Deep learning improves mastitis detection in automated milking systems

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Automated milking systems (AMS) are used in 12% of Canadian dairy farms and >20% of dairy farms in Western Canada, with indications of increasing adoption. Therefore, a need exists for accurate, early automated disease detection. Although many AMS models incorporate chemical sensors to assess milk, including mastitis detection, udder health often declines in the year after transitioning. AMS generate much more data than milk characteristics, and animal behavior data may offer novel indicators for disease onset, with great potential to improve mastitis detection when analyzed with state-of-the-art machine learning methods. Initial models were developed using data from 13 farms in Ontario, of which 3 were used to validate model performance, including 400 animals followed for the first 50 DIM. The models were used to predict daily probability of an animal being diagnosed with clinical mastitis. Deep learning models use a series of connected neurons to identify relationships between variables, and recurrent networks capture time-dependent relationships and base predictions on individual animal patterns. Using a prediction window of 3 days, accuracy was 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. Additional data have been collected from 64 farms: 3 in BC, 2 in Manitoba, 2 in New Brunswick, 55 in Ontario, 15 in Quebec, and 6 in Saskatchewan. These data include cows followed between January and August 2019 in all stages of lactation. Updated results including these farms will be presented at the seminar, increasing the robustness and external validity of the models. **Impact.** AMS data bring novel opportunities. Earlier detection of mastitis would decrease long-term udder health impacts, reduce antimicrobial use and improve milk production, quality, and profitability.