# Origin of the UK Foot and Mouth Disease epidemic in 2001

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## Introduction

1. A full inquiry has been carried out into the origin of the 2001 Foot and Mouth Disease (FMD) epidemic in the UK. The conclusions reached in this paper are based on information obtained as a result of the investigations completed to date. These investigations continue and any new information may result in the need to revise some of the opinions expressed.

2. There have been genuine difficulties in establishing precise timelines for events such as the introduction of infection onto key premises such as outbreaks FMD/04, FMD/06 and FMD/01. These stem from (a) difficulties in ageing FMD lesions in animals, (b) determining when clinical disease was first evident on premises such as FMD/04 and FMD/06 either because the animals that were first infected were not present at the time disease was first identified and investigated or because throughout the course of the epidemic, cattle often acted as the first indicator of the presence of disease that had gone unnoticed in sheep and (c) farmer recollection of when they first thought animals were affected by FMD as compared with other conditions. As a consequence, estimates of when infection entered a premises are just that, estimates, and represent theoretical ranges calculated on the basis of maximum and minimum incubation times. Ultimately, judgements on the likely sequence of events have had to be made on the totality of the epidemiological information available.

## Factors contributing to the size and extent of the epidemic

3. The uniqueness of this epidemic in terms of its size and geographical extent is considered to have been due to a combination of factors. These included:

    - a delay in reporting suspicion of disease in pigs at the index case[1],
    - airborne infection of sheep on a premises nearby to the index case,
    - movement of infected sheep through markets before the first case[2] was diagnosed,
    - the fact that the above events took place at a time of year when the climate favoured virus survival and when large numbers of sheep were being marketed and moved around the country,
    - the nature of the disease in sheep and critically the absence of distinctive signs, compared with other classes of livestock,
    - structural changes in the sheep industry which over a period of years have resulted in an increase in the size of the national flock, a reduction in the farm labour force resulting in greater reliance on shared or contracted labour and the fact that >50% of livestock holdings have sheep on them at some time of the year,
    - the fact that sheep are regularly gathered throughout the year for management purposes creating opportunities for disease spread particularly if shared or contracted labour is used.

4. The initial movement of infected sheep through markets and dealers led to multiple (effectively primary[3]) introductions of FMD virus into major sheep keeping areas.

[1] the first premises to be infected with FMD (outbreak FMD/04)
[2] the premises on which FMD was first confirmed (outbreak FMD/01)
[3] outbreaks which acted as the principle source of infection for others or as local “index” cases

Subsequent local spread from these initial insertions of disease undoubtedly caused the majority of cases in the epidemic.

**Origin of the epidemic**

5. Although the first FMD outbreak was confirmed in pigs in an abattoir in Essex on 20 February (outbreak FMD/01), the origin for that outbreak, and the index case for the whole epidemic, is considered to have been a pig finishing unit at Burnside Farm, Heddon on the Wall, Northumberland (outbreak FMD/04), which was licensed to feed processed waste food under the Animal Byproducts Order 1999. Disease was confirmed on these premises on 23 February as a result of the epidemiological inquiry carried out into the origin of outbreak FMD/01. Detailed investigations carried out on 24 February at Burnside Farm by FMD experts from the National and World FMD Reference Laboratory, Institute for Animal Health, Pirbright, revealed that the majority of pigs on the premises at that time were infected with FMD but at different stages of the disease. The expert's opinion was that some pigs had 12-day-old lesions. This implies that disease was certainly present on 12 February and with an incubation period of 2-14 days it could have been present from as early as 26 January. However, Burnside Farm had moved pigs off the premises on two occasions between 8 and 22 February. With an ever-changing pig population and advancing disease, it is possible that pigs that had recovered from the initial, acute phase of the disease had already been sent to the abattoir. The significance of this is that the pigs that had been sent to slaughter may have had older disease than that evident on the farm at the time of the 24 February investigation, so disease may have entered the premises earlier in January.

6. All possible means for the introduction of FMD into Burnside Farm have been investigated. Investigations have shown no evidence that disease was introduced to the farm by animals, people, vehicles, equipment, vermin, wildlife etc. There was no evidence of disease on premises within 3km of Burnside Farm which predates that found there.

7. Having investigated and eliminated all other possible sources of infection I have concluded that the likeliest source of infection for the pigs on Burnside Farm was meat or meat products containing or contaminated with FMD virus and that the virus could have been introduced to his pigs through the consumption of such material in unprocessed or inadequately processed waste food or the consumption of processed waste food contaminated with such material.

**Subsequent spread of the disease**

8. The epidemiological inquiry indicates that there were two routes of spread from the Burnside Farm. First, the movement of diseased pigs or pigs recovering from FMD on 8 and15 February resulted in infection being transferred to Cheale's abattoir in Essex where the first FMD outbreak (FMD/01) was confirmed on 20 February. Recovered pigs in the post-acute phase of the disease could be difficult to identify at ante-mortem inspection. The subsequent spread of disease to holdings in Essex was a consequence of mechanical and personnel transmission from the abattoir. Compared

with the second route of spread, this first route made only a small contribution to the totality of outbreaks in the country as a whole.

9. Second, airborne spread of disease from Burnside Farm to sheep on a nearby premises (Prestwick Hall Farm, Ponteland, outbreak FMD/06) and the subsequent sale of 16 sheep, some of which were inapparently infected, from these premises at Hexham market on 13 February. These sheep entered the marketing chain and were sold via Hexham and Longtown markets and through dealers where they infected other sheep, people or vehicles thereby spreading FMD virus widely in England and Wales and the bordering counties of southern Scotland.

10. Having investigated and eliminated all other possible sources of infection, it is my opinion that the likeliest source of infection for the animals on Prestwick Hall Farm was airborne virus from infected pigs on Burnside Farm.

11. Epidemiological investigations of the other 2,025 outbreaks, the majority of which were due to local spread after the initial introduction of disease into an area, have shown no evidence of any disease pre-dating outbreak FMD/04.

**Other potential origins**

12. A range of other potential origins, including the possibility that disease was already present in GB before this epidemic, have also been investigated. There is no evidence for the presence of disease in the country prior to the index case, outbreak FMD/04.

**Type of FMD virus**

13. Genetic analysis of the FMD viruses isolated from outbreaks in different parts of Great Britain, Northern Ireland, Ireland, the Netherlands and France has shown only minor differences suggesting that the same strain of virus (Type O, Pan-Asia) was responsible for all the outbreaks in Europe during 2001.

14. Similarly, genetic analysis of the FMD viruses responsible for the outbreaks in the UK and those in an earlier outbreak in South Africa, indicated they were closely related if not identical. However the epidemiology of the South African outbreak, the control measures imposed and the strict control on imports of meat into the UK indicate the most likely explanation is that the UK and South African strains had a common origin in the Far East.

**Introduction of FMD virus into Great Britain**

15. A detailed analysis of potential routes of entry into Great Britain indicates that the source of the virus for the 2001 epidemic was most probably infected or contaminated meat or meat products. The probability of other sources is very low especially with this strain of virus.

16. Whilst legal imports of meat or meat products are a theoretical possibility as an origin of disease, the complex of risk management measures makes the practical reality of this occurring extremely unlikely. Legal imports have not taken place from any country

where the Type O, PanAsia strain of FMD virus occurs apart from South Africa. It is highly improbable that disease was imported with South African meat and the information available on imports from South Africa would support this view.

17. It will never be possible to determine the exact route by which the virus entered the country. Infected meat or meat products imported as "personal imports" are a possibility but it is more likely that most will be consumed or discarded as domestic waste and not find their way into animals. Even if they did end up being included in food for livestock, proper observance of the legislative controls covering the feeding of waste containing meat or meat products, and which had been in place since 1973, should prevent any virus reaching livestock. A total ban on the feeding of catering waste containing meat or meat products was introduced early in the 2001 epidemic.

18. Illegal shipments on a commercial scale are more likely to be intended for wholesale outlets or sale to restaurants or canteens. These are more likely to be refrigerated and illegally described as food or dried, cured or salted and presented as non-food imports. This increases the chance of the virus getting into catering waste which if not properly cooked before feeding to livestock could reach pigs in sufficient quantities to cause disease.

