Precision Dairy Data Standards for Welfare and Behavior

Working Group Meeting North America

Date: 7th May 2024.

Location: ADSA Discover Conference 2024, Milking the Data: Value-Driven Dairy Farming.

Organizing group: Daniel Foy (AgriGates), Rene van der Linde (ICAR), Silvia Orlandini (ICAR), Helene Soyeurt (ULiege)

Meeting Summary Author: Daniel Foy (AgriGates, USA)

Attendee list:

1. Heather Dann — William H Miner Agriculture Research Institute, USA
2. Joao Durr — CDCB, USA
3. Craig Edwards — Aurora Organic Dairy, USA
4. Daniel Foy — AgriGates, USA
5. Sebastien Franceschini — ULiege - Gembloux Agro-Bio Tech, Belgium
6. Meggan Hain — Organic Valley Coop, USA
7. Michael Iwersen — Vetmeduni, Austria
8. Daniel Lafebvre — Lactanet, Canada
9. Jay Mattison — National Dairy Herd Information Association, USA
10. Catherine McVey — OsRostrum Inc, USA
11. Clemence Nash — Dairy Farmers of Canada/ Nouvs International, Canada
12. Alex Pape — William H Miner Agriculture Research Institute, USA
13. Margaret Quaassdirff — Cornell Cooperative Extension, USA
14. Michael Rathmall — Aurora Organic Dairy, USA
15. Helene Soyeurt — ULiege - Gembloux Agro-Bio Tech, Belgium
16. Andrew Stewart — Aurora Organic Dairy, USA
17. Fanny Tenehaus-Aziza — CNIEL, France
18. Jeff Traux — Aurora Organic Dairy, USA
19. Shari van de Pol — CATTLEytics Inc, Canada
20. Rene van der Linde — ICAR, The Netherlands

Aim:

To convene a small working group to discuss for a couple of hours further developing a long-term initiative and NA team to work on a welfare and behavioral data standard for/ with PLF systems and targeting challenges and proposed aims.

Objectives:

The establishment of a working group on " Precision Dairy Data Standards for Welfare and Behavior in North America " to foster interdisciplinary collaboration within the research community. The objectives are to:

- Establish a community of researchers eager to co-develop tools designed specifically for research purposes in welfare and behavior measurement and calculations.
- Share needs and initiatives regarding tools for monitoring animal behavior in research, including different centers and research areas.
- Define specifications and requirements for the development of these tools.
- Propose a working plan to establish and broaden the working group to further develop, test, and validate tools, methods, and protocols.
- Set a time frame focused on the development of specific objectives and outcomes for the Working Group.
- Propose another meeting of the Working Group

Scope of discussion

Identify the metrics and calculations from AgriTech tools that can be standardized and cataloged, using the five domains model (Moller, 2020) in dairy across the life cycle as a guide.

Benefits of standards

- Increase PLF methods adoption
- Increase the welfare of dairy animals
- Increase consumer confidence in the ethics of dairy products
- Increase profitability
- Increase sustainability
- Decrease health events
- Decrease false negatives
- Decrease the economic cost of data systems

Current Challenges

There are no well-recognized standards for behavioral and welfare-based AgriTech tools that are in research and with farm-level AgriTech tools outside of milk flow meters, lab sampling, and RFID tags.

67% of NA AgriTech comes from outside the US, with 40% of NA AgriTech coming from the EU (Lee, 2024).

There are many "blackbox" and propriety welfare and behavior algorithms impeding deeper value and insights. Remove, map, and reduce "blackbox" algorithms (Foy, 2023).

