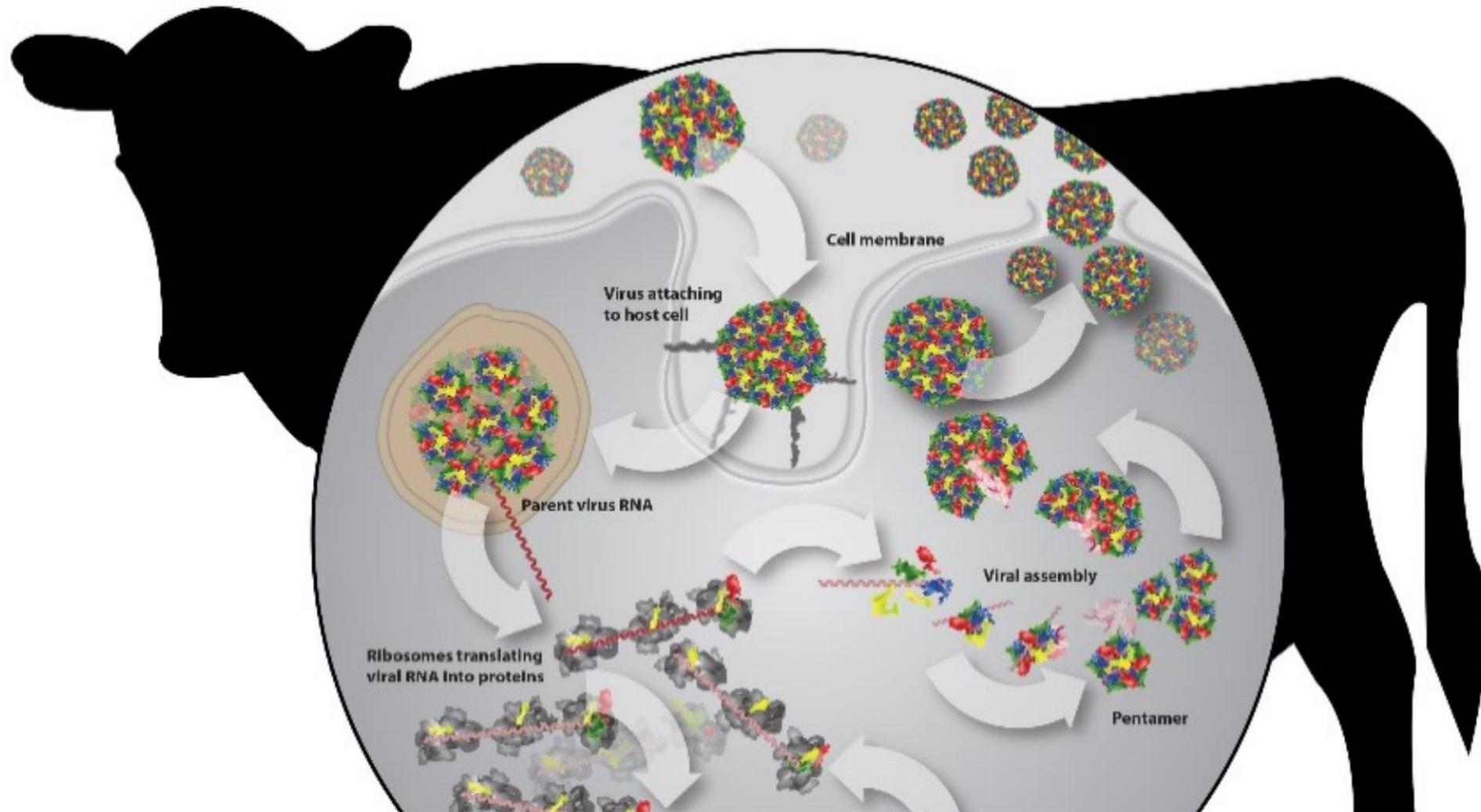


**FOOT AND MOUTH
DISEASE
(FMD)**

- Foot and mouth disease (FMD) is a highly contagious viral disease that primarily affects cloven-hoofed animals, i.e. cattle, sheep, goats, pigs, deer, elephants, and many other wild ruminants such as buffalo, impala and kudu in Africa and humans.



Foot and Mouth disease virus lifecycle



Zoonotic disease !

It is a characteristic viral disease with cyclic, acute, febrile vesicles and erosions.

Degenerative Disorders in the Heart of Young Animals.

Economically important

Notifiable Disease

Etiology

Picornaviridae,
Aphthovirus

RNA, Non-enveloped

The smallest Virus

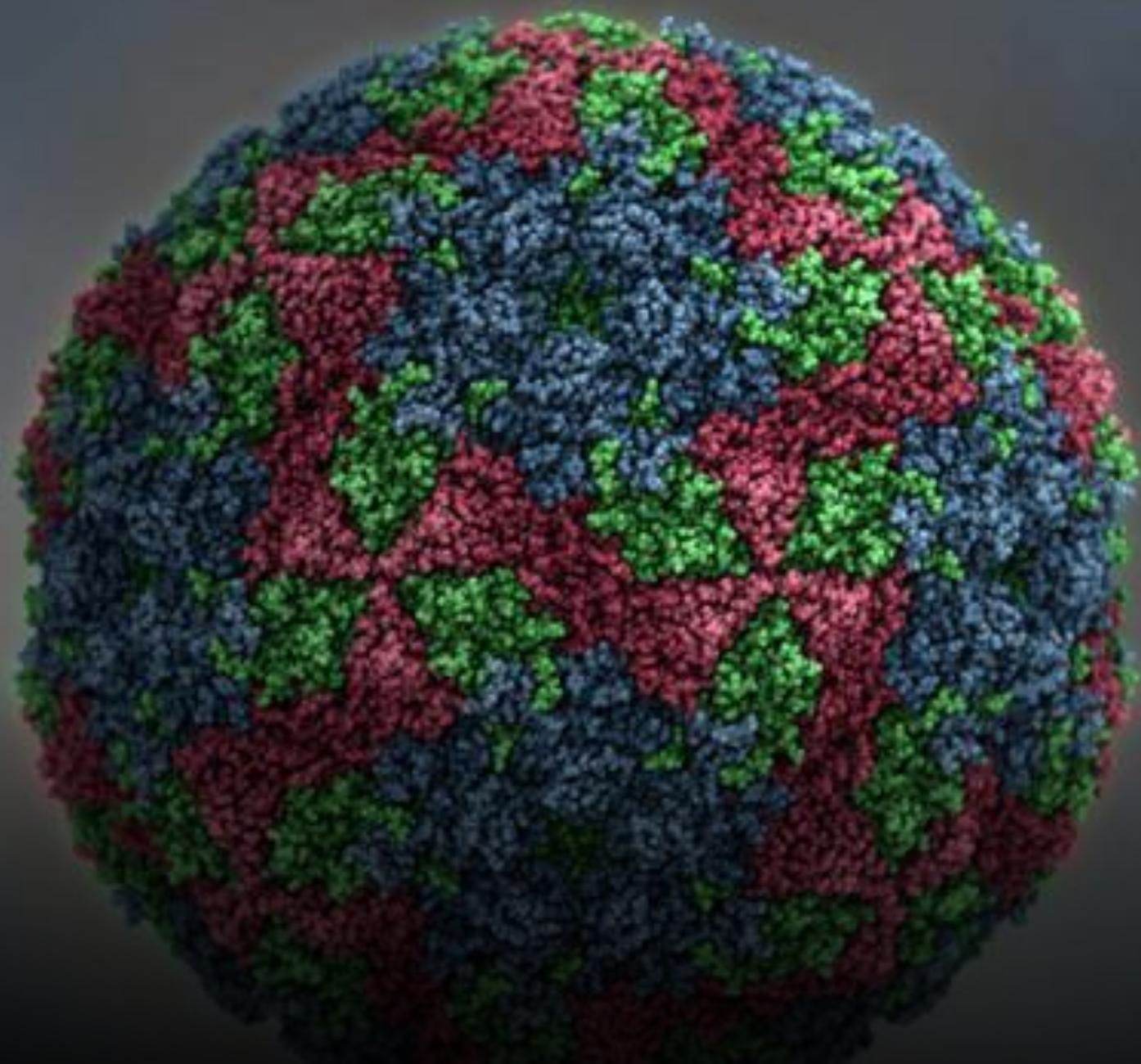
Antigenically; 146S
Virion (serotype
specific immunization
inactive vaccines)

7 Serotype ; A, O, C,
Sat 1,2,3 , Asia 1

- Over 60 subtypes
- Antigenic variation seems to be greatest for Serotype A.

