Implementation of genomic evaluation for digital dermatitis in Canada

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Hoof Lesions

- In Canada, around 25-30% of cows have at least one hoof lesion

- Hoof lesions compromise animal welfare
- Economic loss, costs associated with:
  - Treatment of lesions
  - Decreased cow performance

How to Reduce Incidence of Lesions

- Improving management practices at herd level
- Through genetic selection

Improving Hoof Health in Canadian Dairy Herds

- Project funded by the **Dairy Research Cluster 2**
  - Dairy Farmers of Canada, Agriculture and Agri-Food Canada, CDN, Canadian Dairy Commission
- Principal investigator: Dr. Filippo Miglior (Canadian Dairy Network & University of Guelph)
- 2014-2017

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Objectives

Improve hoof health in Canada

1. Centralize data collected by hoof trimmers into a coherent and sustainable national data base
   - Standardize the hoof lesion data
   - Develop a data pipeline: **Hoof trimmers - CDHI - CDN**
2. Develop a DHI management report for producers
3. Develop genomic evaluations for hoof health

Objectives

- **Standardize the hoof lesion data collection**
- Develop a data pipeline

  Hoof trimmers - Canadian DHI - Canadian Dairy Network
- Develop a DHI management report for producers
- Develop genomic evaluations for hoof health

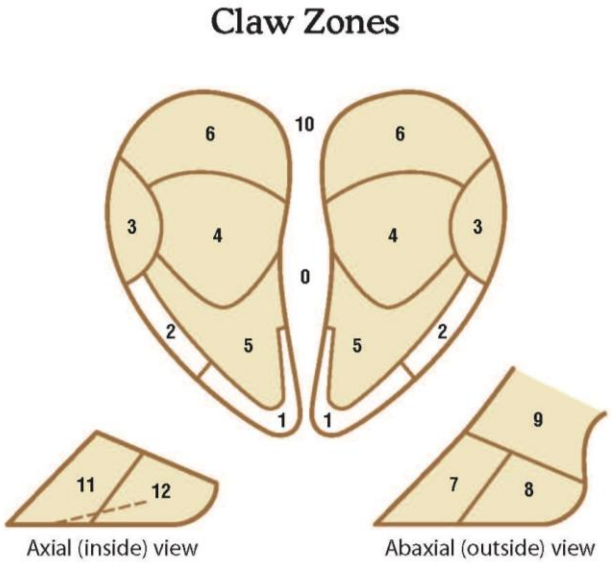
Standardize the hoof lesion data collection

Hoof Supervisor System

- Codes of lesion
- Severity
- Claws
- Zones

Standardize the hoof lesion data collection

Hoof Supervisor System - Codification



Code	Lesion Name	Page	Zones
U	Sole Ulcer	4	4
T	Toe Ulcer	8	1
W	White Line Lesion	12	1,2,3
H	Sole Hemorrhage	16	4,5,6
F	Foot Rot	19	9
D	Digital Dermatitis	22	9,10
E	Heel Erosion	25	6
I	Interdigital Dermatitis	26	0,10
C	Corkscrew Claw	27	7
V	Vertical Fissure	28	7,8
X	Axial Fissure	29	11,12
G	Horizontal Fissure	32	7,8
Z	Thin Sole	35	4,5
K	Interdigital Hyperplasia	37	0
L	Periople Ulcer	39	11

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Participation of Hoof Trimmers

- 54 trimmers across Canada now routinely provide hoof health data to Canadian DHI

