

# A simulation model to determine the economic value of changing diagnostic characteristics for identifying bovine respiratory disease

M.E. Theurer, BS<sup>1</sup>; B.J. White, DVM, MS<sup>2</sup>; R.L. Larson, DVM, PhD<sup>2</sup>; T.C. Schroeder, PhD<sup>3</sup>

<sup>1</sup>Department of Diagnostic Medicine and Pathobiology, Kansas State University, Manhattan, KS 66506

<sup>2</sup>Department of Clinical Sciences, Kansas State University, Manhattan, KS 66506

<sup>3</sup>Department of Agriculture Economics, Kansas State University, Manhattan, KS 66506

## Introduction

Bovine respiratory disease (BRD) is an economically important syndrome in the beef industry, and diagnostic accuracy is important for optimal disease management. Diagnostic test improvements are typically focused on changing sensitivity or specificity, but enhancement in both simultaneously is rare. The research objective was to determine whether improving diagnostic sensitivity or specificity was of greater economic value at varied levels of BRD prevalence by the use of Monte Carlo simulation.

## Materials and Methods

Existing literature was used to populate stochastic model distributions of expected diagnostic sensitivity and specificity, and performance (average daily gain, carcass weight, yield grade, quality grade, and mortality rate) differences among calves based on clinical BRD status. Data from multiple cattle feeding operations were used to generate ranges of BRD prevalence and associated mortality. Input variables were combined into a single model to calculate the estimated net returns for

animals deemed as true positive, false positive, false negative, and true negative for BRD on the basis of the prevalence, sensitivity, and specificity for each iteration. Net returns for each category were multiplied by the proportion of animals in each category to determine group profitability. Apparent prevalence was categorized into <15% and ≥15% groups.

## Results

For both prevalence categories, increasing specificity created a more rapid, positive change in net returns than did improving sensitivity.

## Significance

Improvement of diagnostic specificity, perhaps by means of a confirmatory test interpreted in series, can increase diagnostic value more than improvements in sensitivity. This study demonstrated a novel method for modeling diagnostic tests, and the results will aid in the design of future research projects to analyze diagnostic techniques for BRD