

# Trop. Med. Infect. Dis., Volume 7, Issue 6 (June 2022) – 31 articles



**Cover Story** ([view full-size image](#)): In March 2022, a locally acquired human case of Japanese encephalitis (JE) was confirmed in southern Queensland, Australia. Forty cases were subsequently discovered in four states, representing a dramatic range expansion from the virus' historical presence in far north Australia. Recommendations for JE immunization for the Australian population have now expanded to include those at occupational risk. This includes those working with pigs (a major amplifying host) and those who operate JE surveillance programs. However, many cases during this outbreak appear not to have been infected by these routes, and immunization programs may need to target a much wider population. With a current shortage of JE vaccines in Australia, vaccination with fractional doses may help to stretch the limited supplies. [View this paper](#)

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## **The Natural Alkaloid Trypanthrin Induces Apoptosis-like Death in *Leishmania* spp.**

by [Andreza R. Garcia](#), [Yasmin P. G. Silva-Luiz](#), [Celuta S. Alviano](#), [Daniela S. Alviano](#), [Alane B. Vermelho](#) and [Igor A. Rodrigues](#)

*Trop. Med. Infect. Dis.* 2022, 7(6), 112; <https://doi.org/10.3390/tropicalmed7060112> - 20 Jun 2022

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**Abstract** Leishmaniasis is a vector-borne disease against which there are no approved vaccines, and the treatment is based on highly toxic drugs. The alkaloids consist of a chemical class of natural nitrogen-containing substances with a long history of antileishmanial activity. The present study aimed [\[...\] Read more.](#)

(This article belongs to the Topic [Novel Therapeutic Strategies against \*Leishmania\* and \*Trypanosoma\*](#))

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## **Presence and Multi-Species Spatial Distribution of Oropouche Virus in Brazil within the One Health Framework**

by [Sofia Sciancalepore](#), [Maria Cristina Schneider](#), [Jisoo Kim](#), [Deise I. Galan](#) and [Ana Riviere-Cinamond](#)

*Trop. Med. Infect. Dis.* 2022, 7(6), 111; <https://doi.org/10.3390/tropicalmed7060111> - 20 Jun 2022

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**Abstract** Oropouche virus (OROV) is an emerging vector-borne arbovirus with high epidemic potential, causing illness in more than 500,000 people. Primarily contracted through its midge and mosquito vectors, OROV remains prevalent in its wild, non-human primate and sloth reservoir hosts as well. This virus [\[...\] Read more.](#)

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## **Trends in Influenza Infections in Three States of India from 2015–2021: Has There Been a Change during COVID-19 Pandemic?**

by [Anup Jayaram](#), [Anitha Jagadesh](#), [Ajay M. V. Kumar](#), [Hayk Davtyan](#), [Pruthu Thekkur](#), [Victor J. Del Rio Vilas](#), [Shrawan Kumar Mandal](#), [Robin Sudandiradas](#), [Naren Babu](#), [Prasad Varamballi](#), [Ujwal Shetty](#) and [Chiranjay Mukhopadhyay](#)

*Trop. Med. Infect. Dis.* 2022, 7(6), 110; <https://doi.org/10.3390/tropicalmed7060110> - 19 Jun 2022

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**Abstract** The COVID-19 pandemic and public health response to the pandemic has caused huge setbacks in the management of other infectious diseases. In the present study, we aimed to (i) assess the trends in numbers of samples from patients with influenza-like illness and severe [\[...\] Read more.](#)

(This article belongs to the Special Issue [Operational Research and Capacity Building to Strengthen Health Systems for Tackling Public Health Emergencies](#))

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### **Prevalence of Common Diseases in Indigenous People in Colombia**

by [Hannah Bauer](#), [Gustavo Andrés Concha Mendoza](#), [Lothar Kreienbrock](#), [Maria Hartmann](#), [Hagen Frickmann](#) and [Simone Kann](#)

*Trop. Med. Infect. Dis.* **2022**, 7(6), 109; <https://doi.org/10.3390/tropicalmed7060109> - 18 Jun 2022

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**Abstract** The Indigenous tribe called the Wiwa lives retracted in the Sierra Nevada de Santa Marta, Colombia. Little is known about their health status and whether the health care system in place covers their needs. In 2017 and 2018, a permanent physician was in [\[...\]](#) [Read more](#). (This article belongs to the Special Issue [Women's Special Issue Series: Tropical Medicine and Infectious Disease](#))

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### **A Contemporary Exploration of Traditional Indian Snake Envenomation Therapies**

by [Adwait M. Deshpande](#), [K. Venkata Sastry](#) and [Satish B. Bhise](#)

*Trop. Med. Infect. Dis.* **2022**, 7(6), 108; <https://doi.org/10.3390/tropicalmed7060108> - 16 Jun 2022

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**Abstract** Snakebite being a quick progressing serious situation needs immediate and aggressive therapy. Snake venom antiserum is the only approved and effective treatment available, but for selected snake species only. The requirement of trained staff for administration and serum reactions make the therapy complicated. [\[...\]](#) [Read more](#).

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### **Epidemiology of COVID-19 in Individuals under 18 Years Old in Cartagena, Colombia: An Ecological Study of the First 14 Months of the Pandemic**

by [Steev Loyola](#), [Eder Cano-Pérez](#), [Jaison Torres-Pacheco](#), [Dacia Malambo-Garcia](#), [Ruben Gomez](#) and [Doris Gomez-Camargo](#)

*Trop. Med. Infect. Dis.* **2022**, 7(6), 107; <https://doi.org/10.3390/tropicalmed7060107> - 15 Jun 2022

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**Abstract** The epidemiology of the coronavirus disease (COVID-19) has been scarcely described in individuals under 18 years old, particularly during the first months of the pandemic. The study aimed to describe the COVID-19 epidemiology in the Colombian department of Bolívar from March 2020 to [\[...\]](#) [Read more](#).

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### **Pathogenesis and Manifestations of Zika Virus-Associated Ocular Diseases**

by [Bisant A. Labib](#) and [DeGaulle I. Chigbu](#)

*Trop. Med. Infect. Dis.* **2022**, 7(6), 106; <https://doi.org/10.3390/tropicalmed7060106> - 15 Jun 2022

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**Abstract** Zika virus (ZIKV) is mosquito-borne flavivirus that caused a significant public health concern in French Polynesia and South America. The two major complications that gained the most media attention during the ZIKV outbreak were Guillain-Barré syndrome (GBS) and microcephaly in newborn infants. The [\[...\]](#) [Read more](#).

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### **Epidemiology and Response to the COVID-19 Pandemic in Kerala, India, 2020–2021: A Cross-Sectional Study**

by [Ajan Maheswaran Jaya](#), [Anthony D. Harries](#), [Anisur Rahman](#), [Mohammed Khogali](#), [Palanivel Chinnakali](#), [Lakshmi Geetha Gopalakrishnan](#) and [Mahesh Narayana Pillai](#)

*Trop. Med. Infect. Dis.* **2022**, 7(6), 105; <https://doi.org/10.3390/tropicalmed7060105> - 14 Jun 2022

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**Abstract** Kerala, a southern state in India, experienced a slightly different COVID-19 pandemic than the rest of India. Using data from daily COVID-19 bulletins and two other Kerala health information systems, this study reported on epidemiological characteristics and response measures of the COVID-19 pandemic [\[...\]](#) [Read more](#).

(This article belongs to the Special Issue [Operational Research and Capacity Building to Strengthen Health Systems for Tackling Public Health Emergencies](#))

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**Compliance with Medication amongst Persons with Diabetes Mellitus during the COVID-19 Pandemic, Kerala, India: A Cross Sectional Study**

by [Aján Maheswaran Jaya](#), [Anthony D. Harries](#), [Anisur Rahman](#), [Mohammed Khogali](#), [Palanivel Chinnakali](#) and [Bipin Gopal](#)  
*Trop. Med. Infect. Dis.* **2022**, 7(6), 104; <https://doi.org/10.3390/tropicalmed7060104> - 14 Jun 2022

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**Abstract** Compliance with medication in persons with diabetes mellitus (DM) has been a challenge during the COVID-19 pandemic, leading to poor glycemic control and higher risk of complications. In the state of Kerala, India, 20–25% of adults have DM. Our cross-sectional study aimed to [...] [Read more.](#)

(This article belongs to the Special Issue [Operational Research and Capacity Building to Strengthen Health Systems for Tackling Public Health Emergencies](#))

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**Correction: Nalin, D. Issues and Controversies in the Evolution of Oral Rehydration Therapy (ORT). *Trop. Med. Infect. Dis.* 2021, 6, 34**

by [David Nalin](#)

*Trop. Med. Infect. Dis.* **2022**, 7(6), 103; <https://doi.org/10.3390/tropicalmed7060103> - 14 Jun 2022

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**Abstract** In the original publication [...] [Full article](#)

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**Non-Invasive Detection of SARS-CoV-2 Antigen in Saliva versus Nasopharyngeal Swabs Using Nanobodies Conjugated Gold Nanoparticles**

by [Manal Kamel](#), [Sara Maher](#), [Hanan El-Baz](#), [Faten Salah](#), [Omar Sayyouh](#) and [Zeinab Demerdash](#)