- Additional trimmers invited to participate to the data collection

Objectives

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- Develop a data pipeline

  Hoof trimmers - Canadian DHI - Canadian Dairy Network

- Develop a DHI management report for producers
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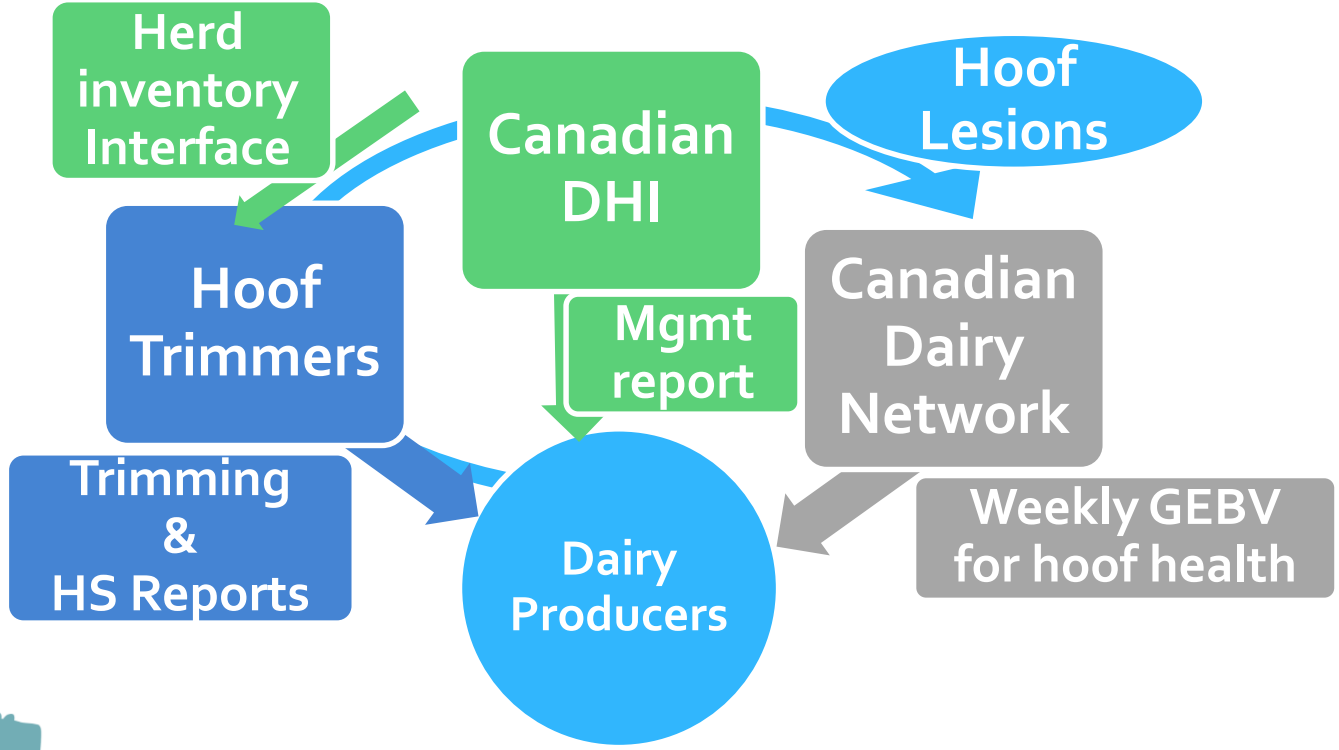
Data Pipeline



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  Hoof trimmers - Canadian DHI - Canadian Dairy Network

- **Develop a DHI management report for producers**
- Develop genomic evaluations for hoof health

DHI Management Report

- Working group with hoof trimmers, dairy advisors, veterinarians and researchers
  - To develop a new DHI management report on hoof health
- This report may include
  - Prevalence of lesions on farm
  - Trends over time
  - Benchmarks with province and national averages
- Added value for trimmers and dairy producers

Objectives

- Standardize the hoof lesion data
- Develop a data pipeline

  Hoof trimmers - Canadian DHI - Canadian Dairy Network

- Develop a DHI management report for producers
- **Develop genomic evaluations for hoof health**

