REGISTRATION OF HEALTH TRAITS – STRATEGIES OF PHENOTYPING, ASPECTS OF DATA QUALITY AND POSSIBLE BENEFITS

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OVERVIEW

- Registration of direct health data
  - Standardisation
  - Data security and recording
  - Validation
- Benefits
  - Herdmanagement
  - Genetic evaluation
  - Others
- Challenges and important measures for success
- Conclusions
Farmers: Increase productivity and use existing potentials

Breeding Organisations: Genetic evaluation for health traits

International image: marketing advantages

Performance Recording Organisations: Additional information to support herd management

Ministries: Operating figures on animal health status

Veterinarians: Support for health management

Consumer: Food safety

Animal Health Organisations: Support for evaluation and preventive measures

Benefit for stakeholders is precondition for registration!
BACKGROUND/NECESSITIES

- Food safety:
  - consumer acceptance and confidence.
  - concerns about risks connected to the use of antibiotics
- Animal welfare aspects severe issue.
- Production efficiency: efficient use of feed, longevity, but also health aspects essential.
- Functional traits economically important.
- Genetic gains for functional traits not satisfactory.

Emphasis on measures to improve animal health!
Genetic Trend Milk kg
(Holstein; Fuerst, 2011)
GENETIC TREND - TIME BETWEEN FIRST AND LAST INSEMINATION (HOLSTEIN; FUERST, 2011)
GENETIC TREND – SOMATIC CELL COUNT (SCC) (HOLSTEIN; FUERST, 2011)

Trends SCC stable, but potential for economic improvement!
SOLUTIONS/APPROACHES

- Direct selection for health traits more effective than indirect selection (Heringstad et al., 2007).
- Improvement of herd management by integration of direct health data.
- Preventive measures within veterinarian approaches (EU-Animal Health Strategy (2007-2013) - Prevention is better than cure).
- Close cooperation between farmers and veterinarians.

Availability of direct health data precondition!
EXAMPLE NORWAY

(NORWEGIAN CATTLE HEALTH SERVICES, 2005)
# Sources of Direct Health Data

<table>
<thead>
<tr>
<th>Sources</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Veterinarians</strong></td>
<td>+ High quality data, allows joint use of data between producers and veterinarians.</td>
<td>- Motivation! If based on documentation of use of drugs only, it might not be complete.</td>
</tr>
<tr>
<td><strong>Producers</strong></td>
<td>+ Early recognition of disorders; comprehensive recording possible; possible use of already established data flow (routine performance testing, reporting of calving, documentation of inseminations).</td>
<td></td>
</tr>
<tr>
<td><strong>Expert groups (claw trimmer, nutritionist, ...)</strong></td>
<td>+ Specific and detailed information on a range of health traits important for the producer (high quality data)</td>
<td>- Motivation; business interests may interfere with objective documentation.</td>
</tr>
<tr>
<td><strong>Others (laboratories, on-farm technical equipment, ...)</strong></td>
<td>+ Automated or semi-automated recording systems; objective measurements.</td>
<td>- Lab: might only be from preselected animals.</td>
</tr>
</tbody>
</table>
DIRECT HEALTH DATA
PRESENT SITUATION

Veterinarian diagnoses:
- Norway, Sweden, Finland, Denmark – long history
- Austria – started 2006, Baden-Württemberg und Bavaria 2010,…
  - Routine genetic evaluation for direct health traits in Scandinavian countries and Austria/Germany

Producer recorded health data:
- US, Canada, Germany, France, UK, .. (Cole et al., 2006; Neuschwandner et al., 2008;..)
- Other projects and initiatives…
# Frequency of the Most Common Health Disorders (Lactation Incidence Rate (LIC))

<table>
<thead>
<tr>
<th>Breed / Trait</th>
<th>Time period</th>
<th>LIC %</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Danish Holstein</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Udder diseases</td>
<td>-10 to 100 dpp (1st lactation)</td>
<td>21</td>
<td>Nielsen et al., 2000</td>
</tr>
<tr>
<td>Reproductive disturbances</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Digestive and metabolic diseases</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Feet and legs disorders</td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td><strong>Fleckvieh (Simmental)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical mastitis</td>
<td>-10 to 150 dpp</td>
<td>10</td>
<td>Koeck et al. 2010a,b</td>
</tr>
<tr>
<td>Early reproductive disorders</td>
<td>0 to 30 dpp</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Late reproductive disorders</td>
<td>30 to 150 dpp</td>
<td>14</td>
<td></td>
</tr>
</tbody>
</table>

4 main complexes: udder, reproduction, digestive and metabolic disorders and feet and legs.
RECOMMENDATION ON REGISTRATION

- Additional effort and expected benefit has to be in good balance.
- Priority to use of existing data sources and infrastructure for recording.
- Use of legal documentation requirements.
- Clear definitions of health incidents to be recorded, without options of diverse interpretation.
- Standardisation understandable by all parties involved. Different levels of detail should be permitted (very specific diagnoses of veterinarian compared to very general diagnoses or observations of producers).
# Standardisation

