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FOOT AND MOUTH DISEASE

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Foot and mouth disease (FMD) is, in many countries, the disease farmers fear most of all. Its consequences to a farm can be devastating. It is a highly infectious and contagious disease that can spread very fast from farm to farm. The obvious signs of the disease one can guess from the name of the disease: lameness (Foot) and not eating with a lot of saliva discharging from the mouth (Mouth). A dairy farm producing milk can become bankrupt overnight with this disease. Milk production drops to less than half, cows don't eat, some die, the value of the remaining cows drops greatly and the cost of restoring the farm is very high. Similarly, pig units can become farms that simply lose money. For these reasons including the need to safeguard the food supply many governments are willing to spend billions trying to control the disease.

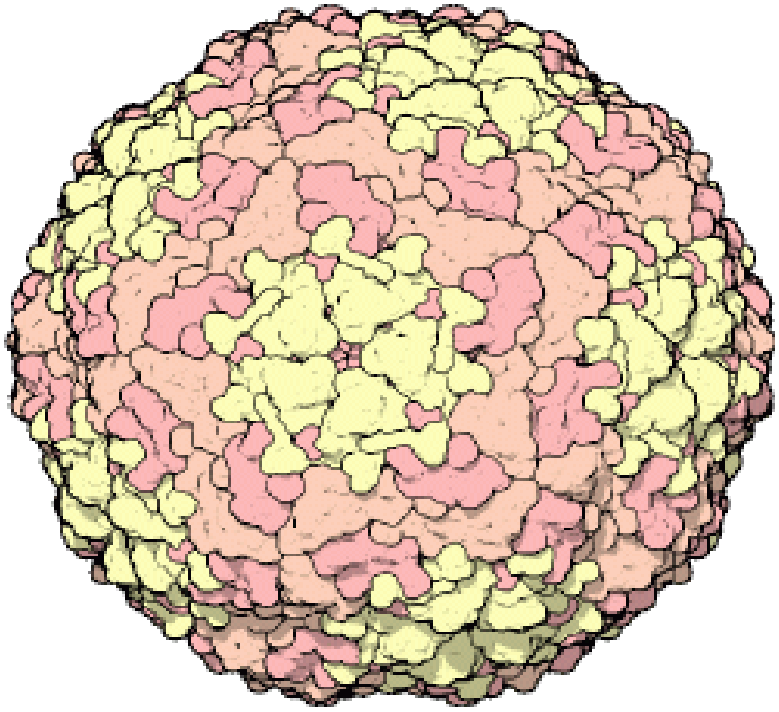


Illustration of FMD Virus provided by Wikipedia.org

Yet while there are many simple and direct truths about FMD. It is also a paradoxical disease. A paradox is 'a statement that seems to say the opposite to common sense or the truth, but which may contain a truth' *(Oxford Dictionary)*. So for example it is a very serious disease. But it is not always fatal. In fact most animals recover. Most of the serious animal diseases such as rabies, anthrax and African swine fever kill nearly every animal they infect. FMD doesn't. Another paradox is that FMD spreads very much like flu by direct contact and in small pieces of material. Yet it also can move by methods not commonly found in many diseases. It can move on the wind for over 100 miles in certain cold cloudy weather conditions. It can also move from country to country in the bone marrow of frozen meat that has not been deboned. A final paradox is that some governments are willing to spend billions to control the disease and eradicate (completely remove) it. While other governments equally reasonable approach is to put in biosecurity controls and vaccinate their animals to reduce the losses: they do not try to eradicate the disease.

This article is aimed to inform you of the main facts of FMD, some of its paradoxes and the recent history of the disease in the world.

I. Quick Facts

What is Foot and Mouth Disease (FMD)?

Foot and Mouth Disease (FMD) is one of the most important animal diseases in the world. FMD virus is a member of the Aphthovirus genus(口瘡病毒屬). Animals with FMD have fever and blisters (水泡) in the mouth and on the nose, teats and feet. Affected animals have difficulty in eating and moving but usually recover. Severe losses in meat and milk production occur as a result of this disease. Outbreaks of FMD can result in huge losses in the livestock industry particularly in FMD free countries.

