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A register-based study of the antimicrobial usage in Danish veal calves and young bulls

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ABSTRACT

High antimicrobial usage and multidrug resistance have been reported in veal calves in Europe. This may be attributed to a high risk of disease as veal calves are often purchased from numerous dairy herds, exposed to stress related to the transport and commingling of new animals, and fed a new ration. In this study, we used national register data to characterize the use of antimicrobials registered for large Danish veal calf and young bull producing herds in 2014.

A total of 325 herds with veal calf and potentially young bull production were identified from the Danish Cattle database. According to the national Danish database on drugs for veterinary use (VetStat), a total of 537,399 Animal Daily Doses (ADD_{200}) were registered for these 325 herds during 2014. The amount of antimicrobials registered in 2014 varied throughout the year, with the highest amounts registered in autumn and winter. Antimicrobials were registered for respiratory disorders (79%), joints/limbs/CNS disorders (17%), gastrointestinal disorders (3.7%) and other disorders (0.3%). Of the registered antimicrobials, 15% were for oral and 85% for parenteral administration. Long-acting formulations with a therapeutic effect of more than 48 h covered 58% of the drugs for parenteral use. Standardized at the herd-level, as ADD_{200}/100 calves/day, antimicrobial use distributed as median [$CI_{95\%}$] for starter herds (n = 22): 2.14 [0.19;7.58], finisher herds (n = 24): 0.48 [0.00;1.48], full-line herds (n = 183): 0.78 [0.05;2.20] and herds with an inconsistent pattern of movements (n = 96): 0.62 [0.00;2.24]. Full-line herds are herds, which purchase calves directly from a dairy herd and raise them to slaughter.

Furthermore, we performed a risk factor analysis on the 183 herds with a full-line production. Here, we investigated, whether the number of suppliers, the number of calves purchased, the frequency of purchase, the average age at introduction, the average time in the herd and vaccination influenced the amount of antimicrobials used in the herds. The final multivariable regression analysis revealed that the number of calves introduced was positively associated with the antimicrobial use in the herd.

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1. Introduction

High antimicrobial usage and multidrug resistance have been found in Belgian and Dutch veal calves (Catry et al., 2007; Pardon et al., 2012a; Bos et al., 2012). In the same countries antimicrobial usage in veal calves has been found to exceed that of pig, poultry, dairy and beef cattle production (Pardon et al., 2012a; Bondt et al., 2013). An explanation may be that producers of pigs and poultry receive animals from a limited number of suppliers, while veal calf producers typically purchase calves from numerous dairy herds. A large number of suppliers, new feed and stress related to the transport and commingling of new animals exposes veal calves to a high risk of disease and may explain the higher use of antimicrobials (Pardon et al., 2012a).

Veal calf production can generally be divided into two types; white and rosé veal calf production. White veal calves are primarily fed on calf milk replacer and are slaughtered at around 6–8 months of age, while rosé veal calves are weaned in the beginning of the fattening period and subsequently fed on roughage and concentrate, until they are slaughtered at around 8–12 months of age (Bos et al., 2012). Additionally, rosé veal calf production can be divided into rosé starter and rosé finisher herds with large differences in antimicrobial usage (Bos et al., 2013).

Denmark only produce rosé veal calves. The vast majority of Danish rosé veal calves, are bull calves purchased from domestic dairy herds. Some of the calves are slaughtered as veal (8–12 months of age) (EU Regulation EC, 2007), while some are slaughtered as young bulls (>12 months of age) (Danish Agriculture and

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Food Council, 2016). In 2014, around 200,000 veal and young bulls were slaughtered in Denmark (Danish Agriculture and Food Council, 2015). Heifers only make up around 1% of the total number of produced calves (SEGES, 2016). After arrival in a specialized veal calf herd, the calves receive calf milk replacer until around 8 weeks of age, after which they are typically fed on a ration of grain and concentrate or on a total mixed ration based on corn silage. The calves are predominantly Danish Holsteins, though a small percentage of them are Holstein crossbreds. Specialized Danish rosé veal calf producers generally keep the calves in compartments of multiple straw-bedded pens or cubicles, where each unit may hold 6–50 calves of the same age, depending on the producer. Typically, an all-in-all-out production is implemented at pen level, but not at compartment level. Depending on the facilities, this may result in calves of different ages being housed under the same roof, thus facilitating the transmission of airborne pathogens (Mars et al., 1999; Niskanen and Lindberg, 2003).

In herds with a Veterinary Advisory Service Contract, Danish veterinarians can prescribe drugs for use within 63 days (Anon., 2016). This means that most Danish veal and young bull producers have a veterinary visit at least every second month. All prescription-only drugs for veterinary use are registered in the national database VetStat, which holds detailed information on each purchase of drug such as the date, prescribing veterinarian, receiving herd ID, species, age group and clinical indication (Stege et al., 2003). In addition, the Danish cattle database holds detailed information on all Danish cattle and their movements, including the date of birth, date of movement and herd ID of the sender and recipient.

