

Foot and Mouth Disease in Ireland; History, Diagnosis, Eradication and Serosurveillance

Patrick J O'Reilly¹; Michael.O'Connor¹; Anne Harrington¹; Sally Gaynor²; Dianne Clery¹

¹*Central Veterinary Research Laboratory Abbotstown Castleknock Dublin 15 Ireland*

²*Department of Agriculture and Food Kildare Street Dublin 2 Ireland*

Abstract

Foot and Mouth disease first appeared in Ireland during the 19th Century and persisted for about half of that century. However during the 20th Century the disease occurred occasionally with total devastation during its visitations in a primarily agriculture based economy. The 21st century started with a recurrence of the disease. This means by which it came to the island of Ireland are described as are the measures for its diagnosis, control and eradication. It represents the first time in Ireland when modern diagnostic methods proved their value with this disease, which historically has been eradicated on clinical and epidemiological control principles.

Introduction

On the 22 March 2001 Foot and Mouth Disease (FMD) was confirmed in the Republic of Ireland (ROI) after a lapse of sixty years. This article summarizes the history of the disease in Ireland, the diagnosis of the disease on this occasion and its eradication. The rationale and methods of serosurveillance, both to facilitate eradication and to establish that the country had regained its status as a country free from FMD without-vaccination, are discussed.

History of the Disease in Ireland

FMD was first introduced into Ireland in 1839 probably from Great Britain (GB) where it had been introduced in the same year (Ferguson 1842; Anon 1869; Dun 1850). Contagious Bovine Pleuropneumonia also appeared in the country in the same year and may have been introduced with the same animals imported by the Cloncurry family into Cork from the Netherlands. The family however later denied that such an event had ever occurred (Anon 1873).

FMD reappeared in 1869 being conveyed into Counties Antrim and Down via Southampton and the Channel Islands and spread to Co Cork and Waterford by November. Outbreaks began to wane until a further introduction in 1871, with calves imported from Bristol via Dublin to Castlepollard, Co. Westmeath. It continued to persist until 1877 (Anon 1877). The Select Committee on Contagious Diseases XI of 1873 concluded, that attempts to control the disease in Ireland and Great Britain had been unsuccessful. They recommended that the sale of diseased animals in public places or the carriage of infected animals by rail should be prohibited and that the Privy Council should cease issuing orders for the control of the disease. The disease reappeared in 1883 with 1397 outbreaks in Eastern Ireland and a small number in Ulster and Munster. This was eradicated in 1884 following movement controls and stamping out, which was used in Ireland for the first time.

There were no further outbreaks until 1912 when the disease was diagnosed in animals in a slaughter plant in Liverpool. Infection, which was identified by backward tracing, was confirmed on a farm in Swords, Co. Dublin on 30 June. The disease infected 382 animals on 68 herds in seven counties and persisted until 17 November. A Royal Commission of inquiry investigated the handling of the disease

(Anon 1913). One of the side issues was the diagnosis of Armagh disease, which causes peeling of the superficial epithelium of the tongues of cattle and is caused by an undetermined infectious agent. Experiments demonstrated that it could be transmitted to susceptible animals when challenged with homogenized epithelium. No signs occurred when the challenge dose was first passed through a Berkfeld filter. This disease has no clinical significance except that it can be confused with FMD.

FMD was again confirmed on 30 January 1914 with outbreaks occurring in Kildare, Dublin, Cork and Tipperary (Anon 1915). There were in all 76 outbreaks with 957 animals being affected and 4180 slaughtered. Trade restrictions were removed on 9 September. The origin of the disease was not determined.

On 17 January 1921 FMD was confirmed on a premises in Co. Wicklow, which together with a neighboring premises were slaughtered out. No further outbreaks were recorded until 16 May when six farms were detected in southwestern Wexford and a total of 169 animals slaughtered. The origin of these infections was not determined and no connection between the two outbreaks could be established (Anon 1922).

