

Impact of disease on individual culling risk and herd culling rate in dairy cattle

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Introduction

A culling rate > 30% in dairy cattle is common in United States and Canada, despite general recommendations to lower cull rates in order to save on replacement costs. Also, higher cull rates are sometimes viewed as a sign of management failure, but the association between culling and disease at the cow level may not hold true at the herd level. Therefore, the objective of this study was to explore the relationship between disease events and individual-cow survival, and the relationship between herd-level disease incidence and culling rate.

Materials and Methods

A retrospective study was conducted by extraction of data regarding health information events from DSA (the herd health management software used by many Quebec dairy producers and veterinarians) for dairy herds in Quebec, Canada. Data were extracted for all cows that calved during 2008, and cows were censored at their next calving or when they were culled. When a cow started 2 lactations during 2008, the first lactation started was used. For each cow, disease events including milk fever, displaced abomasum, dystocia, metritis, and abortion were dichotomized (present or absent) and number of mastitis events during the lactation was categorized (0, 1, or ≥ 2), and their association with time to culling was assessed. Putative causal diagrams were sketched to identify potential confounders. The proportional hazards assumption was checked graphically by examination of the log-cumulative hazard plot ($\ln[H(t)]$) vs. $\ln(t)$, which resulted in the use of a gamma shared frailty Weibull survival model with herd as a random effect (library frailtypack, R statistical software). Herd culling rate was defined as the number of cows culled divided by the number of lactations observed. Then the relationship between herd culling rate and lactation disease incidence rate was assessed with simple and multivariable linear regression.

Results

The dataset included data from 66,550 cows (first lactation, 30.3%; second lactation, 25.6%; and \geq third lactation, 44.1%; median parity, 2) from 986 herds. A total of 20,377 culling events (22% in first lactation, 27% in second lactation, and 39% in \geq third lactation) were used. Median herd culling rate was 30% (25th and 75th percentiles, 25.3% and 34.9%, respectively). Milk fever (hazard ratio [HR], 1.59; 95% confidence interval [CI], 1.48 to 1.69), dystocia (HR, 1.65; 95% CI, 1.54 to 1.76), metritis (HR, 1.13; 95% CI, 1.06 to 1.20), displaced abomasum (HR, 1.29; 95% CI, 1.21 to 1.37), and abortion (HR, 1.78; 95% CI, 1.66 to 1.89) were significantly ($P < 0.001$) associated with time to culling. Compared with cows with 0 mastitis events, the hazard ratio for cows with 1 mastitis event was 1.06 (95% CI, 1.01 to 1.11) and that for cows with ≥ 2 mastitis events was 0.82 (95% CI, 0.74 to 0.90). Results of simple and multivariable linear regression indicated that none of the disease incidences assessed were significantly associated with herd culling rate; in fact, the coefficient of determination (R^2) for all models was close to zero.

Significance

Cows with all health disorders assessed except mastitis were at an increased risk of being culled from the herd. An association between mastitis and milk production, which could not be assessed in this study, may have been the reason cows with mastitis were not at increased risk of being culled. From a herd-level perspective, disease incidence rates were not associated with culling rate in Quebec dairy herds; therefore, culling should not be interpreted as a proxy for health at the herd level. Further research is needed to better understand what defines the optimal culling rate for a dairy herd.