Controlling FMD with Traceability

by **Meghan Richey**

At first there was just one red map dot in northeastern Nebraska signifying a beef cow latently infected with foot-and-mouth disease (FMD). For nine days nothing happened — the cow's infection progressed to subclinical, then clinical, and then she began shedding the virus and infecting everything around her. Like wildfire red dots then started to pop up all over the map. Soon all auction markets in the state were closed. Within 120 days, nearly 75,000 cattle from 105 herds had to be depopulated to control FMD.

For those familiar with the economic, political and social devastation that accompanies FMD, the previous scenario is frightening but not that far-fetched. In fact, it's not far-fetched at all; it's based on real data and represents just one likely U.S. outbreak scenario that resulted from an FMD simulation modeled by the Center for Animal Disease Modeling & Surveillance (CADMS) at the University of California at Davis. Since 2004, CADMS has been using computer simulation models to help predict how FMD would spread in the U.S. and identify the best control strategies for containment.

"Foot-and-mouth is extremely destructive," says Clair Thunes, CADMS project manager. "Modeling must occur before a disease outbreak so that decision makers can create disaster plans and see what resources they would need.

"Disease modeling helps minimize disease impact, minimize industry disruption and identify resource constraints," she continues. "We can use the information to reduce animal suffering and unnecessary depopulating should an outbreak occur. It also allows us to investigate the success of regionalization and compartmentalization and identify optimal control strategies."

What is FMD?

Foot-and-mouth disease (FMD) is a highly contagious vesicular disease that affects cloven-hoofed animals such as cattle, hogs and sheep. Caused by a virus with seven serotypes, the disease gets its name from the blisters and erosions that appear on the mouth, feet and teats of diseased animals. A veterinarian or other animal health official should be contacted immediately upon detection of such blisters to determine if the animal is infected with FMD or one of the other clinically indistinguishable vesicular diseases.

The highly infectious FMD virus is shed in all body fluids and secretions. It can be transmitted through exhaled air, direct contact, unprocessed meat products and inanimate objects. Quarantines, targeted vaccinations and movement restrictions are used to control the disease's spread. Surveillance and traceability are key monitoring practices.

There is no cure for FMD. Infected animals must be depopulated and destroyed along with those that have had contact with them. Preemptive culling is sometimes employed for at-risk animal populations.

Without immediate containment, the economic, political and social effects of an FMD outbreak can be widespread and long lasting.

— From *www.defra.gov.uk/footandmouth/*

Survey improves FMD model results

There's one major limitation with the model: the results are limited by the input data.

In this case, input data used to parameterize the FMD model were obtained from Animal & Plant Health Inspection Service (APHIS)-approved livestock markets and census data from the National Agriculture Statistics Service (NASS). Neither of these data sources is able to provide precise herd information, including animal movement behaviors, so Thunes says the model randomly distributes the data across the map.

"In the Nebraska simulation and all others that we do, the model always underestimates the number of animals infected with the disease when we use randomized data," she explains. "With precise data we would not only see a much more accurate distribution of the disease, the model would also likely show a significantly larger number of animals affected."

Livestock producers can help improve the FMD model results — and thus improve the United States' FMD preparedness — by completing an anonymous, five-minute online survey about their operations and animal movement behaviors. Results from the survey, which is located at *www.fmdsurvey.com*, will help CADMS gather precise data to replace the randomized data.

"The survey includes just nine questions that cover information such as the type of facility livestock producers have, the frequency of animal movements they make and the size-category of number of animals they have. They don't even have to provide us with the exact number of animals they have; they simply select a range category that they fit in," Thunes says. "From this survey we can gather the information we need to put into the model to get even more accurate results based on what's really going on in the industry."

The online survey is part of a research study funded by the Department of Homeland Security and the National Center for Foreign Animal and Zoonotic Disease Defense. CADMS guarantees that all the information submitted through the survey will be kept confidential and will only be used for modeling purposes.

"It is very important that we get as many responses as possible from producers so we can determine the best containment strategy and stop foot-and-mouth disease in its tracks," says Tim Carpenter, professor of veterinary epidemiology and primary investigator for the study. "This year's (2007) outbreak in the U.K. is a stark reminder that foot-and-mouth can strike the U.S. at any time. Because the U.K. has up-to-date databases of premises locations and animal movements, animal health authorities have been able to quickly identify and isolate infected and at-risk premises without having to cull massive numbers of livestock (compared to the 2001 outbreak)."

"In the U.S., the economic impact of an FMD outbreak is estimated to be as high as $13 billion," Carpenter says, noting that the U.K.'s highly publicized outbreak in 2001 required the depopulation of 7 million animals and totaled $5 billion in direct costs to the agriculture industry. "By answering our short survey at *www.fmdsurvey.com* and forwarding it to others, livestock producers can help us prevent this from happening in the U.S."

