Dissertation Defense

The University of Texas at Arlington
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MS Teams Invitation, https://tinyurl.com/MondalZahidDefense

Phone: 817-502-2418 Conference ID: 964 317 699#

"Impact of domestic animals on prevalence of vector-borne diseases in humans"

Abstract:

Vector-borne infectious diseases are one of the leading problems for public health worldwide, particularly in underdeveloped and developing countries. These diseases infect humans through the bite of infected vectors. The effect of host diversity on disease persistence, well studied in ecological literature, is examined here in a domestic setting. Some additional hosts dilute infection, while others amplify certain disease infections. Domestic animals can play an important role, as an additional host, in the disease dynamics by affecting host-pathogen interactions. However, the effect of additional hosts is not always straightforward since their presence impacts negatively by helping the vector population grow faster, and positively by reducing vector-human interactions. These facts develop a very interesting ecological question if domestic animals are helpful to human health. This study uses dynamical systems to understand disease dynamics in the presence of domestic animals, and analyses these systems qualitatively and quantitatively to understand the trade-off between these negative and positive impacts. Deterministic population models and nonlinear ODEs are used in the development of these systems.

First, the case of Chagas disease is considered in the presence of chickens, which works here as an incompetent host. Rural customs of different placement of chickens are studied, and results showed chickens presence can reduce human infections of Chagas if they are placed at a certain distance. However, the basic reproduction number, R_0 behaves as an increasing function for up to a certain numbers of chickens, and then continues as a decreasing function of chickens. Second, visceral leishmaniasis (VL) is studied in the presence of protected dogs. As a reservoir host, dogs usually increase risk of human infections. Hence, two cases are studied here – a community without dogs, and a community with dogs protected by insecticide collars. Outcomes of this work show that community with protected dogs is better than a community without dogs in terms of human cases of VL infection. However, this reduction in infections depends on dogs' tolerance for sandfly bites. Finally, the case of Japanese encephalitis (JE) is studied in the presence of cattle. As a dead-end host, cattle help to reduce human infections of JE virus. However, in some JE prevalent areas, like India, their presence causes another human disease, leptospirosis, which spreads through the urine of infected cattle. To understand the impact of cattle in such areas, three SIR models are used. Qualitative analyses of model dynamics show that the endemic equilibria are unconditionally stable. To identify the impact of cattle, total disease burdens are estimated and compared for two different scenarios – a community with cattle, and a community without cattle. These estimations show that cattle are helpful to reduce disease burden even though they cause leptospirosis infections. These three studies show that host richness by addition of domestic animals is helpful to reduce human infections of vector-borne diseases, conditionally in some cases and unconditionally in other cases.