IT-Solutions for Animal Production

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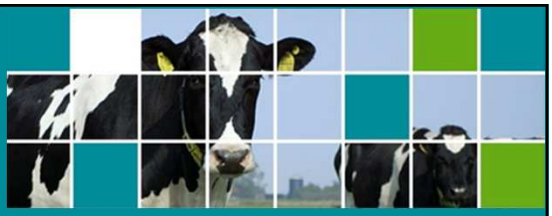


Owner-recorded data as source of information for genetic analyses of health traits of dairy cattle

K.F. Stock[1], D. Agena[1], S. Spittel[2], M. Hoedemaker[2], F. Reinhardt[1]

[1] Vereinigte Informationssysteme Tierhaltung w.V. (vit), Verden at the Aller / Germany

[2] University of Veterinary Medicine Hannover, Clinic for Cattle, Hanover / Germany

Email: friederike.katharina.stock@vit.de

Background

- considerable improvement of dairy performance (production traits) over the last decades
- increasing importance of functional traits: influence on long-term efficiency of milk production
- need for new and more specific functional traits → dairy health as a major factor, but
  - no standardized recording routines for health data yet
  - data security issues
  - data quality issues

Recording of health events

- veterinarians
  - legal obligations of documentation
  - high-quality data (exact diagnoses), but possible bias of diagnosis spectrum
- expert groups
  - own interest in documentation (follow-up)
  - small spectrum of specific diagnoses: claws, nutrition
- owners
  - own interest in health monitoring (management control, herd health and performance)
  - expert-support needed to ensure appropriate data quality

Study approach

***GKuh* ('healthy cow'):**

Recording, analysis and genetic evaluation of disease diagnoses in dairy farms to select for health and longevity

- owner-recorded health data
  - 49 farms in the Northwest of Germany (region of traditional dairy farming)
  - no existing health-recording system → installation with intense on-farm support
  - use of existing ways of data transfer (milk recording agencies)
- expert cooperation

Outline of project *GKuh*

- project start in October 2009
  → continuous health recording since January 2010
- study period 01.01.2010 - 30.06.2011
  - average herd size (49 farms):
    ~ 60-70 cows in milk recording
  - animals under observation:
    12,032 females including 7,294 females > 24 months of age
  - health records:
    13,081 diagnoses (5,227 females with diagnoses)

Collection of health data

- standardized numerical key of diagnoses
  - set of 176 diagnoses
    (possible: comprehensive key with 976 diagnoses)
  - hierarchical structure allowing input of varying specificity
- documentation of health events
  - disease observations,
  - veterinary medical diagnoses,
  - findings from claw trimming, ...

  by the farmers via herd management software
  → transfer to health data base (vit)

Definition of health traits

- available health information
  diagnosis + date of diagnosis
  + location of diagnosis (if applicable: quarter of the udder, limb)
- diseases with <u>period of risk</u> within each lactation
  → observation unit: animal X lactation
- period of risk
  - reference for interpretation of lactations without diagnoses as unaffected or non-informative
    → determinant of total number of observations
  - 'unaffected lactation' = proportion P of period of risk under observation and without diagnosis
    → different restrictiveness (100-75-50% = P100-P75-P50)

Coding of health traits

- <u>binary</u>
  affected lactations = lactations with at least one diagnosis
  vs. unaffected lactations = at risk lactations without diagnosis
  → all diseases (any period of risk, single or multiple locations)

  $$\Rightarrow \quad \textbf{lactation incidence rate (LIR)} = \frac{\textbf{affected lactations}}{\textbf{affected+unaffected lactations}}$$

- <u>quasi-continuous</u>
  number of health events in a given lactation (accounting for repeated occurrence of disease and multiple affections)
  → diseases with longer periods of risk and/or multiple locations

Lactation incidence rates (LIR)

Trait	n_{aff}	*P100*		*P75*		*P50*	
		n	*LIR (%)*	*n*	*LIR (%)*	*n*	*LIR (%)*
Early mastitis (MAST)	920	5,699	16.1	6,173	14.9	6,514	14.1
Retained placenta (RET)	564	5,379	10.5	5,440	10.4	5,535	10.2
Non-purulent claw diseases (NPCL)	530	4,231	12.5	5,280	10.0	6,438	8.2
Purulent claw diseases (PCL)	1,592	4,819	33.0	5,731	27.8	6,766	23.5

n_{aff} = number of affected lactations; n = total number of observations (affected+unaffected lactations)

Influence of restrictiveness of control definition on LIR:
increasing with duration of period of risk (RET MAST NPCL, PCL)

Estimation of genetic parameters

- variance component estimation with REML (VCE6)
- repeatability linear animal model
- comparative analyses
  - binary vs. quasi-continuous coding of health traits
  - varying restrictiveness of control definitions of controls (lactations at risk)
  - uni- and bivariate analyses

$$y_{ijkl} = \mu + PAR_i + hys_j + pe_k + a_k + e_{ijkl}$$

with PAR_i = fixed effect of parity class,
hys_j = random effect of herd X year-season of calving,
pe_k = random permanent environmental effect of the animal,
a_k = random additive genetic effect of the animal, e_{ijkl} = random residual