## Direct Health Data

<table>
<thead>
<tr>
<th>Nr. of diag.</th>
<th>Comprehensive key of diagnoses</th>
<th>Reduced key of diagnoses</th>
<th>Simple key of diagnoses</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 600</td>
<td></td>
<td>60-100</td>
<td>10-15</td>
</tr>
<tr>
<td>Source</td>
<td>veterinarian</td>
<td>veterinarian</td>
<td>producer</td>
</tr>
<tr>
<td>Recording</td>
<td>electronic submission (vet)</td>
<td>vet, performance record., producer</td>
<td>producer</td>
</tr>
<tr>
<td>Example</td>
<td>Staufenbiel: mastitis catarrhalis acute and subacuta, mastitis parenchymatosa acuta and subacuta, ...</td>
<td>E.g. AUT: acute mastitis chronical mastitis;</td>
<td>mastitis</td>
</tr>
</tbody>
</table>

Coding of diagnoses precondition of use! For harmonisation it is important how different keys of diagnoses can be linked!
DATA RECORDING

- Examples: Denmark (Aamand, 2006):
  - Transfer from different invoicing systems (vets).
  - Registrations by the herd manager and vets by use of a pencil in a standard system (e.g. calving, sale).
  - Direct registration in the central database (data processing centres for milk recording, farmers, advisors and veterinarians).

- Scand./Austria:
  - By employees of performance recording organisations and/or direct electronic submission by vets. Additional possibilities by farmers.

Combine information from different sources! Store information about type of recording! Differences in completeness might exist!
**DATA STORAGE — ACCESS TO DATA**

- Complex national database with other relevant information is of advantage (plausibility checks easier,..)
- Enable extra gain – chance to link different information easily (electronic interfaces,..)
- **Further information:**
  
  [http://www.eadgene.info/Portals/0/WP10_1_Public_Downloads/EADGENE_Annex_VF.pdf](http://www.eadgene.info/Portals/0/WP10_1_Public_Downloads/EADGENE_Annex_VF.pdf)
  
  - Construction and maintenance of animal health data collections (Definitions and storage of data)
  - Facilitation of exchange of data
  - Facilitation of analysis of data (for investigation of specific data, benchmarking etc.)
  - Level of harmonization (Following ISO principles)
DATA SECURITY - ISSUES

- Ownership and use of data – consent of farmer needed!
- Access rights of (original) health data and results from health data analyses.
- Rights to edit the health data are provided very restrictively (use for control purposes dangerous!)
- If information about veterinarian is recorded - anonymisation of veterinarian advisable.

Data security – crucial – farmers and veterinarian have to build up trust into the system!
DATA VALIDATION

- Plausibility checks before storage in database (e.g.: http://www.bmg.gv.at/cms/home/attachments/9/7/3/CH1141/CMS1271936439807/tgdkundm74200_46-ii-b-10-10gesundheitsprogrammrindprogramm.pdf)
  - provision of health reports and use within animal health programmes (farmers/veterinarians)

- Validation concerning completeness of recording:
  „Farm with low incidence of disorders or farm with incomplete recording?“
  - DK: MIN 0.3 diagnoses/cow and year;
    AUT: MIN 0.1 first diagnoses/cow and year
  - continuous recording of diagnoses
  - definition of the time under observation
BENEFITS

- Improvement of management (farm level)
  a. Farmers
  b. Veterinarians
    - Immediate reactions (action lists, internet based information,..)
    - Long term adjustments (benchmarks, yearly reports,..)
  
- Monitoring of the health status (population level)

- Genetic evaluation (population level)

Rapid feedback is essential for motivation of farmers and veterinarians! Increase of economic efficiency!
Genetic evaluation

- Genetic differences exist although heritabilities are low (0.01-0.15).
- Direct health traits are an important additional information (e.g. Koeck et al. 2010a: \(rg \approx -0.4\) Early fertility disorder and NR56), CM and SCC \(rg \approx 0.5-0.7\) (Heringstad et al. 2004; Zwald et al. 2006; Koeck et al. 2010b).
- Combination of direct and indirect health traits is of advantage (fertility index, udder index).
- Combination of single diagnoses is of advantage due to low frequencies (Koeck et al. 2010: e.g. Early fertility disorders more stable than single traits retained placenta, puerperal disorders and metritis,..).
HEALTH DATA AND GENOMIC SELECTION

- Huge amount of data needed—reliable phenotypes and genotypes!
- Reference population of 3,000 bulls comparable with 21,000 cows at heritability of 0.1 (de Roos, 2011).
- Important to record complete herds!
CHALLENGES

SUFFICIENT DATA FOR BREEDING PURPOSES

- Coverage of data recording has to be comparable with other functional traits
  - Due to low heritabilities a big amount of data needed.

