UKBA Foot and Mouth FAQ.

Sarah Wroot

Table of Contents

1. Introduction.

1.1 Disclaimer.

This document is provided as is without any express or implied warranties. While every effort has been taken to ensure the accuracy of the information contained in this article, the author/maintainer/contributors assume no responsibility for errors or omissions, or for damages resulting from the use of the information contained herein.

Hypertext links from this document are provided for convenience only. Links are provided to World Wide Web locations only. The material kept at any World Wide Web location to which this document provides a link is the responsibility of the operator of the server on which it is held. In particular, the provision in this document of a link to another World Wide Web location does not constitute any authorisation by the author of this document to the user to access material held at that location, nor is it evidence of any endorsement by the author of this document of the material held there.

1.2 The Story Behind this FAQ.

On the 4th May 2001 in a Farmers Weekly article entitled "Internet to be election battleground?" Isabel Davies wrote

> "Discussion groups such as uk.business.agriculture have also proved a lifeline for farmers hungry for information about the disease.
>
> This newsgroup was first to report the disease. Farmers who have used it have stayed ahead of events by sharing information with producers across the country."

In the initial days of the epidemic, a dearth of hard background information about the disease soon became apparent. A consequence of this was a number of newsgroup contributors independently researching resources worldwide and reporting the results on the newsgroup. This in turn fostered a considerable volume of informed and detailed discussion. Scientific papers were analysed and compared. A number of experts were contacted and their opinions on particular aspects of the disease, preventative and eradication methodologies were solicited.

As the weeks passed the body of informed opinion within the newsgroup improved both qualitatively and quantitatively. More often than not, particular aspects were analysed and tentative conclusions reached well in advance of either Media focus on those aspects or official decisions associated with those aspects. Neither Media or official positions always reflected the informed conclusions arrived at earlier in the newsgroup.

Although much of the newsgroup discussions are accessible via various newsgroup article archive resources, the volume of discussions spread over many weeks may deter all but seasoned researcher. This FAQ is an attempt to bring together in one document the substance of those discussions. ***This FAQ concentrates on animals/facts important in the UK FMD 2001 epidemic.***

1.3 Reference Information about the FAQ itself.

Last−Updated : 19 June 2001

Posting−Frequency : TBA

Newsgroups : uk.business.agriculture

Version : 2.01.00

Master Document Author/Compiler :

Sarah Wroot <mailto:swroot@farm−direct.co.uk>

Web Edition Presentation :

Chris Salter <mailto:fmdfaqmaint@originalthinktank.org.uk>

Primary Site.

Web Edition : <URL:http://www.farm−direct.co.uk/faq/fmd/v2/index.html>

PDF Edition : <URL:http://www.farm−direct.co.uk/faq/fmd/v2/ubafmd.pdf>

Maintenance Site.

Web Edition : <URL:http://www.originalthinktank.org.uk/fmd/ubafmdfaq.html>

PDF Edition : <URL:http://www.originalthinktank.org.uk/fmd/ubafmdfaq.pdf>

Text editions will soon be available via anonymus FTP and automated email response.

2. The FAQ.

2.1 What is Foot and Mouth Disease?

FMD is a highly contagious disease of cloven−hoofed animals such as sheep, goats, pigs, cattle and deer. Rarely, other animals including humans can catch FMD. (See 'Can other animals catch FMD?' for more information about this.)

The cattle plague described by Aristotle in 350BC might have been FMD or rinderpest, but the first detailed description is from Venice in 1546 by the Italian physician Fracastorius. FMD was first recorded in Britain in 1839. It's caused by a virus (of the family Picornaviridae, genus *Apthovirus*) with seven different strains or serotypes: A, O, C, SAT1, SAT2, SAT3 and Asia1. FMD virus is very adaptable and very variable; each of these seven serotypes has evolved sub−types that may be more or less infective, or affect different species in different ways, and may require slightly different vaccines.

The current outbreak (began early spring of 2001) in Britain is caused by the Pan−Asian type O strain. This strain first appeared in India in 1990 and is now the most widely distributed of the seven. It is endemic in many South American, African and Asian countries. It has several sub−types each of which is associated with a particular areas and species; for example, the strain prevalent in the Middle East affects primarily sheep and cattle (perhaps because there are few pigs in the area), whereas the Far East type O is responsible for major outbreaks in pigs. Nucleotide sequencing can distinguish between sub−types causing outbreaks in areas with both cattle and pigs such as Vietnam.

2.1.1 How do animals catch FMD?

- The most frequent mode of transmission is by inhalation of virus particles. FMD is very infectious: as few as 1−10 virus particles can produce the disease.
- Infections are also transmitted by direct contact with fluids from blisters and open wounds containing the virus. Laboratory workers on FMD often infect subjects by injecting the virus into the skin (intradermal) or into the body cavity (intraperitoneal).
- Animals may catch FMD by eating contaminated feed (a higher dose is required); drinking contaminated water or milk (a higher dose is required unless the animal actually inhales liquid and virus particles while drinking), or through exposure to contaminated semen or vaccine (some vaccines are prepared using live virus, which may cause infections).
- Active virus particles may be carried on inanimate objects such as vehicles, clothing, or in mud attached to boots.

In 'Foot−and−Mouth Disease: Sources of Outbreaks and Hazard Categorisation of Modes of Virus Transmission' (1994), the USDA assessed the risk of carrying FMD virus on various items/substances (virus survival is longest time reported in the literature they surveyed):

- bedding (straw, woodshavings): high hazard. Virus survived 4 weeks, transmission to livestock demonstrated.

