# Mycoplasma and Hemophilus — Other Feedlot Pathogens

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Respiratory disease causes the highest economic loss of feedlot diseases. Diagnosis of infectious diseases occurring in feedlot environments tends to focus primarily on respiratory pathogens. The role of viral entities, including infectious bovine rhinotracheitis (IBR), bovine viral diarrhea (BVD), parainfluenza-3 (P13), and bovine respiratory syncytial virus (BRSV), in conjunction with *Pasteurella hemolytica* in respiratory disease is well documented. They are generally regarded by veterinary clinicians as the primary pathogens involved in feedlot respiratory disease. Presence and involvement of other pathogens has been acknowledged and documented. However, their importance, incidence, pathogenicity, and cost to the industry are less well understood.

Diagnostic investigations involving feedlot pathogens of lesser overall economic importance are important in order to address issues including therapy, prevention, and prognosis. Unusually high morbidity and/or mortality in some animal populations give them critical importance in some cases. Client education is also important in order to communicate occurrence of losses that at times mimic more common disease entities or present new diagnostic challenges.

*Mycoplasma bovis* and *Hemophilus somnus* are two organisms that produce clinical and subclinical disease resulting in feedlot morbidity and mortality, with accompanying economic loss.

## Bovine Mycoplasma Infections

Over 20 species of *Mycoplasma, Ureaplasma*, and *Acholeplasma* have been isolated from disease conditions in cattle. They are all members of the class Mollicutes, which at times have been referred to as the mycoplasmas.[1] The importance of mycoplasmas in the feedlot industry is related to their effect on respiratory disease and also disease produced from hematogenous spread. Although there are a number of species associated with bovine disease, including *Mycoplasma dispar, Mycoplasma bovirhinis,* and *Mycoplasma bovigenitalium, Mycoplasma bovis* is most often implicated in North America and is considered the most pathogenic species. Many clinically normal cattle harbor *M. Bovis* in the upper respiratory tract with no apparent detrimental clinical effect.

Realistically, detailed examinations for mycoplasmas are often not conducted in most investigations of feedlot respiratory disease. However, *M bovis* has been found frequently in cases of bovine respiratory disease where examinations for mycoplasmas have been attempted. For example, in a study where 500 lungs from feedlot pneumonia deaths were cultured, mycoplasmas were recovered from 86% of the lungs. *M. bovis* was the predominant isolate.[2] In another recently reported study, mycoplasmas were cultured from 33.3% of 409 pneumonic lungs.[3] From these studies and others, it appears that *M. bovis* infections are widespread as well as common.[1]

### *Clinical Features*

*Mycoplasma bovis* is thought to initially invade the respiratory tract, spreading hematogenously to other body systems, including joints and tendon tissues. The respiratory disease caused by mycoplasmas, including *M. bovis*, is usually considered to be subclinical when mycoplasma only is present. However, clinical pneumonia becomes apparent when environmental stresses and/or other organisms such as bacteria, viruses, and other mycoplasmas are involved in the infectious process.[4]

Prevention of septicemic mycoplasmas is important for avoiding other clinical signs, such as lameness. Arthritis is the most frequently reported sequel in beef cattle, however keratoconjuctivitis, seminal vesiculitis, decubital abscesses in Holstein cattle,[5] and other conditions are possible. Necrotic tenosynovitis was present in feedlot animals in this report. Immunosuppression is a feature of septicemic mycoplasmosis.

Severe environmental conditions and excessive animal stress, including commingling, transportation, crowding, feed changes, etc., predispose cattle to more severe

effects of mycoplasmas. Specific mechanisms resulting in the septicemic form of the disease are not well defined.

