J. Dairy Sci. 101:1–16
https://doi.org/10.3168/jds.2017-13733

Associations between management practices and within-pen prevalence of calf diarrhea and respiratory disease on dairy farms using automated milk feeders

Catalina Medrano-Galarza,*†[1] Stephen J. LeBlanc,*† Andria Jones-Bitton,* Trevor J. DeVries,†‡ Jeffrey Rushen,§ Anne Marie de Passillé,§ Marcia I. Endres,# and Derek B. Haley*†
*Department of Population Medicine, Ontario Veterinary College,
†Campbell Centre for the Study of Animal Welfare, and
‡Department of Animal Biosciences, Ontario Agricultural College, University of Guelph, Guelph, ON, N1G 2W1, Canada
§Faculty of Land and Food Systems, University of British Columbia, Agassiz, BC, V6T 1Z4, Canada
#Department of Animal Science, University of Minnesota, St. Paul 55108-6118

ABSTRACT

Data on management practices used with automated milk feeders (AMF) are needed to identify factors associated with calf health in these systems. The objectives of this observational, longitudinal, cross-sectional study were to estimate the prevalence of calf diarrhea (CD) and bovine respiratory disease (BRD), and to identify factors associated with prevalence of these diseases at the pen level on dairy farms feeding milk to group-housed calves with AMF. Seventeen dairy farms with AMF in Ontario, Canada, were visited 4 times, seasonally, over 1 yr. The clinical health of all calves (n = 1,488) in pens (n = 35) with AMF was scored to identify the number of calves with CD and BRD. Data on calf, feeder, and pen management practices were analyzed using generalized linear mixed regression models for each disease. Overall calf-level prevalence of CD and BRD were 23 and 17%, respectively. Median (interquartile range, IQR) within-pen prevalence of CD and BRD were 17% (7 to 37%) and 11% (0 to 28%), respectively. Median age (IQR) for diarrheic calves was 25 d (16 to 42 d), and for calves with BRD was 43 d (29 to 60 d). Factors associated with lower within-pen prevalence of CD were the administration of vitamin E and selenium at birth [odds ratio (OR) = 0.56; 95% confidence interval (CI): 0.32 to 0.99], feeding of probiotics (OR = 0.44, 95% CI: 0.22 to 0.93), and adding fresh bedding every 2 to 3 d (OR = 0.43; 95% CI: 0.24 to 0.76) compared with every 7 or more days. In contrast, sharing air with older cattle (>9 mo old) was associated with increased within-pen prevalence of CD (OR = 4.54, 95% CI: 1.88 to 10.52). Additionally, total bacteria counts ≥100,000 cfu/mL in milk samples taken from the AMF mixing jar were associated with increased within-pen prevalence of CD during the summer visit (OR = 3.34; 95% CI: 1.31 to 8.54). Increased total solids in milk or milk replacer (OR = 0.48, 95% CI: 0.27 to 0.85) and feeding whole milk versus milk replacer (OR = 0.29, 95% CI: 0.11 to 0.75) were associated with lower within-pen prevalence of BRD. Factors associated with greater within-pen prevalence of BRD were sharing air with weaned cattle up to 8 mo old (OR = 3.21, 95% CI: 1.26 to 8.16), and greater depth of the wet bedding pack. The use of maternity pens for reasons other than just calving was associated with increased prevalence of both CD and BRD (OR = 1.85, 95% CI: 1.03 to 3.33; OR = 2.61, 95% CI: 1.21 to 5.58, respectively). These results suggest that isolation from older animals and frequent cleaning of the feeder and pen may help to reduce disease prevalence in group-housed calves fed with an AMF.
Key words: dairy calf, morbidity, automated feeding, group housing

INTRODUCTION

In North America, a growing proportion of calves is group-housed and fed with automated milk feeders (**AMF**) during the milk-feeding period (USDA, 2016). Medrano-Galarza et al. (2017a) reported that 36% of 670 dairy farms that participated in a survey on calf rearing practices across Canada housed calves in groups and 16% fed milk through AMF machines. The adoption of AMF is increasing steadily among producers (Medrano-Galarza et al., 2017a) as a way to improve working conditions and reduce physical labor while facilitating feeding high volumes of milk in multiple portions throughout the day to group-housed calves (Medrano-Galarza et al., 2017b). Nevertheless,

