

Foot and mouth disease: lessons to be learned from the experience of France

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Summary

The appearance of foot and mouth disease (FMD) in the United Kingdom in late February 2001 took European veterinary services by surprise. Differences in the types of measures taken by European countries, and in the speed with which they were implemented, partly explain the different animal health situations observed. France, as a major importer of British sheep, is an interesting country to study. The measures taken there are described in detail, as is the history of the two cases registered on 13 and 23 March 2001. The crisis management procedure is also detailed. The majority of the decisions taken and protocols followed are part of the national intervention plan for FMD. However, experience has shown that it is also important to remain pragmatic and to be able to adapt to new developments during the implementation of the plan.

While pre-emptive killing may indeed have reduced the number of outbreaks in France, the social impact of such measures also needs to be taken into account in the development of animal health policy.

Keywords

Foot and mouth disease – France – Intervention plan – Pre-emptive slaughter.

Introduction

The announcement, on the evening of 20 February 2001, that an outbreak of foot and mouth disease (FMD) had occurred among pigs at an abattoir in Essex in the United Kingdom (UK) was a real shock. The enquiry which followed this initial case soon indicated that this was probably not the site of the primary outbreak and, given that the virus needs only three to five days to complete its cycle, further cases of the disease were likely. The primary outbreak was in fact identified a few days later (outbreak no. 5), in the north of the country. This showed that the virus had begun on around 1 or 2 February. However, this fact could not immediately be ascertained.

The alarm was raised in France on the morning of 21 February, following a telephone conversation between the Chief Veterinary Officers of France and the United Kingdom. Following the immediate establishment of an embargo on animals and animal products originating in the UK, the first step was to reactivate the emergency plan to combat foot and mouth disease. A fifteen-member national emergency action

group was set up to co-ordinate the various services and gather information. This group, housed within the General Directorate for Food (DGAL), operated for several weeks as a 24-hour-a-day crisis centre. At the same time, the National Committee on Foot and Mouth Disease (Comité national de lutte contre la fièvre aphteuse), which is made up of representatives of relevant organisations as well as professional agricultural groups, veterinary authorities and the French Agency for Food Safety (AFSSA), met on a number of occasions. Co-ordination centres, set up by the prefects (government officials in the French administrative districts, or Departments), ensured that measures were properly implemented at the local level, by mobilising the manpower and equipment needed to manage the crisis, as required by the Director of Veterinary Services.

The second step consisted of assessing the risk that French animals had been exposed to the virus. To achieve this, it proved essential to have a register of live animals belonging to susceptible species, and the products of such animals, introduced directly or indirectly into France from the UK since 1 February. Veterinary Services carried out enquiries in the field

to find out whether these animals were still located at their original points of arrival, or whether they had been sold. The task faced by the Veterinary Services was considerably complicated by the lack of a general system for the identification of individual sheep as well as the absence of records relating to livestock movements, so that the information gathered was only relatively accurate.

A total of 31,477 sheep and one pig, were identified through the European veterinary information network, ANIMO, which records all live animal movements between EU countries. These were the only animals to have travelled between the UK and France between 1-21 February 2001, directly or through other countries. As a precaution, animals whose origin could not be identified with certainty and which had arrived during this period, were grouped with the sheep from the UK.

Pre-emptive slaughter and serological testing

A difficult decision was very quickly taken to locate, record, then slaughter and destroy the animals imported during the risk period. The rapidly changing situation in the UK, on the one hand, and the absence of any clinical expression of the disease in sheep on the other hand, both pointed to the need for a pre-emptive slaughter of the imported animals, and also of those animals deemed to be contacts, i.e. animals belonging to susceptible species and having possibly been in contact with the imported animals.

