

SCIENTISTS ON THE FOREFRONT

The Department of Homeland Security (DHS) Science and Technology Directorate's (S&T) Office of National Laboratories (ONL) operates the Plum Island Animal Disease Center (PIADC). At PIADC, scientists within DHS S&T and the Department of Agriculture's (USDA) Agriculture Research Service (ARS) and Animal and Plant Health Inspection Service study knowledge gaps and test, evaluate, and develop countermeasures and outbreak prevention and control measures for foot-and-mouth disease (FMD) and other transboundary animal diseases. PIADC is the only facility within the U.S. that is permitted to utilize live FMD virus (FMDV) as part of its scientific activities.

OVERVIEW OF FOOT-AND-MOUTH DISEASE

FMD is a highly contagious, viral disease affecting domestic and wild cloven-hooved animals, including cattle, swine, sheep, goats, deer, and buffalo. It is a disease of economic importance, impacting animal production, food security, and trade in susceptible animals and animal products.

FMD is not a threat to human health and does not represent a food safety concern, but established FMD outbreaks in the U.S. would disrupt critical agriculture markets and exports, including beef and pork. Though FMDV has not been present in the U.S. since its eradication in 1929, estimates suggest an outbreak could cost \$2 billion to greater than \$200 billion.¹ FMDV is widely dispersed; it is present in Africa, the Middle East, Asia, and parts of South America and Europe. Countries with confirmed cases are subject to international trade restrictions aimed at reducing the risk of introducing FMD to disease-free countries.

FMDV infection often results in acute fever and vesicles, or blisters, that primarily appear on the feet, in and around the mouth, and on the mammary glands of susceptible animals. The vesicles rupture, resulting in painful lesions that can induce anorexia, excessive salivation, and lameness.

Natural infection is generally through the oral/nasal route; animals can become infected through inhalation, ingestion, or direct contact with skin abrasions or mucus membranes. FMDV is present in exhaled air and bodily fluids from acutely infected animals. The virus is also transmitted through indirect contact (via objects carrying infectious materials, or fomites), wind dispersion, and by infected insects feeding upon the

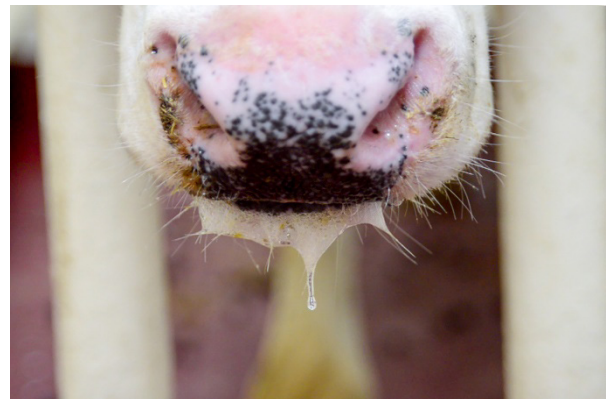
animals. Infectious FMDV can remain present in animal products, such as processed meat, which led to the establishment and implementation of sanitary practices and trade restrictions to prevent the spread of FMD.²

Although traditional FMD vaccines are available, they are all currently manufactured outside the U.S. Similar to seasonal influenza, FMDV is highly diverse, continuously mutating, and classified into seven major serotypes (serotypes are groups within a single species of microorganisms).³ Vaccines must be strain-specific to adequately protect animals. This need for "vaccine matching" complicates vaccine stockpiling and outbreak response measures.⁴

MITIGATING THE THREAT OF FOOT-AND-MOUTH DISEASE

In 2012, USDA ARS discovered and S&T developed with commercial partners an adenovirus-vectored FMD vaccine (where a harmless virus is used as a vaccine platform) that received a conditional license for production in the U.S. and for use as part of outbreak response.⁵ This achievement enabled regulatory evaluation of other, next-generation FMDV vaccine platforms and vaccine candidates.

In 2017, a laboratory-based diagnostic test designed to differentiate between infected and vaccinated animals co-developed by S&T, USDA ARS, and Texas A&M University, in partnership with Veterinary Medical Research and Development Inc., received a product license. This 3-hour, rapid-response diagnostic test is an important outbreak mitigation tool for animal health first responders, and can be used on cattle, sheep, and swine.



Excessive saliva seen in an FMD-infected cow