Mortality due to fibrinous pneumonia (shipping fever) can be a significant problem in beef feedlots. Determining whether the disease clusters within specific management groups is an important step towards understanding the epidemiology of the disease and planning preventive strategies. There is anecdotal evidence for the existence of, in the vernacular of feedlot personnel, "wreck pens" or "wreck trucks". These terms refer to pens of calves or transport truckloads of calves where cases of fatal fibrinous pneumonia (FFP) apparently cluster. But these apparent clusters might be no more than coincidental concentrations of FFP cases selected from a truly random distribution of cases throughout the feedlot. The pattern of FFP must be examined critically to distinguish between these two possibilities. The primary objective of the present study was to determine if FFP cases were distributed randomly across the population of auction market-derived calves entering a large commercial feedlot in SW Alberta from 1985-1988 inclusive.

MATERIALS AND METHODS

The subjects for this study were all calves (n = 58,885) entering a large feedlot in SW Alberta between 1 September and 1 January from 1985 to 1989 inclusive. The calves were purchased by sixteen order-buyers buying from 42 auction markets spread across the four western provinces of Canada. Incoming calves arrived in groups from the auction markets on transport trucks capable of handling 75-90 calves per load. Within 24 h of arrival, all calves were processed, identified with eartags, and placed in a home pen, each home pen containing a total of 300 animals. Once created, a home pen did not receive any additions of new animals for the duration of the feeding period.

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The health events for each calf were recorded on a database software program written specifically for this feedlot. The information was entered into computer terminals located at the processing chute and at the hospital chutes. Processing information recorded at arrival for each calf included tag number, date processed, sex, entry health status, vaccinations given, and implants administered upon arrival. A complete necropsy was performed by a veterinarian on all mortalities within 24 h of death. A gross diagnosis was recorded for each case and entered into the feedlot computer. When the diagnosis was tentative, appropriate tissue samples were harvested and sent to the Alberta Agriculture Veterinary Pathology Laboratory in Airdrie for histopathology and microbiology.

The analysis for clustering was performed on each of the four years (1985-1988) separately because the incidence of FFP varied dramatically between years. To determine if cases of fatal fibrinous pneumonia (FFP) were distributed randomly across transport trucks within a pen, a test for homogeneity of binomial samples (Snedecor and Cochran, 1980, pp. 201-202) was run on each individual pen, using the FFP risk for each truck within the pen. A high value of the chi-square for an individual pen was interpreted to mean that the disease was clustering within certain trucks within that pen.

A chi-square value was calculated for all trucks within each of up to 51 pens for each of the four years. With the Type I error rate set at 5% for each individual test, a significant chi-square value was expected by chance alone in 5% of the pens within any given year. If the proportion of pens found to have a significant chi-square within any one year approached 15% (three times greater than the expected Type I error rate), we concluded that cases of FFP were not distributed randomly across the trucks.

To determine if cases of FFP were distributed randomly across pens within the feedlot, a test for homogeneity of binomial samples was run for each year using the FFP risk for each pen. A significant chi-square suggested that cases of FFP tended to cluster within certain pens in that particular year. However, truckload groups of calves were completely nested within pens of calves. Apparent clustering of FFP within certain pens might have been due to clustering within the truckload groups within these pens. To correct for this "truck effect", the chi-square was adjusted using a correction factor calculated from the intracluster correlation coefficient and the average cluster (truck) size (Donald and Donner, 1987).

RESULTS

The overall incidence of FFP from 1985 to 1988 was 1.8%, 1.2%, 2.5%, and 0.3%; the proportionate mortality due to fibrinous pneumonia was 52.3%, 30.2%, 55.6%, and 10.7%,
respectively. Only 2% of the pens had more than two cases of FFP in 1988, whereas 33% or more of the pens had more than two cases of FFP in the other three years.

FFP clustered within truckload in a significant number of pens in 1985 and 1987. The disease also clustered within pen from 1985 to 1987; however, clustering within pen in 1985 disappeared after correcting for the clustering that was occurring within the transport trucks.

**DISCUSSION**

When the incidence of FFP (FFP) was high, the disease clustered—either within truckload groups of calves, or within pens, or both. In 1988 we found no evidence of clustering, but neither did we find many cases of FFP—only one pen contained more than two cases of FFP. The absence of the disease here cannot be used as evidence for the absence of clustering. Our general conclusion, therefore, was that the disease clustered when it was present.

Why did the disease cluster? FFP may have clustered because it is a true contagion. Alternatively, FFP may not be contagious at all. Clustering of FFP cases within truck, for example, might be due to non-contagious factors—like inclement weather, or distance trucked, or other "stressors"—which act on certain truckloads to increase the risk of FFP for calves within those trucks. A third possibility is that sufficient causes (Rothman, 1976) for the disease require both contagious and non-contagious components for completion. Further research is necessary to distinguish between these three possibilities.

Further work is also necessary to develop techniques to predict which truckloads (or pens) of calves are at highest risk to FFP. This would allow feedlot owners to either avoid the problem truckloads completely, or observe them carefully and treat the calves aggressively upon their arrival at the feedlot.

**REFERENCES**

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