Thus, the first days were entirely taken up with counting and separating animals, then preparing for the pre-emptive slaughter of at-risk animals – both imported and contact animals. The heads of Veterinary Services in each Department therefore received the order to start operations. They were also asked to carry out clinical examinations and take blood samples from 10% of the animals before slaughter. This figure of 10%, with an accepted margin of error of 5%, would allow researchers to locate antibodies if the serological prevalence was at least 10% in the affected flocks. Since the disease is extremely contagious, this figure seemed appropriate, particularly given that serological testing carried out on 4,000 French sheep in 1997, using OIE reference laboratory methods, resulted in 4.6% 'positive' reactions (8). However, the specificity of these methods should probably be reconsidered, given that they were developed for use on export animals rather than for serological monitoring of flocks. The total sheep population affected (including both imported and contact animals) was around 50,000, so that approximately 5,000 serological tests needed to be carried out. Following the slaughter and destruction of the animals, provision was also made for disinfecting farms. Cattle were spared from the few affected farms where both species (sheep and cattle) were present. Cattle have a considerably higher economic value than sheep and, in addition, their

clinical expression of FMD is different, so they could be used as a kind of early warning system.

The same policy was applied to animals and animal products imported from Ireland and the Netherlands following the announcement of outbreaks in those countries in March.

Finally, a country-wide ban on the movement of animals from susceptible species was intended to prevent any possible spread of the disease, in the event that affected animals had not been identified. It is believed that this ban was not enforced until 26 February, because of the time needed to communicate instructions to each of the Departments and to set up a framework for the measures. This time lag partly explains how a sheep importer in Mayenne, whose farm became the first site of the French outbreak (see below) as well as the animal protection 'staging point' on the route leading from Ireland to the rest of Europe, was able to receive a truck-load of Irish calves on the night of 23-24 February.

Results of serological testing and additional measures

Increased knowledge about exposure to risk has justified the adoption of regulatory controls. Thus, it was quickly agreed that farms which returned positive serological results would be considered to be at risk and that confinement measures such as security cordons should be set up: a 3-km protective zone and a 10-km monitoring zone around affected farms.

In all, 57,968 animals, of which 43% were imported and 53% contacts, were slaughtered and destroyed at 117 different farms, and 5,404 blood samples were taken. Approximately thirty clinical alerts led to the examination of 160 samples for the virus between 21 February and the end of April. The serological results (first screening by enzyme-linked immunosorbent assay [liquid-phase ELISA] and confirmation by seroneutralisation) proved to be negative in the case of 111 farms (5,048 sera) and positive for six others (28 sera) (Fig. 1). Positive titres (Manisa O₁ antigen) obtained by seroneutralisation ranged from 1:64 to 1:512. In addition, all the serological tests carried out on animals from seventeen different farms in the Netherlands proved to be negative.

Six security zones were set up in five Departments of France.

The first case of FMD occurred inside one of these closely monitored security zones.

The two outbreaks in France

On 26 February, a few days after the pre-emptive slaughter and destruction, at a rendering plant, of the animals owned by a sheep importer in the Mayenne Department, the epidemiological investigation revealed that on 16 February he

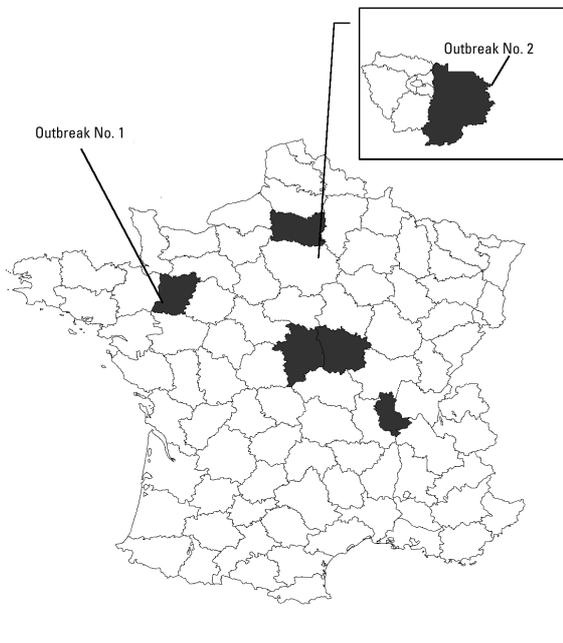


Fig. 1
Map showing the location of outbreaks of foot and mouth disease in 2001 and the Departments in which animals presented positive serology

