RESEARCH ARTICLE **Open Access**

Gema Lingkungan Kesehatan
Vol. 23, No. 1 (2025), pp 160-166
e-ISSN 2407-8948 p-ISSN 16933761
Doi:https://doi.org/10.36568/gelinkes.v23i1.208 *Journal Hompage: https://gelinkes.poltekkesdepkes-sby.ac.id/*

Spatial Analysis of Health Facility Locations and Tuberculosis Treatment Outcomes in Jambi City, 2024

Suhermanto[1]*, Fakhrida Khairat[1], Erwin Hari Astuti[1], Naris Dyah Prasetyawati[2]

[1] Environmental Health Department, Polytechnic of Health Ministry of Health Jambi, Jambi, Indonesia
[2] Environmental Health Department, Polytechnic of Health Ministry of Health Yogyakarta, Yogyakarta, Indonesia

*Correspondence: email@gmail.com

ABSTRACT

Tuberculosis (TB) remains a global health problem with an increasing incidence rate, including in Indonesia. Jambi City has experienced an increase in TB cases from year to year, while the treatment success rate has not reached the target. This study aimed to analyse the relationship between the location of health facilities (puskesmas), travel time, and transportation costs with TB treatment success in Jambi City. This study was an observational survey with a cross-sectional design, using QGIS Overlay spatial analysis (network analysis) and Chi-Square statistical test. The sample consisted of 120 bacteriologically confirmed TB patients at four health centres. QGIS analysis showed that 98.33% of TB patients were located within the 3,000-metre service radius of the puskesmas. However, not all patients with successful treatment rated the location of the health centre as easily accessible, while a small proportion of patients with treatment failure rated the location of the health centre as difficult to access. Chi-Square test results showed no significant association between the location of the health centre and TB treatment success (p = 0.066). Thus, the affordability of health facilities based on travel time and transport costs is not a major factor that causes non-achievement of TB treatment success targets in Jambi City. This study recommends further research to identify other factors that may influence TB treatment success, such as patient compliance and quality of health services.

Keywords: Health Centre, Treatment Statues, Treatment Outcomes, Tuberculosis

INTRODUCTION

Tuberculosis (TB) is still a public health problem in the world. According to the Global Tuberculosis Report, more than 80% of tuberculosis incidents occur globally (WHO, 2021). Indonesia is the country with the largest TB burden after India, based on the Global Tuberculosis Report, it is estimated that TB in Indonesia is 969,000 cases, this figure has increased by 17% from 2020(WHO, 2022). Indonesia, which has the second highest tuberculosis (TB) burden after India, experienced a continuous increase in the number of TB cases each year. The estimated number of TB cases reached 824,000 in 2020 (WHO, 2021), 969,000 in 2021 (WHO, 2022), and 1,060,000 in 2022 (WHO, 2023). This upward trend is also evident in Jambi Province, where the TB incidence rate increased from 382 per 100,000 in 2021 to 425 per 100,000 in 2022.

The COVID-19 pandemic has led to an increase in the number of people who are not diagnosed with TB and has become a major source of transmission leading to high morbidity and mortality rates (Siahaya et al., 2022). TB treatment success rate drops 69% during COVID-19 pandemic (Marwah Widuri, 2022). Until 2021;2022, no region in Indonesia has reached the treatment success rate target of at least 90%, including Jambi City, where the percentage of complete treatment;percentage of success treatment of tuberculosis patients in Jambi Province has only reached 68.3% (Sulistyo et al., 2022);81.52% (Sulistyo et al., 2023), with one of the contributions of TB patients for Jambi Province coming from Jambi City as many as 766 cases (Dinas Kesehatan Kota Jambi Sub. Bagian Informasi dan Humas, 2022);1294 cases (Dinas Kesehatan Kota Jambi Sub. Bagian Informasi dan Humas, 2023).

It is necessary to analyze the unachieved target between the number of TB cases treated and reported (*Treatment Coverage*) and the success rate of tuberculosis treatment (*Treatment Success Rate*) which has not reached 90%. Based on a study conducted by Pradipta et al. (2021), published in BMC Public Health revealed several factual problems faced by TB patients in Indonesia, causing TB treatment failure, including the demographics of TB patients who live in the suburbs or rural villages often have difficulty accessing health facilities due to long distances. In addition, from the economic sector, although the cost of TB drugs has been covered by the government, TB patients still need to spend money on transportation costs when seeking

treatment. The Patient Pathways Analysis study also found that only 24% of people with tuberculosis symptoms visited a health care facility. While a total of 27% of the estimated patients had confirmed successful treatment, 5% had failed outcomes, and the remaining 68% were unconfirmed (Kemenkes RI, 2020).

