MATHEMATICAL MODELLING IN TUBERCULOSIS TRANSMISSION AND IMPACT ON EARLY INTERVENTION (CHEMOPROPHYLAXIS) IN MALAYSIA

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5. Report

5.1 Executive Summary

Despite being an avoidable and treatable disease with effective antimicrobial chemotherapy for the last fifty years, tuberculosis (TB) remains with the highest incidence as well as the leading cause of death from all infectious diseases in Malaysia[1]. The trend has been persistently high and plateau for the last twenty years[2]. More alarmingly, among the seven countries in the Western Pacific Region, Malaysia has the highest incidence of tuberculosis contracted among the HIV (Human Immunodeficiency Virus) infected patients, and in the rising trend[3]. Why does the burden of this disease remain high for this long? The contradictory reports between the current available treatment and the high cure rate, the high DOTS (Directly Observed Therapy - Short Course) coverage, the high BCG (Bacillus Calmette-Guérin) vaccination coverage as well as the very low multidrug resistance cases from the national prevention and control programmes versus the consistently high incidence, prevalence and mortality have triggered an urgent need for new approach to curb the plateau trend by effectively reducing the incidence[2].

One new area of research to be explored, yet to be adopted by Malaysia is an additional treatment of chemoprophylaxis to the current treatment protocol for tuberculosis as per the Malaysian CPG (Clinical Practice Guideline)[49,50,51]. Available evidence favouring success shows that this could be a promising answer for Malaysia[4,5]. But before the Malaysian Ministry of Health can be convinced to develop strategies in that regard, the empirical evidence is required that such strategy is a viable option in Malaysia.

5.2 Abstract of Research

Background: Tuberculosis remains as one of the highest unresolved disease burden among re-emerging diseases in Malaysia for the last twenty years. With current treatment protocol emphasizing among the infectives, we seek to find if combination treatment of these active cases with Isoniazid Preventive Therapy for high risk latent tuberculosis infection groups among non-HIV population would give greater impact on reducing incidence.

Methods: Our study aims to apply the use of infectious disease modelling to study the progression of latent tuberculosis infection among non-HIV population in Malaysia, and to assess the impact of Isoniazid as preventive therapy on reducing incidence. We present a deterministic compartmental age-structured tuberculosis model which incorporates treatment of infectives as well as the preventive therapy. The model assumes that latently infected individuals develop active disease as a result of primary infection, endogenous reactivation and exogenous reinfection. We start by formulating and analyzing the model without any intervention strategy then, we extend to incorporate the preventive therapy and treatment of infectives. The epidemic thresholds known as reproduction numbers and equilibria for the model are determined, and stabilities analyzed. The reproduction numbers for the model are compared to assess the possible community benefits achieved by treatment of infectives, preventive therapy and a holistic approach of combination of both intervention strategies. The model then further quantifies the effectiveness of preventive therapy for early latent tuberculosis infection and demonstrates how effective the therapy has to be to eliminate tuberculosis, when use in conjunction with treatment for active tuberculosis.