TSE

Chapter Content

Overview

The first case of Bovine Spongiform Encephalopathy (BSE) confirmed worldwide occurred in an animal which died in the UK in 1985 (Wells et al., 1987). The first confirmation of BSE in Ireland occurred in 1989 (Sheridan et al., unpublished). In response to the identification of BSE in Ireland, the Department of Agriculture and Food (DAF) introduced a series of control measures which relied, as the UK measures did, on a ban on the direct feeding of meat and bone meal (MBM) to ruminant animals.

Cases of BSE continued to be confirmed sporadically in Ireland between 1989 and 1995 (average 15 cases annually). The epidemiological features of the cases confirmed in Ireland did not differ in any significant way from those described by Wilesmith et al in 1988 (Griffin et al., 1997). By the end of 1996 it was clear both in Ireland and in the UK that the MBM ban, though capable of controlling disease, was not capable of completely preventing transmission. Several authors (Denny and Houston, 1997; Hornlimann et al., 1997; Stevenson et al., 2000) suggested that the cause of these so called BAB (born after the ban) cases was inadvertent cross contamination of ruminant rations with MBM intended for use in pig and poultry rations. In response to these findings, and the critical repercussions of the UK announcement in March 1996 that 10 cases of a novel disease (now called variant Creutzfeldt-Jakob disease) linked to BSE had been confirmed in human patients, the Department of Agriculture comprehensively reviewed its BSE control strategy, replacing it in 1996 and 1997 with a cumulative risk management strategy aimed at eradication.

Following the introduction of these controls, CVERA began work on a model based on that first used by Anderson et al, in 1996. The purpose of this model was to predict the number of cases per year, assuming that feed borne transmission had been eliminated. Comparison of predicted values with observed values enabled the effect of the enhanced control measures to be measured. Accuracy of this model has been assisted by the results of the active surveillance programme introduced throughout the European Union in 2001 which increased the ability of Member States to identify cases.

Although the controls introduced in Ireland in 1996 and 1997 have been very effective, BSE has been confirmed in a small number of animals born after their introduction (16 cases). Work is currently underway at CVERA with a view to identifying the route through which these animals were exposed.

References

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Wells, G. A. H., Scott, A. C., Johnson, C. T., Gunning, R. F., Hancock, R. D., Jeffrey, M., Dawson, M., Bradley, R., 1987. A novel progressive spongiform encephalopathy in cattle. Veterinary Record 121: 419-420.

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Peer-reviewed papers

These papers have been written in collaboration with colleagues from Canada, Ireland and Sweden.

"The model was used to assess the nature of the disease propagation, to predict the number of future cases and to assess the risk to humans in terms of the number of infected animals that were processed in Ireland"

Analysis and prediction of the BSE incidence in Ireland

Pawitan, Y., Griffin, J.M. and Collins, J.D., 2004. Analysis and prediction of the BSE incidence in Ireland. Preventive Veterinary Medicine, 62: 267-283.

Donnelly and Ferguson (2000) have described detailed epidemiologic models for BSE from the classical mathematical modelling route. The purpose of this paper is to report on the statistical methods that were used to model Irish BSE data. The model was a simplified version of the British models. However, it contained some novel aspects including the development of a numerical method to describe the model parameters, inclusion of over-dispersion in the model and the development of appropriate bootstrap procedures for estimation and prediction. It was fitted to the available data as a nonlinear Poisson regression model. The model was used to assess the nature of the disease propagation, to predict the number of future cases and to assess the risk to humans in terms of the number of infected animals that were processed in Ireland.

"Among BSE case herds identified in Ireland between 1996 and 2000, one statistically significant primary spatial cluster and one statistically significant secondary spatial-temporal cluster both of which may be associated with feed source can be detected"

A temporal-spatial analysis of bovine spongiform encephalopathy in Irish cattle herds, from 1996 to 2000

Sheridan, H.A., McGrath, G., White, P., Fallon, R., Shoukri, M.M. and Martin, S.W., 2005. A temporal-spatial analysis of bovine spongiform encephalopathy in Irish cattle herds, from 1996 to 2000. Canadian Journal of Veterinary Research, 69: 19-25.

