Model simulates animal disease spread, control

Editor's note: The North American Animal Disease Spread Model Development Team includes representatives from the United States Department of Agriculture, Colorado State University, Department of Computing and Information Science at the University of Guelph, Canadian Food Inspection Agency, and the Ontario Ministry of Agriculture, Food and Rural Affairs.

The North American Animal Disease Spread Model (NAADSM) is a stochastic, spatial, state-transition simulation model designed to simulate the spread and control of highly contagious diseases in a population of susceptible animals. User-established parameters define model behavior in terms of disease progression; disease spread by direct contact, indirect contact, and airborne dissemination; and the application of control measures such as movement restrictions, mass depopulation, and vaccination (Figure 1). Resources available to implement mass depopulation and vaccination programs, as well as the calculation of estimates for direct costs associated with the control strategies implemented, are then taken into consideration. The model records detailed and summary statistics that can be used to reconstruct and analyze the simulated outbreaks. Geographical information can be used to produce maps, which can serve as visual aids to understand the distribution characteristics of a simulated outbreak.

The NAADSM has been developed through a continuing international collaboration involving researchers from the United States and Canada, along with support, involvement, and advice from a broad international pool of subject matter experts. While a major emphasis of the NAADSM project is the application of a model suitable for use in North America, it has been used in several training courses offered largely to international audiences. The model has also been used to assist with emergency disease preparedness. On three separate occasions, the model was used to simulate outbreaks of highly pathogenic avian influenza (HPAI). The scenarios were then used during tabletop exercises to illustrate the potential scope and impact of an HPAI outbreak. Most recently, the model was used to estimate the number of vaccine doses needed in the event of a pseudorabies virus outbreak in Iowa and North Carolina.

NAADSM can be used to:

- Evaluate the effectiveness of various surveillance strategies;
- Illustrate the consequences associated with differing probabilities of detection and reporting;
- Identify areas to target preparedness and surveillance activities;
- Provide realistic scenarios for exercises;
- Evaluate proposed disease control strategies, plans, and policies;
- Assess the potential economic impacts of disease and associated control measures;
- Estimate consequences as part of the risk analysis process;
- Estimate resources needed in the event of an outbreak;
- Develop animal disease emergency preparedness and response plans;
- Offer outreach and training in the use of disease models in general and of NAADSM in particular to the scientific and veterinary medical communities in North America and abroad;
- Create simple scenarios for teaching disease modeling or complex scenarios for policy research;
- Communicate principles of epidemiology and disease control; and
- Support researchers who incorporate disease modeling in their work.

The NAADSM application is freely available via the Internet at http://www.naadsm.org. It is hoped that the accessibility and usefulness of the NAADSM will foster the development of a community of users who will be actively involved in improving the model as it is applied to various situations.

Reference:

Harvey N., Reeves A., Schoenbaum M.A., Zagmutt-Vergara F.J., Dube C., Hill A.E., Corso B.A., McNab B., Cartwright C.I., & Salman M.D. (2007) The North American Animal Disease Spread Model: A simulation model to assist decision making in evaluating animal disease incursions. Prev. Vet. Med., 82, 176-197.

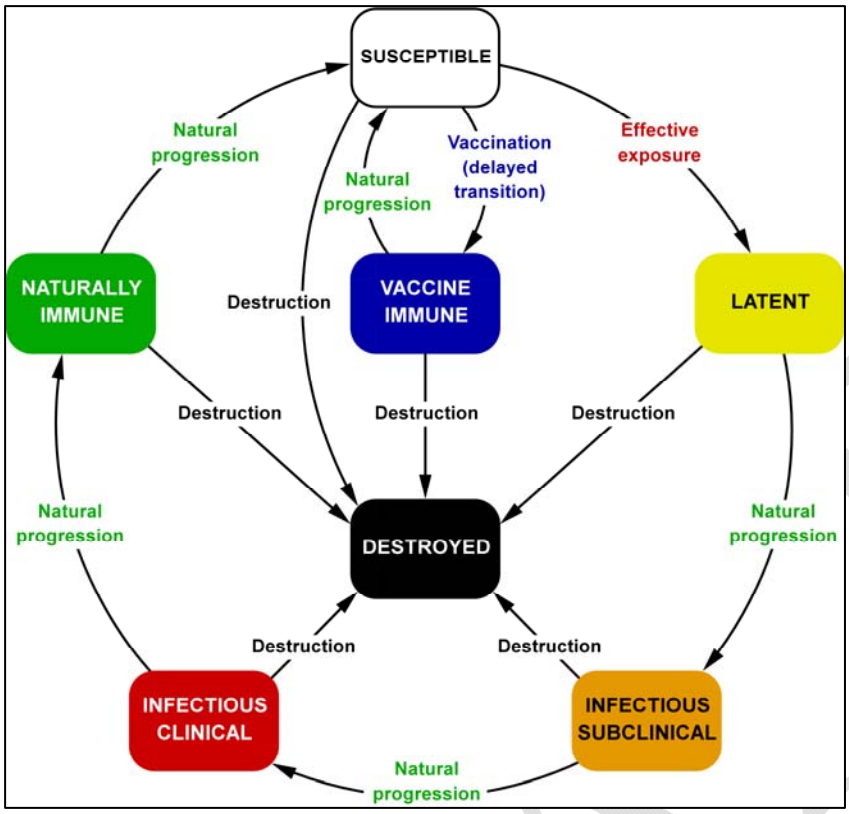

Figure 1 illustrates the transition between disease states as simulated by NAADSM. When disease occurs within a unit, it moves from one disease state to another. This cycle may be interrupted upon the implementation of disease control mechanisms.