- clothing: high hazard. Virus survived up to 100 days, transmission demonstrated.
- buckets, tools: moderate hazard. Virus not shown to survive, but transmission demonstrated.
- feed/fodder: high hazard. Virus survived up to 200 days, transmission to livestock demonstrated.
- garbage/rubbish containing animal products or by−products: high hazard. Virus not shown to survive, but transmission demonstrated. (Imported animals and infected meat products are the two main causes of FMD outbreaks in most countries.)
- packing materials: high hazard. virus survived 46 days at room temperature, transmission demonstrated.
- shoes/boots: high hazard. Virus survived 9 weeks summer, 14 weeks winter, transmission demonstrated.
- soil: summer (drier) moderate hazard, survival 3−7 days. Autumn/winter high hazard, survival 4 weeks/21 weeks. Transmission to livestock not demonstrated.
- vehicles: moderate hazard. Virus not shown to survive, but transmission demonstrated.

The OIE recommendations at <http://www.oie.int/eng/normes/MCode/A_00028.htm> are a useful summary of some treatments used to ensure products such as straw are FMD−free before export.

2.1.2 What are the symptoms and when do they appear?

After infection there is an incubation period of 2−14 (OIE) 1−21(USDA) days during which the virus multiplies. It's important to note that the speed with which the symptoms appear and the severity of the symptoms depend on:

- the strain of FMD
- the initial dose and route of infection: if only a few particles are inhaled as an aerosol, then the infection will incubate for longer than if the animal was in direct contact with the larger quantities of virus found in the feces, urine, saliva, and lesions of an infected animal. So aerosol infections between farms take longer to incubate than those within a single herd. Once FMD has begun to spread within a herd or flock the incubation period is about 2−4 days in cattle and sheep and 3−6 days in pigs.
- the species of the animals infected. For example, when cattle are infected they normally show symptoms more quickly and more severely than pigs, sheep or goats (possibly because their pulmonary volume is greater, so they inhale larger quantities of virus). But in the 1997 FMD epidemic in Taiwan cattle appeared to be resistant − only pigs contracted that strain of FMD in the field. So FMD has very different effects on different animals: some may catch it and develop symptoms, some may catch it without developing noticeable symptoms, and others may not be affected by the same strain of virus.
- the breed of animal involved: breeds originating in areas where FMD is endemic tend to be less susceptible to the disease than different breeds of the same species brought into the area for the first time. African breeds of cattle are more resistant (but not immune!) than European breeds.
- the health of the individual animal. Physiological stress leaves animals more vulnerable to infection, so cows in heavy lactation are more likely to succumb than low−yielding individuals. Shipping stress and social stress are also likely to increase vulnerability.

Classic symptoms are that after the incubation period, in addition to a fever (103−105°F, 39.4−40.6°C) and loss of appetite, FMD causes vesicles (blisters) to develop on various parts of the body of infected animals. The virus affects the throat first, where it multiplies in the primary vesicles. Eventually virus particles enter the blood stream and are carried to different parts of the body where they cause secondary vesicles. Affected

animals have nasal discharges and salivate excessively. As the name suggests, the most obvious secondary vesicles are on the feet and in/on the nose, mouth and tongue, but others may appear on/in the mammary gland or udder and internal organs such as the rumen. A high death rate in young animals is associated with vesicles or lesions on the myocardium (heart muscle).

These vesicles often rupture after about 24 hours, leaving large, painful open wounds that bleed easily. Vesicles on the coronary band (where the hoof joins the ankle) may result in sloughing of the hooves, leaving animals unable to stand.

http://www.aphis.usda.gov/vs/ep/fad_training/VESVOL7/page22_7.htm and subsequent pages illustrate the symptoms of FMD.

Pregnant animals often abort their young, or the young are born dead; lactating females lose 50−60% of their milk for that lactation. Draught animals such as oxen lose 60−70% of their draught power in the first month of an outbreak: the Vietnamese authorities have estimated that each case of FMD in working cattle or buffalo results in the loss of 3 tons of rice.

2.1.3 How long does the illness last? Does FMD inflict permanent damage?

The acute phase (when the symptoms are obvious) lasts about 8−15 days. Afterwards those animals that can recover will do so, gradually. Sheep and goats tend to be less badly affected than cattle, which may be left with scarring on their tongues and in their mouths that makes it difficult or painful to eat; deformed feet; mastitis or other permanent drop in milk production and damaged heart muscle. Some lose the ability to regulate their body temperature. Animals that have recovered from FMD gain weight more slowly and (as a result of secondary infections and mastitis) produce less milk than uninfected animals, a overall decrease of 10−25% in productivity for both beef and dairy cattle.

2.1.4 Virus 'factories'.

It's very important to remember that infected animals are also virus 'factories', producing large quantities of virus particles and shedding them into the environment where they can infect other animals. The most important route is through the lungs: infected animals exhale virus particles that can be inhaled by other animals. In the acute phase and during convalescence there are virus particles in all fluids secreted by the animals, such as blood, saliva, tears, faeces, urine, milk, and semen.

<http://aleffgroup.com/avisfmd/A010−fmd/tools/3−chrt−virus−production.html> shows virus levels in different fluids from different species, but note there is no information about the conditions (temperature, for example) in which survival was determined.

Some virus may be shed even after the animal recovers (see 'The Carrier State' below).

- Different species produce differing amounts of virus: sheep, goats and cattle produce moderate amounts but pigs breathe out between 30 and 100 times as much, up to a hundred million infectious doses per day. It is said that in an outbreak sheep act as maintenance hosts, pigs act as amplifiers, and cattle act as indicators because they tend to be more susceptible to illness.
- Different species appear to produce the virus at different stages in the development of the disease:

according to the MAFF, virus production in sheep and goats peaks 7−10 days after infection. According to AVIS <http://aleffgroup.com/avisfmd/> virus production in cattle peaks around the onset of clinical signs, but milk and semen may be contaminated up to 4 days before clinical signs develop. Ferguson assumed constant infectiousness from 3 days after infection in his model of the current UK epidemic; I don't know enough about it to explain this discrepancy.