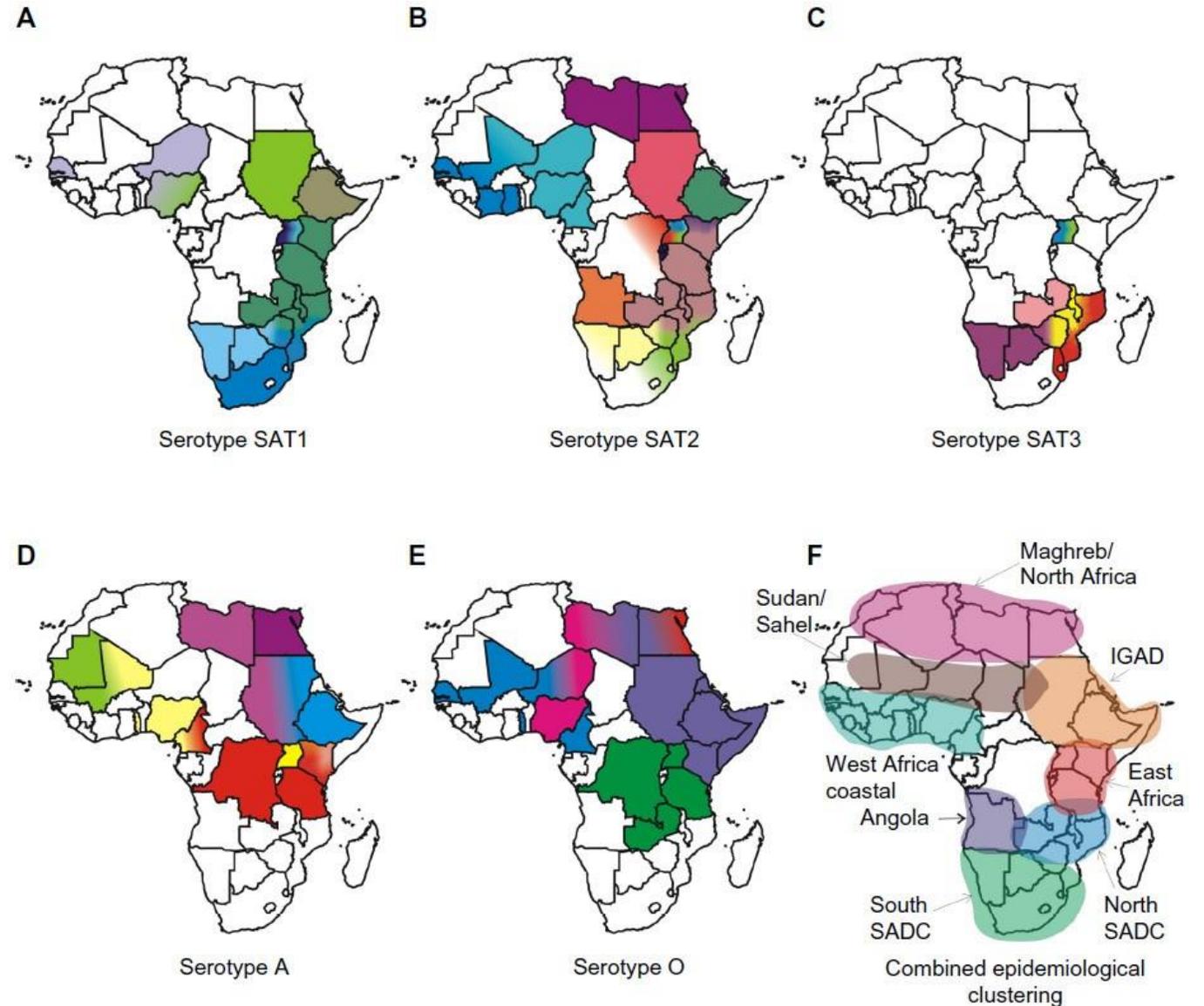
Foot-and-mouth disease A10

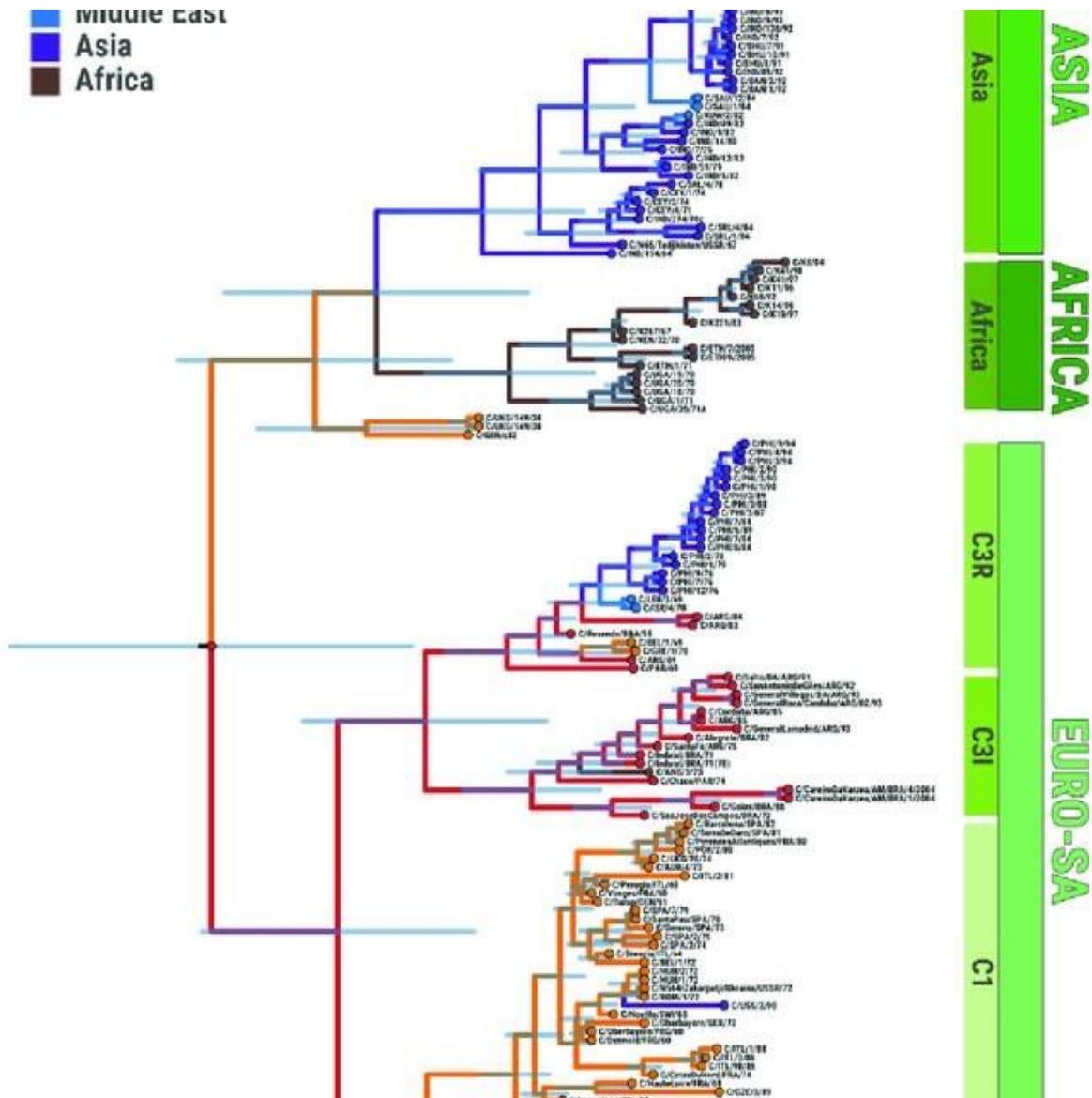
PDB: 1zba



Serotypes

- Immunity to one FMDV serotype does not protect an animal from other serotypes. Protection from other strains within a serotype varies with their antigenic similarity

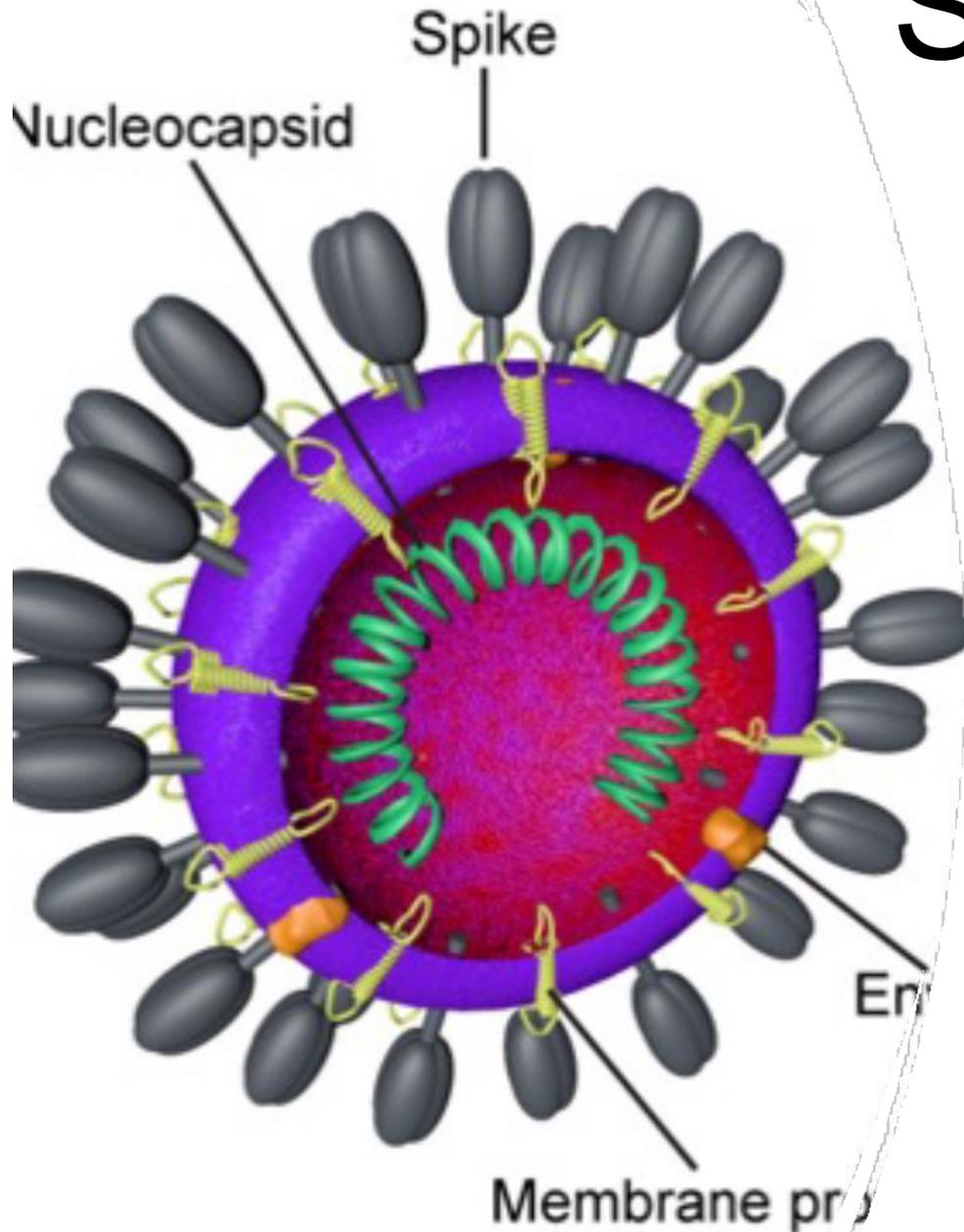




What happened to Serotype C

- Although the virus is no longer considered extinct, no C serotype has been reported in the world for the last 20 years.