*Immune Suppression Associated with Mycoplasmosis*

*Mycoplasma bovis* has been shown to be immunosuppressive, with both cell-mediated and humoral immunity affected.[6] Suppression of the cell-mediated response appears best documented.[7] Immune responsiveness of the host animal is decreased by either stimulation of suppressor cell function or by transient depression of T-lymphocyte activity. This suppression is especially pertinent in the presence of septicemic disease but less well established in pulmonary infections.[2]

The ability of diagnostic laboratories to isolate *M. bovis* on culture appears to increase with longevity of disease in infected animals in some cases,[2] although reports have been mixed. An inflammatory toxin from *M. bovis* has been isolated and characterized, but its association with immune suppression has not been substantiated.[8]

*Treatment, Prevention and Control*

Tetracyclines, tylosin, lincomycin, spectinomycin, as well as mitomycin, tiamulin, doxycycline, and minocycline are antibiotics found to have the most potential for successful treatment.[1] Approved antibiotics should be used wherever possible. Recently, tilmicosin has been shown to have beneficial effect against myoplasmas.[9] Antibiotics generally should be used in high dosages and consideration should be given to the clinical signs, such as lameness, in selecting antibiotics likely to be successful. Failure of treatment is not unusual in many cases, and may be related to factors such as irreversible joint damage, immunosuppression, and others. Sulfas and penicillin are not regarded as being effective antibiotics.

Prevention and control options are related to reduction of stress, management, and other factors consistent with good husbandry. Mycoplasma vaccines are available for swine and chickens in the United States. Limited research on bovine vaccines has been conducted with some promise.

*Case Report - Arthritis, Periarthritis and Synovitis in a Pen of Feedlot Cattle*

A pen of 139 mixed breed, recently weaned beef calves, purchased at a sale barn and originating from 30 sources, was trucked about 100 miles to a commercial feedlot. Dr. Brent Van Patten of Bridgeport, Nebraska is the attending veterinarian. The steers, which averaged 664 pounds, began experiencing respiratory disease 4 days after entry into the feedyard. Fifty-four percent (75 head) were treated during the first 2 weeks. Severe lameness began occurring after an initial respiratory disease episode and the overall incidence rate of respiratory disease and lameness for the first 4 months after entry was 61.2% (85 head). The case fatality rate was 14.1% (12 deaths among 85 head), which was attributed to respiratory disease. The mortality rate for the first 4 months after entry was 8.6% (12 head) and occurred during weeks 3 through 8.

Severe lameness began occurring about 4 weeks after entry in a high percentage of the cattle. A visit to the feedlot during the seventh week revealed that 26.6% (37 head) of the cattle were lame and located in the hospital and recovery pens. In addition, approximately 25% of the animals in the original pen were lame. The population of lame animals remained relatively constant until about 12 weeks after entry. The exact incidence rate of lame animals versus those with respiratory disease could not be calculated from feedlot records.

*Mycoplasma bovis* was isolated (National Veterinary Services Laboratory, Ames, Iowa) from synovial fluid in 3 of 3 animals tested and 4 joints and fibrinonecrotic tendon tissue of a necropsied animal. Aerobic and anaerobic cultures were negative on samples of synovial fluid and synovium from all 4 animals. Necropsy of one steer revealed severe fibrinonecrotic tenosynovitis and arthritis. Lesions of chronic pneumonia affected about 15% of lung tissue. Cartilage was absent from about 20% of the joint surface of one stifle. Cartilaginous defects were apparent grossly in other large joints as well. Histopathologic lesions in synovium and periarticular tissue are characterized by severe fibrinopurulent synovitis and periarteritis with mild multifocal lymphofollicular hyperplasia. Virus isolation attempts were negative.

This report suggests involvement of *Mycoplasma bovis* in cases of arthritis and tenosynovitis in this population of cattle with high morbidity due to respiratory disease and lameness. Lameness appeared to occur as a sequel to respiratory disease. Mycoplasmas should be included in differential diagnoses of bovine infectious lameness.

