

MODELING THE EFFECTS OF DRUGS OF ABUSE ON HIV INFECTIONS WITH TWO VIRAL SPECIES

Injection drug use is one of the greatest risk factors associated with contracting human immunodeficiency virus (HIV), and drug abusers infected with HIV suffer from a higher viral load and rapid pathogenesis. Replication of HIV may result in a large number of mutant viruses that can escape recognition of the host's immune response. Experimental results have shown that the presence of morphine can decrease the viral mutation rate and cellular immune responses. In this study, we present a mathematical model to determine if the decrease in mutation and cellular immune response in the presence of morphine can account for the increased viral load. Our model describes the dynamics of two viral species, a wild-type and a mutant, and shows that under morphine conditioning the morphine altered mutation rate and cellular immune response can allow the wild-type virus to out compete the mutant resulting in a higher set point viral load. Analysis of the basic reproduction number of the virus shows that the dominant species can be determined by a threshold morphine concentration, with the mutant dominating below the threshold and the wild-type dominating above. Using mathematical analysis and numerical simulations of our model, we evaluate how morphine conditioning impacts the viral load and the switch between the two viral species.