*Trop. Med. Infect. Dis.* **2022**, 7(6), 102; <https://doi.org/10.3390/tropicalmed7060102> - 13 Jun 2022

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**Abstract** The development of sensitive, non-invasive tests for the detection of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) antigens is imperative, and it is still challenging to manage the extent of infection throughout the population. Here, we designed and optimized a sandwich enzyme-linked immunosorbent assay [...] [Read more.](#)

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**Medication Adherence of Vietnamese Outpatients with Chronic Diseases during the COVID-19 Pandemic**

by [Suoi Thanh Pham](#), [Cuong Van Dam](#), [Chu Xuan Duong](#), [Nghì Huynh Phuong Duong](#), [Xuyen Thi Kim Nguyen](#), [Han Gia Diep](#), [Nguyet Kim Nguyen](#), [Duyen Thi Nhan Le](#), [Trang Thi Nhu Nguyen](#), [Tu Thi Cam Le](#), [Thao Thi Thanh Nguyen](#), [Henri van Asten](#) and [Thang Nguyen](#)

*Trop. Med. Infect. Dis.* **2022**, 7(6), 101; <https://doi.org/10.3390/tropicalmed7060101> - 13 Jun 2022

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**Abstract** The purpose of this study was to determine the medication adherence of outpatients with chronic diseases and the association between both patient attitudes and preventive practices regarding COVID-19 and their medication adherence. We performed a cross-sectional study in Vietnam. Medication adherence was determined [...] [Read more.](#)

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**Microbiological Characterisation of Community-Acquired Urinary Tract Infections in Bagamoyo, Tanzania: A Prospective Study**

by [Joseph Schmitter](#), [Nina Bühler](#), [Hasina Mkwatta](#), [Anna Lechleiter](#), [Tarsis Mlaganile](#), [Jürg Utzinger](#), [Tutu Mzee](#), [Theckla Kazimoto](#) and [Sören L. Becker](#)

*Trop. Med. Infect. Dis.* **2022**, 7(6), 100; <https://doi.org/10.3390/tropicalmed7060100> - 12 Jun 2022

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**Abstract** Urinary tract infections (UTIs) are among the most common infections in sub-Saharan Africa, but microbiological data to guide treatment decisions are limited. Hence, we investigated the bacterial aetiology and corresponding antimicrobial susceptibility patterns in outpatients with UTIs in Bagamoyo, Tanzania. Urine samples from [...] [Read more.](#)

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### **COVID-19 Amongst Travelers at Points of Entry in Nepal: Screening, Testing, Diagnosis and Isolation Practices**

by **Koshal Chandra Subedee**, **Krishna Prasad Paudel**, **Mohammed Khogali**, **Amrit Pokhrel**, **Palanivel Chinnakali**, **Nishant Thakur**, **Deepak Timsina**, **Rabin Gautam**, **Anisur Rahman**, **Shrawan Kumar Mandal**, **Mahendra Dhose Adhikari** and **Anthony D. Harries**

*Trop. Med. Infect. Dis.* **2022**, 7(6), 99; <https://doi.org/10.3390/tropicalmed7060099> - 10 Jun 2022

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**Abstract** WHO recommends surveillance for COVID-19 among travelers at Points of Entry (POE) to countries. At 13 selected POE at the Nepal-India border, between March 2021 and July 2021, we describe the screening, testing, diagnosis and isolation practices of COVID-19 amongst travelers. Those who [...] [Read more](#).

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### **Operational Gaps in Implementing the COVID-19 Case Investigation and Contact Tracing in Madhesh Province of Nepal, May–July 2021**

by **Nishant Thakur**, **Florian Vogt**, **Srinath Satyanarayana**, **Divya Nair**, **Krishna Garu**, **Koshal Chandra Subedee**, **Shrawan Kumar Mandal**, **Amrit Pokhrel**, **Dipendra Gautam** and **Krishna Prasad Paudel**

*Trop. Med. Infect. Dis.* **2022**, 7(6), 98; <https://doi.org/10.3390/tropicalmed7060098> - 10 Jun 2022

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**Abstract** In Nepal, case investigation and contact tracing (CICT) was adopted as an important public health measure to reduce COVID-19 transmission. In this study, we assessed the performance of CICT in Madhesh Province of Nepal against national benchmarks, using routine programmatic data reported by [...] [Read more](#).

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### **Enhancing Tuberculosis Case-Finding: A Case of Quality Improvement Initiative in Tanzania**

by **Eliud Wandwalo**, **Deus V. Kamara**, **Mohammed A. Yassin**, **Linden Morrison**, **Nnamdi B. Nwaneri**, **Sarah Asimwe**, **Sode Matiku**, **Riziki Kisonga** and **Allan Tarimo**

*Trop. Med. Infect. Dis.* **2022**, 7(6), 97; <https://doi.org/10.3390/tropicalmed7060097> - 09 Jun 2022

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**Abstract** Background: Tanzania is 1 of the 30 high TB burden countries and 1 of the 13 countries in which 75% of people with TB are unaccounted for and that is prioritized for the Global Fund Catalytic investment and Strategic Initiative support. Tanzania decided [...] [Read more](#).

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### **Cortical Blindness Due to Neurocysticercosis in an Adolescent Patient**

by **Nnennaya U. Opara**

*Trop. Med. Infect. Dis.* **2022**, 7(6), 96; <https://doi.org/10.3390/tropicalmed7060096> - 08 Jun 2022

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**Abstract** Neurocysticercosis (NCC) is a common cause of recent-onset seizures in both adults and children in tropical areas, especially when there is no other suggestion of another underlying neurological disorder. In addition, there have been reports of very rare cases of bilateral cortical blindness [...] [Read more](#).

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### **Consumption of Herbal Supplements or Homeopathic Remedies to Prevent COVID-19 and Intention of Vaccination for COVID-19 in Latin America and the Caribbean**

by **Guido Bendezu-Quispe**, **Jerry K. Benites-Meza**, **Diego Urrunaga-Pastor**, **Percy Herrera-Añazco**, **Angela Uyen-Cateriano**, **Alfonso J. Rodriguez-Morales**, **Carlos J. Toro-Huamanchumo**, **Adrian V. Hernandez** and **Vicente A. Benites-Zapata**

*Trop. Med. Infect. Dis.* **2022**, 7(6), 95; <https://doi.org/10.3390/tropicalmed7060095> - 08 Jun 2022

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**Abstract** Users of complementary and alternative medicine (CAM) have a lower intention to receive vaccines. Furthermore, Latin America and the Caribbean (LAC) region are among the most affected areas by the COVID-19 pandemics and present a high proportion of CAM users. Therefore, this study [...] [Read more](#).

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**Interaction of *Haemagogus leucocelaenus* (Diptera: Culicidae) and Other Mosquito Vectors in a Forested Area, Rio de Janeiro, Brazil**

by [Shayenne Olsson Freitas Silva](#), [Cecilia Ferreira de Mello](#), [Sergio Lisboa Machado](#), [Paulo José Leite](#) and [Jeronimo Alencar](#)  
*Trop. Med. Infect. Dis.* **2022**, 7(6), 94; <https://doi.org/10.3390/tropicalmed7060094> - 08 Jun 2022

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**Abstract** The yellow fever (YF) virus has been detected throughout Brazil, with the occurrence of human cases, cyclic epizootics, and its isolation from *Haemagogus janthinomys* and *Hg. leucocelaenus*. We assessed the seasonal occurrence, egg abundance, and oviposition interaction of mosquito vector species captured [...] [Read more](#).

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**Identification and Characterization of a Potential Antimicrobial Peptide Isolated from Soil *Brevibacillus* sp. WUL10 and Its Activity against MRSA Pathogens**

by [Apichart Atipairin](#), [Nuttapon Songnaka](#), [Sucheewin Krobthong](#), [Yodying Yingchutrakul](#), [Thapanee Chinnawong](#) and [Thamonwan Wanganuttara](#)

*Trop. Med. Infect. Dis.* **2022**, 7(6), 93; <https://doi.org/10.3390/tropicalmed7060093> - 07 Jun 2022

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**Abstract** Methicillin-resistant *Staphylococcus aureus* (MRSA) is a severe threat to public health globally. The development of novel agents has encountered the repeated mechanism of drug resistance. This study aimed to investigate an anti-MRSA substance isolated from a promising soil bacterium. The result showed that [...] [Read more](#).

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**Incidence and Risk Factors of Bilateral Herpetic Keratitis: 2022 Update**

by [Stergios K Chaloulis](#), [Georgios Mousteris](#) and [Konstantinos T Tsaousis](#)

*Trop. Med. Infect. Dis.* **2022**, 7(6), 92; <https://doi.org/10.3390/tropicalmed7060092> - 07 Jun 2022

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**Abstract** Simultaneously occurring bilateral herpetic keratitis is a rare clinical manifestation of ocular herpes. Immunocompromised patients are more susceptible to develop bilateral disease. The purpose of this study is to review recent literature on the topic and to highlight latest updates, regarding risk factors [...] [Read more](#).