This study describes a spatial-temporal analysis of BSE case herds identified in Ireland in the years 1996 to 2000. Geographical clustering suggested by spot and Standardised Morbidity Ratio (SMR) maps was investigated using SatScan Version 2.1. A statistically significant cluster (P=0.0001) without a temporal element was detected in the northeast of the country centred on County Monaghan. A second statistically significant cluster (P=0.001) with a temporal component (1992-1994) was detected in the southeast centred on County Wexford. Both clusters remained significant after correction for confounding by herd size and enterprise type though this correction did remove the statistical significance of a third cluster detected in the south centred on County Cork. Although inclusion of the co-ordinates of major feed suppliers increased the power of the analysis, models were not able to agree on the feed supplier at the centre of either the primary or secondary cluster. The study provides evidence that BSE herds in Ireland cluster geographically. The factor/s responsible for clustering are more likely to be associated with the herd where the case animal was located at the time of infection (putative exposure herds); thought to occur under one year of age. The study provides evidence of a spatial association between feed supplier and clusters of putative exposure herds.

Work in progress

BSE cases in Ireland in post-1997 born animals

Principal investigators: Hazel Sheridan, Rob Doyle (DAF) and Simon More (CVERA)

To date, 16 cases of BSE have been confirmed in animals born after 1997. Of these 16, 4 animals were born in 1998, 7 in 1999, 3 in 2000 and 2 cases were born in 2001.

As described by Dr Wilesmith in the UK, such cases fit the pattern of the 'third' epidemiologically distinct series of cases of which more than 100 have been diagnosed in the UK to date. The first series occurred prior to the introduction of a ban on meat and bone meal (MBM) when cattle were fed contaminated MBM directly. The second occurred between the initial ban and the re-enforced ban and have been attributed to the cross contamination of ruminant rations with MBM intended for use in pig and poultry ration. The third series have occurred in animals born after the enhanced controls (Ireland 1996/1997; UK 1996). The cause of such remains unproven and is still the subject of debate.

In all cases of BSE confirmed in Ireland in animals born after 1997, a detailed investigation has been or is being carried out focussing on the farm in which the case animal spent its first year of life in an effort to establish:

- What feeds which the positive animal may have received in its first year of life;
- Any other feeds which may have been present on the farm when the animal was in it's first year of life;
- Any material which may have been spread on land or used in the environment of the farm on which the animal spent its first year of life has been inspected;
- Any medicines or remedies which were administered to the animal;
- The fate of the animal's dam.

The investigation into 12 of the 16 post-1997 born cases has been completed. Beyond the fact that all cases received concentrate feeding in their first year of life, no factor common to all farms has been found. Both suckler and dairy enterprises have been affected. Cases have occurred throughout the country both in counties with a relatively high incidence in previous years but also in counties which had a low incidence in years gone past. 6 of the cases have occurred on farms, which had another case of BSE either in the same cohort (2 farms have produced 2 post-1997 cases each) or in previous years (2 cases). The dam in 11 of the 12 completed investigations was dead by the time the case was detected. In the one case where the dam was still alive, the dam was purchased and held on the Department's research farm for 2 years. No signs were observed in the animal before slaughter and the animal produced a negative result to a rapid test at the time of slaughter. In 11 of 12 completed investigations, there was no evidence that blood, MBM, factory or knackery waste had been spread on the holding. In one case, adult bovine carcasses had been dumped on land adjacent to where the positive animal spent its first grazing season. Evidence of scavenger activity both at the dump and on surrounding land was detected. A number of farms had working dogs on the holding or an adjacent holding though no evidence could be found (with the exception of the case listed above) that these dogs had been fed on fallen animals. No evidence was found on any holding of failure to comply with the very stringent controls introduced in Ireland in 1996 to prevent unauthorised access to MBM or accidental contamination of ruminant feed with MBM intended for use in pig and poultry rations (with the possible exception of dry dog food). On 4 of 9 affected holdings, evidence of trace amounts of terrestrial land animal bone (sometimes with or without fish bone) were found in feed storage areas and/or disused silos. No evidence could be found that this material had been recently introduced; instead evidence existed that this material had been present on the farm for many years.

