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

R. Bongers[1], C. Lynch [1], F. Miglior[1, 2], F. S. Schenkel[1], H. R. Oliveira[2], D.F. Kelton[3], N. van Staaveren[1], K. Houlahan[1], C. F. Baes[1,4]

[1]Centre for Genetic Improvement of Livestock, Department of Animal Biosciences, University of Guelph; [2]Lactanet Canada, Guelph, Ontario, Canada; [3]Department of Population Medicine, University of Guelph, Ontario, Canada; [4]Institute of Genetics, Vetsuisse Faculty, University of Bern, Bern, Switzerland

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Overview of genetic evaluations in Canada

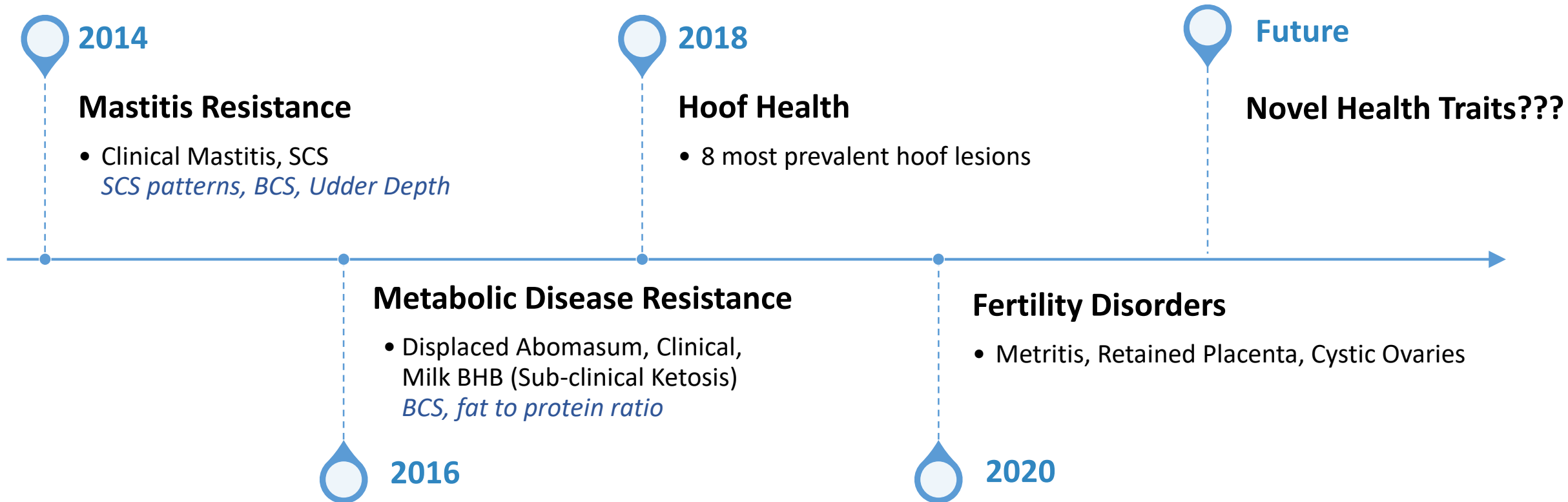
Production

Conformation

Functional

Reproduction

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

2018

Hoof Health

- 8 most prevalent hoof lesions

Future

Novel Health Traits???

Metabolic Disease Resistance

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

Fertility Disorders

- Metritis, Retained Placenta, Cystic Ovaries

2016

2020

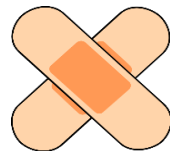# Novel health traits

Leukosis

Johne's

Calf health

Leukosis: What is it?

Milk Production

Immune Response

Fertility

Welfare

Risk of Persistent Lymphocytosis

Risk of Malignant Lymphoma

No Vaccine

No Treatment

Leukosis: How is it detected?