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**Continuous Circulation of Chikungunya Virus during COVID-19 Pandemic in Jambi, Sumatra, Indonesia**

by [Marsha Sinditia Santoso](#), [Sotianingsih Haryanto](#), [Fadil Rulian](#), [Rahma F. Hayati](#), [Amanda Kristiani](#), [Rini Kartika](#), [Benediktus Yohan](#), [Martin L. Hibberd](#) and [R. Tedjo Sasmono](#)

*Trop. Med. Infect. Dis.* **2022**, 7(6), 91; <https://doi.org/10.3390/tropicalmed7060091> - 05 Jun 2022

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**Abstract** Chikungunya fever is a self-limiting viral illness that is caused by the chikungunya virus (CHIKV). CHIKV is found in multiple provinces of Indonesia, with clustered local outbreaks. This case series investigates a local chikungunya outbreak during the COVID-19 pandemic, involving two virologically confirmed [...] [Read more](#).

(This article belongs to the Section [Vector-Borne Diseases](#))

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**Epidemiological Interface of Sylvatic and Dog Rabies in the North West Province of South Africa**

by [Ayla J. Malan](#), [Andre Coetzer](#), [Claude T. Sabeta](#) and [Louis H. Nel](#)

*Trop. Med. Infect. Dis.* **2022**, 7(6), 90; <https://doi.org/10.3390/tropicalmed7060090> - 05 Jun 2022

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**Abstract** Rabies is a viral zoonosis that causes an estimated 59,000 preventable human fatalities every year. While more than 120 countries remain endemic for dog-mediated rabies, the burden is the highest in Africa and Asia where 99% of human rabies cases are caused by [...] [Read more](#).

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**Antimicrobial Susceptibility Testing Patterns of *Neisseria gonorrhoeae* from Patients Attending Sexually Transmitted Infections Clinics in Six Regions in Tanzania**

by [Said Aboud](#), [Simon N. Buhalata](#), [Onduru G. Onduru](#), [Mercy G. Chiduo](#), [Gideon P. Kwesigabo](#), [Stephen E. Mshana](#), [Alphaxard M. Manjurano](#), [Mansuet M. Temu](#), [Coleman Kishamawe](#) and [John M. Chungalucha](#)

*Trop. Med. Infect. Dis.* **2022**, 7(6), 89; <https://doi.org/10.3390/tropicalmed7060089> - 02 Jun 2022

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**Abstract** Antimicrobial resistance (AMR) is global health threat that is on the increase, and it has been adversely affecting the proper management of sexually transmitted infections (STI). Data on antimicrobial susceptibility testing patterns of *N. gonorrhoeae* are limited in local settings. We determined in [...] [Read more](#).

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### [Systematic Surveillance of Rickettsial Diseases in 27 Hospitals from 26 Provinces throughout Vietnam](#)

by [Nguyen Vu Trung](#), [Le Thi Hoi](#), [Tran Mai Hoa](#), [Dang Thi Huong](#), [Ma Thi Huyen](#), [Vuong Quang Tien](#), [Dao Thi Tuyet Mai](#), [Nguyen Thi Thu Ha](#), [Nguyen Van Kinh](#), [Christina M. Farris](#) and [Allen L. Richards](#)

*Trop. Med. Infect. Dis.* **2022**, 7(6), 88; <https://doi.org/10.3390/tropicalmed7060088> - 31 May 2022

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**Abstract** In Vietnam, the public health burden of rickettsial infections continues to be underestimated due to knowledge gaps in the epidemiology of these diseases. We conducted a systematic study among 27 hospitals from 26 provinces in eight ecological regions throughout Vietnam to investigate the [...] [Read more](#).

(This article belongs to the Special Issue [Advances in Vector-Borne Diseases: Celebrating the First Impact Factor of TMID and in Memory of Sir Patrick Manson \(1844-1922\)](#))

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### [Performance of an Emergency Road Ambulance Service in Bhutan: Response Time, Utilization, and Outcomes](#)

by [Tshokey Tshokey](#), [Ugyen Tshering](#), [Karma Lhazeen](#), [Arapine Abrahamyan](#), [Collins Timire](#), [Bikash Gurung](#), [Devi Charan Subedi](#), [Kencho Wangdi](#), [Victor Del Rio Vilas](#) and [Rony Zachariah](#)

*Trop. Med. Infect. Dis.* **2022**, 7(6), 87; <https://doi.org/10.3390/tropicalmed7060087> - 31 May 2022

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**Abstract Background:** An efficient ambulance service is a vital component of emergency medical services. We determined the emergency ambulance response and transport times and ambulance exit outcomes in Bhutan. **Methods:** A cross-sectional study involving real-time monitoring of emergency ambulance deployments managed by a central [...] [Read more](#).

(This article belongs to the Special Issue [Operational Research and Capacity Building to Strengthen Health Systems for Tackling Public Health Emergencies](#))

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### [Medical Care for Tuberculosis-HIV-Coinfected Patients in Russia with Respect to a Changeable Patients' Structure](#)

by [Olga P. Frolova](#), [Olga V. Butylchenko](#), [Patimat G. Gadzhieva](#), [Margarita Yu. Timofeeva](#), [Valeria A. Basangova](#), [Vladislava O. Petrova](#), [Inna A. Fadeeva](#), [Maria I. Kashutina](#), [Nadezhda N. Zabroda](#), [Artem A. Basov](#), [Elena V. Belova](#), [Yury V. Zhernov](#), [Oleg V. Mitrokhin](#), [Inga I. Enilenis](#) and [Lyudmila P. Severova](#)

*Trop. Med. Infect. Dis.* **2022**, 7(6), 86; <https://doi.org/10.3390/tropicalmed7060086> - 31 May 2022

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**Abstract** To date, tuberculosis (TB) remains the primary cause of mortality in human immunodeficiency virus (HIV) patients in Russia. Since the beginning of 2000, a sharp change in the HIV patients' structure, to the main known risk factors for HIV infection has taken place [...] [Read more](#).

(This article belongs to the Special Issue [HIV Testing, Prevention and Care Cascade](#))

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### [The Emergence of Japanese Encephalitis in Australia and the Implications for a Vaccination Strategy](#)

by [Luis Furuya-Kanamori](#), [Narayan Gyawali](#), [Deborah J. Mills](#), [Leon E. Hugo](#), [Gregor J. Devine](#) and [Colleen L. Lau](#)

*Trop. Med. Infect. Dis.* **2022**, 7(6), 85; <https://doi.org/10.3390/tropicalmed7060085> - 29 May 2022

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**Abstract** Japanese encephalitis (JE) is the leading cause of viral encephalitis in Asia. Until 2022, only six locally transmitted human JE cases had been reported in Australia; five in northern Queensland and one in the Northern Territory. Thus, JE was mainly considered to be [...] [Read more](#).








(This article belongs to the Special Issue [Advances in Vector-Borne Diseases: Celebrating the First Impact Factor of TMID and in Memory of Sir Patrick Manson \(1844-1922\)](#))

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**Pathogenic *Leptospira* Species in Bats: Molecular Detection in a Colombian Cave**

by  Carlos Ramiro Silva-Ramos,  Sandra M. Chala-Quintero,  Álvaro A. Faccini-Martínez,  Marylin Hidalgo,  Adriana del Pilar Pulido-Villamarín,  Jairo Pérez-Torres and  Claudia Cuervo

*Trop. Med. Infect. Dis.* 2022, 7(6), 84; <https://doi.org/10.3390/tropicalmed7060084> - 27 May 2022

Cited by 1 | Viewed by 1328

**Abstract** Leptospirosis is caused by pathogenic *Leptospira* spp., which can be found in nature among domestic and wild animals. In Colombia, the Macaregua cave is known for its bat richness; thus, because bats are reservoir hosts of human microbiological pathogens, we determined if the [...]