## Conclusions

19. Based on the currently available evidence and following detailed investigations I have concluded that:

- There was a single index case for the UK epidemic
- The source of the infection was infected meat/meat products consumed by pigs on Burnside Farm (outbreak FMD/04
- Disease was present at Burnside farm on 12 February and was probably present at the beginning of February/late January.
- The movement of infected pigs from Burnside farm on 8 and 15 February spread disease to pigs in the Essex abattoir (outbreak FMD/01) from which disease spread to a limited number of other farms in Essex and Kent.
- Windborne spread from Burnside Farm resulted in the transmission of FMD virus to sheep at Prestwick Hall farm (outbreak FMD/06) and their subsequent sale through Hexham and Longtown markets resulted in infection being widely disseminated to other parts of the country by animal or mechanical means.
- There is no evidence of the existence of FMD disease in the UK, pre-dating the development of disease at Burnside farm.
- The source of the virus for the 2001 epidemic was most probably infected or contaminated meat or meat products but it is unlikely that the origin of this material or the route by which it entered the UK and reached Burnside Farm will ever be identified.

20. A more detailed account of the investigations carried out into the origin of the 2001 epidemic is provided in Annexes 1-7 to this paper.

21. Finally I would like to acknowledge the assistance I have received from members of the FMD epidemiological teams in London, the Veterinary Laboratories Agency and in the

field, as well as the Institute of Animal Health Pirbright, in gathering and interpreting the information contained in this report.

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# ANNEX 1

## OVERVIEW OF THE 2001 FMD EPIDEMIC IN THE UK

### Summary

1. A total of 2,026 cases of Foot and Mouth Disease (FMD) were confirmed in Great Britain between 20 February and 30 September 2001. Although the first case to be confirmed was in pigs at an abattoir in Essex (outbreak FMD/01), this was not the index or primary case in the epidemic.

**2.** Epidemiological evidence suggests that the index case occurred in pigs on Burnside Farm, Heddon on the Wall, Northumberland (outbreak FMD/04) which was licensed to feed waste food under the Animal Byproducts Order 1991. Disease is thought to have been introduced to this holding at the beginning of February or the end of January 2001. It was subsequently spread in two ways. First, by the movement of pigs to an Essex abattoir and from there by various means to other farms in Essex and Kent. Second, airborne spread to sheep at Prestwick Hall Farm, Ponteland, Northumberland (outbreak FMD/06). Subsequent sale of infected sheep from Prestwick Hall Farm, through markets at Hexham (Northumberland), and Longtown (Cumbria), resulted in widespread dissemination of disease throughout the rest of England and Wales and to bordering counties in southern Scotland. The latter took place before the suspicion of FMD in pigs at the Essex abattoir had been reported and the index case traced and identified (Gibbens et al 2001)[4]

3. The scale and temporal pattern of FMD cases in the first months of the 2001 epidemic was similar to that in 1967/8. Both reflected the practical problems of controlling epidemics characterised by initial multiple seeding followed by local spread. However the evidence suggests that in the 2001 epidemic, the index case (outbreak FMD/04) was the source of infection for all other cases, whereas the 1967/68 epidemic had a multi-centric origin in which a number of pig farms were infected concurrently from the same source. The peak of the 1967/68 epidemic was greater and occurred earlier after the first case.

4. In the 2001 epidemic there was a delay between the introduction of infection and the reporting of suspect disease to the authorities. This contributed to the widespread dissemination of disease and the scale of the epidemic (Gibbens et al 2001). In the 1967/68 outbreak disease was detected within 4 days of the onset of clinical signs on the first affected farm (Northumberland Report, Part 1, 1968). The only intervening outbreak in 1981 was detected on the index farm and was restricted to a single farm (Donaldson and others, 1982)[5].

[4] Gibbens JC et al Descriptive epidemiology of the 2001 epidemic in Great Britain: the first five months Veterinary Record 2001 **149** 729-743

[5] Donaldson AI et al (1982)Use of prediction Models to forecast and analyse airborne spread during the foot-and-mouth disease outbreaks in Brittany, Jersey and the Isle of Wight in 1981. Vet. Rec. **110** 53-57.

## Investigations

5. Each of the 2,026 FMD cases was subjected to a detailed clinical and epidemiological investigation. This data and information was used to estimate the age of the lesions at the time of reporting, to evaluate the origin of infection for each premises and thereby estimate the date on which infection was introduced to each infected premises. Considerable effort, in terms of field epidemiological research, has been put in to investigating the early cases in order to provide substantive epidemiological evidence, so far as is practically possible, to identify the index case and therefore where infection was first introduced to the country.

6. Initial spread of disease from the index case was by two routes, the first linked to the movement of infected pigs from Burnside Farm, Northumberland to Cheales Abattoir, Essex, the second associated with airborne spread to sheep from Burnside Farm on a nearby holding, Prestwick Hall Farm, and subsequent movement of those sheep through market/dealer premises which was facilitated by the relatively large market at Longtown and subsequent dealing.

7. The earliest case of FMD was identified at a pig finishing unit located at Burnside Farm in Northumberland (Outbreak FMD/04) which was licensed to feed waste food. This unit sent infected pigs to Cheales Abattoir in Essex where FMD was confirmed on 20 February 2001 in pigs that had been in contact with pigs from Burnside Farm. Before the possible presence of FMD in the country was reported to the authorities on 19 February 2001, windborne spread of the virus from Burnside Farm had infected sheep and cattle on nearby farms in Northumberland including Prestwick Hall Farm (outbreak FMD/06) that was the second farm to show disease in Northumberland.

8. The accumulated epidemiological evidence suggests that movement of infected sheep from Prestwick Hall Farm through markets, led to the widespread dissemination of FMD throughout Great Britain. Sixteen sheep from Prestwick Hall Farm, believed to be incubating disease, together with 3 others, were sold through Hexham Market on 13 February. Onward tracing of the sheep from Prestwick Hall Farm showed the group of 19 was split at Hexham Market and sold to two dealers (lots of 7 and 10 sheep) and 2 local butchers (2 sheep). One dealer sent the 7 sheep he bought to his home farm in Lancashire where disease was confirmed on the 27th February (outbreak FMD/15). The second sent the 10 sheep he bought, together with 174 other sheep also bought at Hexham Market on 13th February, for sale at Longtown market in Cumbria, on 15th February.

9. Thereafter disease was spread either by the movement of infected animals or through the contamination of vehicles and people in this initial transmission phase. The bulk of infected animals passing through markets went through Longtown market; some infected sheep passed through more than one market.

**10.** Examination of Longtown market's records showed that at least 24,500 sheep entered the market between 14 and 23 February and could have been exposed to infection. Tracing of the 181 purchasers of sheep at Longtown began on 25th February. This tracing exercise was confounded by the immediate trading of sheep subsequent to

their formal sale in the market and subsequent inter-dealer trading which increased the risk of transmission.

11. Movement of infected sheep out of Longtown market accounted directly for the infection of at least 71 premises, including 20 sheep dealers' premises in Cumbria, Dumfries & Galloway, Devon, Durham, Hereford and Lancashire and 3 abattoirs, 1 in Wales (Anglesey) and 2 in Durham, by 23 February.

12. When it became clear that the presence of disease was not confined to Essex, national animal movement controls were imposed on 23 February. Subsequent epidemiological analysis has shown that at least 57 farms were infected by the time the first outbreak was confirmed on 20 February and at least 119 farms in 11 of the 12 mini-epidemics or geographical clusters of outbreaks that characterised the epidemic as a whole, had been infected as a result of "infected animal" movements before national movement controls were imposed on 23 February.

**Epidemiological clustering of outbreaks**

13. The greatest numbers of outbreaks occurred in Cumbria (893), Devon (173), Dumfries & Galloway, Scotland (176) and North Yorkshire (133), Co Durham (85), Powys, Wales (70) and Northumberland (88). Collectively, outbreaks in these 7 counties were responsible for 75.5% of all FMD outbreaks in Great Britain.

14. This reflects the original distribution of sheep that took place via Longtown Market and subsequent spread by markets and dealers during February and before the existence of disease in the country had been recognised. These movements coupled with subsequent local spread resulted in the epidemic resolving itself into 12 epidemiological groups centred around outbreaks in Anglesey, Cumbria, Devon, County Durham, Lancashire (East), Essex, Hereford & Worcester, Northumberland, North Yorkshire, Wales (Powys), Staffordshire and Yorkshire (Yorkshire and Lancashire).

