Selection for Disease Resistance in Canadian Dairy Cattle

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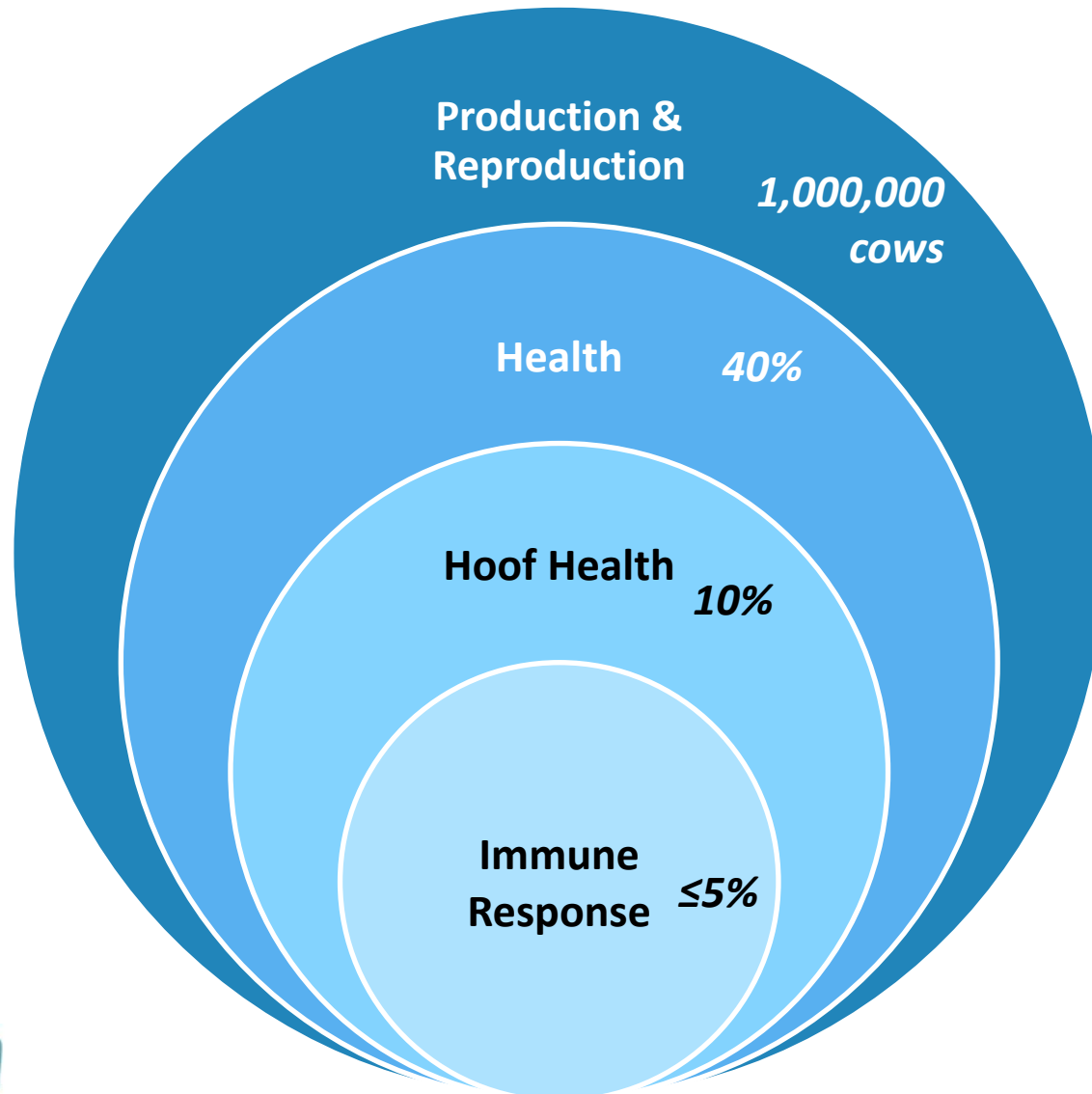PhD & Post-Doc, Canada

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Research on Health Traits from our team

- Target health traits that impact profitability for farmers and dairy industry

- Identify predictors to increase GEBV reliability of targeted traits

- Develop a pipeline to move new phenotypes from herds to DHI, from DHI to CDN, from CDN to R&D

