonary TB at the Bakunase Community Health Center

Age	Urea Levels			
	High		Normal	
	N	%	N	%
19–59 years	0	0	25	83,34
>60 years	0	0	5	16,67
Total	0	0	30	100

Based on Table 2. The urea levels in TB patients of productive age at 19–59 years old, are 25 patients (83,34%) who had normal urea levels. Meanwhile, among non-productive age patients, 5 individuals (16,67%) had urea test results within the normal range.

The results of the study of TB patients undergoing anti-tuberculosis drugs therapy, whose urea levels were examined based on gender, can be seen in the table below.

Table 3. Frequency distribution of urea levels based on gender in patients with pulmonary TB at the Bakunase Community Health Center

Gender	Urea Levels			
	High		Normal	
	N	%	N	%
Male	0	0	17	56,67
Female	0	0	13	43,37
Total	0	0	30	100

Based on Table 3, urea levels in TB patients were analyzed by gender 17 (56,67%) male patients had normal urea levels within the range of 17–49mg/dL, while 13 female patients (43,37%) had normal urea levels of <50mg/dL, as determined by blood testing.

The results of the study of TB patients undergoing anti-tuberculosis drug therapy, whose urea levels were examined based on the duration of treatment, can be seen in the table below.

Table 4. Frequency Distribution of Urea Levels Based on the Duration of Treatment in Patients with Pulmonary TB at the Bakunase Community Health Center

Duration of Treatment	Urea Levels			
	High		Normal	
	N	%	N	%
Intensive phase	0	0	18	60
Continuation phase	0	0	12	40
Total	0	0	30	100

Based on Table 4, the data show that, with respect to treatment duration, 18 patients (60%) in the intensive phase did not experience an increase in urea levels. Similarly, among the 12 patients (40%) in the continuation phase, no increase in blood urea levels was observed.

The relationship between urea levels and duration of treatment in patients with pulmonary tuberculosis at the Bakunase Community Health Center in Kupang City can be seen in the table below.

Table 5. Relationship between Urea Levels and Duration of Treatment

Duration of treatment	Urea levels						P. Value	Correlation Coefficient
					Total			
	High		Normal					
	N	%	N	%	N	%	.105	.302
Intensive phase	0	0	18	60	18	60		
Continuation phase	0	0	12	40	12	40		
Total	0	0	30	100	30	100		

The statistical test used to examine the correlation between blood urea levels and the duration of treatment for tuberculosis patients was Spearman's correlation. This test was selected because the normality assessment using the Kolmogorov–Smirnov test yielded a significance value of <0,05, indicating that the data were not normally distributed. The results of the Spearman correlation analysis showed a significance value of 0,105 (>0,05) with a correlation coefficient (r) of 0,302 (30,2%). Although a weak positive correlation was observed, the association was not statistically significant.

Discussion

Normal blood urea levels are generally indicative of healthy kidney function. According to the reference standards provided by the BT151 Chemistry Analyzer, normal urea levels in females are <50 mg/dL, while the normal reference range for males is 17–49 mg/dL. The increase in urea levels is a clinical indication of reduced glomerular filtration due to glomerular damage. In tuberculosis patients, this metabolic strain can be triggered by the sustained consumption of anti-tuberculosis drugs over a defined standard treatment duration, which carries a documented nephrotoxic potential.

The analysis of patient characteristics revealed that the majority of tuberculosis patients fell within the productive age group (19–59 years), accounting for 25 patients (83,34%). These findings are consistent with previous studies by Tanof, Buntoro, & Trisno (2022) at a community health center in Kupang City, which showed that the majority of tuberculosis patients were in the productive age group, patients aged 17–25 years, with a percentage of 29,6%. In the productive age group, people have high mobility, often engaging in direct contact or meeting with others, which can increase the risk of TB transmission (Tanof, Buntoro, & Trisno, 2022). Research conducted by Dewi & Susilawati (2024) shows results consistent with the table above, indicating that 73,4% of respondents (290 cases) in this study were patients in the productive age group (15–50 years old). This demographic is characterized by high social mobility and frequent interpersonal interactions, significantly increasing the risk of *Mycobacterium tuberculosis* exposure and transmission (Dewi & Susilawati, 2024).

