Use of health data in genetic evaluation and breeding

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Use of health data in genetic evaluation and breeding

1. Introduction
2. Data collection
3. Genetic evaluation for health traits
4. Health traits in the breeding goal
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Disease - Health

- Diseases
  - Reduce animal welfare
  - Economic losses for farmers extra costs:
    - Veterinarian treatments
    - Labour
    - Decreased production
    - Discarded milk
    - Involuntary culling

Disease - Health

- An improvement of health is desirable from:
  - A general ethical point of view
  - Lead to increased consumer acceptance
  - Economic importance to the farmer

Disease - Health

- An improvement of health can be reached by:
  - Management

  and
  - Genetic

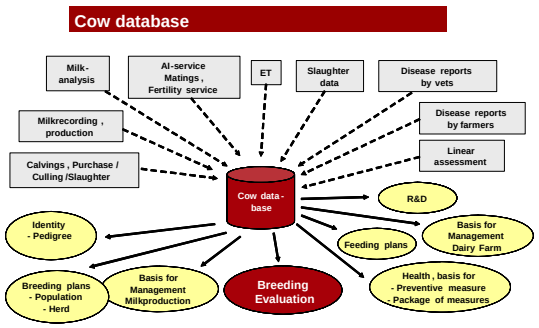
  A good registration system is essential for both management and genetic improvements!

Disease recording

- The systems in Denmark, Finland, Sweden and Norway are very similar
- The Danish system is used as an example

Systematic disease recording

- Started in Denmark in 1990 cooperation between Danish Cattle Federation and the Danish Veterinarian Society
- Started earlier in Norway, Sweden and Finland



Data flow in relation to the central data base

Disease recording system

- Transfer from invoicing systems used by veterinarians to the database
- By pencil in a standard system used also for other purposes - Herd manager and veterinarian
- Direct registration in central data by use of EDP (electronic data processing) software

Disease recording system

- Direct registration in central data base by use of EDP software is increasing. Now possible both by:
  - Traditional disk top
  - PDA – Personal Digital Assistance (pocket computer)

Disease recording system

- Recording of disease diagnoses can be made by both veterinarians and herd manager – double registrations are automatically avoided
- More than 80 different disease codes are used to describe the diagnoses

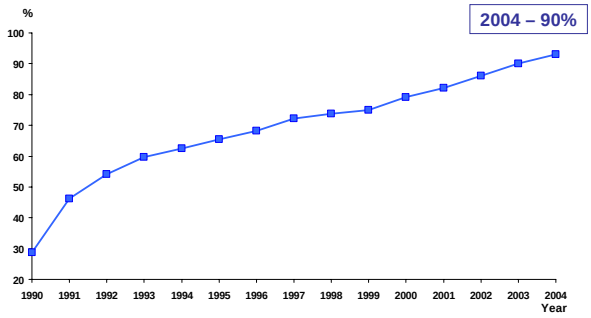
Disease recording system

- For management and breeding purposes the codes are usually pooled within four categories:
  - Udder diseases
  - Reproductive diseases
  - Digestive and metabolic diseases
  - Feet and leg diseases

Disease recording system

- Mandatory in Sweden and Norway
- Voluntary in Finland and Denmark
  - Exact figures unknown
  - Simple data rules ensure exclusion of herds not under systematic disease recording

Proportion of cows in herds with regular disease registration, Danish Holstein



Ownership and access to data

- The data are owned by the farmer
- Veterinarians are not paid for the registrations
- The farmer can give permissions to his advisors including the veterinarian to use his data

Use of the disease records

- Management purposes (direct benefit)
  - The farmer and the advisors can get access to several printouts, key figures etc. about the herd combining different registrations in the central database
- Breeding purposes (important spin-off)
  - Estimation of Breeding Values

Breeding purposes

Grouping of traits:

- Clinical mastitis
- Other diseases
  - Reproductive diseases
  - Digestive diseases
  - Feet and leg diseases

Mastitis frequency – year 2004

	Red Breeds		
Parity	DNK	SWE	FIN
1st day -15-50	13.8	5.8	6.8
1st day 51-305	8.5	4.5	5.1
2nd day -15-150	19.0	9.5	11.1
3rd day -15-150	25.6	12.9	14.4

Mastitis frequency – year 2004

	Holstein		
Parity	DNK	SWE	FIN
1st day -15-50	13.5	7.2	8.4
1st day 51-305	10.7	7.2	7.5
2nd day -15-150	21.7	12.9	13.3
3rd day -15-150	25.9	16.6	15.3

Traits used in the current udder health index

	CM	SCC	Udder conformation
Outside Scand.		x	(X)
Norway	x		
Sweden	x	x	
Finland	x	x	
Denmark	x	x	x

International genetic evalaution for SCC and mastitis (May 2006)

- 17 countries participate with SCC
- 4 countries participate with both SCC and mastitis

Joint Nordic Estimation of udder health

- Finland, Sweden and Denmark
- Presented at the Open Interbull (Johansson et al., 2006)
- Udder health index
  - Clinical mastitis
  - SCC
  - Udder depth, fore udder attachment

EBV – udder health - Nordic

Definition of mastitis traits:

- 15 days before calving until 50 days after calving in 1st parity
- 51 days after calving until 300 days after calving in 1st parity
- 15 days before calving until 150 days after calving in second parity
- 15 days before calving until 150 days after calving in third parity.

