# Monitoring systems for identifying bovine respiratory disease

**Brad White**, DVM, MS
Department of Clinical Sciences, Kansas State University, Manhattan, KS 66502

**Abstract**

Accurate diagnosis of bovine respiratory disease (BRD) is a critical component of applying appropriate therapy at the optimal time. Visual observation is the conventional manner for BRD diagnosis; however, this method has been shown to have relatively low diagnostic accuracy. Identifying diseased calves visually is a challenging prospect as observers often have limited time, and the clinical signs of BRD are subjective and variable among cases. Several tools have been evaluated to augment the BRD diagnostic accuracy including evaluation of rectal temperature, specific pathogen diagnostics, evaluation of the inflammatory profile, and determination of changes in behavior. New methods have been employed remotely monitoring cattle behavior and utilizing these data to determine changes in wellness status. Remote behavioral monitoring has shown promise for early, accurate BRD diagnosis, but the decision to use this technology should be based on the expected benefits compared to costs of employing the system.

**Key words:** cattle, feedlot, pen riding, BRD

**Resumé**

Le diagnostic fiable du complexe respiratoire bovin (CRB) est une composante essentielle du traitement appropriée au moment opportun. L'observation visuelle est la méthode utilisée traditionnellement pour poser un diagnostic. Toutefois, on reconnait que cette méthode n'a pas une valeur diagnostique très élevée. L'identification visuelle des veaux atteints représente un défi pour les observateurs en raison de la limite de temps et parce que les signes cliniques associés au CRB sont subjectifs et variables selon les cas. Plusieurs outils ont été évalués afin d'augmenter la fiabilité du diagnostic du CRB incluant l'évaluation de la température rectale, le diagnostic d'agents pathogènes particuliers, l'évaluation du profil d'inflammation et la détermination de changements comportementaux. De nouvelles méthodes de surveillance de veaux à distance ont été développées et leurs données sont utilisées pour déterminer les changements dans l'état de santé. La surveillance à distance du comportement semble prometteuse pour poser un diagnostic fiable et précoce du CRB. La décision d'utiliser cette technologie devrait toutefois se baser sur les bénéfices attendus versus les coûts d'utilisation du système.

## Introduction

Bovine respiratory disease (BRD) is a major disease syndrome for post-weaned calves. Despite advances in preventatives and therapeutics, the overall level of morbidity in US feedyards has been relatively unchanged in recent years from 14.4% in 1999 to 16.2% in 2011.[10] During this same period the cost of BRD treatment has increased from an average of $12.59 per head to $23.60.[10] The detrimental impact of BRD encompasses more than just the cost of therapy, but also includes adverse health outcomes and decreased performance associated with this disease syndrome. In a study comparing economic and performance outcomes associated with the number of BRD treatments, cattle that were never treated had a $72 advantage over cattle that were treated 3 or more times.[2] Feedyards are affected by BRD, and while it is unlikely to eliminate the disease, minimizing the deleterious impacts of this syndrome are important.

One of the key components of applying effective therapy is accurate, timely, and consistent identification of cases. The objective of this review is to describe BRD diagnostic procedures including conventional modalities, the value of adjunct information to improve diagnostic accuracy, and potential new methods to identify BRD cases.

## Conventional Diagnosis

The most common method for identification of BRD cases is visual observation based on clinical signs. Clinical signs associated with BRD are subjective and include depression, anorexia, nasal discharge, and labored breathing. Feedyards observe calves once or twice daily depending on the expected risk status of the animals. While visual observation is the most common BRD identification method, several reports have identified a relatively high number of calves with lung lesions present at slaughter that were never identified as BRD or treated during the feeding phase.[5,14] This finding coincides with other estimates that have described relatively low sensitivity (61.8%) and specificity (62.8%) associated with visual observation for diagnosis of BRD.[13]

There is no gold standard for diagnosis of BRD in live animals, but research has evaluated the association of clinical signs with pulmonary lesions soon after diagnosis in a small population.[1] In this study, multiple observers classified calves as diseased or healthy and a comparison of the results to pulmonary lesions revealed a broad range in estimated

sensitivity and specificity among observers. Additionally, there was a low level of agreement (kappa = 0.16) among observers. Identifying a clear case definition and ensuring that observers are evaluating similar signs can help with agreement, but further work may need to be done to increase the overall accuracy of observations.

