

Foot-and-Mouth Disease Vaccine

Foot-and-Mouth Disease

Foot-and-mouth disease (FMD) is a severe, highly contagious viral disease of cloven-hooved animals. Although not usually fatal, it causes suffering and vastly reduces animals' commercial value by reducing their weight and milk output. Cattle, swine, sheep, goats, and deer are highly susceptible and can exhibit signs of clinical illness after an incubation period of only 1 to 8 days; however, the incubation period may last longer and, especially in sheep and goats, signs of illness may go undetected altogether. Clinical signs include fever and blister-like lesions followed by erosions on the tongue and lips; in the mouth, muzzle, and snout; on the teats; between the hooves; and around the digits. Excessive salivation, lameness, and decreased feed consumption may also be observed.

FMD is widely believed to be the most economically devastating livestock disease in the world. If it were introduced into the United States, which is FMD-free, the disease could cause billions of dollars in losses to the U.S. economy. Although the disease is not a risk to humans, people who have worked around or been near infected animals can carry and spread the virus via their clothing, shoes, and vehicles.

The FMD Vaccine

Vaccines are used to produce or stimulate immunity against a particular disease. FMD vaccines are killed virus preparations that are pure, safe, and effective, and they are available to the U.S. Department of Agriculture (USDA) through the North American Foot-and-Mouth Vaccine Bank. Mexico and Canada are also members of the vaccine bank.

There are seven different types and more than 60 subtypes of FMD virus, and there is no universal vaccine against the disease. Vaccines for FMD must match to the type and subtype present in the affected area. When matched to type and subtype, the vaccine will normally protect animals from developing clinical signs of disease, but will not necessarily protect animals against FMD infection.

This is an important point when considering whether to use FMD vaccine or not (see "Reasons Not to Vaccinate").

The North American Foot-and-Mouth Vaccine Bank stores different types of concentrated, inactivated FMD virus antigen at ultralow temperatures over liquid nitrogen. In this state, several types of antigen can be kept indefinitely and formulated into vaccine rapidly should an FMD outbreak occur.

FMD antigen is produced by first growing the virus in cell cultures; filtering the virus harvest to remove debris; and inactivating it using a chemical such as binary ethyleneimine. The resulting antigen is then concentrated, purified, and stored in a cold, secure holding facility. The vaccine bank stores several FMD antigens, which are sent to designated production facilities abroad when a specific vaccine needs to be formulated. The vaccine bank can obtain hundreds of thousands of doses of FMD vaccine within days. Animals that receive the vaccine usually develop some degree of protection against clinical signs of FMD within 7 to 8 days.

The North American Foot-and-Mouth Vaccine Bank

The vaccine bank is housed at USDA's Foreign Animal Disease Diagnostic Laboratory (FADDL) at the Plum Island Animal Disease Center. The center, located 1.5 miles off the coast of Long Island, New York, is the only place in the United States where scientists can conduct research and diagnostic work on highly contagious exotic animal diseases such as FMD. Currently, the facilities on Plum Island operate at a biosafety-3 level, which means that they are designed, constructed, and operated to prevent the escape of microorganisms from the laboratory into the environment.

Scientists at FADDL monitor FMD outbreaks around the world and stock the vaccine bank with antigens for the most active serotypes or strains of the virus. If necessary, these scientists can isolate and identify an FMD serotype from a field sample in as little as 4 days. With this information, FADDL scientists would know what vaccine type to order from an overseas supplier, and if it were not in stock, the supplier could use the isolate to create a new vaccine. FADDL scientists also test currently available vaccines. Their testing has helped ensure that FMD vaccines are not contaminated with other microorganisms and that they do not produce adverse reactions following administration.

Reasons to Vaccinate

Emergency vaccination can play an important supporting role in the control of FMD outbreaks in FMD-free countries such as the United States. Vaccination can help contain the disease if it can be used strategically to create barriers between infected and disease-free areas.

If USDA officials were to determine that FMD vaccine should be administered to U.S. livestock in response to an FMD outbreak, they would collaborate with State and local officials to determine vaccination zones, and to inform livestock producers and the general public of the necessary quarantines and vaccination procedures.

Reasons Not to Vaccinate

Although there are FMD vaccines available, they are not currently used in this country because the United States has been free of the disease since 1929. There is no need to vaccinate against a disease that no animals have, especially when strict import restrictions are in place. USDA's Animal and Plant Health Inspection Service (APHIS) imposes import prohibitions on live ruminants and swine and their products from all FMD-affected regions. Additionally, because there is no way of knowing ahead of time what type and subtype of FMD virus might cause an outbreak in the United States, there is no way to know which FMD vaccine to use for protection prior to an outbreak. If an outbreak occurred here, USDA's first response would be to take swift measures to contain and eradicate the disease.

USDA has several reservations about implementing a vaccination program if FMD is ever detected in the United States. First, there is a risk of spreading the disease. For example, vaccine teams could carry the virus from an infected farm that did not yet have signs of disease, to a clean farm, if proper sanitary procedures were not strictly followed. In addition, if a vaccinated animal is exposed to the disease, that animal could possibly become infected and harbor the virus for an extended period of time. If such an animal later came into contact with an unvaccinated animal, including deer or other wildlife, disease spread could occur.

Finally, if an FMD vaccination program were implemented in the United States, our country's international trade status would be compromised. Countries that vaccinate for FMD cannot claim FMD-free status, so U.S. livestock exports would face trade restrictions. This could cost U.S. producers millions, if not billions, of dollars. The World Organization for Animal Health's current Terrestrial Animal Health Code requires FMD-free countries such as the United States to undergo

a 3-month waiting period between the time they have slaughtered their last vaccinated animals and the time they can claim FMD-free status, assuming ongoing surveillance and serological testing have demonstrated the country's freedom from FMD viral activity. In the event that vast numbers of animals are vaccinated, our country could wait many months after the last actual case of disease, while all vaccinated animals are still being slaughtered, before the 3-month waiting period could even begin. This could greatly delay U.S. efforts to re-establish its FMD-free status.

Summary

USDA currently maintains a variety of FMD antigens, which could be swiftly finished and deployed as vaccine if officials determined this to be an appropriate response to an FMD outbreak. There are drawbacks to using the vaccine, including its potentially devastating impact on export markets, so USDA's first response to an outbreak would be one of "stamping out"—imposing animal movement restrictions and eradicating the disease immediately.

USDA scientists at Plum Island Animal Disease Center continue to develop and experiment with novel biotechnology to improve the FMD vaccine.

Additional Information

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