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EDITORIAL

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SHORT RESEARCH ARTICLE

NARRATIVE

ORIGINAL RESEARCH ARTICLE

An Analysis of The Trend of Incidences and Fatality of Pulmonary Tuberculosis in East Java from 2015-2020: A Lesson From COVID-19

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ABSTRACT

Background: Pulmonary tuberculosis is still a public health problem, and surveillance data analysis has not been done much. Recently a global pandemic of COVID-19 has the potential in disturbing TB elimination programs and treatment. This study aims to comprehensively analyse the incidence rate (IR) and Case Fatality Rate (CFR) of pulmonary tuberculosis in East Java from 2015–2020 and during COVID-19 and the strategies for optimizing tuberculosis disease control.

Methodology: The study analyzed annual surveillance data using an analytical descriptive design. The Variables were analyzed with Spearman correlation with a level of evidence of 95% ($p<0.05$).

Results: The prevalence of pulmonary tuberculosis in East Java fluctuated from 2015–2020. In 2020 and during the COVID-19 pandemic, the number of cases and morbidity rates increased. Statistic results confirm the presence of a significant correlation between the values of Incidence rate (IR) and Case Fatality rate (CFR) ($p = 0.032$), IR and Treatment Success Rate (TSR) ($p = 0.020$), and CFR and TSR ($p = 0.002$). Population density is not correlated with the number of new cases ($p = 0.667$). Treatment rates have increased to 51%; cure and treatment rates have decreased to 76% and 89%, respectively, and there was a 4% increase in mortality during COVID-19.

Conclusions: COVID-19 has tremendously affected the treatment of pulmonary TB cases in East Java, Indonesia by increasing the incidence rate and decreasing the fatality rate. The pandemic promotes fear in the community to check their medical status and improve the quality of their health in East Java.

Key-words: COVID-19, pulmonary tuberculosis (TB), Incidence Rate (IR), Case Fatality Rate (CFR), surveillance

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INTRODUCTION

Tuberculosis (TB) is an airborne disease caused by the bacteria *M. tuberculosis* (MTB) that damages the lungs and respiratory tract. It can spread to other organs quickly through sneezing, coughing, and saliva. Tuberculosis increases the disease burden and economic losses globally, especially in low-to-middle-income countries such as Indonesia.[1] The latest report states that the prevalence of tuberculosis disease dominated by pulmonary tuberculosis reaches 80%, and globally in the world, it reached 10 million cases in 2019, by the World Health Organization. The country that contributed the highest number of cases was Indonesia, which occupied the second position among the eight countries that contributed to tuberculosis cases worldwide.[2] Two-thirds of TB cases in the world are contributed by India, Indonesia, China, the Philippines, Pakistan, Nigeria, Bangladesh, and South Africa, all of which are classified as lower-middle-income countries.[3]

The high number of positive confirmed cases of pulmonary tuberculosis has resulted in various related sectors trying to overcome and minimize transmission from person to person through education and TB elimination promotion programs in Indonesia. Nevertheless, these efforts have not gotten good results.[1] During the COVID-19 pandemic, Indonesia, like all countries in the world, is faced with global problems that have resulted in several regions in Indonesia having to be restricted and have implications for reducing the quality and quantity of health services, especially the treatment of pulmonary tuberculosis in the community. In addition, it has implications for patients due to services focused on controlling COVID-19 but reducing and exacerbating TB eradication efforts in Indonesia.[4]

The low standards in screening, diagnosis, and identification of the COVID-19 virus have resulted in various health services experiencing considerable obstacles due to delays in treatment, including misdiagnosis and symptoms of TB and influenza.[5,6] Previous studies have identified several disorders caused by the COVID-19 pandemic in treatment management and TB case-control, including allocating TB treatment funds for COVID-19, stopping diagnostic services such as rapid molecular testing (TCM), inadequate health education, and the low quality of TB treatment and treatment in Indonesia.[7] Numerous studies confirm that a higher percentage of COVID patients with TB is 11% higher and associated with older age, male gender, and having invasive ventilation.[6,8,9] These results confirm that a unique prevention and control strategy for COVID-19 in people with positive TB is needed to reduce morbidity and mortality rates, especially in Indonesia. This is in line with WHO's prediction that deaths will increase due to tuberculosis during the COVID-19 pandemic. Furthermore, the low access to first-level health services has resulted in a decrease in the number of notification cases of pulmonary tuberculosis, which also has implications for an increase in deaths due to TB and COVID-19 as comorbidities.[10,11] However, there are concerns that the COVID-19 pandemic has implications for increased pulmonary tuberculosis infections in the community.[12,13]

