Departmental Colloquium

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HH3017, 1:00p.m.

Epidemic Dynamics of Cholera in Non-homogeneous Environments

Abstract:

The transmission of cholera, a water- and food-borne intestinal infection, involves complex interactions among human hosts, pathogens, and the environment. This talk will address the epidemic dynamics of cholera in non-homogenous environments, with a focus on the spatial variation, seasonal fluctuation and bacterial hyperinfectivity, using partial differential equation models.

The presentation will consist of two parts. In the first part, we will discuss seasonality and spatial heterogeneity. The model we employ is built on a reaction-convection-diffusion system to represent the spatial movement of the hosts and pathogens, and incorporates time-periodic parameters to describe the seasonality of the disease transmission and bacterial growth. Using the next generation method, we define and analyze the basic reproduction number of this model, based on which we establish the threshold type results for cholera transmission in a spatiotemporally heterogeneous environment. In the second part, we develop a new modeling framework to study the effect of bacterial hyperinfectivity on cholera epidemics in a spatially non-homogeneous environment. For the second model, the global threshold dynamics is established. The global attractivity of the unique endemic equilibrium is derived in a special case. We then investigate the dependence of the basic reproduction number on model parameters by theoretical and numerical means.

Our findings highlight the importance of seasonality, hyperinfectivity and their interplay with spatial variation. The result indicate that the prevention and intervention strategies need to take into account the non-homogeneity of the environments in order to effectively control cholera while optimize the use of available resources.