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Antimicrobial use and resistance in feedlot cattle

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Project Title:

Development of a Longitudinal Antimicrobial Resistance and Antimicrobial Use Surveillance Program for the Feedlot Sector in Western Canada

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Background

Antimicrobial resistance has two implications for cattle producers. One is the animal health concern: if cattle pathogens are resistant, then the antimicrobial drug will no longer effectively treat cattle diseases. The other implication is maintaining consumer confidence: there are concerns that resistant bacteria may be able to transfer antimicrobial resistance genes to other bacteria that cause disease in humans. Antimicrobial use in livestock has been recognized as a potential risk factor for human health, but there is a lack of definitive information. The biggest concern is with Category 1 antimicrobials (e.g. Baytril, A180, Excenel and Excede) that are related to drugs used to treat very serious human infections. Category 2 drugs (e.g. Tylan, Draxxin, and Micotil) are of intermediate concern. Category 3 drugs (e.g. tetracyclines) are of less concern, because they are rarely used to treat serious human health issues. The least important animal drugs are the Category 4 ionophores (e.g. Rumensin, Bovatec and Posistac) that are never used in human medicine.

Through the “Canadian Integrated Program for Antimicrobial Resistance”, the Public Health Agency of Canada monitors antimicrobial resistance through samples collected from sick cattle at diagnostic labs, samples from healthy cattle entering abattoirs, and retail beef samples. This project developed a protocol to expand the CIPARS program to the farm level.

Objectives

Two of the key objectives of this project were to

1. Establish a framework for tracking antimicrobial use and antimicrobial resistance in the feedlot sector

2. Provide data for potential use in human health risk assessments

What they did

This research was conducted in four large feedlots in Southern Alberta. Individual nasal and fecal samples were collected from nearly 5,500 cattle in 310 pens over three years, and composite manure samples were collected from the pen floor. Samples were collected at feedlot entry and several weeks later, and cultured for three bacteria. Mannheimia haemolytica (cultured from nasal swabs), is the main bacterium associated with bovine respiratory disease. Fecal samples were cultured for generic E. coli and Salmonella. E. coli is naturally found in the digestive tracts of all mammals. It does not cause disease in older cattle, but it may be able to develop antimicrobial resistance and pass those genes to other bacteria that do. Salmonella can cause animal as well as human illness. If M. haemolytica was detected in the nasal samples, then the individual fecal samples were also cultured, and all bacteria were tested for resistance to 16 different antimicrobials. Antimicrobial use was measured in all animals and used to calculate the defined daily dose of each antimicrobial received by the average feedlot animal over the course of the feeding period.

What they learned

Bacterial prevalence: Close to 15% of the nasal samples contained M. haemolytica. As expected, nearly all of the fecal samples contained E. coli, but Salmonella was only found in 0.2% of samples. This helps to explain why Salmonella is extremely rare in beef.

Antimicrobial use: Fewer than 1% of the antimicrobial doses given to the average feedlot animal came from the very high importance Category 1 drugs. Category 2 drugs amounted to 7%. Over 90% of the doses came from Category 3 drugs. Most cattle also received an ionophore, so adding Category 4 drugs to these calculations will make the percentages even smaller for Category 1, 2 and 3 drugs.

Antimicrobial resistance tended to rise over the course of the feeding period. However, extremely low (below 1%) or no antimicrobial resistance was seen for Category 1 drugs in the individual E. coli samples, even at the end of the feeding period. Resistance to category 2 drugs was below 2.5% except for streptomycin (which was over 5% on arrival). Resistance to Category 3 drugs was higher, particularly for tetracycline. Similar results were seen in the pen composite fecal samples. Less than 20% of the E. coli from the individual fecal samples, and fewer than 30% of the E. coli from the composite fecal samples were resistant to more than one antibiotic.

M. haemolytica displayed less than 2.6% resistance to Category 1 drugs, less than resistance 10% to Category 2 drugs, and less than 13% resistance to category 3 drugs. The mechanism causing tetracycline resistance in M. haemolytica isolates was different than the mechanism causing tetracycline resistance in E. coli. This suggests that antimicrobial resistance genes are not being traded among E. coli and M. haemolytica. Fewer than 5% of the M. haemolytica isolates were resistant to more than one antimicrobial.

Salmonella was identified in 2 composite fecal samples from different feedlots. Those from one feedlot were susceptible to all antimicrobials tested; those from another were resistant to two category 3 and one category 2 drugs.

What it means

Industry and legislators need solid data collected by credible scientists in the Canadian industry context so that they can develop sound policy pertaining to antimicrobial use in cattle. This study indicates that the antimicrobial drugs that are most important in human medicine are rarely used in beef production. More importantly, the bacteria found in cattle likely to be treated for bovine respiratory disorder do not appear to be developing resistance to these drugs. Because microbes are continuously evolving, continued long-term funding support for ongoing surveillance is critical to ensure that industry can demonstrate that it uses antimicrobial drugs responsibly. This will also provide an early warning if antimicrobial resistance to drugs of very high importance in human medicine does develop in the future.

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