***Summary***

**Mycoplasmas play significant roles in feedlot disease, but often go unnoticed until the clinical picture warrants attention. Several observations might be made: *Mycoplasma bovis* was reliably isolated from longstanding arthritis cases in the case report, possibly supporting the immunosuppressive role. Immunosuppression due to mycoplasma, either alone or in concert with other suppressive factors, may be contributing to adverse feedlot health more than is generally acknowledged. Antibiotics effective against mycoplasma should receive consideration in treatment programs. Client education about lesser known pathogens should be part of feedlot health programs.**

## Hemophilus Somnus Infections

Bovine hemophilus infections are usually classed as respiratory, septicemic, and reproductive, with other forms occurring as well.[10,11,12] The disease in feedlot animals is most often manifested by its respiratory effects and by the body systems damaged due to septicemia. The central nervous system, heart, and joints are most often affected by septicemia. *Hemophilus somnus* is the causative organism of bovine hemophilosis. *H. somnus* has been reviewed previously.[10,13,14,15] *H. somnus* is found commonly in the respiratory and urogenital tracts of clinically normal animals, but there is debate as to whether the respiratory tract is a primary site of colonization. The respiratory tract may become contaminated via shedding from the urogenital tract into the environment.[10]

*H. somnus* is widespread in cattle populations. Surveys have shown that 25% of normal cattle have titers. Animals undergoing clinical disease have seropositivity of 50-100%.[16,17,18,19] Seroconversion also occurs in cattle with no apparent signs of disease.[16,17] It appears reasonable to assume that cattle in feedlot environments have a high probability of exposure to *H. somnus* at some time during the feeding period.

Respiratory disease, including pneumonia, is thought to result from an extension of localized infection, not requiring bacteremia for its occurrence. In septicemic forms, vasculitis and thrombosis result in damage to specific organs. *H. somnus* is capable of adhering to vascular endothelial cells, has cellular penetration ability, and produces necrosis in affected cellular tissues. The result is vascular endothelial sloughing, which exposes underlying collagen and promotes initiation of the clotting process and resulting thrombosis, infarction, and tissue damage.[20,21] Lesions in affected organs, such as lung, brain, and heart then develop, resulting in the appearance of clinical signs.

Histologic lung lesions are primarily a purulent bronchiolitis and bronchopneumonia.[22] Other lesions have been reported, some of which include pulmonary abscesses, necrotizing bronchiolitis, and perbronchiolar fibrosis. A significant feature appears to be that the lesions found are associated with subacute to chronic pneumonia in calves. These subacute to chronic lesions have also been produced experimentally.[23]

Development of septicemia affects the outcome of hemophilus infections. Strains of *H. somnus* have varying degrees of virulence, with some exhibiting greater potential of becoming septicemic and some exhibiting specificity toward certain organs, such as the central nervous system.[24] For example, a group of isolates from animals with clinical disease had greater serum susceptibility than a group of preputial isolates from carrier bulls.[25] Other work has been conducted in this area as well.

Onset of clinical disease resulting in morbidity and mortality in feedlot animals is a result of colonization and tissue damage to respiratory tissues. Central nervous system disease, cardiac involvement, and arthritis are most often the result of respiratory colonization and/or the disease becoming septicemic. Important predisposers to these occurrences include stressors such as commingling, overcrowding, transportation, and cold weather.[13]

*Clinical Features and Diagnostic Findings*

Respiratory involvement of *H. somnus* includes laryngitis, tracheitis, and pneumonia. Septicemic manifestations include primarily central nervous signs due to thromboembolic meningoencephalitis, heart failure due to cardiac lesions, usually abscesses, and lameness due to infected, arthritic joints. Other conditions reported include conjunctivitis, retinitis, otitis, and mastitis.

