# STUDENT RESEARCH PRESENTATION COMPETITION

# ABSTRACTS

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# Effect of wheat straw chop length in high-straw dry cow diets on behaviour and physiology of dairy cows across the transition period

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Feeding high-straw dry cow diets to control energy intake is common in the dairy industry. We investigated the impact of wheat straw chop-length in high straw dry cow diets (29% on DM basis) on the feeding behaviour and health of dairy cows. Forty Holstein cows were enrolled at dry off, approximately 45 days prior to expected calving, and assigned to 1 of 2 dry cow diet treatments: straw chopped with a 10.16cm screen (Long; n=20), or straw chopped with a 2.54cm screen (Short; n=20). Post-calving, all cows were fed the same lactating cow TMR and the same measurements were recorded with the addition of daily milk yield and weekly milk components. During the dry period, DMI did not differ between treatments (~2.0% of BW), but cows on the Long treatment had a more rapid drop in DMI in the week leading up to calving ($P$<0.05). Cows on the Short treatment tended to have a faster feeding rate, consumed +0.4 kg/meal, and had 0.6 fewer meals/d. Pre-calving dietary treatment did not influence post-calving DMI (~2.7% of BW), but cows on the Short treatment continued to have 0.8 fewer meals ($P$=0.05) and had a longer interval between meals ($P$=0.05). There were no differences in rumination time or reticulorumen pH between treatments in both the dry and lactating period ($P$ ≥0.59). Regardless of treatment, cows sorted against the long particles and in favour of the short particles, but cows on the Long treatment sorted to a greater extent than cows on the Short treatment ($P$≤0.01). Dietary treatment in the dry period did not influence sorting behaviour post-calving; regardless of treatment cows sorted in favour of the long particles and against the fine particles in the first week post-calving. Cows that were on the Long treatment also tended to have a greater decline in rumen pH in the first week post-calving ($P$=0.07) and had a BHB reading of +0.5 mmol/L in the third week post-calving ($P$=0.05). Pre-calving treatment did not influence efficiency of milk production ($P$=0.83) or milk components.

Implications: Shorter chopped straw in dry cow diets did not improve intake, but did minimize the drop in DMI in the week prior to calving. The shorter chopped straw also reduced sorting in the dry period and resulted in a more stable rumen environment in the first week post-calving and lower BHB levels in the third week post-calving.

# Deep learning improves mastitis detection in automated milking systems

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Automated milking systems (AMS) are already used in 10% of Canadian dairy farms and >20% of dairy farms in Western Canada, with indications of increasing adoption. Therefore, there is increasing need for accurate, early automated disease detection. Although many AMS models incorporate chemical sensors to assess milk, including detection of mastitis, udder health often declines in the year after transitioning. AMS generate much more data than milk characteristics. For example, some animal behavior data may be novel indicators for disease onset, with great potential to improve mastitis detection when analyzed with state-of-the-art machine learning methods.

Detailed disease recording for individual animals were collected from 13 commercial AMS dairy herds in Ontario for the first 50 days of lactation. The following animal and herd-level features not directly measured were generated using AMS measurements: number of attempted visits, latency to exit milker, daily milk temperature, and number of cows per robot each day. Farms were allocated into 3 groups: 9 farms for training and model development, 2 farms to act as model-testing sets and 2 farms to serve as a hold-out validation set for model performance.

Deep learning models were used to predict daily probability of an animal being diagnosed with mastitis. Deep learning models use a series of connected neurons to identify complex relationships between predictor variables and the outcome of interest. Recurrent neural networks capture complex, time-dependent relationships and base predictions on individual animal patterns. Using a prediction window of 7 days centered around the day of diagnosis, models achieved 92% accuracy (8% false-positive and false-negative). Using a more practical prediction window of 3 days, accuracy decreased to 86% (13% false-positive and false-negative). Furthermore, a combination of milk characteristics and behavioral traits resulted in prediction accuracy of 85%, 9% higher than when using milk characteristics alone.

Impact. AMS generate much data and novel opportunities. Earlier detection of mastitis would decrease long-term impacts on udder health, reduce antimicrobial use and improve milk production, milk quality and profitability.

# Economic evaluation of longevity to increase profits

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Dairy cow longevity is a highly desirable quality, due largely to the economic benefits associated with a longer productive life. DHI provides measures of longevity at both the herd level (average herd age, % in lactation 3+, and herd removal rate) and cow level ($/day of life). These measures, however, can be misrepresentative as they do not incorporate all aspects of the productive, reproductive, or health status of the cows. Nor do they account for the substantial financial loss that stems from heifers who are culled or die before first calving, and, therefore, incompletely represent the economic conditions of the herd. As a result, the objectives of this study are to 1) assign economic values to specific cow factors, and 2) evaluate the effect these factors have on the economics of longevity.