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**Comparison Epidemiology between Tuberculosis and COVID-19 in East Java Province, Indonesia: An Analysis of Regional Surveillance Data in 2020**

by  Budi Utomo,  Chow Khuen Chan,  Ni Made Mertaniasih,  Soedarsono Soedarsono,  Shifa Fauziyah,  Teguh Hari Sucipto,  Febriana Aquaresta,  Dwinka Syafira Eljatin and  I Made Dwi Mertha Adnyana

*Trop. Med. Infect. Dis.* 2022, 7(6), 83; <https://doi.org/10.3390/tropicalmed7060083> - 27 May 2022

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**Abstract** Tuberculosis and COVID-19 are among the infectious diseases that constitute a public health concern. Therefore, this study aims to examine the recent epidemiology of tuberculosis and COVID-19 in East Java Province, Indonesia, in 2020. Case-based surveillance data were acquired with a retrospective design [...][Read more.](#)

(This article belongs to the Topic [Impact of COVID-19 Global Crisis on the Sustainable Development Goals](#))

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**Identifying Hotspots of People Diagnosed of Tuberculosis with Addiction to Alcohol, Tobacco, and Other Drugs through a Geospatial Intelligence Application in Communities from Southern Brazil**

by  Alessandro Rolim Scholze,  Felipe Mendes Delpino,  Luana Seles Alves,  Josilene Dália Alves,  Thaís Zamboni Berra,  Antônio Carlos Vieira Ramos,  Miguel Fuentealba-Torres,  Inês Fronteira and  Ricardo Alexandre Arcêncio

*Trop. Med. Infect. Dis.* 2022, 7(6), 82; <https://doi.org/10.3390/tropicalmed7060082> - 24 May 2022

Viewed by 1296

**Abstract** (1) Background: tuberculosis (TB) is considered one of the leading causes of death worldwide by a single infectious agent. This study aimed to identify hotspots of people diagnosed with tuberculosis and abusive use of alcohol, tobacco, and other drugs in communities through a [...][Read more.](#)

(This article belongs to the Special Issue [Geospatial Health \(GeoHealth\): Current Trends, Methods, and Applications](#))

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Article

# Comparison Epidemiology between Tuberculosis and COVID-19 in East Java Province, Indonesia: An Analysis of Regional Surveillance Data in 2020

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**Abstract:** Tuberculosis and COVID-19 are among the infectious diseases that constitute a public health concern. Therefore, this study aims to examine the recent epidemiology of tuberculosis and COVID-19 in East Java Province, Indonesia, in 2020. Case-based surveillance data were acquired with a retrospective design between January and December 2020 by the East Java Health Officer. The data were analyzed using Quantum Geographic Information System (QGIS) for mapping, and Microsoft Excel for recording. Furthermore, the statistical analysis (Spearman correlation test) was carried out via Statistical Package for Social Science (SPSS) applications. A total number of 38,089 confirmed cases of tuberculosis was recorded, with an incidence rate of 95.49/100,000 population, a case fatality rate (CFR) of 3.6%, and an average treatment success rate of 87.78%. COVID-19 is a new viral disease, with a total of 84,133 confirmed COVID-19 cases in East Java, with an incidence rate of 232.9/100,000 population. The highest incidence rate was found in Mojokerto city, while the lowest was found in Sampang. Furthermore, the CFR values of tuberculosis and COVID-19 were 1.4% and 6.8%, respectively. The regional survey in East Java Province showed that the incidence of tuberculosis remains high. This indicated that the search for active cases and preventive promotion was not completed. Therefore, inter-sectoral collaboration can be adapted to provide suitable tuberculosis health care.

**Keywords:** tuberculosis; COVID-19; infectious disease

## 1. Introduction

Coronavirus disease 2019 (COVID-19) was identified as an infectious illness caused by Coronavirus-2 Severe Acute Respiratory Syndrome (SARS-CoV-2). The daily increase in

cases significantly affected the world, with 3.8 million fatalities reported in 2020; therefore, it was declared a pandemic by the World Health Organization [1].

During the pandemic threat, respiratory disorders were aggravated by COVID-19 infection. Due to the significant morbidity and mortality caused by COVID-19, several sectors in society attempted to avoid and conquer the pandemic. Pulmonary tuberculosis is caused by mycobacterium tuberculosis, which is transferred to people in close contact with patients, such as relatives, coworkers, colleagues, and friends, through coughing, talking, and sneezing [2]. This was particularly true for patients with pulmonary tuberculosis (TB), who are very susceptible to viral infection [3,4].

Studies on the existence of COVID-19 co-infection in pulmonary tuberculosis patients are important, due to the high risk and severity of COVID-19 disease. According to Coronel et al., tuberculosis patients have a very high risk of severe illness and mortality from COVID-19 [3]. Furthermore, incorrect treatment and hazardous conduct also increase the possibility of developing new diseases [4,5]. Therefore, this study aims to determine the epidemiology of the number of cases of pulmonary tuberculosis and COVID-19 in Indonesia, specifically in the province of East Java.

## 2. Materials and Methods

### 2.1. Study Design

The East Java Province is the eastern part of Java Island with a land area of 47,799.75 km<sup>2</sup>. It is located in 111°0' to 114°4' East Longitude (BT) and 7°12' to 8°48' South Latitude (LS) with four regional boundaries, namely, the north side (Java Sea), south, (Indian Ocean), west, (Central Java Province), and east (Bali Strait).

This was a retrospective cohort study using routinely regional surveillance data. The data were obtained from the Health Province Open Data Website, which offers free access to current epidemiological resources for infectious and non-communicable diseases (<https://bit.ly/profil-kesehatan-2020> (accessed on 22 March 2021), including COVID-19 and TB [6]. The province consisted of 38 regencies, with a total population of 39,886,288, in accordance with the the East Java Health Profile. Therefore, the service was managed by East Java Health Officers from January to December 2020. Subsequently, the collected data were represented using graphs and geographical mapping for easier comprehension. COVID-19 cases were defined as all patients with or without symptoms of COVID-19 that were confirmed as positive using Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) methods. Geographical mapping for the distribution of tuberculosis and COVID-19 cases was analyzed using Quantum Geographic Information System (QGIS) version 3.16.14-Hannover.

### 2.2. Statistical Analysis

All demographic data, together with tuberculosis and COVID-19 cases, were collected and analyzed using Statistical Package for Social Science software. The correlation between the incidence rate and the case fatality rate of tuberculosis and COVID-19 was calculated. An evaluation of the correlation between the case recovery rate and case fatality rate of tuberculosis, as well as the incidence rate and treatment success rate of tuberculosis, was also carried out. Furthermore, the correlation between treatment success rate and case fatality rate of tuberculosis, case recovery rate, and case fatality rate of COVID-19, was determined. We also calculated geographical factors, including the ratio of public health centres, number of doctors, nurses, midwifery, public health workers, environmental health workers, nutritionists, and pharmacists (Tables S1–S3). All the ratios were calculated per 100,000 of the population. These ratios were statistically tested by Pearson Correlation Test. For the sex distribution, the difference between both female and male patients with COVID-19 and tuberculosis was calculated. The data were analyzed using the Spearman correlation test, with a significance value of  $p < 0.05$ .

### 2.3. Ethical Clearance

This study used routine/annual surveillance data from regional open platforms, which were provided by the Health Officer of East Java Province. The data were already anonymized; therefore, no ethical clearance was needed.

## 3. Results

### 3.1. The Incidence Rate (IR) of Tuberculosis and COVID-19

In this study, the incidence rate of tuberculosis in East Java Province in 2020 was 95.49/100,000 population (Table 1), with a varying case recovery rate (Table 2). The number of cases was higher among males than females (Tables 3 and 4). The number for women in East Java in 2020 was 20,374,104, while the number for men was 20,291,592. Among all the residents in East Java, Probolinggo residents have a higher number of females (604) with tuberculosis than males (561). The highest infection rate was discovered in Madiun (296.51/100,000 population), while the lowest was proposed in Malang (0.07/100,000 population) (Table 1). When the data were analyzed according to sex, the incidence rate of tuberculosis in males (117.66/100,000 inhabitants) was higher than in females (93.49/100,000 inhabitants) (Table 3).

**Table 1.** Distribution of incidence rate (IR) and case fatality rate of TB and COVID-19 in 2020.

No.	Regency	TB Infection		COVID-19 Infection	
		IR *	CFR	IR *	CFR
1.	Pacitan	51.8	1.9%	136.5	2.8%
2.	Ponorogo	103.69	1.3%	142.2	4.0%
3.	Trenggalek	57.63	0.9%	148.9	4.4%
4.	Tulungagung	78.70	1.4%	129.8	<b>2.1%</b>
5.	Blitar	55.08	1.7%	156.5	8.0%
6.	Kediri	0.1	0.8%	152.8	7.8%
7.	Malang	<b>0.07</b>	1.3%	56.5	5.7%
8.	Lumajang	0.11	0.8%	230.9	6.6%
9.	Jember	0.12	0.7%	180.4	4.7%
10.	Banyuwangi	0.12	2.0%	253.4	9.3%
11.	Bondowoso	114.54	1.0%	193.1	5.3%
12.	Situbondo	142.47	0.7%	248.5	7.0%
13.	Probolinggo	0.1	3.2%	188.4	5.1%
14.	Pasuruan	0.11	0.8%	133.8	7.2%
15.	Sidoarjo	0.11	1.2%	349.7	6.6%
16.	Mojokerto	0.1	0.6%	132.0	3.0%
17.	Jombang	0.1	1.4%	182.8	10.6%
18.	Nganjuk	68.02	1.0%	103.8	9.9%
19.	Madiun	86.28	1.8%	57.0	7.4%
20.	Magetan	75.04	1.1%	150.1	5.0%
21.	Ngawi	90.95	1.4%	71.1	5.9%
22.	Bojonegoro	0.11	1.4%	102.8	7.2%
23.	Tuban	0.11	1.7%	152.1	10.6%
24.	Lamongan	0.13	1.0%	146.0	6.0%
25.	Gresik	0.11	1.3%	313.9	6.6%
26.	Bangkalan	100.48	0.7%	100.6	9.4%
27.	Sampang	82.71	1.2%	<b>52.5</b>	5.2%
28.	Pamekasan	82.07	1.2%	86.7	8.1%
29.	Sumenep	0.15	2.1%	110.3	6.1%
30.	Kediri City	199.92	1.2%	248.3	7.2%
31.	Blitar City	166.67	1.1%	467.1	5.4%
32.	Malang City	0.16	0.6%	422.8	9.9%
33.	Probolinggo city	145.59	<b>7.0%</b>	611.7	7.3%
34.	Pasuruan City	258.45	1.1%	497.1	<b>11.0%</b>



**Table 1.** *Cont.*

No.	Regency	TB Infection		COVID-19 Infection	
		IR *	CFR	IR *	CFR
35.	Mojokerto City	254.06	0.9%	<b>789.9</b>	5.7%
36.	Madiun City	<b>296.51</b>	1.6%	227.7	7.7%
37.	Surabaya City	0.14	<b>0.4%</b>	625.3	6.9%
38.	Batu City	88.46	0.5%	498.7	8.3%
	Average	68.44	0.013	232.93	0.067

\* IR: Incidence rate per 100,000 populations. CFR: Case Fatality Rate. Bold font indicated the highest or the lowest data.