The accuracy of BRD diagnosis could be improved by adding multiple tests in parallel (increased sensitivity) or multiple serial evaluations (increased specificity). Changing the sensitivity or specificity of a diagnostic test often does not result in equivalent differences in gained value due to differential costs of false positive and false negative diagnosis. Improving the diagnostic characteristics of BRD detection in feedlots was evaluated with a stochastic economic model, and the results illustrated that improvements in diagnostic specificity had a greater influence on expected profitability than improvements in diagnostic sensitivity.[7] While other factors had greater influence on overall cattle profitability than BRD diagnostic characteristics, this work illustrates the importance of BRD confirmation as part of an accurate diagnostic plan.

## Value of Adjunct Information for BRD Diagnosis

One way to improve the accuracy of BRD diagnosis is collecting additional information after initial identification of diseased cattle based on clinical signs. Several methods are available to augment the diagnostic process including using rectal temperature, diagnostics for specific pathogens, combining available production information, evaluation of the inflammatory profile, or determining objective measures of behavioral changes.[16] The evaluation of rectal temperature at the time of diagnosis is commonly included in many diagnostic protocols and discussed in detail elsewhere so will not be addressed in this review.[8]

Evaluation of the animal's inflammatory or infectious disease response could be helpful for confirming BRD diagnosis; however, in calves challenged with BRD pathogens, the complete blood count and serum biochemistry profiles do not provide the level of discrimination to separate true cases from healthy cattle.[3,4] Specific inflammatory proteins or biomarkers (e.g. haptoglobin) may be useful as a confirmatory diagnostic technique as these variables have been shown to distinguish true cases from healthy controls.[9] One challenge of biophysical profiling at the time of treatment to determine BRD status is the ability to collect samples and evaluate the results chuteside in a real time fashion.

Visual observation for BRD often focuses on identifying behavioral changes in cattle indicative of changes in wellness status. Several tools are available that can accurately monitor calf behavior, both activity and feeding information, and this technology has been evaluated for identification of BRD. Research projects have illustrated differences in behavior associated with BRD status.[9,12,15] Multiple tools are available to augment visual observation for BRD diagnosis, and research should be evaluated to determine which additional tests are most appropriate and economically efficient in each situation.

## Potential New Methods of BRD Detection

Automated behavioral monitoring combined with diagnostic algorithms has illustrated promise for improving the accuracy and timing of BRD diagnosis. Aspects of feeding behavior have been shown to be associated with BRD status,[6] and recent technological changes have allowed further progression of this work.[15] In a direct comparison of a system that evaluated calf movement, feeding behavior, and social network, the system agreed with a trained observer 85% of the time, but identified cases an average of 18 hours before the observer.[11] This research indicates that remote monitoring of cattle behavior can be a valuable asset for early, accurate identification of BRD. Further research should be performed to evaluate the efficacy of employing behavioral monitoring to accurately identify BRD cases.

## Conclusions

Bovine respiratory disease is a major disease in feedlots and accurate, timely diagnosis can lead to the appropriate application of therapy to diseased animals. Visual observation is the most common method for diagnosis, and several tools exist to augment the accuracy of this technique. Evaluating which additional diagnostic tests should be employed in each situation is dependent on the additional diagnostic costs compared to the potential benefits of improved diagnostic accuracy.