For this reason, we tried to analyze the annual surveillance data of East Java Province, which can be used as a preliminary reference in assessing the relationship between the incidence of pulmonary tuberculosis during COVID-19 and that analyzed over the past six years. East Java Province was chosen because it has an area with a reasonably high number of tuberculosis cases and COVID-19 on Java Island. The aim of this study was to comprehensively analyze the incidence of pulmonary tuberculosis in East Java from 2015–2020 and during COVID-19, as well as strategies offered for TB disease control. This research is helpful as preliminary information indicates that the COVID-19 pandemic has affected the healthcare system, especially at the first level. Service providers need to work together in the prevention, control, and eradication of tuberculosis in East Java. A critical prevalence analysis is carried out to describe trends in the incidence, mortality, and success of treatment during the current year. It is used as an instrument for evaluating health programs.

METHODOLOGY

Analytical descriptive research uses a retrospective cohort study design to analyze the relationship between independent and dependent variables that have been established using secondary data.[14] This research does not require ethical feasibility for data collection because it is secondary and open public data so that it can be accessed fully and thoroughly. The data obtained is then carried out by independent screening, and data conversion is carried out as needed, namely COVID-19 and tuberculosis data for the last six years. We comprehensively analyzed the Health Profile of East Java Province from 2015 – 2020 to obtain variables related to pulmonary tuberculosis, including data on patients who are newly registered (new cases), and bacteriologically confirmed by laboratory test (positive/confirmed), patients who are recovered with treatment, and patients who are dead before finishing their regimen (number of deaths during treatment) gender, and age. Furthermore, data collection related to COVID-19, namely confirmed cases, the number of patients examined, morbidity and mortality rates, and the distribution of COVID-19 infection events in East Java [15]. The data is obtained from the East Java Health Office (https://dinkes.jatimprov.go.id/). For population data obtained from the Central Statistics Agency by searching websites that have been open access at (https://jatim.bps.go.id/).[16–21]

The variables studied in this research are the Incidence Rate (IR) and Case Fatality Rate (CFR) as the dependent variable, meanwhile, the independent variables are population by district or city and the

sex ratio in 2020 of one thousand people. The population density was measured by the number of people per hectare (people/ha). The incidence rate was calculated based on the number of new cases divided by the total population. This results in an incidence rate (IR) per 100,000 population. The mortality rate was obtained from the number of people who died divided by the number of districts to obtain the percentage (%) of the risk of fatality rate (CFR), as well as the TB case cure rate (CCR), the treatment completion rate (TCR) and the treatment success rate (TSR) in 2015-2020. Furthermore, the TB treatment success rate (TSR) is defined as the total number of cured and fully treated cases among all reported TB cases. The treatment completion rate (TCR) was recorded from patients who had completed the entire course of treatment and had a negative result on one of the examinations before the end of treatment. The treatment success rate is counted as the number of patients who has completed and been cured. Data were analyzed descriptively and correlation tests using the *Spearman* correlation test (p<0.05) with Statistical Product and Services Solutions (SPSS) ver 25.

RESULTS

Demographic characteristics of East Java

East Java Province is geographically located between 11100 East Longitude – 11404' East Longitude and 70 12' South Latitude – 8048" South Latitude, with an area of 47,963 km^2 which covers two main parts, namely Mainland East Java and Madura Islands. The mainland area of East Java is 88.7%, or an area of 42,541 km^2, with the total population in 2020 reaching 39,886,288 people. East Java is divided into 29 regencies and nine cities, with Surabaya City as the provincial capital. East Java is the province with the most significant number of districts or cities in Indonesia. Most districts or cities have a gender ratio of 1:1. East Java has 851 people per square kilometer, with the highest population density located in Surabaya (8.286 people/km^2), Mojokerto (6.427 people/km^2), and Malang (6.022 people/km^2).