Aligning behavior and welfare metrics to the five freedoms
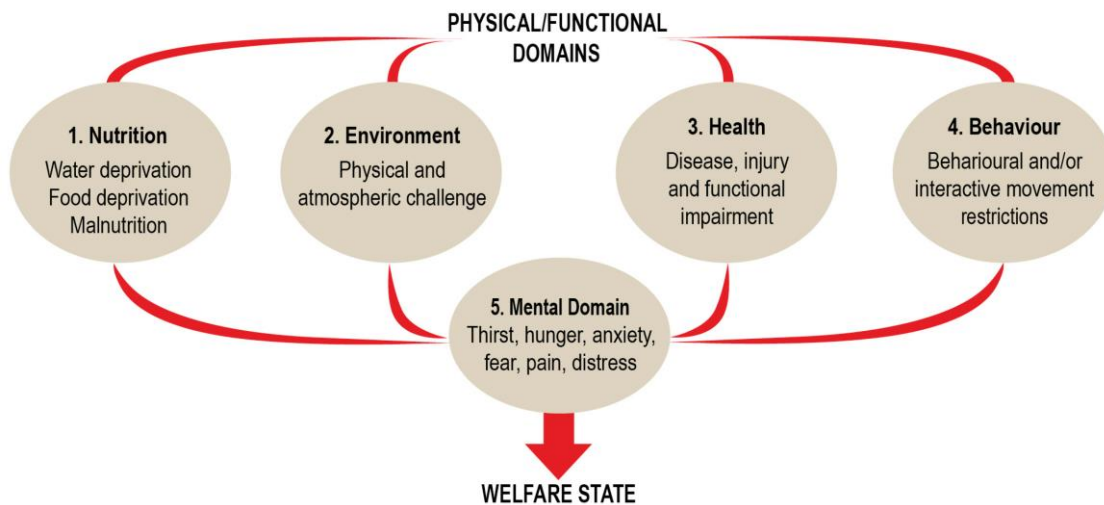

Image 1: Five Domains Model. Moller 2020

Ensuring that behavioral metrics and calculations align with the five-domain model, that help understand and benchmark the welfare state.

Notes from discussion

Behavior is the conduit and measures to welfare, giving us the baseline(s) with the welfare state.

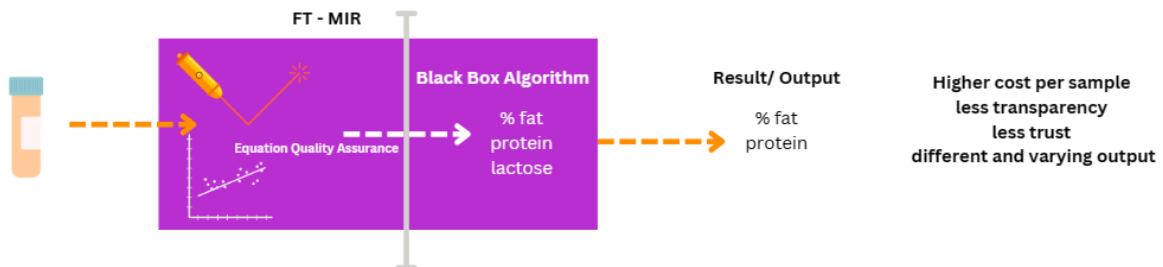**Behavior** ⟶ **Welfare State**

Example:

Steps, head bobbing, transitions up/down = Lameness = Decrease health events, increase welfare standards

Identifying critical behaviors as the starting point for standards.

Focus on one behavior as case study standard.

Following the ExtraMIR (Extra value from- smart use of-MIR spectra) projects successes, as a joint project working group at ICAR, this could be a Blueprint for Welfare and Behavior standards with dairy data systems, as we have similar challenges.

Pre Data Standard model with MIR analysis model

FT - MIR

Equation Quality Assurance

Black Box Algorithm
% fat
protein
lactose

Result/ Output
% fat
protein

Higher cost per sample
less transparency
less trust
different and varying output

Pre-data standard with MIR system meant that there were "black boxes", higher cost per sample, less trust in outputs, with different and varying outputs.

