Antimicrobial use and resistance and the relationship with health and biosecurity status in CIPARS data from Canadian grower-finisher swine herds

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Introduction

Antimicrobial resistance (AMR) is a global threat to public and animal health. The Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS), created in 2002, is a national program dedicated to the collection, integration, analysis, and communication of trends in antimicrobial use (AMU) and resistance (AMR) in selected bacteria from humans, animals, and animal-derived food sources across Canada. This information supports (i) the creation of evidence-based policies for AMU in hospitals, communities, and food-animal production with the aim of prolonging the effectiveness of these drugs and (ii) the identification of appropriate measures to contain the emergence and spread of resistant bacteria among animals, food, and people.

Material and Methods

The CIPARS program is composed of multiple components including Human, Retail, Abattoir, Farm, and Antimicrobial Use. The CIPARS Farm Swine component actively collects surveillance data from approximately 90 sentinel grower-finisher (GF) farms in the five major pork producing provinces of Canada: Alberta, Saskatchewan, Manitoba, Ontario, and Québec. In 2013, 89 GF herds participated in the program. In order to protect producer confidentiality and optimize data quality, herd veterinarians recruit producers to the program and facilitate the collection of both samples and data. During an annual herd visit, pooled pen fecal samples are collected from pigs that are close to market (>80 kg) and data on farm demographics, biosecurity measures, animal health and AMU are collected through a questionnaire. Fecal samples are processed and resulting *Salmonella* and generic *Escherichia coli* (*E.coli*) isolates are tested for resistance to 15 antimicrobials of human and veterinary health importance, in accordance with CIPARS protocols (1). Information on the status of the GF herds as well as their associated nurseries and sow herds is collected for 11 major swine diseases. This status is defined as confirmed positive, likely positive, confirmed negative, or likely negative. Data on these diseases is also collected with respect to vaccination and the use of antimicrobials for treatment / control. As feed is the primary route for AMU administration in GF pigs, quantitative AMU data is collected for use in feed and qualitative data is collected for use in injection or water.

Results

In 2013, 99 *Salmonella* and 1573 *E.coli* isolates were susceptibility tested. The proportion of *Salmonella* and *E.coli* isolates resistant to classes of antimicrobials commonly used in swine production was: azithromycin 1%, 1%; ceftiofur 6%, 11%; ampicillin 38%, 31%; and tetracycline 64%, 75% respectively. None of the *Salmonella* or *E. coli* isolates were resistant to ciprofloxacin.

Overall (feed, water, and/or injection) the most commonly used antimicrobials in 2013, in the 89 enrolled herds included penicillin G (61%), lincomycin (40%), tylosin (33%) and chlortetracycline (30%). Parenteral ceftiofur use was reported by 18% of farms. In 13% of grower-finisher herds there was no reported use of AMU by any route of administrations and in 27% of herds there was no AMU reported in feed.

Broad categories for use in feed included treatment (8%), prevention (51%) or growth promotion (41%). For disease prevention, the most commonly used antimicrobial classes in feed were tetracyclines (24%), macrolides (18%), and lincosamides (20%). Tetracyclines were most commonly used in the prevention of respiratory disease (20%). Macrolides (14%9) and lincosamides (11%) were the most commonly used in the prevention of enteric disease. The antimicrobial classes most commonly used for growth promotion in feed were macrolides (16%) and ionophores (18%). The greatest median grams per 1000 pig-days at risk (g/TPDAR) in feed were chlortetracycline (800 g/TPDAR), tilmicosin (253 g/TPDAR), and lincomycin (228 g/TPDAR). The most common antimicrobials given to GF pigs by injection in 2013 were penicillin (53%) and ceftiofur (18%). The most common reasons for use of antimicrobials by injection were penicillin for the treatment of lameness (44%) and respiratory disease (18%), as well as ceftiofur for respiratory disease (8%) and lameness (10%). When antimicrobials were used by injection, 95% of the time they were administered to less than 5% of the pigs.

The diseases most commonly reported as confirmed or likely positive in GF herds were *Streptococcus suis* (*St. suis*) (82%, 69/85), Porcine coronavirus associated disease (PCVAD) (82%, 67/82), and *Lawsonia* (77%, 64/83). The diseases most commonly reported as confirmed or likely positive in nursery herds associated with these GF herds were *St. suis* (73/76, 96%), PCVAD (95%, 72/76), and *E. coli* (86%, 60/70). Over 75% of the sow herds associated with these GF herds reported as confirmed or likely positive to *E. coli*, *Erysipelas*, *Lawsonia*, PCVAD, and *St. suis*. Antibiotics were most commonly used for the treatment or control of *St. suis*, *Mycoplasma*, and *Lawsonia* in GF herds and *St.suis*, *E. coli*, and *Mycoplasma* in nurseries.

The vaccinations given most commonly in GF herds and associated nurseries were for PCVAD, *Mycoplasma* and *Lawsonia* in 20%, 16% and 6% of GF herds and 95%, 60%, and 26%.of nurseries respectively. It should be noted that the percentage of herds vaccinating for these diseases was substantially higher in the associated nurseries than in the GF herds.

In 2013, 60% of farms reported owning their own breeding sows; 45% kept sows on-site and 15% had sows off-site. Thirty-one percent of farms reported that they purchased pigs from a single source while 9% purchased pigs from multiple sources. Fifty-two percent of farms reported being all-in-all-out operations and 48% of farms indicated operating as a continuous flow system. The number of pig farms located within 2 km of the CIPARS GF herds were; no herds (49%), 1 to 3 herds (31%), 4 to 6 herds (17%), and 7 to 10 herds (2%). Providing boots (92%), providing coveralls (83%) and having a biosecurity sign (87%) were the most commonly reported biosecurity measures. Biosecurity in the majority of GF herds (72%) included a shower entry or a combination of providing boots and coveralls with a minimum of 12 hours downtime.

