Herd-level risk factors for antimicrobial demanding gastrointestinal diseases in Danish herds with finisher pigs
A register-based study

G.K. Hybschmann [a,*], A.K. Ersbøll [b], H. Vigre [c], N.P. Baadsgaard [d], H. Houe [a]

[a] Department of Large Animal Sciences, Faculty of Life Sciences, University of Copenhagen, Denmark
[b] National Institute of Public Health, University of Southern Denmark, Denmark
[c] Division of Microbiology and Risk Assessment, National Food Institute, Technical University of Denmark, Denmark
[d] Danish Agriculture and Food Council, Pig Research Centre, Denmark

ARTICLE INFO

ABSTRACT

Endemic gastrointestinal (GI) diseases have a substantial negative impact on pig production, because, when present, they reduce animal welfare, productivity and generate high antimicrobial (AM) demand. In Danish legislation, AM can be prescribed only for therapeutic purposes. The objective of the study was to estimate the association between herd-level risk factors and the amount of AM use (AMU) in connection with GI diseases in finisher herds. We conducted a register-based cross-sectional study with repeated measurements from 2004 to 2007. Data were extracted from databases in the Danish Register of Veterinary Medicine, the Central Husbandry Register and the Danish Agriculture and Food Council. In total, 3192 pig herds with 26,973 records (quarters with prescriptions) were included. The outcome was presented as average AM use (measured as Animal Daily Dosage) for GI diseases per finishing pig per quarter per herd. Three potential herd-level risk factors were evaluated: herd size (number of finishers delivered for slaughter); herd health status (herds in the Specific Pathogen Free (SPF) System, conventional herds); and herd type (herds including only finishers, integrated herds). Data were analyzed using general linear mixed models with repeated measurements. Smaller herds had a larger AMU per finisher than larger herds. Integrated herds had lower AMU as compared with herds with only finishers. Herds within the SPF System had a larger decrease in AMU with increasing herd size compared to conventional herds. Significant regional differences in AMU were seen. Additionally, the results showed that other herd factors and veterinarians were more influential than the investigated herd risk factors. This illustrates the difficulties of characterising AM-demanding GI diseases in herds by the use of register data only.

© 2010 Elsevier B.V. All rights reserved.

1. Introduction

Endemic gastrointestinal (GI) diseases in finisher pigs have a considerable negative impact on pig production, because they compromise animal welfare and reduce productivity and hence cause substantial economic losses (McOrist et al., 1997; Kroll et al., 2005; McOrist, 2005; Straw et al., 2006). In Denmark, the major infectious cause of GI diseases in finishers is *Lawsonia intracellularis*, the aetiological agent of porcine proliferative enteropathy. However, *Brachiospira pilosicoli*, *Brachiospira hyodysenteriae*, *Escherichia coli* and Porcine Circovirus Type 2 also cause diarrhoea and poor growth performance in finishers (Stege et al., 2000; Jacobson et al., 2003). Furthermore, these GI diseases trigger considerable use of antimicrobials

* Corresponding author at: University of Copenhagen, Faculty of Life Sciences, Department of Large Animal Sciences, Veterinary Epidemiology, Grønnegaardsvej 8, DK-1870 Frederiksberg C, Denmark.
Tel.: +45 3528 3011; fax: +45 3533 3022.
E-mail address: gkh@life.ku.dk (G.K. Hybschmann).

(AM), and this is believed to have an impact on the development of AM resistance within pig herds as well as in humans (Aarestrup, 1999). Better understanding both at the herd and at the regional level, of the risk factors at play here should, therefore, help to clarify the factors that can influence the presence of these multi-factorial GI diseases. Previous studies evaluating risk factors for infectious GI diseases have identified associations between the presence of the infectious agent/disease and management and feed-related factors (Pearce, 1999; Stege et al., 2001; Chouet et al., 2003). Herd size is frequently studied as a risk factor for swine diseases, and there do appear to be associations between swine diseases and management, environmental factors and herd size (Gardner et al., 2002). Smith et al. (1998) found a strong association between proliferative enteropathy and herd size in herds with more than 500 sows. However, a Danish study by Stege et al. (2001) did not identify herd size as a significant factor. Pig herds in the Danish herd health system, the so-called SPF-system (SPF – Specific Pathogen Free) must comply with high standards of biosecurity and have to be free from at least one of the specified SPF diseases (Boklund et al., 2004). Therefore, herd health status is a relevant risk factor. Herds with only finishers continuously have to purchase new pigs and introduce them into the herd. This could mean that the risk of infectious GI agents being transmitted into the herd is higher in these herds compared to integrated herds.

