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Udder health in Canadian dairy heifers during early lactation

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ABSTRACT

Mastitis is the most prevalent and costly disease in dairy cattle worldwide, with implications for animal health and welfare as well as production and economics. Nonlactating heifers are an often-neglected group of animals concerning mastitis management, as they are assumed to be free of mastitis. An observational field study was conducted between 2007 and 2008 on 91 dairy herds across Canada, representative of provincial averages of bulk milk somatic cell count (BMSCC) and barn type. The aims of that study were to (1) estimate in early-lactating heifers overall and pathogen-specific incidence rate of clinical mastitis (IRCM), prevalence of intramammary infection (IMI), and prevalence of subclinical mastitis (SCM; defined as SCC ≥200,000 cells/mL); (2) compare these udder health parameters between heifers and multiparous cows; and (3) determine regional patterns and variations in these udder health parameters across BMSCC categories. During the first day of lactation, IRCM was higher in heifers than in multiparous cows (99 vs. 48 cases per 10,000 quarter-days at risk, respectively). Clinical mastitis affected 4% of heifers (0.73 cases per 100 quarters) in the first 30 d after calving, with the most common pathogens isolated being *Staphylococcus aureus* and *Escherichia coli*, whereas *S. aureus* and non-*aureus* staphylococci were the most commonly isolated pathogens in multiparous cows. The IRCM in heifers was highest in Ontario heifers, but overall IRCM did not vary by BMSCC category and it was only higher in multiparous cows than heifers in high-BMSCC Ontario herds. Intramammary infections were present in 33% of heifer quarters, with non-*aureus* staphylococci the most commonly isolated group of bacteria in both heifers (26% of quarters) and multiparous cows (18% of quarters). Pathogen-specific prevalence of IMI did not differ between heifers and multiparous cows, but we noted regional differences and differences across BMSCC categories in pathogen-specific prevalence of IMI. Prevalence of SCM in heifers was 13.6% and was lowest in Alberta herds. In all regions, SCM prevalence was higher in multiparous cows than in heifers. In conclusion, udder health of Canadian dairy heifers was similar to that of other countries, demonstrating the importance of the issue. Differences between heifers and multiparous cows early in lactation highlighted the need for management practices to target the precalving period in heifers, when exposure to risk factors differs from that in lactating cows.
Key words: heifer mastitis, epidemiology, CNS, environmental, infectious

INTRODUCTION

Dairy heifers are typically not a focus when it comes to mastitis prevention and detection on farms, as they are not lactating and free from the physical and physiological stresses associated with the milking process (De Vliegher et al., 2012). However, the incidence of clinical mastitis (**CM**) and prevalence of subclinical mastitis (**SCM**) is high in heifers around calving, and the effect of CM on heifers is more severe than that in older animals (Piepers et al., 2009). Heifers that calve with SCM or CM are more likely to be culled during their first lactation, and persistence of mastitis into lactation has a stronger effect on future udder health and milk production (Piepers et al., 2009). Raising an animal to first calving represents a considerable investment that may not be recuperated over the course of a single lactation, and, as such, there is a strong economic incentive for prevention and management of mastitis around calving in heifers (Rollin et al., 2015).

Mean incidence rate of CM (**IRCM**) on dairy farms ranges from 20 to 30 CM cases/100 cow-years at risk (Olde Riekerink et al., 2008; Verbeke et al., 2014; Levison et al., 2016) in all lactating cows, but disease progression may be different in primiparous heifers. The incidence of both new IMI and CM in primiparous heifers are highest in the weeks before and immediately after calving, as rates are higher than in multiparous cows in early lactation (Barkema et al., 1998; De Vliegher et al., 2004; Moosavi et al., 2014).

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The distribution of bacterial species in milk samples from cows with CM varies with geographic region, bulk milk SCC (**BMSCC**), barn type, herd hygiene, and bedding type (Kalmus et al., 2006; Olde Riekerink et al., 2008; Verbeke et al., 2014; Rowbotham and Ruegg, 2016), whereas no study has quantified bacterial species distribution in CM cases from Canadian heifers. In lactating cows, *Staphylococcus* species often comprise a very large proportion of bacteria isolated from IMI and mastitis cases (Kalmus et al., 2006; Verbeke et al., 2014; Yang et al., 2015). In contrast, in heifers raised on pasture in New Zealand, *Streptococcus uberis* accounted for the majority of CM cases at calving (Pankey et al., 1991). In studies comparing bedding types in heifers housed indoors in the United States and China, CNS and *Escherichia coli* were the most prevalent CM pathogens (Yang et al., 2015; Rowbotham and Ruegg, 2016). The distribution of pathogens in CM cases differ in their long-term effect on udder health (Piepers et al., 2009; Supré et al., 2011), and affect primiparous cows differently than multiparous cows (Gröhn et al., 2004).