15. Disease was introduced into Mid Wales when ewes destined for Welshpool market were transported there in a contaminated lorry that had carried infected sheep from Longtown Market the previous day. The Staffordshire cluster of farms and dealers received infected sheep from Longtown and Hexham markets, and infected cattle from Northampton market. The Durham group was associated with one infected dealer and two infected abattoirs.

16. Infected abattoirs were the main source for the Anglesey, "Essex & Kent" and the "Yorkshire & Lancashire" clusters of cases, as well as the Wiltshire cluster. Sheep dealers were the primary source of FMD for the Devon and Hereford clusters. In fact, a dealer's premises in Devon became infected on 15/16 February as a result of movement for Longtown market and this was the sole reason for the introduction of infection into Devon and eastern Cornwall. In Hereford this was compounded by further market distribution of infected animals. The East Lancashire Group was infected by local spread from the Settle subgroup in North Yorkshire into which disease was

introduced as a result of mechanical (vehicle) transmission via a dealer with Longtown Market connections.

## Conclusions

17. A study of FMD epidemics in unvaccinated populations in Europe between 1965 and 1982 (Lorenz,1989)[6] showed a median of 29 holdings affected, indicating that outbreaks had usually been controlled rapidly. However, under certain favourable conditions very large epidemics could occur. The 2001 epidemic proved to be much larger and with many more livestock holdings affected than might reasonably have been expected or predicted following the introduction of FMD virus into Great Britain.

18. The 2001 epidemic was largely sheep based and its size can be attributed to a variety of factors which led to many, initially undetected, secondary sources of infection across the sheep dense areas of England, Wales and southern Scotland. These were equivalent in effect to multiple primary cases of FMD that propagated the epidemic locally for days before the first case was diagnosed in GB.

19. One important factor was the initial delay in reporting suspicion of FMD on the index farm. Awareness of FMD as a possible differential diagnosis for the cause of lameness or oral lesions in pigs and sheep is low in countries such as Great Britain that have been free of the disease for many years. There had been little propaganda since the last outbreak to make farmers aware of the clinical signs or to encourage reporting of suspect disease. In most FMD epidemics, as in this one, the first case has been detected and reported by a veterinary surgeon (Donaldson and others, 1982; Hugh-Jones, 1976)[7]. In both the 1967/68 and 2001 epidemics, FMD was detected when pigs were observed to be lame and when the morbidity had reached 25%.

20. This in itself might not have been so important if windborne spread of infection from the index case had not infected sheep on a nearby farm or that the introduction of disease had occurred at another time of the year when large numbers of sheep were not being traded through markets and dealers as part of the seasonal sheep management cycle. Setting aside the problems of diagnosing FMD in sheep, prolongation of the epidemic could in part be attributed to changes in the structure of the sheep industry over the years leading to a greater reliance on shared or contract labour creating greater opportunities for the spread of disease despite a national ban on livestock movements.

[6] Lorenz (1989)Economic evaluation of the foot-and-mouth disease vaccination control programme in the Federal Republic of Germany, Part1.Tierarztliche **44** 275-279

[7] Hugh-Jones (1976) Epidemiological studies on the 1967-68 foot and mouth disease epidemic; the reporting of suspect disease. Journal of Hygiene, Cambridge, **77** 299-306.

# ANNEX 2

## THE ESSEX CLUSTER OF FMD CASES

### Summary

1. On 20 February FMD was confirmed in 3 groups of pigs which had arrived at Cheales abattoir in Essex on 16-18 February. There was no evidence of FMD on the farms from which these pigs originated. The source farms for the three groups were not infected with FMD.

2. FMD virus was probably introduced into the abattoir by pigs delivered from Burnside farm (outbreak FMD/04) on the nights of 8/9 February and 15/16 February. Mechanical and personnel spread from the abattoir was the probable cause of infection at farms in Upminster (outbreak FMD/02), Brentwood (outbtreak FMD/03) and Canewdon (outbreak FMD/05) in Essex.

3. The pigs in which suspect FMD was reported on 19 February showed early acute clinical signs with obvious lameness which could be easily detected on ante mortem inspection. Pigs usually recover quickly especially once the blisters on the feet have ruptured and provided the horn of the hoof does not separate and there is no secondary infection. Affected but recovered pigs would not be expected to show clinical evidence of disease at post mortem examination. This may account for the failure to detect evidence of disease in pigs arriving from Burnside Farm on 8/9 February.

4. No other possible source of infection for outbreak FMD/01 was found in spite of intensive tracing to identify and visit all holdings that might have introduced FMD infection into the abattoir.

### Investigations

5. On 19th February 2001 the Official Veterinary Surgeon at Cheales abattoir in Essex noticed lameness with vesicles on the feet in sows at ante-mortem veterinary inspection. He reported suspicion of a vesicular disease to MAFF and all slaughtering ceased. A MAFF Veterinary Officer (VO) examined the 109 pigs remaining alive at the abattoir and found disease suspicious of FMD in 28 of them. FMD was confirmed the following day after the receipt of positive laboratory test results from the National and World Reference Laboratory for FMD, the Institute for Animal Health, Pirbright, Surrey.

6. An expert from the Pirbright Laboratory visited the abattoir on 20 February. The oldest lesions were seen in two groups of pigs from the Isle of Wight and Buckinghamshire that had entered the abattoir on the 16th February. More recent lesions were seen in the third group of pigs that had arrived from Yorkshire on the 18th February and in a group of pigs that arrived from Suffolk on 19 February, suggesting a very short incubation period.

7. FMD virus Type O, Pan-Asia strain (Knowles and others, 2001)[8] was recovered from epithelial tissue samples from pigs from all three sources.

8. Urgent tracings were instigated and the farms of origin for the 3 groups of pigs were subjected to clinical inspection by the MAFF State Veterinary Service (SVS). No evidence of FMD was found on these farms. This fact, together with the estimated age of the lesions suggested that all the pigs had become infected after leaving their farms.

9. Pigs (cull adults and finishers) were sent to Cheales Essex abattoir from all over the country. Pigs were not normally slaughtered at the weekends. If they arrived late in the week they sometimes remained in the lairage to be slaughtered on the following Monday. This practice appears to have allowed FMD to develop and manifest itself in the pigs that remained in the lairage over the weekend of 16/17 February.

10. MAFF VOs visited all premises that had supplied livestock to the abattoir during the previous two weeks. Tracings were prioritised and visits to premises feeding waste food to pigs were undertaken first. In addition the tracing of dangerous contacts with potential links to the abattoir were initiated.

**11.** On 22 February, a MAFF VO reported suspect FMD at Burnside Farm(outbreak FMD/04) a pig finishing unit in Northumberland. Disease was confirmed following laboratory confirmation on 23 February. This farm had sent sows to Cheales abattoir that arrived on the nights of 8/9 and 15/16 February and which were slaughtered on the mornings of 9 and 16 February.

**Spread of FMD from Burnside Farm (Outbreak FMD/04)**

12. Burnside Farm regularly supplied pigs to Cheales abattoir every Thursday. These were either pigs purchased by the owners from other premises and markets or from their own premises. Burnside Farm had not sent pigs to the abattoir for a period of 4 weeks from 12 January until 8 February.

13. Pigs from Burnside Farm arrived at Cheales abattoir during the night of 8/9 February. 10 sows and 1 boar in the batch were slaughtered on Friday 9 February, possibly quite early in the morning. A further 160 pigs from other sources arrived on 9 February and were put into the lairage over the weekend of 10/11 February. Although they overlapped with pigs from Burnside Farm, no clinical signs of disease were seen in pigs slaughtered on Monday 12 February. These pigs were held in a separate pen and did not move around the lairage.

14. On 15/16 February two batches of pigs arrived at the abattoir. One batch comprised 29 pigs from the owners of Burnside Farm which possibly originated from the farm, the second batch comprised 34 pigs from Burnside Farm and 34 pigs bought by the owners via Darlington market.

15. The relatively small number of pigs sent by Burnside Farm on 8/9th and the relative position of the lairage pens is critical. Some of them may have been incubating

[8] Knowles et al (2001) Outbreak of foot-and-mouth diseasevirus serotype O in the UK caused by a pandemic strain. Vet Rec **148** 258-259

disease in which case virus excretion may have been low depending on the stage of incubation. On 9 February the pigs that overlapped with those from Burnside Farm remained solely in pen 23 at one end of the lairage until they moved for slaughter. As a consequence they did not have close contact with the pigs from Burnside farm. On 15/16 February, Burnside Farm supplied many more pigs to Cheale's Abattoir and it appears there was much more movement within the pens in the lairage over the subsequent weekend which could have facilitated transmission, and with possibly a much greater virus load lead to shorter incubation in the contact pigs.