A study is required to investigate the issue of the suboptimal tuberculosis treatment success rate in Jambi City, which is believed to be associated with the location of health centers in relation to travel time and transportation costs. One potential approach is the use of spatial analysis through a geographic information system (GIS), which can integrate diverse data types, including graphical elements (maps, charts), tabular information (tables), and text, to generate new insights on spatial data. This process produces thematic maps that illustrate the location, place, and spatial relationships of various elements (Soenarmo, 2009). In order to know the relationship between the location of puskesmas and the treatment status of tuberculosis patients in Jambi City.

RESEARCH METHODS

This study is a cross sectional study by surveying 4 (four) locations of health facilities (Puskesmas) and 120 tuberculosis patients using Global Position System (GPS) to determine the distance or radius of achievement of the puskemas based on SNI 03-1733-2004 set at 3,000 meters (Badan Standarisasi Nasional, 2004), while determining the criteria for the location of puskesmas based on the scoring value of Travel Time and Transport Costs obtained from the results of distributing questionnaires, for the travel time required to health services is not more than 30 minutes (Fitriani et al., 2021), and affordable transportation costs are Trans-Siginjai ranging from Rp 3,958 to Rp 5,249 (Nabila, 2022). The location criteria of the puskesmas will be entered into the map of the kelurahan area per working area of the puskesmas using the QGIS program. Furthermore, the location criteria of the health center will be linked to the number of tuberculosis patients according to the category of treatment status of each health center.

Study Design

This study conducts an observational survey at four selected health centers (Puskesmas) in Jambi City. It aims to analyze the relationship between the location of these health centers and the treatment success of tuberculosis (TB) patients. The study adopted a cross-sectional design to examine whether the proximity of TB patients to health centers (in terms of travel time and transportation cost) affects their treatment outcomes.

Sample and Setting

The study involved 120 bacteriologically confirmed tuberculosis patients across four health centers (Puskesmas) in Jambi City during 2022-2023, with one patient per household who consented to participate. Patients were excluded if they no longer resided in the service area of the Puskesmas or declined to participate. Eligible patients were required to reside within the coverage radius of 3,000 meters from Puskesmas, as recommended by the SNI 03-1733-2004 standard. The Puskesmas were categorized as either easily accessible or not easily accessible, based on scoring criteria for travel time and transportation costs. The travel time to Puskesmas was required to be less than 30 minutes, and affordable transportation costs, such as Trans-Siginjai, ranged from IDR 3,958 to IDR 5,249.

Data Collection

Data were collected using:

1. Global Positioning System (GPS): GPS was used to measure the distance and coverage radius of accessibility from patients' residences to Puskesmas.
2. Questionnaires: A set of questionnaires was distributed to patients to collect data on their travel time and transportation costs to reach Puskesmas. The responses were then scored to assess the accessibility of the Puskesmas locations.
3. Documentary Study: Medical records of patients at each Puskemas were accessed to obtain information on their treatment status over the past year, including whether they were cured, dropped out, relapsed, or failed treatment.

Data Analysis

Data were analyzed using QGIS 3.14 to map the distribution of tuberculosis patients within a 3,000-meter radius of health centers (Puskesmas), with the coordinates of both patients and Puskesmas inputted into the administrative map of Jambi City. Puskesmas locations were then scored based on travel time and transportation costs derived from questionnaires. A network analysis tool was conducted using overlay and buffer methods to assess the distribution of patients. The relationship between Puskesmas locations and treatment outcomes was tested using Chi-Square statistical analysis to determine whether there was a significant association between the two variables.

RESULT AND DISCUSSION

Distribution of Tuberculosis in Jambi City based on The Treatment Status of Patients.

