

A MATHEMATICAL MODEL FOR CTL EFFECT ON DRUG RESISTENCE DURING ANTIRETROVIRAL TREATMENT OF HIV INFECTION

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Abstract. This paper investigates theoretically and numerically the effect of immune effectors, such as the cytotoxic lymphocyte (CTL), in modeling HIV pathogenesis; our results suggest the significant impact of the immune response on the control of the virus during primary infection. Qualitative aspects (including positivity, boundedness, stability, uncertainty, and sensitivity analysis) are addressed. Additionally, by introducing drug therapy, we analyze numerically the model to assess the effect of treatment consisting of a combination of several antiretroviral drugs. Nevertheless, even in the presence of drug therapy, ongoing viral replication can lead to the emergence of drug-resistant virus variances. This fact is addressed in our model by including two viral strains, wild-type and drug-resistant. Our results show that the inclusion of the CTL compartment produces a higher rebound for an individual's healthy helper T-cell compartment than drug therapy alone. Furthermore, we quantitatively characterize successful drugs or drug combination scenarios for both strains of virus.

Keywords. HIV dynamics, Cytotoxic Lymphocyte, Antiretroviral Therapy, Drug resistance, Mathematical model

AMS (MOS) subject classification: 92D30, 92B05, 34A34.

1 Introduction

The severe and deadly impacts of the Acquired Immunodeficiency Syndrome (AIDS) have motivated scientists to investigate them in the sequential stages of the Human Immunodeficiency Virus (HIV) infection [56, 55]. AIDS is the result of a long battle between an individual's immune system and the HIV [7, 10, 11]. The body's initial response to HIV infection is similar in nature to the response to many other viruses. Unfortunately, the virus has a demonstrated ability to evade these natural defense mechanisms, with the result that after the initial period of infection, the disease progresses to latency [19]. During this latent stage of infection, the virus can go undetected, while it continues to attack and weaken the immune system [31]. The latent period of infection