B



Serotypes in Turkey

The two common serotypes in Turkey are A and O.

A, O, Asia-1 and SAT-2 types have been detected in disease outbreaks in Turkey after 2000.

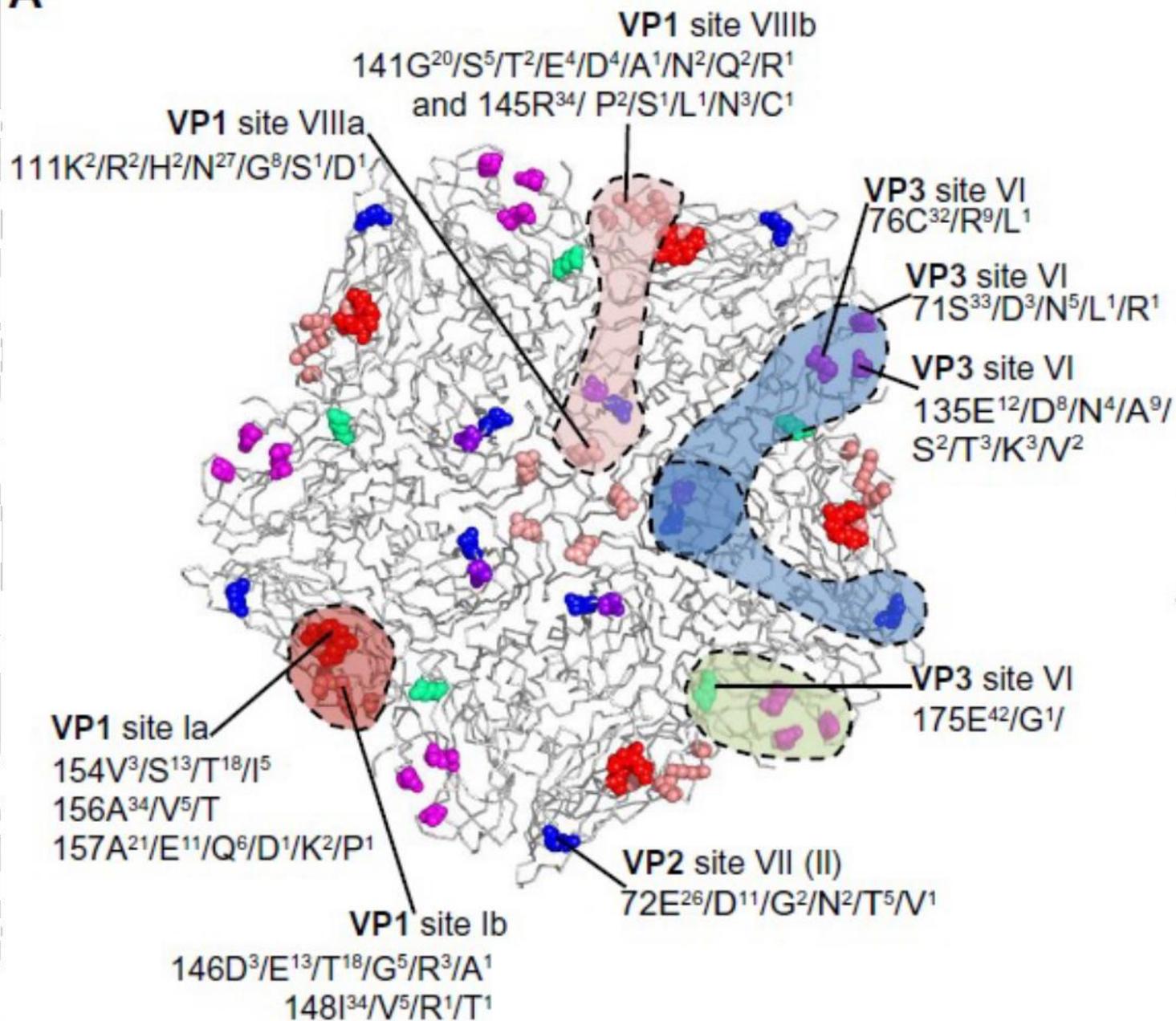
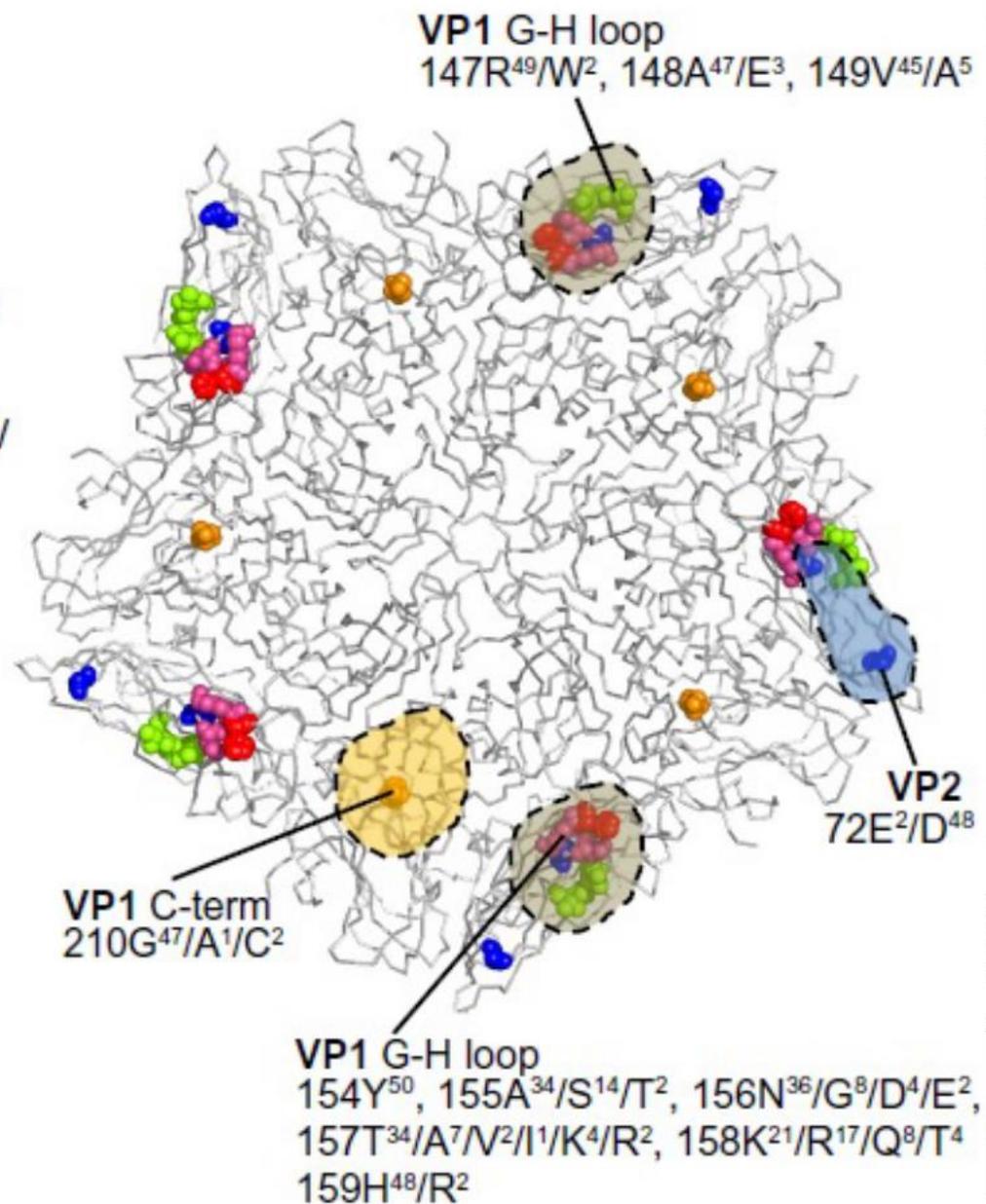
Serotype A exhibits a great diversity of antigenic subtypes, and there is usually no cross protection between them.

Quarantine and vaccination have been implemented in Turkey since 1962.

Serotypes in turkey

Since 1999, two serotype A subtypes have been circulating in Turkey, designated as IRN96 and IRN99 by the World Reference Laboratory Pirbright.

Due to the high mutation rate of the virus, all seven serotypes have 60 topotypes and cross immunity does not occur between the types. The genetic and antigenic diversity of FMD strains causes difficulties in developing vaccines for effective FMD control. This situation necessitates the maintenance of specific vaccines for each region.