There is a growing tendency to use register data in epidemiological studies, as this is a manageable and affordable way to obtain access to large amounts of data describing longer periods of time.

The objective of the present study was to determine the association between AM-demanding GI diseases in finishers and the following herd-level risk factors: herd size, herd health status and herd production type, adjusted by region, season and year. Danish legislation requires that AM only can be used if it is prescribed by a veterinarian and it must be strictly used for therapeutic purposes (Anonymous, 2007). Therefore, AM treatment can be used as an indirect measure of the presence of disease. The study uses general linear mixed models with repeated measurements of register data.

2. Materials and methods

2.1. Study design and population

A cross-sectional study with repeated measurements was designed. Danish pig herds with finisher pigs were the target population. Finishers were defined as pigs from 30 kg until slaughter. The study population was indoor production herds with more than 50 finishers produced each quarter and with AM prescriptions for GI diseases to finisher pigs; see Section 2.4.1 for a description of the exclusion criteria. The study unit was the herd per year per quarter.

2.2. Data

Data on AM consumption were obtained from the Danish Register of Veterinary Medicine (Vetstat). Since 2002,

it has been mandatory to record any AM prescribed to production animals in Vetstat. Information on prescribed AM use (AMU) for pigs is recorded in Vetstat by primarily pharmacies. For each prescription, the data encompass information on day of prescription, herd identity code (Central Husbandry Register (CHR) number), animal species, age group (sows and piglets, weaners, finishers) and disease category in terms of diseased organ (gastrointestinal diseases, respiratory diseases, joints and limbs diseases, reproductive diseases, udder diseases, metabolic diseases, and other diseases) as well as information on the drug (product identity (the Anatomical Therapeutic Chemical (ATC) classification system, specific number and name of the product); and quantity (amount of the product in specified unit) (Anonymous, 2009a, 2010a). In order to compare different AM types of different strengths and potency, the amount of AM prescribed is in Vetstat standardized by a standardized measure for drug use, Animal Daily Dosage (ADD). The measure is defined as the average daily dose for the main indication, using recommendations on doses approved by the Danish Medicine Agency and the Veterinary Pharmaceutical Producer Association (Jensen et al., 2004); on the main part in practice, these doses recommendations for animals are only specified on animal species. The disease category (indication) and ADD is included in the information from Vetstat.

Data on herd characteristics (herd type, location) were extracted from the CHR and from the Danish Agriculture and Food Council. Abattoirs submit information on the number of delivered finishers to the Zoonosis Register, and these data were extracted. Furthermore, laboratories automatically send laboratory results to the SPF Company. This information had been applied in the SPF Company to classify the herds into the SPF system. These data were obtained for this study.

The majority of Danish pig herds have a herd health contract, which implies monthly visits by a veterinarian. Therefore, using a month as the time unit was unsuitable and quarters of a year were selected as the unit of time.

Data from the different sources were merged and aggregated at herd-year-quarter level. In the final data set, one observation (herd-year-quarter) included information on the amount and type of prescribed AM, the number of pigs delivered for slaughter, the number of sows in the herd, herd health status, prescribing veterinarian and region, and, additionally, derived variables.

2.3. Description of derived variables

2.3.1. Outcome variable

Outcome was amount of prescribed AM for GI diseases per finisher per quarter at herd-level, quantified by ADD. We linked AMU with antimicrobial demanding disease as AM is only allowed for treatment purpose in Denmark. Compliance to this legislation is closely followed by the authorities, and therefore, we assumed that this legislation in general was followed.

AM prescribed for GI diseases was included for all application types. AMU is prescribed to groups of finishers in the herds (population at risk). Vetstat does not give information on whether for example five pigs had been treated