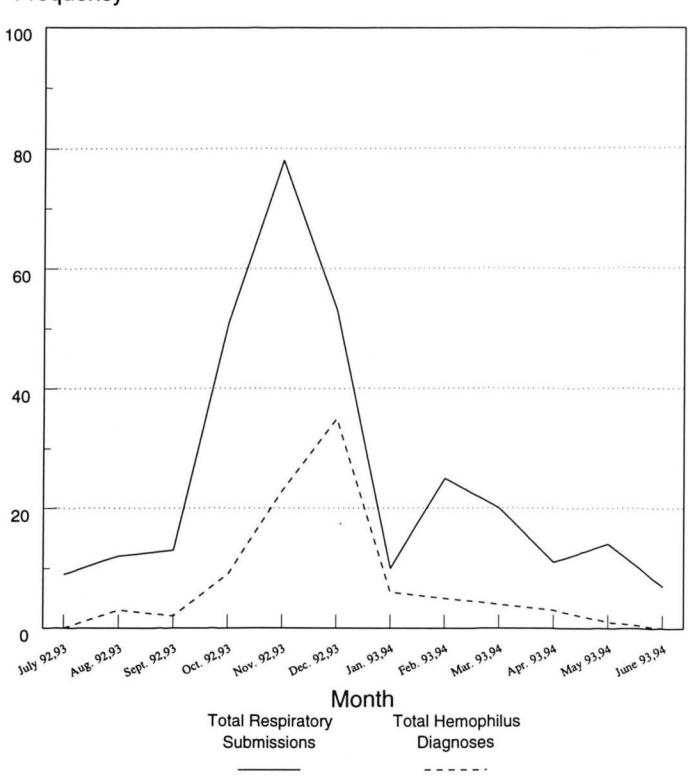
Diagnostic results from two fiscal years at the Panhandle Veterinary Diagnostic Laboratory represent tissues submitted from 100 animals indicating disease by *H. somnus* by culture, histopathology, or both. Of these cases, 58% were from feedlot cattle and 42% were from ranch-based cattle not yet moved to feedlots. Diagnostic results can be misleading since diagnostic laboratories perform workups often not intended to discover all systems involved and the workups performed are not randomly selected. Also, isolation of organisms that can occur naturally, such as, *H. somnus* does not always imply cause of disease. In cases submitted, multiple systems were frequently involved. Of the 100 cases, 27% of the results indicated two or more systems were involved.

Cardiac involvement was found in 21% of the cases, CNS involvement in 30% of the cases and respiratory involvement in 78% of the cases. Only two cases of arithritis were documented; however, joint involvement was investigated very infrequently. Significant concurrent bacterial infections including *Pasteurella hemolytica, Pasteurella multocida, Mycoplasma bovis,* and *Corynebacterium sp* were isolated in 21% of the cases. Concurrent viral infections, including BRSV, BVD, IBR, and PI3, were detected in 16% of the cases. BVD was involved in 75% of these cattle.

The relationship of monthly frequency of *H. somnus* diagnoses to monthly frequency of respiratory submissions at the Laboratory was graphed for a two-year period (Figure 1). Graphs for each individual year were very similar. It is interesting to note *H. somnus* diagnoses have had about a one-month lag behind respiratory submissions, both in increasing numbers and the time when peak numbers of diagnoses have occurred.

Several observations concerning reasons for this time lag may be made. If respiratory disease due to *H. somnus* began at the same time as other respiratory

**Figure 1.** Monthly Respiratory Submissions and Hemophilus Diagnoses - Two Fiscal Years. Panhandle Veterinary Diagnostic Laboratory




disease, it is possible that the infection may be present for a time before becoming septicemic. It is also possible *H. somnus* infections are initiated at later time periods due to other factors. The data may also be spurious diagnostic laboratory data resulting from other uncontrollable factors. Subacute to chronic histologic lesions can be seen with *H. somnus* respiratory disease. It is possible that mortality from *H. somnus* respiratory disease occurs later. It has been noted that *H. somnus* occurs more frequently following severe stresses.[19,26] Veterinary practitioners frequently observe *H. somnus* disease when cold weather is severe. It may be that the relationship noted is due to stresses occurring later than those responsible, at least in part, for the increased respiratory disease.

*Treatment*

*H. somnus* is adversely affected by a number of antibiotics. A common problem with diagnostic submissions is that *H. somnus* organisms may have been rendered inactive due to treatment with antibiotics. Laboratories must often rely on histopathology for diagnosis in these cases.

