# Development, implementation, and future perspectives of health evaluations in the U.S.

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# DEVELOPMENT

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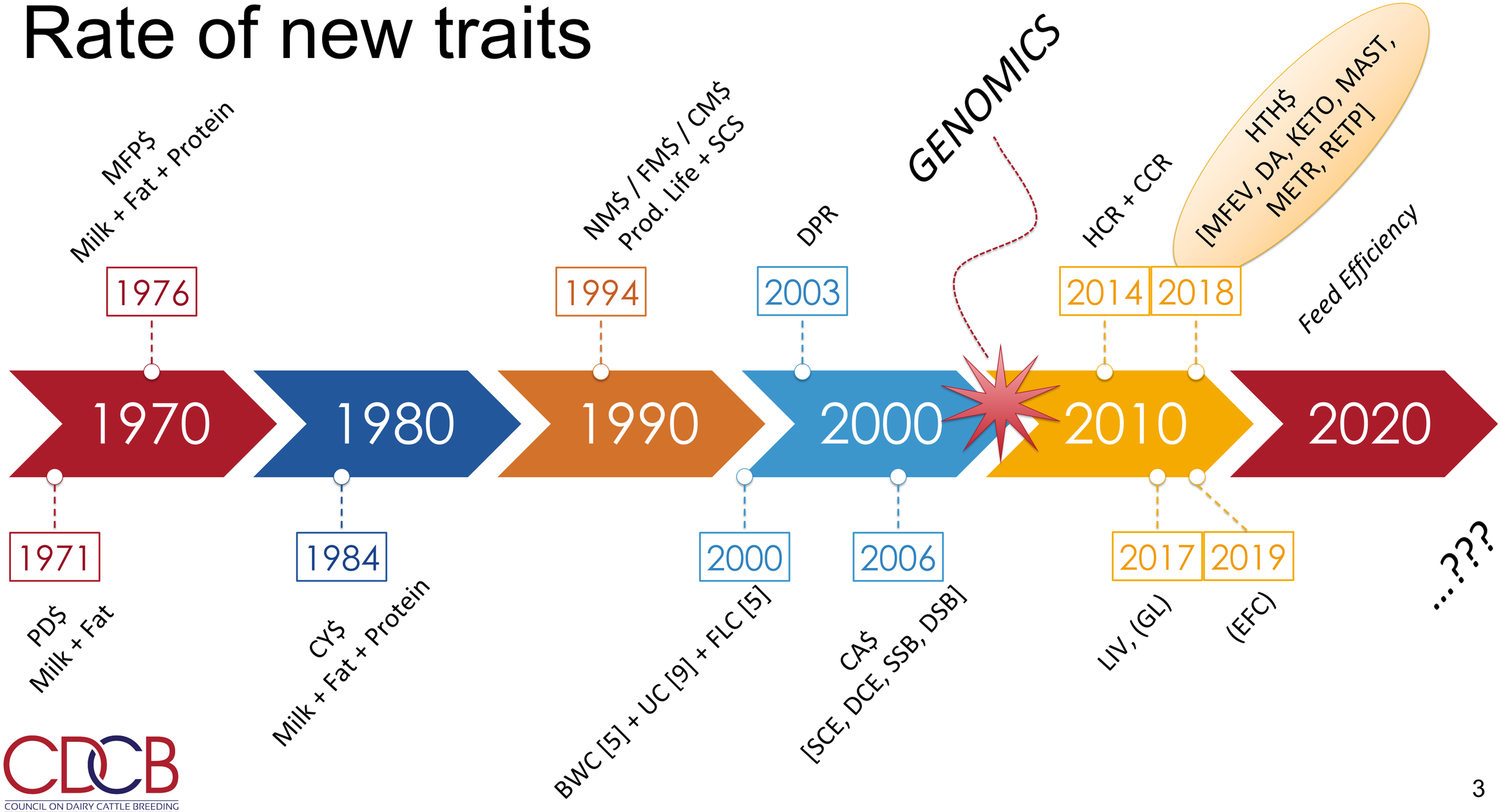
# Rate of new traits