What animals are susceptible to FMD?

Cattle, swine, goats, sheep, deer, other cloven-hoofed (偶蹄類) animals. Wild even toed ungulates such as rats, and hedgehogs (刺蝟) are also susceptible to FMD. Horses, dogs, and cats are not susceptible but could spread the virus by carrying it on their hair.

How are animals exposed to the FMD virus?

The FMD virus is easily spread to animals and nearly 100% of exposed animals become infected. The virus can spread from infected animals, contaminated animal feed or water, contaminated shoes or clothing, and contaminated vehicles or farm equipment. In some circumstances, the virus is able to spread from farm to farm by the wind.

Where does FMD occur?

The disease is widespread around the world but North America, Central America, Australia, New Zealand, Chile, and some European nations are considered free of FMD.

Is there only one type of FMD or are there variations?

No, there are seven FMD serotypes: O, A, C, SAT-1, SAT-2, SAT-3, and Asia-1. These serotypes tend to be found in different regions, and the O serotype is most common.

What is done to prevent the introduction of FMD?

Countries free of FMD ban the importation of certain animals and meat products and apply restrictions on the types of food products travelers can bring in. Travelers arriving in these countries are often questioned about travel to farms or contact with livestock.

Does FMD cause illness in humans?

Only very few human cases of FMD have ever been documented. All of these persons had direct contact with infected animals. The cases experienced a mild illness with headache, fever and possibly blisters appearing on the hands or feet, or in the mouth. The virus is not spread person-to-person or via food to humans.

Is it safe to eat meat or meat products?

There have never been reported human cases of FMD linked to eating contaminated foods. Adequate cooking of meat or other animal product will destroy many infectious agents, including the FMD virus.

Is FMD the same condition as Hand, Foot and Mouth disease that occurs in humans?

No. Hand, Foot and Mouth disease in humans is an illness caused by a different virus (Enterovirus(腸病毒)). It occurs most commonly in children under 10 years old. Hand, Foot and Mouth disease is spread person-to-person by direct contact of nose and throat discharge and in the feces of infected persons.

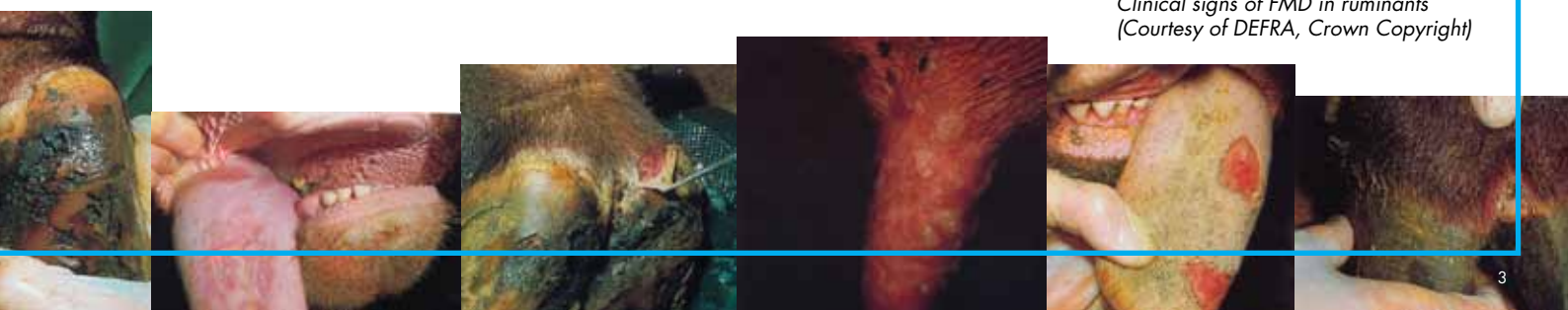
What losses can a farm experience due to this disease?

