



FOOT-AND-MOUTH DISEASE

ANIMAL GROUP AFFECTED	TRANSMISSION	CLINICAL SIGNS	FATAL DISEASE?	TREATMENT	PREVENTION & CONTROL
artiodactylids elephant tapir hedgehog kangaroo	Aerosol Direct contact Indirect contact	Fever vesicles on tongue, gums, interdigital space, coronary area and teats death mostly due to necrosis of the myocard in young animals	Species and age dependant. In general mortality is higher in young animals	Hyper-immune serum. Symptomatic.	<i>In zoos</i> Vaccination Quarantine Noticeable disease

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<p>Susceptible animal groups All artiodactylids belonging to the bovidae, tragulidae, cervidae, antilopidae, camelidae, cervidae, antilocapridae, capridae, ovidae, suidae and tayassuidae. Tapir sp. Elephant European hedgehog Kangaroo No reports of FMD in okapi, and hippopotamidae. There is a distinct difference in susceptibility between species, that also depends on serotypes. Many other species can be infected experimentally, but play no role in natural infections. Only ruminants can become carriers. African buffaloes in southern Africa are natural carriers (SAT-serotype, >5 years). Cattle up to 5 years in exceptional circumstances. Kudu, Sable antelope and wildebeest up to 28 days.</p>	
<p>Causative organism Picorna virus; 7 serotypes (A, O, C, SAT1, SAT2, SAT3, Asia1) each serotype has several antigenic subtypes. No cross immunity between serotypes. One of the most contagious virus infections. Persistent in the environment, especially in colder/moderate climate. Labile at pH values below 6 and above 9.</p>	
<p>Zoonotic potential Man is affected very sporadically; approximately 35-40 cases have been described in the literature. Symptoms are mild (lesions in mouth, on hands and feet resembling symptoms caused by an enterovirus Cocksackie A16).</p>	
<p>Distribution Enzootic in large parts of Asia, South America, Africa and parts of Europe. Australia and North America are free. The OIE-website (www.OIE.org) indicates what areas are currently free of disease.</p>	
<p>Transmission</p> <ol style="list-style-type: none"> 1. Bovine species generate highest level of total contamination. Swine create highest level of infectious aerosols 2. Respiratory secretion (exhaled air, 1-3 days prior to clinical onset till 7-14 (10)days after development of lesions) 3. Urine and faeces (also infectious prior to development of clinical signs until 7-10 days after development of clinical signs) 4. Milk, meat, fomites, vehicles, people 	



5. Aerosols. Long distance by aerosols (>100 km) - only under very specific conditions.

Incubation period

Incubation period varies from a few days to 14 days.

Clinical symptoms

Species and serotype dependant. In some species, the disease may pass without any symptom.

Generally: high fever; after 2-3 days vesicles may develop on the oral mucosa (gums, tongue), rostrum, in the coronary area, in the interdigital space and/or on the teats and other areas of friction. These vesicles rupture and the underlying tissue may become secondary infected. Salivation and lameness may result from these lesions. Loss of a hoof is not uncommon in domestic animals. A discontinuity of the skin-hoof junction that can occur in an early stage of FMD infection may result in abnormal wear of the horn and a double-hoof structure may develop. This abnormality has been observed in impalas; it took 5-6 months before the abnormality was no longer present because of normal growth and wear.

Myocard necrosis (tiger heart) resulting in acute death has been reported in (young) domestic and non-domestic artiodactylids, camels and elephants. In elephants, (partial) loss of the foot sole has been reported. Only ruminants can become carriers after infection. African buffalo can maintain the SAT-serotypes for more than 5 years. Sable antelope and kudu may carry the virus for about 1 month. European hedgehogs carried the virus during hibernation and excreted the virus when resuming normal activities in spring.

Not much is known about carriers amongst non-domestic animals.

Post mortem findings

Vesicles in the mouth and on the feet, rostrum and teats. Severe lesions in tissue where there is mechanical stress on infected epithelial surfaces. Species dependent predilection sites. Myocarditis (mainly in young animals). See also clinical symptoms. Vesicles can also be observed on the pillars of the rumen

Diagnosis

Clinical symptoms + antibodies (VN-test and ELISA; alternative CF). Note that in the early stages of the disease antibodies are usually not easily detected.