- *Main objectives*

  – *Development of new pipelines and databases*

  – *Development of genetic and genomic evaluations*

  – *Development of sub-indexes for targeted selection*

  – *GWAS to identify SNP of interest to add to revised SNP panels*

Size of recorded population

Production & Reproduction — 1,000,000 cows

Health — 40%

Hoof Health — 10%

Immune Response — ≤5%

Systematic disease recording

- Canada: health recording system since April 2007
  - Recording done by producers or veterinarians on a voluntary basis
- Producers provided with disease definitions for identification and recording of the diseases
- Data collected by milk recording technicians at each test day herd visit and forwarded to the DHI
- Eight diseases are recorded:
  - mastitis, displaced abomasum, ketosis, milk fever, retained placenta, metritis, cystic ovaries and lameness

Targeted disease recording

- Hoof infections and horn lesions
  - Recording done by hoof trimmers on a voluntary basis
- Immune-response
  - Recording done by vets or trained field staff

Mastitis Resistance

- Multiple-trait evaluation including mastitis and well correlated predictors with higher heritability
  - Patterns of SCS, BCS, Udder Depth and Fore Udder
  - Increase of **+30 points in reliability** of EBV **due to predictors**
- Since Aug 2014, Index for Mastitis Resistance
  - **MR** = $\frac{1}{3}$ CM-First + $\frac{1}{3}$ CM-Later + $\frac{1}{3}$ SCS
- **Genomics**
  - Holsteins: over 2,600 reference bulls
  - **Increase in reliability of +16 points** for young bulls, and +8 for proven bulls

Why an index?

- Why not using just mastitis EBV?
- Mastitis EBV are indicators of clinical mastitis
- SCS EBV are indicators of subclinical mastitis
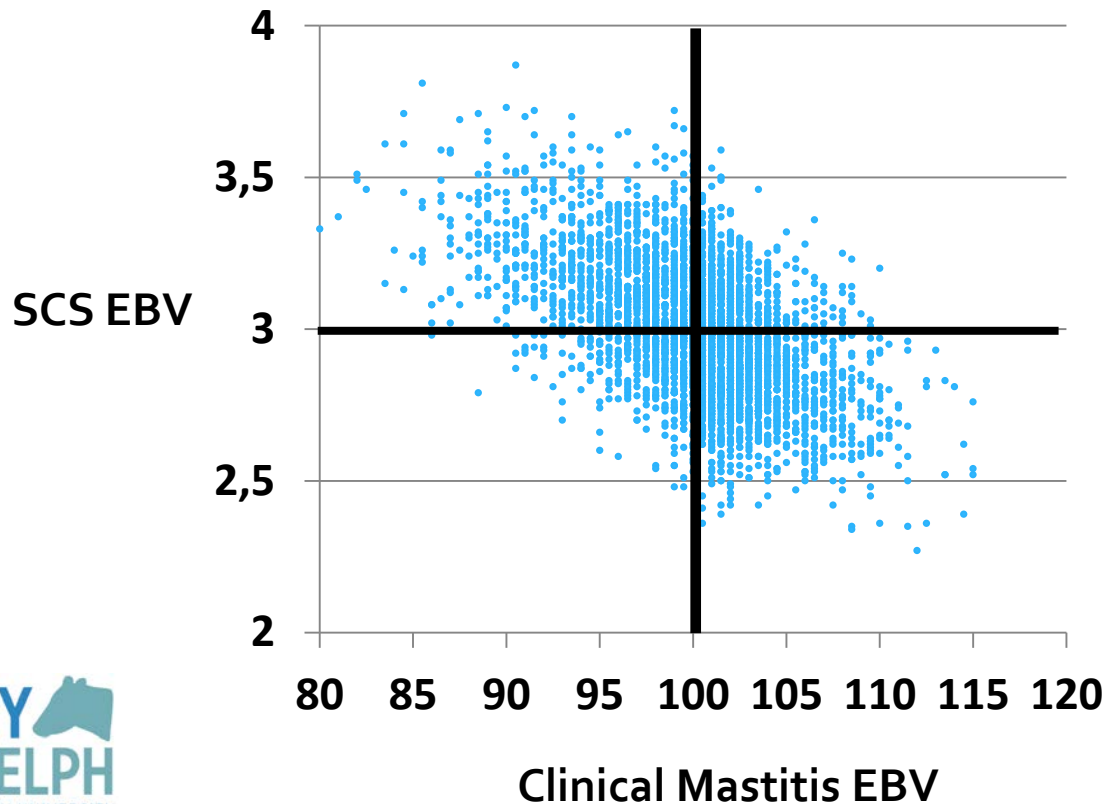
Metabolic diseases

- Negative energy balance occurs in early lactation
  - To have more energy, cows break downs fat stores to produce non-esterified fatty acids (NEFA) and ketone bodies (BHBA)
- Some cows with poor adaptive response produce excessive NEFA and BHBA
  - Detrimental effects on immune function, milk production and overall health
- Subclinical ketosis more common than clinical ketosis
- Cost of ketosis estimated at around $300 per case
  - Subclinical less costly per single case but more costly at herd level due to 10-fold higher frequency