The results of the study of 120 respondents with tuberculosis with the focus of the research area at four health centers with the highest tuberculosis patients obtained the following distribution data:

Table 1
Frequency Distribution of Respondents

Research Data	Categories	Frequency	Percentage (%)
Patients Statues Patient Status Categories	BPJS	99	82,5
	General	21	17,5
Drugs Statues	Cured	98	81.67
	Drug Discontinuation	12	10
	Relapse	8	6.66
	Failure	2	1.67

Travel Time	< 15 minutes	91	76
	15 – 30 minutes	28	23
	30 – 40 minutes	1	1
	> 45 minutes	0	0
Transportation Cost	< Rp. 5000	46	38
	Rp. 5000 – 10.000	57	48
	Rp. 10.000 – 20.000	14	12
	> Rp. 20.000	3	3
Health Centre Location	Easy to Access	107	89
	Difficult to Access	13	11

Source of primary data processed (2024)

Based on the data distribution of respondents, it can be described that patients with a history of tuberculosis treatment who have received Anti-tuberculosis Drugs (OAT) for 1 month or more are grouped into four statuses, namely Cured, Drug Discontinuation, Relapse and Failure (Kementerian Kesehatan Republik Indonesia, 2013). The results showed that the treatment status of tuberculosis patients was predominantly successfully cured as much as 81.67% while the rest could not be cured by 18.33% with details of failure (1.67%), relapse (6.66%) and drug Discontinuation (10%).

Specifically, the treatment status of tuberculosis patients in the study area can be categorized as cured, with treatment success rate ranging from 70% to 90%, as shown in Table 2.

Table 2
Treatment Success Rate in the Study Area

Treat-ment Outcome	Health Center				Total	Percen-tage (%)
	Putri Ayu	Talang Banjar	Rawasari	Simp.Kawat		
Cured	37	21	25	15	98	81.67
Relapsed	0	4	3	5	12	10
Dropped Out	1	5	2	0	8	6.66
Failed	2	0	0	0	2	1.67
Total	40	30	30	20	120	100
Treatment Success Rate	92,5 %	70 %	86,7 %	75 %	81,7 %	

Based on Table 2, Puskesmas Putri Ayu has achieved the minimum target of 90% treatment success, while Puskesmas Talang Banjar, Rawasari, and Simpang Kawat have not yet reached the minimum target. The distribution of tuberculosis treatment outcomes was analyzed using QGIS version 3.14 by overlaying the coordinates of tuberculosis patients with a buffer analysis of the health center service areas based on the 3,000-meter radius standard set by SNI 03-1733-2004. The analysis revealed that all patients, regardless of their treatment status, were generally located within the health center service areas with a coverage radius of 3,000 meters, as shown in Figure 1 below:

Tuberculosis treatment status when viewed based on the distribution using QGIS application that overlays the coordinates of tuberculosis patients with buffer analysis of puskesmas working areas within the distance or radius of achievement of the puskemas based on SNI 03-1733-2004, it is known that all patients with any criteria treatment status are generally located in the puskesmas working area within a radius of achieving a puskemas as far as 3,000 meters, as shown in Figure 1.

Figure 1 shows the distribution of patients based on treatment outcomes within the health center's coverage radius. Most patients, regardless of whether they are cured, relapsed, dropped out, or failed, are generally distributed within close proximity to the health center's coverage radius. This applies both to Puskesmas Putri Ayu, which has met the minimum treatment success rate target of 90 percent, and to other health centers that have not yet achieved this target.

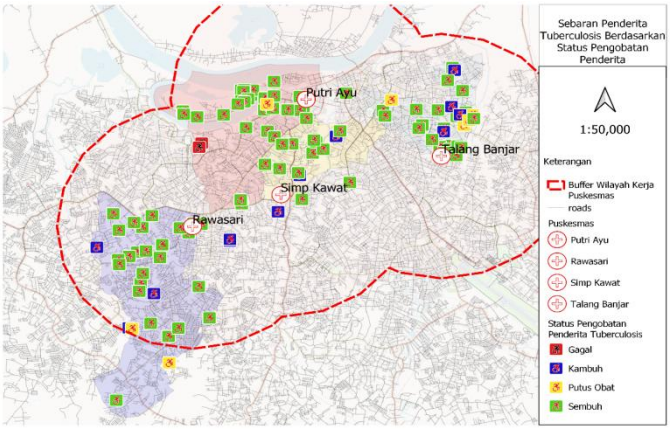

Figure 1. Distribution of tuberculosis patients based on the patient's treatment outcomes

Figure 1 also illustrates that 118 tuberculosis patients, accounting for 98.33 percent of the total, are located within the coverage radius. Specifically, 100 percent of patients with relapsed and failed statuses are within this radius, while only one patient (1 percent) with a cured status and one patient (8 percent) with a dropped-out status are outside the coverage area.