This is one of FMD's paradoxes. On a farm with animals of a very high pedigree, this disease can be disastrous. That is a farm possessing efficient high quality animals with very good genes. Also many countries free of FMD do not allow their farmers to vaccinate their animals since vaccinated animals could hide the disease making it difficult to spot. However, FMD is an even more serious disease if the animals are not vaccinated. A dairy farm could have its milk production halved overnight. The sale of milk day by day is the main source of cash for the dairy. So immediately, it has lost half its income. Also often as much as 20% of the capital value of the farm consists of the animals. Once they have contracted the disease, their value goes down. They will never be so productive as the disease has permanently damaged them. So overnight the farm can lose about 10 % or more of its total capital value as well as the reduced cash flow. Many more losses will occur in the months following due to secondary disease coming after the FMD. In the recent Japanese outbreak, the individual value of some prize animals killed was extremely high. This is one reason why many governments use slaughter to control the disease. The farm unit is no longer financially viable and it is a source of infection for other farms. It is better literally to cut one's losses.

On the other hand in some other countries, the situation on the farm is different. If the farm is already vaccinating its animals, the farm's animals have average genes and the disease is often seen. Then the losses, while significant, are usually not so large as to bankrupt the farmer. On a vaccinated dairy, for instance, the drop in milk production may well not be as much as 50%, it could in some circumstances be only 10%. In these cases, the government will usually use control measures other than slaughter.

Why is FMD an important disease?

FMD is a disease of national and international importance, particularly in countries free of FMD, because it is highly infectious, spreads rapidly through out animal populations and over long distances on the wind and is difficult and costly to control. The production losses on affected farms are very significant. Large disease outbreaks of FMD in countries free of FMD have resulted in control measures which included the slaughter of millions of animals. This is despite it being a frequently non-fatal disease. Due to international efforts to eradicate (根絶) the disease, infection leads to trade bans on the export of susceptible animals and their products being imposed on affected countries. Large sums of money have been invested in control and eradication programmes and also into research. The FMD virus is one of the most studied viruses in the world.



Clinical signs of FMD in ruminants
(Courtesy of DEFRA, Crown Copyright)

II. History

FMD has been around for many centuries and has been recognized as a significant epidemic disease. In the late nineteenth century it was shown to be caused by an extremely small agent, smaller than any known bacteria. The agent causing FMD was thus the first virus of vertebrates (脊椎動物) to be discovered.

Recent Noteworthy Epidemics

The Taiwan 1997 Epidemic Cost US$6.9 Billion To Control

Taiwan had previous epidemics of FMD in 1913-14 and 1924-29 but since had no major problems and considered itself free of FMD as late as in the 1990s. However in March 1997, a sow at a farm in Hsinchu prefecture, Taiwan was diagnosed with a strain of FMD . Mortality was extremely high in the infected herd. The cause of the epidemic was not determined, but the farm was near a port known for its pig-smuggling and illegal slaughterhouses. The disease spread rapidly among pig herds in Taiwan, with 200-300 new farms being infected daily. Slaughtering and removing all the pigs from each farm with the disease was a massive undertaking. The military contributed substantial manpower. At peak capacity, 200,000 pigs per day were disposed of, mainly by electrocution (電擊致死). Carcasses were disposed of by burning and burial. But burning was avoided in water resource protection areas. In April, industrial incinerators (焚化爐) were running around the clock to dispose of the carcasses. Taiwan had previously been the major exporter of pork to Japan and among the top 15 pork producers in the world in 1996.

During the outbreak, over 3.8 million swine was destroyed at a cost of US$6.9 billion. The Taiwanese pig industry was badly damaged and as a result its pig export market was completely ruined.