Metabolic Disease Resistance

- Direct traits (Ketosis, BHB and Displaced Abomasum)

- Predictor traits (type BCS and 1st test-day F:P ratio)

- Six EBV to be considered in the MDR index
  - Subclinical ketosis (BHB data) for first and later parities
  - Clinical ketosis and Displaced abomasum (producer recorded) for first and later parities

- **MDR** index = 50% BHB, 25% ketosis, 25% DA
  - EBV are the average of the first and later lactation EBV of each trait

MDR official in December 2016

Fertility Disorders Resistance

- Direct traits (Metritis and Retained Placenta)
- Predictor traits
  - None identified so far
  - Fatty Acids currently investigated
- Four EBV to be considered in the FDR index
  - Metritis (producer recorded) for first and later parities
  - Retained Placenta (producer recorded) for first and later parities
- **FDR** index = 50% Metritis, 50% Retained Placenta
  - EBV are the average of the first and later lactation EBV of each trait

FDR to be launched in December 2017

Hoof Lesions

- Prevalence of 40 to 70% of cows with at least one hoof lesion – North America and Europe

- Hoof lesions compromise the welfare of animals

- Economic loss, costs associated:
  - with treatment of lesions
  - with decreased cow performance (production and fertility)

- **Low correlations** between hoof lesions and feet and leg conformation traits

- Solution:
  - Use data collected by hoof trimmers

New Data Pipeline

- From hoof trimmer tablets to DHI, and to CDN
- Pipeline just tested with Quebec hoof trimmers
- To be tested in Ontario in next few months
- We estimate to get 10-20% of milk recorded cows

Traits	%	h^2
Digital Dermatitis	14.0	0.05
Interdigital Dermatitis	1.3	0.01
Interdigital Hyperplasia	1.4	0.03
Sole Hemorrhage	3.4	0.01
Sole Ulcer	4.9	0.03
Toe Ulcer	1.1	0.01
White Line	3.8	0.01

183 Sires
≥ 50 daughters

% healthy daughters vs Sire EBV
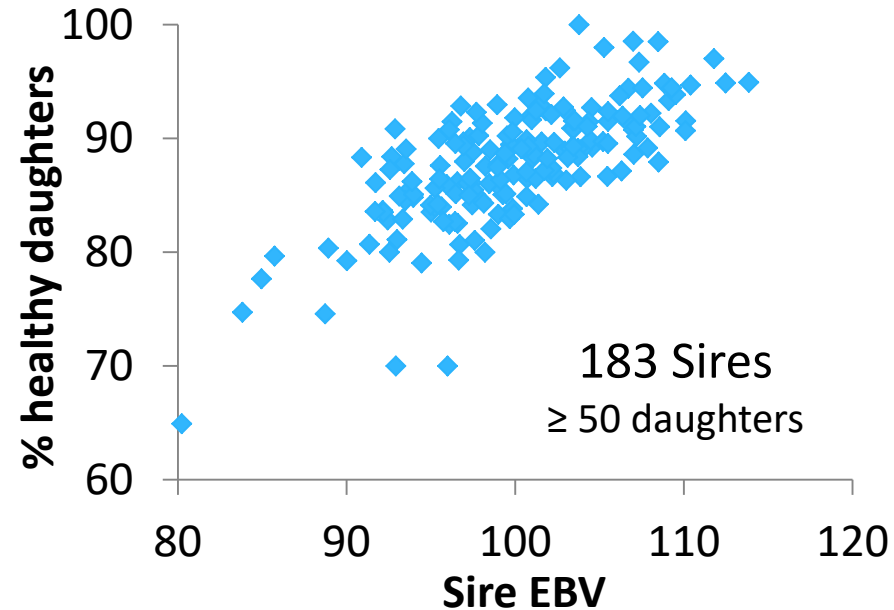
Hoof Health Index

- Most frequent hoof lesions

- Lameness recorded by producers

- Locomotion and Feet & Legs traits recorded by breed classifiers

- Work in progress for developing genetic evaluation and sub-index

- Exploring Single Step approach for genomic evaluation

- Targeted for 2018

Overall Health Index

- Combination of 4 health sub-indexes based on economic importance

  - Mastitis Resistance

  - Metabolic Disease Resistance

  - Fertility Disorder Resistance

  - Hoof Health

- To be launched in early 2019

High Immune Response

- Dr. Bonnie Mallard team at University of Guelph

- Using a patented test, cows with naturally superior immune response traits can be identified