Table 1: Area, population, gender ratio, and population density by district/cities in East Java from 2015-2020

Area	Wide/km^2	Gender			Ratio (%)	Total Population	Population Density
		Female	Male	Total			
Pacitan	1.389,92	295,163	293,945	295,163	100	555.984	400
Ponorogo	1.305,70	477,428	478,411	477,428	100	871.825	667,7
Trenggalek	1.147,22	369,196	365,692	369,196	101	697.600	608,1
Tulungagung	1.055,65	548,563	548,025	548,563	100	1.043.182	988,2
Blitar	1.336,48	620,060	610,953	620,060	101	1.163.789	870,8
Kediri	1.386,05	830,315	814,085	830,315	102	1.580.092	1.140
Malang	3.530,65	1,344,541	1,323,755	1,344,541	102	2.619.975	742,1
Lumajang	1.790,90	557,352	569,742	557,352	98	1.044.718	583,3
Jember	3.092,34	1,271,535	1,278,825	1,271,535	99	2.459.890	795,5
Banyuwangi	5.782,40	860,245	858,217	860,245	100	1.617.814	279,8
Bondowoso	1.525,97	383,325	395,200	383,325	97	778.789	510,4
Situbondo	1.669,87	337,859	350,478	337,859	96	685.776	410,7
Probolinggo	1.696,21	570,237	585,657	570,237	97	1.174.890	692,7
Pasuruan	1.474,02	806,505	805,300	806,505	100	1.637.682	1.111
Sidoarjo	634,38	1,052,978	1,038,952	1,052,978	101	2.282.215	3.597
Mojokerto	717,83	566,019	559,503	566,019	101	1.126.392	1.569
Jombang	1.115,09	668,443	657,471	668,443	102	1.268.504	1.137
Nganjuk	1.224,25	558,087	551,596	558,087	101	1.057.011	863,4
Madiun	1.037,58	371,712	378,431	371,712	98	683.784	659
Magetan	688,84	331,598	342,535	331,598	97	629.020	913,2
Ngawi	1.295,98	433,525	439,821	433,525	99	830.134	640,5
Bojonegoro	2.198,79	656,564	651,038	656,564	101	1.252.020	569,4
Tuban	1.834,15	600,785	602,342	600,785	100	1.177.016	641,7
Lamongan	1.782,05	678,500	677,527	678,500	100	1.189.380	667,4
Gresik	1.191,25	664,874	655,696	664,874	101	1.326.420	1.113
Bangkalan	1.001,44	528,275	543,437	528,275	97	994.212	992,8
Sampang	1.233,08	484,721	491,299	484,721	99	989.001	802,1
Pamekasan	792,24	418,577	434,930	418,577	96	888.214	1.121
Sumenep	1.998,54	545,236	584,586	545,236	93	1.092.387	546,6
Kediri City	63,4	144,174	143,788	144,174	100	289.109	4.560
Blitar City	32,57	74,811	75,560	74,811	99	142.798	4.384,
Malang City	145,28	420,383	424,550	420,383	99	874.890	6.022
Probolinggo City	56,67	119,577	121,625	119,577	98	239.024	4.217
Pasuruan City	35,29	104,788	104,740	104,788	100	201.585	5.712
Mojokerto City	20,21	66,089	67,183	66,089	98	129.891	6.427
Madiun City	33,92	96,277	100,640	96,277	96	177.399	5.229,
Surabaya City	350,54	1,427,872	1,452,412	1,427,872	98	2.904.751	8.286
Batu City	136,74	108,091	106,562	108,091	101	209.125	1.529

Table 2: The total number of reported cases with pulmonary TB, cured, completed, and death cases in East Java from 2015-2020