**Table 2.** Case recovery rate (CRR) of TB and COVID-19 in East Java Province in 2020.

No.	Regency	Case Recovery Rate (CRR)	
		TB (%)	COVID-19 (%)
1.	Pacitan	81.5	79.71
2.	Ponorogo	84.5	81.93
3.	Trenggalek	91.2	83.92
4.	Tulungagung	64.4	71.86
5.	Blitar	75.9	85.61
6.	Kediri	92.2	80.49
7.	Malang	78.2	92.03
8.	Lumajang	52.4	83.58
9.	Jember	86	80.96
10.	Banyuwangi	76.2	83.24
11.	Bondowoso	68.7	90.82
12.	Situbondo	85.4	87.61
13.	Probolinggo	83.5	85.08
14.	Pasuruan	57.8	83.84
15.	Sidoarjo	74.3	<b>92.62</b>
16.	Mojokerto	78	89.24
17.	Jombang	81.1	85.25
18.	Nganjuk	74.1	81.58
19.	Madiun	73.4	65.89
20.	Magetan	<b>96.6</b>	84.74
21.	Ngawi	84.9	78.81
22.	Bojonegoro	93.1	75.13
23.	Tuban	75	<b>64.8</b>
24.	Lamongan	82.9	86.52
25.	Gresik	76.7	91.59
26.	Bangkalan	92.2	74.9
27.	Sampang	58.3	83.84
28.	Pamekasan	84.5	68.44
29.	Sumenep	77.4	74.19
30.	Kediri City	74.8	79.53
31.	Blitar City	84.3	86.2
32.	Malang City	63.2	81.42
33.	Probolinggo city	59.6	73.59
34.	Pasuruan City	84.6	84.23
35.	Mojokerto City	58.7	92.59
36.	Madiun City	91.4	75.74
37.	Surabaya City	72.5	92.32
38.	Batu City	<b>11.3</b>	88.68
	Average	75.81	82.17

Source: East Java Health Profile 2020. Bold font indicated the highest or the lowest data.

**Table 3.** Distribution of TB and COVID-19 cases according to sex.

No.	Regency	TB (Number of People) *		COVID-19 (Number of People) *	
		Male	Female	Male	Female
1.	Pacitan	170	118	386	373
2.	Ponorogo	530	374	674	566
3.	Trenggalek	237	165	491	548
4.	Tulungagung	463	358	636	718
5.	Blitar	366	275	913	908
6.	Kediri	815	727	1066	1349
7.	Malang	1026	802	761	720
8.	Lumajang	630	499	1168	1244
9.	Jember	1640	<b>1407</b>	2076	2369
10.	Banyuwangi	1119	886	1902	2197
11.	Bondowoso	477	415	503	1001
12.	Situbondo	531	446	738	966
13.	Probolinggo	561	604	926	1287
14.	Pasuruan	910	860	1130	1061
15.	Sidoarjo	1440	1080	4015	3965
16.	Mojokerto	615	465	702	785
17.	Jombang	706	582	1057	1262
18.	Nganjuk	417	302	500	597
19.	Madiun	345	245	<b>198</b>	<b>192</b>
20.	Magetan	271	201	456	488
21.	Ngawi	441	314	291	299
22.	Bojonegoro	820	611	599	688
23.	Tuban	714	572	844	946
24.	Lamongan	858	637	834	903
25.	Gresik	839	624	1878	2285
26.	Bangkalan	534	465	507	493
27.	Sampang	467	351	234	285
28.	Pamekasan	409	320	350	420
29.	Sumenep	952	660	480	725
30.	Kediri City	319	259	290	428
31.	Blitar City	134	104	367	300
32.	Malang City	739	638	1817	1882
33.	Probolinggo city	177	171	768	694
34.	Pasuruan City	289	232	502	500
35.	Mojokerto City	189	141	489	537
36.	Madiun City	327	199	203	201
37.	Surabaya City	<b>2305</b>	1846	<b>8889</b>	<b>9275</b>
38.	Batu City	<b>93</b>	<b>92</b>	545	498
	Total	23,875	19,047	40,185	43,955

\* Source: East Java Health Profile 2020. Bold font indicated the highest or the lowest data.

The regency with the highest tuberculosis incidence rate in males was Madiun (342.62/100,000 population), while the lowest rate was found in Pacitan (57.88/100,000 population) (Table 3). For females, the regency with the highest incidence rate of tuberculosis was Pasuruan (223.16/100,000 inhabitants) and the lowest rate was discovered in Pacitan (93.49/100,000 inhabitants) (Table 3). The highest incidence rate of COVID-19 infection was discovered in Mojokerto (789.9/100,000 populations), while the lowest was found in Sampang (52.5/100,000 populations) (Table 1). An analysis based on sex showed that the incidence rate of COVID-19 in females (215.74/100,000 inhabitants) was higher than in males (198.04/100,000 inhabitants). Meanwhile, the regency with the highest rate of males was Mojokerto (744.46/100,000 inhabitants), while the lowest rate was found in Sampang (48.58/100,000 inhabitants) (Table 3). The regency with the highest incidence rate of COVID-19 in females was Mojokerto (804.51/100,000 inhabitants), while the lowest rate was found in Madiun (51.14/100,000 inhabitants) (Table 4).

**Table 4.** The incidence rate of TB and COVID-19 according to sex group.

No.	Regency	Incidence Rate of TB		Incidence Rate of COVID-19	
		Male	Female	Male	Female
1.	Pacitan	<b>57.88</b>	<b>40.36</b>	131.42	127.57
2.	Ponorogo	111.75	78.73	142.12	119.14
3.	Trenggalek	64.51	45.36	133.65	150.65
4.	Tulungagung	84.91	65.75	116.64	131.86
5.	Blitar	59.37	45.29	148.09	149.53
6.	Kediri	98.68	89.82	129.08	166.66
7.	Malang	76.69	60.91	56.88	54.68
8.	Lumajang	113.81	88.21	210.99	219.91
9.	Jember	129.65	110.63	164.11	186.28
10.	Banyuwangi	130.84	103.88	222.40	257.59
11.	Bondowoso	124.80	105.35	131.60	254.11
12.	Situbondo	157.68	127.72	219.15	276.62
13.	Probolinggo	98.65	103.45	162.83	220.43
14.	Pasuruan	113.22	107.20	140.59	132.25
15.	Sidoarjo	137.33	104.43	382.90	383.38
16.	Mojokerto	109.25	83.59	124.70	141.12
17.	Jombang	106.23	89.06	159.04	193.13
18.	Nganjuk	75.10	55.05	90.04	108.82
19.	Madiun	93.52	65.26	53.67	<b>51.14</b>
20.	Magetan	82.12	58.98	138.17	143.20
21.	Ngawi	102.09	71.68	67.37	68.25
22.	Bojonegoro	125.44	94.30	91.63	106.18
23.	Tuban	119.33	95.39	141.06	157.75
24.	Lamongan	127.55	94.87	123.98	134.48
25.	Gresik	127.07	95.86	284.42	351.04
26.	Bangkalan	102.15	86.50	96.98	91.70
27.	Sampang	96.95	71.92	<b>48.58</b>	58.40
28.	Pamekasan	98.09	73.89	83.94	96.98
29.	Sumenep	175.41	113.46	88.44	124.63
30.	Kediri City	222.12	180.89	201.93	298.92
31.	Blitar City	180.55	138.79	494.50	400.36
32.	Malang City	175.99	150.50	432.72	443.96
33.	Probolinggo city	148.95	141.53	646.31	574.41
34.	Pasuruan City	277.76	<b>223.16</b>	482.48	480.95
35.	Mojokerto City	287.74	211.24	<b>744.46</b>	<b>804.51</b>
36.	Madiun City	<b>342.62</b>	199.53	212.69	201.54
37.	Surabaya City	161.74	127.39	623.72	640.03
38.	Batu City	86.67	87.00	507.92	470.94
	Average	131.16	102.29	221.87	236.13

Bold font indicated the highest or the lowest data.

