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Changes in group treatment procedures of Danish finishers and its influence on the amount of administered antimicrobials

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ABSTRACT

When treating groups of pigs orally, antimicrobials can be administered through either feed or water. During the last decade, the group treatment procedure for finishers has shifted from feed to water administration. We hypothesized that farms implementing this change in treatment procedure would increase their total amount of administered antimicrobials. Based on Danish national register data, we performed a retrospective cohort study with three groups. The cohort of primary interest (Cohort Change) consisted of 50 finisher farms which changed their group treatment procedure from feed administration to water administration between 2008 and 2009. In addition, we identified 221 farms where treatment was administered through feed (Cohort Feed), and another 553 farms where treatment was administered through water (Cohort Water). Both of these groups retained their original treatment procedure throughout the study period. Cohort Change experienced a significant increase in the total amount of prescribed antimicrobials between the years. This increase might be caused by the treatment of more pigs, since antimicrobials administered through the feed are mainly administered at the pen level, while antimicrobials administered in water are mainly administered at the section level. However, we cannot exclude that a change in clinical disease has influenced the amount of prescribed antimicrobials. No change was observed in the other two cohorts. Furthermore, the difference in the amount of prescribed antimicrobials between the years was significantly different in Cohort Change when compared to both Cohort Water and Cohort Feed. Results from this study demonstrate that farms changing their procedure of group treatment from feed administration to water administration may increase their overall use of antimicrobials.

1. Introduction

In Denmark, treatment of production animals requires a veterinary prescription and is restricted to cases of clinical disease, excluding use for prophylaxis and growth promotion (Anon., 2014a). The majority of antimicrobial treatments for weaners and finishers are administered orally (Jensen et al., 2014), traditionally through group treatment. Group treatment accounts for 70% of all antimicrobials given to Danish finishers, calculated as ADDs. Group treatment may only be used for infectious conditions where a certain proportion of pigs in the pen or section are in a pre-clinical or clinical phase.

Antimicrobials used in group treatment can be categorized as water-soluble or non-water-soluble. The latter are mainly administered as top-dressing in dry-feed for the individual pen, whereas water-soluble antimicrobials are administered in wet-feed (through a medicine dispenser or directly in the trough) or in water (through a pipe or medicine dispenser) for the individual pen or section. The administration of antimicrobial treatment in water has two major advantages over administration in feed: (1) Feed intake is reduced in diseased pigs and therefore medicine intake is prone to under-dosage when administered in feed; (2) The drug mixes homogenously in water.

From 2005 to 2013, the amount of prescribed water-soluble antimicrobials increased from 33% to 59% of the total amount of antimicrobials (ADDs) prescribed for finishers. It has been speculated that administration of antimicrobials through water might result in the treatment of more animals. The objective of this study was to investigate how a change in the type of prescribed

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antimicrobials (water-soluble or non-water-soluble) affected the total quantity of prescribed antimicrobials.

2. Materials and methods

2.1. Study design

A retrospective cohort study with three cohorts was performed, based on three Danish national databases: Central Husbandry Register (CHR), Specific Pathogen Free register (SPF) and VetStat. On the basis of solubility of products prescribed for Danish pig farms as stated in VetStat, three cohorts were established. The cohort of primary interest included finisher farms that changed their antimicrobial group treatments from non-water-soluble to water-soluble products between 2008 and 2009 (Cohort Change). In addition, two cohorts of farms retaining their group treatment procedure from 2008 to 2009 were identified. These farms used either entirely water-soluble products (Cohort Water) or entirely non-water-soluble products (Cohort Feed).

2.2. Administration of antimicrobials

The quantity of prescribed antimicrobials was presumed to be a consistent proxy for the level of administered antimicrobials. Data on antimicrobials prescribed for pigs were retrieved from VetStat (Stege et al., 2003). All veterinary antimicrobial prescriptions for production animals are recorded in VetStat by feed mills, veterinarians and pharmacies. However, this study only included information from pharmacies, comprising more than 99% of the total amount of antimicrobials prescribed for pigs. To avoid disturbances of legislative actions, we chose to include data prior to July 2010 (Jensen et al., 2014; Anon., 2010).

