# Accepted Manuscript


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PII: S0378-4371(18)30600-9
DOI: https://doi.org/10.1016/j.physa.2018.05.056
Reference: PHYSA 19596

To appear in: *Physica A*

Received date : 14 December 2017
Revised date : 23 March 2018

Please cite this article as: B. Wen, Z. Teng, Z. Li, The threshold of a periodic stochastic SIVS epidemic model with nonlinear incidence, *Physica A* (2018), https://doi.org/10.1016/j.physa.2018.05.056

# The threshold of a periodic stochastic SIVS epidemic model with nonlinear incidence

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**Abstract:**In this paper, a stochastic periodic SIVS epidemic model with nonlinear incidence and vaccination is investigated. The threshold conditions on the existence of stochastic positive periodic solutions and the extinction of disease with probability one are established by constructing the new stochastic Lyapunov functions and using the new technique to deal with the nonlinear incidence and vaccination for the stochastic epidemic model. The numerical simulations are given to illustrate the main theoretical results and present some new interesting conjectures.

**Key words:** Stochastic SIVS epidemic model; nonlinear incidence; vaccination; stochastic periodic solution; extinction; Lyapunov function.

## 1 Introduction

Mathematical models describing realistic epidemiological systems and disease controls for a long time have played an important role. It has been confirmed that vaccination is an important strategy for the control and elimination of infectious diseases. In recent years, many scholars have investigated various types of epidemic models with vaccination (See, for example [1–7]).

However, in the real world, epidemic models are always affected by the environmental white noise which is an important component in an ecosystem (See, for example [8–11]). Consequently, it is essential to reveal that how the environmental white noise disturbs the epidemic models. Stochastic differential equation models play an important role in many kinds of branches of applied sciences including disease dynamics, as they can predict the future dynamics of their deterministic counterpart accurately. Therefore, lots of scholars

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