A multi-site surveillance of the prevalence, associated antimicrobial resistance and antimicrobial use in beef cattle from six weeks of age to pre-slaughter.

TRACKING ANTIMICROBIAL RESISTANCE

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Background: Bovine respiratory disease (BRD) is a complex and multifactorial issue that is the leading cause of morbidity and mortality in the feedlot. Involving bacteria (*Mannheimia haemolytica, Histophilus somni, Pastuerella multocida and Mycoplasma bovis)* as well as viruses, individual animal characteristics and environmental influences, treatment and prevention of BRD continues to rely heavily on antimicrobials. Given increasing public scrutiny on beef production, including antimicrobial use (AMU), a better understanding of the factors affecting the development of BRD and how BRD pathogens acquire antimicrobial resistance (AMR) as calves move through the value chain is critical to our ability to manage this disease in the future.

Objectives: The objectives of this study were to:

1. Measure the frequency of BRD pathogens and prevalence of AMR in those pathogens from six weeks of age through to reprocessing at the feedlot
2. Investigate associations between AMR profile of BRD pathogens, AMU, and morbidity/mortality
3. Analyze risk factors for BRD development, such as vaccination history, season of arrival to the feedlot, transport time, weight, commingling, etc.

What they did: Twenty-two cow-calf operations (purebred and commercial) were enrolled in the study. Thirty calves from each were randomly selected during spring processing when calves were between two to eight weeks old and nasal swabs were collected. Calves were sampled again at weaning/feedlot arrival (aged 5-8 months) and reprocessing at the feedlot (aged 9 months to 1 year of age). Processing protocols followed those normally used at the ranch or feedlot including metaphylaxis when indicated. From the nasal swabs, BRD-causing bacteria were isolated (*Mannheimia haemolytica, Pasteurella multocida, Histophilus somni, Mycoplasma bovis*) and antimicrobial susceptibility profiles determined. A subset of bacterial isolates was also selected for genome sequencing.

All antimicrobial treatments were recorded from birth to reprocessing, including reason for treatment and type of antimicrobial used. Days on feed, as well as morbidity and mortality data, was tracked at the feedlot.

What they learned: In total, 660 calves were enrolled in the study. However, attempts to follow calves through the value chain are quite challenging. Nearly 40% of calves were not sampled at all time points, primarily due to calves being sold at different time points than expected.

Antimicrobial use:

Antimicrobial use prior to, or at, branding was limited, with only seven calves receiving treatment for

pneumonia (5), navel ill (1) or foot rot (1). At weaning/feedlot arrival animals from five operations were considered low risk and not treated. The others were treated with tetracyclines, macrolides (e.g., Draxxin), or a combination of the two classes.

From weaning/feedlot arrival to reprocessing, calves from seven operations received no antimicrobials. Two operations used in-feed tylosin (Tylan) to prevent liver abscesses, and fourteen other caves were treated at least once for BRD (9), lameness (3), footrot (2), atypical interstitial pneumonia (1) and pinkeye (1) using florfenicol (e.g., Nuflor), ceftiofur (e.g., Excenel) or tilmicosin (e.g., Micotil).

Antimicrobial resistance:

P. multocida was the most frequently recovered BRD pathogen, followed by *M. haemolytica*, *M. bovis* and *H. somni*. The prevalence of all BRD bacteria was generally higher at reprocessing versus branding, and M. bovis increased substantially between weaning/feedlot arrival and reprocessing, and was the second most common pathogen at feedlots. Commingling, location of feedlot and cow-calf operation, and results from spring processing did not affect the presence of BRD pathogens at weaning/feedlot arrival.

Generally, low levels of AMR were found in *P. multocida* while *M. bovis* was generally resistant to the macrolide class (e.g., Draxxin, Zuprevo, Tylan), and resistance to other drugs of the highest importance in human medicine was extremely rare. Administration of tetracyclines at weaning/feedlot arrival was not linked to an increase in tetracycline resistance at reprocessing, however; significant effects were seen with the use of macrolides at weaning/feedlot arrival and increased resistance in *P. multocida, M. haemolytica,* and *H. somni* at reprocessing.

What it Means: It is possible that P. multocida may have a larger role in the development of BRD than previously given the high prevalence at all sampling time points, but because healthy cattle were sampled, P. multocida's contribution to clinical disease requires more investigation. In line with several other published studies to date, AMR in BRD pathogens to those drugs most important to human health is quite low. However, AMR to macrolides, such as Draxxin, that are commonly given on arrival at feedlots or administered in feed to prevent liver abscesses was high, especially for M. bovis, and it may be that use of these drugs on arrival is reducing their efficacy.

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