



# Health monitoring concepts for long-term improvement of dairy health

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## Background



- dairy health and welfare worldwide in the focus of research
- health monitoring in dairy cattle
  - benefitting from available standards for recording and analysis of health data
  - challenged by economic considerations and general conditions of livestock keeping (data security issues)
- different approaches (sources of health data) in several independent regional projects in Germany
  - unsatisfactory use of the potential of health monitoring



# Objective

- development of an integrated system for routine health monitoring in German dairy farms:

## step 1

- different recording systems (herd management software)
- heterogeneous farm structures
- varying farmer experience with routine health documentation



preliminary model based on two regional projects:

- Lower Saxony (Osnabrück) → GKuh
- Thuringia → THU

## step 2

- integration of further sources of health data (treatment data / veterinary software)

# Outline of regional projects

Key figure	GKuh	THU
Region in Germany	Northwest (Osnabrück)	Mideast (Thuringia)
Starting point	No existing health-recording system → installation with intense on-farm support	Long-term experience in electronic documentation (incl. health data) → some adjustments
Total no. of farms	63	23
Farm size (average no. of cows per farm 2011/2012)	103 (max. 567)	768 (max. 1.710)
Time horizon	01.01.2010 - 30.06.2013	01.01.2009 - 30.06.2013
<b>Total no. of females (all farms, whole period)</b>	<b>21,395</b> incl. <b>12,788 cows</b>	<b>61,703</b> incl. <b>37,342 cows</b>
Total no. of health events (first diagnoses of disease)	27,995	275,588
No. of animals with ≥ 1 diagnosis record	9,093	44,423

## Routine health data analyses (I)

- plausibility checks with delivery of error protocols  
→ control of data quality
- management-oriented statistical analyses  
→ health reports (quarterly, annual summaries),  
health-/prophylaxis-oriented action lists (monthly)
  - distribution of diagnoses by age and disease group
  - time course of proportions of animals without diagnoses (vertical statistics)
  - respective summary statistics from the matched group of farms (horizontal figures)



different formats / sets of analyses  
as requested by the farmers



## Routine health data analyses (II)

- breeding-oriented statistical analyses
  - estimation of genetic parameters & prediction of breeding values for health traits
  - pilot implementations in the context of regional projects
  - promising results of comparative analyses across regional projects

significant positive genetic correlations for all health traits:  
metabolic diseases, purulent claw diseases (> 0.95)  
> reproductive disorders, mastitis (≥ 0.7)  
> non-purulent claw diseases

## Routine health data analyses (II)

- breeding-oriented statistical analyses
  - estimation of genetic parameters & prediction of breeding values for health traits
  - pilot implementations in the context of regional projects
  - promising results of comparative analyses across regional projects  
 ↔ step towards national genetic evaluation for health traits (across regions) to be taken  
 → preliminary joint analyses of data from GKuh & THU

**single-trait repeatability linear animal model** (variance component estimation with REML / VCE6, genetic evaluation with BLUP / PEST)

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

with  $PAR_i$  = fixed effect of parity class,

$hys_j$  = random effect of herd X year-season of calving,

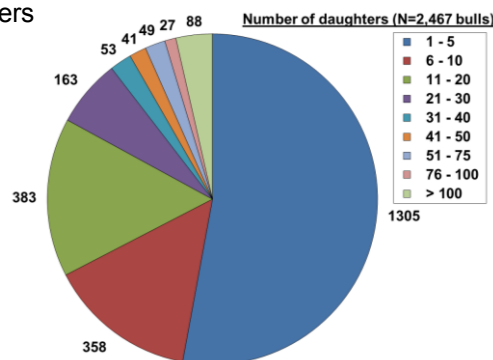
$pe_k$  = random permanent environmental effect of the animal,

$a_k$  = random additive genetic effect of the animal,

$e_{ijkl}$  = random residual

## Distribution of bulls

- in each of the projects many bulls with mostly few daughters (1,151 in GKuh, 1,633 in THU)
- combined data set (GKuh+THU): 2,467 bulls
  - 169 bulls with  $\geq 50$  daughters



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- combined data set (GKuh+THU): 2,467 bulls
  - 169 bulls with  $\geq 50$  daughters
  - 317 bulls with daughters in GKuh+THU

Offspring distribution	N	Region / project	Herds	Daughters
			mean (max.)	mean (max.)
GKuh only	834	GKuh	2.8 (36)	4.6 (172)
THU only	1,316	THU	3.2 (20)	15.9 (804)
GKuh+THU	317	GKuh	6.2 (55)	22.9 (1,251)
		THU	3.6 (22)	37.9 (1,292)
		GKuh+THU	9.8 (69)	60.8 (1,581)
Total	1,151	GKuh	3.7 (55)	9.7 (1,251)
	1,633	THU	3.3 (22)	20.2 (1,292)
	<b>2,467</b>	<b>GKuh+THU</b>	<b>3.9 (69)</b>	<b>17.9 (1,581)</b>

## Disease frequencies & heritabilities

GKuh+THU

Health trait	N	LIR [%]	$h^2$	$N_{\text{daughters}}$ for $r^2=0.5$ **
Early mastitis (-10 to 50 DIM)	76,123	20.2	<b>0.050</b> 0.005	78
Late mastitis (51 to 305 DIM)	62,192	30.7	<b>0.092</b> 0.008	42
Retained placenta	79,512	10.9	<b>0.040</b> 0.005 *	98
Ovary cycle disturbances	62,164	8.4	<b>0.042</b> 0.003	93
Ketosis	74,807	3.5	<b>0.026</b> 0.005 *	150
Milk fever	81,197	4.3	<b>0.024</b> 0.004 *	163
Abomasal displacement to the left	68,927	3.0	<b>0.034</b> 0.004 *	115
Non-purulent claw diseases	61,129	26.7	<b>0.096</b> 0.008	40
Interdigital hyperplasia / Corns	57,194	8.0	<b>0.172</b> 0.012	22
Purulent claw diseases	63,781	41.3	<b>0.086</b> 0.007	45
Claw ulcers	58,279	17.1	<b>0.104</b> 0.008	37
Digital dermatitis / Mortellaro	58,632	17.8	<b>0.083</b> 0.009	47
Digital phlegmon / Panaritium	58,078	12.6	<b>0.053</b> 0.007	73