2.1.5 What happens after the animal recovers?

2.1.5.1 The carrier state.

Although the animals that survive the acute phase may not show any symptoms, they still have virus particles circulating in their bodies. The concentration of these particles normally decreases over time as the animals' immune systems fight the infection, but while there are virus particles present any animal that has FMD will be shedding virus. The amount and duration varies according to the species involved (see above). Some animals become carriers: they continue to shed virus from the pharynx, and may infect other animals although they themselves display no symptoms. Sheep and goats may continue to shed virus for about 9 months after infection, cattle for up to 2.5−3 years. Pigs do not become carriers.

Transmission from 'true' carrier cattle (those that have had the disease and recovered, but show virus in pharyngeal fluid) to susceptible cattle has not been demonstrated under experimental conditions (Salt, 1994) and it sounds as though they've tried ***really*** hard. Nonetheless, there's a lot of anecdotal evidence that such transmission occurs.

There is some experimental evidence that over time in the carrier animal the virus becomes less virulent to other members of the same spp as the carrier, but retains its virulence towards other spp. Virus isolated from carrier cattle was less cytopathic in culture than wild−type virus, and was less virulent towards susceptible cattle. But it retained its virulence for pigs and guinea pigs, regaining its virulence for cattle after a single passage in pigs.

Vaccination doesn't prevent animals becoming carriers: please see section 2.2.4 on Vaccination for more information.

2.1.5.2 Immunity.

<http://aleffgroup.com/avisfmd/A010−fmd/mod4/4411−infection.html> Animals that have recovered from FMD are immune to that strain for some time; the strength of the immunity normally decreases with time after infection. Cattle have been demonstrated to retain immunity against the original virus for up to 5.5 years − this is thought to be related to the carrier state that lasts up to 30 months. Both may be a function of continuing challenge from trace amounts of virus. AVIS state that little is known about the immune response/duration of immunity for sheep and goats. Pigs appear to retain immunity for a much shorter period than cattle, perhaps 3−6 months.

2.2 Isn't there a treatment, a drug or vaccination that will prevent or cure this disease?

2.2.1 Antibiotics.

Antibiotics have no effect on viral diseases such as FMD, although they can be used to treat secondary infections.

2.2.2 Other remedies.

Other publicised remedies, such as Jeyes fluid (a phenolic compound), may act as disinfectants to prevent or treat secondary infections in wounds but according to the OIE [*1*] have no effect on the virus: 'Resistant to iodophores, quaternary ammonium compounds, hypoclorite and phenol, especially in the presence of organic matter'.

2.2.3 Homeopathic remedies.

Borax 30 is a homeopathic remedy said to ease the symptoms of FMD. The MAFF has NOT APPROVED its use against FMD <http://www.maff.gov.uk/animalh/diseases/fmd/disease/borax.asp>:

"Use of Borax 30
Products that are presented for the treatment or prevention of disease in animals, or which have that function, must be authorised under the terms of the Marketing Authorisations for Veterinary Medicinal Products Regulations 1994 before they can be legally sold or supplied in the United Kingdom. This ensures that such products are properly assessed and are demonstrated as being safe, of consistent good quality and effective when used in accordance with the label instructions.
We are aware that some pharmacies have advertised a homeopathic product called Borax 30 as a preventative measure against foot and mouth disease. However this product has not been authorised under these regulations. We have received no scientific evidence to demonstrate its effectiveness against foot and mouth disease and we have not assessed its safety or quality. For further information contact − Simon Hack at the Veterinary Medicines Directorate, 01932 338306, email: s.hack@vmd.maff.gsi.gov.uk If foot and mouth disease is suspected it must, by law, be notified to the MAFF Divisional Veterinary Manager or the police."

Other homeopathic treatments are discussed at <http://www.anth.org.uk/biodynamic/Foot%20and%20Mouth.htm> Readers should note this statement made towards the end of that document: "Organic and biodynamic farms may have a certain resistance to the disease but its certainly not worth taking any chances since any outbreak must be reported and dealt with in accordance with MAFF eradication policy."

2.2.4 Vaccination

2.2.4.1 How does vaccination work?

Modern vaccines are manufactured from chemically inactivated FMD virus grown in tissue culture (see <http://aleffgroup.com/avisfmd/A010−fmd/mod4/4413−vacc−manufacture.html> for detailed information about the manufacturing process). The inactivated virus or antigen may then be combined with an adjuvant which alters the effectiveness of the vaccine in different species (oil−based adjuvants are effective in all species; aluminium hydroxide adjuvanted vaccines are not effective in pigs) and stored ready for use, or stored as a concentrate over liquid nitrogen to be made up into vaccine as required. Stocks of ready−to−use vaccine have a shelf−life of about 18 months. When an animal is vaccinated the inactivated virus shows the animal's immune system what FMD virus looks like; the immune system then produces antibodies to the virus which circulate in its body, ready to attack any live, wild virus that tries to infect the animal. "It should be noted, however, that during the 14 days following the vaccination of cattle and 7 days following the vaccination of pigs, virus transmission can occur from those species to susceptible animals in contact with them"[*2*].

Without further 'challenge' (exposure to virus) the amount of circulating antibody decreases over time, so animals have to be re−vaccinated regularly if protection is to continue. It's important to note that each vaccine protects against only one of the seven strains of FMD. Countries regularly threatened by several strains may choose to use bi− or tri−valent vaccines combining antigens from two or three strains of FMD.