It can be seen in the figure that 118 patients with tuberculosis both with treatment status of recovery,

relapse, drug withdrawal and with a status of failure 98.33% are scattered in the radius of coverage of the health center, with details of patients with treatment status Relapse and Failure 100% are within the radius of coverage of the health center, only 1 respondent (1%) patient with treatment status of recovery and 1 respondent (8%) patient with treatment status of drug withdrawal is outside the radius of coverage of the health center.

The results showed that the health center as the spearhead of Tuberculosis management has fulfilled one of the requirements of health services, namely easy to reach (Azwar, 1996). This is evidenced by the fact that almost all tuberculosis patients are scattered within the radius of achievement of the puskesmas working area so that the treatment success rate in Jambi City of 81.67% has not reached the minimum target of 90%. This is not caused by the reach of health facilities (puskesmas) that are difficult to reach, as evidenced by the radius of existing puskesmas services in Jambi City as a result of QGIS buffer analysis that can reach the entire distribution of tuberculosis patients as far as 3000 meters. According to WHO quoted by Primadiah, it is stated that the distance between the patient and the place of treatment should be as close as possible, ranging from 3000 to 5000 meters (Salam & Wahyono, 2020).

The results of research by Hartanto, T.D., Sarasusanti, L.D., Adi, M.S and Udiyono, A also explain that the distribution of pulmonary TB cases in Semarang City is quite a lot found in the distance of the patient's home close to the health center. This is because almost all health centers cover all areas of Semarang City and some are located close to each other and no more than 3000 meters away(Hartanto et al., 2019). This was also explained by Fitriani Eka that 75.8% of the incidence of pulmonary tuberculosis in the Ketanggungan Health Center working area was found at a close distance or ≤ 5 km from the health center and stated that there was no relationship between the distance of health services and the incidence of pulmonary tuberculosis (Ariani et al., 2022). However, different results were obtained by Salam and Wahyono, T.Y.M., where the distance of the patient's house to health care facilities (Hospital) influenced the default of pulmonary TB patients at Goeteng Taroenadibrata Purbalingga Hospital (Hartanto et al., 2019).

To ensure that the radius of health center services is not the cause of not achieving the target of successful tuberculosis treatment in Jambi City. It is necessary to explore community responses regarding the radius of puskesmas services in terms of travel time and affordable costs. The results of these responses will be explained in the following subchapters.

Relationship Between The Location of The Health Center and The Success Of Tuberculosis Treatment In Jambi City

The results of the study that looked at the location of the puskesmas (easy to reach or difficult to reach) based on the scoring value of travel time and transport costs whether it was related to the success of tuberculosis treatment, the results showed that there was no relationship between the two variables. The author used two analysis techniques to answer the relationship between the two variables, namely the QGIS Overlay Technique and the Chi-Square Statistical Test.

The results of QGIS processing using the network analysis tool illustrate the shortest distance of tuberculosis patients to the puskesmas so that it can be seen how the scoring results of tuberculosis patients on travel time and transport costs are symbolized as easy to reach (green line) and difficult to reach (red line) for their treatment status as shown in Figure 2.

Figure 2 shows that not all tuberculosis patients who were successfully cured gave a score or response that the location of the puskesmas was easy to reach, whereas very few tuberculosis patients who were not successfully cured (failure, relapse, drug withdrawal) gave a score or response that the location of the puskesmas was difficult to reach. As can be seen in Figure 2 (c) treatment status failed but gave a score or response that the location of the puskesmas was easy to reach.

Using statistical testing techniques also resulted in no relationship between the location of the health center and the success of tuberculosis treatment in Jambi City as shown in Table 2.

Table 2 explains that almost all tuberculosis patients who were successfully treated until cured (91.8%) thought that the location of the puskesmas was easy to reach, as well as tuberculosis patients who were not successfully cured such as patients with drug discontinuation status of 89.9% thought that the location of the puskesmas was easy to reach, patients with relapse status thought that the location of the puskesmas was easy to reach, even for patients with failed treatment status 100% responded that the location of the puskesmas was easy to reach.

