Veterinary epidemiologists Tim Carpenter and Mark Thurmond began modeling foot-and-mouth disease (FMD) seven years ago following an outbreak that devastated the swine industry in Taiwan.

After the 2001 FMD epidemic that swept the United Kingdom and the 9/11 terrorist attack increased concern in the United States, the two School of Veterinary Medicine professors formed the Center for Animal Disease Modeling and Surveillance (CADMS) to develop mathematical, simulation and statistical models to understand and predict the biological behavior of FMD and other potentially devastating diseases.

CADMS is a partner in the $18 million National Center for Foreign Animal and Zoonotic Disease Defense, a consortium of four schools, including UC Davis, University of Texas Medical Branch, and University of Southern California, hosted by Texas A&M University and funded by the Department of Homeland Security.

CADMS has two components—the Animal Disease Modeling & Surveillance Laboratory, focused on domestic diseases and directed by Tim Carpenter, and the Foot and Mouth Disease Surveillance & Modeling Laboratory (www.fmd.ucdavis.edu), focused globally and directed by Mark Thurmond. Twenty-five CADMS investigators—including MS, MPVM, PhD students and postdoctoral fellows from UC Davis and universities in Maryland, Texas, British Columbia, Denmark, the United Kingdom and Argentina—are collaborating with the United States Department of Food and Agriculture and the California State Veterinarian.

As part of its homeland security mission, the Carpenter laboratory, with separate funding from the NSF, NIH, Intelligence Community and USDA, is engaged in a number of projects to study FMD, avian influenza, West Nile virus and brucellosis, and to model wildlife-human, livestock-livestock and livestock-wildlife interactions.

The Thurmond laboratory, with separate funding from the Department of Homeland Security and the Armed Forces Medical Intelligence Center, is developing global surveillance systems and using mathematical and statistical models to predict changes in global FMD risk.

The CADMS researchers, analysts and programmers are developing an epidemiologic model for FMD initially focused on a three-county area in the dairy-intensive California Central Valley. The model uses livestock population and demographic parameters (such as animal movement between different herds) to predict the spread of disease. Detailed agricultural census data, including disease treatment and control activities from thousands of farms, make the model as realistic as possible.

“We break the disease cycle (incubation period, infection period, etc.) into measurable segments. We want to know about the vegetative, meteorological, cultural, socioeconomic, religious and political factors that can influence emergence of FMD in any given area. We are expanding the model to encompass the United States and are developing models to identify when and where we expect to find FMD in the world,” says Dr. Thurmond.

Another focus of research is evolution of the virus. FMD is caused by a very small RNA virus with a high mutation rate. Generating many mutant strains allows the virus to survive under varied conditions including vaccination. CADMS is modeling evolutionary changes in the nucleotide sequences of the virus and working to understand the environmental, host, and management factors that influence mutation.

The Thurmond lab is working with Homeland Security in developing a global surveillance network for FMD viruses, and is collaborating with the University of Arizona Artificial Intelligence Laboratory to develop the BioPortal-FMD, a web portal system that transfers data (sequences) to and from researchers and features real time mapping and “hot spot analysis,” to identify clusters of disease.

“We expect to become involved in other diseases on a global level depending on future funding of CADMS model prototypes for other diseases including avian influenza, hog cholera and brucellosis, and for BioPortal communications that may link to any surveillance network worldwide,” says Dr. Thurmond.