2.2.4.2 Complications and problems associated with FMD vaccination.

- FMD vaccine is perishable: a vaccination programme requires a 'cold−chain', ensuring the vaccine is always refrigerated to about 4°C (but not frozen). Some vaccine 'breakdowns' (failure to protect animals) are associated with failure to keep the vaccine cold.

- Animals that are ill, or have weak immune systems may not produce enough antibodies after vaccination to protect themselves from the virus. In Saudi Arabia high hormone levels in pregnant heifers have been suggested as the reason for vaccine failure[*3*].

- Partly because of the above, vaccination doesn't actually prevent all animals from catching FMD. Some animals that come into contact with the virus after vaccination will still catch FMD, even though they've been vaccinated. They don't normally develop the symptoms of the disease, but will still be shedding virus [*4*]. Especially if emergency vaccine is used [*5*], these post−vaccination carriers shed less virus than un−vaccinated animals that catch the disease normally, but because they show no symptoms they're difficult to spot unless they come into contact with susceptible unvaccinated animals that then develop FMD. One argument against vaccination was that in the past there was no effective test to distinguish between animals that had been infected by FMD and those that had been vaccinated: both were producing antibodies. It is now possible to distinguish these, but "when a vaccinated animal becomes infected, this distinction is usually lost. This becomes a critical issue for epidemiological surveillance and for export. Thus any animal with antibodies must still be considered as having potentially been infected."[*4*].

- <http://www.maff.gov.uk/animalh/diseases/fmd/vaccination/keyfacts.asp> "Vaccine does not work if it is administered after an animal has caught the disease, though it may mask the clinical signs of infection. There is always a risk that this will happen, as there is an incubation period of about a week between catching the disease and showing the signs. An animal vaccinated during this period will still have foot and mouth disease and be capable of passing it on to others."

- <http://www.maff.gov.uk/animalh/diseases/fmd/vaccination/keyfacts.asp> "Females pass on immunity to their offspring through their milk. If young animals are vaccinated while they have maternal antibodies in their bloodstream, the vaccine immunity has to break through the maternal immunity, so protection is not certain. There is a period while the maternal antibodies are wearing off when vaccine may still not work, but the young animal is vulnerable to the disease, if exposed to infection."

- <http://aleffgroup.com/avisfmd/A010−fmd/mod4/4411−adverse.html> Crude or impure vaccine produced in some parts of the world may produce adverse reactions in vaccinated livestock, ranging from a short−term but significant drop in milk production to anaphylactic shock and death.

- In the past vaccine was prepared from very weak preparations of live FMD virus. These vaccines could and did cause outbreaks of FMD. Up to 1994 the USDA recorded a total of 20 primary outbreaks of FMD attributed to improperly inactivated vaccine or FMD−contaminated vaccine (some for other diseases). All 17 such outbreaks after 1969 occurred in Europe [*6*], where prophylactic vaccination was widely used at that time.

2.2.4.3 Where is FMD vaccine made and stored?

The manufacture of the vaccine requires the most stringent precautions because live virus is used. (The US is so concerned about the dangers of FMD that in the 1950s it was made illegal to possess FMD virus − even in the form of vaccine − on the US mainland. Their only FMD research laboratory is on Plum Island, off the east coast of the US.) Some countries rely on commercial production of vaccine, while others have arranged access to the international vaccine banks. A useful summary of vaccine bank facilities is available at <http://aleffgroup.com/avisfmd/>, from which the following is an extract:

"Strategic FMD vaccine reserves have been in existence since the 1970s as part of FMD control programmes. However, the shelf−life of conventional formulated FMD vaccines is in the order of one year, and the cost of maintaining these reserves by annual replacement is therefore high. In the 1970s, advances in technology prepared the ground for the introduction of highly concentrated FMD antigen in low volumes stored at ultra−low temperatures over liquid nitrogen or in −80ºC freezers. In this form antigens appear to be extremely stable. Thus the three international FMD vaccine banks comprise pretested FMD antigen concentrates of a spectrum of virus types and subtypes which are stored for rapid formulation into vaccines in the event of an FMD emergency situation. 'Strategic FMD Antigen Reserve' is perhaps a more appropriate title for these banks.

The first essential component of an FMD antigen bank is the concentrated, inactivated antigen supplied by a commercial source. The antigen needs to be capable of producing a highly potent vaccine when reformulated. Thus, the manufacturer should specify the expected dose volume to yield a vaccine with minimum potency in excess of the commercial prophylactic FMD vaccines.

The second element of an FMD antigen bank is a capacity to store the antigen at ultra−low temperatures, either at −80ºC in freezers or over liquid nitrogen at −130ºC.

The third essential element is the facility to reformulate the antigens rapidly into potent vaccines. The three international banks have different arrangements for this part of the process. The European Union Vaccine Bank (EUVB) has an ad hoc arrangement to return the antigen to the manufacturer for reformulation at 2.5 million doses over a 10−day period. The International Vaccine Bank (IVB) maintains its own emergency manufacturing facility to Good Manufacturing Practice (GMP) standards and holds both Product and Manufacturing Licences for aqueous FMD vaccines. This facility can manufacture up to 200,000 doses of vaccine over a 24−hour period. The North American Vaccine Bank (NAVB) is seeking an arrangement with a commercial FMD vaccine manufacturer to produce 2 million doses in the first week."

2.2.4.4 When can vaccination be used?

The EU (and therefore the United Kingdom) and other countries wishing to maintain FMD−free status are required to attempt to bring an FMD outbreak under control by using a 'stamping out' policy (swift slaughter and disposal of infected herds and contacts) before considering vaccination. Only if an outbreak threatened to become extensive or affect particularly valuable livestock is consideration would be given to 'emergency' vaccination as an additional control measure. 'The control measures for foot−and−mouth disease laid down in Directive 85/511/EEC are aimed at eradicating the disease as quickly as possible by stamping out of infected, contaminated or in−contact herds, applying strict movement controls on animals of susceptible species and products derived from such animals and surveillance in the affected area to substantiate prior to lifting the control measures the absence of virus circulation' (2001/257/EC, 31.3.2001). Provision is made for emergency vaccination 'where the disease expands'.