Region	Total Case	Cured	Treatment Complete	Dead
Pacitan	987	683	352	74
Ponorogo	2047	1379	2168	215
Trenggalek	863	684	855	91
Tulungagung	2360	1163	1546	215
Blitar	1833	973	825	151
Kediri	6051	3556	2870	253
Malang	6770	4124	3959	462
Lumajang	4548	3096	3168	890
Jember	14266	10224	3353	509
Banyuwangi	5205	2864	3854	390
Bondowoso	3844	1084	1389	162
Situbondo	3164	2126	1217	146
Probolinggo	5402	3598	2616	382
Pasuruan	8566	4937	7057	368
Sidoarjo	5803	4296	4024	341
Mojokerto	5191	3915	3073	64
Jombang	4815	2596	1709	211
Nganjuk	1899	854	1354	59
Madiun	2955	2322	1672	108
Magetan	2290	1423	1642	106
Ngawi	3049	1640	1316	142
Bojonegoro	5404	3708	2790	109
Tuban	4852	3257	2541	153
Lamongan	6770	4814	3445	289
Gresik	5632	3338	2377	233
Bangkalan	3678	2604	2249	131
Sampang	3123	1354	1663	162
Pamekasan	4544	3255	1498	175
Sumenep	5389	2898	2216	295
Kediri City	1337	757	1375	111
Blitar City	478	289	357	51
Malang City	3913	1885	2883	148
Probolinggo City	1269	611	1152	163
Pasuruan City	1785	1044	975	113
Mojokerto City	803	435	692	50
Madiun City	1155	797	1178	251
Surabaya City	14457	9395	9674	695
Batu City	579	277	366	28
Total in East Java Province	156423	98255	72126	8496

