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GLOBAL STABILITY FOR SWITCHED EPIDEMIC MODELS WITH MULTI INFECTION STAGES AND PROLIFERATION TERM

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Abstract. The dynamics of new HIV (the Human Immunodeficiency Virus) epidemic models with switching parameters and multi infection stages are investigated. The models' parameters are assumed to be time-varying functions and switching their functional forms due to changes in host behavior, which are more realistic significance to model epidemic models. A new basic reproduction number is defined to determine whether the disease is extinct or not by using Lyapunov functions and Razumikhin-type approaches. The result shows that the disease-free equilibrium is globally stable if the basic reproduction number is less than one, which implies that the disease could die out. Furthermore, a logistic proliferation term for uninfected cells is incorporated into the above model. New sufficient conditions are presented to ensure the disease eradication theoretically. Examples are given to verify the theoretical results.

Keywords. Global stability, Switched HIV models, $CD4^+$ T cells, Lyapunov function, Razumikhin-type method.

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1 Introduction

Mathematical models of viral infections have been established to improve our understanding for the disease. The earlier models of virus dynamics have three basic components: the healthy $CD4^+$ T cells, infected $CD4^+$ T cells and free virus particles. In these models, it was assumed that after infection, $CD4^+$ T cells immediately become actively infected and start producing viruses [1]. Since Phillips [2] introduced two types of infected $CD4^+$ T cells (latently infected cells which do not immediately participate in viral reproduction, and actively infected cells which are actively producing virus) into HIV models, more and more dynamical models on infectious diseases have been formulated from a physical perspective. Tuckwell and Le Corfec[3] incorporated stochastic components into the deterministic model presented