A**B**

Virus cultivation;

- 1- Tissue Culture: BHK, Cattle, Pig, Chicken Fibroblast
- 2- Lab animals ; mice (3-5 days) , Rattus (back foot skin), Guinea pigs which develop vesicles are the experimental host for vaccine studies and antiserum production.
- 3- ECE (Embrionated chicken eggs)



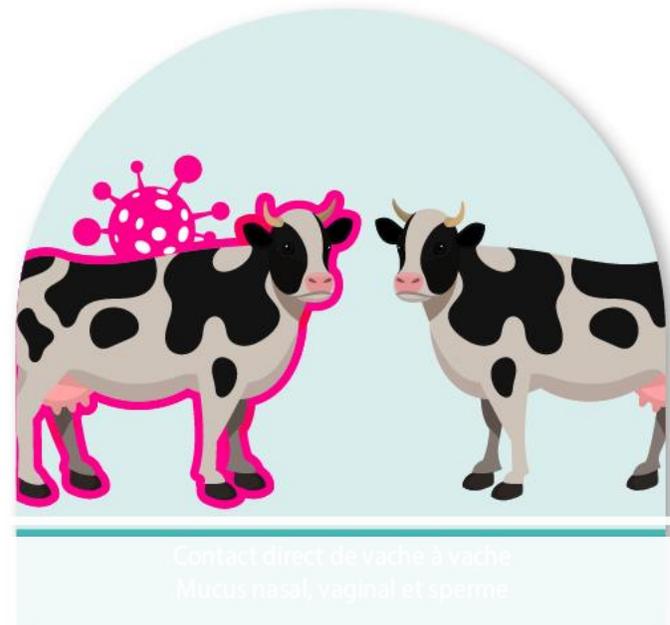
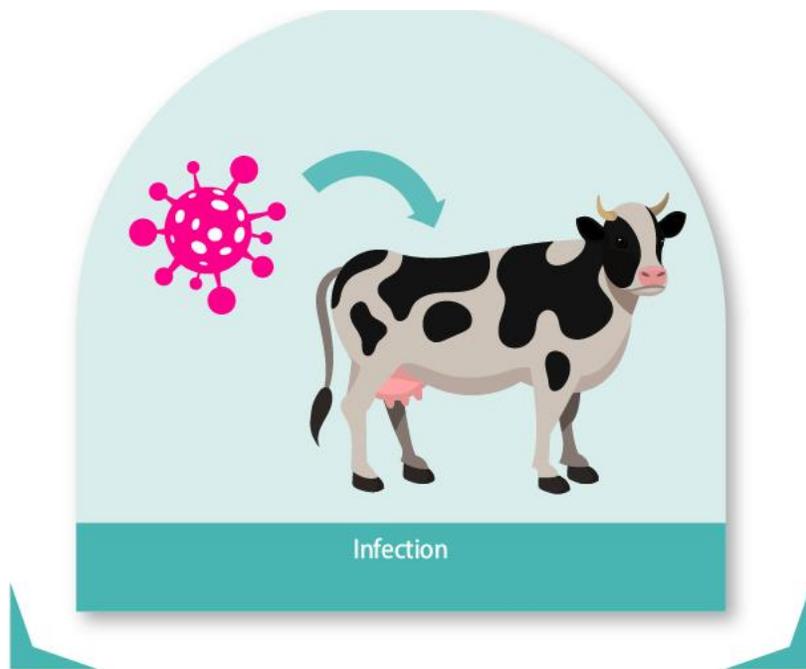
BEFORE
INFECTION

AFTER
INFECTION

A close-up photograph of a pig's head, focusing on the snout area. The pig has dark fur on its snout and lighter fur on its face. There is a prominent, reddish, ulcerated lesion on the snout, which is characteristic of African Swine Fever. The lesion is surrounded by a clear, gelatinous exudate. The pig's eye is partially visible, and the overall appearance is one of a diseased animal.

Viability

- Virus could continue the long-term viability of the environment.
- Acid sensitive, FMDV is rapidly inactivated in the muscles, which become acid during the "setting" of meat but survives well in the lymph nodes and bone marrow of chilled or frozen carcasses.

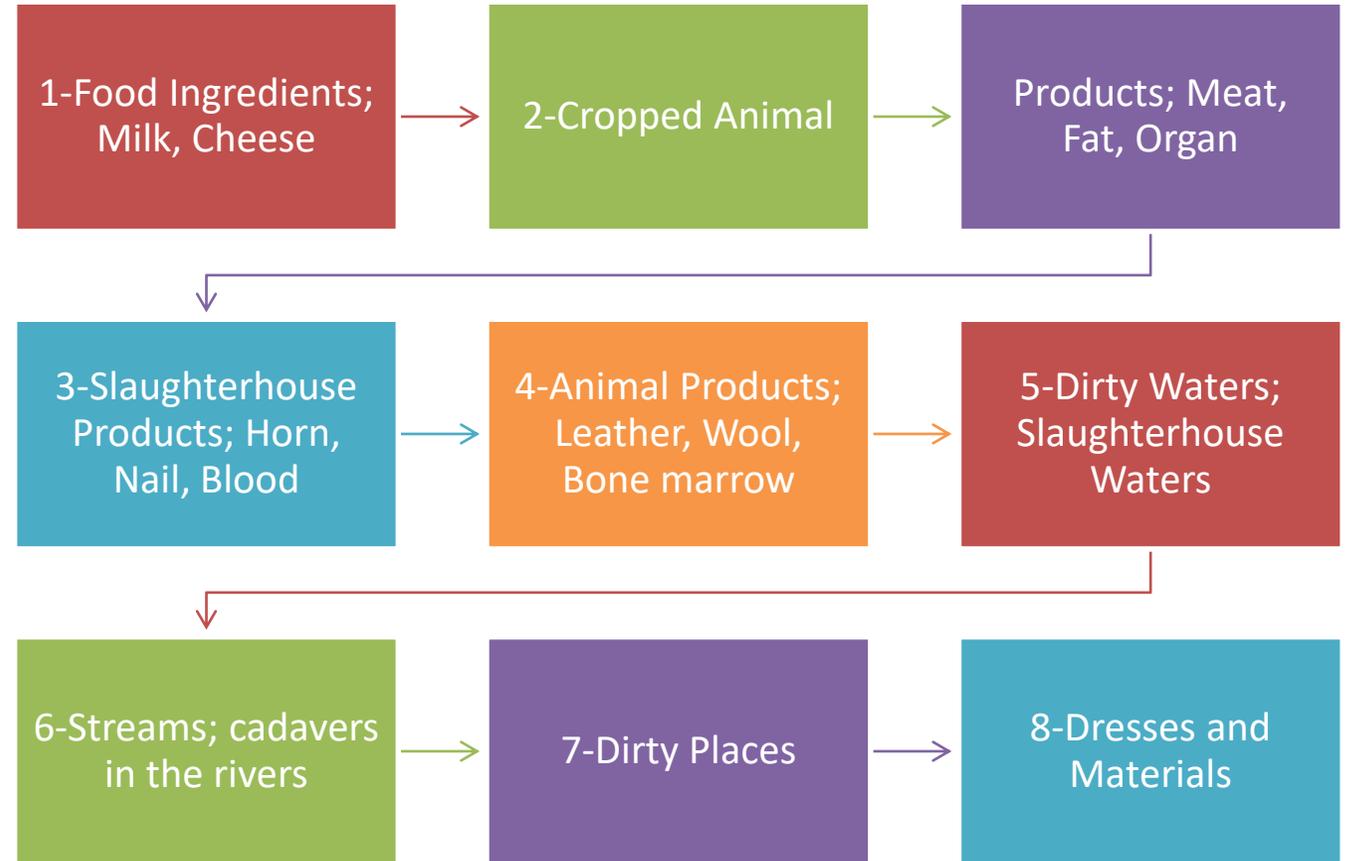


Direct Transmission;

- The Most Important role in Transmission is Cattle movements.
- 1- Contact :
 - a- The barn, pasture, animal markets.
 - b- Urine, feces, saliva, Vesicle
- 2- Plecental Inf : pregnant sheep
- 3- Insemination Inf : via Semen
- 4- Milking Inf: via mother's milk
- 5- Vaccine Inf: via vaccination