had brought in animals from an English farm which had since become the eleventh FMD outbreak site in the UK. This flock of 700 sheep, 400 of which had come from the UK, had been slaughtered even before this fact was known, under the protocol outlined above. The first serological results revealed a few positive animals, but no specific symptoms had been noted at slaughter. A protective zone and a monitoring zone were therefore established around the farm. In view of the epidemiological data, two other small flocks owned by the same importer, but located a few kilometres away from the farm and having officially had no contact with the original flock, were slaughtered on 5 and 6 March. Six positive tests were obtained in one of the two flocks. Animals from the two flocks were slaughtered on the spot and their bodies were burned on the importer's property on 6 March, at which time the farm was also disinfected.

Farms located within the 3-km security zone which included 112 herds of cattle, 16 flocks of sheep and 4 pig herds, and those within the 10-km zone covering 486 herds of cattle, 118 flocks of sheep, 20 pig herds and one deer herd, were all inspected regularly by veterinarians, and farmers were warned of the risk.

On 12 March, a lesion was observed for the first time on the udder of a dairy cow at milking. The cow belonged to a farm immediately adjacent to that of the sheep importer, with just 500 metres between the farm buildings and only a road separating their fields (Fig. 1). By the afternoon, two animals had lesions. As previously arranged, the farmer rang his

veterinarian who arrived just before 5 pm. The latter contacted the Departmental branch of Veterinary Services, which in turn contacted the national reference laboratory at Maisons-Alfort (AFSSA) at 5 pm. The clinical presence of FMD was suspected almost immediately. The Director of Veterinary Services, acting on the orders of the central administration, and given the clinical signs and the epidemiological context, did not wait for the result of the laboratory tests and ordered the immediate slaughter of all 114 cattle. Shortly afterwards samples left the farm for despatch to Maisons-Alfort, where they arrived at around 9 pm, just as the slaughter had commenced. By then, six dairy cows showed clinical signs of the disease whereas the other animals including heifers, calves and males which were slaughtered next, had no symptoms. The first positive virology result was obtained at 3 am on 13 March. At 6 am the European Commission was informed, and, at 10 am the head of French Veterinary Services officially notified member states at a meeting of the Standing Veterinary Committee.

The origin of the Mayenne outbreak can be traced, even if the interval of 14 days between the slaughter of the sheep (26 February) and the appearance of clinical signs among the cows (12 March) exceeds the usual incubation period. Indeed, the epidemiological survey which was carried out on 14 March revealed the movement of people, animals and equipment on the sheep importer's property on 6 March. The virus probably escaped that day, even though it is not clear how exactly it did so. The spread of the virus may have been due to the movement of agricultural machinery and of disinfection and transport units which was observed by many – perhaps even too many – people, including journalists, police, Veterinary Services personnel and technicians during the slaughter of the two flocks.

On 14 March, the 3,223 pigs from the two farms situated within the security zone were slaughtered as a precaution.

On 23 March, a second outbreak was discovered in the Department of Seine-et-Marne (Fig. 1), following an investigation carried out by the police at the request of Veterinary Services, at the site of the first outbreak. Sales documents revealed that animals from the site of the first outbreak had been sold to a farm near Paris. Veterinary testing had not been sufficient. Again in this case, the animal that developed FMD was a calf, aged 18 months. Symptoms of abundant salivation and aphthous ulcers showed clearly that it was affected, whereas sheep in the vicinity were less obviously affected. The 276 animals on the farm – 119 cows, 147 sheep and 10 pigs on three different sites – where hygiene conditions were in general not very good, were slaughtered, as were 1,050 sheep which had recently been sold on to another Department and 215 sheep and 10 pigs from within the protection zone. This outbreak was located fairly close to the Paris region and Roissy airport. The protection and monitoring zones included only a limited number of animals and herds: three cattle farms and one sheep farm within the 3-km zone and nine cattle

farms, thirty-five sheep farms and seven pig farms within the 10-km zone.