**FMD infections on other, related farms in Essex**

Old England Farm, Brentwwod (FMD/02)

16. Old England Farm (outbreak FMD/02) is adjacent to Cheale's Essex abattoir and was sometimes used as an extension to its lairage. On Wednesday 14 February a bull from Oswestry entered the abattoir but was too dirty to slaughter and was removed to Old England Farm for cleaning. Old England Farm was visited on 20 February as a dangerous contact to the abattoir. The bull was identified as an index case on the farm with early clinical disease and lesions approximately 1 day old. Pigs on the premises were stated not to be affected.

17. The period is far too short for the bull to have been infected by airborne spread from the abattoir and two other routes of infection are possible:

- the bull became infected in the lairage on 14 February and following a 5 day incubation developed clinical disease on 20 February;
  .
- mechanical transmission of the virus by personnel movement from the abattoir on 16 or 17 February. This would fit in with an incubation period of 2-3 days resulting in the one day old lesions seen in the bull on 20 February.

Great Warley Hall, Basildon (FMD/03)

18. The outbreak at Great Warley Hall (outbreak FMD/03) was reported on 22 February and 3 cattle were identified with 2-3 day old lesions. Two other cattle nearby had signs of FMD when slaughtered on 21 February. This was a beef farm and was 1 km from Cheale's abattoir. There were personnel contacts with the abattoir but the premises were also very close to a minor road down which pigs from Burnside Farm would have been transported to enter the abattoir.

Greenacres Farm, Canewdon (FMD/05)

19. This was a licensed waste food feeding premises situated approximately 30 km from the Cheale's abattoir. Waste food was processed on site and pipeline fed to the pigs

20. The pigs belonged to the owner of Cheale's abattoir and a tracing visit took place on 22 February. Around 40 sows were affected by FMD. The pigs in two pens had the oldest lesions and in one other pen in the same shed, pigs with early lesions were

observed. The pigs in all other pens were unaffected. Early lesions were seen in some pigs in a second shed. Lesions thought to be 7-8 days old were visible when the pigs were slaughtered on 23 February. A stockman had reported they were becoming concerned about the pigs and increasing lameness.

21. By the ageing the lesions on this farms it was apparent that infection had been present from 15 or 16 February.

22. The outbreak at Greenacres Farm raises the question of whether the pigs were infected before the pigs from Burnside Farm arrived at the abattoir on 15/16 February. There are a number of possible options:

- First, infection entered the abattoir at some earlier date from Burnside Farm and infection at Greenacres Farm was due to mechanical or personnel transmission from the abattoir.

- Second, infection at Greenacres Farm predated the infection at the abattoir and was transmitted there and to Old England Farm and Great Warley Hall by mechanical means before the Burnside Farm pigs arrived at the abattoir on 15/16 February. There is no evidence that there was any direct contact with pigs from Burnside Farm. Equally the disease picture at these premises, the timelines and the lack of significant fallout in the immediate area where there were cattle indicators does not support the view that disease at Greenacres farm predated the infection at the abattoir

- Third, infection entered both the abattoir and Greenacres Farm at the same time from another common source. The available epidemiological evidence does not support the existence of disease on any premises in GB predating that at Burnside Farm.

23. Option 1 is the most likely scenario based on the available evidence and suggests that Burnside Farm was the most likely common source for these outbreaks

# ANNEX 3

## OUTBREAK FMD/04 - "BURNSIDE FARM", HEDDON ON THE WALL, NORTHUMBERLAND

### Summary

1. After exhaustive inquiries into the origin of FMD the conclusion has been reached that the likeliest source of infection at Burnside Farm was meat or meat products containing or contaminated with FMD virus consumed by the pigs on this premises sometime between in mid-January and early February 2001.

2. There is strong circumstantial evidence that inadequately processed waste food was the vehicle for the introduction of virus to the pigs especially when considered in conjunction with the procedures for the collection, processing, storage and feeding of waste food to the pigs on this premises.

3. There was no evidence of FMD predating the outbreak at Burnside Farm in the vicinity of the farm or on the premises that supplied it with pigs, or for that matter, anywhere in the UK. No disease was detected during the serological testing and clinical surveillance of farms within the 3km or 10km Protection and Surveillance Zones established around the outbreak. No evidence exists for a possible source of FMD virus from the tracing exercises conducted as part of the epidemiological inquiry carried out in connection with this outbreak.

4. Based on the timescales for infection, the age of the disease in the pigs at Burnside Farm, the movement of pigs to the Essex abattoir where the first FMD outbreak was detected and the airborne spread to Prestwick Hall Farm (outbreak FMD/06), the outbreak at Burnside Farm remains the index case for the GB epidemic of 2001.

5. Airborne spread from this outbreak was probably responsible for the outbreak at Prestwick Hall Farm and also for a further 9 outbreaks in the area under the plumes of virus excreted by affected pigs.

### Investigation

6. FMD was confirmed at Burnside Farm on 23 February following the laboratory examination of samples collected from affected pigs on 22 February. Samples were examined at IAH Pirbright and included epithelium samples from 2 pigs and 20 blood samples taken from other pigs on the premises. The farm was visited on the afternoon of 22 February as a result of the epidemiological inquiry carried out to identify the source of infection for the abattoir outbreak (outbreak FMD/01) in Essex.

7. The pigs were accommodated in 4/5 sheds on the premises and the owners were licensed to feed them processed waste food obtained from a neighbouring premises. They were not licensed to process waste food for feeding to livestock.

8. At the clinical inspection on 22 February, there was little obvious sign of vesiculation in pigs in Shed 1 but the presence of “freckles” lesions on the snouts, indicative of long standing FMD infection, was recorded. None of these pigs appeared notably unwell, distressed or lame. Several, however, showed a growth check line on the hoof, often well down the hoof.

9. Shed 3, contained 70% of all the pigs on the premises. All the pigs in pens 14 & 16 were clearly unwell. They appeared miserable, were huddled together and reluctant to rise. FMD lesions of varying ages were found in the pigs, ranging from 9 to10 days old to one-day-old.

10. On 24 February 200, the premises was visited by FMD experts from IAH Pirbright. His examinations revealed widespread lameness in the pigs and it was estimated that approximately 90% of the 527 pigs on the farm had lesions suggestive of FMD. Many pigs exhibited lameness, with the feet showing separation of old horn from the underlying tissue. Vesicles were found on the snouts of some pigs and it was from these that FMD virus of an identical strain to that found at the Essex abattoir was recovered (N. Knowles, personal communication). The oldest lesions on this farm were estimated to be 12 days old.

11. The pigs with the oldest lesions were found in Shed 2, where a high proportion exhibited lesions estimated at 10 and 12 days old. In contrast, some of the pigs exhibited lesions only one to two days suggesting that disease was still active and spreading within the herd.

12. The pigs in Shed 1 showed lesions that were 1-4 days old with a few aged 8-10 days old.

13. This pattern of lesions suggested that the disease may have been spreading within the herd helped by the continuous introduction of purchased, susceptible pigs and that there may originally have been a point source introduction of FMD infection to one or a small number of pigs

14. Assuming an incubation period of 2-14 days and that those undertaking the epidemiological investigation had been presented with the pig with the oldest lesion, virus could have infected pigs between 26 January and 7 February 2001. However, Burnside Farm had moved up to 85 pigs of the premises on two occasions between 8 and 22 February. With an ever-changing pig population and advancing disease, it is possible that pigs that had recovered from the initial, acute phase of the disease had already been sent to the abattoir. The significance of this is that the pigs that had been sent to slaughter might have had older disease than those evident on the farm and that the introduction of virus onto the holding could have taken place earlier in January.

15. 88% of the 241 pigs blood sampled were seropositive for FMD Type O antibodies. This included pigs that showed no discernible FMD lesions. Given that the pipeline system used to deliver the processed waste food to the pigs was blocked and pigs were therefore being fed using a barrow and bucket, it would have been possible for inadequately processed waste food to have reached only one or two pens of pigs initially. The first phase of disease could then have been succeeded by second and third waves until all the

pigs on the premises were infected. The disease could spread to other pens in the same house, and then adjoining houses. This could support an earlier introduction date.