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Data

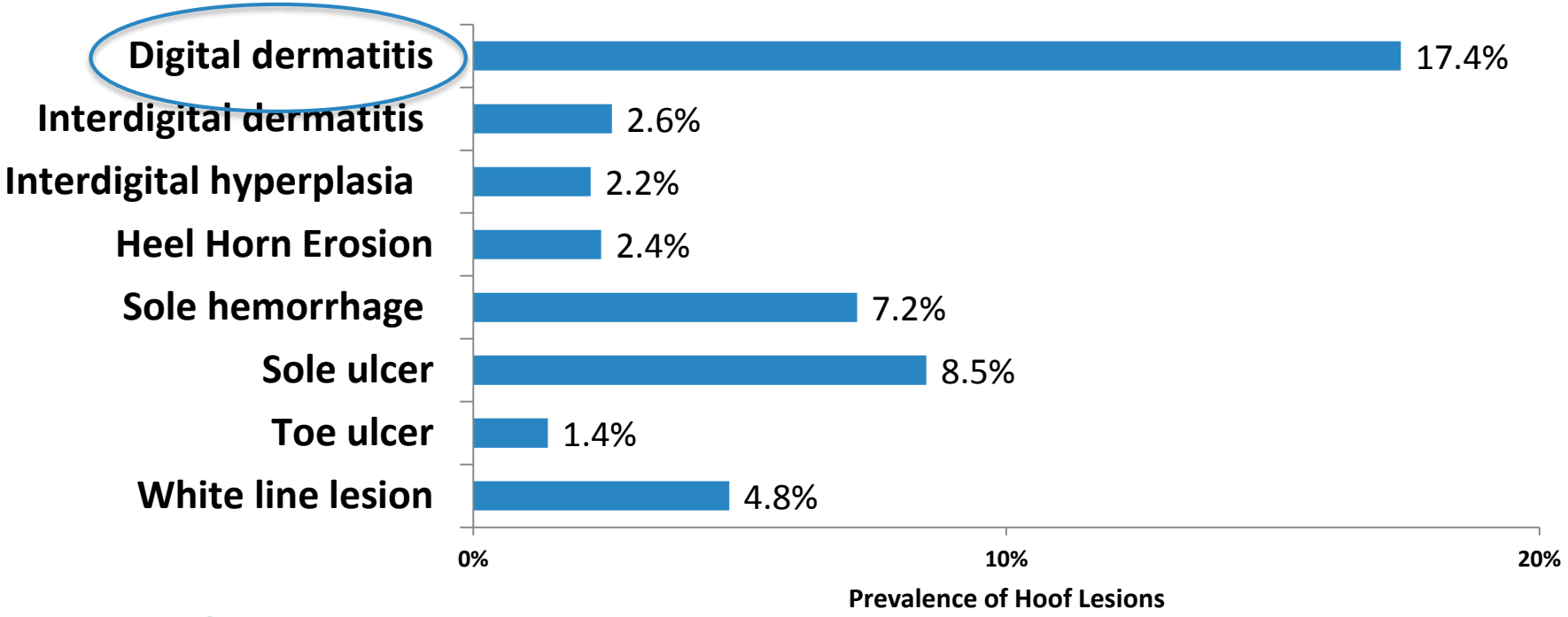
- Historical data from provincial projects up to 2012
- New pipeline data
  - From summer 2015 for Quebec
  - From early 2016 Ontario
  - From mid 2016 for newly recruited trimmers
- Historical data from hoof trimmers

Research Outcomes

- Heritability and Repeatability of hoof lesions
- Effect of pre-selection of cows for trimming
- Correlations with conformation traits
- Severity *vs.* Binary
- Threshold *vs.* Linear Model
- Single-step GBLUP

Genetic Evaluation at CDN

Prevalence of Hoof Lesions



Digital Dermatitis Holsteins

- 307,172 records
- 127,729 cows
- 8,293 sires
- **332,561- animals in pedigree (4 generations)**

Aim is 10-20% of milk recorded cows

Single-step GBLUP

- **Single-trait** (no indicators)
- **Animal linear model with repeated observations (0/1)**
- **Single-step GBLUP using Mix99**
- **Environmental factors:**
  - Herd-Trimming Session
  - Trimmer
  - Days after calving
  - Parity
  - Cow effect (PE)

Single-step Model

- Genetic parameters:
  - Heritability: **0.08**
  - Repeatability: **0.20**
- Reference population (animals):
  - All genotyped sires and cows that are in the pedigree
- Single-step: **19,459** animals
  - 5,268 sires
  - 7,178 cows
  - 7,013 cows with data