LIR = lactation incidence rate = no. of affected lactations / no. of affected+unaffected lactations; affected lactation = lactation with at least 1 diagnosis; unaffected lactation = at risk lactation without diagnosis;

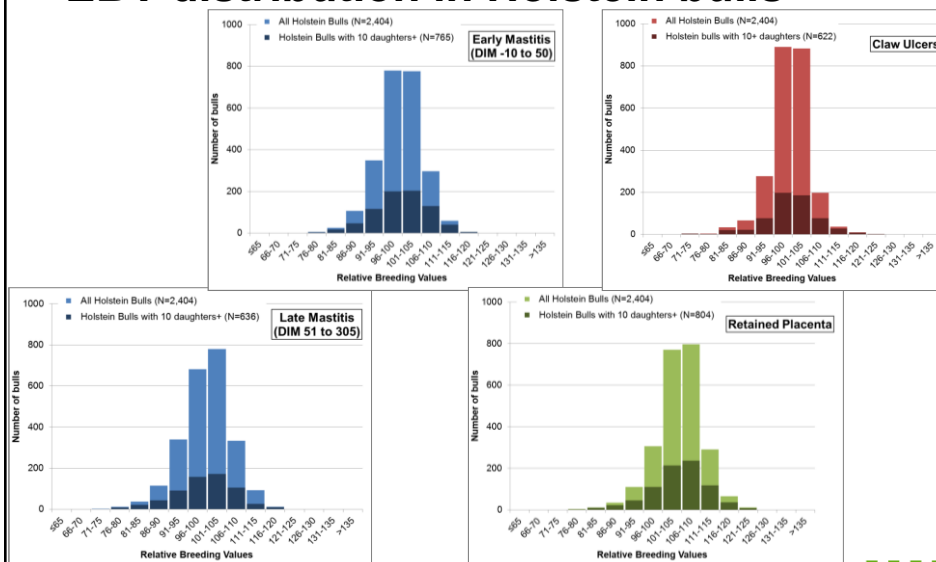
\* transformed heritabilities (binary traits): 0.110-0.205 (SE 0.013-0.026); \*\* approximation as  $r^2 = n / (n + k)$  with  $k = (4 - h^2) / h^2$

# Distribution of EBV

Health trait	Base bulls (N=1,439) *	All bulls (N=2,467)	
	std <sub>EBV</sub>	std <sub>EBV</sub>	range <sub>EBV</sub>
Early mastitis (-10 to 50 DIM)	6.37	5.65	77 - 121
Late mastitis (51 to 305 DIM)	6.92	6.37	74 - 124
Retained placenta	6.90	6.17	70 - 120
Ovary cycle disturbances	6.17	5.56	62 - 122
Ketosis	5.72	5.21	76 - 123
Milk fever	5.81	5.29	68 - 120
Abomasal displacement to the left	7.08	6.17	59 - 118
Non-purulent claw diseases	6.02	5.22	57 - 133
Interdigital hyperplasia / Corns	6.39	5.62	40 - 121
Purulent claw diseases	6.03	5.35	71 - 127
Claw ulcers	6.01	5.31	64 - 126
Digital dermatitis / Mortellaro	6.19	5.38	53 - 133
Digital phlegmon / Panaritium	5.52	5.07	73 - 121

\* base bulls = bulls with daughter information for Early mastitis, Late mastitis, Retained placenta, Ketosis, and Non-purulent claw diseases

# EBV distribution in Holstein bulls



## Conclusions

- heterogeneity regarding collection of health phenotypes (e.g. disease incidences influenced by extent of routine screenings) requiring thorough definition of comparison groups  
⇒ health reports as valuable tool to improve herd management and dairy health in the short-term ("immediate reward")
- consistent results of genetic analyses with mutual benefit from joint use of health data  
⇒ EBV for health traits as valuable tool to improve dairy health population-wide in the long-term ("lasting reward")

## Implications & Prospects

- flexible, integrated concepts providing the basis for successful extension of health monitoring in dairy cattle
- challenges to be met by synergistic actions of the dairy industry
  - implementation of routine health data recording (data security, logistics, expert start-up support on farm)
  - data quality and continuity of data flow (motivation aspects, expert support on farm)
  - transfer of knowledge into practice (veterinary / management / breeding consultants)
- collaboration of experienced partners in a national initiative promoting routine health monitoring for improvement of health and longevity in dairy cattle



Thank you !

owners of participating farms



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## EBV reliabilities (approximation)

No. of progeny (n)	EBV reliability *			
	h <sup>2</sup> =0.05	h <sup>2</sup> =0.07	h <sup>2</sup> =0.10	h <sup>2</sup> =0.15
5	0.06	0.08	0.11	0.16
10	0.11	0.15	0.20	0.28
15	0.16	0.21	0.28	0.37
20	0.20	0.26	0.34	0.44
<b>25</b>	0.24	0.31	0.39	<b>0.49</b>
<b>50</b>	0.39	<b>0.47</b>	<b>0.56</b>	<b>0.66</b>
<b>75</b>	<b>0.49</b>	<b>0.57</b>	<b>0.66</b>	<b>0.75</b>

\* approximation:  $r^2 = n / (n + k)$  with  $k = (4 - h^2) / h^2$