**Origin of the outbreak**

16. A full investigation has been made into the origin of the outbreak and all possible routes by which FMD could have been introduced onto the farm between 1 January and 22 February 2001have been considered.

- *Movements of live animals:-* The statutory animal movement records for Burnside Farm showed that all pig movements off the premises were sent to Cheale's Abattoir in Essex: The animal movements onto Burnside Farm involved the direct purchase of 110 pigs from 11 producers between 3 January and 19 February 2001. All these producers were visited and none showed evidence of FMD on their premises

- *Purchase of pigs from markets:-* Burnside Farm purchased pigs at Darlington, Thirsk, and Stokesley Markets.

    - Darlington between 11 January 2001 and 15 February 2001. Burnside Farm purchased 83 pigs from 23 vendors. No evidence of disease was found on these premises when they were visited and no outbreaks of disease were associated with the movement of pigs from these premises

    - Thirsk between 4 January 2001 and 15 February 2001. Burnside Farm purchased 116 pigs from 46 vendors. Again, no evidence of disease was found on these premises when they were visited and no outbreaks of disease were associated with the movement of pigs from these premises

    - Stokesley between 2 January 2001 and 13 February 2001 Burnside Farm bought 90 pigs from 16 vendors. No evidence of disease was found on these premises when they were visited and no outbreaks of disease were associated with the movement of pigs from these premises.

- These visits to market vendors premises and the lack of evidence that disease was present in Darlington, Thirsk or Stokesley Markets indicates that the markets and the vendors were unlikely to have been the source of FMD infection for Burnside Farm.

- *Movements of people***:-** The tenants of Burnside Farm lived off site and visited the premises daily. Their landlord was not a farmer and did not enter the site. They had contact with the owner of Heddon View Farm East Heddon, where the waste food used by Burnside Farm was processed. There was one employee, who also had contact with Heddon View Farm.. There were no other visitors. Burnside Farm visited Thirsk, Stoksley and Darlington Markets during the period. No disease was associated with market source tracings. There were no migrant workers employed and none were noted in the area.

- *Feed*:- Burnside Farm was licensed under the Animal Byproducts Order 1999 to feed processed waste food to its pigs: it was not licensed to process waste food for feeding to livestock. The waste food for Burnside Farm's pigs was collected from a

number of restaurants, hotels, schools, bakeries and an armed forces establishment in the north-east of England by the tenants and two other collectors using their own vehicles. The records maintained by Burnside Farm did not allow these sources to be identified reliably. Unprocessed waste food was deposited on a hardstanding outside the curtiledge of Burnside Farm before being sent for processing at a neighbouring establishment, Heddon View Farm, after which it was returned to Burnside for feeding to the pigs, Burnside Farm had a pipeline feeding system for delivering the processed waste food to the pigs but this had not been in operation since late 2000 and the processed waste food was being fed by means of a barrow and bucket.

Bins of unprocessed waste food were present on Burnside Farm at the time of the MAFF VO visit on 23 February, some of which was in bins supposedly reserved exclusively for processed waste. There was also evidence of cutlery in the pig troughs and pens at Burnside Farm. Catering waste normally contains some cutlery but it would be unusual for this cutlery to survive the processing operation and end up in the processed waste fed to livestock.

- *Vehicles and equipment:-* Slurry tanker traced with negative results. No visits by the knackerman.

- *Public:-* No public footpaths or rights of way crossed the premises which were locked. The gates giving access to the premises were chained and locked. There was a well maintained perimeter fence. No hunts, hare coursing or whippet racing crossed the premises. No new age travellers seen in the area

- *Vehicles and Equipment:* No evidence of disease was found on all the premises linked by vehicle movements with Burnside Farm. The tenants of Burnside Farm used their own vehicles for private movements. A contractor was used to move pigs from markets and to abattoir. They entered the site and reversed to a loading bank. Only Burnside Farm vehicles are thought to have entered the farm. Equipment moved between Burnside Farm and the waste food processing premises at Heddon View Farm.

- *Discharges onto site;* - Human sewage sludge was not used on the premises. Slaughterhouse effluent had not been used on the premises. There was no evidence of discharge or overflowing from septic tanks from houses adjoining the premises.

- *Materials used on the farm:* - Bedding was only used in hospital accommodation. No bedding had been purchased during the risk period.

- *Wildlife:* - There were 2 dogs on the premises. No cats. No feral pigs, goats or sheep were in the area. Foxes seen occasionally in the area, no den on farm, not seen in or near farm buildings. Badgers were not reported on the farm. Rabbits and hares were present in the area. Roe deer were seen in the area but had not been seen in or near the pig sheds. Rats were present. No control other than the presence of 2 dogs on the premises.

- *Birds:* -No migrating flocks were noted passing or alighting on the site during winter of 2000/2001. Birds noted include crows, sparrows, pigeons and starlings. None were recorded in unusual numbers. Small birds fly into farm buildings.

- *Waste Disposal site*: -There was a municipal waste disposal site within 10 km run by Seta. No flocking of seagulls from this site had been seen. No movement of waste from the site had been seen or recorded.

- *Newcastle airport:* - The airport is 5 km from the farm. There was a chain link, 2 metre high, perimeter fence around the airport. The airport buildings and main car park were 5 km from the farm; an overflow car park was half km further away.

- *Neighbouring farms:* -Clinical examination of cattle and sheep and serological surveillance of sheep within the 3 km protection zone and 10 km surveillance zone was completed with negative results. No disease, which predates infection at Burnside Farm was found during the epidemic.

- *Windborne: -T*he prevailing wind was from the southwest and there was not evidence that windborne spread could have caused disease on these premises. Viral plumes from the premises infected ten farms to the north and east.

- *Illegal rubbish dumping:* -There was unprocessed waste food on the premises

# ANNEX 4

## PRESTWICK HALL FARM, PONTELAND, NORTHUMBERLAND (OUTBREAK FMD/06)

### Summary

1. Having investigated and eliminated all other possible sources of infection the likeliest source of infection for the animals on Prestwick Hall Farm (outbreak FMD/06), was airborne spread of virus from infected pigs belonging to Burnside Farm (outbreak FMD/04)

2. The FMD virus could have infected cattle as early as 2 February but if sheep were the species first infected, then this could have occurred earlier in January especially if the sheep treated for lameness on 6,10 and 12 February were affected by FMD and experienced the maximum incubation period. However, tracing evidence suggests that when a sheep scanner was there on 3 February, the sheep were not excreting virus.

3. The sale of 19 sheep, some of which were incubating disease, from Prestwick Hall Farm to Hexham market on 13 February represents the initial stage of the widespread dissemination of FMD virus.

4. Ten of these sheep were subsequently sent for re-sale to Longtown Market on 15 February and the movement of sheep through this market and those held on later dates, resulted in the introduction of infection to the sheep dense areas of England and Wales and the southern borders of Scotland.

### Investigation

5. FMD was confirmed on Prestwick Hall Farm, Ponteland Northumberland (outbreak FMD/06), a mixed beef and cattle sheep farm, on 23 February 2001 as a result of the ownerreporting suspect FMD in his cattle. The farm enterprise comprised three farms, two in Ponteland and one near Morpeth.

6. On 25 February, experts from IAH Pirbright carried out a detailed investigation on the premises. Four groups of cattle housed in a single shed showed evidence of FMD but young stock housed separately did not have evidence of disease. Of the four affected groups, 38 heifers in two groups in the southwest corner of the shed all had lesions but only 13/37 bulls housed in two groups on the other side of the shed were showing lesions

7. Epidemiological investigations revealed that until 12 February a group of 26 ewes were grazed during the day and housed at night in an outside bull pen close to the affected heifers which had the oldest lesions (estimated as 9 days old on the 25$^{th}$

February). The group of 26 was reduced to 11 when 15 of the ewes, together with a ram from a separate field and 3 sheep from the owner's other premises, were sent to Hexham market in Northumberland on 13 February.

8. The ewes had been kept together since early February. The owner reported that the group of 26 had experienced two episodes of lameness which he thought to be due to "foot scald" necessitating footbath treatment on 6, 10, 12 and 20 February. Examination of the 11 remaining ewes from this group when they were slaughtered on 25 February, revealed healing foot lesions consistent with FMD in five animals; all 11 were seropositive for FMD.

