Modelling the economic impact of three lameness causing diseases using herd and cow level evidence

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Introduction

- Lameness causing diseases are reported to vary between 21% and 70% in modern dairy farms
- Consequences of lameness are
  - Animal welfare problems
  - Reduced productivity
  - Reduced reproductive performance
  - High economic losses - estimated from € 104/case to € 192/case per cow-year

Three lameness causing diseases are focused on in this study:
- Digital Dermatitis (DD), curable, lasts 42 days
- Interdigital Hyperplasia (IH), chronic
- Claw Horn Disease (CHD), lasts for the rest of the lactation
Objective

What are the consequences in economy and productivity when the risk of three lameness causing diseases in a herd is reduced by 50% calculated by a Monte Carlo simulation model (SimHerd IV) where the input parameters are expressed by hyper-distributions.

Using hyper-distributions to describe disease risks is new (using SimHerd)

Materials and methods

Characteristics of SimHerd IV

- Dynamic (weekly time-steps)
- Monte Carlo simulation
- Stochastic
- Mechanistic
- Repeated

Simulates production and state changes in dairy herds including young stock (heifers)

The state of a cow or heifer is defined by nine parameters

- Age
- Parity
- Lactation stage
- Milk yield
- Body weight
- Culling status
- Reproductive status (estrus and pregnancy)
- Somatic Cell Count (SCC)
- Disease status
Materials and methods

Characteristics of SimHerd IV

The nine parameters are updated for each cow and heifer every week by drawing random samples from a probability distribution.

Hence, the production and input consumption for the herd is calculated.

Results are found

The process is repeated.

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Hyper-distributions

Cow specific probability of becoming diseased - diseases status

9 state-of-nature parameters representing disease risks (3 disease risks × parity 1, 2, 3) are described by a joint posterior distribution - not fixed estimates!

This posterior distribution is based on a combination of:
- Prior knowledge of disease prevalence in the herd
- Different levels of knowledge

For every replica of the model a disease risk was drawn from the joint posterior distribution

The model is run 1000 times.
Materials and methods

Deterministic calculations:

Fixed general values like length of diseases, prices and costs of diseases are included

Materials and methods

43% conception rate
50% estrus detection rate

Results – half risk

FH herd with average reproduction increased total gross-margin by € 24,840 (€ 123/cow-year)

FH herd with poor reproduction increased total gross-margin by € 38,820 (€ 143/cow-year)

More evidence/knowledge -> higher effect on gross-margin
Discussion
Demonstrates a consistent way of using field data on disease prevalence for calculating a cow specific disease risk
Cow trimming is expensive and should be considered in a full economic evaluation
Even though 9 parameters were described by hyper-distributions – more than 1000 parameters are still fixed - uncertainties are underestimated
Disease prevalence is more varied than either 40% or 7%

Conclusion
The use of hyper-distributions describing disease risk was demonstrated
Uncertainties in input parameters are reflected in the uncertainties in the model’s output (a risk) – important in decision support
This model represents an improvement in representing uncertainties although they are still underestimated

Thank you