Based on the data above, 30 patients in both the productive and non-productive age groups had normal urea levels. This finding aligns with the study conducted by Djasang & Saturiski (2019), which reported that, among 30 TB patients undergoing treatment, 25 samples (83,34%) exhibited urea levels within the normal range. This indicates that the patients' kidney function remains effective in excreting metabolic waste products, demonstrating that anti-tuberculosis drug treatment is safe to use as long as it adheres to the prescribed dosage and medical instructions (Djasang & Saturiski, 2019).

Regarding urea levels in TB patients based on gender, 17 male patients (56,67%) and 13 female patients (43,37%) exhibited normal urea levels. This finding is consistent with the study conducted by Risma & Rahman (2020), which reported that all five samples (100%) assessed based on gender showed normal urea test results

(Risma & Rahman, 2020). However, this result is not in line with the study conducted by Helmi, Saputri & Yusran (2024), which reported that three male patients (21,4%) and one female patient (16,7%) experienced elevated urea levels (Helmi, Saputri & Yusran, 2024). Urea, the primary end product of protein metabolism, is excreted from the body via the kidneys. Consequently, an elevation in blood urea levels often serves as a clinical indicator of renal dysfunction, suggesting that the kidneys are failing to effectively filter metabolic waste products. Such impairment can arise as a potential adverse effect of long-term anti-tuberculosis drug therapy. However, the examination results in this study revealed that both male and female patients maintained urea levels within the normal reference range. These findings suggest that the participants' renal functions remained preserved, with the kidneys effectively performing their filtration roles despite the duration of treatment.

Meanwhile, research by Dewi & Susilawati (2024) indicated a higher incidence of tuberculosis (TB) in men, accounting for 53,4% (211 patients) compared to 46,6% (184 patients) in women. This higher prevalence among males may be attributed to several factors that increase their susceptibility to *Mycobacterium tuberculosis* exposure. Such factors include unhealthy lifestyle, specifically alcohol consumption and smoking, as well as strenuous physical activities, suboptimal hygiene, such as the habit of sharing eating utensils with others, and limited health awareness. Furthermore, smoking can significantly exacerbate the risk of TB infection by inducing immunosuppression, as the tar and nicotine in cigarettes weaken the body's natural immune defences (Dewi & Susilawati, 2024; Kambuno, et al., 2019).

Data on TB patients based on treatment duration characteristics show that the highest proportion of patients was in the intensive phase, with 18 patients (60%), while 12 patients (40%) were in the continuation phase (3–6 months). These findings are consistent with the study conducted by Naim & Rahmatika (2024), which reported that, out of 15 study participants, 10 patients (66,7%) were undergoing anti-tuberculosis therapy in the intensive phase, while the remaining 5 patients (33,3%) were in the continuation phase. The predominance of patients in the intensive phase indicates a high case detection rate of new cases in the Bakunase community health center, or a large volume of patients who are still within their first two months of treatment, a period during which clinical symptoms are generally still severe, thereby driving high patient adherence to facility-based follow-ups. These results differ from a study conducted by Yuni in 2016, which showed that the majority of patients were in the continuation phase. The prolonged duration of treatment can lead to patient fatigue (treatment fatigue) and negatively affect medication consistency; this was evident in her study, where 37,3% of patients were non-adherent to their treatment. Such non-adherence frequently triggers the development of resistance to anti-tuberculosis drugs (Yuni, 2016).

Regarding urea levels in TB patients based on treatment duration, 18 patients (60%) in the intensive phase did not experience an increase in urea levels. Similarly, among the 12 patients (40%) in the continuous phase, none showed elevated blood urea levels. These findings are inconsistent with the study conducted by Djasang & Saturiski (2019) which reported that, out of 30 samples of pulmonary TB patients undergoing treatment, 5 patients (16,67%) experienced increased urea levels. The normal urea levels observed in the other 25 patients indicate that their renal function remained effective in excreting metabolic waste products. These findings may also reflect high medication adherence, appropriate dosage adjustments tailored to the patients' clinical conditions, and the absence of significant nephrotoxic effects from the anti-tuberculosis treatment administered (Djasang & Saturiski, 2019).