These outbreaks underlined the role of animal traders. The approach of the Moslem festival of Aid-el-Kebir, which was due to take place on 6 March 2001, partly explains the atypical movement of sheep at this time, the large numbers involved and the speed with which they were moved towards the end of February. Prices paid for animals at that time were also highly inflated.

The outbreak intervention plan

The two outbreaks were managed according to the national FMD plan which was revised after 1992, when widespread vaccination of cattle against FMD was suspended in Europe.

The first part of this plan lists all the regulatory documents (the legal framework). The second part deals with the financial framework. The remaining sections deal more directly with operational matters: the third elaborates the hierarchical structure of the programme, the fourth describes the Animal Health and Protection Division of the DGAL in the French Ministry of Agriculture. Local work at the Departmental level constitutes the fifth section, and teams of experts the sixth. Human resources are dealt with in the seventh part, and resources such as premises and equipment in the eighth. The final five sections relate to standing procedure, diagnostic laboratories, emergency vaccination, and training and education programmes about the disease. The plan ends with a list of personnel such as veterinary inspectors and Veterinary Services technicians, and important addresses including DGAL and AFSSA. The appendices to the document are made up of flow charts describing prevention and crisis stages, a risk scale and the six stages in managing FMD outbreaks.

The consequences of the return of foot and mouth disease

Some 63,000 animals, mainly sheep, were slaughtered during the two French outbreaks of FMD and most of all in the course of the related preventive measures. The number of outbreaks is lower than in 1970-1980: there were 25 outbreaks in 1974, 89 in 1979 and 15 in 1981, despite the fact that animals were being vaccinated at the time. With regard to the species affected, the 2001 outbreak affected mainly imported sheep, while the previous outbreaks hit export cattle and pigs. This makes comparisons difficult. Another major difference is linked to the role played by newspapers and television. Widespread dissemination of images showing the elimination of the disease in the UK had a profound impact on Europeans.

It is unclear whether a policy based simply on slaughter and disinfection could have continued to be implemented in France if the number of outbreaks had multiplied.

At the end of May, the situation returned to normal in France, even if the resumption of exports was slow and dependant on the good will of importers, regardless of the measures decided at the national or European level.

Foot and mouth disease has always been associated with farm animals, and it is not specific to the production systems prevailing in France. However, its impact on modern agriculture is clearly more severe than it is on extensive nomadic agricultural systems such as those found south of the Sahara, since the two economies are quite different. A country which is heavily reliant on agro-industrial exports is more vulnerable to the effects of such a disease than an importing country. In March and April, a number of trading partners stopped importing poultry meat, fish and sometimes even cereals from France.

The vaccination debate

This episode renewed the debate on vaccinating against FMD. Public opinion had difficulty accepting the mass destruction of apparently healthy animals, given that a vaccine to protect these animals was available. It quickly became necessary to distinguish between the different types of vaccination:

- regular preventive vaccination (but for which animals and using which virus strains in the vaccine?)
- emergency vaccination (but immunity is not achieved for 15-20 days; however, recently developed highly concentrated vaccines should shorten this period of time)
- suppressive vaccination (all vaccinated animals should be slaughtered as soon as possible after vaccination).

The three types of vaccination are not equivalent. For thirty years Europe successfully implemented an annual preventive vaccination programme in cattle to eliminate the disease and the virus. This type of programme requires care in the choice and development of the appropriate vaccine valency (i.e. the viral strains included in the vaccine), as well in the choice of species to be vaccinated, the frequency of vaccination and its administration (who should perform the vaccinations?). A number of countries outside the EU currently conduct such programmes, but they are expensive and can be considered only where the expected economic gains, such as realistic export opportunities, are worth the investment. But in economic matters, the final choice lies with the buyer. An exporting country has a different approach from that of an importing country. Since an absence of risk cannot be demonstrated, the vaccinating country runs the risk of no longer being able to export. From this point of view, France is in a vulnerable position (3). Decisions must anticipate future consequences.

