Harmonization of recording and use of direct health data as basis of sustainable improvement of dairy health and longevity

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Abstract

Animal health and welfare issues have emerged as important factors for efficiency, competitiveness and public acceptance of livestock keeping and breeding worldwide. In dairy cattle, health monitoring has been in the focus of multiple research projects since the 1970s. Information on diseases from veterinary records and on-farm documentation systems are the main sources of direct health data, for which routine genetic evaluations were first implemented in the Nordic countries and more recently in a few other countries. The goal of the ICAR Functional Traits Working Group is to deliver information and tools that facilitate the use of health data across sectors and countries, thereby supporting the implementation of sustainable health monitoring and improvement systems. The ICAR guidelines for Recording, Evaluation and Genetic Improvement of Health Traits cover different approaches for the collection and use of health data in dairy management and breeding, and recommend best practices. Standardization is essential for building up the required information base on dairy health by collaborative and integrative approaches, and the hierarchically structured, comprehensive key for health data recording can serve as a reference which facilitates the connection of data sources. International and interdisciplinary exchange of experiences and collaborations can contribute to the development of efficient breeding strategies with increased weight on health and welfare traits. The ICAR 2013 Health Data Conference showed the potential of broad adoption of the available health data standards for the benefit of all stakeholders in the dairy sector. Clear and restrictive regulations regarding access and use of health information help increase the rate of data integration which is needed for maximum performance regarding support of short- and long-term improvements of the dairy herd. Based on internationally harmonized recording of direct health

data, joining of sectoral, regional and national initiatives is expected to propel the targeted improvement of health, welfare, and longevity in dairy breeding.

Keywords: direct health traits, disease records, key of diagnoses, recording standard

Introduction

The health and welfare status of livestock are closely related with productivity and profitability of the farms and can serve as indicators for the match of animal husbandry and production with the animals' needs. As such, their importance has increased considerably because the high yields achieved by decades of production-oriented selection are making animals more prone to disease and suffering, which drives the need for effective health management in modern livestock.

Health monitoring, i.e., the systematic recording and use of animal health data, is the basis of targeted improvements in individual farms and at the population level. Harmonization of the health-related documentation is desirable for analyses across farms, and multiple aspects of health data logistics impact the adoption of routine monitoring in practice. For dairy cattle, the first national health monitoring programs were established in the 1970s on the basis of the compulsory documentation of veterinary treatment in the Scandinavian countries (Østeras *et al.*, 2007). Since then, many projects and initiatives have worldwide focused on the dairy health monitoring with rather consistent outcome regarding the challenges and benefits of health data recording. In the following discussion, recent developments towards the routine usage of direct health information in dairy breeding will be reviewed and prospective extensions of data usage will be outlined.

Legal framework of animal health

Legislation had - and still has - relevant impacts on the health data that become available for central analyses. Documentation requirements relating to the use of drugs have markedly increased over the years for the whole livestock sector and across countries. Veterinary diagnoses from medication records can give a good overview of the occurrence of diseases of dairy cattle that required veterinary intervention. However, the coverage of health information from this source varies between diseases (according to their therapeutic options), and public concerns about the humane and responsible treatment of animals imply reference to increasingly strict measures of animal health and welfare. The legislative provisions of the European Union are reflecting the high expectations of consumers (Pavón, 2013), and documentation requirements regarding animal-based indicators of health and welfare are expected to increase for dairy farmers as for any other livestock operations. The regular checking of the animals for signs of disease and the keeping of detailed records are referred to as parts of good dairy farming practice (FAO & IDF, 2011).

Dairy farming practice and health data recording

Given the obvious interdependencies between health and performance, many dairy farms are keeping health records for their animals that go beyond compulsory documentation of medications. Data are also often voluntary recorded in countries that do not require collection of

health and treatment data. With the advances of herd management tools, such proactive and extensive voluntary documentation as basis of informed on-farm decisions is no longer confined to larger herds that used to organize the herd health management with computerized systems. Technical solutions are today available that make health data recording feasible for medium-sized and small dairy herds.

Possible comparison with other farms (horizontal analyses), improved benchmarking and support of selection decisions resemble added value of central analyses of pooled health data when compared to the within-farm statistics (vertical analyses) provided by the herd management system. The internationally approved standard for health data recording (health key) and recommendations for its use (health guidelines; ICAR, 2012) are important for the development of health monitoring concepts, which are capable to meet the current and future demands of smart usage of data.

Integration of animal health data

With the comprehensive coding system of the health key (ICAR, 2012), that is fully compatible with existing recording protocols, everything from simplified to highly detailed recording of health events is supported. Accordingly, linking health records from different data sources and the establishment of integrated health monitoring systems is facilitated. Major challenges of long-term implementation of health monitoring in dairy cattle include the practical feasibility of recording, the need for optimized data management, and demand for output that is useful for on-farm decision-making. Linking of the heterogeneous sources of health data available on an individual animal level (Table 1) resembles efficient usage and sustainable extension of existing infrastructure and is for example successfully practiced in the Nordic countries (Frandsen, 2013; Heringstad & Østeras, 2013; Kyntäjä, 2013).

Table 1. Examples for the integration of direct health information on individual animals in data bases for dairy cattle.