Clinical symptoms + positive cell culture

Clinical symptoms + positive PCR

Carriers can be diagnosed by PCR on a probang sample (oropharynx), although the number of positive results may drop significantly over time. Probangs should be diluted in 5 ml of phosphate buffer and put in liquid nitrogen as soon as possible after sampling. Dry ice can be used also, but care should be taken to seal the vials well. Entry of CO₂ into the vial will inactivate the virus

ELISA 3ABC-marker claims it can distinguish vaccine induced antibodies from natural virus-induced antibodies if well purified vaccine has been used. This test still needs to be validated.

Material required for laboratory analysis

Vesicular epithelium for virus isolation (in phosphate buffer pH 7.4 at 4°C). The best is 50% glycerine/ phosphate buffer pH 7.4. Add not more than 20% epithelial material. This sample can be stored frozen (-20 C or kept refrigerated).

Vesicular epithelium for PCR frozen or in formalin.

Lymph nodes for virus isolation.

Myocardium sample on dry ice and in formalin in case of sudden death.

If transportation will take long, samples must be kept on dry ice or liquid nitrogen (not in a conventional freezer)

Probang specimens from pharyngeal region

EDTA or heparin blood for virus isolation during viremia and for serology.

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Treatment

If treatment is allowed by the national authority, (species specific??) hyper-immune serum can be administered parenterally. Mild cases can be treated symptomatically (NSAID, disinfection of local lesions, etc.).

Prevention and control in zoos

- Quarantine of all new animals coming from suspected areas and check them serologically.
- When a zoo is near an outbreak, vaccination of all susceptible animals with the same serotype is



recommended. Double-oil-emulsion (DOE) vaccine has preference (as compared to aquaous vaccine). It is highly recommended to check antibody titers per species before and after vaccination in order to validate vaccination. Vaccination in non-domestic animals has been done in the past on a small scale. Very few data are available about the efficacy of vaccination except for cattle, sheep and pigs.

Other measures to be taken when a zoo is near an outbreak:

- Hygiene and disinfection (keepers, public, vehicles)
- No direct contact between susceptible animals and visitors
- Check origin of roughage and other feedstuff
- No swill feeding
- Keepers with artiodactylids at home should not work with susceptible animals in the zoo
- Susceptible animals should be kept indoors as much as possible
- The zoo should be divided into compartments. Each compartment has its own team of workers for susceptible animals.

Vaccination of contact animals with a double oil emulsion FMD-vaccine is highly recommended. In domestic animals protection against clinical symptoms is achieved within 2-7 days after vaccination. FMD vaccine is a safe „killed“ vaccine that does not infect a vaccinated animal. However, vaccination protects against disease but not infection by severe contact exposure. In that case virus may be isolated from the oro-pharynx (probang samle) of vaccinated (infected) animals by inoculation of cell cultures or unweaned mice. It may also be detected by PCR. Therefore, in outbreak situations, quarantine of vaccinated animals should be maintained for at least one month post-vaccination, eventhough vaccinated animals have never been a source for a new outbreak.

The Council of the EU has approved by means of Directive 2003//EC ref. 9474/2/03 Rev 2 that under certain conditions (valuable) zoo animals may be be safed even if the zoo has been declared FMD-infected (art.15.2). During an outbreak in an EU memberstate, national authorities may decide to start emergency vaccination of susceptible (zoo) animals (art.50). Regarding the movement of vaccinated animals, specific measures may be provided to facilitate the movement of vaccinated zoo animals for the sake of important breeding programs (art.64.2).

Suggested disinfectant for housing facilities

Recommended disinfectant: 2% citric acid or 4% washing soda (Na₂CO₃), which is corrosive.

Notification

Any suspicion of FMD has to be reported to the national veterinary authorities.

Guarantees required under EU Legislation

Guarantees required by EAZA Zoos

Measures required under the Animal Disease Surveillance Plan

Measures required for introducing animals from non-approved sources

Follow instruction of national veterinary authorities.

Measures to be taken in case of disease outbreak or positive laboratory findings

Notify national veterinary authorities. Institute emergency quarantine and control measures.

Conditions for restoring disease-free status after an outbreak

Consult national veterinary authorities.

Experts who may be consulted

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