The United Kingdom 2001 Epidemic Cost US$16 Billion To Control

The epidemic of foot-and-mouth disease in the United Kingdom in the spring and summer of 2001 was caused by the "Type O Pan Asia" strain of the disease. This event saw more than 2,000 cases of the disease in farms throughout the British countryside. Around 7,000,000 sheep and cattle were killed in an eventually successful attempt to halt the disease. With the intention of controlling the spread of the disease, public rights of way across land were closed by order. This damaged the popularity of many tourist destinations. What made this outbreak so serious was the amount of time between infection being present at the first farm, and the time when countermeasures were put into operation against the disease, such as transport bans and detergent washing of both vehicles and personnel entering livestock areas. The epidemic was probably caused by infected pigs which had been fed swill that had not been properly heat-sterilized. It is further believed that the swill contained remains of infected meat which had been illegally imported to Britain.

By the time the disease was halted by October 2001, the crisis was estimated to have cost Britain £8 billion (US$16 billion) in costs to the agricultural and agricultural support industries and to the outdoor tourist industry.

United Kingdom 2007

An infection of FMD in the United Kingdom was confirmed on 3 August 2007, on farmland located in Surrey. All livestock in the vicinity were culled on 4 August. A nationwide ban on the movement of cattle and pigs was imposed, with a 3 km (1.9 mile) protection zone placed around the outbreak sites and the nearby virus research and vaccine production establishments, together with a 10 km (6.2 mile) increased surveillance zone. On 4 August, the strain of the virus was identified as an "O1 BFS67-like" virus, one linked to vaccines and not normally found in animals, and isolated in the 1967 outbreak. The same strain was used at the nearby Institute for Animal Health and

Notice telling people to keep off the North York Photography by Ben Gamble

Merial Animal Health Ltd at Pirbright, 2½ miles (4 km) away which is an American and French owned research facility, and was identified as a possible (and probable) source of infection.

Korea 2010

Korea has already suffered two outbreaks in the year 2010.

The first outbreak occurred in January in Pocheon, officials were quoted to have said that the source of the infection was FMD virus contaminated clothing sent to an immigrant farm worker from his home in a Northeast Asian country. The Korean National Veterinary Research and Quarantine Service in an official statement stated that the type A FMD virus causing the infection was found to be 97.64 percent identical with the ones causing FMD outbreaks in other Northeast Asian areas. The

The field in which the infected cattle were grazing immediately before testing positive for FMD. Photography by Kvetina-Marie

Moors

disease was then spread to 5 other farms in the area by people moving from the infected farms to these farms. It is even possible that subsequently more spread could have occurred due to farmers already contaminated with FMD virus gathering with other farmers for emergency meetings to discuss the outbreaks. The government officially declared the outbreak was over in March after slaughtering approximately 6000 animals at 55 farms in the Pocheon area with a financial cost of 42.5 billion won (US$36.8 million).

A second outbreak was reported in April in Gangwha Island area. The likely cause of this outbreak was due to the owner of the farm who had travelled abroad in March. He was probably contaminated on his journeying. He returned to

One of the many foot paths closed in an attempt to stop the spread of the disease.
Photography by Mark Boyce

his farm without following proper sanitization procedure. The virus strain that caused this outbreak was 99.06 percent identical with the type O FMD virus involved in recent outbreaks in Asia. The disease then spread to Gimpo, Chungju and Cheongyang probably through the transport of animal feed and insemination technicians and local farmers' meetings. The outbreak was still ongoing in late May and may yet to prove more costly than the first outbreak.

Japan 2010

In April 2010, FMD broke out in Japan. The country had been free for nearly 10 years without vaccinating animals. The disease outbreak is very significant and costly.

