Genetic aspects of udder health

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Mastitis

- Complex trait
  - From mild subclinical to severe acute clinical
  - Different phatogenes

Phenotypes

Direct traits

- Clinical mastitis
  - Veterinary treatments
  - Farmer recoded
- Pathogene spesific mastitis
  - Data from mastitis laboratory
- Subclinical mastitis
  - Above threshold SCC

Indicators

- Somatic Cell Count
- Udder conformation
- From automatic milking systems
  - Electric conductivity
  - OCC

Trait definitions and models

- Binary 0 or 1 within a given interval
- Number of cases
- Multitrait model
- Longitudinal model

Genetic paprameters

- Heritability of clinical mastitis is low
  - Many daughters needed in progeny testing to obtain reliable breeding values of sires
- Unfavorable genetic relationship to milk production
  - Genetic correlation **0.43** between 305-d protein yield and mastitis in 1. lactation Norwegian Red
  - Selection for increased milk yield -> genetic deterioration of mastitis resistance
- Positive genetic correlation between mastitis and other diseases
  - Selection against mastitis -> genetic improvement of resistance to other diseases as correlated response

Genetic evaluation of mastitis in Norwegian Red

- Mastitis included in total merit index since 1978
- Information on veterinary treatments of clinical mastitis (CM) from health recording system
- CM defined as 0 or 1 in 7 intervals of lactation 1-3

  (-15, 30), (31-120), (121-305) days in 1st lactation, and

  (-15, 30) and (31, 305) days in 2nd and 3rd lactation
- Increasing weight on mastitis from less than 3 % in 1978 to 24 % in 2003, today 18 % weight on udder health

Mastitis and SCC

- SCC an indicator of clinical and subclinical mastitis
- Genetic correlation <1
- SCC mainly an indicator of subclinical mastitis
  - Testday records
  - Daily records (OCC)
- SCC higher heritabilty than CM
  - Indirect selection less efficient than direct selection

Genetic Evaluation

- Direct selection requires large-scale recording of disease traits
- Alternatively, indicators can provide information to be used in genetic evaluation

Genomic selection:

- Use information from later lactations
- Genotyping cows + high resolution phenotyping in selected herds

Efficient selection against mastitis

Selection experiment with Norwegian Red, since 1989

- Low clinical mastitis (LCM)
- High milk production (HPY)

LCM

- “Extreme version” of Norwegian Red
- Illustrates the potential for genetic improvement of udder health

Phenotypic mastitis frequency HPY and LCM cows

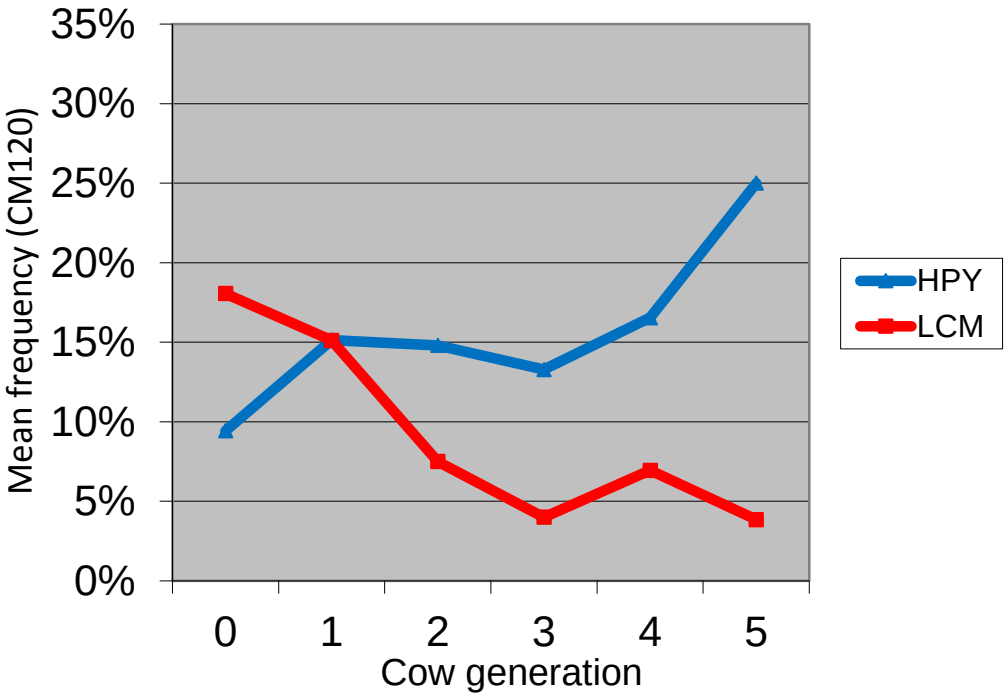


Figure 1. Mean frequency of CM120 per cow generation for high milk yield (**HPY**) and low clinical mastitis (**LCM**) cows from the selection experiment with Norwegian Red

