A Systematic Review of Bovine Respiratory Disease Diagnosis Focused on Diagnostic Confirmation, Early Detection, and Prediction of Unfavorable Outcomes in Feedlot Cattle

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KEYWORDS

• Bovine respiratory disease • Feedlot • Detection • Health monitoring system
• Diagnostic test

KEY POINTS

- Serum haptoglobin concentrations are useful to confirm bovine respiratory disease (BRD) but several other parameters are not useful or need further research.
- Feed intake measurements, changes in cattle behavior, infrared thermography, and reticulorumen boluses have been successfully used for early disease detection.
- Prognostic methods using routinely collected treatment and cohort data at the time of treatment can be used to identify cattle at risk of unfavorable outcome.

INTRODUCTION

Despite substantial advances in antibiotics and vaccines against respiratory pathogens, bovine respiratory disease (BRD) remains the most common and economically important disease in the modern feedlot industry. Approximately 21% and 9% of cattle arriving with a bodyweight of less than 318 kg and at least 318 kg, respectively, are

The authors have nothing to disclose.

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Vet Clin Food Anim ■ (2015) ■–■
http://dx.doi.org/10.1016/j.cvfa.2015.05.005 **vetfood.theclinics.com**
0749-0720/15/$ – see front matter

affected by BRD during the feeding phase.[1] The detrimental economic effects of BRD increase with disease severity and the number of treatments administered.[2–5]

Traditionally, feedlot personnel evaluate cattle health subjectively based on cattle behavior and appearance, which have limited sensitivity (62%) for detecting BRD.[6] One of the diagnostic challenges is the natural behavioral pattern cattle express in response to human presence, because as prey animals, cattle mask signs of weakness and disease.[7] Cattle with BRD are therefore often detected late in the disease process or not detected at all.[8] Nonetheless, early intervention is key to effective BRD treatment resulting in lower relapse rates and lower mortality.[9,10]

Furthermore, clinical signs expressed by sick animals are often not specific of BRD (ie, depression, loss of appetite, respiratory character change, and increased rectal temperature [DART]).[11] Consequently, a large proportion of treated cattle is not truly affected by BRD (specificity of clinical diagnosis = 63%).[6] An increase in specificity of BRD diagnosis would lead to more prudent use of antimicrobials and lower costs of BRD control in feedlots.[12]

Although widely used, treatment records using DART signs are poorly correlated with post-therapeutic prognosis.[13] Accurate prognosis of BRD at the time of treatment is crucial for effective management (drug selection, sorting). To improve accuracy of diagnosis, early detection, and prognosis of BRD, new methods and technologies have been developed recently . The objective of the current review is to provide a summary of BRD confirmatory diagnostic tests, early detection methods and modalities to estimate post-therapeutic prognosis or predict unfavorable or fatal outcomes by means of a rapid systematic review.[14]

METHODS

Definitions for the Search

The systematic review included confirmation, early disease detection, and modalities to estimate post-therapeutic prognosis or predict unfavorable or fatal outcomes of BRD. Definitions for outcomes included in the review are as follows:

1. The case definition of BRD in the included manuscripts has to be based on a minimum of clinical signs of respiratory disease and elevated rectal temperature (threshold varied among studies, but $\geq$39.5°C).
2. Confirmatory tests are laboratory and other tests used to increase specificity of BRD case definition.
3. Early disease detection methods are those used to detect sick cattle before obvious visual signs of BRD appear.
4. Prognostic methods at the time of initial treatment identify cattle at risk for multiple treatments or unfavorable outcome.

Criteria for Considering Studies

The review question was defined based on key concepts in terms of population (P), intervention (I), comparator (C), outcome (O) and study design (S), as described in the PRISMA statement.[15] The population of interest for this review was newly arrived feedlot calves. Studies were considered if they included beef breeds at the age of weaning (6–9 mo) up to yearlings (11–12 mo).[16] The purpose of the article was not to look for interventions or risk factors, but rather methods and technologies to detect and diagnose BRD and provide a post-therapeutic prognostic outcome. The comparator was the current industry standard. Studies were included if they used visual detection methods and at least hyperthermia ($\geq$39.5°C). Outcomes of interest were confirmatory, early detection, or prognostic