

*Haemophilus somnus* Infections I. A Ten Year (1969-1978)  
Retrospective Study of Losses in Cattle Herds in Western Canada

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SUMMARY

A total of 838 outbreaks of fatal *Haemophilus somnus* infections in herds of cattle were diagnosed at provincial veterinary laboratories in Manitoba, Saskatchewan, Alberta and British Columbia during the period 1969-1978. The index cases from these outbreaks included 759 cases of thromboembolic meningoencephalitis, 78 cases of fibrinous pneumonia with pleuritis and one case of *H. somnus* abortion. The epizootics were subdivided on the basis of province, class and age of cattle and seasonal occurrence. Most outbreaks occurred in a feedlot-type of operation, approximately four weeks after arrival of the cattle. There was often a history of respiratory disease prior to an outbreak and in some cases thromboembolic meningoencephalitis had occurred in the herd the preceding year. The average morbidity-mortality ratio was 2.7/1. The average economic loss per herd was \$3 190 based on an average of 15 sick animals and five deaths per affected herd.

RÉSUMÉ

**Infections à *Haemophilus somnus* I. Une étude rétrospective des pertes subies dans les troupeaux de bovins de l'ouest du Canada de 1969 à 1978.**

De 1969 à 1978, les laboratoires provinciaux du Manitoba, de la Saskatchewan, de l'Alberta et de la Colombie-Britannique rapportèrent un total de 838 éruptions d'infections bovines fatales, attribuables à *Haemophilus somnus*. Ce nombre incluait 759 cas de méningo-encéphalite thrombo-embolique, 78 cas de pleuropneumonie fibrineuse et un cas d'avor-

tement. La subdivision des épizooties tenait compte de la province, de la classe et de l'âge des bovins, ainsi que de l'incidence saisonnière des infections à *H. somnus*. La plupart des éruptions se produisirent dans des parcs d'engraissement, environ quatre semaines après l'arrivée des bouvillons. Une anamnèse de troubles respiratoires précédait souvent une éruption et, dans certains cas, la méningo-encéphalite thrombo-embolique avait sévi dans le troupeau, l'année précédente. Le rapport morbidité-mortalité atteignait en moyenne 2.7/1. Les pertes économiques atteignaient environ \$3 190 par troupeau, lorsqu'on y dénombrait 15 sujets malades et qu'on y enregistrait cinq mortalités.

INTRODUCTION

The clinical-pathological entity, infectious thromboembolic meningoencephalitis (ITEME), which was first recognized in feedlot cattle in Colorado in 1956 (8), was later shown to be caused by a *Haemophilus*-like bacterium (10). In Canada, this disease was initially diagnosed in beef cattle in Alberta in 1969 (11) and less than a year later in Ontario (19). It is presumed that the infection was introduced into Alberta from the United States and that it was subsequently spread to Ontario and other provinces via inapparently infected, western feeder cattle. Since 1975 *H. somnus* infections have also been reported from several European countries (15, 18).

Following the first description of ITEMÉ in Alberta in 1969 (11), it was then recognized in Saskatchewan and Manitoba in 1970 and in British Columbia in 1973. Since 1973, ITEMÉ

and other syndromes (2, 3, 14, 20) associated with *H. somnus* infection have continued to be a major problem for beef producers in western Canada. Recognition of this problem has resulted in research aimed at (a) its pathogenesis and epizootiology (4, 5, 6, 13), (b) the characteristics of the etiological agent (1, 7) and (c) the immune response of cattle to the organisms (6, 9, 12, 21).

The objectives of this retrospective study were: (i) to determine the monthly incidence of *H. somnus* disease by herd, class and age of cattle, (ii) to identify and reevaluate common management and epidemiology features and (iii) to estimate the economic losses from morbidity and mortality.

MATERIALS AND METHODS

During the summer of 1978, diagnostic records for the period October 1, 1968 to September 30, 1978 from all Provincial Veterinary Laboratories in Manitoba, Saskatchewan, Alberta and British Columbia were searched manually or by computer for all diagnoses of mortality associated with *H. somnus* infection. Copies of all appropriate records were made. Only the index case (first submission of a whole carcass or representative tissues) from each *H. somnus* infected herd was used in the compilation of annual incidence figures.