Type of data	Data source
Diagnoses of diseases requiring medical treatment	veterinarian, farmer
Diagnoses of diseases treated conservatively	veterinarian, farmer
Claw health information	claw trimmer, farmer
Reproduction data	inseminator, veterinarian, farmer
Outcome of special veterinary examinations	veterinarian, laboratory, farmer
Calving related disorders (cow, calf)	farmer
Culling reasons	farmer
Post mortem diagnoses	slaughterhouse

Sensitivity of health data require thorough addressing of data security, which may complicate extensive data merges. However, the benefits of increased data pools for validation purposes and analyses are obvious: The possibilities to validate direct health information are generally limited, so options for testing internal and external consistency should be used to a maximum to ensure reliability of data and derived results (Egger-Danner *et al.*, 2013; Emanuelson & Egenvall, 2014). Improved completeness of health and disease information implies larger variation and better

individual discrimination with respective impact on both management- and breeding-oriented analyses.

Further extension of the integration of health-related information, particularly with respect to measures from automated recording systems, is the subject of ongoing research. With the worldwide increasing number of dairy farms using milking robots and electronic devices for management support, intelligent solutions are needed to realize gain rather than loss of data in the ongoing process of replacing manual input by automation. To optimize predictions of health and disease for individuals, detailed environmental information is likely included in future innovative monitoring systems. However, it must be taken into account that the advanced merging of data makes data processing and validation more and more demanding, so substantial research and development work will be needed for implementation of the next generation health monitoring system. Guidelines for quality control of animal health data will require respective adjustments to keep up with the new systems of data collection and use.

Health traits in dairy breeding

The wish of more targeted selection for improved robustness and health of the dairy cows placed the breeding organizations into the position of important supporters of the developments towards routine health monitoring. Because direct health information is difficult and expensive to measure, sustainable concepts for efficient data collection, appropriate support of participating dairy farmers, and implementation of the desired spectrum of health data analyses required collaborations within the dairy sector. In these preferably interdisciplinary consortia, animal breeders were particularly important because genetic evaluations for health traits provided the long term perspective of population-wide improvements of animal health and welfare. However, the multiple initiatives aiming at routines for breeding use of direct health information had to account for the fact that high data quality and continuous data flow are dependent on persistent motivation of contributors which is again relying on the visible short-term benefit of complete and correct health data recording. Accordingly, the intended use of direct health data for genetic evaluation was a relevant driver of the comprehensive approach of animal health improvement in the dairy farms by optimized management and veterinary care (short- to medium-term improvements on individual farm level) and targeted selection (long-term improvement on the population level). By smart usage of the available recording tools, and especially user-friendly technical solutions, standardization of health data recording as basis of genetic dairy health improvement programs could be established within reasonably short time periods (Egger-Danner *et al.*, 2012; Stock *et al.*, 2012a).

In the last couple of years, multiple research and development projects worldwide have progressed towards routines for direct health traits in dairy breeding (Table 2). Across countries, multidisciplinary approaches linking the expertise of veterinarians and animal breeders were particularly successful. Concerning the trait spectrum, mastitis still ranks highest among the diseases of dairy cows included in genetic and genomic analyses. However, the number of national and transnational genetic evaluations for traits from the other major disease complexes, reproduction disorders, metabolic diseases and feet and leg problems, has increased and is expected to grow further in the near future. Only with the refined trait definitions for health and disease, dairy breeding will meet the ever increasing demands for appropriate consideration of health and welfare in animal production.

As low heritability traits with estimates of mostly $h^2 \leq 0.10$ for which phenotyping efforts are tedious, direct health traits are among those which gain most through genomic approaches (Parker-Gaddis *et al.*, 2014). Accordingly, genomics and the related quality offensives regarding phenotype data collection will further push the already intense research and development activities (Stock *et al.*, 2012b), increasing the opportunities for targeted ad sustainable improvement of health and welfare of dairy cattle.

*Table 2. Examples for direct health traits in routine genetic evaluations (GE) and prospected genetic evaluations (ongoing research and development, R&D) in international dairy breedin*g.

Country	Trait(s)
Austria [1]	GE [*]: mastitis, early reproduction disorders, cystic ovaries, milk fever; R&D: metabolic disorders, feet and leg diseases
Canada [2]	GE: mastitis; R&D: displaced abomasum, ketosis, milk fever, retained placenta, metritis, cystic ovaries, lameness
Denmark, Finland, Sweden [3]	GE: clinical mastitis, metabolic diseases (incl. ketosis, milk fever), early and late reproduction disease, feet and leg diseases; R&D: claw health (digital and interdigital dermatitis, heel horn erosion, skin proliferation, sole haemorrhage, sole ulcer, cork skrew claws, white line separation / double sole)
Germany [4]	R&D: early and late mastitis, retained placenta, ovary cycle disturbances, ketosis, milk fever, displaced abomasum, non-purulent and purulent claw diseases (corns, laminitis, claw ulcers, digital dermatitis, digital phlegmon)
France [5]	mastitis
Norway [6]	GE: mastitis, ketosis, milk fever, retained placenta; R&D: claw health, fertility-related disorders
Switzerland	R&D: mastitis, metabolic diseases and others (broad health data recording)
USA [7]	R&D: mastitis, retained placenta, cystic ovaries, metritis, displaced abomasum, ketosis, lameness

[1] Fürst & Egger-Danner, 2014, [2] Jamrozik *et al.*, 2013, [3] Heringstad & Østeras, 2013, [4] Stock *et al.*, 2012a, [5] Govignon-Gion *et al.*, 2012, [6] Heringstad *et al.*, 2005; [7] Parker Gaddis *et al.*, 2014; [*] joint GE for Austrian and German Fleckvieh and Brown Swiss

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