Modelling of data from 2009 to 2014 will be conducted in order to evaluate the impact of herd status for specific diseases on AMU in feed, water and by injection for prevention or treatment while accounting for factors such as region and year. The impact of additional factors including; the number of pig sources, biosecurity level, and farm density on AMU will also be explored

Discussion

Descriptive data from CIPARS Farm Swine Surveillance indicated macrolides, lincosamides, penicillins and tetracyclines were the most commonly used antimicrobial classes in GF feed. The Veterinary Drugs Directorate of Health Canada categorizes antimicrobials with respect to their importance to human health (2). Ceftiofur was the only antimicrobial categorized as very important to human health (Category I) that was

used in CIPARS herds. These results were consistent with previous North American research and support the representativeness of CIPARS sentinel herds with respect to AMU (3,4). Data from sources other than CIPARS on biosecurity and vaccination measures in Canadian GF herds were not available.

AMR is an issue of increasing concern to human and animal health and therefore the use of antimicrobials is also of concern. Antimicrobials are used in swine production systems to prevent or treat disease, as well as for growth promotion purposes. As a result, improvements in health status, increased vaccination and a focus on biosecurity have been discussed in the context of decreasing AMU at the farm level. However, in order to assess the usefulness of potential initiatives it is important to better understand the relationships between these factors. Data gathered through the CIPARS Farm Swine Surveillance program provide an opportunity to explore these relationships through modelling approaches.

Conclusion

In order to promote prudent AMU and better understand AMR in swine herds, it is essential to have a better understanding of the impact of disease pressure and biosecurity measures on AMU and AMR. The use of CIPARS Farm Swine surveillance data to investigate these relationships will provide valuable information to swine industry groups as well as individual veterinarians and producers.

Acknowledgements
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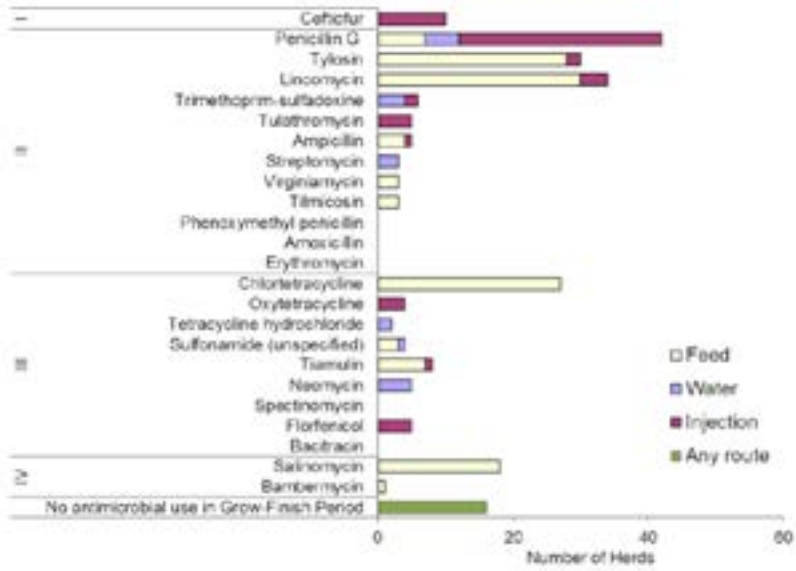

Figure 1: Number of pig herds with reported use of specific active antimicrobial ingredients by route of administration; CIPARS Farm-Swine Surveillance 2013 (n = 89).

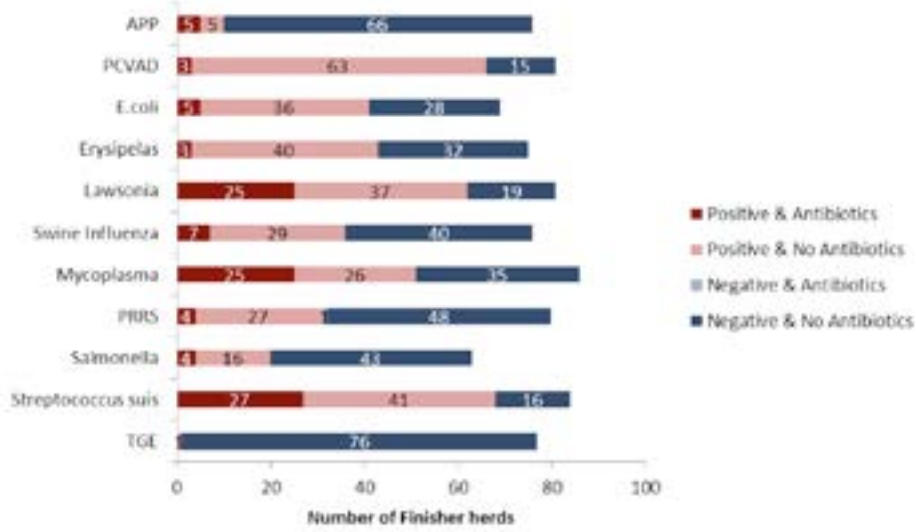

Figure 2: Reported antimicrobial use for treatment or control of specific diseases in CIPARS grower-finisher herds, by disease status; CIPARS Farm Swine Surveillance 2013

Positive= “confirmed positive” or “likely positive”

Negative = “confirmed negative” or “likely negative”.

Positive & Antibiotics = Positive for a disease and used an antibiotic to control that disease

Positive & No Antibiotics = Positive for a disease and did not use antibiotics to control that disease
Negative & Antibiotics = Negative for a disease and used antibiotics to control that disease

Negative & No Antibiotics = Negative for a disease and did not use antibiotics to control that disease

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