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Optimal Intervention Strategy for Prevention Tuberculosis using a Smoking-Tuberculosis Model

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Abstract

In this paper, we developed a dynamic model of smoking-tuberculosis (TB) transmission in South Korea, and investigated the effects of control strategies on the number of incidence of TB using optimal control theory. Model parameters regarding TB and smoking are estimated through least-squares fitting to real data. We considered three TB controls (distancing, case-finding, and case-holding) and two smoking controls (distancing and quitting), in order to minimize the number of exposed and infectious individuals and the cost of control. Numerical simulations for the various control strategies highlight that implementing the smoking controls, not with TB controls, can effectively reduce the incidence of TB transmission.

Keywords: Epidemic model, Optimal control theory, Parameter Estimation

1. Introduction

Tuberculosis (TB) is a major global health threat, with 8.6 million new cases and 1.3 million deaths reported in 2012, along with one third of the total population carrying a latent infection [52]. Susceptible individuals, in airborne contact with active pulmonary TB patients, are infected with *Mycobacterium tuberculosis*, usually through the lungs. Tobacco smoking is also a significant cause of disease, disability, and death. Considering both the direct smoking and the effects of second-hand smoke, smoking kills nearly six million people every year. The World Health Organization (WHO) has warned that of the one billion smokers worldwide, up to half of those will die of tobacco-related diseases in the long run [54]. TB is a serious problem in South Korea, which has the highest TB incidence, prevalence, and mortality rates among Organization for Economic Cooperation and Development (OECD) nations [51]. The smoking rate in Korea is in the intermediate level of the OECD member countries, although it is very high among male adults

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