Heritabilities

Trait		*P100*	*P75*	*P50*
		$h^2 \pm SE_{h^2}$	$h^2 \pm SE_{h^2}$	$h^2 \pm SE_{h^2}$
Early mastitis (MAST)	- BIN	**0.072 ± 0.027** (0.163 ± 0.061)	**0.066 ± 0.020** (0.155 ± 0.048)	**0.055 ± 0.017** (0.133 ± 0.041)
	- CAT	**0.104 ± 0.039**	**0.093 ± 0.036**	**0.078 ± 0.027**
Retained placenta (RET)	- BIN	**0.035 ± 0.019** (0.098 ± 0.054)	**0.036 ± 0.020** (0.104 ± 0.058)	**0.038 ± 0.021** (0.108 ± 0.060)
Non-purulent claw dis. (NPCL)	- BIN	**0.036 ± 0.014** (0.093 ± 0.035)	**0.054 ± 0.017** (0.156 ± 0.051)	**0.048 ± 0.013** (0.157 ± 0.043)
	- CAT	**0.038 ± 0.013**	**0.050 ± 0.016**	**0.044 ± 0.014**
Purulent claw dis. (PCL)	- BIN	**0.042 ± 0.015** (0.070 ± 0.025)	**0.056 ± 0.018** (0.100 ± 0.033)	**0.042 ± 0.016** 0.080 ± 0.030)
	- CAT	**0.087 ± 0.021**	**0.086 ± 0.021**	**0.071 ± 0.021**

Influence of restrictiveness of control definition on h^2:
increasing with duration of period of risk (RET MAST NPCL, PCL)
Benefit of quasi-continuous trait definition: NPCL MAST PCL

Heritabilities & genetic correlations

Trait		*P75 - UNIVARIATE*	*P75 - BIVARIATE*	
		$h^2 \pm SE_{h^2}$	$h^2 \pm SE_{h^2}$	$r_g \pm SE_{rg}$
Retained placenta (RET)	- BIN	**0.036 ± 0.020** (0.104 ± 0.058)	**0.048 ± 0.020** (0.137 ± 0.057)	**0.722 ± 0.188**
Other puerperal disorders	- BIN	**0.038 ± 0.023** (0.330 ± 0.201)	**0.048 ± 0.021** (0.422 ± 0.186)	
Purulent claw dis. (PCL)	- BIN	**0.056 ± 0.018** (0.100 ± 0.033)		
Sole ulcers	- BIN	**0.071 ± 0.027** (0.208 ± 0.078)	**0.058 ± 0.022** (0.169 ± 0.064)	**-0.088 ± 0.267**
Dermatitis digitalis / Mortellaro	- BIN	**0.026 ± 0.015** (0.065 ± 0.036)	**0.027 ± 0.010** (0.066 ± 0.024)	

Benefit of refined trait definition
(e.g., reproductive disorders, PCL)

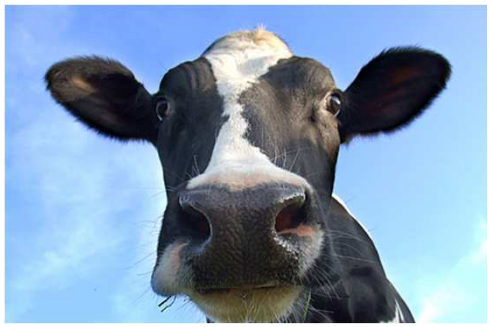
Conclusions

- owner-recorded health data as valuable source of information for genetic analyses
- quantitatively most important health traits
  - claw diseases, mastitis, retained placenta: LIR ~ 10-30%
  - heritability estimates of 0.04-0.10 (liability scale: 0.07-0.16)
- trait-dependent impact of definition of at risk lactations
- possible use of detailed information on health events for refined trait definition (repeated and/or multiple affections)

Implications

- high quality of owner-recorded health data justifying the efforts of implementing health recording systems with intense expert support
- health reports as immediate rewards for the owners ensuring continuous data flow
- use of experiences from projects like ***GKuh*** when extending health data collection
  → sound basis for genetic evaluation for health traits to allow selection for improved health and longevity

Thank you !



owners of *GKuh* farms

Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz

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lkv Weser - Ems

vit Service & Daten aus einer Quelle

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PD Dr. habil. Kathrin F. Stock
Email: friederike.katharina.stock@vit.de
Phone: ++49 - 4231 - 955 623

vit

IT Solutions for Animal Production

Vereinigte Informationssysteme Tierhaltung (vit) w.V.
Heideweg 1, 27283 Verden at the Aller, Germany