- Possibilities:
  - All farms under performance recording are participating (advantage also for herd management use).
  - Contract herds with comprehensive recording: expensive, but higher heritabilities possible (Swalve, 2010); eventually phenotypes and genotypes (Pryce and Daetwyler, 2011).
IMPORTANT MEASURES

- Participative approach for veterinarian diagnoses.
- Benefit for key players: motivation for support depends on expected benefit and additional effort.
- Technical implementation with emphasis on data security and data quality (validation!).
- Continuous information and motivation: essential, more challenge than technical aspects. Opinion leaders important!
- Legal frameworks: continuous recording of health data on a high level of participation is a big challenge - legal frameworks are very valuable.
CONCLUSIONS

- Registration of direct health traits needed, but challenging.
- No standardised recommendation – only best practices adjusted to regional circumstances.
- Possibilities based on new technologies in future.
- Emphasis on data security and data validation.
- Benefit, information and motivation crucial issues.
- Harmonisation: key for standardisation of diagnoses, protocols for conversion of data between systems.

ICAR-working group on functional traits: presently working on guidelines for direct health data.
Feedback, recommendations, .. welcome.

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REFERENCE

- ...
Thank you for your attention
COMPLEX CATTLE DATA BASE
(AAMAND, 2006)
Occurrence of Mastitis

- Mastitis accumulated at the beginning of the lactation.

MASTITIS (Appuhamy et al. 2009)
Occurrence of Fertility Disorders

- Retained placenta, puerperal diseases after calving
- Disturbances of cycle mainly between 30 – 150 days.
- Disturbances of cycle could be recorded with inseminations, early fertility disorders with calving ease.

Koeck et al. 2010
Occurrence of Metabolic Disorders

- Milk fever occurs to more than 90% till 10 days after calving.
- Higher incidence in higher lactations (Heringstad et al. 2005).

Schwarzenbacher et al. 2010

Metabolic disorders
(Appuhamy et al. 2009)
Occurrence of Feet and Leg Problems

- Feet and leg problems occur during the whole lactation.
- Diagnoses related with metabolic disorders mainly at the beginning of the lactation.
- For comprehensive information about feet and legs – information from claw trimmers needed!
- Veterinarian diagnoses cover only severe cases.
**Utilization of Incidence Data (Schwarzenbacher et al. 2010)**

**Visual Health Reports**

<table>
<thead>
<tr>
<th>Period: 01.10.07 - 30.09.08</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
</tr>
<tr>
<td>- no cows</td>
</tr>
<tr>
<td>- Milk yield (kg)</td>
</tr>
<tr>
<td>- Fat content</td>
</tr>
<tr>
<td>- Protein content</td>
</tr>
<tr>
<td>- Culling rate</td>
</tr>
<tr>
<td><strong>Fertility and Calving</strong></td>
</tr>
<tr>
<td>- Calving interval</td>
</tr>
<tr>
<td>- Days to first service</td>
</tr>
<tr>
<td>- Insemination index</td>
</tr>
<tr>
<td>- Rate of cows with dystocia</td>
</tr>
<tr>
<td>- Rate of cows with stillbirth</td>
</tr>
<tr>
<td>- Rate of cows with diagnoses</td>
</tr>
<tr>
<td>- Culling for infertility</td>
</tr>
<tr>
<td><strong>Udder</strong></td>
</tr>
<tr>
<td>- Somatic cell score</td>
</tr>
<tr>
<td>- Rate of SCC &gt; 200 t</td>
</tr>
<tr>
<td>- Rate of cows with &gt; 2 exceedings</td>
</tr>
<tr>
<td>- Rate of cows with diagnoses</td>
</tr>
<tr>
<td>- Culling for mastitis</td>
</tr>
<tr>
<td><strong>Metabolism</strong></td>
</tr>
<tr>
<td>- Rate with FPR &gt; 1.5 od. &lt; 1.0</td>
</tr>
<tr>
<td>- Rate with protein content &lt;.3, 1-100 Lakt.</td>
</tr>
<tr>
<td>- Rate with urea content &gt;30, 1-100 Lakt.</td>
</tr>
<tr>
<td>- Rate with urea content &lt;15, 1-100 Lakt.</td>
</tr>
<tr>
<td>- Rate of cows with diagnoses</td>
</tr>
<tr>
<td>- Culling for metabolic diseases</td>
</tr>
<tr>
<td><strong>Feed and Legs</strong></td>
</tr>
<tr>
<td>- Rate of cows with diagnoses</td>
</tr>
<tr>
<td>- Culling for leg- and feed diseases</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>below average</th>
<th>10%</th>
<th>25%</th>
<th>average</th>
<th>25%</th>
<th>above average</th>
<th>10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>District (N=52)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Province (N=1428)</td>
<td></td>
</tr>
</tbody>
</table>