FMD was confirmed on a farm in Wexford town on 17 February 1928 and on two adjoining farms on 22 March. One hundred and seventy nine animals were destroyed. It was suggested at the time that meat imported from South America might be the source of the infection. Trade restrictions were removed on 3 August.

On the 19 June 1931, FMD was confirmed in Downpatrick, Co. Down, NI on the farm of a Mr Hutton from whence it spread to Westmoreland, Lancaster and Yorkshire North Riding. The origin of the infection was not determined, but the introduction of animal feed from the continent was believed to have been the source (Anon 1931b). Trade restrictions were removed on 23 August (Anon 1931; Anon 1931a; Anon 1932).

On the 16 January 1941 FMD was diagnosed at Merklands Wharf Glasgow in cattle exported from Co. Derry NI. On the same date it was confirmed in Eglinton, NI and within a few days in Claudy, Campsie, Thermoyle, Every and Derry City and on 20 January in Bridestown, Kilmanagh Irish Free State (now the ROI). Subsequently the disease affected 556 farms in the Republic of Ireland, of which 5,912 cattle, 143 sheep and 198 pigs were diagnosed as infected and a total of 42,047 animals were destroyed including 27,942 cattle, 10,187 sheep, 3,310 pigs and 608 goats (Anon 1942; O' Brien 1941).

2001 Outbreak

The most recent outbreak was diagnosed in a single holding in Co. Louth in the ROI (Outbreak number FMD 2001/1) on 22 March 2001 in a sheep flock where the disease was first suspected on clinical grounds on 20 March. FMD came to the Island of Ireland (IOI) with a truckload of about 349 sheep imported into NI on 19 February. These had been assembled as two lots consisting of Lot A and Lot B purchased in Longtown Market, Carlisle on 15 February. Lot A went to a lairage at Penrith and Lot B went to Lockerbie in Scotland from 15 to 18 February. Lot A subsequently went to Broadway Market Carlisle for health certification and thence to Lockerbie to collect the other sheep and to unload some. The consignment crossed to NI on 19 February. Initial information indicated that some sheep were dropped off at Killeen and the rest went to Meigh, Co. Armagh NI where 21 sheep were dropped off with the remainder going for slaughter in Athleague, Co Roscommon in the ROI. FMD was confirmed

in Meigh, NI (a distance of approximately 2km from the border with Ireland) on 1 March. FMD was also confirmed at the lairage at Lockerbie.

The disease in Britain was first confirmed in a meat plant in Essex on 20 February. The index case was believed to be a swill feeding pig herd at Tyne on Wear, Heddon on the Wall, Northumberland where FMD was confirmed on 23 February (Case No 4). The date of infection here was estimated as being 2 February. Outbreak number 6 probably became infected by aerial spread from index case no 4. Sixteen sheep from this flock were sent to Hexham Market on 13 February. Ten of these were brought to Longtown Market Carlisle on 15 February (Gibbens *et al* 2001). Thus these sheep movements and probably transport of one of them to NI constituted the source of the Meigh outbreak. Following the confirmation of the outbreak in Northern Ireland on 1 March further epidemiological tracings from the infected holding at Meigh were carried out by staff of DAFRD, including, the Special Investigation Unit (SIU) and the National Bureau of Criminal Investigation (NBCI) of the Irish Police force (The Gardai). Seven premises, including two abattoirs and five farms, had received animals from the single consignment of sheep imported into Northern Ireland on 19 February. No evidence of FMD was found in these five farms, despite extensive clinical and serological examination of all susceptible species present on the holdings, and clinical examination of animals on contiguous holdings.