In any case, a change in animal health policies can be conceived of only at the European level – or at the international level, through the OIE.

Emergency vaccination is probably not the best approach since it signals a crisis. Nor is it easy to choose the right moment for a decision on matters such as the areas to cover, species to vaccinate, vaccine strains and resources to be employed.

Suppressive vaccination was the method chosen in 2001 in the Netherlands to compensate for the inadequate capacity for destruction of animal carcasses in the rendering plants, which could not keep up with the rate at which animals were being slaughtered.

The UK had enquired about the possibility of using a special protective vaccine, in an attempt to safeguard genetic resources in areas where certain breeds originate but which are subject to regulations requiring the slaughter of all animals within a 3-km radius of an outbreak. In the event this type of vaccine was not used.

The role of serology

Until these outbreaks, serology had been employed mainly on individual consignments of animals for export. While it was highly sensitive, it achieved only average specificity, i.e. there was a clear risk of false positives, or non-specific positive reactions. This is incompatible with large-scale serological monitoring where the margin of error must be lower (8). New tests being developed allow the identification of antibodies directed against non-structural proteins (NSP), which are indicators of viral infection. This new diagnostic tool can be usefully applied to a whole flock, but is of limited use for individual animals.

A model for the airborne spread of the virus

During the major epizootic of 1967-1968 in the UK, the issue of virus transmission became particularly significant. At the time it became apparent that the breath of sick animals functioned as a virus aerosol which could contaminate susceptible animals in areas located down-wind of the outbreaks. To quantify these observations, experiments carried out at the Institute for Animal Health (Pirbright Laboratory, IAH) in the UK demonstrated that pigs could excrete more than one thousand times more virus than ruminants. This is how the 1981 outbreak in the north of the Côtes-d'Armor Department, which affected pigs, led to the transmission of the virus to the island of Jersey (one outbreak), the Cotentin area (one outbreak) and the Isle of Wight (one outbreak). In fact, there are two models for the transmission of the virus: one for transmission over land where the risk zone extends to 10 km around the outbreak, and a second for transmission over water where the risk zone may extend to 200 km. During this crisis, the 'land' model was developed and used, in conjunction with the French Atomic Energy Commission (CEA) and the National Meteorological Bureau (4, 7).

In 2001, given that the affected animals were mainly small ruminants (sheep), the model confirmed that the risk of airborne contamination was negligible. Tight control of animal movements was enough to contain the risk.

At the same time, the World Reference Laboratory at the IAH carried out experiments on animals which had been experimentally infected with the strain responsible for the 2001 outbreak (serotype O, pan-Asian lineage). It seems that it is less easily transmitted through the air than the 1967-1968 strain, a fact which worked in favour of France (5).

Emerging from the crisis

Around the sites of the two outbreaks and the sheep establishments where positive serological results had been observed, and throughout the country in general, a number of clinical and serological surveillance measures were taken (2).

Thus, in March and April 2001, tests were carried out on at-risk animals including cattle, sheep, goats and pigs, as follows:

- flocks slaughtered because they included sheep from the UK, the Netherlands or Ireland
- animals located within the protection zone
- animals presenting symptoms or lesions which suggested FMD.

As the final weapon in the fight against the disease, and in order to ensure that the virus had not spread in France, serological testing was carried out on resident and nomadic sheep populations at the end of April 2001. These animals had had no contact with either the farms where sheep from other infected member states were found or the French outbreak sites.

In all, 17,932 serological tests – in 893 batches from 68 Departments – were carried out during this operation. The results of these analyses were all negative, apart from the samples taken from the two FMD outbreak sites and seven batches from sheep imported from the UK which had been pre-emptively slaughtered and destroyed. These animals had displayed no symptoms of FMD when they were slaughtered.

During a meeting of the heads of national European laboratories on 26 March 2001 in Brussels, serological methods were revised in order to create a more appropriate serological surveillance tool. A maximum of 30 blood samples were tested per batch (10% prevalence with a 5% admitted risk). All animals were tested if there were fewer than 30. All tests proved to be negative.