- High immune responders have a lower occurrence of diseases, improved colostrum quality, and superior response to vaccination

- Immune response traits are heritable (0.25-0.35)

- Research in progress to test and genotype 3,000 cows

- Test picked up by Semex to test their bulls

From Research to Service
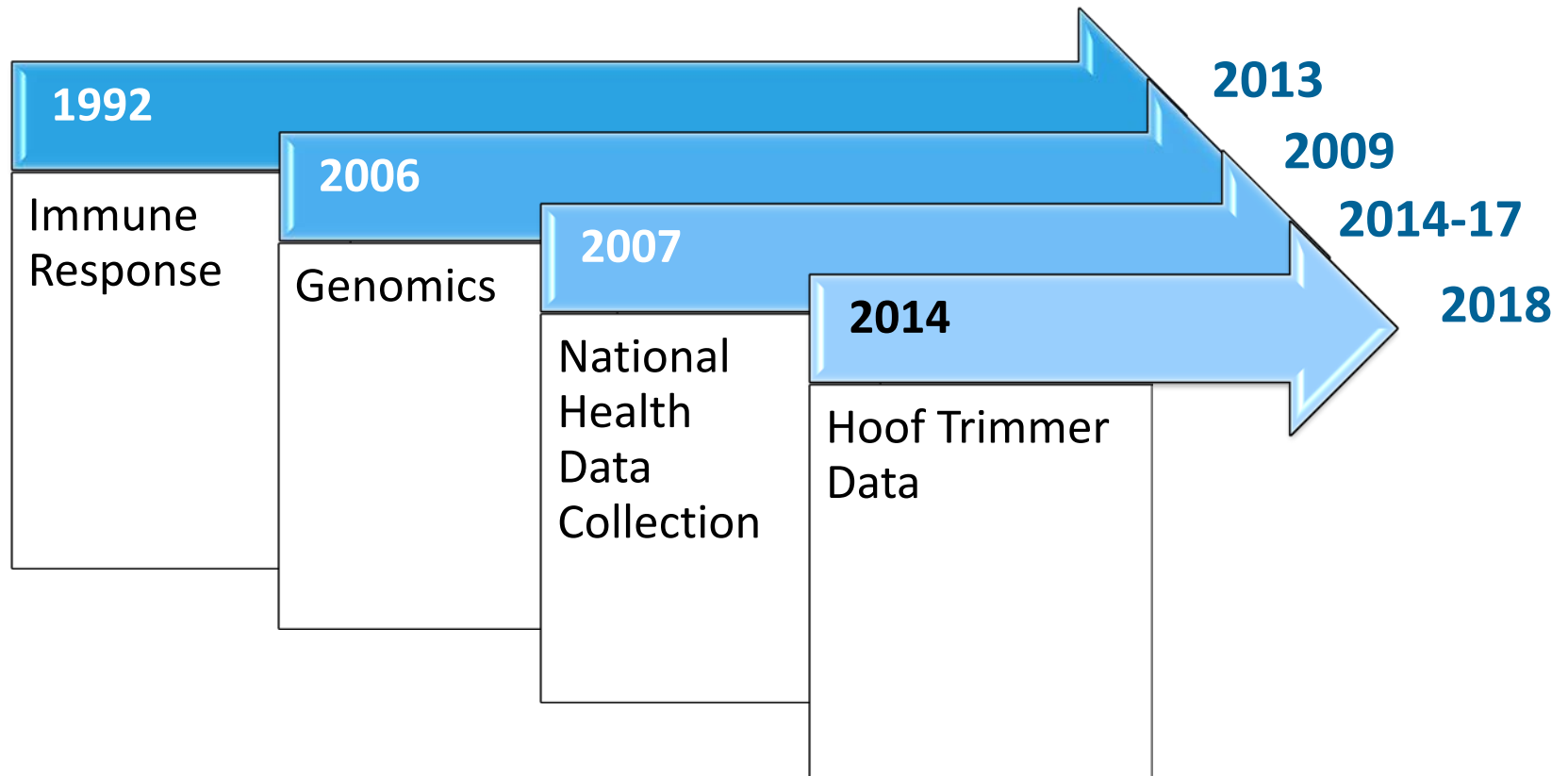
Final Remarks

- Extensive research effort on genetics of disease resistance in Canadian dairy cattle in the last 10 years
  - Industry has been very proactive and committed
- Building new data pipelines from farms to CDN is essential for developing new services for producers
- Integrated partnership among industry, academia, producers and government is also key for success

Producers' data + Predictors + Genomics GEBV with moderate reliability

Acknowledgements

- Participating dairy producers and hoof trimmers
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- Alberta Milk