Evaluation of monthly individual cow somatic cell count data to predict the risk of exceeding a bulk-tank somatic cell count threshold of 400,000 c/mL

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Introduction

Since August 2012, the upper tolerance limit for bulk-tank somatic cell count (BTSCC) in Canada is 400,000 c/mL. Among Quebec's dairy herds in 2011, 13% of BTSCC analyses exceeded that limit and were at risk of financial penalties. Herd indices on the basis of individual-cow somatic cell count (SCC) variations around a threshold of 200,000 c/mL between 2 consecutive months in lactation have been described (proportion of cows cured, new intramammary infection [NIMI], healthy or chronic) and could be used to monitor the dynamics of herd udder health. The objective of this study was to use individual-cow udder health indices for the preceding 3-month period to develop a predictive model to estimate the risk of exceeding the BTSCC limit of 400,000 c/mL the following month.

Materials and Methods

Data were analyzed from the DHI database from January 1 to December 31, 2008, for 924 Quebec dairy herds. Only herds with a minimum mean herd size of 30 cows on test and a minimum of 6 DHI tests during 2008 were included. The database consisted primarily of Holstein cows, although some Jersey, Ayrshire, and Brown Swiss cows were included as well. The following variables were evaluated to develop the final model: proportion of healthy cows at test-month -1 and -2, proportion of cured cows at test-month -1 and -2, proportion of chronically infected cows at test-month -1 and -2, proportion of newly infected cows at test-month -1 and -2, proportion of cows over 1,000,000 c/mL, 500,000 c/mL, and 200,000 c/mL at test-month -1 and -2, mean individual linear score at test-month -1 and -2, mean herd size, mean herd parity, within-herd trend in SCC over the last 3 tests (from a linear regression), milk production at test-month -1 and -2, mean 305-day milk production, and days-in-milk at test-month -1 and -2. Season was not included because of the limited number of observations during winter. To avoid over-fitting the model and because of possible correlation between some variables, a cluster analysis (Spearman ½ correlation and correlogram) and a principal component analysis were used to identify clusters of variables in the dataset. Then, a lasso regression was applied on each of the identified clusters. The remaining variables were used in a logistic regression model for repeated measures, with backward stepwise variable selection made on the basis of $P < 0.15$. Full and nested models were compared with a likelihood ratio test. Model discrimination was assessed by area under the ROC curve, and a more parsimonious model was built from the previous one, with backward stepwise variable selection made on the basis of $P < 0.05$.

Results

The mean herd size was 56 cows. The mean linear score was 2.8 and the mean 305-day milk production was 19,540 lb (8,882 kg)/cow. A total of 768 (11.8%) BTSCCs exceeded 400,000 c/mL. The final predictive model included 5 significantly associated variables: proportion of healthy cows during lactation at the current test, proportion of cows > 1,000,000 c/mL at the current test, proportion of cows > 500,000 c/mL at the previous test, mean herd linear score at the current test, and annual mean daily milk production. These variables explained 68% of the observed variation in the data. The area under the ROC curve was good at 0.82 (95% confidence interval [CI], 0.81 to 0.83). The sensitivity and the specificity of the predictive model were 71.9% (95% CI, 62% to 80%) and 77.9% (95% CI, 69% to 85%), respectively.

Significance

Veterinarians can use this 5-variable predictive model to monitor and advise dairy producers of impending risks of exceeding the BTSCC limit. However, factors related to management decisions that can affect next month's BTSCC should also be considered, such as number of culled cows, number of cows calving, number of cows dried-off, mortality rate, and number of cows purchased.