Preliminary analysis of herd management data for development of genetic evaluations for enhanced disease resistance in dairy cattle

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A national system for collecting health events in Canada started in 2007.
Eight key diseases (*mastitis, ketosis, displaced abomasum, milk fever, metritis, cystic ovaries, retained placenta, and lameness*).
Health genetic evaluations in Canada

2014
Mastitis Resistance
- Clinical Mastitis, SCS
  
  SCS patterns, BCS, Udder Depth

2014
Metabolic Disease Resistance
- Displaced Abomasum, Clinical
  
  Milk BHB (Sub-clinical Ketosis)
  
  BCS, fat to protein ratio

2018
Hoof Health
- 8 most prevalent hoof lesions

2018
Fertility Disorders
- Metritis, Retained Placenta, Cystic Ovaries

2020
Future
Novel Health Traits???
Novel health traits

Leukosis

Johne’s

Calf health

Overview  Leukosis  Johne’s  Calf health  Conclusions
Leukosis: What is it?

Milk Production

Immune Response

Fertility

Welfare

No Vaccine

No Treatment

Risk of Persistent Lymphocytosis

Risk of Malignant Lymphoma

Overview

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Conclusions
Leukosis: How is it detected?

Milk ELISA test
• Sensitivity = 97% - 100%
• Specificity = 78% - 100%

Blood PCR
• Calves < 6 months
Introduction

87% of herds infected, out of herds which test for leukosis

39% of cows infected on farms with leukosis present
Leukosis: Animal model

\[ y_{ijkl} = y_{s_j} + l_{a_k} + h_{y_i} + a_l + e_{ijkl} \]

where

- \( y_{ijkl} \) is the leukosis test result (0=healthy, 1=sick)
- \( y_{s_j} \) is the fixed effect of year-season of calving (61 levels)
- \( l_{a_k} \) is the fixed effect of lactation-age class at calving (17 levels)
- \( h_{y_i} \) is the random effect of herd-year of calving (2,502 levels)
- \( a_l \) is the random additive genetic effect
- \( e_{ijkl} \) is the random residual effect
### Leukosis: Results

**Variances***

<table>
<thead>
<tr>
<th>Type</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genetic</td>
<td>0.02</td>
</tr>
<tr>
<td>Herd-Year</td>
<td>0.06</td>
</tr>
<tr>
<td>Residual</td>
<td>0.14</td>
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<tr>
<td>Phenotypic</td>
<td>0.22</td>
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</tbody>
</table>

* All standard errors < 0.01

**Leukosis heritability:**

0.10 (SE = 0.01)
Leukosis: Next steps

- Production
  - 305-day Milk, Fat and Protein Yields
- Fertility
  - First Service to Conception
  - Number of Services/Conception
- Health
  - Mastitis
  - Somatic Cell Score
Overview

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Caused by *Mycobacterium avium* ssp. *paratuberculosis* (MAP)

Wasting disease causing chronic intestinal inflammation

No treatment or commercially viable vaccine
Johne’s in Canada

40% of herds infected, out of herds which test for Johne’s

3% of cows infected on farms with Johne’s present
Johne’s: Future work

Work is ongoing to estimate heritability for Johne’s disease
Calf health: What is it?

Incidence rates
• Diarrhea: 33%
• Respiratory disease: 12%

Causes of pre-weaning mortality

- Diarrhea: 26%
- Respiratory disease: 53%
- Other: 21%
Calf health in Canada

Overview
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Johne’s
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<table>
<thead>
<tr>
<th></th>
<th>Diarrhea</th>
<th>Respiratory disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diseased</td>
<td>18,887</td>
<td>43,281</td>
</tr>
<tr>
<td>Healthy</td>
<td>101,857</td>
<td>212,502</td>
</tr>
<tr>
<td>Total records</td>
<td>120,774</td>
<td>255,783</td>
</tr>
<tr>
<td>Number of herds</td>
<td>425</td>
<td>664</td>
</tr>
</tbody>
</table>
Calf disease rates in Canada

**Overview**
- Leukosis
- Johne’s
- Calf health

**Conclusions**
Calf health: Threshold model

\[ l = Xb + Za + e \]

where

- \( l \) is a vector of underlying liabilities corresponding to the binary observation (0= healthy, 1= diseased)
- \( b \) is a vector of systematic fixed effects of year-month born and herd
- \( a \) is a vector of random additive genetic effects
- \( e \) is a vector of random residuals
- \( X \) and \( Z \) are corresponding incidence matrices
Calf health: preliminary results

Diarrhea heritability:  
0.011 (SE = 0.001)

Respiratory disease heritability:  
0.035 (SE = 0.003)
Further work to be done before this can be implemented into genetic evaluations

Analysis is still ongoing for these novel health traits

Improved recording needed for calf health
The inclusion of additional health traits into Canadian genetic evaluations would allow the opportunity to select for broader disease resistance.
Acknowledgements
Thank you for listening!

Questions?

For further questions:

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