Indirect transmission



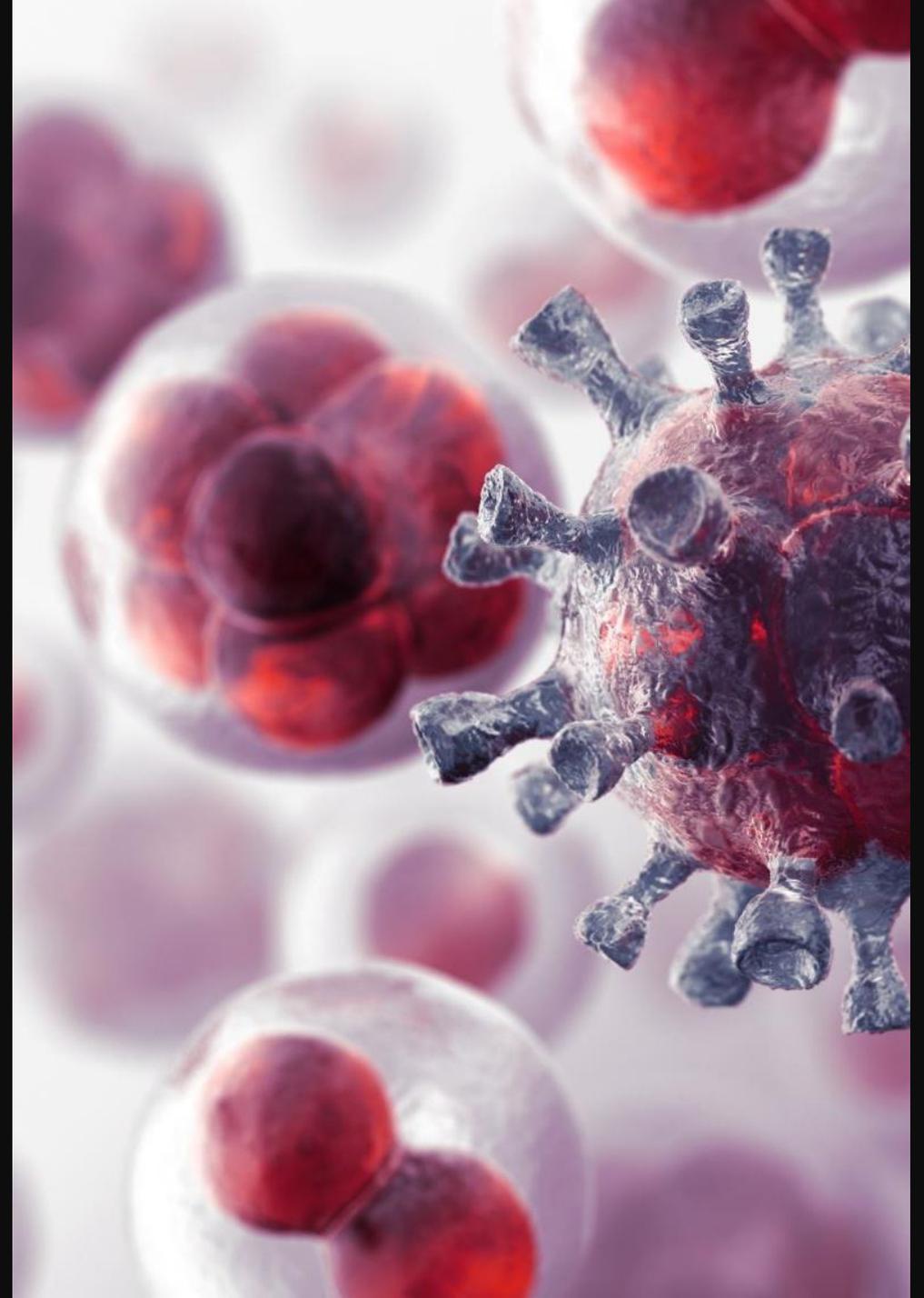


Other Animals



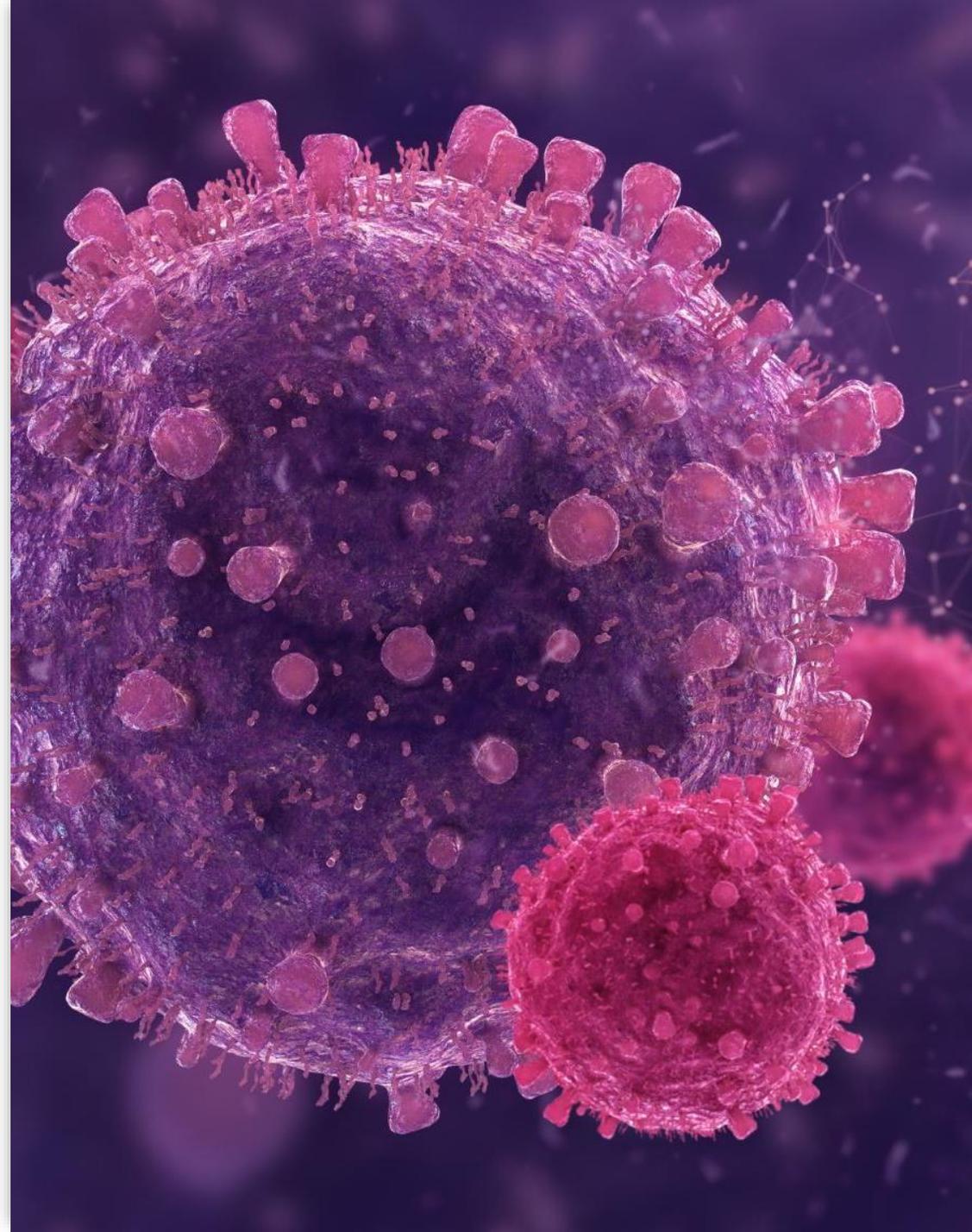
HIGHLY CONTAGIOUS

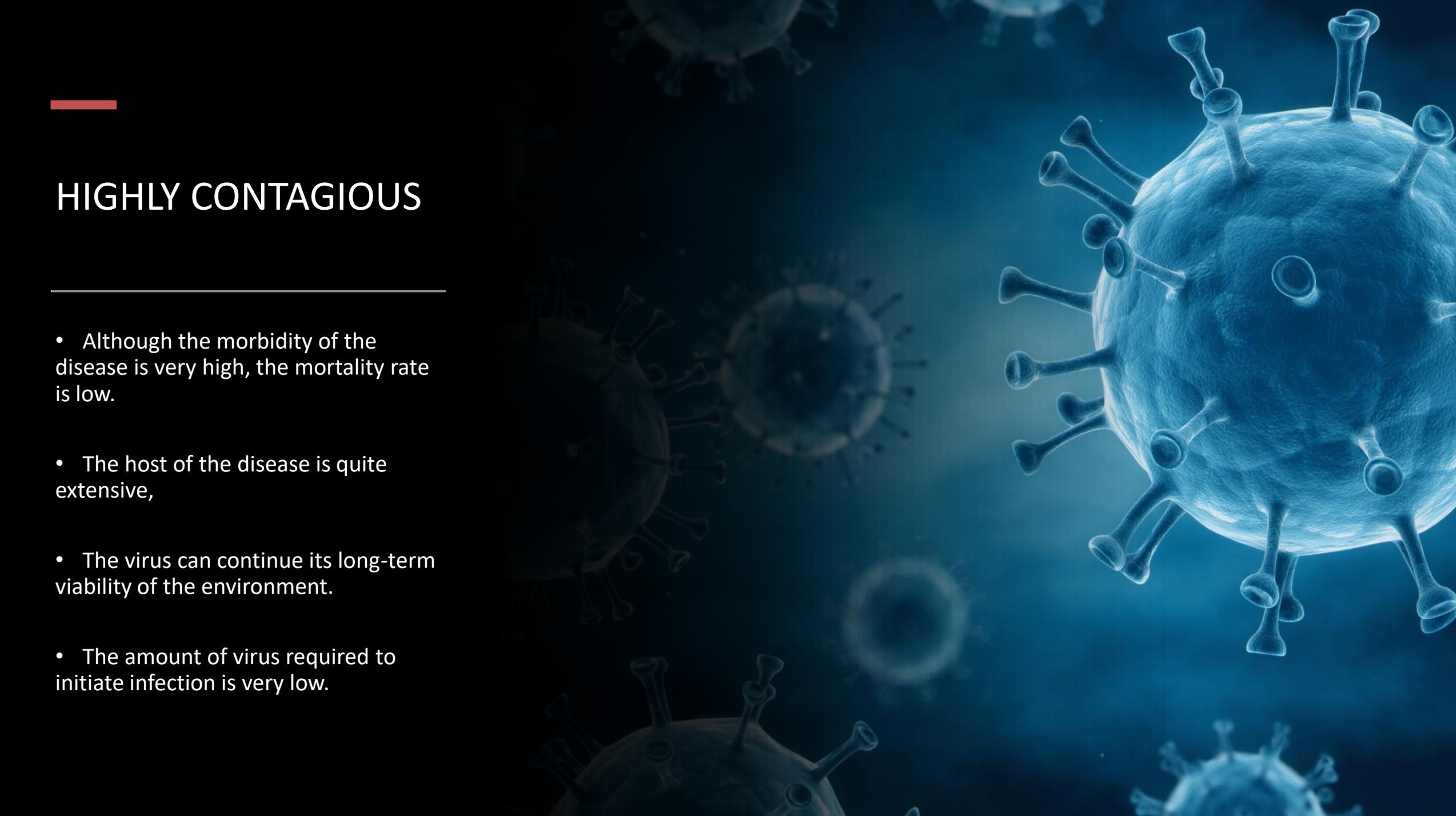
- There are many types and subtypes of the agent, the cross immunity between them is none or low.
 - Since the mutation rate of the virus is very high and therefore constantly developing new viruses with the continuous development of new viruses
 - The virus is spread all over the body with its secretions and excretions very long time
-



HIGHLY CONTAGIOUS

Virus shedding starts 4 days before lesions are seen and can continue until 15 days after the lesions are seen.





HIGHLY CONTAGIOUS

- Although the morbidity of the disease is very high, the mortality rate is low.
- The host of the disease is quite extensive,
- The virus can continue its long-term viability of the environment.
- The amount of virus required to initiate infection is very low.