Accepted syndromes associated with *H. somnus* infection included: (a) the classical ITEMÉ, (b) primary respiratory disease (usually fibrinous pneumonia and pleuritis) without involvement of the central nervous system (CNS) or (c) sporadic abortions in association with a clinical history of an earlier ITEMÉ-like disease in the herd. Not included were cases of primary infertility in 1974 to 1976 in eight herds in Alberta in which there was an associated *H. somnus* infection of the mucosa of the female or male genital tracts (G. Klavano, personal communication).

The basis for a diagnosis of ITEMÉ was the presence of typical gross or microscopic lesions in the CNS with or without isolation of *H. somnus*. The basis for the diagnosis of *Haemophilus*-associated primary respiratory disease or abortion was the recovery of *H. somnus* from tissues and the exclusion

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of other known etiological agents (usually bacteria or viruses). It was not feasible to review tissue sections microscopically from all diagnosed cases of *H. somnus* infection nor to acquire all isolates of *H. somnus* from these cases for biochemical characterization.

Factors selected for evaluation as contributory to the development of infection in affected herds over the survey period included: (a) the class, age, breed and sex of the affected cattle (b) the seasonal variation in the occurrence of the disease, (c) the housing or handling system in effect in these herds, (d) the type of ration and whether or not silage was fed, (e) the length of time animals were in the feedlot or the length of time after weaning before the outbreak began, (f) whether infectious bovine rhinotracheitis (IBR) vaccine was used or whether respiratory disease occurred prior to the outbreak and (g) whether the herd had experienced outbreaks in previous years.

In the estimation of losses we calculated mean morbidity and mortality rates based on 20 small herds, 15 intermediate-sized herds and ten large herds. These rates were then applied to the total number of herds affected for one year or for the ten year period. These rates were also applied to the total bovine population at risk by means of a conversion factor of four based on the assumption that only one of every four outbreaks was referred to a diagnostic laboratory for confirmation of the clinical diagnosis.

## RESULTS

A total of 838 index cases of fatal *H. somnus* infections were found (Table I). This total included 759 cases of ITEME, 78 cases of *H. somnus* - associated fibrinous pneumonia or pleuritis and one case of *H. somnus* abortion. This abortion was not associated with obvious illness of the dam or other cattle in the herd.

The distribution of the 838 outbreaks by production year and province is shown in Table II. The first outbreaks of ITEME were seen in feeder cattle in Alberta in 1969, followed closely by outbreaks in Saskatchewan and Manitoba in purchased feeder cattle, the source of which could not be traced.

The yearly incidence of fatal infections is depicted in a histogram (Figure

TABLE I  
PATHOLOGY AND BACTERIOLOGY RESULTS FROM INDEX CASES OF 838 HERD OUTBREAKS OF *H. SOMNUS* INFECTION IN MANITOBA, SASKATCHEWAN, ALBERTA AND BRITISH COLUMBIA IN THE DECADE 1969-1978

Pathological Diagnosis	Cases Positive	Isolations of <i>H. somnus</i>
ITEME	759 <sup>a</sup>	170 <sup>b</sup>
Pneumonia and pleuritis	78	78
Abortion	<u>1</u>	<u>1</u>
Totals	838	249

<sup>a</sup>206 cases of ITEME were observed to have pulmonary lesions and 96 cases had arthritis (one or more joints)

<sup>b</sup>115 index cases of ITEME were not cultured, therefore, an isolation rate of 170/644 (26.4%) was achieved.

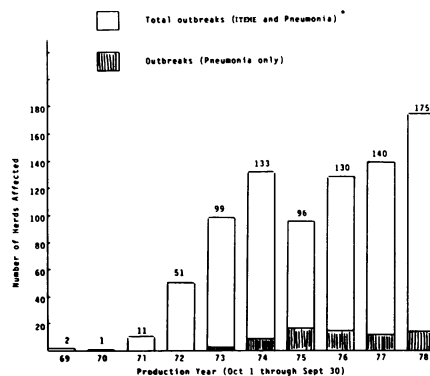


Figure 1. Occurrence of laboratory-confirmed *Haemophilus somnus* disease in herds in western Canada, 1969-1978.

\*Includes one index case of abortion due to *H. somnus*.

1). Primary *H. somnus* respiratory infections were not diagnosed until 1973 and were seen with a gradually increasing frequency thereafter.

The yearly distribution of outbreaks is broken down further into cumulative quarterly totals (Figure 2). There is a definite seasonal pattern of distribution, the greatest prevalence being in the fall quarter (October through December) in a close temporal association with introduction of cattle into feedlots.