EBV – udder health - Nordic

Information traits:

- SCC day 5-150 after calving in 1st parity
- SCC day 5-150 after calving in 2nd parity
- SCC day 5-150 after calving in 3rd parity
- Udder depth 1st parity
- Fore udder attach. 1st parity

EBV – udder health
Genetic parameters

- Clinical mastitis 4%
  - SCC 13%
  - Udder conformation 25%
- Genetic correlations:
  - CM different lactations 0.70-0.95
  - CM-SCC 0.60
  - CM-Udder conformation 0.35-0.50

EBV–udder health - Reliability (r_{IA}^2)

- Udder health in theory
  - Based on CM - max 100%
  - Based on SCC – max 36% (r_g^2)
- Udder health in practice (DNK)
  - 40% first proof same time as production
  - 60-65% based on 1. lact. daughters
- FIN and SWE higher r_{IA}^2 due to larger daughter group size!

Genetic response

- Genetic response udder health (Nielsen et al., 1996)
  - + 22% by adding CM to an Udder health index based on SCC + UC
  - + 50-60% adding CM to Udder health index based on SCC or UC

Genetic response

- Keeping genetic response for udder health constant (Nielsen et al., 1996)
  - Adding CM to an Udder health index based on SCC + UC increase the genetic response in protein

EBV – udder health
Nordic Economic weights

- 25% at -15 - 50 days in first parity
- 25% at 50 – 300 days in first parity
- 30% at -15 - 150 days in second parity
- 20% at -15 - 150 days in third parity

Effect of index for udder health
Danish Holstein

	Percentage of cows with mastitis	
Sire's index for udder health	1st parity	3rd parity
≤ 85	21.7%	28.9%
86-95	18.3%	26.0%
96-105	15.3%	23.8%
106-113	13.9%	21.0%
≥ 114	10.7%	17.0%

Other health traits

- Reproductive diseases
- Metabolic & digestive diseases
- Feet and leg diseases

- Heritabilities 1-3%
- Moderate positive correlations among disease traits
- Based on 1. batch daughters seldom r_{IA}^2>65%

Sire's index for other health traits	Effect of other health index Holstein 3rd parity			
	Percentage of cows with a diagnose			
	Rep.	Dig.	Feet & Legs	Sum
≤85	14.4%	12.5%	2.6%	29.5%
86-95	14.6%	9.7%	3,3%	27.6%
96-105	15.9%	9.3%	3.1%	28.4%
106-113	14.6%	8.3%	2.8%	25.6%
≥ 114	12.9%	7.0%	2.7%	22.6%

1) Standard deviation of the index is approx. 10

Health traits in the Total Merit Indices

- Over the last 10 years
  - The focus has shifted from production to a more balanced breeding goal
  - Health has become more important
- Future
  - Health will become even more important
  - Farmers (and consumers) wish more healthy and fertile cows
  - A substantial weight has to be given to health to balance the unfavorable correlation with production

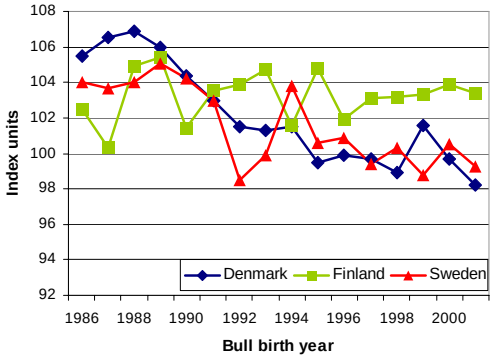
Correlation with TMI – Holstein

	Denmark	Sweden	Finland
Yield	0.67	0.45	0.74
Fertility	0.18	0.40	-0.03
Mastitis	0.35	0.43	0.18
Other disease	0.37	0.24	-

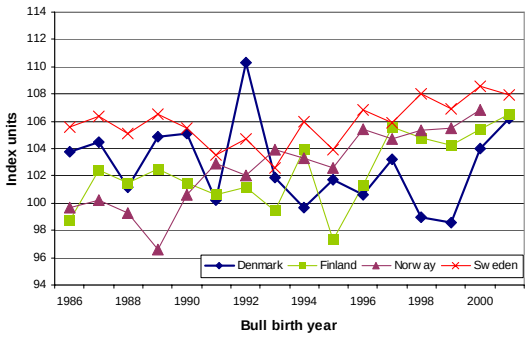
Correlation with TMI – Red breeds

	Denmark	Sweden	Finland
Yield	0.73	0.56	0.72
Fertility	0.15	0.20	0.03
Mastitis	0.44	0.34	0.19
Other disease	0.32	0.19	-

Genetic trend udder health – Holstein



Genetic trend udder health – Red breeds



Final remarks I

Registration:

- Direct benefit important (management) and spin-off (genetic purposes)
- Develop current system – easier registration (Nordic countries)
- Setting up registration systems (non Nordic)
- Registrations from each milking (SCC other things)

Final remarks II

EBVs – use of data and statistical models :

- MT-models combine CM with indicator traits (SCC and UC)
- Split CM in different periods/traits to get an EBV early
- Consider the nonlinear magnitude of the CM data
- Move from lactation model to TD or mixture models for SCC

Final remarks III

EBVs – use of data and statistical models

- Improve genetic evaluation for other diseases
- Include QTLs in genetic evaluation of diseases – registrations is a basic
- Include pathogen data

Final remark IV

Breeding goal and breeding work:

Disease resistance against mastitis and other diseases are important both economical and ethical

Follow TMI when selecting both proven sires and bull sires

Important to look carefully at all available information to ensure positive genetic trend for disease (mastitis) resistance.

Conclusion - health

- Registration of diseases is a basic
- Low heritability but large genetic variation
- EBVs use data as efficient as possible
- Economic important
- Has to be included in a breeding goal and given a substantial weight