SPATIAL CLUSTERING OF SWISS BOVINE SPONGIFORM ENCEPHALOPATHY (BSE) CASES

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The first case of bovine spongiform encephalopathy (BSE) has been diagnosed in Switzerland in 1990.[1] Since then, the country has experienced a BSE epidemic that peaked in 1995. Until April 30, 2000, a total of 353 BSE were detected. The main risk factor for BSE is considered to be the feeding of concentrates containing ruminant-derived meat-and-bone meal (MBM).[2] The use of mammalian MBM in ruminant feed was banned in Switzerland in December of 1990. However, 113 cases born after this ban (BAB) have been observed so far. This suggests that, despite the feed ban, ruminant MBM to some extent still has reached cattle. There was some evidence that the spatial distribution of the BSE cases followed the distribution of the underlying cattle population. Among the BAB cases, however, visual evidence pointed towards spatial clusters in at least two distinct geographic regions (Figure 1). The objective of this work was to evaluate the spatial distribution of BAB cases and to generate hypotheses that could explain existing spatial clusters of disease.

Materials and Methods

The addresses (postal ZIP code and town) of the 343 farms on which BSE and BAB cases were known to have been born and reared were geo-referenced to the respective Swiss communities (ArcView GIS, ESRI Inc., Redlands CA 92373, USA). The spatial distribution of the BAB cases was compared to (a) the spatial distribution of a random sample of 2000 farms without a reported BSE case (also geo-referenced to the community level), (b) with the cattle population density information at the community level and (c) with the spatial distribution of the cases born before the feed ban (BBB). Three statistical techniques, the Cuzick-Edwards test (STAT!, Applied Biomathematics, Setauket, NY, USA) as well as Poisson and Bernoulli statistics (SaTScan, National Cancer Institute, Maryland 20892, USA) were used to assess spatial clustering of all cases until September 30, 1999, and the results compared.[3-7]
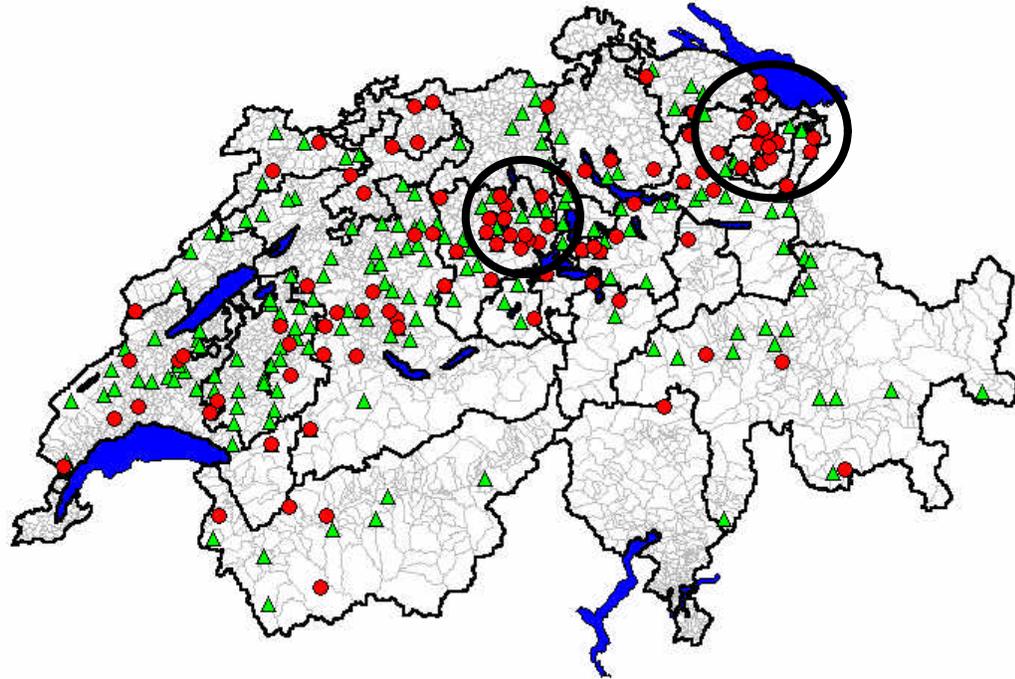
Figure 1 – Spatial distribution of Swiss BSE cases born before the feed ban (BBB = 234; green triangles) and born after the feed ban (BAB = 109; red circles) observed until April 26, 2000 for which the farm of origin (birth/rearing) address was known. Data on farm of origin were not available for 8 additional cases; these cases were excluded from the analysis. "Visual" clusters are circled in black.

Results

Spatial clustering was identified among the BAB cases when compared to the underlying population as well as to the distribution of the BBB cases (Table 1).

Table 1 – Results of spatial cluster analysis of Swiss BSE cases born after the feed ban (BAB) in comparison to the spatial distribution of the cattle population and of the cases born before the feed ban (BBB). P-values of < 0.05 indicate significant spatial clustering

Case data	Control data	Cuzick-Edwards [1]	Bernoulli [2]	Poisson [2]
BAB cases	Random herds	< 0.001	0.001	
	(n = 2000)	< 0.001	0.004	
BAB cases	Cattle population			0.001
	density			0.002
BAB cases	BBB cases		0.009	
			0.063	

[1]The two p-values refer to the Bonferroni and the Simes test statistic, respectively
[2]The two p-values refer to the two most significant clusters identified

The two main clusters identified in the Bernoulli and Poisson tests geographically corresponded with the BAB clusters observed visually.

Discussion

Two significant geographic clusters of BAB cases were identified. At current, investigations are continued to identify hypotheses for the occurrence of these clusters. Some of the possible explanations are regional differences in (a) levels of compliance with the feed ban, (b) levels of process-dependent cross-contamination of cattle feed with feedstuff produced for pigs and poultry (suggested as the main source of infection after the MBM ban), (c) supplementing the cattle rations with pig- or poultry feed and (d) activities of the regional veterinary authorities and practitioners that influence disease awareness, suspect case ascertainment and reporting.

There was no evidence that the Swiss feed ban of 1990 was implemented with regional variation in effectiveness. Data from the United Kingdom and the Republic of Ireland suggest a shift of BSE incidence toward regions with higher pig and poultry density after the introduction of the feed ban, indicating the importance of cross-contamination and cross-feeding for the spatial distribution of BAB cases. The two significant BAB clusters in Switzerland were located in regions of higher pig density. However, there are additional regions with higher pig and poultry densities that are lacking any clustering of BAB cases. This fact and the issue of differential reporting requires further investigation.

References

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