Prevalence of antimicrobial resistance (AMR) in fecal *Escherichia coli* and *Enterococcus* spp. isolated from beef cow-calf operations in northern California and associations with farm practices

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Introduction

Antimicrobials are necessary for treatment of bacterial infections in both humans and animals; however, antimicrobial resistance (AMR) is becoming a public health threat. As a result, antimicrobial use in food animals has come under scrutiny. *Enterococcus* and *E. coli* are both part of the normal flora of the bovine gastrointestinal tract, with the potential to cause disease, and often serve as sentinels for AMR. Studies investigating AMR in cow-calf operations are sparse but are essential for understanding of AMR in the beef industry. The objective of this cross-sectional study was to assess prevalence of AMR levels in *E. coli* and *Enterococcus* spp. in beef cattle of different life stages, breeds, pasture type exposure and antibiotic drug exposure on a herd and individual level.

Materials and methods

A convenience sample of 18 beef cow-calf operations in northern California were enrolled either through the network of University of California Cooperative Extension livestock advisors or as clients of the Veterinary Medical Teaching Hospital (VMTH) at the University of California,Davis. Fecal samples were collected on farm from a total of 83 calves and 104 adult cows, and an in-person survey regarding management, production and antimicrobial practices on each operation was conducted. A total of 482 isolates (244 *E. coli* and 238 *Enterococcus* spp.) were successfully cultured and tested for antimicrobial susceptibility to 19 antimicrobials by the broth microdilution method. Breakpoints for antimicrobial susceptibility were selected based on Clinical and Laboratory Standards Institute (CLSI) guidelines. Statistical analysis was performed in SAS and R. Association between antimicrobial use or farm management predictors and AMR were analyzed using univariable and multivariable generalized linear mixed models.

Results

Farm level survey results indicated that 10/18 (55.56%) farms had primarily Angus cows and the most common farm size was <100 cows (6/18, 33.33%). Most of the farms (10/18, 55.56%) raised cattle primarily on dryland and 14/18 (77.78%) farms were conventional producers. Oxytetracycline was the most used antibiotic on farm (14/19, 73.68%). Two farms reported no antimicrobial use and no disease treatments in the past year, while 1 farm reported routine use of antibiotics. Six of the antimicrobials tested had established breakpoints for *E. coli* for which resistant or non-susceptible status could be assigned: 243 isolates were resistant to ampicillin (100%), 1 resistant to ceftiofur (0.41%), 47 non-susceptible to florfenicol (19.26%), 62 resistant to sulfadimethoxine (25.41%), 32 non-susceptible to tetracycline (13.11%), and 12 resistant to trimethoprim-sulfamethoxazole (4.92%). None of the factors in this study were found to be statistically significantly associated with AMR in univariable *E. coli* models. Three of the antimicrobials had established breakpoints for *Enterococcus* for which resistant or non-susceptible status could be assigned: 1 (0.42%) *Enterococcus* isolate was resistant to ampicillin, 4 (1.68%) non-susceptible to penicillin, and 30 (12.61%) non-susceptible to tetracycline. No animal or antibiotic related factors or management practices were significantly associated with resistance or non-susceptible status for *Enterococcus* isolates.

Significance

AMR is an evolving, multifactorial problem critical to the health of both animals and humans worldwide. Despite recent research efforts, there are still gaps in knowledge of what specific factors drive resistance and how resistance is transferred between bacterial populations of humans and animals. The results of this study serve as a reference for future studies on the prevalence of AMR phenotypes of bacteria from cow-calf operations in California and contributes to a better understanding of risk factors for shedding of drug resistant fecal pathogens. Continued surveillance will allow more informed decisions and directions for combatting AMR in the future.