Post Data Standard model with MIR analysis model
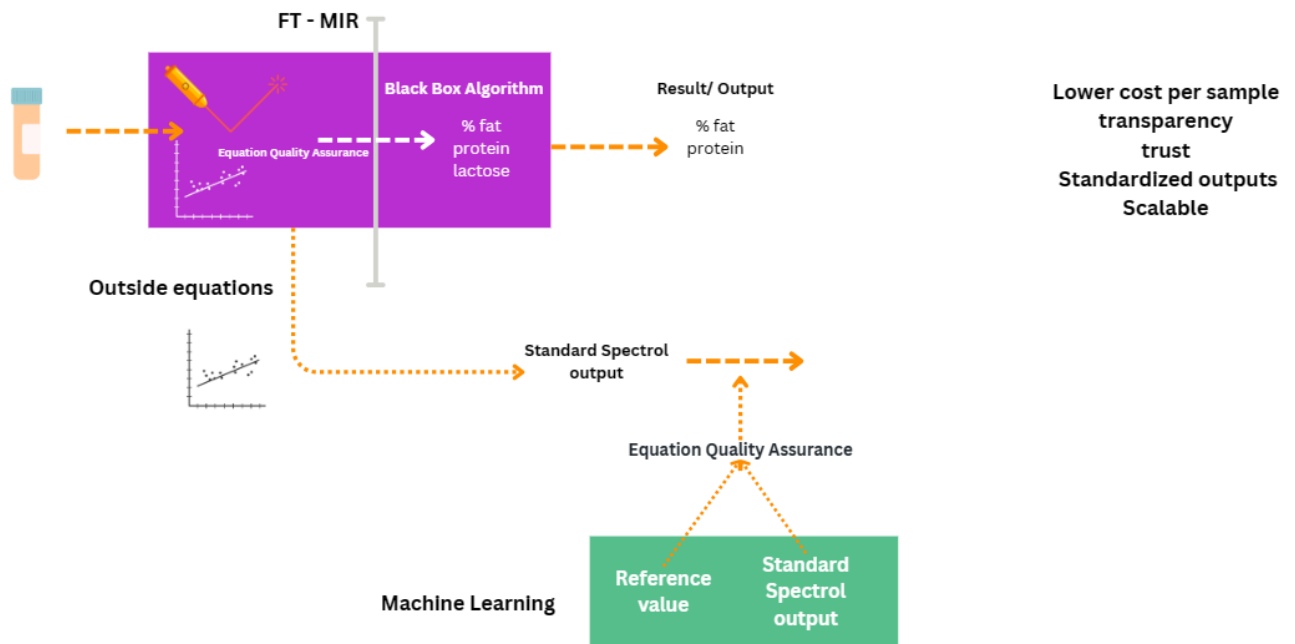
The benefit of the standardization process:

Lower cost per sample or unit, transparency, trust standardization of outputs, scalability.

For precision livestock technology in dairy, taking on a similar method enables the same benefit and greater application of technology and insights into different breeds and species.

- More specific phenotypic identification
- Central labeling of behavioral and welfare critical standards and calculations
- Path to state-based measurement

The steps that ExtraMIR Project has taken, to establish working groups:

1) References value identification
2) Validation of reference values
3) Quality assurance
4) Comparison working group

ExtraMIR Working group strucuture
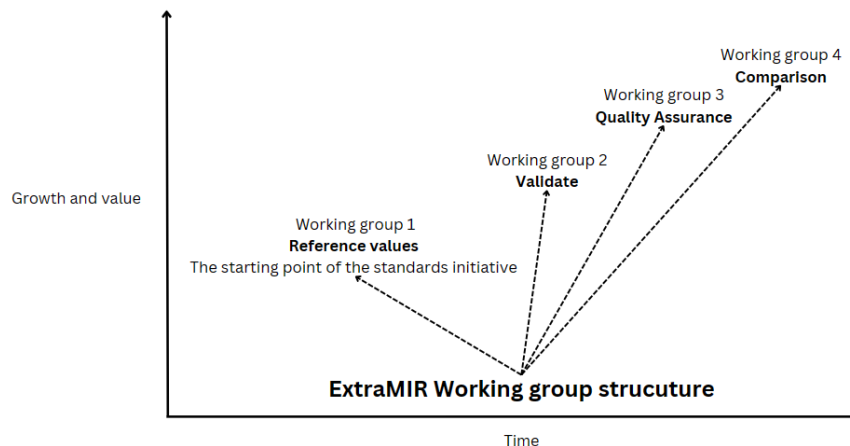
With the ExtraMIR project structure and how they established, the first sub working group was for the reference values, that all other working groups where built from.