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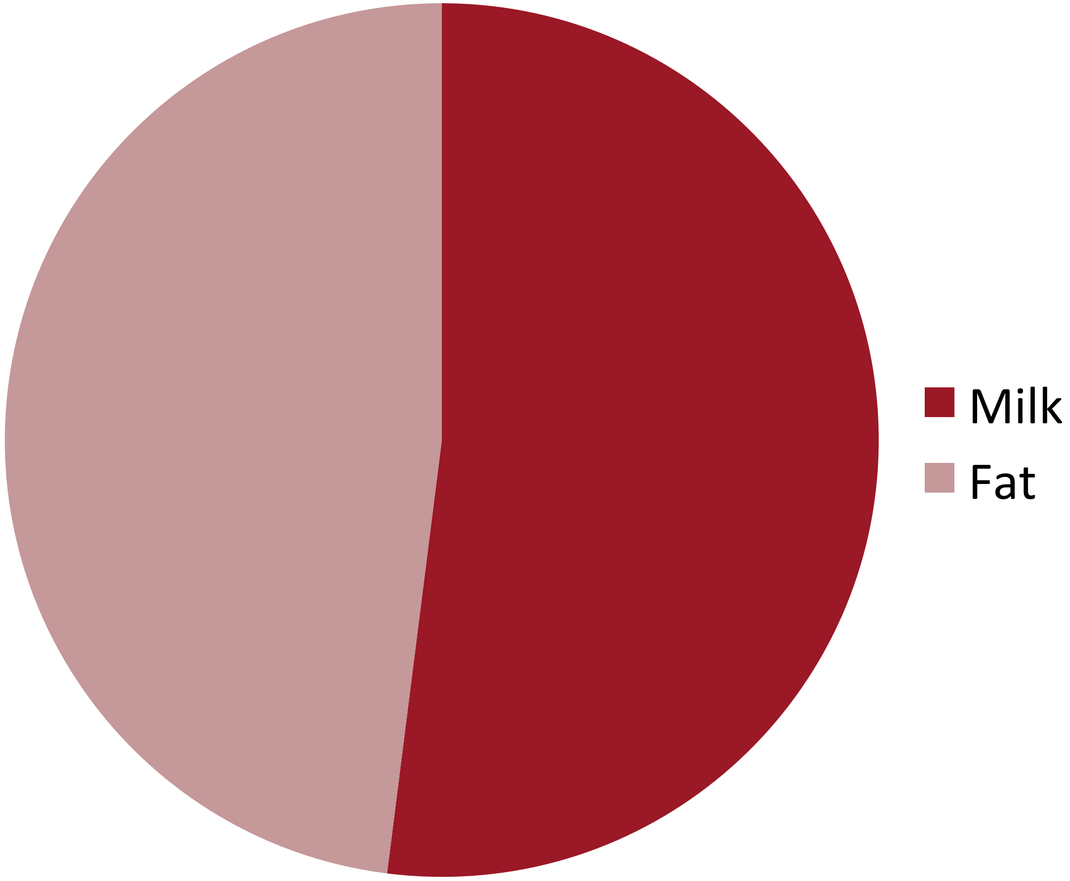
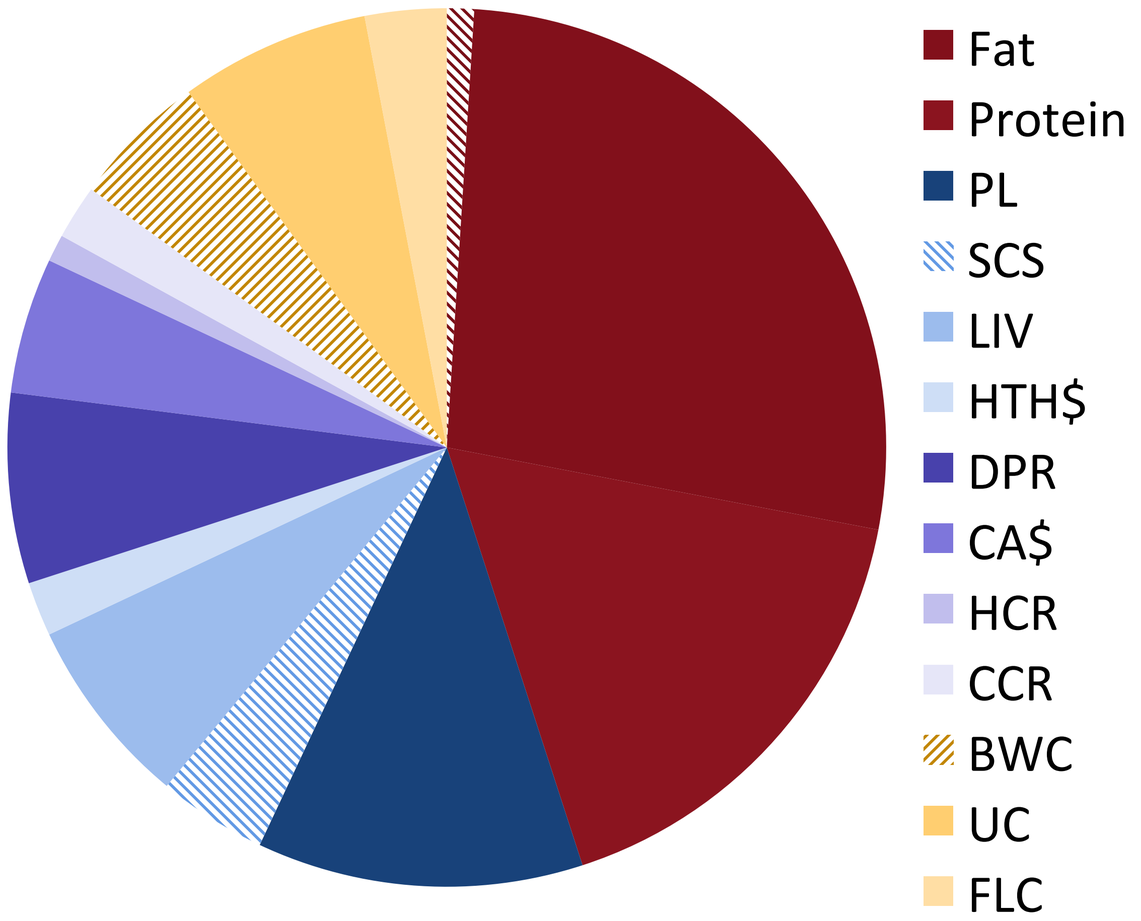
# Changes in emphasis over time