### 3.2. The Case Fatality Rate (CFR) of Tuberculosis and COVID-19

The overall case fatality rate of tuberculosis in East Java Province in Indonesia was 3.6%. The highest CFR of TB infection was discovered in Probolinggo (7%), while the lowest was found in Surabaya (0.4%). Meanwhile, the highest CFR of COVID-19 infection was obtained in Pasuruan (11%), while the lowest was found in Tulungagung 2.1% (Table 1).

### 3.3. Case Recovery Rate (CRR) of Tuberculosis and COVID-19

The case recovery rate of tuberculosis was defined as patients with positive examination results upon treatment, bacteriological examination results at the end of treatment, and at one of the previous examinations.

The highest case recovery rate for tuberculosis was discovered in Magetan (96.6%), while the lowest was obtained in Batu City (11.3%). Meanwhile, the case recovery rate of COVID-19 was defined as COVID-19 patients with positive results at the beginning of

RT-PCR, and negative results at the end of the examination. The highest case recovery rate of COVID-19 was found in Sidoarjo (92.6%), while the lowest was discovered in Tuban (64.5%) (Table 2).

### 3.4. The Treatment Success Rate (TSR) of Tuberculosis

The treatment success rate of tuberculosis is defined as the number of patients in all cured cases and complete treatment among treated and reported cases. In this study, the highest treatment success rate of tuberculosis was found in Magetan (95.97%), while the lowest was found in Bondowoso (65.89%) (Table 5).

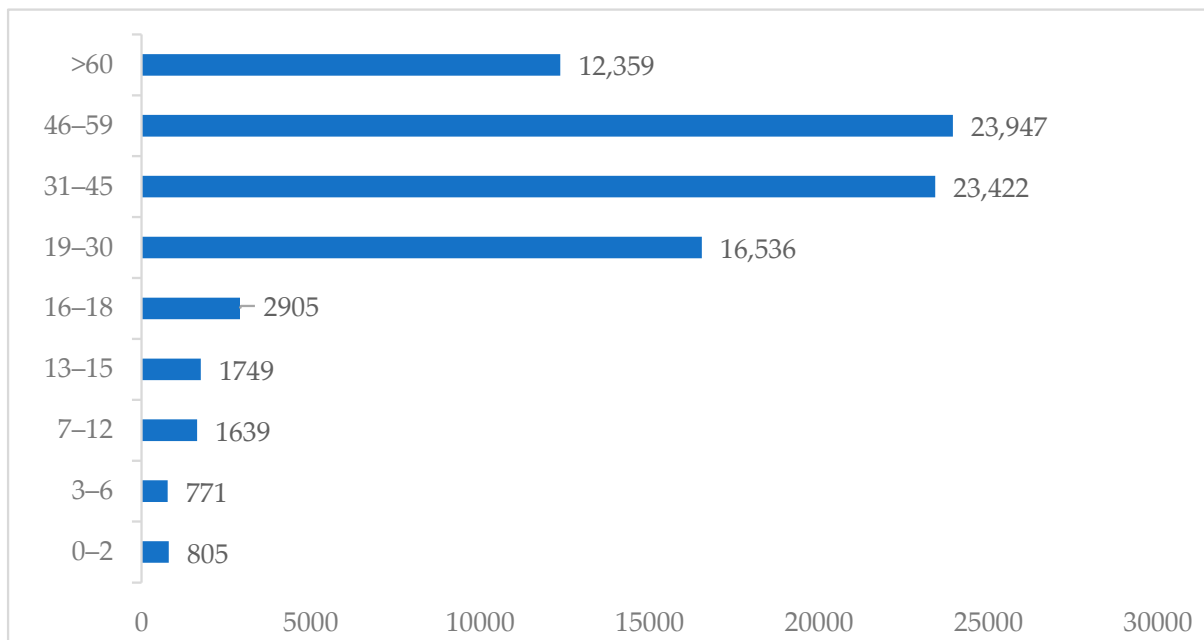
**Table 5.** The treatment success rate of TB in 2020.

No.	Regency	Treatment Success Rate Tuberculosis (%)
1.	Pacitan	82.96%
2.	Ponorogo	85.49%
3.	Trenggalek	94.03%
4.	Tulungagung	89.20%
5.	Blitar	88.85%
6.	Kediri	79.65%
7.	Malang	86.06%
8.	Lumajang	92.27%
9.	Jember	87.55%
10.	Banyuwangi	90.17%
11.	Bondowoso	<b>65.89%</b>
12.	Situbondo	93.28%
13.	Probolinggo	91.41%
14.	Pasuruan	89.34%
15.	Sidoarjo	91.08%
16.	Mojokerto	89.40%
17.	Jombang	88.02%
18.	Nganjuk	79.17%
19.	Madiun	89.82%
20.	Magetan	<b>95.97%</b>
21.	Ngawi	92.54%
22.	Bojonegoro	93.57%
23.	Tuban	92.33%
24.	Lamongan	94.89%
25.	Gresik	91.69%
26.	Bangkalan	92.26%
27.	Sampang	85.67%
28.	Pamekasan	90.58%
29.	Sumenep	89.44%
30.	Kediri City	95.46%
31.	Blitar City	81.07%
32.	Malang City	85.14%
33.	Probolinggo city	72.69%
34.	Pasuruan City	91.51%
35.	Mojokerto City	81.05%
36.	Madiun City	93.66%
37.	Surabaya City	90.61%
38.	Batu City	71.78%
	Average	87.78%

Bold font indicated the highest or the lowest data.

### 3.5. The Age Group of COVID-19 Cases

Based on age group, the highest number of COVID-19 cases was found in those between 46 to 59 years old (23,947 individuals), while the lowest was found in those between 3 and 6 years old (771 individuals) (Figure 1).



**Figure 1.** The distribution of COVID-19 cases based on age group.

### 3.6. The Correlation Test

The analysis of data with Spearman correlation showed no significant correlation between the incidence rate and case fatality rate of tuberculosis ( $p = 0.912, p > 0.05$ ) (Table 6). It was also discovered that there was no significant correlation between incidence rate and case fatality rate for COVID-19 ( $p = 0.219, p > 0.05$ ), the case recovery rate and case fatality rate for tuberculosis ( $p = 0.698, p > 0.05$ ), the incidence rate and treatment success rate for tuberculosis ( $p = 0.795, p > 0.05$ ), the treatment success rate and case fatality rate for tuberculosis ( $p = 0.659, p > 0.05$ ), and the case recovery rate and case fatality rate for COVID-19 ( $p = 0.164, p > 0.05$ ). The difference between the number of male and female patients with tuberculosis ( $p = 0.202, p > 0.05$ ) and COVID-19 ( $p = 0.942, p > 0.05$ ) was not significant (Table 6). In this study, we also calculated the geographical data consisting of the ratio number of public health centers, doctors, nurses, midwifery, public health workers, environmental health workers, nutritionists and pharmacists, and also the incidence rate of HIV in these areas (Tables S1–S3). Table 7 shows that the total number of health workers per 100,000 populations was significantly correlated with the incidence rate of tuberculosis ( $p < 0.05$ ). These variables demonstrate a positive correlation with the tuberculosis incidence rate. Surprisingly, the incidence rate of HIV was also correlated with the incidence rate of TB ( $p < 0.05$ ) (Table 7). However, the case recovery rate between TB and case recovery rate of COVID-19 was also significantly different (Table 8). While in COVID-19 aspect, the incidence rate of COVID-19 was also significantly correlated with the incidence rate of HIV and the number of health workers (doctor, nurse, public health workers, environmental health workers, nutritionist, and pharmacist) (Table 9).

**Table 6.** The Results of Spearman Correlation and Mann–Whitney test.

<b>Spearman Correlation Test (<i>p</i>-Value Was Calculated as Significant If <math>p &lt; 0.05</math>)</b>			
<i>p</i> -Value	CFR_TB	CFR_COVID-19	TSR_TB
IR_TB	0.912		0.795
IR_COVID-19		0.219	
CRR_TB	0.698		
CRR_COVID-19		0.164	
IR_TB			0.795
CFR_TB			0.659
<b>Mann–Whitney Test</b>			
<i>p</i> -Value	IR_TB_Female	IR_COVID-19_Female	
IR_TB_Male	0.202		
IR_COVID-19 Male		0.942	

**Table 7.** The results of Pearson correlation test of demographical factors related to the incidence rate of TB.

<b>Bivariate Analysis of Geographical Factors with the Incidence Rate of Tuberculosis</b>			<b>Correlation between Two Variables</b>
<i>Variables</i>	<i>p</i> -Value	<i>r</i> -Correlation	
Ratio of public health centre	0.001 *	0.53	Strong positive correlation
Ratio of doctor	0.000 *	0.65	Strong positive correlation
Ratio of nurse	0.000 *	0.70	Strong positive correlation
Ratio of midwifery	0.000 *	0.74	Strong positive correlation
Ratio of public health workers	0.002 *	0.49	Enough positive correlation
Ratio of environmental health workers	0.000 *	0.71	Strong positive correlation
Ratio of nutrionist	0.000 *	0.72	Strong positive correlation
Ratio of pharmacist	0.000 *	0.67	Strong positive correlation
Incidence rate of HIV	0.002 *	0.48	Enough positive correlation

\* A *p*-value less than 0.05 is statistically significant.

