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Risk factors for calf mortality in large Swedish dairy herds

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ABSTRACT

The aim of this study was to identify possible risk factors for 1–90 day calf mortality in large Swedish dairy herds. Sixty herds with a herd size of ≥160 cows were visited once between December 2005 and March 2006. Thirty herds were known to have low mortality (LM) and 30 were known high mortality herds (HM). Upon the visit, data about housing and management was collected from interviews with personnel responsible for the calves. The herd status regarding the calves' passive transfer (total protein), levels of α-tocopherol, β-carotene and retinol, and excretion of faecal pathogens (*Cryptosporidium* spp., *Escherichia coli* F5, rota and corona virus) was evaluated based on targeted sampling of high risk calf groups; in each herd, blood and faecal samples were collected from calves 1–7 and 1–14 days old, respectively. Similarly, the herd status regarding clinical respiratory disease in calves and history of respiratory virus exposure was evaluated based on lung auscultations and blood samplings of calves 60–90 days old. The median calf mortality risk (in calves 1–90 days of age) among HM herds was 9% (Range: 6–24%) and among LM herds 1% (Range: 0–2%). LM and HM herds were compared using five logistic regression models, covering potential risk factors within different areas: "Disease susceptibility", "Factors affecting the gastrointestinal tract", "Factors related to transmission of infectious disease", "Hygiene" and "Labour management". The percentage of calves, 1–7 days old, with inadequate serum concentrations of α-tocopherol and β-carotene were significantly higher in HM herds compared to LM herds and also associated with higher odds of being a HM herd (OR = 1.02; $p = 0.023$ and OR = 1.05; $p = 0.0028$, respectively). The variable "Average number of faecal pathogens in the sampled target group" was significantly associated with higher odds of being a HM herd (OR = 4.65; $p = 0.015$), with a higher average in HM herds. The percentage of calves with diarrhoea treated with antibiotics was significantly higher in HM herds and was associated with higher odds of being a HM herd (OR = 1.08; $p = 0.021$). The median age at death of calves in the age interval 1–90 days that died during a one-year period was significantly lower among HM herds (13 days) than in LM herds (24 days) ($p = 0.0013$) The results indicate that gastrointestinal disorders may be an important cause of calf mortality in large Swedish dairy herds. Furthermore, our study provides additional indications that fat soluble vitamins might play an important role for calf health.

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1. Introduction

High calf mortality is an important cause of economic loss in dairy production (Agerholm et al., 1993; Losinger and Heinrichs, 1997; Mee, 2008). Calf mortality may also retard progress in replacing less productive cows or increasing the herd size (Speicher, 1968; Wathes et al., 2008), and might consequently result in a shortage of replacement heifers and a need to buy animals that further increases the replacement costs of the herd.

Diarrhoea and respiratory infections are the most important disease problems in calves, and enteritis and pneumonia the major causes of death (Virtala et al., 1996; Svensson et al., 2006). *Cryptosporidium* spp., bovine rota and corona viruses (BCV) and *Escherichia coli* F5 are the most important pathogens causing neonatal diarrhoea in calves under Scandinavian conditions (Björkman et al., 2003; Gulliksen et al., 2009a). Respiratory disease is most often initiated by viral agents and bovine respiratory syncytial virus (BRSV), BCV and parainfluenza 3 (PIV-3) are among the most important of these (Autio et al., 2007). Hägglund et al. (2006) found BRSV, BCV and PIV-3 to be common infections in replacement calves in south western Sweden.

