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by

Submission date: 27-Aug-2021 05:00PM (UTC+0700)

Submission ID: 1636776422

File name: 2._idr-12-s1-8727.pdf (214.14K)

Word count: 3270

Character count: 17100

13 The spatial analysis of extrapulmonary tuberculosis spreading and its interactions with pulmonary tuberculosis in Samarinda, East Kalimantan, Indonesia

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Abstract

Background: Extrapulmonary Tuberculosis (EPTB) is an infectious disease that affects tissue outside the lungs. EPTB patients cannot be source of infection, therefore the findings in the community indicate that there are still active pulmonary TB patients acting as a source of infection. Understanding distributions of EPTB can be used as indicator to individuate the unmonitored source of TB transmission in the community.

Objectives: The aim of this study is to analyze EPTB using spatial modeling based on patients' location.

Methods: This study is an observational research with spatial analysis approach using SotScanv.9.4.4 and ArcGis v.10.4. Involving 46 samples of EPTB patients in Anatomy Pathology Laboratory of RSUD Abdul Wahab Sjahranie in 2017 and 7 pulmonary TB patients who were contacts of EPTB patients. The distribution of EPTB patients is mostly located in areas with high population density.

Results: The results showed that the distribution pattern of EPTB patients was mostly in areas with high population densities. Space-time permutation model shows there are 3 clusters of EPTB with a 2.91, 0.97, 1.13 km radius centered on -0.504177 S/117.092132 E, -0.476895 S /117.141700 E, -0.517031 S/117.092132 E.

Conclusion: The distribution of patients

with EPTB and pulmonary TB indicates there is an interaction between EPTB and pulmonary TB in the cluster area. Bernoulli model shows that there is 1 cluster of EPTB and pulmonary TB with relative risk 5.29, radius of 3.19 km, and centered on -0.458159 S / 117.149945 E.

30 Introduction

Tuberculosis (TB) is an infectious disease caused by *Mycobacterium tuberculosis* (M.TB), that can infect lung (pulmonary TB) and other organs outside the lungs (extrapulmonary tuberculosis, EPTB). TB remains a global health problem, with an estimated 6.3 million new TB cases in 2017, 16% of which are EPTB cases.¹

In recent decades, EPTB cases in developed countries have increased in proportion to the total TB cases.^{2,3} Several studies have been carried out in various countries, and found the highest percentage of EPTB in Brazil (45.6%), England and Wales (41%), Iran (27.3%), North India (27.3%), Korea (29.4%), and United States (18.7%), respectively.^{2,7} Meanwhile in Indonesia, the number of national EPTB cases is unclear, even though it can be estimated that there are many EPTB cases in the community following the increase in TB in the past 5 years, which is went 324,539 cases in 2014 to 511,873 in 2018.^{8,9}

Human can become infected with TB when inhaling M.TB from the droplet nuclei. When this tubercle bacillus reaches the alveoli it will be digested by alveolar macrophages, so that most of them will be destroyed or inhibited and only a few of them multiply intracellularly and are released when the macrophages die. The bacillus spreads through blood vessels or lymphatics to organs outside the lungs, such as lymph nodes, genitourinary, pleura, bones and joints, peritoneal organs, meninges and the central nervous system, which are the most common EPTB manifested organs.¹⁰ However, EPTB can also occur through reactivation of dormant bacilli or directly from adjacent organs that have been previously infected.¹¹ Therefore EPTB is less transmissible^{12,13} than pulmonary TB, which makes the presence of EPTB patients in the community makes it possible to be an indicator of active TB as a source of transmission.

Spatial analysis is one way to map the pattern of disease spread so to obtain EPTB surveillance. Spatial analysis is widely used in the health sector to help identify the distribution and clustering of disease cases, individuate high-risk areas, and identify the risk factors that influence them, so to

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Key words: Extrapulmonary tuberculosis, pulmonary tuberculosis, spatial analysis.

Contributions: NT, WUM, EN, data collecting and analyzing; PS, DEB, manuscript writing; YY, manuscript reviewing and references search.

16 Conflict of interest: The authors declare no potential conflict of interest.

Funding: The work was supported by a research grant from Medical Faculty, Mulawarman University FY 2018.

Acknowledgments: The authors acknowledged all respondents who were willing to be the sample of this study. All authors are all researchers involved in this study and do not have a conflict of interest.

Clinical trials: This work was registered in ethical clearance committee of A. Wahab Sjahranie hospital, Samarinda, East Kalimantan.

Conference presentation: This paper was presented at an international conference on Infectious Diseases, Biothreats, and Military Medicine (INSBOMM), 2019 Aug 27-28, Surabaya, Indonesia.

11 Received for publication: 17 February 2020.
Accepted for publication: 1 July 2020.

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Infectious Disease Reports 2020; 12(s1):8727
doi:10.4081/idr.2020.8727

increase the efforts to control diseases.¹⁴ In addition, it also helps in supporting decision making with short time and relatively little cost in terms of health resource management, epidemiological monitoring and disease control.¹⁴

The aims of this study were to spatially analyze the spread of EPTB based on the location of the patient's residence and to determine the geographical relationship between EPTB sufferers and pulmonary TB patients.

3

Materials and Methods

This study is a cross sectional study with a spatial analysis approach aimed to describe the geographical distribution of EPTB sufferers in the population. The sample in this study were all patients with EPTB who were diagnosed based on the results of histopathological examination and/or FNAB. The diagnosis of EPTB was carried out by pathologist based on the examination of the lymph nodes, breast, intestinal, genitourinary, bone and joint and other organs obtained from the patients of the Abdul Wahab Sjahranie Hospital, Samarinda, from January 2017-December 2018.