**Table 8.** The results of Mann–Whitney test for the comparison between case recovery rate of tuberculosis and case recovery rate of COVID-19.

<b><i>p</i>-Value of Mann–Whitney Test between Case Recovery Rate of TB and Case Recovery Rate of COVID-19</b>	
	<i>p</i> -Value
CRR TB	0.051

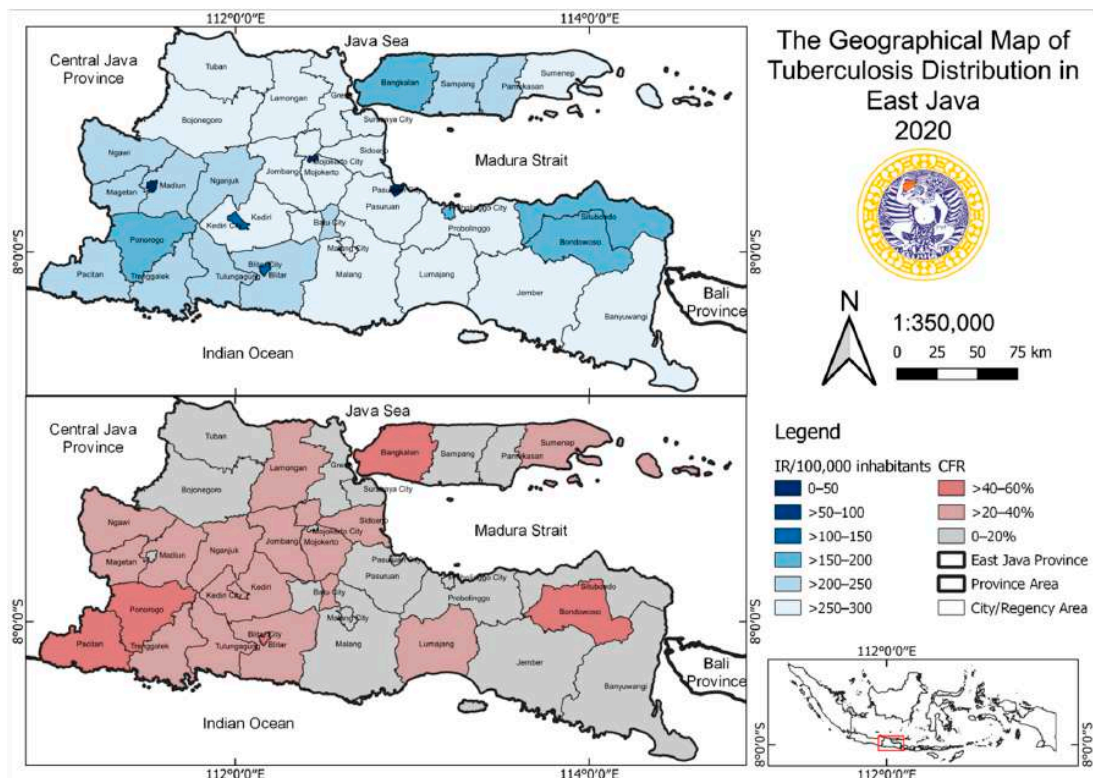
**Table 9.** The results of Pearson Correlation test of demographical factors related to the incidence rate of COVID-19.

Bivariate Analysis of Geographical Factors with the Incidence Rate of COVID-19			Correlation between Two Variables
Variables	p-Value	r-Correlation	
Ratio of public health centre	0.44	0.13	Very low positive correlation
Ratio of doctor	0.001 *	0.7	Strong positive correlation
Ratio of nurse	0.001 *	0.64	Strong positive correlation
Ratio of midwifery	0.27	0.18	Very low positive correlation
Ratio of public health workers	0.01 *	0.42	Enough positive correlation
Ratio of environmental health workers	0.01 *	0.41	Enough positive correlation
Ratio of nutritionist	0.001 *	0.56	Strong positive correlation
Ratio of pharmacist	0.001 *	0.55	Strong positive correlation
Incidence rate of HIV	0.002 *	0.49	Enough positive correlation

\* A p-value less than 0.05 is statistically significant.

3.7. Interpretation by Quantum Geographic Information System (QGIS) Application

The geographical maps of the incidence of tuberculosis and COVID-19 are shown in Figures 2 and 3.



**Figure 2.** The geographical map of tuberculosis distribution in East Java Province in 2020.

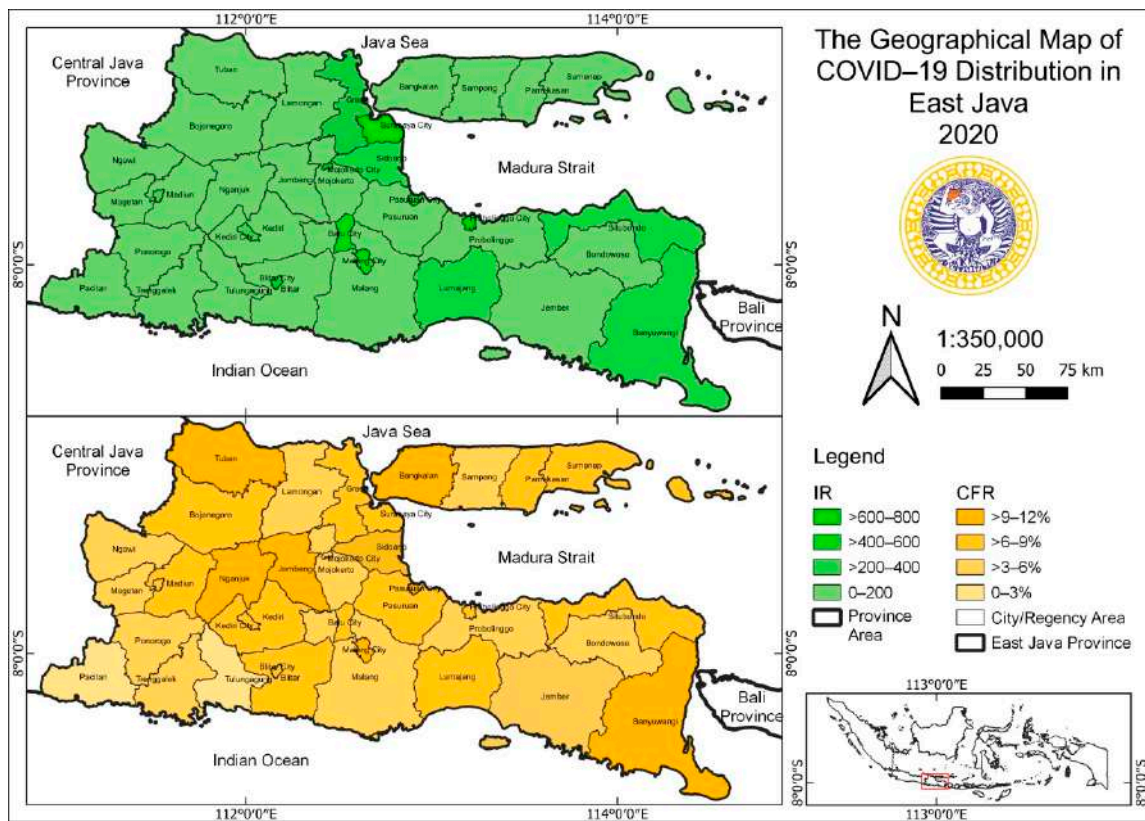


Figure 3. The geographical map of COVID-19 distribution in East Java Province in 2020.

#### 4. Discussion

This study showed no significant correlation between the incidence rate and case fatality rate for tuberculosis ( $p = 0.912$ ;  $p < 0.05$ ). The incidence rate of tuberculosis in East Java Province (586.24/100,000 inhabitants) in 2020 was higher than the national incidence rate (301/100,000 inhabitants). Furthermore, there was a decreasing incidence rate of tuberculosis in 2020 (95.49/100,000 inhabitants) compared to that in 2019 (95.925/100,000 inhabitants) [7]. The global incidence rate of tuberculosis in 2020 was 127/100,000 inhabitants [8]. This showed that the incidence rate in East Java needs to be properly managed. Meanwhile, one of the global milestones proposed by the World Health Organization (WHO) in 2020 is the reduction in incidence rate and tuberculosis deaths by 20% and 35%, respectively [8]. The overall case fatality rate of tuberculosis in East Java Province in 2020 was 3.6/100,000 inhabitants, while in 2019, it was 3.8/100,000 inhabitants [6].

