Data Integration and Use of Machine Learning Algorithms to Monitor Individual Cows’ Health
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BACKGROUND

- The “Dairy Brain” project consists of the daily collection and transformation of different data streams generated on dairy farms and the development of an integrated data repository, used for visualization and development of real-time Decision Support Tools (DST) (Fig. 1).

- One DST aims to alert a possible Clinical Mastitis (CM) case before it happens.
- Somatic cell count is the most used metric to detect CM but is only available once a month.
- Integrating data from different data streams can be used to identify variables to predict the onset of CM on a daily basis.

MATERIALS & METHODS

- Records from 2 different data streams from 2016-2018.
- Management software
  - Previous cases of CM
  - Previous cases of metritis, retained placenta, abortion, ketosis and/or metritis
  - Lactation
  - Days in milk (DIM)
  - Age at 1st calving
  - Pen

- Milking software
  - Milk production (L)
  - Milk conductivity (mS/cm)
  - Milk temperature

- Integrated, edited and normalized (n=484,781 records from n=2,563 cows)

RESULTS

- The SMOTE technique for balancing the data gave the best results.
- The random forest algorithm had the best performance.
- Best results were achieved using data from the 7 previous milkings before the reported case of CM.

Figure 3. Δ in milk conductivity between sick (1) and healthy (0) animals 7 milkings before the onset of CM.

Figure 4. Δ in milk production between sick (1) and healthy (0) animals 7 milkings before the onset of CM.

• Cows with CM compared to healthy cows had higher absolute mean differences of milk conductivity (0.91 vs. 0.86 mS/cm; P < 0.001) and milk production (4.70 vs. 4.29 lbs.; P < 0.001), Figures 3 and 4, respectively.

Figure 5. Receiver Operating Characteristics curve (ROC) of the prediction of CM with Random Forest (RF) algorithm

- The RF algorithm will be certain in detecting 93% of the CM cases with 93% of true positive cases and 88% of true negative cases.
- In other words, the algorithm will correctly classify: 93% of the CM cases and 88% of the healthy cases

APPLICATION

• Farmer will receive daily list of cows at risk of contracting CM.
• Once the alert is emitted, a close-up follow up of the cow can be done.
• According to the health protocols and the evolution of the cow, farmer can better decide the course of actions.

TAKE HOME MESSAGES

• Real-time data integration is an essential element to develop DST.
• The algorithms could be used as a monitoring tool to flag cows that are at risk of contracting CM and follow them closely on a daily basis.
• The integration of other data streams (e.g., sensors), could help improve the predictions.

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FOR MORE INFORMATION
https://dairybrain.wisc.edu/