A data set of 1,182 individual cow records was compiled using CanWest DHI records from two dairy herds over 10 years. Economic values were assigned to cow factors associated with rearing, production, reproduction, and health. Revenue was calculated as milk production, viable calves, and slaughter or dairy sales while costs included rearing, breeding, disease and health, and overhead costs (feed, bedding, facility and machinery maintenance, hired and family labour, and capital costs).

Average loss for culling a cow before first calving was -$1,207 which increased to a loss of -$1,820 for cows culled in the 1st lactation. Culling a cow in the 2nd lactation resulted in a loss of -$667; however, cows culled in the 3rd lactation resulted in a profit of $532. These profits continued to increase throughout the 4th, 5th, and 6th lactations before decreasing for cows culled in the 7th lactation. A sensitivity analysis was performed and this model was most sensitive to the per diem overhead cost per cow, the per diem cost of rearing to first calving, and to the value of milk production.

Implications: This study provides an initial evaluation of the considerable impact of decreased longevity on dairy herd economics and highlights the importance for the future inclusion of rearing and young stock data in both longevity and economic calculations.

# Condition of cull dairy cows at farm, auction and before slaughter

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Cull dairy cows are regularly removed from dairy herds and enter the marketing system which often involves transportation to public auction markets and then to an abattoir. Many cull dairy cows are removed from the herds because of health reasons and their ability to withstand transportation may vary. Moreover, dairy producers lack feedback about potential transport delays and the condition of the cows throughout the transport continuum. The objectives of this study were (1) to follow cull cows from farm to abattoir, (2) to monitor changes in the cows' condition, and (3) to record transport delays. From May 2017 to March 2018, data were collected from 20 dairy farms, 2 auction markets and at 6 abattoirs in British Columbia, Alberta, and the USA. The dairy farms were visited regularly before cows were shipped and a researcher scored the animals for body condition (BCS; 5-point scale), lameness (5-point scale) and udder condition (3-point scale). Trained assessors at the abattoirs also assessed cows' condition at arrival.

During the study, 1,171 cull cows were removed from participating farms and 714 of those animals were observed at one of the participating abattoirs. After leaving the farms, cows spent on average 82 hours in the marketing system until being processed. Including delays at auctions or assembly yards, about 41% of cows were in transit for 4-5 days and 11% for 6-16 days. Regarding distance, around 11% were transported 1,100 km from farm to abattoir. The percentage of thin cows increased from 8% at the farm of origin to 22% at the abattoir ($P$<0.001). Lameness did not change, but transport increased the development of acute milk accumulation and udder inflammation from 8% at farm of origin to 41% at the abattoir ($P$<0.001). At the auctions, 10% of the cows were thin (BCS ≤ 2), 7% were severely lame (lameness score ≥ 4), 13% had engorged and/or inflamed udder, and 6% had other fitness-related injuries including abscesses (2.1% of cows), signs of diseases/weakness (2.0%), hobbles (0.9%), signs of pneumonia (0.3%), eye injury (0.2%), and lump jaw (0.1%).

This information about delays to slaughter and changes in cow condition will now be communicated to producers and veterinarians to help them make better culling decisions.

# Where are we now with lameness prevention and control, after nearly a decade of research?

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Lameness in the dairy industry, both worldwide and within Canada, has major economic and welfare consequences. In Alberta, prevalence of lameness was last reported to be 20% with minimal effort towards adoption of prevention strategies by producers. Because the “one size fits all” approach to prevention and control has failed to make an impact, an on-farm lameness risk assessment (RA) has been developed to identify farm-specific risk factors, with high RA scores being associated with higher risk of lameness. Since its development, however, the RA has not been evaluated. In other words, how well does the RA identify risk factors contributing to high lameness prevalence, specific to the farm? This study aimed to answer this question by determining associations between RA scores and lameness and lesion prevalence. Between March and October 2018, a total of 65 Alberta dairy farms participated in the study and 3,766 cows were assessed for lameness. Data collected included a completed risk assessment, lameness prevalence, and a year of lesion records. To determine associations between RA scores and lameness prevalence, spearman’s rank correlation was used. Overall, within-herd lameness prevalence ranged from 2 to 56% and had a median (IQR) of 20% (12%). Positive associations were determined between lameness prevalence and total RA score ($r=0.26$, $P<0.05$), RA score for non-infectious causes of lameness ($r=0.35$, $P<0.05$), and RA score for infectious causes of lameness ($r=0.26$, $P<0.05$). However, these associations are weak with only 7%, 12%, and 7% of the variation in lameness prevalence being explained by the total RA score, non-infectious RA score, and infectious RA score, respectively. This study reflects no change in within-herd lameness prevalence since 2011, despite research efforts into supporting producers with lameness reduction. Additional work will include troubleshooting and increasing the accuracy of the RA and working closely with producers, using in-depth interviews, to identify barriers to lameness prevention and control. Mitigating this health and welfare issue is becoming increasingly important with mandatory Canada-wide assessments for animal care, including lameness, under Dairy Farmers of Canada’s proAction Initiative.