**1971 PD$**




**2018 NM$**

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# Since the 1980s


- Evidence that selection for health events could be successful
  - E.g., Scandinavian countries – direct recording of health events
- Within U.S. – calls for a unified system of reporting health events
  - Possibility for improvement through selection
  - Since 1994 – Indirect selection through traits SCS and PL, and later LIV

- **Introduction of genomics in 2009** – feasible to select for lowly heritable traits that are expensive and/or difficult to measure

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# U.S. hurdles

- No mandated reporting system
- Need a single repository to collect and store data
- No unified way to record health events
  - Standardization critical

(https://www.thesun.co.uk/news/3420620/showjumping-cow-jumps-hurdles-pictures/)

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# Data flow

- Cooperation from the Dairy Records

  Processing Centers

  - Flow through DHI system
- Necessary standardization performed by DRPCs





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# Format 6

Includes 20 health event codes + 4 management codes

| | | | | | |
|---|---|---|---|---|---|
| | | | | | **Health Event Segments (up to 20 segments)** |
| **Health Event Segment Block (# 1)** | | | | | |
| 138-141 | 4 | AAAA | CH | 170 | Health event code |
| 142-149 | 8 | XX..XX | CH | | Health event date (YYYYMMDD) |
| 150 | 1 | A | CH | | Health event date type (A = actual; E = estimated) |
| 151-156 | 6 | AA..AA | CH | | Health event detail |
| | | | | | |
| 157-175 | 19 | AA..AA | CH | | Health event segment block # 2 |
| 176-194 | 19 | AA..AA | CH | | Health event segment block # 3 |
| 195-213 | 19 | AA..AA | CH | | Health event segment block # 4 |

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# IMPLEMENTATION

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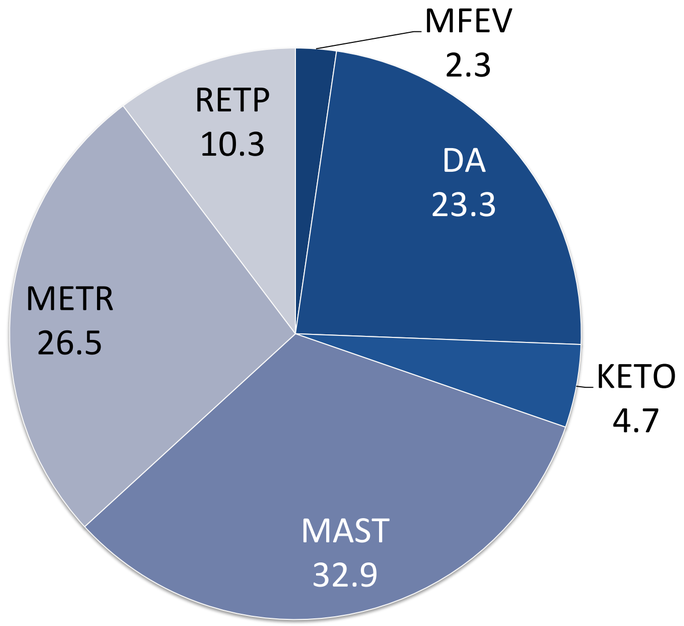
# Health trait implementation

