

# Foot and Mouth Disease

Foot and mouth disease (FMD), a highly contagious viral infection of cloven-hoofed, wild and domestic animals, is characterized by **fever, lameness, vesicles and erosions**. It is one of the most likely agents for use in agro-terrorism. Trade embargoes, eradication efforts and loss of consumer confidence resulting from an FMD outbreak in the United States could lead to dire economic consequences both locally and nationally.

## SPECIES AFFECTED

FMD virus (FMDV) infects **cattle, pigs, sheep and goats**, as well as other cloven-hoofed animals. Llamas and alpacas are minimally susceptible and are not considered important in the spread of the disease. **FMDV does not affect equine species.**

## TRANSMISSION

### ***Direct contact and fomite spread***

The primary means of spread of FMDV during outbreaks is by direct contact of susceptible animals with infected animals or items contaminated by them.

***FMD virus may be shed up to four days before the onset of clinical signs. The movement of infected animals prior to recognition of the disease is the most common means of virus spread.<sup>5</sup>***

FMDV may survive for hours to days on contaminated fomites, e.g., footwear, clothing, instruments, heavy equipment and vehicles, all of which are common sources of spread of FMD to new premises.

***All secretions and excretions (feces, urine, saliva, tears, milk, semen and sloughed tissue) are infective. FMDV survives in organic materials for weeks to months. Reintroduced cattle have been infected up to four months after ineffective cleaning and disinfection of contaminated premises.***

### ***Airborne spread***

Another major route of infection in both ruminants and swine is via inhalation. Aerosolized FMDV may spread over considerable distances, and very small doses may initiate infection at close proximity.<sup>1</sup> Infection may also occur through breaks in the skin or mucosa<sup>2</sup>, as well as by ingestion. Infection by these routes, however, requires a much higher infectious dose than infection by inhalation.<sup>3</sup>

Compared with cattle, swine secrete thousands of times more aerosolized infectious virus<sup>4</sup>; they are FMDV *amplifiers*. Nevertheless, cattle are believed to be the major contaminators of the environment due to their large size and volume of infectious secretions and excretions (e.g., 10-30 grams of sloughed vesicular tongue epithelium may represent more than one billion infectious units).

***FMDV also survives for days to months in some processed animal and meat products. A common source of FMD spread between countries is illegally imported contaminated meat products fed to swine in untreated swill (garbage).***

FMDV may survive in the human nose and throat for up to 24 hours. The virus has been experimentally transmitted on one occasion by aerosol from a human to a steer. Transmission from man to animal in this manner may be possible during an outbreak but is considered far less likely than fomite spread from contaminated clothing, tools or equipment.

### ***Carriers***

Reports of transmission of FMDV by **carriers** such as previously infected recovered animals, are anecdotal and limited to very few cases. To date,

<sup>1</sup> 10-25 infectious doses for cattle and sheep, where infectious doses (TCID<sub>50</sub>) are measured as the number of virus in a specified suspension that infects 50% of a number of tissue culture wells.

<sup>2</sup> TCID<sub>50</sub> as low as 10 through breaks in skin or mucosa

<sup>3</sup> 600,000 TCID<sub>50</sub> for cattle and 80,000 TCID<sub>50</sub> for swine

<sup>4</sup> Swine secrete up to 400 million aerosolized TCID<sub>50</sub> per day compared with 120,000 TCID<sub>50</sub> for cattle.

<sup>5</sup> Movement of infected sheep played a major role in the spread of FMDV during the most recent outbreak in Great Britain.

there has been no convincing experimental evidence indicating that previously infected or vaccinated, then infected cattle or sheep commonly transmit FMDV to uninfected animals. Pigs are not carriers of FMDV.

### **MORBIDITY & MORTALITY**

In susceptible domestic animal populations, morbidity is close to 100%, whereas mortality is usually less than 1%.

### **CLINICAL SIGNS**

***When cattle, sheep and swine are exposed simultaneously to FMDV, cattle are usually first to show clinical signs;*** they are disease indicators. Clinical signs usually develop in cattle within 2-8 days, but may take as long as 14 days. Initial signs of infection include: ***fever*** (103-105°F; 39.4-40.6°C), shivering, dullness, decreased appetite and/or decreased milk production, followed by ***vesicle (blister) formation, drooling***, nasal discharge and/or ***lameness***. Vesicles that form on the tongue, dental pad, gums, soft palate, nostrils, muzzle, teats, coronary band, and/or in the interdigital space, rupture within 24 hours leading to tissue sloughing and ***erosions***. Ulcers may develop after secondary bacterial infection.