So the UK could not simply decide to vaccinate against FMD: the EU, the International Vaccine Bank (of which the UK was a founding member) and the OIE all either recommend or require that 'stamping out' be used to control or eliminate FMD. The UK could expect to receive permission to use vaccination to control an FMD outbreak only if the 'stamping out' policy had demonstrably failed, or if particularly rare animals were at risk. The UK did in fact apply for permission to vaccinate, and received it on the 30 March 2001. After noting that the UK had not only initiated a 'stamping out' policy, but also the pre−emptive killing of susceptible animals in close proximity to infected or suspect holdings, taking into account the density of the livestock population and the exigencies of carcass disposal, the Commission Decision permitted vaccination of bovine animals over 1 week of age in the counties of Devon and Cumbria subject to certain conditions [*10*].

2.2.4.5 Types of FMD vaccine and vaccination programmes

Broadly speaking there are two types of vaccine that can currently be used to protect animals from FMD, each of which is used in different ways. Contrary to some media reports, research on oral, pelleted FMD vaccine is at an early stage: no oral vaccine is currently available.

a) Conventional vaccine and prophylactic vaccination programme.

Conventional vaccines are administered in two doses, 3−4 weeks apart, and may take up to two weeks (after the first injection) to provide protection against FMD. Re−vaccination will be required after 6 months [*4*] or

12 months <http://www.maff.gov.uk/animalh/diseases/fmd/vaccination/keyfacts.asp> (the variation depends on the average immune response of the animals and the level of challenge after vaccination). Because it requires two injections, and takes so long to protect vaccinated animals, conventional vaccine is generally used as part of a prophylactic vaccination programme in which an effort is made to vaccinate as many susceptible animals as possible (85% coverage is regarded as the minimum acceptable [*7*]) each year, regardless of whether or not there has been an FMD outbreak. Prophylactic vaccination is simply intended to reduce the number of FMD outbreaks: by itself it does not completely eradicate the disease. It was used to good effect to control FMD in Europe prior to 1990−91, but a slaughter policy was required to eradicate FMD.

Prophylactic vaccination is currently used in combination with zones of infection to protect FMD−free areas from infection. Such a system is used in South Africa near the Kruger National Park, where Cape Buffalo carry the disease <http://www.nwpg.org.za/NW/DoACE/Food−and−mouth%20disease1.htm>.

Arguments for and against the use of widespread prophylactic vaccination in the UK during the current outbreak:

- Section 2.2.4.2 lists some of the problems which may be encountered during/as the result of a vaccination programme. Remember that vaccination does not prevent animals catching FMD: until an effective test is developed to distinguish between vaccinated animals and vaccinated−and−infected animals, vaccination can conceal the fact that the disease is still present. This is one of the reasons that a country that vaccinates against FMD is not considered truly FMD−free.

- The stated goal was to maintain the UK as FMD−free. Prophylactic vaccination alone cannot do this, so the slaughter would have had to continue.

- Although an annual vaccination against the strains of FMD most likely to affect the UK might prevent further outbreaks, it was not guaranteed to do so. Such a vaccination programme would be expensive, incurring not only the cost of supplying and administering over 100,000,000 doses of vaccine each year together with the cost of accurate records, but also directly and indirectly affecting both exports and tourism (see Section 4 for a brief description, and the OIE's recommendations on classification of FMD−free vs vaccinated areas and treatment of various goods exported from these areas [*8*]).

- There were too many animals to be quickly or easily vaccinated. MAFF statistics for 2000 estimate 11,133,000 cattle and calves; 42,261,000 sheep and lambs and 6,482,000 pigs in Britain [*9*]. This is a total of about 59,000,000 animals, of which over 50,000,000 would have to be vaccinated three times in the first 12 months of a national prophylactic vaccination programme. This was not feasible either in terms of livestock handling, or availability of vaccine. There is doubt that sufficient vaccine was available even for a local prophylactic vaccination programme in the worst affected counties (EUFMD, pers. comm.).

- The UK has a larger livestock population than many other countries. Some livestock, such as the hill flocks, are not easily or conveniently brought in for vaccination. There was not sufficient space, grazing or food to hold all livestock on farms for the 3−4 weeks needed to administer both the initial vaccination and the booster, or to isolate all the animals involved either before or after vaccination. The inevitable stress and mixing of animals brought in for vaccination could have caused many more outbreaks.

b) Emergency vaccine and a programme of ring vaccination or 'damping down' vaccination.

Emergency vaccine is a high−potency preparation designed to elicit a rapid immune response. Animals vaccinated with emergency vaccine are protected within about 4 days of vaccination [*5*], which protection lasts about 6 months [*4*]. Emergency vaccines may be used in a 'ring' or 'protective' vaccination programme (susceptible animals on holdings around an outbreak are vaccinated to protect them against aerosol infection), or 'dampening down'. 'Dampening down' is the vaccination of a chosen group of animals at risk from an outbreak. It is intended to reduce virus spread by reducing the number of susceptible animals, assisting a pre−emptive slaughter policy in places where poor infrastructure, inadequate manpower, delayed stamping out or other factors result in insufficient capacity to dispose of carcasses, and to reduce the severity of direct economic losses from the outbreak (presumably on the assumption that only the most valuable livestock would be vaccinated) [*2*].

