Evaluation of three classification models to predict risk class of cattle cohorts developing bovine respiratory disease within the first 14 days-on-feed using on-arrival and/or pre-arrival information

D.E. Amrine,[1] DVM, PhD; **J.G. McLellan**,[1] MS; **B.J. White**,[1] DVM, MS; **R.L. Larson**,[1] DVM, PhD, DACT, DACVPM, ACAN; **D.G.Renter**,[2] DVM, PhD; **M. Sanderson**,[2] DVM, PhD

[1] Beef Cattle Institute, College of Veterinary Medicine, Kansas State University, 1320 Research Park Drive, Manhattan, KS 66502

[2] Center for Outcomes Research and Epidemiology, College of Veterinary Medicine, Kansas State University, Manhattan, KS 66506

Introduction

Bovine respiratory disease (BRD) remains the leading cause of morbidity and mortality in feedlot cattle. Classification of cattle cohorts into high- or low-risk based on an expected level of BRD is frequently based on highly subjective criteria. Development of a methodology to accurately classify cohorts could lead to more effective resource allocation. The research objective was to evaluate diagnostic performance of 3 classification algorithms to classify cattle into risk classes based on the expected BRD morbidity in the first 14 days-on-feed (DOF) and to evaluate if data collected at the point-of-sale (sale barn) would provide information useful to increase classification performance.

Materials and Methods

Data from 141 management cohorts representing 618 purchase groups and 35,027 animals were used to predict the BRD risk class of the management cohort (lot) at arrival. Point-of-sale, lot-level, and weather variables at each location were used to determine the combination of data most beneficial to model performance. Three classification algorithms were evaluated for their diagnostic performance (accuracy, sensitivity, specificity) in classifying cattle groups into risk classes based on 3 BRD morbidity cutoffs (2%, 4%, 6%) within the first 14 DOF. Bootstrapping methods were applied to estimate confidence intervals around the diagnostic performance point estimates.

Results

Performance of each algorithm varied by cutoff in BRD morbidity within the first 14 DOF used and the data provided to each algorithm. Median overall morbidity during the first 14 DOF was 2.1%. Using a cutoff of 2% to classify cohorts into high- or low-risk achieved the highest accuracy (71.1%) and specificity (71.6%) using only lot level information. At a cutoff of 4%, using only the lot level information, the best model achieved an accuracy of 73.5% and sensitivity of 85.0%. Due to the limited dataset, the 6% cutoff was not useful with respect to our outcome of interest.

Significance

Data coupled with predictive models for accurate identification of those groups of cattle that would and would not benefit from on-arrival antimicrobial therapy could provide a new approach to on-arrival risk management and a tool to increase judicious use of antibiotics. Results presented in this study do not display a benefit to collecting point-of-sale information; however, the impact of a specific locations management practices (i.e. giving metaphylaxis vs not giving metaphylaxis) could have substantial bias and/or confounding effects that mask the true value of the data collected at this level. More data (additional predictors and increased data volume) are needed to refine the algorithms and provide a better estimate of each models' ability to accurately partition cohorts of cattle into risk categories based on the expected BRD morbidity within the first 14 DOF.