"The route through which the small number of animals confirmed positive for BSE (16) born after 1997 (one year after the introduction of enhanced feed controls) were exposed remains uncertain though there is no evidence that the cases are linked to non-compliance with existing feed controls"

Given the number of cases, it is considered unlikely that these cases reflect spontaneous occurrence unless spontaneous disease in cattle is much more common than sporadic CJD in humans. Likewise, maternal transmission is considered unlikely and no evidence could be found of horizontal, iatrogenic or environmental transmission with the exception of the case described in the previous paragraph. Given this and what is known about the transmission of disease in the past, feed borne exposure remains the most likely source of infection in these cases. The precise mechanism by which this has occurred remains unknown. Several theoretical possibilities exist which have yet to be tested in any statistical sense. For example, EU wide feed controls to prevent cross contamination of ruminant rations with MBM intended for other uses did not come into force until January 2001. Given that mainland Europe and Ireland import a considerable amount of feed and feed ingredients, it remains a possibility that the 'infectious' feed could have been introduced from abroad. Also given the findings with regard to terrestrial land animal bone, it remains a possibility that cases could have had access to trace amounts of pre-1996 feed material lying around farms. It should be noted that the amounts were very small and they had been there a considerable length of time. Given that some farms had used dry dog food, which may have contained MBM, it remains a possibility that cases were caused by accidental incorporation of dry dog food in rations intended for ruminant use. Likewise, a theoretical possibility exists that animals were exposed to disease through the spreading of slurry from pigs which had been fed with feed containing MBM (allowed in Ireland until the EU ban in 2001). However, given the regulations regarding the removal of SRMs and pressure treatment of MBM before placing on the market, it is considered unlikely even if cattle had access to such material that it would have been capable of causing disease.

In summary, the cause of these post 1997 cases remains uncertain. There is no evidence that they were caused by a failure to comply with domestic provisions to enhance the feed ban. Cases will continue to be investigated as they emerge though it seems likely at this stage that the cause of these cases may never be known. Disappearance of these cases over time may support a hypothesis that they were caused in some way by residual feed risk, whether this be from feed manufactured before EU wide feed controls or residues on farm. This risk should decline over time.

Year of Birth	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
1981	1																	1
1982	2																	2
1983	1	1																2
1984	6	2	3		1													12
1985	4	8	5	1	2								1					21
1986	1	3	8	8	3	3		2					1	2	1	1		33
1987			1	7	4	3	2	1	2	1				2				23
1988				2	5	7	3	3		2	1	2	1	4				30
1989					1	3	5	8	2	2		1	1	1	4	3		31
1990						3	5	20	11	2	2	1	1	9	2	1		57
1991							1	24	24	8	3	3	7	10	6	3	1	90
1992								16	28	25	13	8	8	10	8	13	2	131
1993									12	29	40	30	19	42	23	16	13	224
1994									1	14	30	44	52	55	34	20	22	272
1995											6	54	115	130	70	39	16	430
1996												6	40	61	32	21	7	167
1997														5	2	3		10
1998																4		4
1999														2		2	3	7
2000																	3	3
2001																	2	2
Total	15	14	17	18	16	19	16	74	80	83	95	149	246	333	182	126	69	1552

Number of BSE cases in Ireland by year of birth and year confirmed, to end of 2005

Modelling the demographics of a cattle population based on data from Ireland

Principal investigators: Jarlath O'Connor (DAF), Eamonn O'Leary (UCD), John Griffin (DAF) and Simon More (CVERA)

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There is a paucity of information on the demography of cattle populations even though many countries have large databases of individual animal data. Some databases are more complete than others with regard to birth and exit data. The Department of Agriculture and Food (DAF), in Ireland, has a database containing all births (1996 onwards) and exits (2000 onwards) in the cattle population. The data has for the most part not been assessed from a demographic perspective. These data were initially recorded to ensure traceability of beef in light of BSE concerns.

The aim of the project is to develop and validate a demographics model for cattle based on data from the DAF database.

The demographics model is based on cohort life tables as used in human actuarial studies. Demographic processes such as births and deaths affect the size and composition of a population. Cohort life tables are tables of data on survivorship within a population. The standard method used to construct life tables is to collect data on cohorts, or groups of individuals all born in the same time period. These are used to determine mortality rates and survivorship, which in turn can be compared from cohort to cohort allowing analysis of their annual variation.

Important future applications of modelled data would be to give a temporally precise count of the cattle population, to look at trends in births and deaths stratified by age, sex or breed, to simulate the effects of ecological processes such as disease on the cattle population, and to help policy makers in the decision making process.