Arguments for and against the use of emergency vaccination in the UK during the current outbreak:

- Remember that vaccination does not prevent animals catching FMD: until an effective test is developed to distinguish between vaccinated animals and vaccinated−and−infected animals, vaccination can conceal the fact that the disease is still present. This is one of the reasons that a country that vaccinates against FMD is not considered truly FMD−free.

- Bearing in mind the the problems which may be encountered during a vaccination programme listed in Section 2.2.4.2, it would have been permissible for the UK to apply for the use of emergency vaccination (see Section 2.2.4.5) to preserve rare breeds or other animals regarded as particularly valuable. The argument against doing so is likely to have been that the benefit of doing so to the individuals and breeds concerned was outweighed by the cost to the agricultural industry in the UK and indeed the EU as a whole of losing FMD−free status for a longer period. As Brownlie *4* phrased it early relatively early in the epidemic, "There may still be a case for strategic vaccination of endangered animals (e.g. the Chillingham herd and zoo animals) however; the political consequences may be prohibitive." The OIE states that a country that eradicates FMD using a combination of stamping out and blood testing may regain disease−free status after 3 months. A country that resorts to vaccination must wait 12 months after the last case where stamping out is applied, or 2 years after the last case if stamping out is not applied, providing that effective surveillance can be shown to have been carried out [*4,8*]. This is one of the reasons that animals given emergency vaccination are often slaughtered later.

- The stated goal was to maintain the UK as FMD−free. Emergency vaccination alone cannot eradicate FMD and indeed the EU and other organisations require that the slaughter of unvaccinated, infected or suspect animals continue during and after the vaccination programme. Vaccinated animals might or might not have been slaughtered once the facilities to process the carcasses were available; slaughtering vaccinated animals (as was done in the Netherlands during the current outbreak) would ensure the earlier return to FMD−free status.

- It is claimed that emergency vaccination earlier in the epidemic would have saved the lives of animals that were otherwise slaughtered after contracting the disease, or as part of the contiguous culls. This is most likely to be true if the primary means of transmission was as an aerosol spreading outward from each outbreak, in which case ring vaccination around each outbreak would have reduced the spread. Sadly, in this epidemic the most significant means of transmission appears to have been infected animals transported long distances between markets, farms and abattoirs, so early ring vaccination could not and would not have prevented the initial national spread of the virus. If sufficient vaccine had been made available it is possible that ring vaccination could have partially replaced the ring cull in badly affected areas such as Cumbria, Dumfries & Galloway and Devon, or

that damping down vaccination could have been implemented earlier in these areas, but it is likely that only cattle would have been vaccinated. The slaughter of less valuable sheep and pigs would have continued. It is possible that the reduction in number of animals slaughtered may have speeded the stamping out process and reduced the total number of cases, but we'd have to go through the whole thing again and try this option in order to find out. Given that farmers in Cumbria have reported fewer cattle culled in any case, the reduction in cattle deaths after vaccination might not have had much effect. And if the decision had been made to cull vaccinated animals at a later date in order to regain FMD−free status, the reduction in deaths would be even smaller.

- The use of vaccination would have meant zoning parts of the UK as FMD−free, FMD−vaccinated areas, and Surveillance areas. Animal movements between zones would have been strictly controlled, and FMD precautions would have continued for some time within the vaccinated areas. Given the current importance of animal transport in the UK livestock industry this would have had a serious impact on the day−to−day functioning of many livestock farms both within the vaccinated area and outside it.

2.3 Can other animals catch FMD? What about horses? What about people?

Non−cloven hoofed animals known to catch FMD naturally include hedgehogs, rats, cats, and dogs. At least 16 other types of animals including mice and guinea pigs can be infected with FMD in the laboratory.

2.3.1 Horses.

Horses are resistant to FMD infection themselves, but can spread infection by carrying virus on tack, their body, or mud on their hooves from an infected area to an uninfected area.

2.3.2 Dogs and cats.

Dogs and cats can catch FMD, but (as with humans) this is very rare. The USDA considers dogs and cats to be 'moderate hazards'[*1*].

Any dogs in an area infected with foot and mouth disease must be kept under control by their owners. This means that they must either:

- be kept in a kennel or enclosure from which they cannot escape or
- be effectively secured to a fixed object by a collar and chain or
- they must be accompanied by and under the effectual control of the owner or a responsible person authorised by the owner.

If you are in an area declared to be infected with foot and mouth disease you must not let your dog run free; if

you do, it may be seized by the local authority or the police and treated as a stray. In addition, an inspector may serve a notice on anyone in the infected area to keep a dog under specific controls.

Dogs which are kept under proper control are not prevented from being moved. Certain sporting activities involving dogs are not allowed in areas infected with foot and mouth disease.

If you feed your dog bones, please dispose of the bones carefully once your dog has finished with them so that wildlife cannot gain access to the bones.

2.3.3 Humans.

The number of documented human cases is small (the virus was found in about 40 cases worldwide to 1994), and humans are thought to be 'quite resistant' to FMD. The most important route of transmission to humans is probably drinking contaminated milk [*6*].

2.4 Deer and FMD.

This draws on information from the British Deer Society, posts to UBA from those involved in deer management and articles from the press and various websites.

2.4.1 Do deer catch FMD?

There are very few studies of FMD in deer, partly because opportunities are rare, and partly because most known outbreaks occur in farmed populations such as deer parks that, like other outbreaks in farmed livestock, are controlled by a slaughter policy as quickly as possible rather than being allowed to run their normal course. But during an outbreak in California in 1924 22,000 wild mule deer were culled, of which 2279 are said to have been infected. According to the OIE <http://www.oie.int/hs2/sit_pays_mald_pl.asp?c_pays=162&c_mald=2> the Russians have been 'controlling wildlife reservoirs' since 1998 to control FMD. Outbreaks in deer, cattle, sheep and pigs were reported in both 1998 and 1999. Russia has endemic FMD and would have difficulty eradicating it as most of its neighbours also have endemic FMD.