***Swine are commonly infected by ingesting FMDV-contaminated swill*** (particularly uncooked restaurant waste from cruise ships), but may also contract the virus by direct contact or by being placed in a contaminated environment. They are less susceptible than cattle to aerosol infection. Pigs infected by the oral route usually develop clinical signs within 1-3 days. Signs include: ***fever*** (104-105°F; 40-40.6°C), ***decreased appetite*** and ***lameness or reluctance to move***. Vesicles (blisters) form on the snout, tongue, coronary band, heels and/or in the interdigital space. ***Foot involvement frequently becomes severe***. Oral lesions are less common in swine.

***Because sheep and goats often exhibit very mild or NO clinical signs, diagnosis in these species may be delayed or hindered, allowing time for viral spread and environmental contamination.*** Clinical signs ***may*** include: fever and small vesicles (blisters) or erosions on the lips, dental pad, gums, tongue, coronary band and/or in the interdigital space. ***Mild lameness may be the only sign of infection in these animals.***

***FMD should be considered in any cloven-hoofed species when salivation and lameness occur simultaneously and a vesicular lesion is observed or suspected. Whenever there is suspicion of FMD or any vesicular disease, a State and/or Federal Veterinarian must be contacted immediately; a rapid response is crucial in containing an outbreak.***

**For a listing of State Veterinarians, visit:**

<http://www.aphis.usda.gov/vs/sregs/official.html>

**For listings by State of Federal Veterinarians:**

**Area Veterinarians In Charge (AVICS), visit:**

[http://www.aphis.usda.gov/vs/area\\_offices.htm](http://www.aphis.usda.gov/vs/area_offices.htm)

Eastern Regional Director: (916) 716-5570

Western Regional Director: (970) 494-7385

### **DIAGNOSIS**

Because of their small size and transitory nature, vesicles (blisters) may be difficult to see. It is recommended that animals be tranquilized to facilitate a thorough physical examination. **To avoid missing a diagnosis, the mouth of any lame animal and the feet of any animal with signs or lesions involving the mouth or nose should be very carefully examined, as should all febrile animals.**

Because FMD is clinically indistinguishable from other vesicular diseases, a definitive diagnosis may only be made by submitting appropriate samples to a reference laboratory. ***Samples will be collected by regulatory veterinarians*** from two or more live animals, including: whole blood and serum samples, as well as vesicular fluid and epithelium covering vesicular lesions. Oropharyngeal fluid may also be collected. ***FMDV must be isolated and identified by a USDA-certified laboratory, such as the one at Plum Island, for the initial confirmatory diagnosis.***<sup>56</sup>

### **TREATMENT**

There is no known cure for FMD. Recovered animals rarely achieve pre-infection production levels. Fifty percent or more of previously infected animals become chronic FMDV carriers, complicating surveillance efforts. ***Palliative care may help relieve an animal's discomfort, but does not prevent the spread of FMDV.***

<sup>56</sup> After confirmation of the initial case, diagnosis during an outbreak may be made by antigen and/or nucleic acid detection alone.

## CONTROL AND ERADICATION

Effective control strategies include the following key features:

- Stopping movement of animals and animal products in the affected area(s)
- Strict surveillance to identify carrier animals
- Slaughter of infected animals and known contact animals (stamping out)
- Proper carcass disposal ([http://www.aphis.usda.gov/vs/ncie/oie/rtf\\_files/tahc-carcass-disp-jan05.rtf](http://www.aphis.usda.gov/vs/ncie/oie/rtf_files/tahc-carcass-disp-jan05.rtf))
- Disinfection of vehicles and people leaving the infected area ([http://www.agr.state.ne.us/homeland/monograph\\_004.pdf](http://www.agr.state.ne.us/homeland/monograph_004.pdf))
- Community education and communication
- Financial indemnification of losses to producers

The use of vaccination in outbreak response strategies will be determined by the United States Department of Agriculture. FMD vaccines are effective only against the specific strains of virus from which they are produced. Therefore, they must be chosen based on the FMDV strain(s) that have caused the outbreak.

**Producers are strongly encouraged to employ biosecurity measures to prevent exposure of their animals to diseases such as FMD.**

Visit: **California Department of Food & Agriculture (CDFA)**, Animal Health Branch, Biosecurity at:  
<http://www.cdca.ca.gov/ahfss/ah/biosecurity.htm>  
Call: CDFA at: (916) 654-0466  
Visit: **The Center for Foreign Animal and Zoonotic Disease Defense** at:  
<http://fazd.tamu.edu>

## RECOVERY

Following an FMD outbreak, restocking takes place under the direction of regulatory veterinarians and may be preceded by the introduction and surveillance of sentinel animals.

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