To characterize prescribed antimicrobials as either water-soluble or non-water-soluble, we used the same classification as VetStat: "Based on the pharmaceutical formulation of the antimicrobial product, Vetstat uses the terminology given by the Health Authorities" (Erik Jacobsen, personal communication). Non-water-soluble substances (premixes and oral powders) were classified as being intended for feed administration, while water-soluble substances (soluble powders and oral solutions) were classified as being intended for water administration. All other formulations were characterized as being intended for single-animal treatments. Furthermore, the indication for prescription registered in VetStat was characterized as either (1) gastrointestinal disorders (2) respiratory disorders (3) joints/limbs/CNS (4) other (including urogenital, udder and generalized) disorders.

2.3. Study population

The selection procedure of farms for the three cohorts is illustrated in Fig. 1. Among all finisher farms, farms with changes in the number of registered finishers, production form or SPF-infection status[1] (Anon., 2015) during the study period were excluded. From the remaining farms, three cohorts were established:

- Cohort Feed: Farms that retained their procedure of group treatment administered 100% through feed between January 1st 2008 and December 31st 2009.
- Cohort Water: Farms that retained their procedure of group treatment administered 100% through water between January 1st 2008 and December 31st 2009.
- Cohort Change: Farms that changed their procedure of group treatment from 100% feed administration to 100% water administration. To retrieve a sufficient study population, three dates of transition were selected for this cohort: January 1st, April 1st and July 1st. This means that farms included in the first study period administered antimicrobials through feed from January 1st to December 31st 2008, and through water from January 1st to December 31st 2009, and likewise for the two other study periods. The total study period therefore ran from January 1st 2008 to June 30th 2010.

Data extractions from the CHR and SPF registers were from February 2008 (CHR and SPF), February 2009 (CHR and SPF) and October 2010 (CHR only).

2.4. Quantification of antimicrobials

Antimicrobials were quantified as Animal Daily Doses (ADDs) (Jensen et al., 2004). For comparison between farms, the amount of administered antimicrobials were aggregated at farm level and standardized as ADDs per 100 finishers per day, assuming an average weight of 50 kg at the time of treatment (ADD_{50}/100 finishers/day). This measure is in agreement with the official unit set by the Danish Veterinary and Food Administration (Anon., 2014b).

2.5. Statistical analysis

The difference in ADDs before and after the transition date (Cohort Change) or before and after 31 December 2008 (Cohort Feed and Cohort Water) was calculated for all farms in each of the three cohorts. This difference between years was used as the primary outcome in the statistical analyses. Non-parametric tests were performed due to non-normality in the outcome. A Kruskal–Wallis test was used to determine, whether there was a significant difference between years for all three cohorts and followed up by a pairwise comparison using a Tukey and Kramer test (Pohlert, 2015). Subsequently, a paired Wilcoxon signed-rank test was used to determine, whether the amount of antimicrobials was significantly different between years for each of the three cohorts. An ANOVA was used to test if the farm size differed significantly between the three cohorts. Likewise, a chi-square test was used to test for significant differences in prevalence of SPF-infection status and indication for prescription between cohorts.

Data management was carried out using the software SAS® (Statistical, 2014), while statistical analyses were performed in R (R Core Team, 2014).

3. Results

Extreme observations (37), crossing the first launched cut-off value of 8 ADD_{50}/100 finishers/day by the Danish Veterinary and Food Administration in 2010, were checked manually. In total, 37 farms administered more than 8 ADD_{50}/100 finishers/day, which was the limit for intervention from the Danish Veterinary and Food Administration in 2010 (Anon., 2010). Of these, 31 were from Cohort water, 5 were from Cohort Feed, and 1 was from Cohort Change. All 37 observations were checked manually, and none of these extreme values were due to changes in the number of registered pigs within the study period, so they were therefore retained in the final dataset.

The resulting dataset held 50 farms in Cohort Change, 221 farms in Cohort Feed and 553 farms in Cohort Water. A significant increase in the amount of antimicrobials administered between 2008 and

[1] SPF pathogens include the following: Porcine Reproductive- and Respiratory Syndrome European variant (PRRS-DK) and American/Vaccine variant (PRRS-Vac), *Actinobacillus pleuropneumoniae* (App) serotype 1–12 (except serotype 11), *Mycoplasma hyopneumoniae* (Myc), *Brachyspira hyodysenteriae* (Dys), toxin-producing *Pasteurella multocida* (Nys).