9. As far as the cattle were concerned, the oldest lesion (9 days) was observed in a heifer when the livestock were slaughtered on 25 February. The other animals in the group had lesions aged 3 days whilst the majority of affected bulls had lesions aged 1-3 days. If the cattle were the first to be infected, this would suggest that the index case on the farm developed clinical signs of disease on about 16 February. With an incubation period of between 2 and 14 days infection could have been introduced on 2 February.

10. However if the sheep had been infected first, the foot treatments on 6, 10 and 12 February could be significant especially if the lameness diagnosed as "foot scald" was due to unrecognised FMD. This was the group that were all positive for antibodies on 25 February. If the initial lameness had been due to FMD, then taking an incubation period into account, the virus could have been introduced onto the farm at an earlier date than if the cattle had been first affected and as early as 23 January.

11. In summary, it is considered likely that the affected sheep were infected concurrently with, and possibly earlier than, the affected cattle. None of the other 339 sheep on the premises showed clinical or post mortem evidence of disease.

**Origin of the outbreak**

12. A full Investigation has been made into the origin of FMD and all possible means whereby FMD could have been introduced onto this farm have been considered in the period 23 January to 19 February 2001.

- *Movements of animals*: - Although cattle and sheep had been moved onto Prestwick Hall Farm, they only originated from the owner's other farms High Callerton, Ponteland, Northumberland, where no disease was recorded prior to slaughter as a "dangerous contact" premises, and Shaftoe Moor Farm, Morpeth, Northumberland where no disease has been diagnosed

- *Movements of people*: - The farmer and his sons moved between the farms but ~~T~~he second son farmed 15km away at Shaftoe Moor Farm, Morpeth, Northumberland and visited the Ponteland farms in the risk period; his stock remained alive and were examined clinically and serologically with negative results. There had been no contact with other farms and they had not taken foreign holidays in the past 12 months There had been no other significant visits apart form one by a sheep scanner who visited on 3 February to scan ewes. No disease had been found on any premises visited by him

either before or after the visit. There were no migrant workers employed and none were noted in the area.

- *Feed:* - Bulk feed was delivered on 28 January 2001, first delivery of the day vehicle and the driver did not enter livestock yards as the feed store was beside the farm entrance. Oats and barley were rolled at Home Farm, and delivered daily to Prestwick Hall using the same bags.

- *Public:* - A footpath passed outside the farmyard and was used by local people. No disease was found on surrounding farms. The right of way did not enter the handling pens or yards, only fields. No picnics were held. No hunts, hare coursing or whippet racing took place.

- *Vehicles and Equipment*: - The owner used his own vehicles. Only own farm vehicles were known to have entered the farm. No evidence of cyclists having using the footpath, none had been seen. No equipment was shared or used by farms out with the same ownership.

- *Discharges onto site:* -Sewage sludge had not been used on the premises. Slaughterhouse effluent had not been used on the premises. There was no evidence of discharge or overflowing from septic tanks from houses adjoining the fields. There was no evidence of fly tipping on or near the farm. There was no evidence of picnic site litter or food wrappings.

- *Materials used on the farm*: - Home-produced straw was used for bedding. No bedding had been purchased. Straw was stored on the site adjacent to the cattle sheds.

- *Wildlife:* - The owner had a collie dog, which he took between the two farms (Prestwick Hall and Home Farm). No feral pigs, goats or sheep were in the area. Foxes were occasionally seen in the area, no den on farm, not seen in or near farm buildings. Badgers were not reported on the farm. Roe deer were seen in the area but had not been seen in or near the cattle sheds.

- *Birds:* -No migrating flocks were noted passing or alighting on the site during winter 2000/2001.Birds noted include crows, sparrows, magpies, pigeons, starlings, robin. None were recorded in unusual numbers. No shooting parties had entered the site.

- *Waste Disposal Site:* - There was a municipal waste disposal site within 5km run by Seta. No flocking of seagulls from this site had been seen. No movement of waste from the site had been recorded.

- *Newcastle Airport* was across a road from the farm. There was a chain link, 2 metre high, perimeter fence around the airport The airport buildings and main car park were 1 km from the farm, an overflow car park was ½ km away. There was no access from the airport or car parks to the farm.

- *Neighbouring Farms*: -No disease was found on farms with livestock that were contiguous with the farm boundaries. Clinical examination of cattle and sheep and serological testing of sheep within the 3-km protection zone was completed with

negative results. No disease, which predates this IP, had been found in the area except at Burnside Farm.

- *Windborne:* -The potential windborne spread of FMD virus from Burnside Farm was later modelled using the Epiman (Sanson and others, 1999), NAME (Gloster and others, 2001) and 'Rimpuff' (Sorenson and others, 2000) models. IP 2001/06 is ~~8~~ 5km north-east of IP 2001/04 and lies under the predicted plume. Suitable weather conditions existed for airborne spread from Heddon to Ponteland in mid January. During early February there were suitable weather conditions not only for spread of virus to Ponteland but also to other farms in the area. The significance of airborne spread in causing FMD at PrestwicK Hall Farm would be dependent on the timing of virus excretion from the infected pigs at Heddon.

# ANNEX 5

## THE ORIGIN OF THE FOOT-AND-MOUTH DISEASE VIRUS CAUSING THE UK 2001EPIDEMIC

The PanAsia strain was identified in India during 1990 and spread westward into Saudi Arabia during 1994 and then throughout the Middle East becoming essentially endemic. Major outbreaks were caused in many countries in the Middle East during the following two years and this particular strain progressively replaced the other Type O strains circulating in the countries. It was responsible for outbreaks in Saudi Arabia on large dairy farms during 1999 in spite of regular vaccination. It reached Turkey from where it then spread into Greece and Bulgaria in1996.

This strain has spread northwards from India into Nepal where it was identified in 1993 and 1994, Bangladesh in 1996 and Bhutan in1998, infecting mainland China by 1999. In 1999 the virus was identified in Taiwan and in 2000 in South Korea, Mongolia, eastern Russia and Japan

In September 2000 it caused the first outbreak of FMD type 0 in the Republic of South Africa where the origin was attributed to the feeding to pigs of untreated shipping waste. The primary case was in pigs but later the disease spread to cattle on the neighbouring premises. Intensive investigations indicated that the disease had been contained in the 10km control zone.

The nucleotide sequences of the VP1-coding regions (639 nucleotides) of a large number of foot-and-mouth disease virus (FMDV) type O isolates belonging to the PanAsia strain have been examined at Pirbright over the last few years. These genes differ by no more than 5% despite being isolated over a period of 11 years.

Virus isolates from recent outbreaks of FMD in South America have been sequenced (VP1 gene) in Pirbright, Brazil (PANAFTOSA) and Argentina (INTA). None of these viruses are related to the PanAsia strain. Similarly, FMD type O viruses from various African regions with the exception of the isolate from Kwazulu-Natal in South Africa are unrelated to the PanAsia strain.

Phylogenetic analyses of the VP1 gene showed an extremely close relationship between the UK and South African outbreaks (99.7% nucleotide identity) leading to the conclusion that they must be connected, either directly or via a third country (i.e. the two outbreaks had a common origin. All of the viruses most closely related to the UK and South African isolates come from the Far East (including south-east Asia), with the Japanese isolate being the closest. Many viruses isolated between 1999 and 2001 in the Middle East (including Turkey) also belong to the PanAsia strain, but are more distantly related.

Confirmation that the UK virus is most closely related to the South African isolate (99.7% nucleotide identity) comes from using other techniques involving complete genome sequencing. Further analysis of these complete genome sequences is in progress.

This note reviews the latest information on the likely origin of the UK outbreak based on nucleotide sequence comparisons. There is no absolute certainty as to the extent of the spread of the PanAsia strain similar to the UK isolates.

## Conclusion

Thus it is most likely that the origin of the UK and South African outbreaks lies in the Far East and that both outbreaks were caused by the feeding of untreated infected meat or meat products to pigs.

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# ANNEX 6

## POSSIBLE ROUTES BY WHICH FMD TYPE O PANASIA STRAIN OF VIRUS COULD HAVE ENTERED GREAT BRITAIN IN 2000/2001

### Summary

1. In order to infect animals, the virus must be introduced into the country in a minimum infective dose and come into contact with susceptible species in order to establish the infection. There may be a single entry or multiple entries, which in turn may or may not initiate disease.

