Abstract

The synergistic relationship between HIV/AIDS and respiratory infections, such as tuberculosis (TB) and pneumonia not only results in high mortality rates but is also a source of economic burden borne by many nations in the sub-saharan Africa. The search for a cure or vaccine for HIV/AIDS has yielded no conclusive results so far. Treatment failure and lack of adherence to treatment schedule which results in the evolution of drug resistant strains of diseases are challenges to grapple with in the management of diseases such as HIV/AIDS and TB. Due to global economic recession, provision and access to subsidized medication may not be sustainable in the long run. Existing HIV/AIDS - TB models do not consider protection, which may be less costly as an intervention measure. Notably, the interaction between HIV/AIDS and pneumonia which contribute to a significant number of mortality cases in HIV/AIDS, has not been mathematically explored. In this work, two deterministic models based on systems of ordinary differential equations, one on the co-infection of HIV/AIDS with TB and the second on the co-infection between HIV/AIDS and pneumonia are formulated and analyzed to investigate protection as a control strategy. Using the next generation matrix approach the reproduction numbers for the models are determined and the respective disease free equilibrium points are shown not to be globally asymptotically stable. This implies that reoccurrence of the disease is possible especially when the conditions favoring such reoccurrence are prevailing. Four cases of maximum protection are considered. In all cases, the endemic states are shown to exist provided that the reproduction number is greater than unity. By use of Routh-Hurwitz criterion and suitable Lyapunov functions, the endemic states are shown to be locally and globally asymptotically stable respectively. This implies that with maximum protection against one infection, the other disease can be controlled with intervention measures possibly resulting in minimal deaths. This is illustrated by the numerical simulations which shows that protection as a strategy reduces the disease prevalence in all the cases considered. Thus, from the findings, emphasis should be placed on advocacy for protection against infection as a strategy for reducing disease prevalence.