Studies at Pirbright in 1974 demonstrated that all five species of deer commonly found in Britain can catch FMD. FMD in roe deer and muntjac is thought to produce symptoms similar to the disease in sheep − they lose condition and become lethargic, while red deer and fallow demonstrate even fewer symptoms: it is possible to have FMD in a herd and never recognise it.

<http://aleffgroup.com/avisfmd/A010−fmd/mod1/0241−clinical−other−deer.html> shows some symptoms of FMD in deer.

There are conflicting reports about long term recovery, ranging from the deer recover fully to 'deer thought to have been infected fail to thrive and die during autumn/winter'. It is possible that the difference is a function of the original condition of the animals and the conditions in which they live post−infection.

It appears that in the past FMD has not normally become endemic in wild deer in Britain, possibly because the populations were not dense enough to sustain it. Wild deer were not regarded as significant during the 1967 outbreak in Britain (in essence they were ignored), but the population of wild deer has increased significantly since that time − The Mammal Society recently estimated there are now 20 times as many deer here as there were in 1967.

2.4.2 Can deer pass FMD on to other animals?

Yes. Like any animal with FMD, infected animals shed virus and have been shown to pass on the virus under natural conditions. In addition to this, the USDA records a white−tailed deer that remained a carrier for 11 weeks. Although they will graze the same pastures as sheep or cattle, wild deer tend to avoid large concentrations of domestic livestock (especially sheep), and do not shed large quantities of virus, so the MAFF does not regard infection in wild or feral deer as a major threat to livestock. The British Deer Society regard it as more serious, as stated in their press release of 4 April: 'If the current FMD outbreak in domestic stock takes hold throughout Britain, there is a strong possibility that some species of wild life including deer will become infected by contact with stock or through wind−borne infection. This would be a very serious development because even if the official "isolate and slaughter" policy succeeds in controlling the outbreak among domestic animals, a reservoir of infection would remain among wild animals which would cause repeated disease outbreaks. FMD would become endemic in this country.'

It may be worth noting that the USDA Emergency Response to a Highly Contagious Animal Disease plans include the distribution and movements of deer and other susceptible wildlife as a factor to be taken into account when designating an FMD Infected Zone. The USDA FMD Hazard Categorization (1994) classifies deer as 'High Hazard' because they are natural hosts and have been shown to both catch and transmit FMD.

The likely routes of transmission to/from livestock and deer during an outbreak are by inhalation of virus particles or by grazing pasture on which infected animals have shed virus (in urine, feces, etc). Inhalation is the most important route: current MAFF advice is that the risk of transmission from sheep to deer is 'unlikely' over distances greater than 10 metres. Oral transmission from grazing infected pasture requires relatively large quantities of virus, so this too is regarded as low risk. The official MAFF advice on deer <http://www.bds.org.uk/fmd/Risk.htm> states that 'By analogy with sheep, the greatest risk of transmission occurs during the 7−10 days following the onset of clinical signs'.

2.4.3 Have wild/feral deer caught FMD in the current outbreak in Britain?

Probably yes. There have so far been numerous reports of deer found dead (possibly as roadkills) with symptoms of FMD such as blisters around the mouth/feet. There have also been reports of others, particularly roe, which are more seriously affected, but none have tested positive for FMD; it has been suggested that the ELISA test used is less effective on deer than on sheep. The current combination of Close Seasons and a ban on shooting since March means it has not been legally possible to sample the health of the UK wild deer herd. The British Deer Society called (4 April 2001) for a limited, carefully planned, sample cull for scientific purposes only in areas where infection in wild deer is suspected. New Scientist 5/5/2001 reports this is to be permitted from 5 May, 2001, but the government has apparently refused to pay to have the carcasses tested for FMD (the Deer Initiative, which is organising the cull, is to apply to the EU for funding).

2.4.4 What can be done about it?

To be blunt, very little.

- It is not currently feasible to vaccinate the wild deer population.
- In normal circumstances wild/feral deer, especially the species found in lowland Britain, do not wander great distances.

NB: It is crucially important to note that all the authorities (including the British Deer Society and the MAFF) agree that any attempt to cull a deer population likely to be infected will only make matters worse: the cull will not only miss many animals, but will cause the (infected) survivors to scatter over a wide area, taking the disease with them.

It seems that the risk of transmission from deer to livestock is low, so in the short term infected deer may not cause large numbers of outbreaks. Official advice from the MAFF is that farmers in areas where deer are thought likely to be infected should confine livestock to areas where they are unlikely to encounter deer, housing them if necessary.

3. References.

1. Office International des Epizooties (OIE) World Organisation for Animal Health Foot and Mouth Disease <http://www.oie.int/eng/maladies/fiches/A_A010.HTM>

2. EU Scientific Committee on Animal Health and Animal Welfare (adopted 10 arch 1999) Strategy for Emergency Vaccination against Foot and Mouth Disease (FMD). <http://europa.eu.int/comm/dg24/health/sc/scah/index_en.html>

3.
< http://www.iah.bbsrc.ac.uk/virus/Picornaviridae/Aphthovirus/fmdnews/v1n2/v1n2.htm#kitching1>

4. Brownlie, J (2001) Strategic Decisions to Evaluate before Implementing a Vaccine Programme in the Face of a Foot−and−Mouth Disease (FMD) Outbreak. BCVA 2001.

5. Sobrino, F, M Saiz, M A Jiminez−Clavero, J I Nunez, M F Rosas, E Baranowski, V Ley (2000) Foot−and−Mouth Disease Virus: a long known virus, but a current threat. Review Article. Vet. Res. 32 (2001) 1−30.