The decrease in the incidence rate of tuberculosis was also in line with another report, where the global data showed a decline in three of the six WHO regions, namely Southeast Asia, the Eastern Mediterranean, and the Western Pacific. In 2020, Indonesia was one of the eight countries that reported a high TB rate, with an estimated incidence of, (1) India (26%), (2) China (8.5%), (3) Indonesia (8.4%), (4) the Philippines (6.0%), (5) Pakistan (5.8%), (6) Nigeria (4.6%), (7) Bangladesh (3.6%), and (8) South Africa (3.3%). The results showed that the incidence of tuberculosis was higher in men than in women. This is in line with the global data in 2020, which showed a tuberculosis rate of 56% in men, 33% in women, and 11% in children [8]. Moreover, these values were also obtained in the national tuberculosis survey in Vietnam [9].

The elimination of tuberculosis depends on the treatment success rate of infected people. In this study, some regencies in East Java with were discovered to have a TSR value below the target (<90%). A total of 20 regencies with a TSR of below 90% need to benefit from public health promotion and sensitize tuberculosis patients to complete their treatment. Indonesia can adopt one of the efforts used to increase the treatment success/completion



rate in India through Private Provider Interface Agencies (PPIAs). In India, the effort was effective in increasing tuberculosis notification rates, testing, and treatment success rates [10,11]. PPIAs can provide interventions related to patient care, training physicians, tuberculosis diagnostics, treatment monitoring, and tuberculosis medicines [12].

Tuberculosis and COVID-19 are airborne diseases; the infection affects the lungs and has similar symptoms. Moreover, COVID-19 symptoms include fever or chills, cough, shortness of breath or difficulty breathing, fatigue and headache, muscle or body aches, loss of new taste or smell, sore throat, stuffy or runny nose, nausea, vomiting, and diarrhea. Meanwhile, tuberculosis symptoms are coughing up phlegm or blood, a cough that lasts more than 2 months, appetite and weight loss, chest pain, chills, fever or night sweats, and fatigue [13]. Previous studies have demonstrated an association between tuberculosis and COVID-19. Both active and a previous history of tuberculosis seem to be related to an increased risk for the development of COVID-19, and aggravate the prognosis of infection [11,14–18]. The damage caused by TB infection in the lungs exacerbates its impact on local immunity and increases the body's susceptibility to airborne pathogens [19]. This increases the risk of COVID-19 developing in patients with a current or previous history of TB. Tuberculosis was found to be associated with a 2.10-fold increase in the risk of severe COVID-19 disease. In patients with previous respiratory disease, lung function can be impaired and a low resistance to viral infections can form, which can develop into acute respiratory distress syndrome (ARDS) [20,21].

In 2020, when all countries were affected by COVID-19, it was reported that there were 84,140 cases in East Java, Indonesia, where the number of infected females was higher than the number for males. This was not in line with the report from Peru, where the incidence rate in females was higher than in that males. COVID-19 can affect any age group due to its fast transmission rate; however, this study discovered that the highest incidence rate was in the age group between 46 and 59 years old. This was in line with the national survey in Peru, where the highest incidence was in people older than 50 years [22].

The elimination of tuberculosis has three pillars and components, namely: (1) integrated, patient-centered care, and prevention, (2) bold policies and supportive systems, (3) and intensified research and innovation. The first pillars can be translated into four activities: (a) early diagnosis of tuberculosis, including testing on universal drug susceptibility, screening of close contact groups, (b) treating and supporting people with tuberculosis to complete their treatment, (c) collaborative care that manages the comorbidities, (d) preventive treatment of people at high risk [8].

COVID-19 and tuberculosis data showed that there is a possibility of coinfection in a patient, where an individual can simultaneously be affected by both illnesses. However, the limitation of this study is its inability to capture co-infected patients or those who are only infected with one of the diseases. Therefore, clinicians should be concerned with chronic diseases in patients, such as coinfection with both COVID-19 and tuberculosis. This is because the coinfection with both diseases was already reported by studies in China [23,24], USA [25], and Italy [15,26], with various clinical characteristics.

Coinfection between tuberculosis and COVID-19 could have an important impact on the public health sector. In another case, public health also has an important role in combatting COVID-19 through various interventions, including physical distancing, self-quarantine, travel restrictions, a semi-lockdown, practicing good personal hygiene, eating nutritious food, increasing case-tracking, and vaccine development [27]. People with underlying respiratory diseases should be considered during the pandemic, to prevent its exacerbation [28].

Lung macrostructural changes caused by pulmonary tuberculosis affect the function and defence of the lower respiratory tract. This condition can be complicated due to the consequences of the inflammatory response exacerbated by SARS-CoV-2, such as oedema [18,29,30]. The reported complications of tuberculosis with COVID-19 coinfection that are hypoxemia, respiratory failure, acute respiratory distress syndrome (ARDS), the need for non-invasive ventilation, glucose abnormalities, and longer lengths of hospital stay,

with a maximum of 130 days, and recurrent or concurrent bacterial infections [19,31–34]. The risk of recovery in COVID-19 patients with tuberculosis is 25% lower [16]. Meanwhile, the risk of mortality for COVID-19 patients with early treatment of pulmonary tuberculosis is 2.5 times higher, and a previous history of tuberculosis has a 50% higher mortality risk [17].

Previous studies showed that pulmonary tuberculosis patients had an increased susceptibility to COVID-19 infection and showed an increase in the severity of symptom development [14]. Cumulative research has reported 80 pulmonary tuberculosis patients with COVID-19 coinfection from China, India, Belgium, Brazil, France, Italy, Russia, Spain, Switzerland and Singapore. The highest case of tuberculosis sufferers presenting with COVID-19 coinfection occurred in Italy [35].

One of the principal efforts to suppress the transmission of tuberculosis in a community is the active case finding (ACF). Case finding could be deciphering this kind of activity, including house-to-house surveys, massive surveillance, increasing case-finding, and out-patient case detection, specifically in high-risk groups [36]. Historical results showed that mass radiography could screen 2000 cases in over 2 million individuals [37]. Sufficient case finding could lead to the successfully treatment of tuberculosis. In certain cases, case-finding could also find HIV-TB-coinfected patients, as mentioned in Nigeria, which could locate 109 HIV-TB infected patients. In Nigeria, successful treatment was proven to be associated with newly registered patients [38].

Health facilities were also a predictor of the treatment success rate for tuberculosis. According to this, intersectoral collaborations with the private sector should be increased. As in another report, private health facilities had a more successful treatment rate than public health facilities [39,40]. The other challenge in tuberculosis management was drug resistance; interestingly, if the treatment success rate reaches 85%, this could lead to a reduction in transmission, drug resistance, TB prevalence, and TB incidence. In East Java Province, the number of health facilities, specifically primary health centers, is 968 units. However, not all primary health centers have the same capacity to tackle tuberculosis, especially during the pandemic, when the all the health facilities were focused on COVID-19. In addition, Indonesia also had an endemic for another tropical disease, which was neglected [41].

Drug resistance in tuberculosis become a challenge in TB management, due to the increasing number of mechanisms that were involved. This phenomenon led to difficulties in the development of diagnostic procedures. However, whole-genome sequencing (WGS) may can help to identify polymorphisms related to drug resistance. In another case, the capacity of laboratories which can conduct WGS in developing countries is still limited [42]. During the pandemic, whole-genome sequencing (WGS) was introduced, specifically to understand the new variant of COVID-19, which continuously increased. According to the latest information, the COVID-19 variants can be classified into three groups, namely, variants of concern (VOC), variants of interest (VOI) and high-consequence variants (VOHC). This classification was formulated according to the capacity and the impact on global public health [41].

## 5. Conclusions

In conclusion, these respiratory diseases still need to be evaluated, specifically in a clinical setting. Although there have been major advances in infectious disease control in recent years, the number of infectious diseases, including TB and COVID-19 in East Java Province, is still a concern. Therefore, a retrospective study was carried out to evaluate the recent epidemiology of the infectious disease in East Java, which is the second largest province in Indonesia and consisted of 38 regencies with large populations. The results showed that the incidence rate of tuberculosis was higher in males than females, while the rate of COVID-19 was higher in females than in males. The highest cases of COVID-19 were discovered in the age group between 46 and 59 years old. The highest COVID-19 incidence rate was found in Mojokerto City, while the lowest was found in Sampang. Tuberculosis

and COVID-19 are the pulmonary diseases which need to be considered. According to this study, the treatment success rate of tuberculosis needs to be improved to achieve a decline in case fatality rates and transmission in the community. During the pandemic, it is important to increase active tuberculosis case detection in order to minimize community transmission.

#### Limitations

The limitation of this study was the limited data that could be provided, due to the data source, which could only capture regional surveillance data.

**Supplementary Materials:** The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/tropicalmed7060083/s1>, Table S1. The demographical factor analysis (Ratio number of public health center, ratio number of doctor, and ratio number of nurse/100,000 populations); Table S2. The demographical factor analysis (Ratio number of midwifery, ratio number of public health workers, and ratio number of environmental health workers/100,000 populations); Table S3. The demographical factor analysis (Ratio number of nutritionist, ratio number of pharmacist, and incidence rate of HIV/100,000 populations).

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