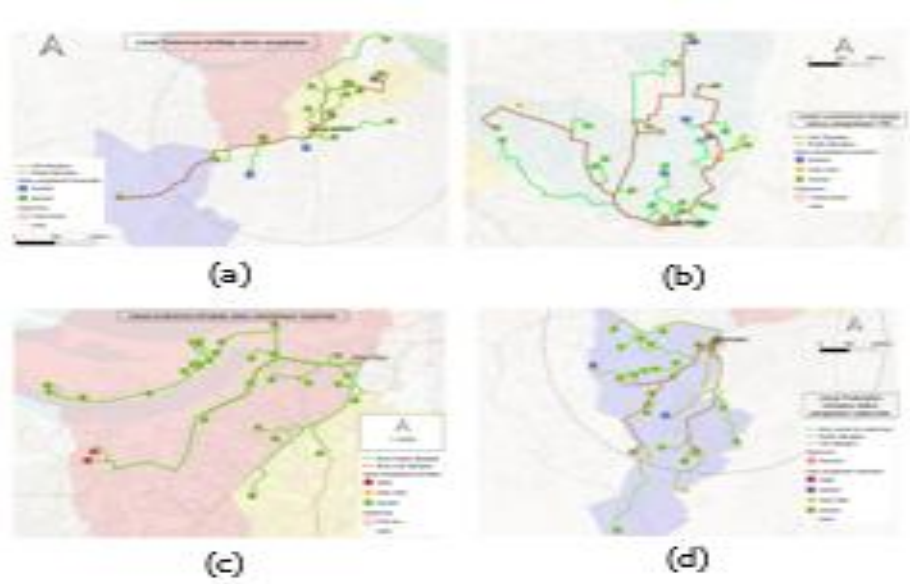

Figure 2. Location of puskesmas and tuberculosis treatment status in Jambi City

The results of the Chi-Square statistical test also stated that Ha was rejected with a p-value of 0.066, which means that there is no significant relationship between the location of the puskesmas and the success of Tuberculosis treatment in Jambi City, so it can be concluded that the radius of puskesmas services seen based on the scoring aspects of travel time and transportation costs is not the cause of not achieving the target of successful tuberculosis treatment in Jambi City.

Table 3
Location of Health Centre on Tuberculosis Treatment Status in Jambi City

Treatment Statues	Location of Health Centre				Total	Percentage (%)	p-Value
	Difficult to Access	Percentage (%)	Easy to Access	Percentage (%)			
Cured	8	8.2	89	91.8	97	100	0.066
Drugs Discontinuation	1	11.1	8	89.9	9	100	
Relapse	4	33.3	8	66.7	12	100	
Failure	0	0	2	100	2	100	

The absence of a significant relationship between the location of the puskesmas and the success of tuberculosis treatment in Jambi City can be due to the cost component that must be incurred by patients when undergoing treatment is still affordable, namely 48% ranging from IDR 5,000 to IDR 10,000 and 38% spending less than IDR 5,000. Currently, the mode of public transportation owned by Jambi City at an affordable cost is Trans-Siginjai ranging from Rp. 3,958 to Rp. 5,249 (Nabila, 2022), as well as using a motorcycle online transportation service costs incurred range from Rp. 7,000 to Rp. 10,000 (Keputusan Menteri Perhubungan Nomor Kp 348 Tahun 2019 Tentang Pedoman Perhitungan Biaya Jasa Penggunaan Sepeda Motor Yang Digunakan Untuk Kepentingan, n.d.). This transportation cost is directly proportional to travel time, the shorter the travel time from a health facility, the less transportation costs that must be incurred. The results showed that as many as 76% of tuberculosis patients could reach the health center in less than 15 minutes, this time is very short because according to Fitriani, Lisa, et al. the short time needed to get to health services is no more than 30 minutes (Fitriani et al., 2021).