Considerations for welfare and behavior data standards working groups

Once reference values, validation, quality assurance, and comparison working groups are established, future groups might be for the management of an anthology of behaviors and gold standards. Later groups will be testing and certification. There are three layers to standardization with sensors that need to be taken into consideration:

- The hardware augmenting the data
    - What type of accelerometer is in use in the device?
- The software handling and processing the data
- The value of the output

It must be remembered the scale of the project for standardization of livestock behavioral and welfare metrics and calculations. It took the ExtraMIR project 20 years to get where it is today with standards. With Livestock welfare and behavioral standards there is a need to trigger and aggregate the academic domain experts to communicate, while achieve data standards sooner than that of ExtraMIR.

The need to bring the industry into the fold, so that it can have wider adoption and application, aid farmers, and is cost-effective. Data systems must become more ubiquitous and much cheaper in cost, which data standards are part of, and where impact in our welfare and sustainability goals can be achieved, especially at the farm level.

As part of the reference value Identification, the critical behaviors must be defined, and definitions given. State based (Lying or standing) could be a great start behavior to analyze

and build a standard for, as then we can add to that state, lying with head up, lying with head down for example, or lying and ruminating or standing and ruminating.

There are several different points in the life cycle to be considered in the standards development.

1) Fetal
2) Newborn calf
3) Weaned calf
4) Heifer (pre-puberty)
5) Breeding age heifer
6) Bred heifer   Different breed and farming system/ style
7) First calving (heifer)
8) Dry cow
9) Transition cow
10) Pregnant cow
11) Lactating cow
12) Multiparous cow

Build up and review of current and future preferred methodologies of validation of technologies used for welfare and behaviors in dairy animals.

To focus the work of the group on the metrics of the individual animal, and their outputs, rather than environmental metrics, including these will make the scope of the working group too large and unmanageable.

For behavioral metrics that align with the five domains model, these should be put on a path for standardization, for wider adoption.

Awareness of how welfare and behavioral metrics and calculations standards fit in with ISO standards should be taken into consideration.

- [ISO/TC 347 - Data-driven agrifood systems](#)
- [ISO/TS 34700:2016 - Animal welfare management — General requirements and guidance for organizations in the food supply chain](#)

Feedback and next steps

- A formal event should be planned that brings everyone together, NA and EU.
  - It was seen that there is value in formally having a working group that is focused on behavior and welfare data standardization.
    - Formalize and establish the working group.
  - The need to make this event international.
  - Set a date and point to convene community for more meetings on this topic.
    - National Institute of Animal Agriculture has offered to be a forum for the welfare and behavioral data standards working group at their 2025 conference in Kansas City MO (Managing Director JJ Jones).
- How do we get vendors on board and engage with them?
- How do we get the right academics for defining behaviors definition (Ethologist and welfare experts).
- How can the farm level play its part?
- Focus on individual animal biometrics.
  - Definition of behavior and critical reference values.
  - The behaviors that align with the five domains models
- Several different points in the life cycle to be considered in the standards development.
- Using behavior metrics and validation standards is the conduit to welfare improvement and baselines.
- Use the ExtraMIR project establishment as a road map, where they started with the reference value working group, this is the same as how the behavioral and welfare standards initiative can start.
  - Working group 1 - References values.
  - Working group 2 - Validation of values.
  - Working group 3 - Quality assurance.
  - Working group 4 - Comparison working groups.
- Set a time frame focused on the development of specific objectives and outcomes for the Working Group.
  - Starting with Reference values.

Reference Items:

Moller 2020 - [Animals | Free Full-Text | The 2020 Five Domains Model: Including Human–Animal Interactions in Assessments of Animal Welfare (mdpi.com)](#)

Lee 2024 - [(PDF) Mapping Hardware and Software Precision Livestock Farming Technologies: The Role of the Texas Dairy Industry in the Worldwide Map of AgriTech (researchgate.net)](#)

Foy 2023 [(PDF) Open-sourcing behavioral algorithms for ruminant welfare monitoring using raw wearable sensor data (researchgate.net)](#)