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TRANSMISSION DYNAMICS OF TUBERCULOSIS IN POOR
RESOURCE SETTINGS WITH HIGH HIV/AIDS PREVALENCE

CLAVER PEDZISAI BHUNU



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Abstract

Tuberculosis (TB) is the world's second commonest cause of death from an infectious disease after HIV/AIDS. Deadly effects of tuberculosis are more pronounced in poor resource-settings with high HIV/AIDS prevalence. Deterministic models in the form of nonlinear differential equations are developed to study the effects of varying factors influencing the transmission dynamics of TB with particular reference to poor resource settings with high HIV/AIDS prevalence. The deterministic models for TB are developed through incorporating more realistic features of TB epidemiology into the basic TB model. Stabilities and assessment of factors influencing TB transmission including intervention strategies are determined with the help of numerical and analytic techniques. The models developed capture the effects of HIV/AIDS and living standards on TB infection. The occurrence of active or latent infection is shown to depend on a number of factors that include nutritional status, HIV infection and overcrowding. Mathematical models developed in the work enables one to (i) compare the intervention strategies currently available to control TB, that is, chemoprophylaxis of the latently infected, treatment of the infectives, and the combined chemoprophylaxis and active TB treatment, (ii) theoretically analyse in detail the development of drug resistance in TB patients paying particular attention to multi-drug resistant and extra drug-resistant TB given the recent emergence of extra drug resistant TB, (iii) analyse the effects of HIV/AIDS on TB transmission, (iv) assess the effects of various components of poverty on TB transmission and (v) analyse the possible benefits of potential vaccines (pre- and post-exposure) currently under development. Analysis of the models show that the holistic approach is the best strategy to control TB epidemics. However, given inadequate resources to fight both forms of TB (latent and active), treatment of active TB cases remain the only route to reduce TB in resource limited settings. Modelling of resistance in TB epidemics have shown that poor adherence to treatment scheme results in the creation of multi-drug resistant TB and extra drug-resistant TB which are more difficult to manage. Combined HIV/AIDS and TB treatments result in a significant reduction of TB cases but not the same for HIV/AIDS. It is concluded from analysing the effects of poverty on TB transmission that improving the living standards of people have a positive impact in TB control as reduced treatment uptake, poor nutrition and overcrowding increase the poverty induced reproduction number. It is shown that vaccines currently under development (pre-exposure and post-exposure) will have a positive impact in TB control. Directions for further research studies are also suggested in this thesis.