There is limited research into the overall disease occurrence in Danish veal calf production. A study from 1984 found pneumonia and enteritis to be the predominant diseases (Madsen, 1984). In Swiss and Belgian white veal calves, respiratory disease was found to be the main indication for antimicrobial treatment (Pardon et al., 2012a; Lava et al., 2016b), with a peak incidence in the third week after arrival (Pardon et al., 2012b). The second most common indication for treatment of Belgian white veal calves was diarrhea (12%), while arrival prophylaxis made up 13% of the treatments (Pardon et al., 2012a). Group treatments were widely applied in the production in both countries (>84%) (Pardon et al., 2012a; Lava et al., 2016b).

Recent risk factor studies on white veal calves in Switzerland have demonstrated purchase of calves and herd size to be significantly associated with the use of metaphylactic treatments (Lava et al., 2016a), while the lack of quarantine and clinical examination upon arrival, as well as shared airspace for several groups of calves were associated with an increased antimicrobial usage (Lava et al., 2016b). To the best knowledge of the authors, no risk factor study on rosé veal calf production has so far been carried out. Therefore, based on register data, our aim was to characterize antimicrobial usage in Danish veal calves specified in the following two objectives:

a Describe the total amount of antimicrobials registered for all large Danish herds with a veal calf and potentially young bull production in 2014.
b Identify risk factors influencing the amount of antimicrobials registered at herd level in large Danish herds which purchased calves and raised them to slaughter (full-line production).

2. Materials and methods

2.1. Study population

Based on the Danish Cattle database, herds included in the study population had to fulfill the following three criteria:

1. No delivery of milk to a dairy in 2014
2. Slaughter more than 100 bull calves in 2014
3. Less than 80% of the cattle in the herd should be of dairy or mixed breeds

Bovines which had stayed in one of the study herds in the period 01 January, 2014–31 December, 2014 were included. For these animals, all movements were extracted from the Danish Cattle database until 31 December 2014. Based on the definition of veal by the European Council (EU Regulation EC, 2007), calves were defined as being less than 366 days of age at the time of slaughter. Only bovines which were calves (<366 days of age) at the time of introduction in one of the study herds were retained in the final dataset.

For each calf, we consecutively numerated each herd through which the calf had passed, aside from the originating dairy herd, markets and delivering traders. Based on this, we defined four different types of herds: Starter and full-line herds, where ≥95% of the calves entering the herd came directly from the herd where they were born (possibly through a market or delivery trader); and finisher herds, where ≥95% of the entering calves came from a starter herd. Herds with a low average age of exit (<250 days) or a high variance in the age at exit (>10 days) were checked manually, to differentiate starter and full-line herds. Herds, which did not fulfill the definitions of starter, finisher or full-line herds, were defined as herds with inconsistencies in movements.

The number of registered calves on the first day of each month was extracted from the Danish Cattle database. We calculated a weighted herd size for 2014 based on this information and taking into account the number of days in each month. Additionally, calf mortality from day 0–180 was calculated for each herd as a modified Kaplan-Meier estimate. The Kaplan-Meier estimate follows a specific cohort of calves during the first 180 days of their lives, for which a mortality risk is calculated as the number of fallen and euthanized calves divided by the number of calves at risk (Nielsen et al., 2010). Due to availability of data, the calf mortality was stated for the period between 01 October, 2014 and 30 September, 2015, covering calves born between 01 April, 2014 and 31 March, 2015. For each herd, we summarized the number of calves purchased, the average age at introduction, the average time in the herd, frequency of purchase, purchase from markets and delivering traders, and the number of suppliers (excluding delivering traders and markets). Furthermore, we calculated the proportion of calves slaughtered <366 days of age out of the total number of slaughtered bovine.

2.2. Antimicrobial prescriptions

In VetStat, all prescription-only drugs for production animals are registered in detail at the time of purchase by farmers (from either pharmacies or veterinarians) (Stege et al., 2003). We retrieved records on antimicrobials for calves registered by both pharmacies and veterinarians in 2014 from VetStat on 01 June, 2015. Antimicrobials registered by veterinarians were manually checked and systematic errors were corrected. Furthermore, registrations with an invalid code of indication (e.g. disease in other species) were deleted.

For each herd in the study, the amount of antimicrobials registered in VetStat for calves was used as a measure for the amount of antimicrobials used. Antimicrobials were quantified as the number of Animal Daily Doses (ADD_{200}) (Jensen et al., 2004). Based on the official Danish quantification of antimicrobials, we used a standard weight of 200 kg for calves (personal communication Erik Jacobsen, Danish Veterinary and Food Administration). The standard dose, ADD_{200} corresponds to the treatment of one 200 kg calf for one day. For comparison between herds, the amount of antimicrobials was standardized in agreement with the official

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