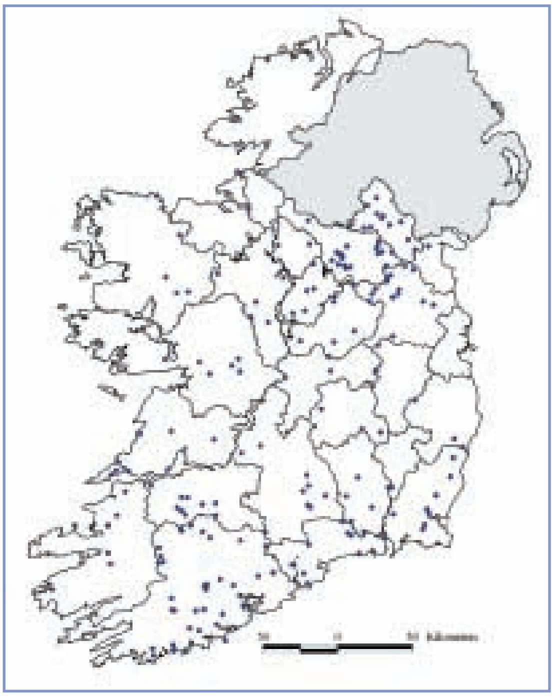
“Work is underway to model the demographics of the Irish cattle population”

Key meetings/presentations

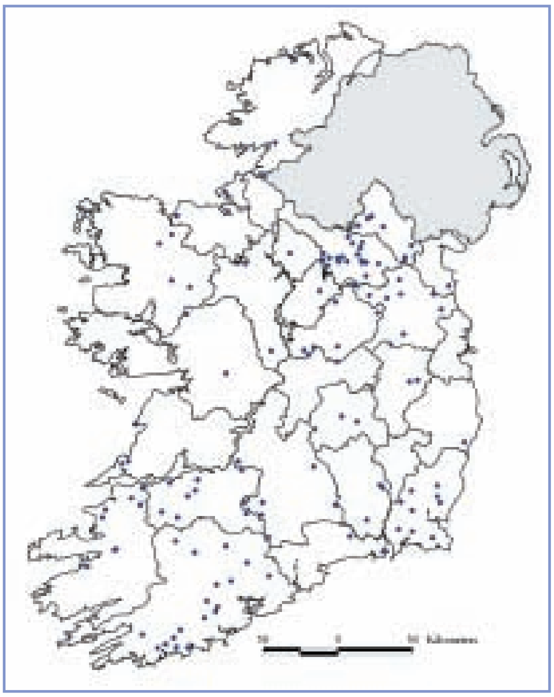
Hazel Sheridan and Simon More

- DAF meeting (BSE investigations; Sligo, 9 February 2005)
- DAF meeting (BSE investigations; Sligo, 1 June 2005)

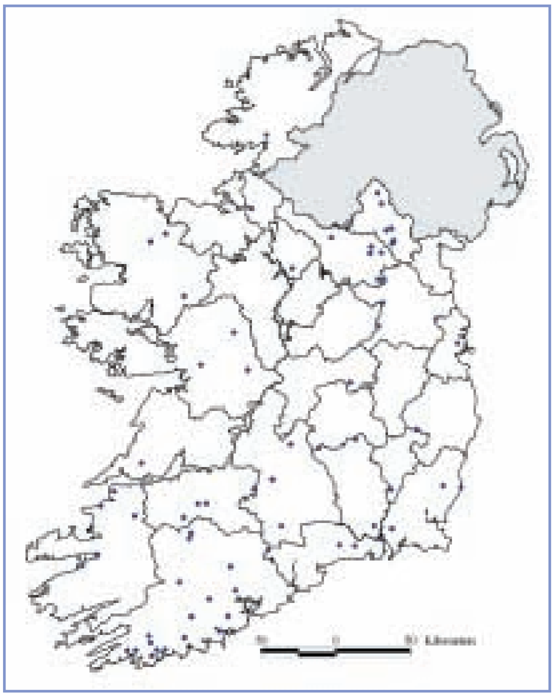
National maps



Confirmed BSE cases in Ireland during 2003



Confirmed BSE cases in Ireland during 2004



Confirmed BSE cases in Ireland during 2005