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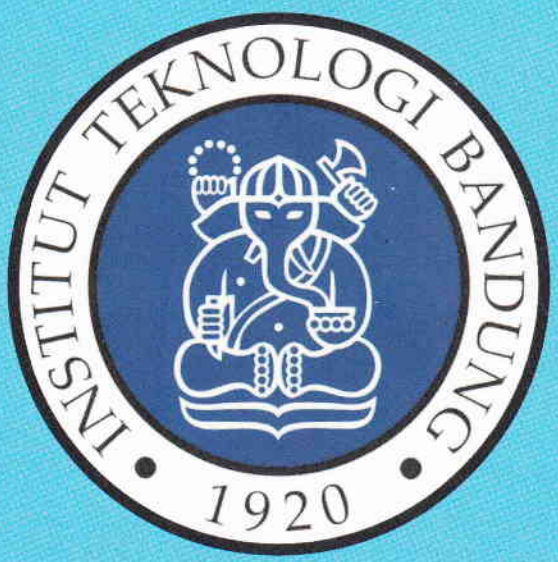

West Java, Indonesia
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Table of Contents

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Mathematical Model of Tuberculosis Transmission in A Two-Strain with Vaccination

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Abstract: This paper deals with the mathematical analysis of the spread of tuberculosis with vaccination in a two-strain model. The vaccination reproduction ratio ($\Re_{rs}$) and equilibria quantities for the models are determined and stability of the solution is analyzed. We prove that if the vaccination reproduction ratio $\Re_{rs} < 1$ the disease free equilibrium is locally and asymptotically stable on the nonnegative orthant and if $\Re_{rs} > 1$ of the other equilibria is locally and asymptotically stable. At the end of this study, the numerical computation presented and it shows that vaccination and treatment capable to reduce the number of exposed and infected compartments.

Key Words: Tuberculosis model, vaccination, drug resistant, stability, the vaccination reproduction ratio.
PACS: 02.30.Hq

INTRODUCTION

Tuberculosis (TB) is a disease that affects human and animal population. The disease is able to spread quickly through the air medium and becoming the second most killer among all transmission disease [5]. This report on global TB in 2011, there were an estimated 8.7 million incident cases of TB (range, 8.3 million–9.0 million) globally. The five countries with the largest number of incident cases in 2011 were an estimated India (2.25 million), China (1 million), South Africa (0.5 million), Indonesia (0.45 million) and Pakistan (0.4 million) [8].

Prevention of TB WHO (World Health Organization) recommended intervention is by giving BCG (*Baccilus Calmete Guerin*) vaccination to newborn baby at ages 2 to 3 months an in general population, while in some of these studies the vaccine is only given to people newly recruited into the population [5, 8]. An example of the person that is vaccinated with BCG could be protected 70% - 80% from TB infection [5].

Some past models of TB, particularly the predictive models attempting to calculate a threshold for the basic reproductive ratio $\Re_0$, have incorporated drug treatment and/or vaccination, and have discussed control of the disease by looking at the role of disease transmission parameters in the reduction of $\Re_0$ and the prevalence of the disease [6].

The antibiotic treatment for an active TB patient requires a much longer period of time and a higher cost than that for those who are infected with sensitive TB but have not developed the disease. Lack of compliance with drug treatments not only may lead to a relapse but to the development of antibiotic resistant TB, one of the most serious public health problems facing society today [4].

Coexistence of different pathogens (strains) in the same host were studied (Bhunu and Garira, [2]; Castillo-Chavez and Song, [3]; Feng et al., [7]), studied TB model without consider multi-drug resistant TB (MDR-TB) and vaccination compartment, (Bhunu and Garira, [1]; and Feng, [4]) studied a two strain TB model in the context of treatment without vaccination compartment. Our work differs from all these studies that, we consider that vaccination compartment. We have also added a scenario where an individual vaccination can be infected and move to sensitive or resistant MDR-TB stage. We have also incorporated a scenario where an individual in the vaccination and exposed can become recovered compartment.

The contributions of the proposed model is the development of a mathematical model of tuberculosis prevention, and health fields as information to take on the spread of tuberculosis control policies.

The paper is organized as follows: Section 2, we discussed a two strain tuberculosis transmission models with vaccination. Section 3 numerical simulation, and section 4 conclution our results.

MODEL

The state variable on population of studied the dynamical model divided into seven compartments: Susceptible (S), vaccination (V), those exposed to DS-TB (E_1), infected to DS-TB with (I_1), those who have recovered (R), those exposed to MDR-TB (E_2), and

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