Materials and Methods

Diagnosis of the disease was based on reported clinical suspicions of the disease followed by inspections and laboratory testing. Virus isolation and identification and virus neutralization tests were performed at the IAH Pirbright Laboratory but extensive serological screening was carried out at the Central Veterinary Research Laboratory, Abbotstown using reagents supplied by Pirbright. The techniques used were the Antigen Capture ELISA (ACE) (Ferris and Dawson.1988) (Roeder, LeBlanc Smith, 1987), the Liquid phase Blocking ELISA (LPBE), (Hamblin, Barnett & Hedger (1986); Hamblin Kitching Donaldson Crowther and Barnett (1987) and virus isolation. Tests were performed in compliance with Office International Epizooties (OIE) Manual of Diagnostic Tests and Vaccines (Anon 2000). Samples were transported to the IAH, Pirbright as described by Kitching and Donaldson (1987) and in compliance with International Airline Transport Association (IATA) rules (Anon 2002).

Suspect Investigations

State Veterinary Officers from local Veterinary Offices investigated suspect cases reported by veterinary practitioners or members of the public. Where samples were to be taken or where a second opinion was sought, officers from one of the six Regional Veterinary Laboratories (RVLs) or from the Central Veterinary Laboratory were deployed. One hundred and sixty four suspects cases were investigated from 25 of the 26 counties between 21 February and 20 July. Animals in fifty two of these cases were sampled and the samples sent to IAH, Pirbright for virus isolation and/ or serology. Thus 31.2 *per cent* of clinical cases required laboratory testing to rule out FMD as determined by clinical opinion. Table 1 illustrates the number of suspected cases by county, the species involved and the proportion of cases where sampling occurred.

Differential Clinical Diagnoses Recorded

Seventy-six suspect cases involved cattle, 80 sheep, 3 pigs and five goats. In 4 cases the species were not recorded and in three cases sheep and cattle presented and in one sheep and goats presented. In excess of 50,000 animals were present on these holdings at the time of suspicion.

Specific clinical diagnoses were offered in 66 cases. These are shown in Table 2. However the making of a specific diagnosis to explain the presenting signs does not always rule out the concurrent presence of FMD. Thus even where a specific diagnosis was made, samples to rule out FMD were sometimes taken. The diagnoses which predominated were Orf,; Foot Rot; Malignant Catarrhal Fever; Mucosal Disease and Papular Stomatitis.

Often where diagnoses were not made the lesions and their locations were described. A summary of these is shown on Table 3. These convey the clinical signs presented to clinicians. Mouth lesions predominated; these lesions were described in 105 cases and limb lesions in 60 cases no lesions were recorded in 29 cases, although a clinical diagnosis was made in some. Lesions in both the foot and the mouth were described in 70 cases. The nature of the lesions were blisters, erosions, ulcers abrasions, trauma and abscesses.

Diagnosis

Mc Manus *et al* (2001) and Murphy (2001) described the clinical signs of the one FMD case recorded (Outbreak number FMD 2001/1). The lesions presented as erosions on the dental pad and adjacent gums, which were demarcated and were between 5 to 25 mm in diameter, extending onto the gums and medial aspects of the lips. The feet of the affected animals were hot and painful. Collapsed vesicles and wetness was seen on the coronary band; inter-digital erosions were also seen. Three lambs aged one to two days old died in the 20 hours prior to examination and 12 more died during examination of the group of 97 ewes. The oldest lesions were estimated to be five days old. FMDV serotype type “O” was confirmed on 22 March by the ACE on two of the five epithelial samples. Virus was isolated from all five samples on cell culture and from one of five heparin samples taken from an animal, which was seronegative by LPBE. The remaining four samples had LPBE titres ranging from 724 to > 2048 and VN titres of 178. Seventeen out of 28 contemporaneously taken samples were antibody positive by LPBE with titres ranging from 90 to >2048. Fifteen of 16 samples taken from sheep on an adjacent land parcel (Proleek) in the same ownership were positive by LPBE with titres ranging from 362 to > 2048 and VN titers 32 to > 90. No evidence of viraemia was substantiated from any of the blood samples. This was considered to be the index case and clinical lesions compatible with FMD infection were seen at the time of slaughter in some animals. It was considered that two cycles of disease might have occurred on this land parcel. Sheep were moved from Proleek to Broughattin about two weeks prior to disease confirmation there. Using median periods for incubation period and infectious periods it was estimated that infection of this site might have been between 25 February and 1 March. The virus strain was confirmed by nucleotide sequencing of part of the genomic region coding for virus protein 1 (VP1) (693 bp) as Pan Asian type “O” indistinguishable from strains isolated in GB and NI (Knowles, Davies, Samuel, 2001 Personal communication; Knowles, Samuel, Davies, & Kitching, 2001).

