CoCo Seminar Series
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Modeling Infectious Diseases: A Multidisciplinary Approach

Dr. Mohammad Abdullah Al-Mamun
Postdoctoral Research Associate
College of Veterinary Medicine
Cornell University

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Infectious diseases formulate a modeling problem consisting of population dynamics, individual's health status, treatments, management, economics, and state/country regulations. Being a multidisciplinary research question, infectious diseases warrant access of several layers of information from a mathematical model. Also, parameterizing all these layers require combined efforts from multiple disciplines: human/veterinary medicine, epidemiology, ecology, statistics, mathematics, economics and computer science. Here, we present an agent based model of Johne's disease (paratuberculosis) of dairy herds where several layers of processes are integrated, such as, individual animal life cycle, dairy management, farmer, treatments, farm economics, state regulations, and dairy herd dynamics. Johne's disease, caused by Mycobacterium avium subsp. paratuberculosis (MAP) infection, results in economic losses (estimated to be more than $200 million per year) in dairy industry. The proposed model tracks each individual animal's life, MAP transmission route, treatment, testing, and culling and provides several decisions to a farmer. A farmer can take culling decisions based on the disease status and net present value of a cow. The model is validated by the real herd dataset from three states (New York, Pennsylvania and Vermont), epidemiologist and veterinarian. Overall, this model presents a multidisciplinary method to investigate an infectious disease of dairy cattle to inform the farmer about right decision making based on management and economic constraints.

Dr. Mohammad Abdullah Al-Mamun is a Postdoctoral Research Associate at the Department of Population Medicine & Diagnostic Sciences in the College of Veterinary Medicine, Cornell University. His research interests include multi-scale and computational modeling of any biological system, mainly based on agent-based modeling, cellular automata, artificial neural network, ODEs/PDEs, and image processing, among others.

For more information, contact Hiroki Sayama (sayama@binghamton.edu).
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