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Mathematical Analysis of the Transmission Dynamics of HIV/TB Co-infection in the Presence of Treatment and Condom Use

This paper addresses the synergistic interaction between HIV and mycobacterium tuberculosis using a deterministic model, which incorporates many of the essential biological and epidemiological features of the two diseases. In the absence of TB infection, the model (*HIV-only model*) is shown to have a globally-asymptotically stable disease-free equilibrium whenever the associated *reproduction number* is less than unity; and has a unique endemic equilibrium whenever this number exceeds unity. On the other hand, it was shown, using Centre Manifold theory, that the model with TB alone (*TB-only model)* undergoes the phenomenon of backward bifurcation, where the stable disease-free equilibrium co-exists with a stable endemic equilibrium when the associated reproduction threshold is less than unity.

The full model, with both HIV and TB, is also rigorously analysed. Its simulation shows that the use of a treatment strategy that targets only one of the two diseases not only results in significant reduction of new cases of the disease being targeted for treatment, but also induces an indirect benefit of reducing the number of new cases of the other disease. Further, although treating individuals with TB only (and those with dual HIV/TB infection treated for TB) always results in more cases of TB prevented than that of HIV, the treatment of people with HIV (including those with dual infection treated for HIV) results in more cases of TB prevented than cases of HIV prevented. Finally, the study shows that the universal treatment of individuals infected with both diseases is more beneficial compared to treating individuals infected with a single disease only.