## References


1. Amrine DE, White BJ, Larson R, Anderson DE, Mosier DA, Cernicchiaro N. Determining precision and accuracy of clinical illness scores compared to pulmonary consolidation scores in Holstein calves with induced *Mycoplasma bovis* pneumonia. *Am J Vet Res* 2013; 74:310-315. PMID: 23363359.
2. Cernicchiaro N, et al. Evaluation of economic and performance outcomes associated with the number of treatments after an initial diagnosis of bovine respiratory disease in commercial feeder cattle. *Am J Vet Res* 2013; 74:300-309.
3. Fraser BC, et al. Associations of various physical and blood analysis variables with experimentally induced *Mycoplasma bovis* pneumonia in calves. *Am J Vet Res* 2014; 75:200-207.
4. Hanzlicek G, et al. Serial evaluation of physiologic, pathological, and behavioral changes related to disease progression of experimentally induced *Mannheimia haemolytica* pneumonia in postweaned calves. *Am J Vet Res* 2010; 71:359-369.
5. Reinhardt CD, Busby WD, Corah LR. Relationship of various incoming cattle traits with feedlot performance and carcass traits. *J Anim Sci* 2009: jas.2008-1293.
6. Sowell BF, et al. Feeding and watering behavior of healthy and morbid steers in a commercial feedlot. *J Anim Sci* 1999; 77:1105-1112.
7. Theurer ME, et al. A stochastic model to determine the economic value of changing diagnostic test characteristics for identification of cattle for treatment of bovine respiratory disease. *J Anim Sci* 2015; 93: In press.
8. Theurer ME, et al. Relationship between rectal temperature at first treatment for bovine respiratory disease complex in feedlot calves and the probability of not finishing the production cycle. *J Am Vet Med Assoc* 2014; 245:1279-1285.

9. Theurer ME, et al. Effect of Mannheimia haemolytica pneumonia on behavior and physiologic responses of calves during high ambient environmental temperatures. *J Anim Sci* 2013; 91: 3917-3929.
10. USDA, *Feedlot 2011 Part I: Management Practices on U.S. Feedlots with a Capacity of 1,000 or More Head*, C. USDA:APHIS:VS, Editor. 2013; Fort Collins, CO.
11. White BJ, Goehl DR, Amrine DE. Comparison of a remote early disease identification (REDI) system to visual observations to identify cattle with bovine respiratory disease. *Intern J Appl Res Vet Med* 2015; 13:23-30.
12. White BJ, et al. Clinical, behavioral, and pulmonary changes in calves following inoculation with *Mycoplasma bovis*. *Am J Vet Res* 2012; 73:490-497.
13. White B, Renter D. Bayesian estimation of the performance of using clinical observations and harvest lung lesions for diagnosing bovine respiratory disease in post-weaned beef calves. *J Vet Diagnostic Investigation* 2009; 21:446-453.
14. Wittum TE, et al. Relationships among treatment for respiratory tract disease, pulmonary lesions evident at slaughter, and rate of weight gain in feedlot cattle. *J Am Vet Med Assoc* 1996; 209:814-818.
15. Wolfger B, et al. Feeding behavior as an early predictor of bovine respiratory disease in North American feedlot systems. *J Anim Sci* 2015; 93:377-385.
16. Wolfger B, et al. A systematic review of bovine respiratory disease diagnosis focused on diagnostic confirmation, early detection and prediction of unfavorable outcomes in feedlot cattle. *Vet Clin North Am Food Anim Pract* 2015; In press.

Elanco

Titanium®™

# A DOSE OF CONFIDENCE

## Easy on cattle[1] and your bottom line.

Titanium® vaccines have no impact on feed intake and result in little to no post-treatment side effects, so you can keep your cattle on track with health management solutions that don't interrupt your day-to-day operations or affect your bottom line.[1,2] It's BRD protection that doesn't impact performance, so you can be confident in every dose.

**ELANCO.US/TITANIUM**

Elanco™ | FULL VALUE BEEF™

The label contains complete use information, including cautions and warnings. Always read, understand and follow the label and use directions.

[1]As measured by body temperature, feed intake, injection-site reaction or white blood cell count. [2]Terhaar, B. 2001. Evaluating the effects of vaccine-induced stress on productivity. Study No. TR-13. Published by Agri Laboratories Ltd.

Do not vaccinate within 21 days of slaughter. Elanco, Titanium® and the diagonal bar are trademarks owned or licensed by Eli Lilly and Company, its subsidiaries or affiliates. © 2015 Elanco Animal Health FYDH 35192 USBAUTT00069