The antibiotic sensitivity summary for *H. somnus* is presented (Table 1). *H. somnus* was isolated from 49% of the cattle studied. Antibiotic sensitivities must be used along with other criteria in selecting antibiotics to be used for treatment, with clinical response being the most important criteria. Feedlot records can be a useful source in evaluating response.

Table 1. Antibiotic Sensitivities of *Hemophilus somnus* Isolates 7/1/94 - 6/30/94. Panhandle Veterinary Diagnostic Laboratory.

| Antibiotic | No. Tested | No. Sensitive | % Sensitive |
|---|---|---|---|
| Ampicillin | 49 | 43 | 87.8 |
| Erythromycin | 49 | 40 | 81.6 |
| Gentamicin | 49 | 42 | 85.7 |
| Lincomycin | 40 | 14 | 35.0 |
| Penicillin | 40 | 31 | 77.5 |
| Spectinomycin | 49 | 39 | 79.6 |
| Sulfa | 49 | 20 | 40.8 |
| Sulfachloropyridazine | 49 | 31 | 63.3 |
| Tetracycline | 48 | 34 | 70.8 |
| Trimethoprim-Sulfa | 49 | 34 | 69.4 |
| Tylosin | 49 | 34 | 69.4 |
| Ceftiofur | 49 | 45 | 91.8 |
| Enrofloxacin | 48 | 48 | 100 |
| Tilmicosin | 49 | 36 | 73.5 |

Evaluation of localized or respiratory forms versus septicemic forms and their occurrence may be equally important in accessing importance of *H. somnus* infections in populations of animals as well as approaches to treatment.


***Summary***

***H. somnus* causes respiratory disease in feedlot cattle via extensions from the respiratory and urogenital systems. Respiratory disease can occur without septicemia but often develop into systemic disease. These infections often require stressors for initiation of the process. Lung lesions tend to be subacute or chronic histologically, possibly lending credibility to diagnostic results presented. Veterinary practitioners have observed that *H. somnus* is found in many pens of feedlot cattle experiencing chronic disease as well. Possibly *H. somnus* respiratory disease is present and is intermittently becoming septicemic in individuals in these pens.**

**Strain differences may result in different clinical pictures in many pens of cattle. Research supports selectivity of various strains of *H. somnus*. Predominance of certain strains in feedlot cattle has not been reported.**


## Conclusion

Both *Mycoplasma bovis* and *Hemophilus somnus*

are widespread and common in beef cattle populations. Both require stressors, concurrent infections, or other factors for them to cause serious clinical disease. Respiratory components of both are considered nonsepticemic. However, septicemias of both cause significant disease. Control strategies designed to minimize septicemia as well as control localized infections are important. Their contributions to disease when concurrent infections and severe stressors are present pose the most serious problem. Their effects on health in both clinical and subclinical disease should be evaluated in feedlot cattle. Attention to these agents should be considered when treatment protocols are developed. Diagnostic approaches should include these pathogens when warranted.