Prevention

Details of preventative and control measures applied are described elsewhere (Costelloe, Gaynor, Gaynor, McAteer, & O'Reilly, 2002). Immediate restrictions were placed on the importation of live animals from FMD infected EU member states. Additionally, nation wide movement controls were instituted on 28 February. All animals imported from GB since 1 February, from France since 16 February and from the Netherlands since 20 February (i.e. the probable dates that infection occurred in these countries) were traced. The records of slaughter of 78 consignments of slaughter pigs from NI and two consignments of sheep from GB were verified. Clinical examinations were carried out on the holdings of destination of two consignments of cattle from both France and The Netherlands. Clinical and serological examinations were performed prior to slaughter on two consignments of sheep from

GB. All examinations revealed negative results. Increased intensity of measures operated at the 141 checkpoints on the 400 km border with NI in addition to surveillance and publicity at 12 major ports and 8 major airports with international connections.

Control Measures and Eradication

Following the confirmation of the outbreak in Meigh control measures were introduced in accordance with Directive 85/511/EEC in that portion of the protection and surveillance zones in the Republic of Ireland. These included a census, clinical examinations, surveillance, testing and culling of sheep and goats within the zones.

The disease, suspected on the infected holding on 20 March, was confirmed on 22 March. The holding was divided into 7 land parcels with total stock numbers of 113 cattle and 447 sheep and was located 8 km south of the Meigh premises and within the extended protection zone of that outbreak. The area was on the Cooley Peninsula bounded to the south and east by sea and bordering NI to the North. Half of the restricted area consisted of mountain, which provided common grazing for sheep and a number of family groups of wild goats and deer. The holding had been subject to the nation wide ban on movement of susceptible species on 28 February and movement control census and surveillance measures introduced according under the EEC Directive following the outbreak in NI.

The affected animals on the land parcel at Broughattin were slaughtered on 20 March. As a precaution the animals on the remaining land fragments were slaughtered within 24 hours. A cull of all susceptible species within one kilometer of the infected premises was carried out within 36 hours. This cull was later extended from 26 March to include all wild goats and deer on the Cooley Peninsula and extended to include all sheep in the same area from 4 April. A total of 53,000 animals was clinically examined and slaughtered and 4,400 sampled during the precautionary cull in Co Louth. Most of this was performed in a disused meat plant in the area. Carcasses were transported in sealed containers for rendering. The product of this was later incinerated. Clinical examination and serology of the remaining sheep goat and cattle holdings, within the surveillance zone, was in accordance with Council Decision 2001/295/EC. Safeguard measures were introduced to control the movement of livestock and animal products in accordance with decision 2001/234/EC as amended by Commission Decision 2001/267/EC.

A precautionary cull of all susceptible species on the holdings traced from the Meigh outbreak was also carried out following clinical and serological examination.

Control measures introduced to protect against the spread of virus by milk initially included on-farm acidification of milk in the infected area. Subsequently designated milk tankers with filters fitted to the exhaust were used to transport milk for processing into milk powder.

Total prohibition was applied to the holding of markets, to the assembly of susceptible species, to inseminator operated artificial insemination, to sheep shearing etc. A total ban on swill feeding was implemented (from 28 March) and is still in force.

Origin of the Outbreak

The immediate source of the infection and the connection with Britain has been described above. What has not yet been determined is how the animals on the holding in Broughattin or Proleek became infected. Investigations in this respect are continuing.