Pathogenesis and Clinical Signs

• Incubation Period;

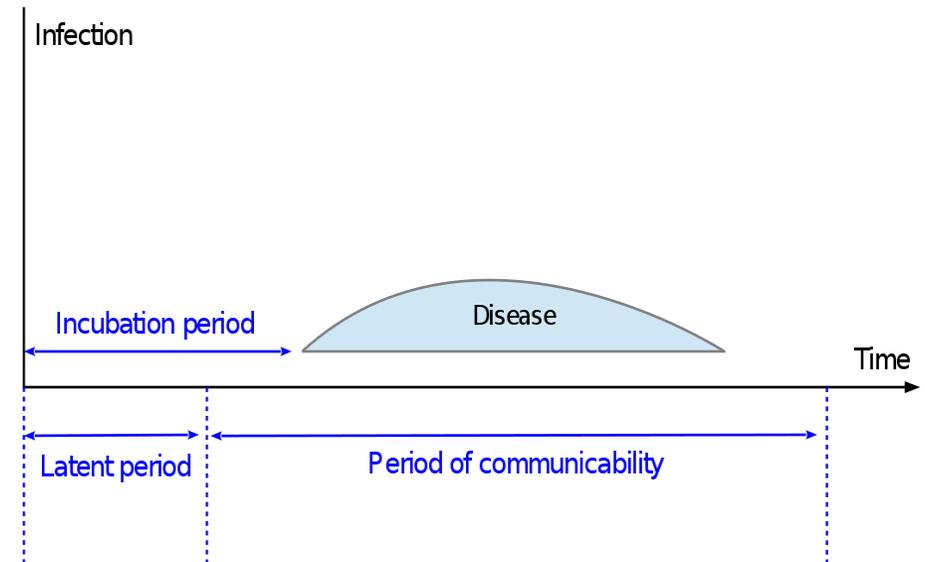
In cattle; 2-7 days

In the sheep; 1-6 days

• The entrance of the disease is the respiratory system.

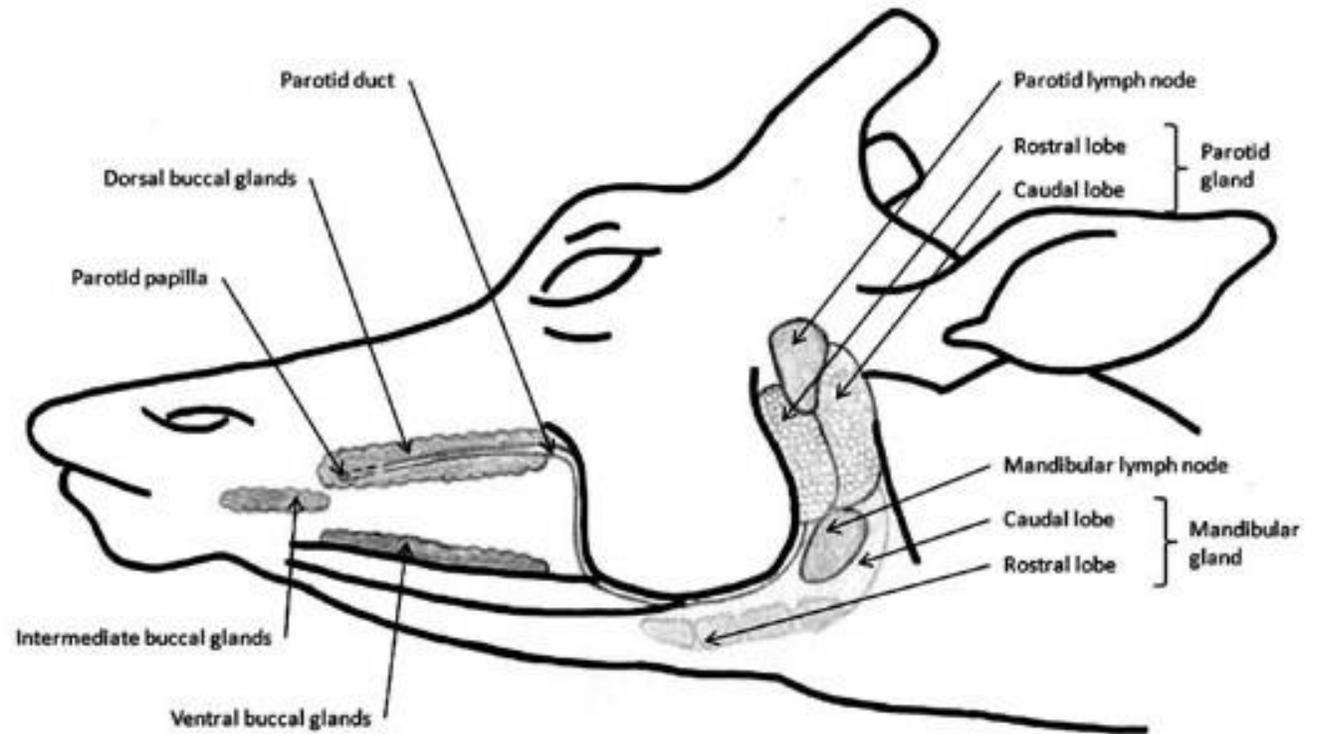
• The first symptom is high fever, it disappears with vesicle formation.

This Photo by Unknown Author is licensed under CC BY-SA

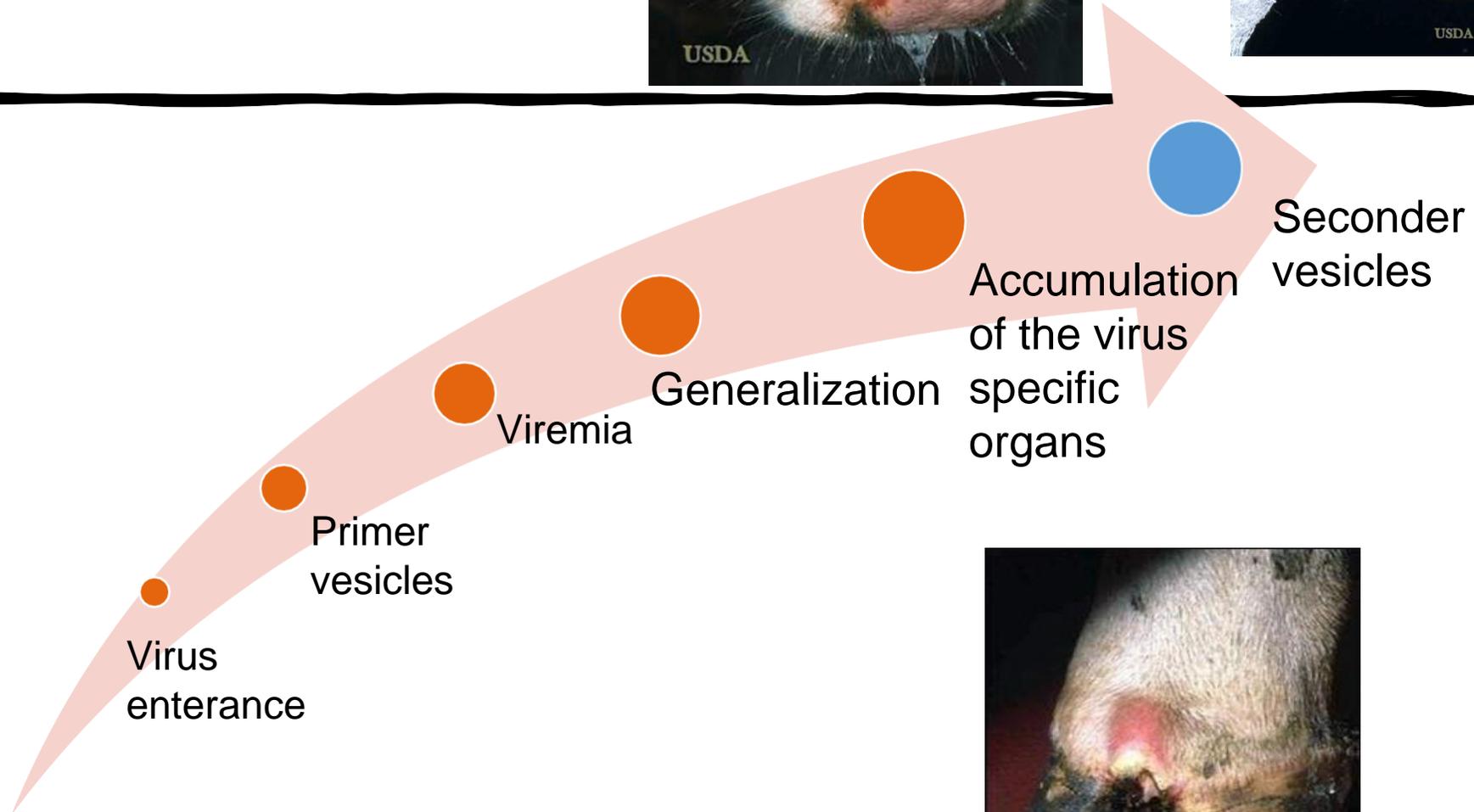


Pathogenesis and Clinical Signs

- Firstly, virus replicates in pharynx, then spreads through other tissues by viremia.
- It is a cyclic disease and spreads to the whole body via viremia and forms vesicles in organs.
- Where the virus enters the body, Primer vesicles occur then Seconder vesicles after Viremia.



SALIVARY GLANDS OF THE GIRAFFE – Superficial plane



Virus entrance

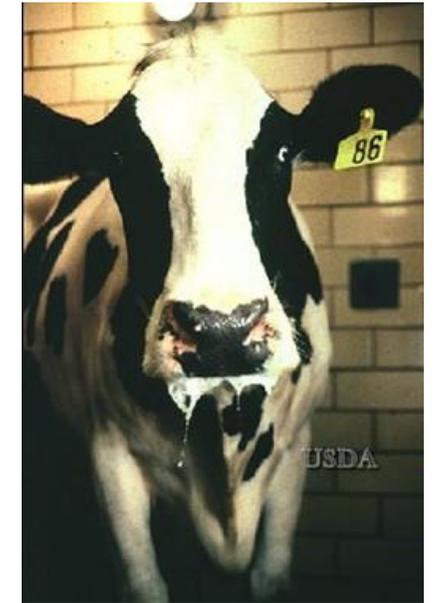
Primer vesicles

Viremia

Generalization

Accumulation of the virus specific organs

Secunder vesicles



Clinical Signs



- Vesicles appear inside the mouth and around the muzzle, in the interdigital cleft and around the coronary band and on the teats.