## References


1. Frey ML. Mycoplasmas in cattle. Current Veterinary Therapy 3. WB Saunders Co., Philadelphia, 1993. 2. Hjerpe CA. The role of mycoplasma in bovine respiratory disease. *Veterinary Medicine.* February 1980, pp 297-298. 3. Welsh RD. Bacterial and mycoplasma species isolated from pneumonic bovine lungs. *Agri-Practice* 1993;14:12-16. 4. Stalheim, Ole HV. Mycoplasmal respiratory diseases of ruminants: A review and update. *JAVMA* 1983;182:403-406. 5. Kinde H, BM Daft, Rl Walker, *et al. Mycoplasma bovis* associated with decubital abscesses in Holstein calves. *J. Vet Diagn Ivest* 1993;5:194-197. 6. Bennett RH and DE Jasper. Immunosuppression of humoral and cell-mediated responses in calves associated with inoculation of *Mycoplasma bovis. Am J Vet Res* 1977;38:1731-1738. 7. Boothby JT, DE Jasper, JG Zinkl, *et al.* Prevalence of mycoplasmas and immune responses to *Mycoplasma bovis* in feedlot calves. *Am J Vet Res.* 1983;44/5:831-838. 8. Geary SJ, ME Tourtellotte, JA Cameron. Inflammatory toxin from *Mycoplasma bovis*: Isolation and Characterization. *Abstract. Science* 1981;212:1032-1033. 9. Gourlay RN, LH Thomas, SG Wyld, *et al.* Effect of a new macrolide antibiotic (tilmicosin) on pneumonia experimentally induced in calves by *Mycoplasma bovis* and *Pasteurella haemolytica. Research in Veterinary Science* 1989;47:84-89. 10. Harris FW and ED Janzen. The *Haemophilus somnus* disease complex (Hemophilosis): A review. *Can Vet J* 1989;30:-816-822. 11. Widel PW. *Haemophilus somnus*: Managing the mystery. *Large Animal Veterinarian.* 1990; July/August pp.16-19. 12. Cortese, V. The 3-way threat: *Haemophilus somnus* infection in beef and dairy cattle. Topics in Veterinary Medicine. Summer 1991, pp. 18-25. 13. Ames TR, Neurologic disease caused by *Haemophilus somnus. Veterinary Clinics of North America: Food Animal Practice.* 1987;3:61-73. 14. Humphrey JD and LR Stephens. *'Haemophilus somnus'*: A review. *Commonwealth Bureau of Animal Health Veterinary bulletin.* Nov. 1983;52:9877-1004. 15. Stephens LR, PB Little, BN Wilkie *et al.* Infectious thromboembolic meningoencephalitis in cattle: A review. *JAVMA*;178:378-384. 16. Dierks RE, SA Hanna, RC Dillman. Epizootiology and pathogenesis of *Hemophilus somnus* infection. *J Am Vet Med Assoc* 1973;163:866-869. 17. Hoerlein AB, K Goto, S Young. *Haemophilus somnus* agglutinins in cattle. *J Am Vet Med Assoc* 1973;163:1375-1377. 18. Humphrey JD and LR Stephens. *"Haemophilus somnus"*: A review. *Vet Bull* 1983;53:897-1004. 19. Olander HJ, AM Gallina, D Beckwith *et al.* Observations on thromboembolic meningoencephalitis (TEME) in cattle in Indiana feedlots. Volume 74 IN *Proceedings of the US Animal Health Association* 1970, pp 589-600. 20. Thompson KG and PB Little. Effect of *Haemophilus somnus* on bovine endothelial cells in organ culture. *Am J Vet Res* 1981;42:748-754. 21. Little PB. *Haemophilus somnus* complex: Pathogenesis of the septicemic thrombotic meningoencephalitis. *Can Vet J.* 1986;27:94-96. 22. Andrews JJ, TD Anderson, LN Slife *et al.* Microscopic lesions associated with the isolation of *Haemophilus somnus* from pneumonic bovine lungs. *Vet Pathol* 1985;22:131-136. 23. Potgieter LND, RG Helman, W Green, *et al.* Experimental bovine respiratory tract disease with *Haeomphilus somnus. Vet Pathol* 1988;25:124-130. 24. Groom SC, PB Little and S Rosendal. Virulence differences among three strains of *Haemophilus somnus* following intratracheal inoculation of calves. *Can J Vet Res* 1988;52:349-354. 25. Corbeil LB, K Blau, DJ Prieur, *et al.* Serum susceptibility of *Haemophilus somnus* from bovine clinical cases and carriers. *J of Clinical Microbiology,* 1985;22:192-198. 26. Little PB and DK Sorensen. Bovine polioencephalomalacia, infectious embolic meningoencephalitis and acute lead poisoning in feedlot cattle. *J Am Vet Med Assoc.* 1969;155:1892-1903.