2. A detailed analysis of potential routes of entry into GB (See the analysis at Appendix 1) suggests that the source of the virus for the 2001 epidemic was most probably infected meat or meat products. The probability of other sources is very low, especially with this strain of virus.

3. To present a risk, virus must enter the country in a viable state and a minimum infectious dose must reach a susceptible animal. (See details at Appendix 2). There are essentially four possible routes by which disease could have entered the country:

- legal imports into the EU from countries with FMD, in which case they must come from defined FMD-free regions approved by the EU Commission
- personal imports in baggage, by mail or by courier;
- illegal commercial consignments
- ships' or airline waste which has not been disposed of in accordance with national (UK) legislation.

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4. Whilst legal imports are theoretical possible as an origin of disease, the complex of risk management measures makes the practical reality of this occurring extremely unlikely. Legal imports have not taken place from any country where the PanAsia strain occurs, apart from South Africa. Information available on imports suggests it is highly improbable that disease was imported from South Africa in this way.

5. It will never be possible to determine the exact route by which the virus entered the country. Personal imports could pose a problem if they were infected and were then discarded in such a way that animals could gain access to them. Experience has shown that only on flights from the African continent are quantities found sufficiently large to be sold into the restaurant trade. But it is more likely that most will go for personal consumption or be discarded as domestic waste and not as catering waste that could have been fed to livestock. Even then, such waste would only have presented a risk to livestock if it had not been properly cooked to destroy FMD virus, a legal requirement that has operated in the UK since 1973 The feeding of catering waste containing meat or meat products was banned early in the 2001 epidemic..

6. Illegal, commercial size, shipments where the meat is likely to be dried, cured or salted are more likely intended for wholesale outlets or for sale direct to restaurants or canteens. This increases the chance of the virus getting into catering waste and if not properly processed find its way into susceptible pigs in sufficient quantities to cause disease.

**Possible Routes of Introduction of Infection via meat or meat products into Great Britain**.

7. The following are regarded as presenting a negligible risk

i. Meat products heated in hermetically sealed container (con) to a $F_o$ value of 3 or more.
ii. Meat deboned and heated to a core temperature of at least 70$^o$C.
iii. Meat deboned and matured for 9 months (hams)
iv. Deboned meat subject to pH of less than 6 throughout its substance.

8. The above present negligible risk whether legally or illegally imported. Products, which have not satisfied the full requirements of ii, iii or iv above, present a risk if fed directly to pigs. The level of risk depends on the origin of the meat, the quantity fed and process used to prepare the product. Virus will survive in partially cured products such as bacon and air or sun dried meat for up to 6 months.

9. The risk from meat varies greatly depending on country or region of origin, livestock species and cut of meat. FMD virus is inactivated within 48 hours in muscle held at 4$^o$C where the pH falls below 6. The pH changes in pork are less than for beef or sheepmeat. However virus will live for <u>at least</u> 5 months at 4$^o$C (chilled) in bone marrow and lymph nodes. If the carcass is frozen the virus could survive for at least 6 months and possible for several years.

10. Legally imported meat will be certified as coming from FMD free countries or regions. If from an FMD vaccinating country or region only deboned matured beef permitted. There are strict conditions applied to legal imports.

11. The highest risk is illegally imported consignments of meat or meat products from countries with endemic FMD and from meat, especially pork, that is still on the bone and with lymph glands attached. Deboned frozen meat especially pork also presents a risk but the likelihood of a significant quantity of frozen meat evading checks is low as it will tend to be in refrigerated containers and easier to target.

12. The high-risk areas for the current strain of FMD virus are Eastern Mediterranean, Middle East, India and Far East where the virus has spread since 1990. Other strains of FMD virus are present in South America, Africa, Middle East and Far East. These illegal imports could be in personal baggage or commercial consignments.

## Personal Imports

13. We have evidence that illegal importations of meat, meat products and fish occur on a regular basis in personal baggage from a number of countries. Searches in the past year have revealed significant quantities of meat from Ghana and Nigeria. Smaller quantities of higher value meat and products have been found on flights from China and Malaysia.

14. Only on flights from the African continent have sufficient quantities been found that give rise to the suspicion that some may be destined for sale to the restaurant trade. But it is more likely that this material is destined for personal consumption or sale for private consumption from market stalls and that unused material would go into domestic waste and not into the waste food chain and hence into livestock. Of course casual discard of these products in such a way that livestock could consume them is a risk e.g. CSF ham sandwich theory.

## Commercial Imports

15. All legal shipments are notified in advance and arrive at Border Inspection Posts where they are checked to ensure they are correctly certified and identified.

16. Illegal shipments are likely to be imported by container or hidden as part of a container load, the contents of which are not disclosed to the Border Inspection Post or HM Customs as animal products and subject to inspection. The meat is likely to be dried, salted or partly cured. It will be intended for wholesale outlets or direct to restaurants or canteens. This increases the chance of virus getting into catering waste and if not properly processed into susceptible pigs in sufficient quantity to cause disease. During 2001 we had knowledge of 2 containers containing illegal meat products entering the country and 3 being intercepted at the port of entry.

17. HM Customs X-ray significant numbers of containers entering the UK as part of its measures against duty evasion and drug trafficking. For example, 7,348 containers were scanned in November 2001 including certain intra-Community traffic. Whilst these checks are not specifically looking for meat, examination following unexplained images would have been likely to identify large scale meat smuggling.

18. Also an exercise to establish the accuracy of Customs declarations was undertaken between 1 November 2000 and 9 April 2001. During this period, 132 Customs declarations were selected as a control sample to test overall compliance with Customs requirements. All consignments selected were to physically examined. Within this sample no instances were found of failure to declare meat products.

## Examples of illegal imports

19. On 5 April 2001 and investigation officer and staff from DEFRA visited a warehouse in Northumberland. The warehouse was owned by a company that provided a storage facility for customers. During the investigation a large quantity of foodstuffs originating from China or Hong Kong were identified. Amongst it were 24 baskets containing dried legs. The anatomical structure of the preserved legs and the presence of cloven hoof structure indicated that they were the legs and feet of pigs. The Chinese characters, which were legible on the hams, suggested that the place or district of origin was in the province of Zhejiang in China, which is famous for Chinese style ham production. The legs were submitted to IAH Pirbright for virus testing but no OIE list A viruses were isolated. The range of test included feeding material to pigs under experimental conditions.

20. Southampton Port handles some 35 million tons of cargo annually. incorporating 55 thousand commercial shipping movements. The container terminal currently handles 1.2 million containers each year with over 1.300 containers of food arriving monthly. The principal trade links are with the North America, South America, Indian Subcontinent, Middle and Far East.

21. The Port Health Authority had identified a recent problem with the importation of animal products contained within personal effects that were either undeclared or mis-described on the ships manifest and on 21 February 2001 it intercepted a consignment of personal effects which contained cured meat sourced from Saudi Arabia. The total of ten cartons were opened and found to contain various undeclared products of animal origins. These illegal products were subject to a Regulation 25(1) Rejection Notice and were destroyed under the supervision of the Authority.

**Waste food from ships and aircraft**

22. EU and UK law prohibits the feeding of this type of higher risk waste food to animals. All such food from ports and airports is collected under MAFF/DEFRA licence and destroyed by incineration or exceptionally supervised landfill. This material presents a high risk if fed to animals and was thought to be responsible for the outbreak of FMD Type O in South Africa.

23. The FMD outbreak in South Africa was probably due to waste from a ship in Durban Harbour being fed to pigs in the nearby locality. The ship was allegedly of Asian origin. The genetic fingerprint of the virus suggests it had originated in the Far East. It is well established that international waste poses a major risk and evidence is available for the spread of FMD, Classical Swine Fever, and African Swine Fever by this route.