Serological Surveillance

Targeted Surveillance

At the first announcement of FMD in Britain reagents were sourced from the Institute of IAH, Pirbright to permit the screening of samples for antibody using the LPBE. Fortunately, a member of staff had attended a training course on FMD diagnosis in Pirbright in the year prior to this outbreak.

The samples taken for laboratory testing for diagnosis and surveillance are recorded in Table 4. In the tracing and eradication phase of the outbreak targeted surveillance testing was performed, which included the screening of 23,902 samples from 1,012 flock and herd units in 18 counties. Most of these arose in the surveillance testing in the initial protection and surveillance zones around Meigh and subsequently in the zones surrounding Proleek /Broughattin. The remaining samples arose from the tracings related to imported and exported stock and tracings associated with illegal or suspected illegal movements. Over 4,400 of these samples were taken during the precautionary cull immediately prior to slaughter.

Screening of these samples resulted in 463 samples being sent to Pirbright for confirmation (using the LPBE and VNT) of which 39 proved to be positive and four suspicious. Most of the positive samples arose from the two land fragments already referred to. Four other samples gave rise to positive results on animals sampled in contiguous flocks during the ensuing cull following disease confirmation. One of ten samples taken from a third parcel of land in the same ownership gave an LPBE titre of 1448 but was negative to VNT. One sample of 61 from a neighboring flock to the first confirmed fragment at Broughattin gave an LPBE titre of 362 but was also negative on VNT. Three other samples with LPBE and VNT titers respectively of 2048 and 64: 181 and 22: 256 and 32 relate to a single animal of twelve sampled on a contiguous farm and two wild goats on a contiguous area of commonage to the infected farm. These samples were all taken at the time of the cull.

The animals, which gave suspect reactions, were all negative when these animals were retested.

Random Survey

It was apparent that there were difficulties in establishing the presence of infection in sheep with the “O” pan-Asian topotype. This was compounded by the extensive systems of management in use in this species, the possibility of illegal trading and the difficulties in identifying individual animals. It became imperative therefore to perform an extensive random survey to show, that the remaining 38,325 flocks in the country, containing 7 million sheep, were free of the disease.

The survey design was based on, and exceeded, the recommendations for serological surveillance in the ‘Guide to the establishment and maintenance of FMD-free zone or country’, which was circulated at the OIE/Food and Agriculture Organization (FAO) International Scientific Conference on FMD on 17/18 April 2001.

A computer-generated, random survey was conducted in two phases. Phase 1 concentrated on flocks in 18 counties, which were at greatest risk of having sheep introduced from Northern Ireland or Great Britain. A total of 3,639 of 18,388 flocks was sampled. Proportional weighting was given such that flocks with more than 100 sheep were five times more likely to be selected than those with 20 sheep. Each epidemiological unit within each selected flock was sampled using a formal randomized technique that would give 95 *per cent* confidence of detecting at least one seropositive animal if a prevalence of 5 *per cent* or greater existed.

Phase 2 concentrated on the lower risk flocks in the remaining counties. A total of 308 of 19,937 flocks was sampled, giving 95 *per cent* confidence of detecting seropositive flocks if they were present at a prevalence of 1 *per cent* or greater. The within-flock sampling was as described above.

All sampled sheep were individually identified. The survey period was between 8 May and 25 July using the LPBE at the Central Veterinary Research Laboratory, Dublin. A total of 159,868 samples from 3,957 flocks from all 26 counties was tested. Of these, 1,232 samples were sent to IAH, Pirbright for confirmatory testing (Table 6). This yielded 11 singleton inconclusive samples. All samples from these animals were found to be negative on resampling, with the exception of one, which was again inconclusive. This animal was slaughtered. A total, including clinical suspect investigations, of 184,324 samples was tested. Of these 2,249 samples were sent to Pirbright in addition to 174 tissue samples and 380 blood samples from primary suspect investigations and 1,695 samples arising from the screening program for confirmatory testing. The screening of samples at the CVRL made the transportation of samples to IAH Pirbright practicable. The prospect of Pirbright meeting all of the ROI testing requirements, in addition to their own requirements and the logistics of sample transportation, would have been impracticable.