- These lesions cause excessive salivation, smacking of the lips, and anorexia, lameness and then secondary mastitis. Internally, lesions may be found in the oesophagus and fore-stomachs.



- Thus, FMDV is a very painful disease with a rapid loss of condition and milk yield but most adult animals survive.

Days of clinical disease

Day 1

Blanching of epithelium followed by formation of fluid-filled vesicle.

Day 2

Freshly ruptured vesicles characterised by raw, bright-red exposed dermis, a clear edge to the lesion and no deposition of fibrin.

Day 3

Lesions start to lose their sharp demarcation and bright-red colour. Deposition of fibrin starts to occur.

Day 4

Considerable fibrin deposition has occurred and regrowth of epithelium is evident at the periphery of the lesion.

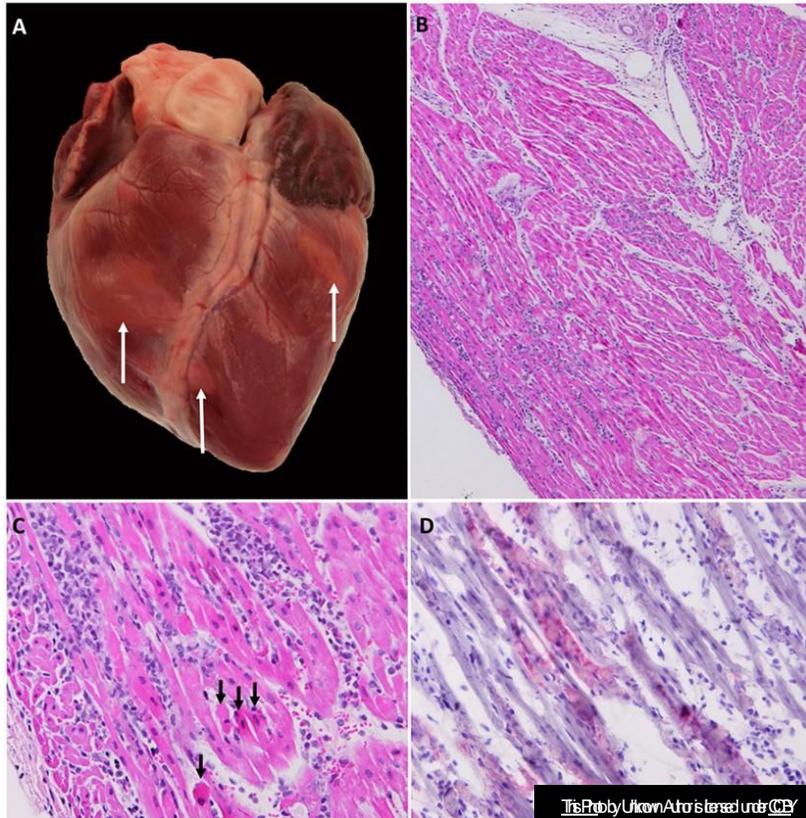
Day 7

Extensive scar tissue formation and healing has occurred. Some fibrin deposition is usually still present.

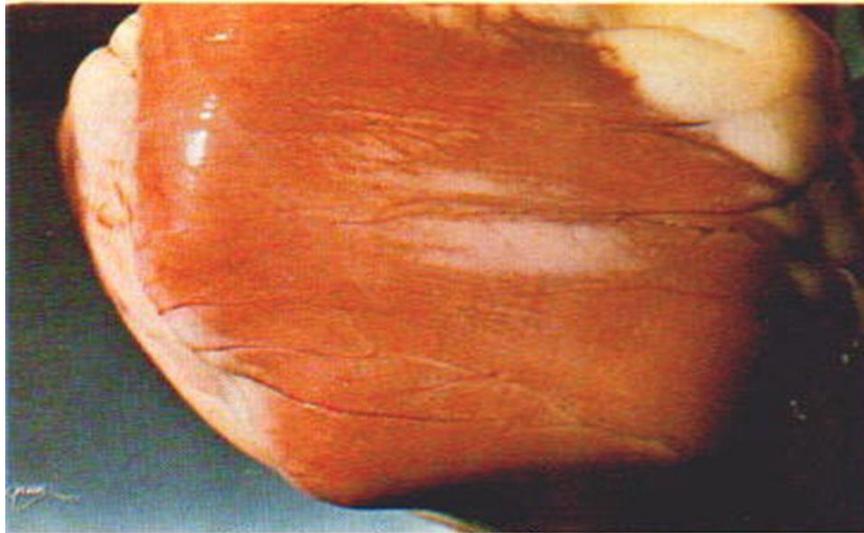
<http://www.fao.org/ag/againfo/programmes/en/empres/gemp/avis/A010-fmd/mod0/0213-ageinglesions.html>

Pathognomonic Findings

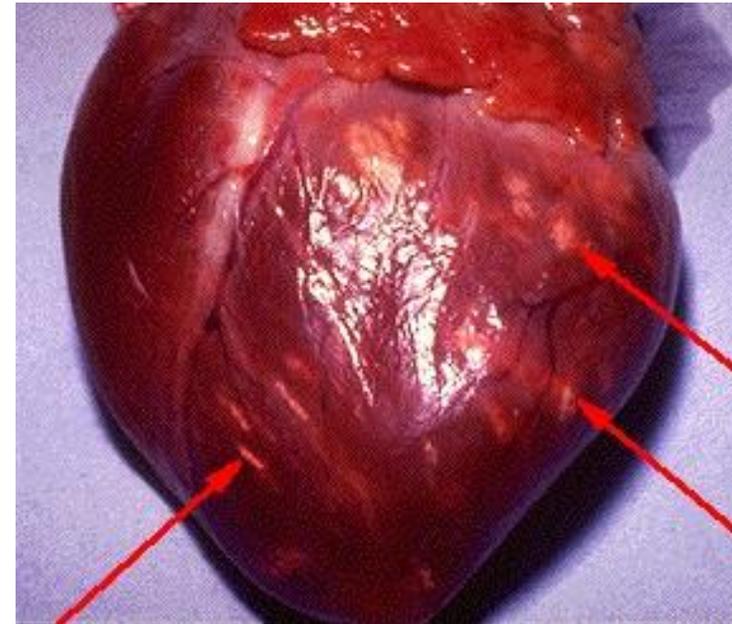
In the young, gray-yellow, gray-white stains form the Tiger's View in the Heart.



- Death from myocarditis occurs in calves, lambs and piglets without maternal antibody to FMDV.
-

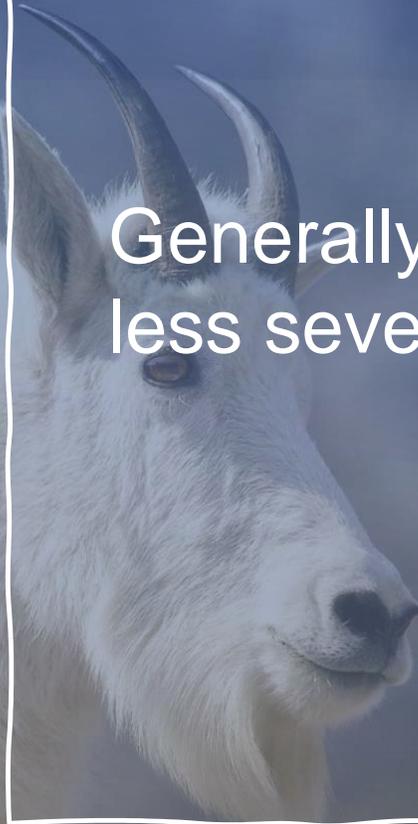


Foot and mouth disease
Tiger heart: pale necrotic myocardial bundles
on the wall of the heart



Pig: Focal myocarditis, 'tiger striping' on the heart of a 4-week old piglet which died due to FMD.

In goats,
mouth
lesions are
more
common
than cattle.



Generally, the disease is
less severe than cattle.

Immunology



Active and Passive Immunity occur.



Immunity is type-specific.



Due to the structure of Virus Complex, after infection;



Neutralizing, Precipitating, Complement Fixation Antibodies occur.

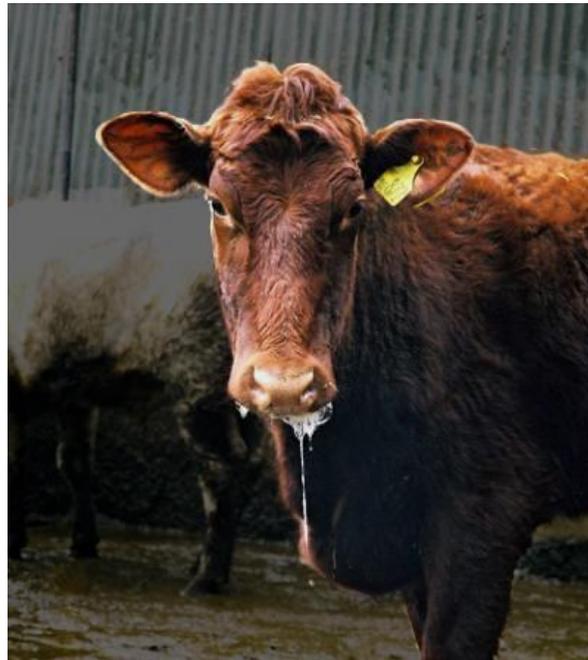
Immunology

Recovered animals produce antibody and resist reinfection by the same subtype of virus for up to one year or more. When immunity has waned, re-exposure to the original subtype can result in a local infection which results in virus excretion without clinical symptoms.

