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Factors associated with dairy calf health in automated feeding systems in the upper Midwest United States

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ABSTRACT

Automated calf feeding systems are becoming more common on US dairy farms. The objective of this study was to evaluate calf health in these systems and to identify risk factors associated with adverse health outcomes on farms in the upper Midwest United States. Over an 18-mo period on bimonthly farm visits to 38 farms, calves (n = 10,179) were scored for attitude, ear, eye, and nasal health, as well as evidence of diarrhea (hide dirtiness score of perianal region, underside of the tail, and tailhead). For all health score categories, a score of 0 represented an apparently healthy animal. Rectal temperatures were taken in calves scoring a ≥2 in any category, and those with a temperature >39.4°C were categorized as having a fever (n = 550). Associations were determined between farm-level variables and health scores to identify risk factors for higher (worse) scores. All health outcomes were associated with season of measurement, with fall and winter seasons increasing the odds of a high health score or detected fever. High bacterial counts measured in the milk or milk replacer were associated with increased odds for higher attitude and ear scores, and higher odds for calves having a detected fever. Higher peak milk allowance (L/d) was associated with lower hide dirtiness score, whereas a longer period of time (d) to reach peak milk allowance was associated with increased odds of higher scores for attitude, ear, eye, and hide dirtiness, as well as fever. Higher fat content in milk was associated with increased odds of high eye score. Less space per calf (m^2/calf) was associated with higher ear and eye scores, whereas larger group sizes were associated with increased odds of higher nasal score and decreased odds of higher hide dirtiness score. Rectangular pen shape was associated with decreased odds of higher eye score. Absence of a positive pressure ventilation tube was associated with increased odds of having a calf detected with a fever. Based on these results, we hypothesize that these factors could be managed to improve health outcomes for dairy calves on automated feeding systems.

Key words: dairy calf, automated feeder, health, welfare

INTRODUCTION

The period between birth and weaning represents a time of high risk for dairy calves; national survey results indicate that 6.0 ± 0.7% of live-born calves die during this period (USDA, 2017). Infectious disease is a particularly high risk for calves, with enteric and respiratory infections being the most common cause of disease-related death (Svensson et al., 2006), and these diseases influence economic efficiency and long-term production in the dairy industry (Heinrichs et al., 2005). Because of the risk of spreading infection between animals, dairy calves in the United States are traditionally housed in individual pens or hutches to minimize physical contact (Callan and Garry, 2002). Although early studies found that calves housed individually had lower morbidity and mortality rates (Waltner-Toews et al., 1986b,c), later larger-scale, observational studies did not report better health in individually housed calves compared with those housed in small groups of 6 to 8 calves (e.g., Losinger and Heinrichs, 1997; Svensson et al., 2003). In addition, individual housing is increasingly criticized for restricting physical movement and social interaction of calves (Rushen et al., 2008) and an increasing number of farm operations are shifting toward group-housed systems.

Housing calves in groups increases the opportunity for social interaction and facilitates normal calf behaviors (Chua et al., 2002), and can affect the transition to solid feed, leading to better postweaning weight gains (de Paula Vieira et al., 2010; Costa et al., 2015; Miller-Cushon and DeVries, 2016). However, group housing

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presents its own challenges. Although group housing systems are not inherently worse for calf health than individual housing (e.g., Losinger and Heinrichs, 1997; Svensson et al., 2003), group size is an important factor. Calves housed in larger groups (>6 to 8 calves) appear to be at higher risk for mortality and respiratory disease than those in small groups (Losinger and Heinrichs, 1997; Svensson et al., 2003; Svensson and Liberg, 2006).

Automated feeding systems are becoming increasingly popular in the upper Midwest United States as a tool for managing calves in group-housed systems. These computer-controlled feeding systems provide operators with individual calf data, flexibility in diet and weaning management, and have been shown to significantly affect manual calf-care labor (Kung et al., 1997; Kack and Ziemerink, 2010). Although popular in Europe, these systems are relatively new to the United States and little is known about the manner in which they are employed on dairy farms in the United States. It is critical to better understand how key management practices, facility design characteristics, and environmental factors may affect calf health. The objectives of this study were to document the health status of calves on farms using automated feeding systems and to investigate the association of management factors with calf health.