ROI was again fortunate, considering the problems in GB and NI, that sufficient reagents to meet the additional requirements of both Ireland and France could be accommodated by the Pirbright Laboratory (Kitching 2001).

Resolution

The checkpoints around Co. Louth were removed on 19 April (the date on which the EU safeguard measures lapsed), leaving the surveillance and protection zones intact. Controls were removed from the latter zones in turn, on 30 April following completion of the clinical and serological surveillance required by Commission Decision 2001/295/EC. The OIE conditions for restoration of the status of Ireland as a FMD free country without vaccination were met on 22 June and this status was confirmed by OIE on 19 September 2001.

Acknowledgements

The authors would like to acknowledge their colleagues in the State Veterinary services both on the laboratory and the field side, who contributed so much to the desired outcome. In particular the tremendous spirit and contribution by the laboratory staff is acknowledged. They would also like to acknowledge the assistance of the staff of the IAH Pirbright in particular Dr Alex Donaldson and Dr Paul Kitching for the supply of reagents to perform the screening tests, report and interpretations of samples submitted to Pirbright and for their advice at crucial times.

References

Anon (1869) Eczema Epizootica- Foot and Mouth Disease. The Veterinarian **XL11**, 852.

Anon (1877) Parliamentary Papers **LXVIII** 345 (Signed by Hugh Ferguson)

Anon (1913) Report on foot-and-mouth Disease in Ireland in the Year 1912 by the Department of Agriculture and Technical Instruction for Ireland. pp.1-68. Printed under the authority of His Majesty's Stationery Office by Browne and Nolan, Ltd., Dublin.

Anon (1931) Foot and mouth disease National Control imposed. Veterinary Record **XI** No's 26 & 31 695 and 843.

- Anon (1915) Report of Proceedings under the Diseases of Animals Act for the Year 1914. Printed under the Authority of His Majesty's Stationery Office by Alexander Thom & Co LTD, Middle Abbey Street, Dublin.
- Anon (1922) Proceedings under the Diseases of Animals Acts. Report by the Department of Agriculture and Technical Instruction for Ireland. London: His Majesty's Stationery Office.
- Anon (1931a) Department of Agriculture Report of Proceedings under the Diseases of Animals Acts for the Year 1928. pp.1-4. Dublin: The Stationery Office.
- Anon (1931b) Foot-and-mouth disease. National control imposed. *Veterinary Record* **11**, 695
- Anon (1932). First Annual Report of the Minister for Agriculture, 1931-1932. pp.112-115. Dublin: Stationery Office.
- Anon (1942) Eleventh Annual Report of the Minister for Agriculture, 1941-1942. pp.121-130. Dublin: Stationery Office.
- Anon. (2002) Infectious substances shipping guidelines, 3rd Ed. International Air Transport Association, Montreal and Geneva
- Anon (2000) Foot and Mouth Disease. In *OIE Manual of Standards and Diagnostic Tests and Vaccines 2000 4th Edition*. Publ. Office International des Epizooties December 2000 Part 2 Section 2.1 Chapter 2.1.1.
- Commission of the European Communities (2001) Commission Decision 2001/234/EC of 22 March 2001 concerning certain protective measures with regard to foot-and-mouth disease in Ireland. *Off. J. Eur. Communities*, **L 84**, 62-68
- Commission of the European Communities (2001) Commission Decision 2001/267/EC of 3 April 2001 amending Decision 2001/234/EC concerning certain protective measures with regard to foot-and-mouth disease in Ireland. *Off. J. Eur. Communities*, **L 94**, 26
- Commission of the European Communities (2001) Commission Decision 2001/295/EC of 10 April 2001 laying down the measures to be carried out before releasing the restrictions applied in accordance with Article 9 of Council Directive 85/511/EEC. *Off. J. Eur. Communities*, **L 100**, 35-37
- Council of the European Communities (1985) Council Directive 85/511/EEC of 18 November 1985 introducing Community measures for the control of foot-and-mouth disease. *Off. J. Eur. Communities*, **L 315**, 11-18
- Costelloe, J. A., Gaynor, M. C., Gaynor, S., McAteer, W. J., & O'Reilly, P. J., (2002). Control of Foot and Mouth Disease: Lessons from the experience in Ireland. *Revue Scientifique et Technique- Office International des Epizooties* in press.
- Dun, Finlay. (1850) On Murrain, or the Vesicular Epizootic. *The Veterinarian* **XXIII**, 485-495.
- Ferguson, H. (1842) A popular Lecture on the Prevailing Epizootic. *The Veterinarian* **xv** 575-592.
- Ferguson, N.M., Donnelly, C.A. & Anderson, R.M. (2001) The foot-and-mouth Epidemic in Great Britain: Pattern of spread and impact of interventions. *Science* **292**, 1155-1160
- Ferris, N. P. and Dawson, M. (1988) Routine application of enzyme linked immunosorbent assay in comparison with complement fixation for the diagnosis of foot and mouth and swine vesicular diseases. *Veterinary Microbiology* **16**, 201-209