Genetic trends for mastitis in the Norwegian Red population and selection experiments

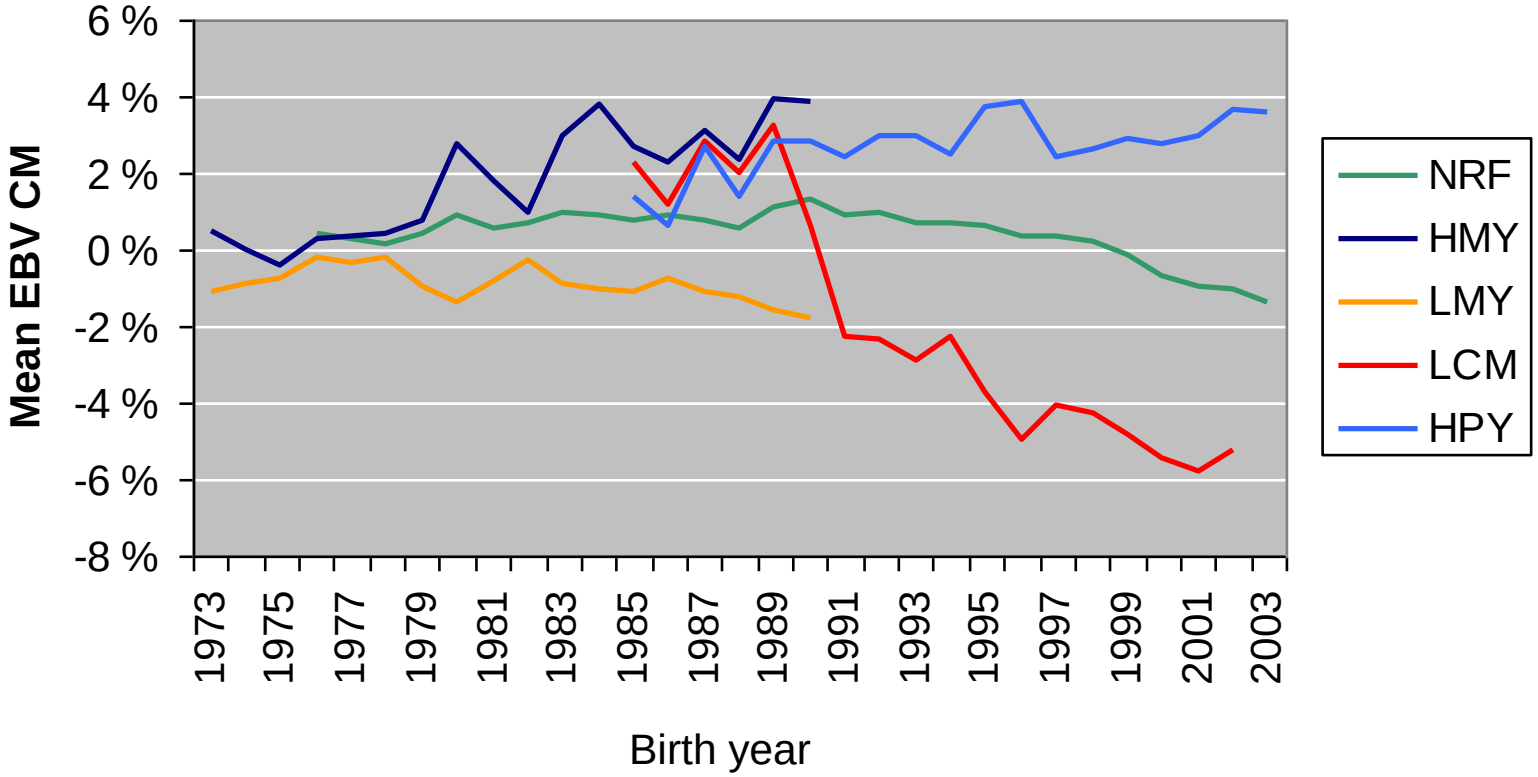
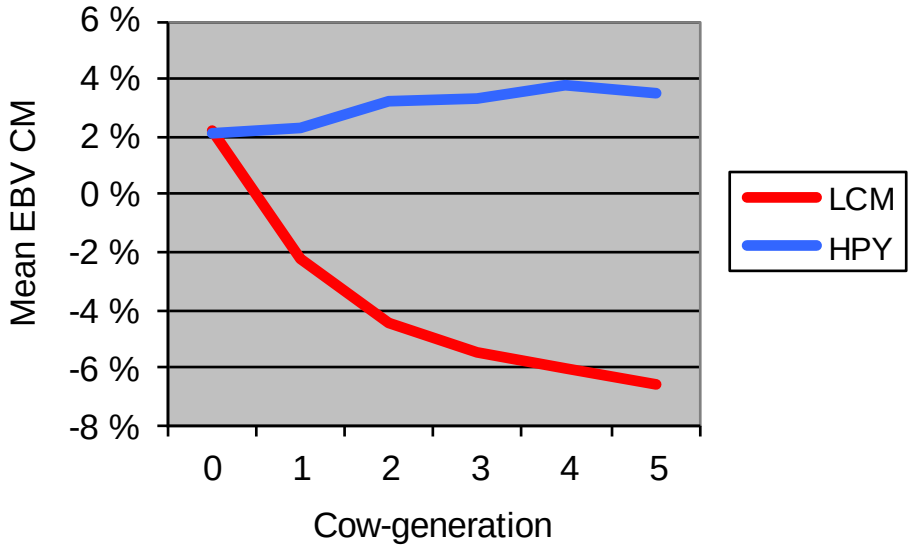