**Appendix 1**

**Analysis of possible route for the entry of FMD PanAsia strain into GB**

| | |
|---|---|
| Airborne - | Unlikely: no outbreaks of disease in nearby countries. |
| Live animals - | Low risk: no live susceptible species legally imported from countries which have had FMD in last 2 years or which have vaccinated animals in past 12 months. Illegal importation from third country unlikely. All Member States have same import policy for farm livestock and exotic species on FMD |
| Semen - | Low risk: country freedom from FMD required plus semen held in quarantine for 28 days after collection to check status of donor. Illegal importation easier but again unlikely. No desirable genetics in affected countries. |
| Embryos - | Very low risk for same reasons as semen plus embryos are washed after collection. This would remove FMD virus. Pig embryo transfer not common for technical reasons. |
| Vehicles - | Low risk that contaminated vehicles would come to UK directly from a third country affected with the relevant strain of virus and that an infective dose would reach susceptible animals. |
| Footwear - | Low risk from normal footwear but heavy contamination with organic material e.g. in the grooves of wellington boots where virus could survive for up to 14 weeks in organic material increases the risk. Again contact with susceptible livestock would be necessary. Virus could survive for up to 14 wks in winter. |
| People and Clothing - | Low risk. Would require direct contact with infected animals within 72 hours prior to entering UK and having close contact with livestock. Virus could be carried for up to 14 wks on clothing that was not cleaned or washed. Virus would be cleared from nose and throat 28 hours after exposure. |
| Hides, skins, blood products | Treatment required for legal importation would safeguard against introduction of FMD virus. Low risk that illegally imported or improperly treated skins would come in contact with susceptible animals. |
| Milk and Milk Powder - | The dilution factor involved in producing bulk milk and subsequent pasteurisation ($72^{o}$C for 15 secs) reduces the infective dose such that a pig would have to ingest between 125 and 1250 litres of milk at one session to become infected. At maximum intake the pig would take in between 20 and 200 |

times less than the infective dose. The risk is low.

In unpasteurised milk virus can survive for up to 15 days if refrigerated but would be inactivated as soon as the milk turns sour. The chance of illegally imported untreated milk reaching susceptible animals in sufficient quantity is low.

The combination of the time/temperature treatment and drying process involved in producing milk powder will decrease infectivity by up to 1 million infective doses. Risk is low for milk powder.

Milk Products - The risk of a dairy product produced by a process involving a higher temperature treatment (UHT) or followed by further heat treatment or acid treatment (cheese) is very low. Virus could not be detected in cheddar cheese 2 weeks after processing or camembert 14 days after processing. Survival time depends on the process used.

Risk of an infective dose reaching a susceptible animal is very low.

Meat products - The following are regarded as presenting negligible risk
1. Meat products heated in hermetically sealed container (con) to a $F_o$ value of 3 or more.
2. Meat deboned and heated to centre temperature of at least 70$^{o}$C.
3. Meat deboned and matured for 9 months (hams)
4. Meat subject to pH of less than 6 throughout substance.

The above present negligible risk whether legally or illegally imported. Products, which have not satisfied the full requirements of 2, 3 or 4 above, present a risk if fed directly to pigs. The level of risk depends on the origin of the meat, quantity fed and process used to prepare the product. Virus will survive in partially cured products such as bacon and air or sun dried meat for up to 6 months.

Meat - The risk from meat varies greatly depending on country or region of origin, species and cut of meat.

FMD virus is inactivated within 48 hours in muscle held at 4$^{o}$C where the pH falls below 6. The pH changes in pork are less than for beef or sheepmeat. However virus will live for <u>at least</u> 5 months at 4$^{o}$C (chilled) in bone marrow and lymph nodes. If the carcass is frozen the virus could survive for at least 6 months and possible for several years.

Legally imported meat will be certified as coming from FMD free

countries or regions.  If from an FMD vaccinating country or region only deboned matured beef permitted.

Illegal meat
Highest risk is from countries with endemic FMD and from meat especially pork still on the bone or with lymph glands attached. Deboned frozen meat especially pork also presents a risk but the likelihood of a significant quantity of frozen meat evading checks is low as it will tend to be in refrigerated containers and easier to target.

The high-risk areas for the current strain of FMD virus are Eastern Mediterranean, Middle East, India and Far East where the virus has spread since 1990.  Other strains of FMD virus are present in South America, Africa, Middle East and Far East. These illegal imports could be in personal baggage or commercial consignments.

**Appendix 2**

## Basic principles

1. Before assessing the route of entry in this case consideration must be given to the following factors:-

- Routes of infection
- Minimum dose of virus to cause infection
- Relative susceptibility of different species
- Strain of virus and infectivity

## Routes of infection

2. Two principle routes of infection are

(a) aerosol with virus entering respiratory tract
(b) ingestion by eating food infected or contaminated with the virus.

Minimum dose of virus required to cause infection

3. Theoretically it takes only one infectious particle to establish infection in a susceptible animal but in practice a greater dose is required due to in activation and clearance of virus by the host.

Relative susceptibility of species - minimum dose to indicate infection

| | Respiratory route | Oral route |
|---|---|---|
| Cattle | 12 $TCID_{50}$ (infectious unit) | 1,000,000 $TCID_{50}$ |
| Pigs | >800 " | 8,000 " |
| Sheep | 10 " | |

4. Adult cattle because they inhale a greater volume of air are more likely to be infected by the airborne route than pigs or sheep.

## Effect of strain of virus type on infectivity

5. The minimum infectious dose does vary with virus type, as does the amount of virus excreted by infected animals. The current UK strain produces about 300 times less virus by aerosol from the respiratory tract of pigs than the strain which was used to do many of the infectivity studies. This can also influence the incubation period of the disease

# ANNEX 7

## ALTERNATIVE THEORIES

There have been a number of allegations that FMD existed in the country before the index case at Burnside Farm (outbreak FMD/04). After detailed investigations into the allegations no evidence has been found to indicate that FMD was present in the country before the index case at Burnside Farm.

For convenience these are dealt with in two separate groups

Alternative theories for the origin

Alternative theories for the time that disease was present in the country

### Alternative theories on the origin

Army caused outbreak by importing food from FMD areas.

All food that is imported for use by the Army complies with all relevant UK and EU regulations. This means only importing from areas that are certified free from FMD.

The Type O, Panasia strain of the virus present has not been isolated from outbreaks of FMD in S America that is where the Army sources its imports of meat. The strains of Type O virus in S America are completely different to the {an Asia strain.

The army receives expert advice from the State Veterinary Service for troops, vehicles and armoury returning from countries which are likely to be infected with FMD.

Outbreak caused by escape of virus stolen from Porton Down

No Foot and Mouth viruses have been stolen from either the Centre for Applied Microbiology and Research (CAMR) or the Chemical and Biological Defence Sector (CBD) of DERA at Porton Down. In fact, no samples of Foot and Mouth virus have been held at CAMR or CBD Porton Down.

Virus was deliberately released from Porton Down research establishment.

The laboratories licensed to hold and manipulated FMD virus in the UK are the Institute of Animal Health, Pirbright Laboratory and the Merial Biological Laboratory (FMD vaccine production), on the same site. No other laboratories are licensed for this purpose in the UK, including Porton Down.

**Alternative theories for the time that disease was present in the country**

FMD found in UK sheep exported to France before 1 February - casting doubt on Heddon-on-the-Wall being the earliest point of infection.

The French authorities responded to a UK letter seeking an explanation for the appearance of FMD antibodies in sheep at a French farmers premises when they were sampled prior to slaughter. The French initially indicated that 7 of the 31 samples had tested positively initially but that subsequent tests had showed that all the samples were FMD negative. The French concluded that these findings invalidated the hypothesis that FMD positive sheep were sent from the UK to France prior to 1 February 2001.

MAFF knew about FMD before the outbreak was officially discovered

MAFF's Staffordshire animal health office carried out a routine foot and mouth disease contingency planning exercise in January during which supplies of a range of items we might need to procure are checked. As part of that annual exercise staff contacted suppliers of railway sleepers for incineration. The reason more than one supplier was contacted was that staff were checking prices to find out the competitive rate.

Similarly, officials spoke to the Antec disinfectant company in November last year as part of a normal contractual discussion. Not surprisingly, routine enquiries were made about disinfectant supplies

A veterinary surgeon working for DEFRA is alleged to have indicated that he had seen disease that pre-dated that seen at Burnside Farm

The veterinary surgeon in question was identified and confirmed that this allegation was incorrect.

A claim was made in the Sunday Express that the disease had been present in the UK in 2000

Claims were made in the Sunday Express that Canada knew of the presence of FMD in the UK prior to February 2000. In a letter to the UK CVO, Canadian CVO refuted any such claim.