- Gibbens, J. C., Sharpe, C. E., Willesmith, J. W., Mansley, L. M., Michalopoulou, E., Ryan, J. B.M., Hudson, M (2001) Descriptive Epidemiology of the 2001 foot-and-mouth disease epidemic in Great Britain: the first five months. *Veterinary Record* **149** 729-743.
- Hamblin, C., Barnett, I.T.R. & Hedger, R. S. (1986) A new enzyme linked immunosorbent assay (ELISA) for the detection of antibodies against foot and mouth disease virus 1. Development and method of ELISA. *Journal of Immunological Methods* **93**, 115-121
- Hamblin, C., Kitching, R. P., Donaldson, A. I., Crowther, J. R., & Barnett, I. T. R., (1987) Enzyme –linked immunosorbent assay (ELISA) for the detection of antibodies against foot and mouth disease virus.3. Evaluation of antibodies after infection and vaccination *Epidemiology. Infection* **99** 733 744.1
- Kitching, P. (2001) FMD- Lessons for the Laboratory. *Cattle Practice BCVA* **9** no 4 231-233
- Kitching, R. P. and Donaldson, A. I. (1987) Collection and transportation of specimens for vesicular virus investigation *Rev. sci. tech. Off. Int. Epiz* **6** (1) 263-272.
- Knowles, N. J., Samuel, A. R., Davies, P. R. & Kitching, R. P. (2001) Outbreak of foot and mouth disease virus serotype “O” in the UK caused by a pandemic strain. *Veterinary Record* **148**, 258-259
- Knowles N.J., Davies,P.R., Samuel,A.R., (2001) Personal Communication
- McManus, T., McConville, J., Collery, P. & Murphy, F. (2001) Diagnosis of the first two outbreaks of FMD in Ireland. *Veterinary Record* **148**, 486-487
- Murphy, F. (2001) Observations on FMD-infected sheep. *Veterinary Record* **148**, 791
- O’Brien, T.F. (1941) Notes on the behavior of the Foot and Mouth Virus during the 1941 epizootic in Eire. *Veterinary Record* **55**, 341-343
- O’Reilly, P. J. and Kitching, P. (1992) Foot and Mouth Disease: A Review and implications post 1992. *Irish Veterinary News* **14** No 7 pp 7-12
- Roeder, P. L., LeBlanc –Smith, P. M. (1987) Detection and Typing of Foot and Mouth Disease Virus by Enzyme Linked Immunosorbent Assay; a sensitive, rapid and reliable technique for primary diagnosis *Research in Veterinary Science* **43** 225-232