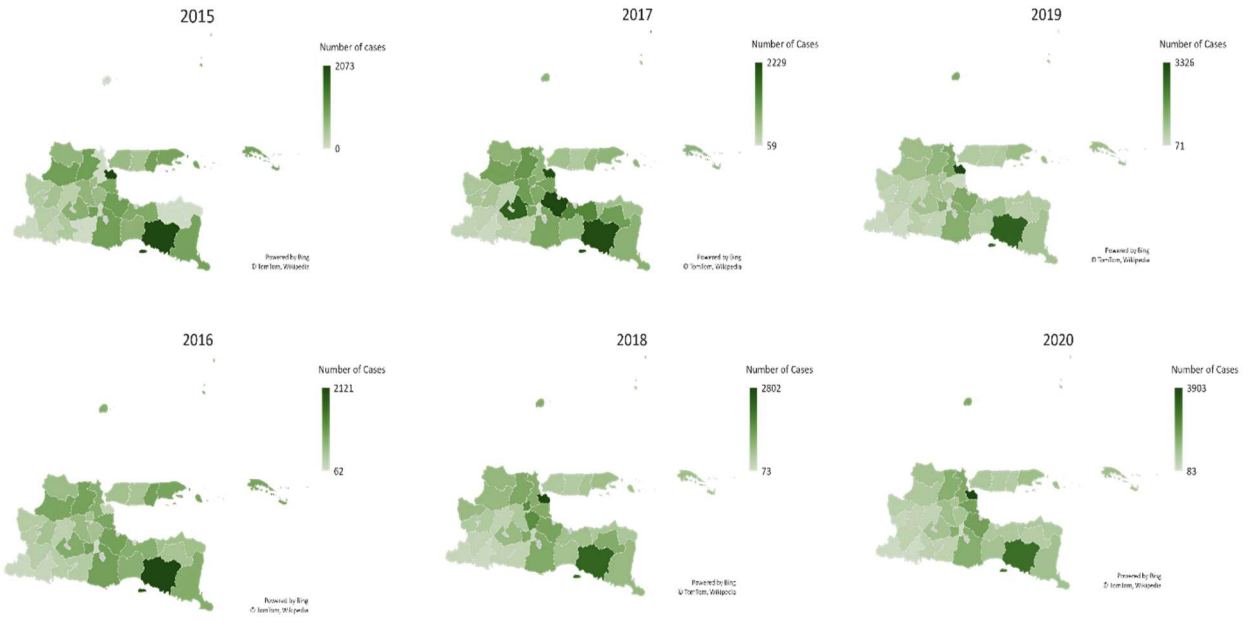

Figure 1: Pulmonary tuberculosis cases in East Java from 2015 – 2020

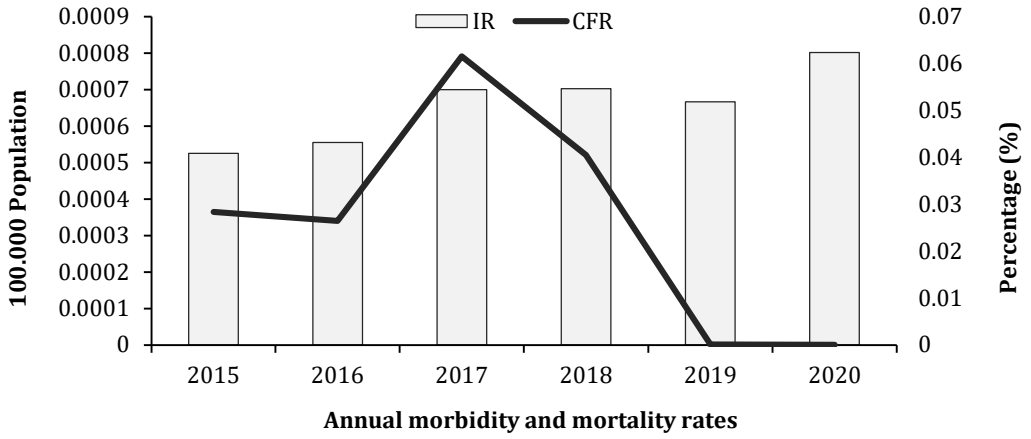

Figure 2: Morbidity and Mortality of pulmonary tuberculosis in East Java from 2015-2020

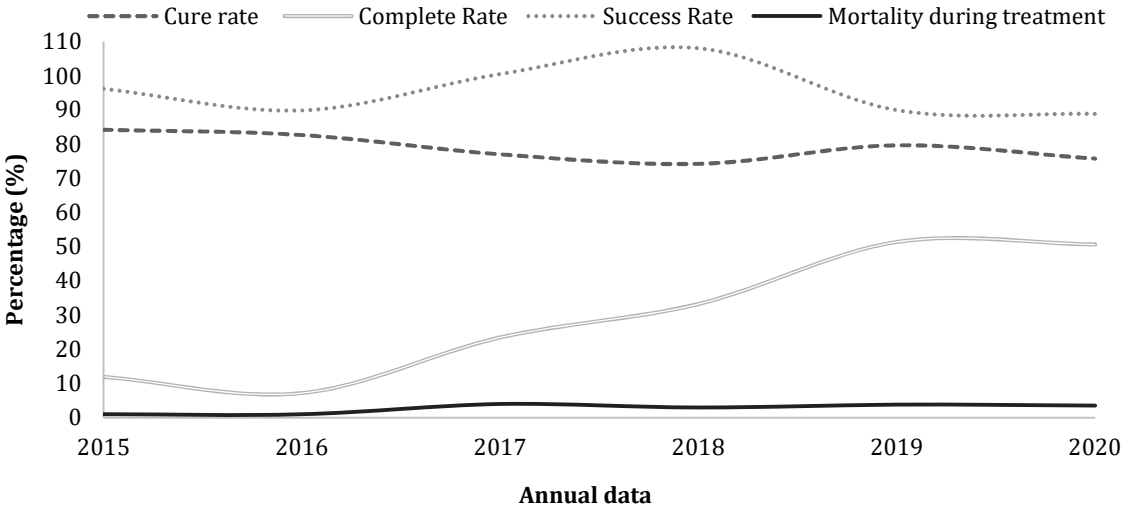

Figure 3: The case cure rate, the treatment complete rate, the treatment success rate, and mortality during treatment of pulmonary tuberculosis in East Java from 2015-2020