All patients were visited at their respective homes, based on the address indicated on the medical record. The coordinates of the patient's residence were carried out using the GPS, and direct interviews were conducted to find out the history of contacts with patients with pulmonary TB in the patient's residence area. All sufferers were in the city of Samarinda spread over 10 sub-districts. Data processing was performed using the GPS Map Coordinate application version 4.5.0, ArcGIS software version 10.4 and SaTScan software version 9.4.4.

Results and Discussion

There were 69 EPTB patients based on the results of the Anatomic Pathology examination at the Anatomy Pathology Laboratory of the Abdul Wahab Sjahranie Hospital Samarinda. Only 46 people met the criteria and became the study sample. When conducting a field visit, based on the results of interviews, we found 7 pulmonary

Table 1. General description of EPTB patient in Samarinda City.

Variable	Total (%)
Age (year)	
0-4	2 (4,36)
5-14	6 (13,04)
15-64	38 (82,6)
Sex	
Female	30 (65,21)
Male	16 (34,79)
Organs Location	
KOB	30 (65,22)
Mamae	6 (13,05)
Intestinal	4 (8,69)
Genitourinari	3 (6,52)
Bones and joints	2 (4,35)
Plerua	1 (2,17)

PETA KOTA SAMARINDA KALIMANTAN TIMUR

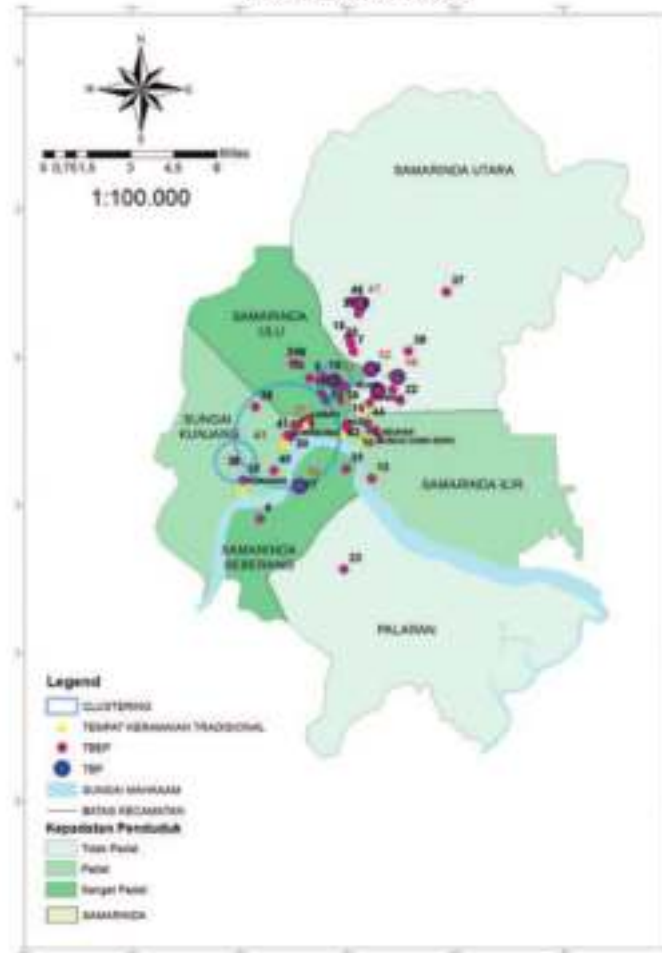


Figure 1. Spatial and pattern distribution of EPTB in Samarinda City. SaTScan Space-Time Permutation model analysis showed 3 clustering of TSEP. Cluster 1 consisted of 9 patients centered at -0.504177 S / 117.118058 E with a radius of 2.91 km. Cluster 2 consisted of 4 patients centered at -0.476895 S / 117.141700 E with a radius of 0.97 km. While cluster 3 consisted of 2 patients centered at -0.517031 S / 117.092132 E with a radius of 1.13 km

Table 2. Geographical distribution and distribution pattern of EPTP in Samarinda city.

Subdistrict	Total EPTB	Percentage (%)	Population density (people / km ²)
Samarinda Ulu	12	26,09	6,902
Sungai Kuning	9	19,57	3,500
Samarinda Utara	8	17,39	303
Sungai Pinang	6	13,04	4,200
Samarinda Kota	4	8,7	5,800
Samarinda Ilir	3	6,52	3,200
Samarinda Seberang	2	4,35	6,200
Palauw	1	2,17	300
Loa Janan Ilir	1	2,17	2,900
Total	46	100	

TB patients and 12 EPTB patients centered on -0.458159 S / 117.149945 E with a radius of 3.19 km (Figure 2). The formation of clustering indicated there is a relationship between EPTB and pulmonary TB geographically in Samarinda city. The presence of pulmonary TB in the cluster area can be a potential source of transmission to the surrounding environment. Based on Purely Spatial analysis with the Bernoulli model, a relative risk of 5.29 is obtained, which means that people in the cluster have a 5.29 times greater risk of suffering from TB than those who live outside the cluster.

Conclusions

The conclusion of this study was the individuation of 3 EPTB clusters in Samarinda City in 2017 in densely populated areas. There is a geographical relationship between EPTB and pulmonary TB in the city of Samarinda with a relative risk of 5.29 times. Spatial analysis of EPTB provides information on the spread of the source of infection from patients with active pulmonary TB.

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