TABLE 1

Suspect Cases Reported and Sampled up to 20 July

County	Bovine Cases	Ovine Cases	Porcine Cases	Caprine Cases	Unknown Cases	Total Cases	Sampled	%
Carlow	4	3	0	0	0	7	2	28.6
Cavan	2	1	0	0	0	3	0	0
Clare	4	2	0	1	0	7	0	0
Cork	10	2	0	1	0	13	4	30.8
Donegal	4	2	0	0	0	6	2	33.3
Dublin	3	3	1	0	0	7	0	0
Galway	1	2	0	0	0	3	1	33.3
Kerry	1	0	0	0	0	1	0	0
Kildare	0	1	0	0	0	1	0	0
Kilkenny ^α	3	4	0	0	0	6	6	100
Laois	2	1	0	0	0	3	3	100
Leitrim	0	1	0	0	0	1	1	100
Limerick ^α	3	1	0	0	0	3	0	0
Longford	0	0	0	0	0	0	0	0
Louth ^α	7	16	0	0	1	23	13	52.5
Mayo	1	7	0	0	0	8	1	12.5
Meath ^β	3	8	0	2	0	12	4	33.3
Monaghan	5	1	0	0	1	7	1	14.3
Offaly	1	2	1	1	0	5	1	20
Roscommon	4	4	0	0	1	9	0	0
Sligo	1	2	0	0	0	3	0	0
Tipperary	9	2	0	0	1	11	5	45.5
Waterford	1	2	0	0	0	3	2	66.7
Westmeath	3	3	0	0	0	6	1	16.7
Wexford	4	7	0	0	1	11	3	27.3
Wicklow	0	3	1	0	1	5	2	40
Total	76	80	3	5	4	164	52	31.7

^α Both sheep and cattle presented in one case

^β Both sheep and goats presented in one case

Table 2

Specific Diagnoses Recorded			
Specific Diagnoses Recorded	No Occurrences	Diagnoses	No Occurrences
Abortion	1	Pasteurellosis	1
Barley Poisoning	1	Perinatal death	1
Calf Diphtheria	4	Photosensitization	1
Foot rot	7	Pneumonia	4
Foot and Mouth	1	Sheep Hepatitis	1
Infectious Bovine Rhinotracheitis	1	Sheep Scab	1
Joint Ill	2	Tetany	1
Listeriosis	1	Trauma	5
Malignant Catarrhal Fever	3	Ulcer on Abomasum	1
Mastitis	1	Uraemia	1
Misc Foot Conditions	1	Wear	1
Mouth Damage	1	Respiratory disease	1
Mucosal Disease	4	Mastitis	2
Orf	12	Diarrhoea	1
Papular Stomatitis	4	None	98
Total Diagnoses	66	Total Cases	164

Table 3			
Anatomical Location of Recorded Lesions/ Clinical Signs			
Mouth Associated Lesions	No	Limb and other Associated Lesions	No.
Stomatitis	2	Lame	42
Tongue	33	Foot	38
Lips	11	Interdigital	7
Gingiva	14	Coronary Band	7
Dentition	1	Joint	4
Dental Pad	8		
Hard Palate	8	No With Limb Lesions	60
Retropharyngeal	1		
Muzzle	5	Fever	32
Rhinitis	4		
Salivation	18	Abscesses	5
Vesicles/Blisters	7	Scald	3
		Limb Vesicle/ Blisters	4
No. with no Mouth Lesions	50	No with no Limb Lesions	96
No. with Mouth Lesion	105	No. with Both Mouth & Limb Lesions	70

Table 4					
Summary of Samples Collected for Laboratory Analysis					
Samples	Number	Pirbright	Positive	Suspect	No. Counties of origin
Targeted Survey (Sera)	23,902	463	20 ^γ	4	18
Random Survey (Sera)	159,868	1232	0	11	26
Suspects (Sera)	261(234) ^α	261 (52) ^β	21 ^γ	0	17
Suspects (Tissues)	158	158 (52) ^β	6 ^γ	0	17
Total	184,189	2114	47	15	

^α Number of Animals Samples

^β Number of Cases Sampled

^γ all positive samples relate to infected premises and contiguous farms as described in text