If re-exposure is to a second serotype or subtype there is little or no resistance to clinical disease.

Diagnosis

Clinical Symptoms and Epizootologic condition helps diagnose.



Diagnosis

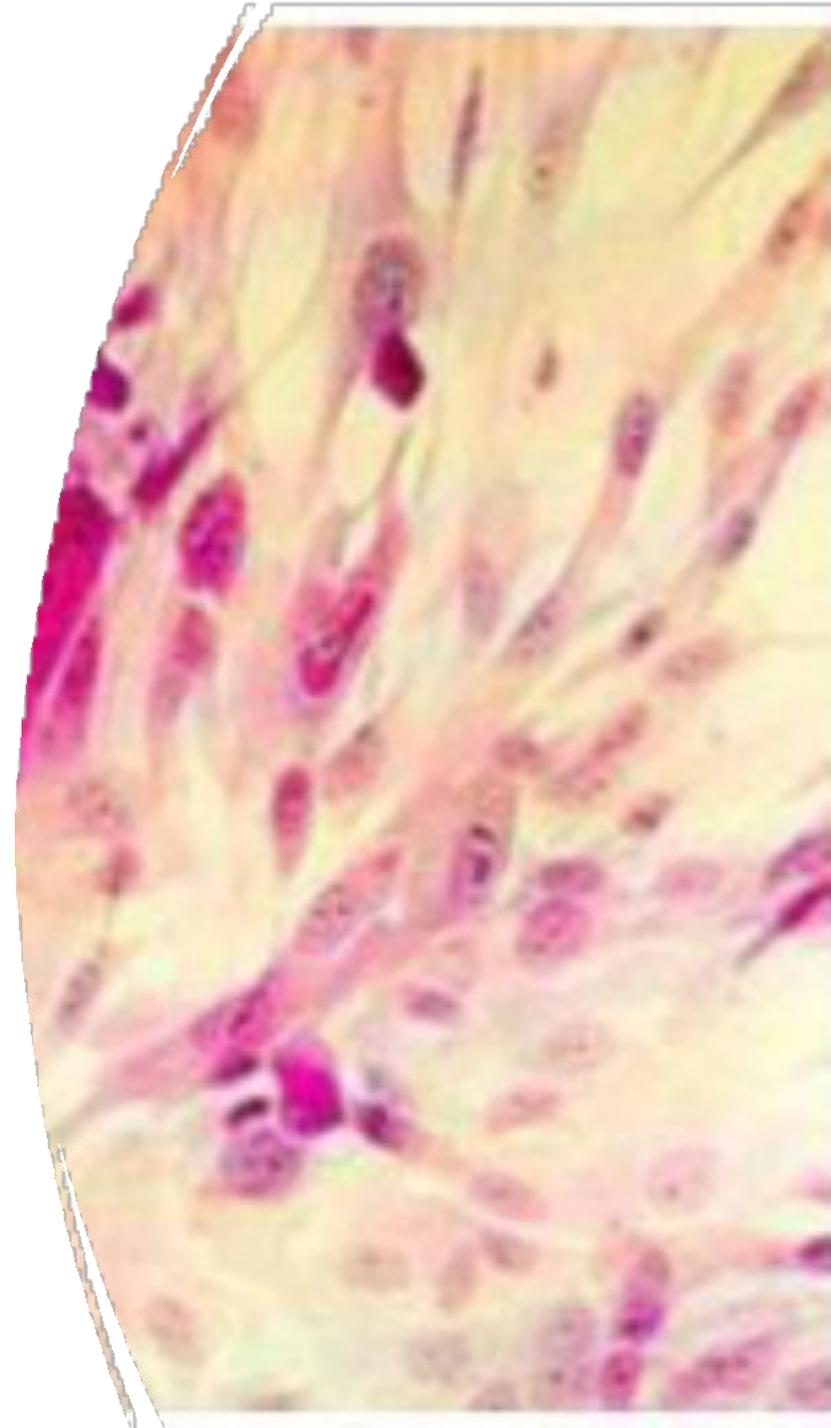
The best materials for diagnosis are vesicle fluid and 1 square inch of epithelium preferably from unruptured lesions. Scrapings from ruptured vesicles are also useful

Virus survives best at pH of 7.2-7.8 and so 50% glycerol with 50% PBS pH7.6 is the traditional transport medium.

Diagnosis

-Virus Isolation; fresh vesicles and saliva are inoculated to cell culture:

- vesicle fluid is inoculated into kidney cell cultures and suckling mice which detects less virus.
- PCR



Diagnosis

Complement Fixation (CFT)

- AGPT
 - Characterization of types
- ELISA and CFT
- ELISA, are serotype specific, ie all 7 serotypes must be tested for with 8 different antisera.



Differential Diagnosis

	Foot & Mouth Disease	Vesicular Stomatitis	Swine Vesicular Disease	Vesicular Exanthema of Swine
Clinical Signs by Species	All vesicular diseases produce a fever with vesicles that progress to erosions in the mouth, nares, muzzle, teats, and feet			
Cattle	Oral & hoof lesions, salivation, drooling, lameness, abortions, death in young animals, "panthers"; Disease Indicators	Vesicles in oral cavity, mammary glands, coronary bands, interdigital space	Not affected	Not affected
Pigs	Severe hoof lesions, hoof sloughing, snout vesicles, less severe oral lesions; Amplifying Hosts	Same as cattle	Severe signs in animals housed on concrete; lameness, salivation, neurological signs, younger more severe	Deeper lesions with granulation tissue formation on the feet
Sheep & Goats	Mild signs if any; Maintenance Hosts	Rarely show signs	Not affected	Not affected
Horses, Donkeys, Mules	Not affected	Most severe with oral and coronary band vesicles, drooling, rub mouths on objects, lameness	Not affected	Not affected

Differential Diagnosis

a- Mucosal Disease; no vesicle

b- Rinderpest; no vesicle. High fever, Bloody diarrhea, sparkling saliva

c- Coriza G. Bovum; Transmission is local. Conjunktivitis, CNS

d- IBR-IPV; No vesicle

Differential Diagnosis

- a- Stomatitis papullosa; No vesicle.
- b- Pseudocowpox; Pustules are typical.
- c- Vaccinia; pox pustules.
- d- Mamillitis; nipple vesicles

Prevention and Control

Slaughtering
and Destruction
Quarantine and
Vaccination
Systemic
Vaccination



Prevention and Control

The most effective method is quarantine, disinfection and vaccination.

- In **endemic areas** annual vaccination using the local subtypes is essential to prevent transmission.
- In such endemic areas disease cannot be prevented by slaughter because of the large number of migrant carrier stock, particularly sheep, eg in S.America, and recovered animals eg in India/Jordan.
- **Thrace is FMD FREE ZONE!**



Prevention and Control

WHEN DIAGNOSIS OF FMD
PRECAUTIONS TO BE SUBMITTED:
Quarantine about 10 km of the
outbreak

- +
-
-

Vaccination with quarantine measures for the control of FMD in Turkey has been implemented since 1962.



VACCINES

- **1-Waltman - Köbe Vaccine**; Virus is given to the cattle tongue as a cuticle, and the resulting lesions are collected and used as vaccine material.
- **2-Frenkel Vaccine**; Healthy cattle tongue are collected and thin layers of epithelial cells are removed. Here the vaccine is prepared by producing virus.
- **3-Tissue Culture Vaccine**; Monolayer or Suspension Prepared in BHK-21 Cell Cultures.



Serotype Specific INACTIVE VACCINES

Monitor disease outbreaks

- Stock active serotypes and strains
- Essential to isolate virus and identify the serotype to select correct vaccine

Vaccine could be prepared as Monovalent, Bivalent and Trivalent.

Vaccine is applied to dewlap, twice or triple a year.

The duration of the immunization that occurs after inoculation with inactivated vaccines is about 6 months.

It depends on the adjuvant type, the potency of the vaccine and the animal species.

FMD in Humans



PEOPLE ARE LESS SENSITIVE TO INFECTION.



- THE DISEASE TRANSMITS BY DIRECT CONTACT WITH ANIMALS AND LABORATORY INFECTIONS



- INDIRECTLY, THE TRANSMISSION OF INFECTION WITH MILK.



- THE INCUBATION PERIOD IS 2-6 DAYS.



- FEVER, FATIGUE, DIARRHEA, HEADACHE, ARMS AND LEGS, VESICLE AND EROSIONS IN



THE MOUTH REGION.



- THE PROGNOSIS IS GOOD. HEALING IN 5-10 DAYS.



CDC Public Health Image Library

Major losses caused by foot- and-mouth disease

-
- Losses in milk and meat yields
 - Abortions in pregnant animals
 - Very high mortality, especially in young animals
 - Economic losses due to restrictions on external trade.

Challenging factors

There is no cross-immunity between the 7 serotypes and subtypes of the virus.

- Immune alteration between multiple antigenic variants.
- Vaccination should be applied at least twice a year.
- Immunization after vaccination is short term.
- Viruses that exotic for Turkey exist in eastern and southeastern neighbors.

Disinfections

- To prevent the spread of infection by providing effective decontamination of businesses, people, equipment and vehicles, to prevent recurrence of the infection following the introduction of the animal again.

Disinfectants known for efficacy against FMD virus

Sodium hypochlorite 3% (Bleach)

Acetic acid (Vinegar) 4-5%

- For disinfection of buildings not suitable
-

Potassium peroxymonosulphate and

Sodium Chloride

- 1-2% use accordance with the operating instructions
-

Sodium Carbonate 4%

- Light burner.
-

Sodium Hydroxide 2% It is very burning.

- Use protective clothing, gloves and goggles.
 - it is quite burning for general use.
-



References

-
- http://www.cfsph.iastate.edu/Factsheets/pdfs/foot_and_mouth_disease.pdf