MATERIALS AND METHODS

Data Collection

This study was conducted on 38 farms in Minnesota, northwest Iowa, and Wisconsin using automated milk feeders for preweaned calves. These farms used Förster-Technik (Engen, Germany) automated calf feeders, with the exception of 2 farms: 1 with a Holm & Laue (Westerrönfeld, Germany), the other an Urban feeder (Wüsting, Germany). Farms were randomly selected from the total known population of automated feeder farms in the region at the time of selection (64 facilities) as identified by extension staff, equipment dealers, veterinarians, consultants, and producers. The number of farms selected was determined to be the number logistically feasible within the established data collection schedule. However, once selected for potential inclusion in the study, participation by individual producers was voluntary. Each farm was visited up to 8 times, approximately every 60 d (bimonthly), between November 2012 and May 2014. Data were collected through a combination of direct observation of the calves and their environment, along with an in-person interview with the farm operator using a questionnaire. The study was carried out in accordance with the recommendations of the Institutional Animal Care and Use Committee, and the protocol was approved by the committee. Consent was granted by the farm operators.

Measurements of calf barn and pen characteristics were recorded at the time of each visit and changes were noted if needed at each visit in addition to any changes in management practices. Barn characteristics included barn construction type (new or retrofitted), ventilation type (natural ventilation, mechanical ventilation), number and size of fans, and aspects of supplemental positive pressure ventilation tubes (diameter, outlet hole size, spacing and placement, and air inlet source) if present. At each visit, pen characteristics were recorded including pen size, group size, space per calf, and bedding type and depth. Bedding wetness was evaluated at 4 locations in each pen (0 = dry; 4 = very wet; Canadian Dairy Research Project, 2011).

At each bimonthly visit, thermal conditions at a central location in each calf area were uploaded from temperature-humidity loggers (HOBO A23 Pro Series, Onset Corp., Bourne, MA), which recorded temperature and humidity hourly throughout the 18-mo study period. To maintain parsimony in the final models produced, calendar season was used as a comprehensive category incorporating temperature, humidity, photoperiod, and other environmental factors that vary significantly throughout the year. Seasons were defined as onset of the study to December 20, 2012 (fall 1), December 21, 2012, to March 20, 2013 (winter 1), March 21, 2013, to June 20, 2013 (spring 1), June 21, 2013, to September 20, 2013 (summer 1), September 21, 2013, to December 20, 2013 (fall 2), December 21, 2013, to March 20, 2014 (winter 2), and March 21 to May 20, 2014 (spring 2).

Calf health was evaluated within 2 calf pens on smaller farms (4 or fewer total pens; 33 farms) or in 3 pens (farms with 5 or more total pens; 5 farms) using a health scoring method adapted from McGuirk, University of Wisconsin (https://www.vetmed.wisc.edu/dms/fapm/fapmtools/8calf/calf_health_scoring_chart.pdf). This method scored physical indicators of calf health status on a 0 to 4, 0 to 3, or 0 to 2 scale. For all health score categories, a score of 0 represented an apparently healthy animal. Attitude score in the current study was on a scale of 0 to 4, with 0 = active, 1 = quiet/dull, 2 = depressed, 3 = nonresponsive, and 4 = dead. Ear position (ear score) was on a scale of 0 to 4 with 0 = no ear droop, 1 = unilateral ear droop, 2 = slight bilateral ear droop, 3 = severe bilateral ear droop, and 4 = head tilt. Ocular discharge (eye score) was on a scale of 0 to 3, with 0 = no discharge, 1 = small amount of ocular discharge, 2 = moderate amount of bilateral discharge, and 3 = heavy ocular discharge. Nasal discharge (nasal score) was on a scale of 0 to 3