Figure 2. Mean EBV for CM per birth year for selection experiment cows together with the Norwegian Red population

The unit is % CM, downward trend = genetic improvement

(From Heringstad et al., JDS 2007)

Genetic trends for mastitis per cow generation



The unit is % CM, downward trend = genetic improvement

Genetic difference after 5 cow-generations:

10 %-units CM

Figure 3. Mean EBV for CM per cow generation for HPY and LCM selection experiment cows

(From Heringstad et al., JDS 2007)

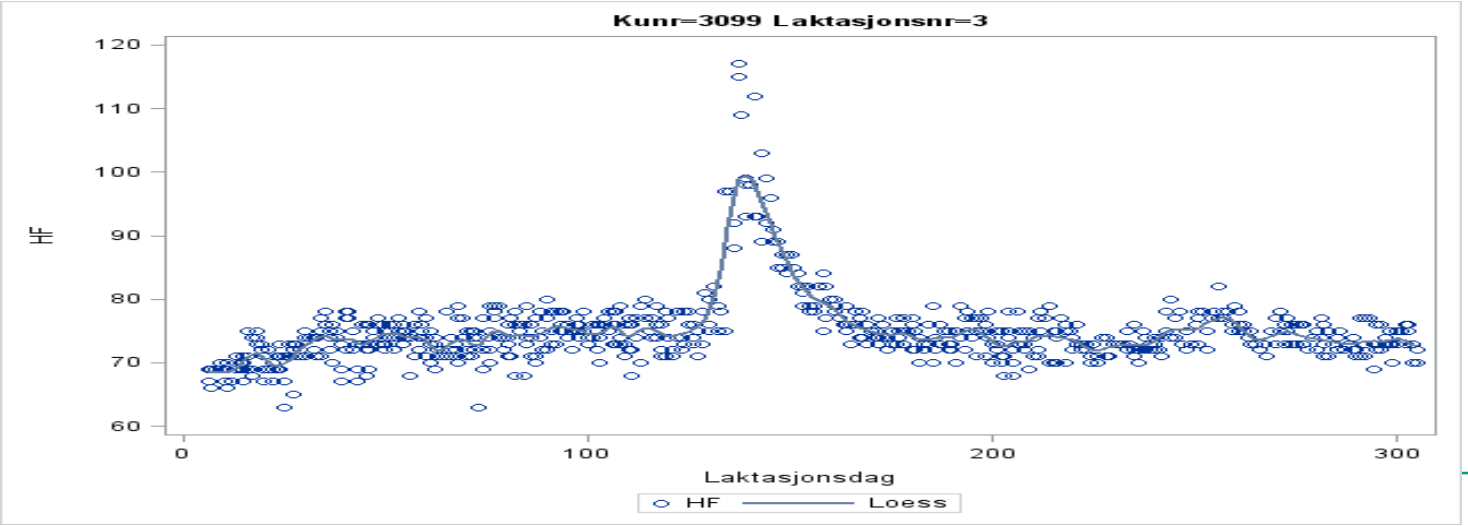
Key factors for genetic improvement of mastitis

- Reliable breeding values
  - Quality and quantity phenotypes
- Sufficient weight in total merit index
  - Balance between weight put on milk production vs wight put on mastitis

Better indicators of udder health?

Data from automatic milking system

- Objective measures from every milking
  - Conductivity
  - OCC
  - FTIR
  - ++



Conclusion

- Direct selection to improve udder health is possible
- Lack of recording of direct disease traits is a challenge
- Genomic selection – new phenotyping strategies
- New phenotypes, including better tools for diagnosis of subclinical cases, may support more efficient selection for udder health.