- April 2018: Official genomic evaluations for 6 direct health traits from CDCB for Holstein
  - Milk fever (MFEV)
  - Displaced abomasum (DA)
  - Ketosis (KETO)
  - Mastitis (MAST)
  - Metritis (METR)
  - Retained placenta (RETP)
- August 2018: Inclusion of health trait sub-index (HTH$) in net merit indices (NM$, FM$, CM$, GM$)
  - 2.3% total emphasis within NM$

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# Data processing

- Two levels of editing at CDCB
  - General edits – date checks, parent checks, herd checks, etc.
  - Constraints to be included for genetic evaluation – parities 1 to 5, Holstein (currently), minimum/maximum incidence restrictions, etc.

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# Phenotypes used for evaluation

| | Number of Records | Number of Cows |
|---|---|---|
| Milk fever | 1.2 M | 0.7 M |
| Displaced abomasum | 1.9 M | 1.1 M |
| Ketosis | 1.4 M | 0.8 M |
| Mastitis | 2.4 M | 1.4 M |
| Metritis | 2.0 M | 1.1 M |
| Retained placenta | 2.2 M | 1.3 M |

*As of April 2019 evaluation

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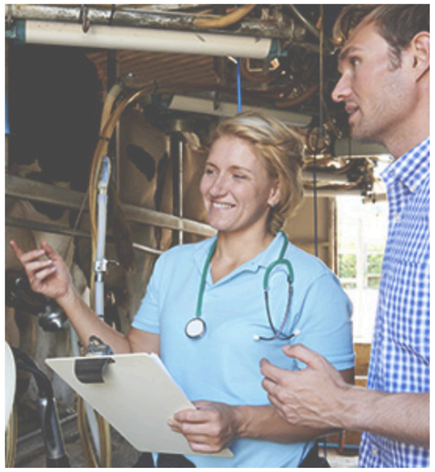
# Evaluation models

- Single-trait linear animal repeatability models
- Additional details available

https://www.uscdcb.com/

| | Heritability (observed) |
|---|---|
| Milk fever | 0.6% |
| Displaced abomasum | 1.1% |
| Ketosis | 1.2% |
| Mastitis | 3.1% |
| Metritis | 1.4% |
| Retained placenta | 1.0% |



**CDCB Health Traits**

As of August 2018, Net Merit $ includes the six health traits launched in April.

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# Cost considerations

- Direct costs of each event used in development of HTH$
  - Considers veterinary and treatment costs
  - Excludes costs that are accounted for by other traits in NM$ (e.g., declines in fertility, decreased production)
- Yield traits designated as “sick” test days are adjusted
  - These test days are accounted for with an additional adjustment (in parentheses above)

| Event | Direct cost |
|---|---|
| MFEV | $34 (38 – 4) |
| DA | $197 (178 + 19) |
| KETO | $28 (28 + 0) |
| MAST | $75 (72 + 3) |
| METR | $112 (105 + 7) |
| RETP | $68 (64 + 4) |

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# Variance adjustments

- Linear model used with binary trait
- Phenotypic pre-adjustments applied to all health events
  - Phenotypes are adjusted based on calving year, parity, and heritability of the trait prior to genetic evaluation
- Similar to methodology described by Wiggans and VanRaden, 1992 and the adjustment applied to livability
- Implemented April 2019

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# Variance adjustments

- Most health traits had PTA correlations ranging from 0.92 to 0.98 for bulls with > 70% reliability born since 2000
  - Exception – milk fever
- For all traits – first lactation trends agreed with the new trends more closely than with the old trends.

