Research Exhibition in Mathematics and Computer Sciences (REMACS 6.0)/
ISBN: 978-629-97440-5-4

ANALYSING THE TRANSMISSION OF TUBERCULOSIS IN MALAYSIA USING SIR MODEL

Nasrullah Jamaluddin and Ku Azlina Ku Akil
College of Computing, Informatics and Mathematics,
Universiti Teknologi MARA, Perlis Branch
nashrullah2001@gmail.com and kuazlina@uitm.edu.my

ABSTRACT - Tuberculosis (TB) is a substantial infectious disease in Malaysia, contributing significantly to morbidity and mortality rates. The lack of awareness regarding the signs and symptoms of TB is one of the causes of the late diagnosis of TB in the population. In Malaysia, the level of awareness about TB is still low. The purpose of the study is to analyses the dynamics of TB transmission using SIR Model and analyze the pattern of TB cases in Malaysia. Ministry of Health Malaysia data on TB cases and fatalities from 2003 to 2021, with a focus on the states of Selangor and Sabah, were collected. The results demonstrated that the number of susceptible individuals in Malaysia decreased swiftly, reaching a threshold of 10,000 in 160 days. The peak infection period lasted between 90 and 120 days, then gradually decreased. Throughout 2021, there was a constant increase in the number of recovered individuals. In Selangor and Sabah, similar patterns were observed. These results emphasize the significance of prompt interventions to reduce the number of susceptible individuals and control the spread of tuberculosis. Future research should be considered to include an exposed (E) group in the model, knowing the SEIR model. Overall, this study contributes to a better comprehension of the dynamics of TB in Malaysia.

Keywords: Tuberculosis disease, SIR Model

1. INTRODUCTION

Tuberculosis (TB) poses a danger to global public health and is one of the world's major infectious causes of death. According to World Health Organization (WHO), TB is one of the top 10 causes of death worldwide, accounting for the deaths of over 1.4 million people annually. In Malaysia, TB is the main cause of death from a single infectious illness (mortality rates ranging from 4.8 to 6.2 cases per 100,000 people); from 2012 to 2016, TB ranked above HIV/AIDS, dengue fever, and malaria. The lack of awareness regarding the signs and symptoms of tuberculosis is one of the causes of the late diagnosis of TB in the population. In Malaysia, the level of awareness about TB is still low. Even though the Malaysia Ministry of Health has organized awareness programmers such as World TB Day, which is on 24 March every year, Malaysian still lack awareness about this disease (Mokhtar et al., n.d.).

2. METHODOLOGY

The data was obtained from the original sources, which were from the website of the Ministry of Health of Malaysia. The yearly data was collected from 2003 to 2020. The SIR model with demography, with only takes into consideration the death rate and the birth rate during the trial time. (Widyaningsih et al. 2018) say that the birth rate and death rate must be the same for the population size to stay the same over time The number of susceptible groups, is raised by the birth rate while it is diminished by the mortality rate and the number of infected individuals who have had intimate contact with the patients. Following that, the disease's transmission rate may increase the number of affected persons, but the disease's mortality rate and recovery rate may drop. Finally, the recovery rate increases the number of recovered people while decreasing the death rates.

3. RESULTS AND DISCUSSION

Based on the SIR model with demography, the number of vulnerable persons in Malaysia rapidly reduced, reaching 10,000 within 160 days. The number of those infected rose between 90 and 120 days, showing the peak infection period for tuberculosis. Throughout 2021, the number of recovered persons increased steadily. A similar pattern was discovered in Malaysia when using the SIR model without demography. The number of vulnerable people peaked early and subsequently declined, reaching 10,000 within 160 days. The number of sick people peaked between 90 and 120 days, then declined gradually. The number of recovered persons climbed gradually and peaked towards the end of 2021.

The same patterns were seen with both models in the particular examples of Sabah and Selangor. Within 240 to 260 days, the number of vulnerable people had fallen to 10,000. The number of sick people peaked between 180 and 260 days and then steadily fell. Throughout 2021, the number of people who have been rehabilitated increased.

4. NOVELTY OF RESEARCH

This research aims to enhance tuberculosis (TB) control in Malaysia by integrating social network analysis (SNA) with the classical SIR (Susceptible-Infectious-Recovered) model. Using Ministry of Health Malaysia data from 2003 to 2021, the study focuses on Selangor and Sabah states. Social networks will be constructed based on contact patterns and demographic information of TB patients. Network analysis techniques will identify influential individuals and communities within the TB transmission network. The SIR model, incorporating network information, will simulate TB spread and evaluate intervention strategies. Integrating social networks into the SIR model provides a realistic representation of TB transmission dynamics, capturing the interplay between epidemiological factors and social connections. This research will offer novel insights into TB transmission in Malaysia, informing targeted interventions for policymakers and healthcare providers. By reducing susceptibility, minimizing transmission, and improving public health outcomes, this approach contributes to evidence-based strategies for TB control.

5. CONCLUSION

In conclusion the SIR model study gives useful insights into the patterns and dynamics of tuberculosis transmission in Malaysia, Selangor, and Sabah. These findings can help policymakers and healthcare providers devise effective methods to lower the prevalence of tuberculosis and enhance public health outcomes.

REFERENCES

Fatmawati, Khan, M. A., Bonyah, E., Hammouch, Z., & Shaiful, E. M. (2020). A mathematical model of tuberculosis (TB) transmission with children and adults groups: A fractional model. *AIMS Mathematics*, *5*(4), 2813–2842. https://doi.org/10.3934/math.2020181

Salwa Mokhtar, K., Rahman, N., Shariff, N., Asna, W., & Nor, W. M. (n.d.). Tuberculosis in Malaysia: A Study on the Level of Societal Awareness and Stigma. In *IOSR Journal of Humanities and Social Science (IOSRJHSS)* (Vol. 1, Issue 4). www.iosrjournals.org

Widyaningsih, P., Nugroho, A. A., & Saputro, D. R. S. (2018). Susceptible infected recovered model with vaccination, immunity loss, and relapse to study tuberculosis transmission in Indonesia. *AIP Conference Proceedings*, *2014*. https://doi.org/10.1063/1.5054525