D4Dairy
How digitalisation and data integration pave the way to dairy health improvement

Lameness detection and prevention in dairy cows

Lameness prediction as part of the D4Dairy project

Overall aim:
Transdisciplinary project with the overall aim of enhancing animal health and welfare as well as product quality by integrating data driven information systems for dairy farm management.
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Lameness detection & prediction:
Integration of data from various farm areas
• … for early lameness detection
• … to provide a decision support tool for individual farms
• … to define auxiliary traits for the development of a claw health genetic evaluation
Lameness in dairy cows remains a widespread animal welfare and economic issue

Lameness is caused by a variety of factors
- Housing, feeding, management, …

May be associated with changes in
- Milk performance
- Behaviour
- …
Lameness detection

• Early detection or prediction of lameness could reduce negative effects, however:
  • **External assessment** by veterinarians or claw trimmers not possible on a regular basis
    ➔ early stage of lameness may be missed
  • **Weekly lameness scoring** is additional workload
    ➔ difficult for farmers to implement

• Are there other indicators, which may be used to predict if a cow is at risk of developing lameness?
Digitalisation in dairy farming

- Technical advances and growing digitalisation
  - … increased amount and quality of data …
  - … in various areas of dairy farming …
  - … supporting data-driven decision making.

- Advances happened incrementally
  ➜ Data from different management areas and systems
    - … available in different formats
    - … different parameters from different devices
  ➜ making informed decisions in the respective area
Lameness prediction

Data integration to create a decision support tool to predict lameness

Relevant information from other management areas
Data, data, data…

- Milking systems
- Veterinary records
- National performance recordings
- Farm records, operational structure
- Claw trimmings, lameness scores
- Sensor data
Data, data, data…

1,080 cows
19 farms
09/2019 – 06/2021

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- National performance recordings
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Basic idea

• Lame cows may show changes in performance and behaviour - even before they show clinical signs of lameness or claw disorders

• Farms increasingly use sensors for monitoring cow health
  • Measure e.g. activity, temperature or rumination
  • Continuous data recording and provision
  • Indicator for changes in cow behaviour
The main challenges are...
Automatic data integration & data quality

• Different data sets were merged manually using the statistical software programs R and SAS® 9.4

• Different parameters, formats and time scales were aligned

• Data cleaning: check for duplicates, inconsistencies and implausible values
Automatic data integration & data quality

- Different data sets were merged manually using the statistical software programs R and SAS® 9.4
- Different parameters, formats and time scales were aligned
- Data cleaning: check for duplicates, inconsistencies and implausible values
- The information from this merging process has to be…
  - … translated into an algorithm to automate data reading and merging
  - … used to establish a control mechanism to guarantee for data quality
Fit a variety of farm conditions

**Milking systems**
- Automatic milking system
- Milking parlour

**Husbandry systems**
- Free stall
- Outdoor access
- Pasture

**Farm records, operational structure**

**Recorded parameters**
- Inner temperature and activity
- Rumination and activity

**Sensordata**

**Digitalisation, Data integration, Detection and Decision support in Dairying**
Approach

• Development of regression models using potential predictors from the different data sets to best predict lameness events.

Detailed enough to produce the best possible prediction for the individual farm and animal.

General enough to be applied to a variety of dairy farms.
Activity index and temperature over time

- Acute mastitis
- Dry off
- Lameness assessment: severe lameness
- Lameness assessment: mild lameness
- Calving
- Heat
- Insemination
Provide real-time decision support

- Milking systems
- Veterinary records
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Digitalisation, Data integration, Detection and Decision support in Dairying
Provide real-time decision support

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- EVERY FEW WEEKS
- TWICE A DAY
- CONTINUOUSLY
- OCCASIONALLY
Outlook

- Development of systems for automatic data integration
- Finalise development and validation of the lameness prediction model
  - Decision support tool based on the predictive model using Machine Learning approaches
- Deduction of auxiliary traits for claw health
  - Prediction model as basis for phenotypic modelling
- Genetic analysis of the traits
- Establishment of conventional and genomic breeding values
D4Dairy – Progress through networking

Scientific partners:
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Landwirtschaft
TU Graz
BUNDESWEHR KOMMANDO UND STÄTTERMANN
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Industry partners:
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Cooperation partners:
LeL
GEA Farm Technologies
DeLaval

Cow-Arwork by Johanna Schodl