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# Interbull validation

- MAST now sent along with SCS PTA to Interbull for Udder Health trait group
- Validation of genetic trends
- Only see on average a 1 point increase in reliability
- Minimal foreign bulls from countries supplying MAST directly that also have genotypes available in the US

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# FUTURE PERSPECTIVES

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# Future developments

(jerseyjournal.usjersey.com)

- Health evaluations for Jersey
  - Genomic evaluations for the 6 health traits
  - Reliability approximately 10-15 points lower than Holstein on average
  - See L. Jensen's talk – ADSA Tuesday 10:30 AM Room 207/208

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# Future developments

- Multiple trait evaluations
  - Approximate genetic correlations
  - Mastitis & SCS
  - Groups of traits – metabolic, reproductive?

| | Protein | PL | LIV | SCS | DPR | CCR | HCR |
|---|---|---|---|---|---|---|---|
| MFEV | -0.21* | -0.10 | 0.08 | -0.02 | -0.07 | -0.08 | -0.01 |
| DA | 0.15 | 0.40* | 0.41* | -0.14 | 0.30* | 0.30* | 0.12 |
| KETO | 0.20* | 0.39* | 0.31* | -0.25* | 0.41* | 0.39* | 0.19* |
| MAST | 0.06 | 0.52* | 0.39* | -0.68* | 0.32* | 0.31* | 0.10* |
| METR | 0.27* | 0.47* | 0.33* | -0.21* | 0.44* | 0.45* | 0.29* |
| RETP | 0.02 | 0.21* | 0.16* | -0.13 | 0.19* | 0.19* | 0.19* |

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# Potential health traits

- Continued investigation on economically important health traits
  - Lameness or locomotion
    - Events represent a variety of reasons for lameness – injury, conformation, metabolic, infection
    - How to differentiate between these?
  - Johne's

(https://vetextension.wsu.edu/research-projects/lameness/)

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# Potential health traits

(https://hoards.com)

- Calf health & calf termination
  - Dairy calf death losses estimated at **$327.3 million** in 2015 (Lombard et al., 2019)
  - Possible to include calf/heifer health records with Format 6
  - Lombard et al., 2019 – proposed death loss categorization scheme
    - Pursuing Data Quality group of CDCB working with this scheme and termination reasons already collected by CDCB
    - Goal: expand termination codes to include calves/heifers

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# Maintenance of data pipelines

- Expand current pipelines to capture additional informationMonitor data being submitted, accepted, and rejected
- Two-way communication with data providers
- Updates to standardization “dictionaries” as needed


Home / What We Can Do For You / Service Documentation / Error Documentation

**Number of Health Event Segments Errors**

| Code | Description | Action | Returned Data | Updated |
|---|---|---|---|---|
| 9Ab | Number of health event segments does not agree with length of record. Length of record corrected | Change | | 08/22/2007 |
| 9Ac | Cow already has 50 health events. New event is ignored. | Reject | Event date | 01/17/2008 |

Error Codes

Complete Error Lists
CSV/Excel
Tab Separated

0 General Record
1 Animal Identification
2 Sire Identification
3 Dam Identification

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# New functional traits

- **Feed efficiency**
  - Project funded by Foundation for Food and Agriculture Research (FFAR) and CDCB
  - Institutions include Michigan State University, University of Wisconsin, Iowa State University, University of Florida, and USDA Animal Genomics and Improvement Laboratory
  - Continuing the work of USDA NIFA grant
  - Projected that breeding for more efficient dairy cows could save the U.S. dairy industry $540 million per year
  - Inclusion of feed efficiency in Net Merit $

# Creation of data pipelines

- New data types
  - E.g., feed intake data, sensor data
    - Different systems at various institutions
    - Protocol needs to be developed to streamline data processing
    - Need for standardization

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# Evaluation sources

- Increasing number of similar evaluations from different sources
  - Published methodologies
    - Health $ (CDCB)
    - Clarifide Plus (Zoetis)
  - Proprietary evaluations / indices
    - TransitionRight index (ABS)
    - Better Life Health index (CRV)
    - Ideal Commercial Cow index (Genex)

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# Differing results

- Traits with limited data + low heritabilities
  - Different populations
  - Different editing
  - Different statistical model
  - Different presentation
  - Different economic assumptions

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# Handling multiple sources

- Producers have to consider the source of information
- Critical to not focus selection on only a few traits
- What does the future hold?

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# Continued progress

- More data available than ever before
  - Make better selection decisions
    - Phenotypes are critical
    - Quality control standards
    - Unbiased science and research
    - Establishment and maintenance of data pipelines
- **Communication and Cooperation**

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# Acknowledgements


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AGIL

DRPCs, DRMS

Dairy producers


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