Genetic Evaluation

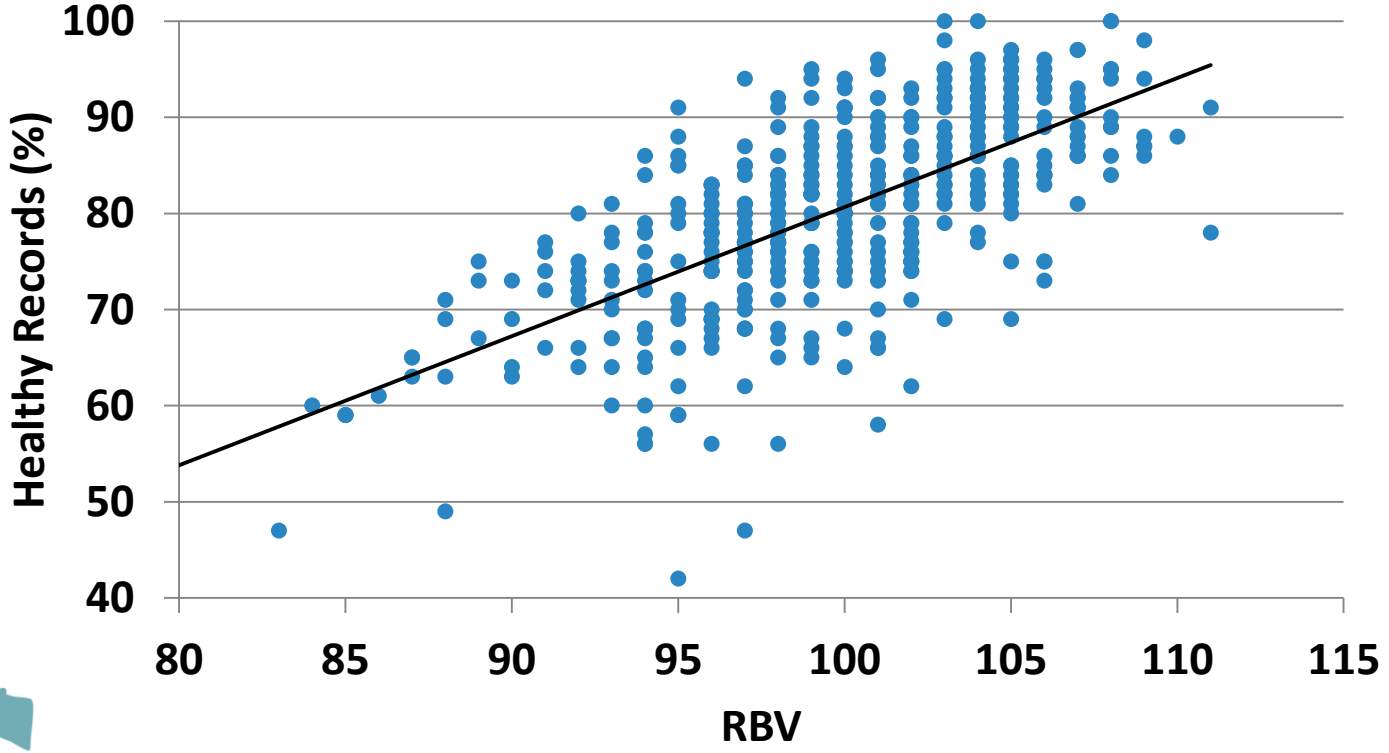
For bulls only:

- Genomic Estimated Breeding Values and Reliabilities
- Like all CDN functional traits, evaluations expressed as Relative Breeding Values (**RBV**):
  - mean = 100 SD = 5 for base sires
  - reversed in sign: higher **RBV** indicate better resistance to **Digital Dermatitis**

Publication Criteria

- Digital Dermatitis proof of a sire official when:
  - Minimum 5 herds
  - Minimum reliability of 70%

RBV distribution by % Healthy Records



RBV distribution

Bulls	Proof				% Healthy Records			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Bottom 10	82	2.0	77	84	61	14.1	33	86
Top 10	114	1.7	112	117	93	7.3	80	100

Summary

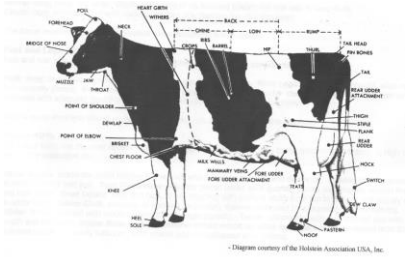
- Hoof trimmers willing to share data and to develop a standard recording protocol identified across Canada
- Routine flow of hoof lesion data from hoof trimmers to Canadian DHI and to Canadian Dairy Network
- Genomic evaluations for Digital Dermatitis from December 2017
- Soon DHI herd management report for Hoof Health

Acknowledgements

Supported by a contribution from the Dairy Research Cluster Initiative (Dairy Farmers of Canada, Agriculture and Agri-Food Canada, the Canadian Dairy Network and the Canadian Dairy Commission) and by Ontario Genomics

Links with Conformation Traits

Traits	Rear side rear view	Feet & Legs	Locomotion
Digital Dermatitis	-0.28	-0.24	-0.45



- Diagram courtesy of the Holstein Association USA, Inc.