Pulmonary Tuberculosis cases in East Java from 2015-2020

In 2020, during the early COVID-19 pandemic, there were increased efforts to find cases with symptoms similar to TB. Therefore, patients with a negative diagnosis of COVID-19 but positive for TB will receive treatment according to procedures. This increases the number of incident cases of pulmonary TB and has an impact on increasing the TSR from the previous year during the pandemic, which indicates the success of the TB treatment program in East Java. The rate of pulmonary TB infection in East Java Province fluctuated from 2015–2020, with the highest rate from 2019–2020 (0.06 per 100,000 population). Overall pulmonary TB cases in East Java Province have increased; recorded deaths (MDT) have also increased from 2017-2020. Furthermore, the IR and CFR rates during the pandemic negatively correlate, increasing the IR rate. In contrast, a 6-fold decrease in the case fatality rate (CFR) percentage by 0.00% from 2017 occurred during the COVID-19 pandemic. The cure rate (CCR) of pulmonary TB cases is defined as patients with positive bacteriological examination results at the beginning of treatment and negative bacteriological examination results at the end of treatment and one of the previous examinations. The study results obtained that the highest CCR for pulmonary TB cases in East Java in 2015 reached (84%) and decreased before the COVID-19 pandemic to (76%).

This study reported the highest TSR in 2018 (108%) and the lowest in 2020 (89%) during the COVID-19 pandemic. Results showed that the highest completion rate in East Java occurred in 2019-2020 (51%) and the lowest in 2016 (7%). The highest MDT of pulmonary TB cases occurred in 2017 and 2020, at around 4%, while the lowest was in 2015-2016, at 1%. The case cure rate (CCR), the treatment complete rate (TCR), the treatment success rate (TSR), and mortality during treatment (MDT) of pulmonary tuberculosis in East Java in 2015-2020 are presented in Figure 3.

Correlation between components of pulmonary

TB surveillance during COVID-19

The IR and CFR rates for pulmonary TB in East Java Province are presented in Figure 2. Based on the *Spearman* correlation test with software SPSS on the data of the number of TB cases in East Java Province, Indonesia, there was no significant correlation between the percentage of population density of an area and the number of registered TB cases (p = 0.667). Furthermore, we found a significant correlation (p =0.032; r =-0.345) between the incidence rate (IR) and the case fatality rate (CFR) that is quite strong and negative; if the IR value increases, the CFR will decrease. Analysis of the incidence rate (IR) and treatment success rate (TSR) of pulmonary TB showed a significant correlation (p = 0.002; r = 0.371). IR and TSR have a positive correlation indicating that the treatment and treatment management of pulmonary tuberculosis patients performed quite well despite the increase in new cases. Furthermore, there is a significant correlation between CFR and TSR levels (p = 0.002; r = -0.478). The correlation between CFR and TSR is negative, which means the correlation is quite strong. Increasing the success rate of TB treatment will reduce the risk of death in patients with pulmonary tuberculosis in East Java. Spearman correlation test results of each research variable are presented in Table 3.

Table 3: Spearman correlation test results of each research variable

p-value	CFR_TB	TSR_TB	Population density
IR_TB	0,032*	0,020*	
CFR_TB		0,002*	
TB cases			0,667

* (p<0.05) = there is a significant correlation

DISCUSSION

The population and population density in East Java continues to increase yearly. This resulted in a population explosion and a high natality rate reported in 2019. The high population density and population in East Java contribute to a greater incidence of infectious diseases.[22] During the COVID-19 pandemic, the population mortality rate exceeded the mortality rate based on the national health report of the Indonesian Ministry of Health in 2020. Based on the East Java Provincial Health Profile in 2021, Surabaya has the first rank with the highest TB cases in the last five years, followed by Jember and Pasuruan districts (Figure 1). The number of pulmonary TB cases in districts or cities in East Java increased in 2020 and ahead of the COVID-19 pandemic. In addition, there is no indication of a decrease in pulmonary TB cases ahead of the pandemic. However, this condition results in morbidity and mortality rates experiencing fluctuating trends depending on the number of cases each year. The number of pulmonary TB cases in East Java has increased yearly from 2015-2020. Morbidity rates are shown as incidence rate data per hundred thousand population, while mortality rates are shown by case fatality rate (CFR) data. The analysis of the number of new cases (IR) and the treatment success rate (TSR) obtained showed that the level of treatment compliance strongly influences the treatment success rate (TSR) by patients and low cases of loss to follow-up (LTFU).[23,24]