Based on the examination results, all 30 patients with pulmonary tuberculosis undergoing anti-tuberculosis drug treatment at the Bakunase Community Health Center demonstrated normal urea levels. Normal urea levels indicate that the glomeruli are functioning properly in filtering metabolic waste, thereby preventing its accumulation in the patients' blood. These findings also suggest good adherence to therapy and appropriate drug administration in accordance with the patients' clinical conditions, which may help minimize potential toxic effects of the medication. In addition, the patients' lifestyles may have contributed positively to their overall clinical status. Elevated blood urea levels are not solely caused by the toxic effects of medication; they may also be triggered by excessive protein intake, disease complications, dehydration, or other underlying health conditions (Nursidika et al., 2017). Based on this study, it was found that there was no significant relationship between urea levels in TB patients and the duration of treatment.

Conclusions

Based on the examination results of 30 pulmonary tuberculosis patients undergoing anti-tuberculosis drug treatment at the Bakunase Community Health Center in Kupang City, the findings were as follows: Statistical analysis using Spearman's rank collection test revealed no significant relationship between serum urea levels and the duration of anti-tuberculosis treatment among patients at the Bakunase Community Health Center. This study contributes to increasing awareness among pulmonary tuberculosis (TB) patients regarding the importance of adherence to anti-tuberculosis therapy to prevent drug resistance, which may result in treatment durations exceeding the standard regimen and potential adverse effects on renal function, including elevated blood urea

levels. Most importantly, this study has shown that anti-tuberculosis treatment does not always lead to elevated urea levels or potential nephrotoxicity. However, future research should expand the variables assessed by incorporating additional standard renal function markers.

Author contributions

LWSL contributed to the research design, data collection, data analysis, and data processing. NMSB, BW and MCVLT contributed to the review and data editing. The Authors have read and approved the final version of the manuscript.

Acknowledgements

The authors would like to thank the Director of the Kupang Health Polytechnic, the Head of the DIII Medical Laboratory Technology Study Program at the Kupang Health Polytechnic, the Head of the Head of Bakunase Community Health Center, and all parties, both directly and indirectly, who have provided ideas and support to the authors' thinking so that this article could be completed.

Funding

There is no specific funding for this study.

Ethical approval statement

The study received ethical approval from the Ethics Committee of Poltekkes Kemenkes Kupang with certificate number No.LB.02.03/1/0066/2025.

Conflicts of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Supplementary materials

No supplementary material available.

References

- Aja, N., Ramli, R., & Rahman, H. (2022). Penularan Tuberkulosis Paru dalam Anggota Keluarga di Wilayah Kerja Puskesmas Siko Kota Ternate. *Jurnal Kedokteran dan Kesehatan*, 18(1), 78-87. <https://doi.org/10.24853/jkk.18.1.78-87>
- Aminah, S. (2013). Perbedaan Kadar SGOT, SGPT, Ureum, dan Kreatinin pada Penderita TB Paru Setelah Enam Bulan Pengobatan. *Jurnal Analis Kesehatan*, 2(2), 260-269. <https://doi.org/10.26630/jak.v2i2.432>
- Badan Pusat Statistik Provinsi Nusa Tenggara Timur. (2023). *Jumlah Kasus Penyakit Menurut Kabupaten/Kota dan Jenis Penyakit (Jiwa)*, 2024. Badan Pusat Statistik Provinsi Nusa Tenggara Timur. Retrieved from: <https://ntt.bps.go.id/id/statistics-table/2/MTQ4NSMy/jumlah-kasus-penyakit-menurut-kabupaten-kota-dan-jenis-penyakit.html>
- Dewi, N. P. A. N., & Susilawati, N. M. (2024). Hubungan Pekerjaan dan Pendidikan dengan Kejadian TB Paru di Kota Kupang. *Inovasi Kesehatan Global*, 1(4), 139-148. <https://doi.org/10.62383/ikg.v1i4.1231>
- Djasang, S., & Saturiski, M. (2019). Studi Hasil Pemeriksaan Ureum dan Asam Urat pada Penderita Tuberkulosis Paru yang Mengonsumsi Obat Anti Tuberkulosis (OAT) Fase Intensif. *Jurnal Media Analis Kesehatan*, 10(1), 59-71. [10.32382/mak.v10i1.985](https://doi.org/10.32382/mak.v10i1.985)
- Helmi, H., Saputri, M. J., & Yusran, D. I. (2024). Analisis Kadar Ureum dalam Serum Penderita Tuberkulosis Paru yang Menjalani Terapi OAT Kategori 1 di Puskesmas Sidomulyo Kota Samarinda: Analysis of Ureum Levels in the Serum of Pulmonary Tuberculosis Patients Undergoing Category 1 Oat Therapy at the Sidomulyo Health Center, Samarinda City. *Borneo Journal of Medical Laboratory Technology*, 7(1), 537-543. <https://doi.org/10.33084/bjmlt.v7i1.7519>