The question was raised a number of times as to exactly how many outbreaks had really occurred in France. The two outbreaks described were those in which the virus was identified and isolated in animals which were clinically affected.

The two strains were sent to the Pirbright World Reference Laboratory (IAH) for more detailed analysis. The example of Japan in 2000 shows that it is possible to declare an outbreak based on a single serological reaction combined with clinical suspicions, but with no virological confirmation (9). In France, the sheep establishments where positive serological results were found, including the one responsible for the two outbreaks, did not raise any clinical suspicions. Even now, the new definition of an outbreak, according to the OIE formulation, allows for a certain flexibility of interpretation, but it is obvious that the debate will continue.

The first lessons to be learned

The most significant points which have come to light concern the speed with which decisions need to be taken, and then adapted to the actual situation in the field. Realism, pragmatism and speed are essential in terms of decision-making. The FMD intervention plan must be precise, but it must not become a limiting factor. The active participation of groups assigned to the plan is also vital, and has been promoted by regular practice alerts in past years. During the crisis, meetings and communication between the various government officials and professional agricultural organisations, and the transparency of the decision-making process, were all very important. The veterinary network, including both government veterinary inspectors and practising veterinarians, played a significant role in applying disease surveillance and combat measures. Finally, the flow of information at the international level proved to be essential. Whether among heads of member state Veterinary Services, administrative sections of the European Commission or the OIE, confidence was only maintained by all parties working together transparently.

It is clear that improvements to the system of prevention and combating the disease are possible and necessary. This is particularly true of the methods used to identify and trace animals (sheep), which still leave much to be desired, especially in trade rather than in farming itself. It is also important to foresee the economic and social consequences of the measures taken and publicised, not only in terms of those immediately affected (the farmers), but also consumers, who have difficulty accepting the large-scale destruction of animals, and politicians, who relay these reactions. In this context, the dissemination of information is again essential. Finding alternative measures should be considered and encouraged. The question of financial compensation also needs to be raised.

This discussion needs to be continued in the light of experience gained at the local, national, European Community and international levels. The French experience has certainly been difficult, but we can learn a great deal from it, provided that we accept the need to revise some ideas which were believed to be irrefutable.

Conclusion

After an absence of twenty years, the reappearance of FMD in France surprised everyone, particularly given that the country of origin is the home of the world reference laboratory and was selected, among other reasons, because of its supposedly advantageous geographical situation in relation to this risk. The outbreak of diseases prevents us from becoming complacent. The lessons learned must neither be forgotten nor underestimated (1, 6).

In the light of this outbreak, do we need to change our intervention plan for FMD? This is a legitimate question, but time is needed to analyse the situation not just in France and the UK, but also in Ireland and the Netherlands, and to discover the real lessons to be learned. To do so, it is important to be wary of first impressions and recent reactions which are not always neutral and objective.

However, it is important to note that most of the professions directly involved with the crisis closely followed the national emergency plan and acted very responsibly, since FMD is a recognised threat.

Oddly enough, during the crisis at least, it was other less directly affected sectors of society, such as consumers, the medical profession and the press, which seemed to overreact. It seems likely therefore that a great deal of information about FMD has still not been properly communicated and thus understood.

Acknowledgements

The authors wish to thank the broad range of people whose skill and hard work helped to limit the impact of FMD on French livestock.

In particular: Departmental Veterinary Services personnel who had already been severely tried by an earlier series of animal health crises; practising veterinarians without whom it would not have been possible to implement the measures; animal health defence groups which once again demonstrated that breeders' organisations have an essential role to play; the farmers who have accepted such difficult and limiting measures despite the economic crisis they are facing; staff at the Maisons-Alfort virology laboratory who, while often working under difficult conditions, were able to deliver results quickly; and finally, the whole DGAL team which displayed outstanding solidarity in the management of this crisis.

The authors also wish to thank the referees of the *Scientific and Technical Review* of the OIE for their useful comments.

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