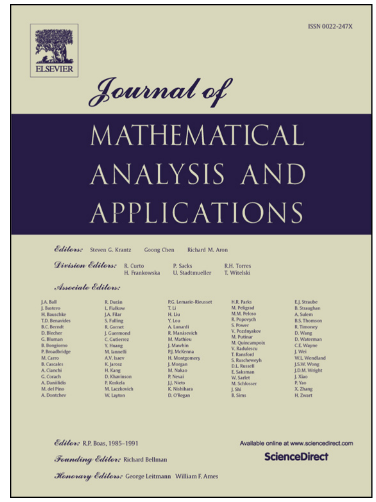
Accepted Manuscript



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PII: S0022-247X(18)30520-1
DOI: https://doi.org/10.1016/j.jmaa.2018.06.029
Reference: YJMAA 22345

To appear in: *Journal of Mathematical Analysis and Applications*

Received date: 3 May 2017

Global dynamics of a reaction-diffusion waterborne pathogen model with general incidence rate☆

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Abstract

In this paper, we first propose a reaction-diffusion waterborne pathogen model with general incidence rate, incorporating both direct and indirect transmission pathways. Then, using the basic reproduction number we investigate the global dynamical behaviors of the continuous model. By nonstandard finite difference scheme, we derive a discrete counterpart of the continuous model. Then, the global properties of the discretized model are investigated. Finally, we conclude the paper by an example and numerical simulations.

Keywords: Waterborne pathogen, Reaction-diffusion, Global stability, Nonstandard finite difference, Lyapunov function

1. Introduction

Waterborne diseases, such as cholera, typhoid, giardiasis, shigella, hepatitis A and E, can be found in contaminated water. They are becoming a major issue for public health, for example, a major cholera epidemic occurred in Zimbabwe in early August 2008, with 98,585 reported cases and 4,287 deaths [1]. Recently, WHO estimates [2] that waterborne diseases have caused nearly 3.5 billion deaths worldwide.

To understand the dynamical properties of waterborne diseases, some mathematical models have been proposed [3–6] as mathematical modelling is an effective way to study the dynamical behaviors of epidemic diseases. For example, in order to describe person-person and person-water-person transmission, Tien and Earn [7] proposed a generalised version of the classical SIR model by adding a water compartment $W(t)$ that measures pathogen concentration in a water

☆Research was partially supported by National Natural Science Foundation of China (Nos. 11501518, 11501519 and 11626219).

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