- Kambuno, N. T., Kleden, S. S., Seran, A. A., Nur, A., Peni, J. A., Miron, I. D., ... & Valensia, Y. (2025). Integrated Intervention for Stunting and Tuberculosis Screening in Mothers and Children: A Case Study at Kapan Health Center, East Nusa Tenggara. *Buletin Penelitian Kesehatan*, 53(2), 69-76. <https://doi.org/10.33860/bpk.v53i2.4172>
- Kambuno, N. T., Senge, Y. H., Djuma, A. W., & Barung, E. N. (2019). Uji Tuberkulosis Laten pada Kontak Serumah Pasien BTA Positif dengan Metode Mantoux Test. *Jurnal Info Kesehatan*, 17(1), 50-63. <https://doi.org/10.31965/infokes.Vol17.Iss1.239>
- Kustiana, U., (2018). Gambaran Kadar Kreatinin pada Tuberkulosis Paru yang Mendapat Terapi Obat Anti Tuberkulosis (OAT) di RS. Khusus Paru Provinsi Sumatera Selatan Tahun 2018. (D3) karya tulis ilmiah, Poltekkes Kemenkes Palembang. Retrieved from: <https://repository.poltekkespalembang.ac.id/items/show/446>
- Naim, M. R., & Rahmatika, D. (2024). Gambaran Kadar Kreatinin pada Penderita Tuberkulosis Paru yang Mengonsumsi Obat Anti Tuberkulosis di Puskesmas Kabila. *Science: Indonesian Journal of Science*, 1(2), 227-235. <https://doi.org/10.31004/science.v1i2.100>
- Nursidika, P., Furqon, A., Hanifah, F., & Anggarini, D. R. (2017). Gambaran Abnormalitas Organ Hati dan Ginjal Pasien Tuberkulosis yang Mendapatkan Pengobatan. *Jurnal kesehatan Kesehatan Kartika*, 12(1).
- Prasetyorini, T., Purwanti, A., Lestari, D., & Warida, W. (2024). Correlation of Ureum and Creatinine Levels in Tuberculosis Patients at Ciawi Public Health Center, Bogor District. *International Journal*, 4(9). <https://doi.org/10.47191/ijpbms/v4-i9-07>
- Risma, R., & Rahman, A. (2020). Pengaruh Lama Waktu Konsumsi Obat pada Penderita TB terhadap Kadar Kreatinin dan Ureum di Laboratorim RSUW UIT Makassar 2018. *Jurnal Media Laboran*, 10(2), 48-52.
- Susanti, D., Kountul, C., & Buntuan, V. (2013). Pemeriksaan Basil Tahan Asam (BTA) pada Sputum Penderita Batuk >2 Minggu di Poliklinik Penyakit Dalam BLU RSUP Prof Dr. RD Kandou Manado. *Jurnal eClinik (eCI)*, 1(1). <https://doi.org/10.35790/ecl.v1i1.4037>
- Tanof, V. P., Buntoro, I. F., & Trisno, I. (2022). Pengaruh Pemberian Terapi Obat Anti Tuberkulosis Fase Intensif terhadap Kualitas Hidup Penderita Tuberkulosis di Kota Kupang. *Cendana Medical Journal*, 10(2), 363-369. <https://doi.org/10.35508/cmj.v10i2.9150>
- Wardani, D. P. K., Sudarsono, T. A., Aprianto, A., & Qo'imah, A. N. (2023). Kadar Thyroid Stimulating Hormones (TSH) dan Kadar Ureum pada Penderita Tuberkulosis Paru. *The Indonesian Journal of Infectious Diseases*, 9(2). <https://doi.org/10.32667/ijid.v9i2.163>
- World Health Organization. (2023). *Global Tuberculosis Report 2023*. World Health Organization. Retrieved from: <https://iris.who.int/handle/10665/373828>
- Yuni, I. D. A. M. A. (2016). Hubungan Fase Pengobatan TB dan Pengetahuan tentang MDR TB dengan Kepatuhan Pengobatan Pasien TB. *Jurnal berkala epidemiologi*, 4(3), 301-312. <https://doi.org/10.20473/jbe.V4i32016.301-312>