6. USDA:APHIS:VS (1994) Foot−and−Mouth Disease: Sources of Outbreaks and Hazard Categorization of Modes of Virus Transmission. <http://www.aphis.usda.gov/vs/ceah/cei/Fmdps.pdf>

7.
<http://www.aleffgroup.com/avisfmd/A010−fmd/mod0/0423−prophylactic−vacc.html>

8. Office International des Epizooties (OIE) World Organisation for Animal Health International Animal Health Code (2000) <http://www.oie.int/eng/normes/MCode/A_00028.htm>

9. Agriculture in the United Kingdom 2000. Produced by: Ministry of Agriculture, Fisheries and Food; Scottish Executive Rural Affairs Department; Department of Agriculture and Rural Development (Northern Ireland); National Assembly for Wales Agriculture Department. HMSO. Available as PDF from www.maff.gov.uk

10. Commission Decision of 30 March 2001 laying down the conditions for the control and eradication of foot−and−mouth disease in the United Kindom in application of Article 13 of Directive 85/511/EEC.

4. Bibliography.

Agriculture in the United Kingdom 2000. Produced by: Ministry of Agriculture, Fisheries and Food; Scottish Executive Rural Affairs Department; Department of Agriculture and Rural Development (Northern Ireland); National Assembly for Wales Agriculture Department. HMSO. Available as PDF from www.maff.gov.uk

http://aleffgroup.com/avisfmd
The ALEFF Group have assembled a great deal of information about FMD in an online example of AVIS (the Advanced Veterinary Information System).

http://www.anth.org.uk/biodynamic/Foot%20and%20Mouth.htm Bernard Jarman's article on Foot and Mouth presents an alternative view of the disease and its treatment, including a description of biodynamic and homeopathic remedies and treatments. But note the warning implied by the quote from the MAFF!

Brownlie, J (2001) Strategic Decisions to Evaluate before Implementing a Vaccine Programme in the Face of a Foot−and−Mouth Disease (FMD) Outbreak. BCVA 2001.

Commission Decision of 30 March 2001 laying down the conditions for the control and eradication of foot−and−mouth disease in the United Kindom in application of Article 13 of Directive 85/511/EEC.

EU Scientific Committee on Animal Health and Animal Welfare (adopted 10 March 1999) Strategy for Emergency Vaccination against Foot and Mouth Disease (FMD).
http://europa.eu.int/comm/dg24/health/sc/scah/index_en.html

Ferguson, N, C Donnelly and R Anderson (2001) The Foot−and−Mouth Epidemic in Great Britain: Pattern of Spread and Impact of Interventions. Sciencexpress www.sciencexpress.org

Harvey, D R (2001) What Lessons from Foot and Mouth? A preliminary assessment of the 2001 epidemic. Available for download from <http://www.ncl.ac.uk/cre/>

Kitching, R P (1994) Foot and Mouth Disease in the Middle East. Foot and Mouth Disease Newletter Vol 1; 2. Available at <
http://www.iah.bbsrc.ac.uk/virus/Picornaviridae/Aphthovirus/fmdnews/v1n2/v1n2.htm>

http://www.maff.gov.uk/animalh/diseases/fmd/default.htm The UK Ministry of Agriculture, Food and Fisheries webpages have general information about FMD, disinfection and treatments, as well as the progress of the epidemic, regulations and advice.

Office International des Epizooties (OIE) World Organisation for Animal Health Foot and Mouth Disease
http://www.oie.int/eng/maladies/fiches/A_A010.HTM webpages on the identification and biology of FMD

Office International des Epizooties (OIE) World Organisation for Animal Health International Animal Health Code (2000)
http://www.oie.int/eng/normes/MCode/A_00028.htm Recommendations for treatment of FMD outbreaks, and infective materials.

Office International des Epizooties (OIE) World Organisation for Animal Health
http://www.oie.int/eng/info/hebdo/a_dsum.htm Information on diseases by country; <http://www.oie.int/hs2> accesses the HANDISTATUS II database of disease/country/year

Salt, J S (1993) The Carrier State in Foot and Mouth Disease − an Immunological Review. Br Vet J (1993) 149, 207

Sobrino, F, M Saiz, M A Jiminez−Clavero, J I Nunez, M F Rosas, E Baranowski, V Ley (2000) Foot−and−Mouth Disease Virus: a long known virus, but a current threat. Review Article. Vet. Res. 32 (2001) 1−30.

USDA:APHIS:VS (1994) Foot−and−Mouth Disease: Sources of Outbreaks and Hazard Categorization of Modes of Virus Transmission. http://www.aphis.usda.gov/vs/ceah/cei/Fmdps.pdf

USDA:APHIS (updated 3/30/01) National Emergency Response to a Highly Contagious Animal Disease. Executive Summary.

http://www.aphis.usda.gov/vs/ep/fad_training/VESVOL7/ The USDA Animal and Plant Health Inspection Service Veterinary Services Emergency Program Foreign Animal Diseases training pages appear to be slightly outdated but nonetheless contain useful information.

5. Resources.

This section is in the process of being compiled.

6. Acknowledgements.

Numerous individuals have contributed to the content of this FAQ either directly by alerting UKBA to sources of information or indirectly by participating in the newsgroup discussions analysing the material. Listing specific contributors would not fairly reflect the extent of the collective input without which this FAQ would not have been possible.

The HTML version of this document is automatically generated from the ascii text master document using John A Fotheringham's AscToHTM shareware application. Web Site http://www.jafsoft.com/asctohtm/

The PDF version of this document is automatically generated from the HTML version using Easy Software Products HTMLDOC, a free software application under the terms of the GNU General Public License as published by the Free Software Foundation. Web Site http://www.easysw.com/htmldoc

7. Copyright.