The age distribution of the 838 index cases is shown in Table III. The age group most commonly affected was seven to nine months old (38.1%). Seventy-five percent of affected cattle were four to 12 months old while 80.6% were one to 12 months old.

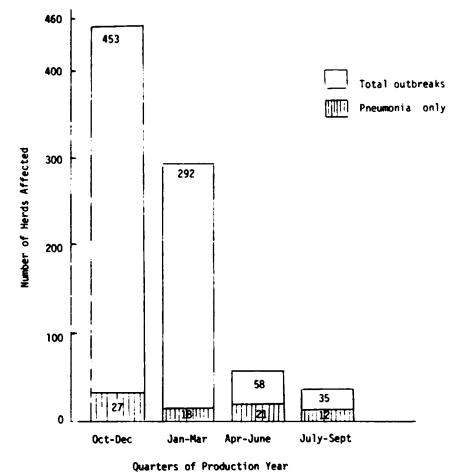


Figure 2. Cumulative quarterly distribution of outbreaks of *Haemophilus somnus* infection in herds in western Canada, 1969-1978.

TABLE II  
DISTRIBUTION AMONG THE WESTERN CANADIAN PROVINCES OF 838 HERDS THAT EXPERIENCED OUTBREAKS OF *H. SOMNUS* INFECTIONS IN THE DECADE 1969-1978

Production Year	Number of Outbreaks in Herds in				Total Outbreaks
	Manitoba	Saskatchewan	Alberta	British Columbia	
1969	0	0	2	0	2
1970	0	1	0	0	1
1971	1	5	5	0	11
1972	0	9	42	0	51
1973	0	21	70	8	99
1974	3	39	86	5	133
1975	0	22	68	6	96
1976	4	44	80	2	130
1977	10	68	55	7	140
1978	<u>14</u>	<u>85</u>	<u>63</u>	<u>13</u>	<u>175</u>
Totals	32	294	471	41	838

TABLE III  
DISTRIBUTION BY AGE OF INITIAL FATAL CASES OF  
*H. SOMNUS* INFECTIONS IN 838 HERDS DURING THE 1969-1978 DECADE

Age in Months	No. of Cattle Affected		Total no. Cattle Affected
	ITEME	Pneumonia/Pleuritis	
< 4	11	35	47 <sup>a</sup>
4-6	154	20	174
7-9	310	9	319
10-12	129	6	135
13-18	4	2	6
19-24	21	2	23
> 24	25	0	25
Unknown	105	4	109
Total	759	78	838 <sup>a</sup>

<sup>a</sup>Includes one abortion

The association between the development of *H. somnus* disease, the type of farm operation, the presence of respiratory disease in the four week period prior to the outbreak and some other factors is shown in Table IV. When outbreaks occurred in feedlots the time cattle had been there prior to development of disease ranged from one week to seven months, with a mean of 4.5 weeks. It should be noted that 26 herds had outbreaks in successive years. A total of 42 premises (four in British Columbia, 19 in Alberta, 19 in Saskatchewan) had two or more outbreaks during the study period. One feedlot had four outbreaks, five herds had three outbreaks each and 36 herds had two outbreaks each. Seventeen of these 42 herds were feedlots, 14 were cow-calf operations, one was a dairy farm and ten were of unknown status.

In addition to the data on previous respiratory disease (Table IV) concomitant cases of other diseases were diagnosed, namely, 20 cases of cocci-

diosis, one of navel infection, one of enteritis (salmonellosis), one of IBR-like clinical disease from which bovine virus diarrhea (BVD) virus was isolated, one case of association of affected feeder calves with an adjoining pen of yearling steers having signs and oral lesions suggestive of BVD, one of neonatal IBR of the rumen and lung (diagnosis by histology and immunofluorescence), one of adenoviral pneumonia (histological diagnosis) and one of *Mycoplasma agalactiae* infection of the lung. For ten cases only were attempts made to isolate viruses from lung or liver but in only a single case (mentioned above) was a virus (BVD) isolated. Although specific association of these infections or conditions with the development of *H. somnus* disease could not be shown conclusively, there was an apparent pattern of events in the development of many outbreaks.

The diagnosis of 78 outbreaks of primary pneumonia or pleuritis considered to be caused by *H. somnus* was

mentioned previously (Table I). This condition was first recognized in 1973, reached a peak of 18 cases in 1975 and subsequently remained at a fairly constant level (Figure 1). A further breakdown of these 78 cases by age and type of cattle, type of operation, and season of the year is presented (Table V). The seasonal prevalence was different from the classical ITEMÉ since more cases were seen in the spring and summer quarters, particularly in nursing calves on pasture. Also, relatively more cases were observed in calves under four months of age as well as in dairy calves as compared to beef calves.