The increase in TB cases in East Java Province during the pandemic is possible due to the standardized diagnosis of both diseases that were not recommended by WHO at the beginning of the pandemic in 2020; hence, patients with clinical symptoms of TB and COVID-19 will receive the same diagnostic procedures.[25] In addition, one possible reason for the increase in TB incidence during COVID-19 is that most cases arise from long-term latent infections; as evidenced suggested by the UK study, a small proportion (4% of 11%) were due to local transmission, suggesting that the majority of TB cases identified were latent. TB transmission may continue in neighborhoods with high TB incidences, such as multigenerational households and homeless populations.[26–29] Furthermore, the decline in the CFR rate is a good indicator of the assessment of TB management programs and strategies in East Java Province during the pandemic. The decline in CFR in East Java is based on H.L Blum's theory that health status is determined by 40% environmental, 30% behavioral, 20% health services, and 10% genetic factors. East Java Province has an achievement for families with access to proper sanitation facilities (healthy latrines), 93.6%. Twenty-five districts or cities have implanted a community-based total sanitation system (STBM), with the achievement of public facilities that meet health requirements of 64.02% and have met the target of the Indonesian Ministry of Health.[16]

The COVID-19 pandemic has led to substantial changes in the detection and treatment of TB cases.[30,31] Based on the updated global TB report from WHO, in 2021, Indonesia has ranked 2nd with the highest reduction in the CNR.[32] This report contrary to our findings, the incidence of pulmonary TB arises during COVID-19 in East Java. Meanwhile, with the trend of morbidity rate during the COVID-19 pandemic decreasing, it is necessary to develop a strategy for TB control and elimination in East Java Province that can be carried out optimally and synergistically through contact tracing, conducting the comprehensive molecular rapid test (GeneXpert®) in areas with a high TB incidence rate[33–35], continuous DOT monitoring at health facilities, and providing health education or counseling to communities in each region[36–39]. Periodic epidemiological analysis helps to provide an overview of TB cases in East Java Province and efforts that can be made to maximize TB testing and treatment, especially in districts or cities with a high incidence.[40–42] The data is valuable for understanding how COVID-19 mitigation policies can influence TB elimination efforts in countries with high TB incidence.[43,44] The COVID-19 pandemic caus-

es patients to be more vulnerable to the treatment given due to a large number of treatments, a psychological decline in patients, and a significant decrease in the patient's clinical condition [24,45]. Studies conducted on patients with COVID-TB infection have a high chance of more severe symptoms and death than patients who are only infected with COVID-19.[46] This research however has limitations in the quality of data collected using secondary data sources and the duration of the study needs to be prolonged to collect more relevant data. Further research is expected to review the correlation between the incidence of pulmonary tuberculosis infection with COVID-19 and risk factors such as the percentage of families with healthy homes, the application of healthy living behaviours, and the population below the poverty line to accelerate the elimination of TB in Indonesia.

Conclusion

The COVID-19 pandemic has resulted in an increase in the incidence of TB following a decrease in the fatality rate. A rapid substantial change in the flow of diagnosis and treatment of disease has also distracted and caused treatment limitations for patients. Improving the quality and quantity of health services and a multisector collaboration is needed, enhancing ongoing epidemiological studies, continuing approach to the susceptible community, increasing diagnosis capacity, setting a good algorithm for dividing patients with and without COVID-19, and adequate treatment facilities are the best strategies for suppressing the incidence of pulmonary TB in East Java.

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