Received August 23, 2017.
Accepted November 16, 2017.
[1]Corresponding author: cata.medrano@outlook.com

some producers attribute difficulties with AMF (i.e., perceived high morbidity and mortality) to the feeders themselves and the type of housing (Endres, 2013), with some producers switching back to individual housing and feeding (Medrano-Galarza et al., 2017a). Producers perceive individual housing and individual feeding as a way to reduce disease transmission (Medrano-Galarza et al., 2017b) by limiting direct contact between calves, which has also been recommended by veterinarians (Callan and Garry, 2002; Stull and Reynolds, 2008). Observational studies in Sweden have shown the risk of bovine respiratory disease (**BRD**) to be significantly higher for AMF-fed calves housed in groups of 6 to 30 calves/pen compared with manually fed calves housed individually (Lundborg et al., 2003, 2005; Svensson et al., 2003) or in groups of 3 to 8 calves/pen (Lundborg et al., 2005). The severity of calf diarrhea (**CD**) cases was significantly higher in AMF-fed calves in large groups than in individually housed calves (Svensson et al., 2003).

For Swedish farms feeding calves with an AMF, overall calf-level incidence risk of CD and BRD, up to 90 d of age, were 9 and 14%, respectively (Svensson et al., 2003). Additionally, Svensson and Liberg (2006) controlled group size in pens with AMF (6 to 9 calves vs. 12 to 18 calves) and found that within-pen incidence risk of CD and BRD ranged from 1 to 42%, and from 0 to 54%, respectively (median incidence in small groups: CD = 13% and BRD = 18%, and in large groups: CD = 20% and BRD = 31%). However, only the risk of respiratory disease was significantly higher for calves housed in large groups compared with those housed in small groups.

Research focused on the health impacts of raising calves with AMF systems and management practices other than group size is scarce. In North America, an observational study across farms in the US Midwest is the only available published research on this topic (Jorgensen et al., 2017). In that study, researchers found associations between individual calf health scores (e.g., attitude, temperature, hind-end dirtiness score) and management practices regarding milk feeding plan, cleanliness of the AMF, and ventilation. To be able to support farmers by helping users of AMF improve their management practices and by providing information to guide decision-making of future adopters of AMF systems, it is essential to estimate disease frequency and determinants of calf health under AMF systems. Hence, the objectives of the present study were to estimate prevalence of CD and BRD, and to identify factors associated with prevalence of these diseases at the pen level on dairy farms feeding milk to group-housed calves with AMF in southern Ontario, Canada.

MATERIALS AND METHODS

This observational, longitudinal, cross-sectional study was reviewed and approved by the University of Guelph Animal Care Committee (Animal Use Protocol #3212).

Sample Size Estimation

During planning stages, and based on research done on farms with AMF in Sweden (Svensson and Liberg, 2006; the only research available at the time), we made the assumption that the mean within-pen prevalences of CD and BRD were 10 and 20%, respectively (SD of 10%), in small (as defined above) groups and 20 and 30%, respectively (SD of 15%), in large groups. Using these assumptions, we estimated a total sample size of 52 pens for a power of 80% and a confidence level of 95% to be able to detect a difference of 10% (WINPEPI statistical program, version 11.62; Abramson, 2011). The estimated sample size was adjusted for clustering by farm (with an estimated average cluster size of 2 pens per farm) and an assumed intraclass correlation of 0.2. This gave an estimated sample size of 64 pens (~32 farms) when analyzing the effect of one exposure variable.

Enrollment of Farms and Farm Visits

A convenience sample of commercial dairy farms was obtained from a list of volunteer farms that expressed interest in participating in this study after completing an online survey on calf management practices (Medrano-Galarza et al., 2017a). Farms were initially selected based on location (no more than 2.5 h drive from the University of Guelph, Ontario, Canada) and willingness to complete a short questionnaire on calving, newborn calf, group-pen, and AMF management practices. Farms fulfilling the location criterion were contacted by telephone to confirm their willingness to participate and to schedule the first farm visit. Of the farms with AMF that completed the online survey, 73 indicated that they were interested in participating in the present study and provided their contact information. Of these, 32 farms were located in the province of Ontario, Canada. Only 18 farms fulfilled the location criterion, 17 of which agreed to participate and were enrolled.

Each farm was visited 4 times, once per season, over 1 yr, starting in the fall of 2015 and ending in the summer of 2016. Fall farm visits were carried out between November 2 and December 1, 2015; winter visits occurred between February 3 and March 16, 2016; spring