Many different researches results state that difficulties in accessing health services due to cost, distance and transportation are factors in the success of tuberculosis treatment. However, there are several studies that agree as stated by Kusmiyani, O.T., Hermanto and Rosela, who stated that there is no relationship between distance from home to health facilities and adherence to taking anti-tuberculosis drugs in pulmonary tuberculosis patients at Samuda and Bapinang health centers (Tri Kusmiyani et al., 2024). Likewise, the research of Samory, U.S., Yunalia, E.M, Suharto, I.P.S., and Nurseskasatmata S.E, which states that there is no significant relationship between distance

to health services and TB treatment compliance in patients with pulmonary TB at the Urei-Faisei Health Center (Urfas) (Samory et al., 2022). There was also no significant relationship between transportation costs and adherence to treatment for pulmonary TB patients with a p-value of 0.957 (Maesaroh, 2009), corroborated by the research of Mujamil, Sety La Ode M., Zainuddin A., Kusnan, A., who obtained the results that there was no relationship between the cost of treatment with adherence to taking OAT at the Kendari City Regional Health Center with a p value = 0.273 (Mujamil et al., 2021). From the description above, it can be revealed that the location of health centers in Jambi City is easily accessible to tuberculosis patients both in terms of distance and transportation costs so that it does not affect the successful treatment of tuberculosis patients.

CONCLUSION

Health centers as the spearhead of Tuberculosis management have fulfilled one of the requirements of health services, which is easy to reach. This is evidenced by the results of the QGIS buffer analysis that the radius of existing puskesmas services in Jambi City can reach all (98.33%) of the distribution of tuberculosis patients as far as 3000 meters.

There was no significant relationship p-value (0.066) between the location of puskesmas with the category of easy to reach or difficult to reach on the success of Tuberculosis treatment in Jambi City; This study found no significant relationship (p-value = 0.066) between the accessibility of health facilities (Puskesmas) and the treatment success of tuberculosis patients in Jambi City. so that the radius of puskesmas services seen based on the scoring aspects of travel time and transportation costs is not the cause of not achieving the target of successful tuberculosis treatment in Jambi City. Therefore, the radius of puskesmas services, as determined by the scoring factors of travel time and transportation costs, does not affect the achievement of successful tuberculosis treatment outcomes in Jambi City. These findings underscore the need to investigate other factors, such as service quality or patient adherence, which may explain why the tuberculosis treatment success rate in Jambi Province remains below the 90 percent target.

REFERENCES

Ariani, F., Lapau, B., Zaman, K., Mitra, M., & Rustam, M. (2022). Faktor-Faktor Yang Berhubungan Dengan Kejadian Tuberkulosis Paru. *Jurnal Bahana Kesehatan Masyarakat (Bahana of Journal Public Health)*, *6*(1), 33–38. [Crossref], [Publisher]

Azwar, A. (1996). *Pengantar Administrasi Kesehatan Edisi Ketiga*. Penerbit Binarupa Aksara. [Publisher]

Badan Standarisasi Nasional. (2004). *SNI 03-1733-2004 tentang Tata Cara Perencanaan Lingkungan Perumahan di Perkotaan*. [Publisher]

Dinas Kesehatan Kota Jambi Sub. Bagian Informasi dan Humas. (2022). *Profil Kesehatan Kota Jambi*. [Publisher]

Fitriani, L., Nur, A. A., Rahayu, R., Jinan, R., Selviana, R. E., Rahman, F., & Laily, N. (2021). Keputusan Pemilihan Pelayanan Pengobatan Ditinjau dari Karakteristik Individu dan Aksesibilitas. *Jurnal Penelitian Dan Pengembangan Kesehatan Masyarakat Indonesia*, *2*(1), 67–75. [Crossref], [Publisher]

Hartanto, T. D., Saraswati, L. D., Adi, M. S., & Udiyono, A. (2019). Analisis Spasial Persebaran Kasus Tuberkulosis Paru di Kota Semarang Tahun 2018. *Jurnal Kesehatan Masyarakat*, *7*(4), 2356–3346. [Crossref], [Publisher]

Kemenkes RI. (2020). Strategi Nasional Penanggulangan Tuberkulosis di Indonesia 2020-2024. *Pertemuan Konsolidasi Nasional Penyusunan STRANAS TB*, 135. [Publisher]

Kementerian Kesehatan Republik Indonesia. (2013). *Pedoman Nasional Pelayanan Kedokteran Tata Laksana Tuberkulosis*. [Publisher]