The crude rate of isolation of *H. somnus* from these 838 outbreaks was 29.7% (249/838), the corrected rate being 34.4% (249/723), since 115 cases were not cultured. In 205 of the 723 cases cultured the cattle had been treated parenterally with antibiotics. The isolation rate from treated animals was 31.7% (65/205) compared to 35.5% (184/518) for untreated ones. An observation made at the Alberta Veterinary laboratory (Lethbridge) was that the *H. somnus* isolation rate from antibiotic treated animals with typical ITEMÉ lesions was improved by culturing from pneumonic lesions (if present) as compared to brain. In a few cases presented to the Department of Veterinary Clinical Studies, the organism was readily cultured from blood or cerebrospinal fluid collected from untreated, clinically sick cattle. However, culture was usually negative from tissues of such animals if they died later than one day after the start of antibiotic therapy. Also, *H. somnus* was isolated on occasion at necropsy from joint fluid of animals that had

TABLE IV  
THE ASSOCIATION OF MANAGEMENT, HANDLING AND OTHER FACTORS  
WITH THE DEVELOPMENT OF *H. SOMNUS* DISEASE IN 838 HERD OUTBREAKS DURING DECADE 1969-1978

Type of Management	No. Herds Affected	No. Herds Where a Program or Factor Known					
		Silage Feeding	Preceding Resp. Disease	Weeks In Feedlot <sup>a</sup>	IBR Vacc'd	ITEMÉ In Previous Year <sup>b</sup>	Weeks Post-weaning <sup>c</sup>
A. Cow-calf	327	21	36	na <sup>d</sup>	26	4	0
B. Feedlot	375	60	38	83	26	17	8
C. Cow-calf and feedlot	27	8	5	0	6	4	17
D. Dairy	29	7	11	na	0	1	na
E. Unknown	80	4	5	0	0	0	0
Totals	838	100	95	83	58	26	25
		(11.9%)	(11.3%)	(9.9%)	(6.9%)	(3.1%)	(3.0%)

<sup>a</sup>Time in feedlot until development of the disease ranged from one week to seven months, the mean being 4.5 weeks.

<sup>b</sup>A total of 42 herds experienced losses from *H. somnus* infections in two or more years during 1969-78.

<sup>c</sup>Time from weaning until development of the disease ranged from one week to 12 weeks, the mean being four weeks.

<sup>d</sup>na = not applicable.

TABLE V  
CLASSIFICATION OF 78 INDEX CASES OF *H. SOMNUS* PNEUMONIA WITH  
PLEURITIS BY AGE AND TYPE OF CATTLE DURING 1968-1978

Age in Months	Type of Cattle			Number of Cases
	Beef <sup>a</sup>	Dairy	Unknown	
< 4	23	11	1	35
4-6	8	1	1	20
7-9	9	0	0	9
10-12	5	0	1	6
12	3	1	0	4
Unknown	0	0	4	4
Totals	58 <sup>a</sup>	13	7	78

<sup>a</sup>34 of these beef operations were classed as feedlots and the remaining 24 were classed as cow-calf operations. In 16 of the cow-calf operations the index cases were nursing calves at pasture.

TABLE VI  
MORTALITY FROM *H. SOMNUS* INFECTIONS ON BASIS OF HERD (UNIT) SIZE  
DURING DECADE 1969-1978

	Numbers of Animals in Unit		
	25-100	100-400	> 400
Average Mortality <sup>a</sup>	7.0%	3.4%	1.3%
Morbidity/Mortality Ratio		2.7/1.0	

<sup>a</sup>Mortality calculated from data from 20 smaller units, 15 intermediate units and ten larger units.

TABLE VII  
ESTIMATED LOSSES FROM OUTBREAKS OF *H. SOMNUS* INFECTIONS  
DURING 1969-1978 IN WESTERN CANADA

To 838 Herds	
Mortality	
\$2.20 × 227.3 kg × 5 animals × 838	\$ 2 095 215
Morbidity	
\$46 × 15 sick animals × 838	578 220
Total	2 673 471
To the Industry	
Assuming that only 25% of ITEM E outbreaks are referred to diagnostic laboratories	
\$2 673 471 × 4	\$10 693 885

acute arthritis and ITEM E. In one case of ITEM E the organism was recovered at postmortem from the brain but also from the urine of a feeder steer that had a hemorrhagic cystitis and renal infarcts in association with septicemia.