No study has been conducted in Canada to determine species-specific IRCM in heifers. Climate and management practices, including housing, vary considerably across Canada, the second largest country in the world. By determining risks and pathogens to which heifers are exposed, producers will be able to create better targeted and more effective management and treatment practices for mastitis. Establishing benchmarks for disease burden will also allow regional dairy marketing boards to better understand the scale of the problem, highlight gaps in knowledge and inform provincial decisions regarding research priorities. The objectives of our study were, therefore, to (1) determine the species-specific IRCM and prevalence of SCM (defined as SCC $\geq$200,000 cells/mL) and IMI in Canadian dairy heifers in the first month of lactation; (2) compare these udder health parameters between primiparous heifers and multiparous cows; and (3) determine regional patterns and variation in these udder health parameters across BMSCC categories.

MATERIALS AND METHODS

Herds and Samples

Details and rationale of the selection of farms, as well as details regarding sampling, were described by Reyher et al. (2011). In short, data were collected from 91 farms in 6 Canadian provinces (17 in Alberta; 27 in Ontario; 29 in Quebec; and 8 in Prince Edward Island, 5 in Nova Scotia and 5 in New Brunswick, grouped together as Atlantic Canada) during 2007 and 2008. Farms were selected to represent farms across Canada in 2006 based on lactating herd housing type (81, 9, 28, and 48% freestall barns in Alberta, Ontario, Quebec, and Atlantic provinces, respectively) and uniformly encompassing 3 strata of 12-mo geometric mean average BMSCC, classified as low, intermediate, and high (<150,000, 150,000 to 300,000, and > 300,000 cells/mL, respectively). In the present study, BMSCC herds were classified as low, intermediate, and high with cut-offs of <150,000, 150,000 to 250,000, and >250,000 cells/mL, respectively, to account for decreased herd BMSCC in the years following data collection. All farms enrolled in the study had at least 80% Holstein-Friesian cows in their herds, milked twice a day, and were enrolled in their regional DHI recording system.

From February 2007 to December 2008, participating farmers were asked to identify cows with CM, based on abnormal milk or more severe signs of mastitis, and submit a quarter-milk sample on the day of CM diagnosis (Reyher et al., 2011). A total of 16 of the 91 herds were excluded from the current study because, when audited, they recorded <80% of CM cases (Dufour et al., 2011). A nonclinical lactating longitudinal milk sampling series was also conducted to determine the prevalence of IMI in cows considered clinically normal. Ten lactating cows were selected randomly along with the 5 most recently calved cows for sampling. All quarter milk samples were collected from these 15 cows by Canadian Bovine Mastitis Research Network (CBMRN, Saint-Hyacinthe, QC, Canada) technicians 3 times every 3 wk during the spring of 2007 and during 2008. During the summer of 2007, an intensive sampling period consisted of 7 samples collected daily for 1 wk. Each animal in the nonclinical longitudinal study had either 3 or 7 samples taken, depending on the sampling period, whereas no samples were taken before March 2007, between September and December 2007, or after August 2008. In this study, only samples collected during the first 30 DIM were considered. Furthermore, although bacteriological findings were reported from all samples collected during the 30 DIM period, prevalence estimates were based on only the earliest sample from each animal during that period (to ensure consistency of IMI definition). Of the included records, 1,267 cows were sampled once, 1,730 were sampled twice, 262 were sampled 3 times, 126 were sampled 4 times, 50 were sampled 5 times, 22 were sampled 6 times, and 8 were sampled 7 times. Prevalence of SCM during the first 30 DIM were estimated from DHI milk records. Subclinical mastitis was defined as a composite milk SCC $\geq$200,000 cells/mL in DHI composite milk samples. Although primiparous heifers differ from multiparous cows in their SCC patterns through lactation (de Haas et al., 2002,