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STABILITY PROPERTIES OF AN SIR EPIDEMIC MODEL WITH STANDARD INCIDENCE AND IMPULSIVE EFFECT

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Abstract. An SIR epidemic model with birth pulses, pulse constant recruitment, pulse vaccination and standard incidence is presented. The dynamics of this disease model is analyzed. The basic reproductive number R^* is defined. It is proved that the periodic infection-free solution is globally asymptotic stability if $R^* < 1$. The periodic infection-free solution is unstable and the disease is uniform persistence if $R^* > 1$. Our theoretical results are confirmed by numerical simulations.

Keywords. Pulse, impulsive differential inequality, global asymptotic stability, persistence.

1 Introduction

Every year billions of population suffer or die of various infectious diseases. Mathematical models have become important tools in analyzing the spread and control of infectious diseases. Differential equation models have been used to study the dynamics of many diseases in wild animal population. Birth is one of the very important dynamic factors. Many models have invariably assumed that the host animals are born throughout the year, whereas it is often the case that births are seasonal or occur in regular pulse. The dynamic factors of the population usually impact the spread of epidemic. Therefore describing the natural phenomenon by means of the impulsive differential equation is more reasonable. Roberts and Kao established an SI epidemic model with birth pulses, found the periodic solutions and determined the criteria for their stability[6]. In view of animal life histories which exhibit enormous diversity, some author studied the model with stage structure and birth pulse for the dynamics in some species[7-9].

On the other hand, vaccination is an effective way to control the transmission of a disease. Mathematical modeling can contribute to the design and assessment of the vaccination strategies. Many infectious diseases always take on strongly infectivity during a period of the year, therefore seasonal preventing is the effective and practicable way to control infectious diseases[10].