A final objective of the study was to estimate the economic losses from *H. somnus* infections. A baseline morbidity/mortality ratio (Table VI) was compiled from case records in which complete histories were provided by the submitting veterinarian. This ratio was then applied to the 838 herds that had confirmed outbreaks (Table VII). A market price of \$1 per lb (\$2.20/kg) live weight was used to estimate mortality losses and a figure of \$46 per head was used to estimate morbidity losses. This total cost was multiplied by a factor of four to take into account

the assumption that a single outbreak in every four is referred by veterinarians to diagnostic laboratories. On this basis it was estimated that the economic loss from *H. somnus* infections over the period 1969-1978 amounted to over \$10 × 10<sup>6</sup>.

#### DISCUSSION

With the exception of Manitoba the distribution of the 838 outbreaks of haemophilosis by province (Alta. 471, Sask. 294, Man. 32, B.C. 41) generally agreed with the estimated beef cattle population (approximate proportion of 7:4:2:1) of these provinces (17). The reason for Manitoba's definite underrepresentation in outbreaks is not clear. As Alberta was the first province in Canada to encounter outbreaks of ITEM E it could be argued that this would have been expected on

the basis of a larger population of beef cattle in comparison to all other provinces (17).

In this study the data compiled on the seasonal occurrence of *H. somnus* infections and the age and class of cattle affected were generally similar to previous reports (2, 6, 11, 13). Some differences were noted and remain unexplained: more outbreaks occurred during the summer, a greater percentage of epizootics was seen in cow-calf (39%) or dairy (3.5%) operations and the infection affected slightly younger cattle.

Although management factors could not be positively correlated with development of ITEM E, there appeared to be a pattern of association as indicated by other authors (2, 4, 5, 6, 14). Factors that we considered significant were: (a) the feedlot environment which includes the purchase of cattle from varied sources, (b) the presence of respiratory disease in the cattle prior to the development of *H. somnus* associated disease, (c) the length of time cattle were in the feedlot or calves had been weaned before development of *H. somnus* infection and (d) the presence of ITEM E in the herd the preceding year. The practice of feeding silage was not shown to be contributory to infection although in only one case was silage submitted for culture with negative results. Similarly, it could not be shown that IBR vaccination prevented or modified *H. somnus* infection as has been suggested (Green, P.D., personal communication).

The identification of 78 cases of primary *H. somnus* respiratory infection without concurrent ITEM E was considered unusual although a variety of lesions of the respiratory tract have been described, usually in association with ITEM E (2, 4, 6, 14). A number of possible reasons for this occurrence includes: (a) improved isolation rates of *H. somnus* through better cultural procedures and (b) increased association by clinicians and pathologists of laryngitis, broncho-pneumonia with vasculitis and fibrinous pleuritis with *H. somnus* infections.

Although some investigators (2, 5) have suggested that some viruses (e.g. IBR) may predispose to *H. somnus* respiratory infections and some viruses (IBR, BVD, PI3, adenovirus) were isolated from or identified in fatal cases of *H. somnus* infection in this

study, no conclusions were possible. Since BVD virus is known to be immunosuppressant this could conceivably interfere with the calf's normal defense mechanisms. The concomitant presence of pasteurellae with *H. somnus* in a few cases and of mycoplasmas in one case also indicated that multiple infections can occur in these types of pneumonia.

This survey generally supported the theory that *H. somnus* initially affects the respiratory tract (2, 5, 6) but did not specifically identify any novel means of transmission of *H. somnus*. However, the isolation of these bacteria from urine in one case of ITEMÉ and the recognition of vasculitis and thrombosis in the intestinal submucosa in a number of cases indicates that a fecal or urine-to-oral transmission route should at least be considered in future studies.

Finally, our estimations of economic losses from *H. somnus* infections are generally similar to figures presented by others (16). Estimated morbidity rates in this study were approximately the same as those seen in Alberta (Green, P.D., personal communication). Mortality rates were higher than one study (16) but lower than in unpublished results from Alberta (Green, P.D., personal communication). Our estimates of morbidity losses were much lower than the latter study but in both instances the figures appear to be more realistic than what has been previously available to the beef producer or to the veterinarian.

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