Traceability and disease containment

"The ability to identify individual animals and track their individual movements can lessen the duration of an FMD epidemic and decrease the number of infected herds," Thunes says.

The CADMS models are only able to track infected animals that originate from a facility that is participating in a traceability program and that move to another facility that is participating in a traceability program.

"If only one of those premises is participating, then the model can't trace the movement. And, naturally, if neither origin nor destination facility participates

Treat Steps **Use** Do Establish Don't Look

in a traceability program, then we can't track the movement," Thunes explains.

"As soon as we have a clinically diagnosed herd, 100% compliance to a traceability system allows us to know specifically what animals have moved from infected herds and where each of them has gone," she explains. "We also know where those infected animals originally came from, so we can go to those original herds and take action to control the disease spread from that facility."

The CADMS models have been used to simulate the effects of varying compliance levels in a national identification and traceability system to contain FMD in the U.S. Although thousands of reiterations are needed to develop a more accurate prediction, one scenario that was modeled approximately 1,000 times returned the following results: Without any ID or traceability program, more than 1,000 U.S. herds would be infected with FMD in a 100-day period. By contrast, the simulation showed that at approximately day 18 of the 100-day simulation less than 100 herds would have been infected if there were 100% compliance to a traceability system.

Outbreak length was also greatly affected by traceability. By approximately day 18, all of the outbreaks would have occurred with 100% compliance to a traceability program. The disease spread would have been completely contained at that point because the infected animals' present and past locations could be identified. However, without full traceability, only about 80% of the outbreaks would have occurred by the end of the 100-day period with the remaining 20% of disease spread potential continuing past the simulation's end.

Thunes concludes that precise data from the online survey and full compliance to a national ID and traceability program will improve the U.S.'s ability to quickly respond to and minimize the effects of an FMD outbreak.

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— Clair Thunes

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"At the touch of a button, we know exactly what we have and where we have it," says British dairyman and National Farmers Union Representative Raymond Brown in reference to the U.K.'s cattle herd. For example, as of Aug. 13, 2007, two weeks before Brown spoke along with Thunes at the 2007 ID Info Expo, hosted by the National Institute for Animal Agriculture, Brown says the U.K.'s cattle herd was at exactly 9,387,618 animals.

Brown's knowledge of this data and confidence in it is enabled by the British Cattle Movement Service (BCMS), the U.K.'s 9-year-old system that individually identifies cattle and tracks their movement from birth to death. It is a mandatory system that registers 100% of the cattle in the U.K. and was developed in response to disease monitoring, containment and eradication concerns stemming from bovine spongiform encephalopathy (BSE). Today one of its many uses is minimizing the effect of the August 2007 FMD outbreak.

BCMS is a paper-based system that uses a pair of visual tags with barcodes to individually identify all cattle. Calves must be tagged within 20 days of birth, and lost tags for all cattle must be replaced within 28 days. Births must be reported to BCMS within 27 days; deaths, within seven days; and movements, within three days. Both sellers and purchasers must record movements.

"Since our 2001 FMD incident, the U.K. has had a six-day retention rule, which stipulates that cattle may not move off your farm for at least six days after bringing new ones in," Brown says. "This does slow down cattle movements and commerce, but it also slows disease spread." (The retention rule was temporarily amended to 20 days following the FMD outbreak in August 2007.)

Cattle are issued "passports" that track movement information in a paper-based checkbook-type system that uses sticker barcodes and signatures to verify movement.

"The passport always stays with the animal; anywhere it goes, the passport has to be there," Brown says.

Data integrity in the BCMS is ensured by an audit system that selects 10% of all cattle holdings to be inspected each year. Penalties for failing to comply with the system include denial of passports, meaning an animal cannot move from its premises, cannot be sold and cannot enter the food supply.

Brown says the BCMS traceability system has enabled the U.K. to "get control of BSE. We're managing to monitor and hopefully get in control of TB (tuberculosis), too. And, of course, with foot-and-mouth, it's an absolute necessity to have BCMS to be able to have the backward trace to see where those animals came from and a forward trace to see where they've gone to."

"I must admit that as a farmer representative when BCMS first came out I was getting absolutely barraged with complaints. But with the way things have gone and the disease problems that we've had in the U.K., I don't think you'd find a person now who wasn't only too happy to comply," Brown says. "It's one of those necessities, really, since, unfortunately, we don't know what's around the corner."

Brown says he knows that the U.S. is working to implement its own traceability and animal ID system and that we must be "wrestling with questions" about why it's needed, how it will work, who will be involved, how much it will cost, who will pay for it and whether it will be mandatory or voluntary.

"What you do is up to you," he says. "However, I can tell you this — BCMS was a costly hassle to implement, but today, I am uncomfortable at the thought of being without it." **HW**

Traceback compliance and number infected