Simulation science takes on Zika with big data

June 20 2016, by Tiffany Trent

The Zika modeling team (from left, Bryan Lews, James Schlitt, and Pyrros "Alex" Telionis) meets to discuss the latest updates on their research. Credit: Virginia Tech

In recent weeks, Zika has proven much more problematic than first expected, and the World Health Organization has named Zika a Public Health Emergency of International Concern. Researchers at the Biocomplexity Institute of Virginia Tech are developing a new computer model of Zika that may predict how it will move through South American and North American populations.

"We are developing novel analytical and decision-support tools that provide epidemiologists unprecedented access and information to plan,

respond, and control pandemics," said Christopher Barrett, executive director of the Biocomplexity Institute. "Our global synthetic information database is one of a kind and can be quickly reconfigured to provide situated decision-making capabilities. The technology has been developed over two decades and honed during its use by analysts during the H1N1, MERS, and the recent Ebola outbreak."

Although Zika can affect adults, it is the unborn who are most at risk. Cases of microcephaly have skyrocketed in Brazil in the past several months. The Aedes aegypti and Aedes albopictus species of mosquito carry the disease.

Initial computer simulations have also suggested the importance of human mobility in the rapid spread of Zika. The researchers hope to use the data to develop disease risk maps. They are also studying the social and economic impacts of the disease as well as potential approaches to contain its impact during the Olympics, which will be hosted in Brazil this August.

The computer models of the institute's Network Dynamics and Simulation Science Laboratory are the result of decades of research in developing computer models for epidemics and other large, complex systems.

"Through years of supporting real-world-driven demonstration studies, we've been able to continuously improve and refine our increasingly powerful simulations, allowing us to provide support to several branches of the federal government," said Bryan Lewis, computational epidemiologist.

The laboratory uses a novel approach based on the concept of synthetic information to develop highly resolved computer simulations. "The approach combines big data methods with social and behavioral theories

to develop realistic and highly detailed representations of epidemic spread through social networks. They capture both the local human habitat, including built infrastructure, as well as that of the disease vector," said Madhav Marathe, deputy director of the laboratory.

"Combined with high-performance computer-generated simulations of disease dynamics, the laboratory provides innovative approaches for situation assessment, planning, and course of action during an epidemic outbreak," Marathe said.

In the case of Zika, this allows researchers to forecast the spread of the disease through understanding the roles of a multitude of factors, especially human mobility and the natural environment. These models can then help analysts develop and assess various courses of action to combat the disease.

The institute has recently completed a detailed synthetic representation of Brazil, a highly resolved and realistic representation based on geospatial and population data, including census data, maps, travel and mobility patterns, and built and natural environments. Researchers worked closely with Brazilian health authorities to develop this synthetic representation.

Provided by Virginia Tech