One of the early reports sent to OIE was as follows:

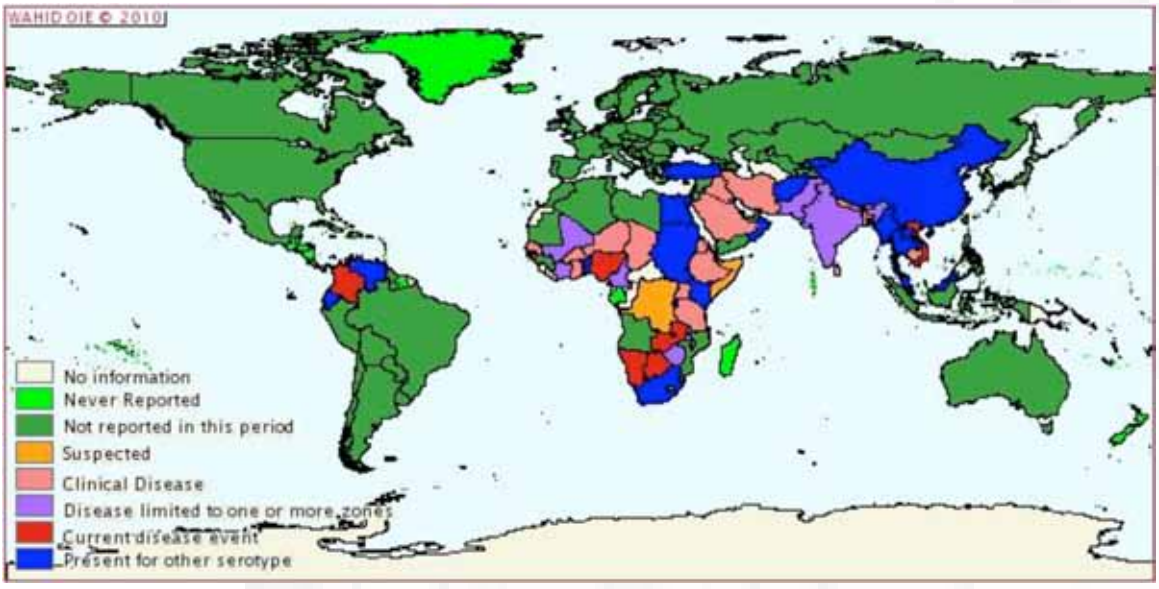
"A private veterinarian first found a suspicious case in the affected farm and reported it to the local government's veterinary service on 9 April 2010. An official veterinarian observed that a cow had fever, anorexia, salivation and erosions in the oral cavity on the same day but the others had no clinical signs. Since two other suspicious cases were found in the same farm

on 16 April, the veterinary service examined similar diseases such as bluetongue, bovine viral diarrhoea-mucosal disease (BVD-MD), infectious bovine rhinotracheitis and Ibaraki disease but they showed negative results by PCR tests on 19 April 2010. The veterinary service submitted the samples to the National Institute for Animal Health (NIAH) on the same day. The NIAH affirmed the cattle were infected with FMD virus by PCR test on 20 April 2010. The samples are being examined by virus isolation."

It is easy to be wise after the event but that 10 day delay in diagnosis is highly significant in the context of FMD. The virus had a 10 day lead on the controlling authorities. The subsequent and continuing devastating effect of this FMD type O on the Japanese cattle industry also highlights the difficulties of controlling one of the most infectious and contagious viruses on the planet.

In one prefecture alone (Miyazaki Prefecture) the costs of supporting farmers after slaughtering their affected animals will be at least US$89 million. On 28th May, the OIE summary for the outbreak stated that in Japan, there had been 218 outbreaks, involving a total of 149,608 animals including 22,179 cattle, 127,372 pigs, 7 goats and 8 sheep. There are several additional suspected cases. In such a bad situation, Japan decided to vaccinate certain groups of their susceptible animals. While this will definitely help in halting the disease, it will mean that the time taken for Japan to once again regain the best quality of FMD freedom (freedom without vaccination) will now be lengthened considerably.