Keputusan Menteri Perhubungan Republik Indonesia Nomor Kp 348 Tahun 2022 Tentang Perubahan Kedua Atas Keputusan Menteri Perhubungan Nomor Kp 348 Tahun 2019 Tentang Pedoman Perhitungan Biaya Jasa Penggunaan Sepeda Motor Yang Digunakan Untuk Kepentingan. [Publisher]

Maesaroh, S. (2009). *Faktor – Faktor yang Berhubungan dengan Kepatuhan Berobat Pasien Tuberkulosis Paru di Klinik Jakarta Respiratory Centre (JRC)/ PPTI Tahun 2009*. Universitas Islam Negeri Syarif Hidayatullah Jakarta. [Publisher]

Marwah Widuri, A. (2022). Karakteristik Pasien Tuberkulosis Paru Pada Masa Pandemi COVID-19 di Poli Paru RSUD dr. H. Chasan Boesoirie. *Nursing Update*, *13*(4), 76–81. [Crossref], [Publisher]

Mujamil, Muhammad Sety, L. O., Zainuddin, A., & Kusnan, A. (2021). Analisis Faktor Yang Berhubungan Terkait Kepatuhan Minum Obat Pasien Tuberkulosis Paru BTA+ di Masa Pandemi Covid 19 di Puskesmas Wilayah Kota Kendari. *Nursing Update*, *12*(2), 1–14. [Crossref], [Publisher]

Nabila. (2022). *Peningkatan Kinerja Pelayanan dan Operasional Bus Trans Siginjai di Kota Jambi*.

Pradipta, I. S., Idrus, L. R., Probandari, A., Lestari, B. W., Diantini, A., Alffenaar, J.-W. C., & Hak, E. (2021). Barriers and strategies to successful tuberculosis treatment in a high-burden tuberculosis setting: a qualitative study from the patient's perspective. *BMC Public Health*, *21*(1), 1903. [Crossref], [Publisher]

Salam, & Wahyono, T. Y. M. (2020). Pengaruh Jarak ke Fasilitas Pelayanan Kesehatan terhadap Kejadian Default pada Penderita TB Paru di RSUD Goeteng Taroenadibrata Purbalingga Effect of Distance to Health Service Facilities on Default Events in Lung

TB Patients in Goeteng Taroenadibrata Hos. *Media Publikasi Promosi Kesehatan Indonesia MPPKI*, *3*(3), 1–7. [Crossref], [Publisher]

Samory, U. S., Yunalia, E. M., Suharto, I. P. S., & Nurseskasatmata, S. (2022). Faktor-Faktor Yang Berhubungan Dengan Kepatuhan Pasien Terhadap Pengobatan Tuberkulosis Paru Di Puskesmas Urei-Faisei (URFAS). *Indonesian Health Science Journal*, *2*(1), 37–45. [Crossref], [Publisher]

Siahaya, F. M., Abrar, E. A., Zaenal, S., Nani, S., Makassar, H., Perintis, J., Viii, K., & Makassar, K. (2022). Pengaruh Pandemi Covid 19 Terhadap Kepatuhan Berobat Pasien Tuberkulosis Paru. *Jurnal Ilmiah Mahasiswa & Penelitian Keperawatan*, *2*(2), 219–225. [Crossref], [Publisher]

Soenarmo, S. H. (2009). *Penginderaan Jauh dan Pengenalan Sistem Informasi Geografis Untuk Bidang Ilmu Kebumian*. Institut Teknologi Bandung. [Publisher]

Sulistyo, Setya Frida Utami, A., Bagus Wicaksono, A., & Dll. (2022). *Laporan Program Penanggulangan Tuberkulosis Tahun 2022*. [Publisher]

Tri Kusmiyani, O., Rosela, K., Studi Sarjana Keperawatan, P., Eka Harap, S., Raya, P., & Tengah, K. (2024). *Analisis Faktor yang Berhubungan dengan Kepatuhan Minum Obat Anti Tuberkulosis pada Pasien TB Paru di Puskesmas Samuda dan Bapinang Kotawaringin Timur Analysis of Factors Related to Compliance with Taking Anti-Tuberculosis Drugs in Pulmonary TB Patients at Samuda and Bapinang Health Centers East Kotawaringin*. [Crossref], [Publisher]

WHO (World Health Organization). (2021). *Global Tuberculosis Report 2021*. Geneva. [Publisher]

WHO (World Health Organization). (2022). *Global Tuberculosis Report 2022*. [Publisher]