Several risk factors for calf mortality have been identified such as routine antibiotic treatment of calf diarrhoea (Lance et al., 1992), group housing (Waltner-Toews et al., 1986b; Olsson et al., 1993), and inadequate passive transfer of colostral immunoglobulin (Jenny et al., 1981; Wells et al., 1996). Inadequate vitamin status has been associated with higher calf mortality during the first week after birth (Lotthammer, 1979). Several authors have reported an association between high calf mortality and increasing herd size (Speicher and Hepp, 1973; Hartman et al., 1974; Lance et al., 1992; Nielsen et al., 2002), whereas other studies found no (Jenny et al., 1981) or little correlation (James et al., 1984). Swedish dairy herds are rapidly getting larger. Between 1997 and 1998, the average dairy herd size was 35 cows, but had increased to 55 cows between 2007 and 2008 (Swedish Dairy Association, 2008). In 2009, 5.4% of the herds affiliated to the Swedish official milk recording scheme had a herd size of 150 cows or more (Swedish Dairy Association, 2010).

Previous Swedish studies have reported low mortality risks in calves 0–90 days of age; 2.6% and 3.1% reported by Olsson et al. (1993) and Svensson et al. (2006), respectively. Higher mortalities have been reported in Denmark (Range: 4.2–13.8%; Nielsen et al., 2002), and the United States (5.6% and 9.4% reported by Virtala et al. (1996) and Losinger et al. (1997), respectively). However, data from the Swedish official milk recording scheme indicate that the mortality risk is getting close to 4% in herds with more than 150 cows (Gidekull et al., 2006). With increasing herd sizes and a trend towards increasing calf mortality in large herds, the calf mortality risk may rise considerably in Sweden in the future.

Although many of the studies on calf mortality in dairy herds during the past 25 years have had similar objectives, the variables examined and the techniques used for analysis have been quite different, which makes direct comparisons of the results difficult. Furthermore, much has changed over time making results from older studies less applicable to the present situation. For example, not only have herds become larger, but there has also been a paradigm shift from treatment of clinical illness to disease prevention (LeBlanc et al., 2006), and new techniques, housing systems and management routines have been introduced. It is well established that management practices affect morbidity and mortality in dairy calves (Kehoe et al., 2007). Studies conducted under prevailing conditions are therefore essential to provide farmers with the latest information and advice matching the present situation.

The objective of this study was to identify risk factors associated with mortality of 1–90 day old calves in large (≥160 cows) Swedish dairy herds known to have high calf mortality risk versus herds known to have low calf mortality risk.

2. Materials and methods

2.1. Study design and selection of herds

2.1.1. Definition of case and control herds

The study was designed as a case–control study and the herd was the unit of concern. The dependent variable was type of herd, classified as case (herds with known high calf mortality risk – HM herds) or control (herd with known low calf mortality risk – LM herds). Herds were classified based on a selection procedure (see Section 2.1.2) in which the herds with the highest and the lowest calf mortality risks among those within the sampling frame were asked to participate in the study. To be classified as a HM herd, the herd's average calf mortality risk had to be *minimum* 6% and to be classified as a LM herd, the average calf mortality risk was allowed to be *maximum* 2%. This design, where extremes are contrasted, was chosen to increase the power of the study, i.e. our ability to detect differences between herds with high and low calf mortality. The underlying assumption is that a strong contrast in the case/control criteria will be reflected in a larger difference between the groups with regards to important risk factors.

2.1.2. Case and control herds – selection criteria

Inclusion criteria for the study were affiliation to the Swedish official milk recording scheme (in 2005, approximately 85% of all Swedish dairy cows were affiliated) and an average herd size of ≥140 cows in September 2003 and ≥160 cows in August 2005. For logistical reasons herds located in the northern part of Sweden, north of the river "Dalälven" (i.e. 6% of the herds in this size range), were excluded. In total, 116 dairy herds met the criteria and were classified as HM or LM herds based on their mortality risk in 1–90 day old calves. They were first ranked based on average mortality risk during the past twelve-month period (September 2004–August 2005) and secondly based on the corresponding mortality risk during the past three months. The 40 herds with the lowest calf mortality risk and the 40 herds with the highest calf mortality risk were invited by mail to participate in the study.

Twenty-five LM herds and 26 HM herds expressed willingness to participate in the study by sending in a written