III. Where In The World Does FMD Occur?



FMD worldwide distribution source from OIE

IV. Symptoms in Pigs

The incubation period, the interval between exposure to infection and the appearance of symptoms, varies between twenty-four hours and 10-15 days. The average incubation period is 3-6 days. The disease is usually mild in vaccinated pigs. It is however more serious in pigs that have not met the disease before or have not been vaccinated. It is usually more obvious in animals over 3 months of age. Infection rate or morbidity (發病率) is usually 100%. The mortality rate is usually low (2-5%) but may be higher in young piglets due to inflammation of the heart.


painfully lameness and hobbling


preference to lie down


foot blisters on the top of the hooves


nose blisters


foot blisters ruptured on the top of the hooves


nose blisters ruptured

Pigs usually recover within 2-4 weeks of infection.

Affected pigs show sudden lameness particularly pigs kept on concrete floors. They prefer to lie down and when made to move, affected pigs squeal loudly and hobble painfully. Boars may go lame and stop serving sows. Blisters form on the upper edge of the hoof, where the skin and horn meet, and on the heels and in the skin between the hooves. Blisters may extend right round the top of the hoof with the result that the horn becomes separated. Blisters may develop on the nose, the tongue or the sow's teats. Affected pigs may salivate a lot and drool because of mouth blisters and ulcers. Affected pigs may eat less. Some pigs appear depressed and have fevers of about 40.5°C, (105°F). Sows may abort, as a result of fever. In severe outbreaks, some adult pigs may die. In piglets, sudden death may occur due to cardiac failure.

FMD is essentially a disease of pigs in Hong Kong.

V. FMD in Hong Kong

FMD is a notifiable disease

FMD is an OIE notifiable disease and AFCD is obliged to report the disease to OIE, the World Organization for Animal Health. AFCD is also obliged to send FMD samples to the World Reference Laboratory for strain typing and vaccine matching.

FMD Vaccination

FMD is largely a winter disease and for this reason, vaccination is advised. It is given to all breeders and stock over 12 weeks of age and then again every 4 months thereafter. Serotype O FMD virus is endemic in HK and vaccination is carried out routinely with a killed serotype O FMD virus. Protection is short-lived, lasting only about 4-6 months and vaccination breakdowns often occur if the disease virus challenge is very high or if disease virus strain is dissimilar to the strain used in the vaccine. There are many different strains within serotype O and careful selection of the correct strain for incorporation into the vaccine is essential to ensure the effectiveness of the vaccine.

FMD Biosecurity

Farmers are advised to keep pig, people and vehicle movements to an absolute minimum. This advice includes: to limit the movement of people between buildings as much as possible; to place foot dips at all entrances, service and feed delivery points; to only allow cleaned and disinfected vehicles to visit the farm; to only allow essential visitors; to limit contact with other peoples, livestock, other keepers of livestock or with people who have had dealings with livestock such as abattoir workers, pig catchers, veterinarians or other farm inspectors; to ensure clean boots and clothing is worn on entrance; to ensure that hands are cleaned and disinfected on entrance; and to control dogs, cats, rats and other small animals that may spread the disease.

FMD Disinfection

Advice is also given whereby cleaning (preferably with a detergent) should precede disinfection. Farmers are informed that pieces of mud, dirt or organic matter including faecal material will reduce the effectiveness of any disinfectant used; and that FMD virus is very sensitive to pH change, thus making acids and most alkalis as good FMD disinfectants; and that disinfectant should be kept fresh, and made up to the correct concentration.

FMD Disinfectants

These include: Citric Acid 0.2% solution; Formalin 10.0% solution (containing no less than 34% formaldehyde); 5.25% Sodium Hypochlorite (NaOCl) (household bleach) diluted to a 3% solution; Acetic Acid 4-5% solution (vinegar is a 4% solution of acetic acid); Potassium Peroxymonosulfate and Sodium Chloride (Virkon-S) 1% solution; Sodium Carbonate (soda ash) 4% solution; Sodium Hydroxide (NaOH) (lye) 2% solution. Hypochlorites, Iodophors, Phenols and Quaternary Ammonium Compounds amongst others may be useful but may not be very effective.

References:

There are four main sources for information for this article. They are: the Department's records, ProMED-mail.org, Wikipedia.org and the OIE. *Their assistance is gratefully acknowledged.*

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