Milk ELISA test
- Sensitivity = 97% - 100%
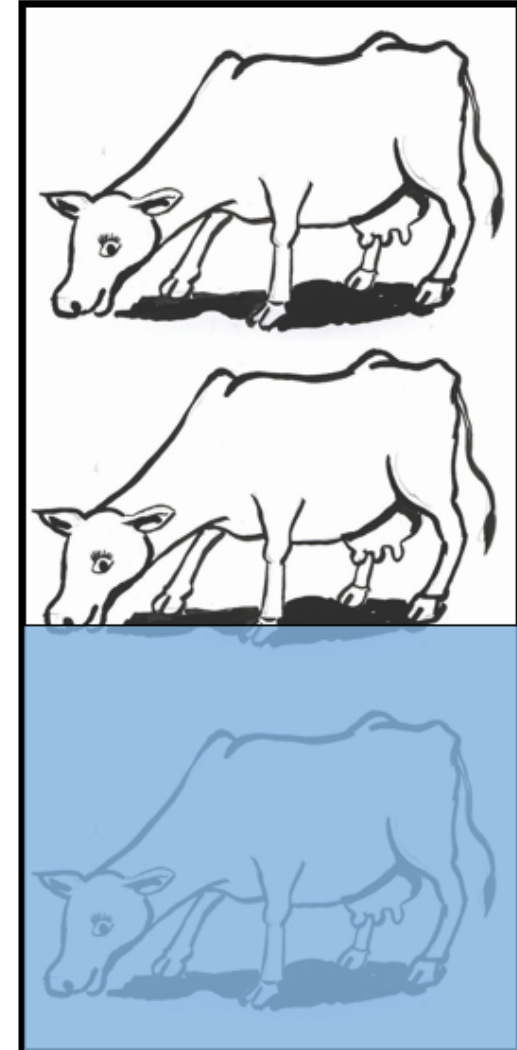- Specificity = 78% - 100%
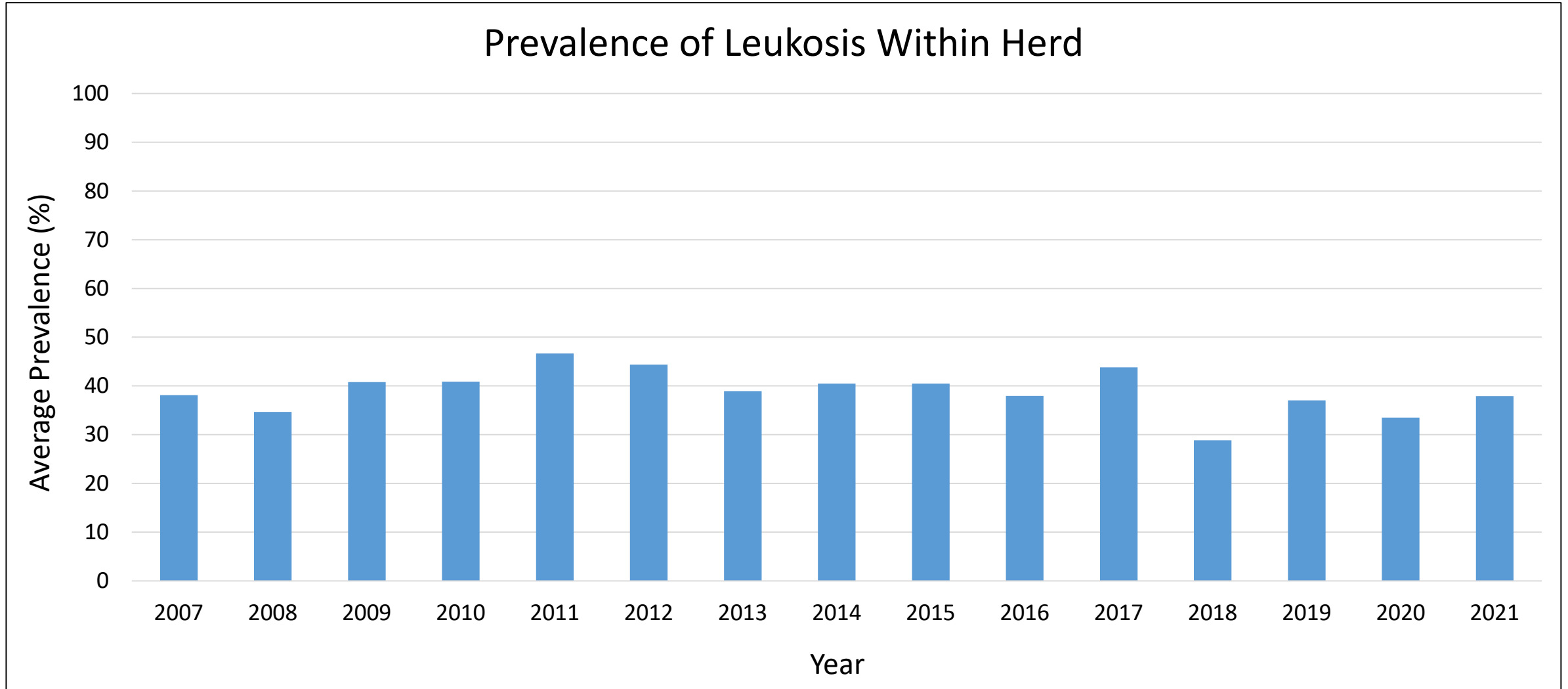
Blood PCR
- Calves < 6 months

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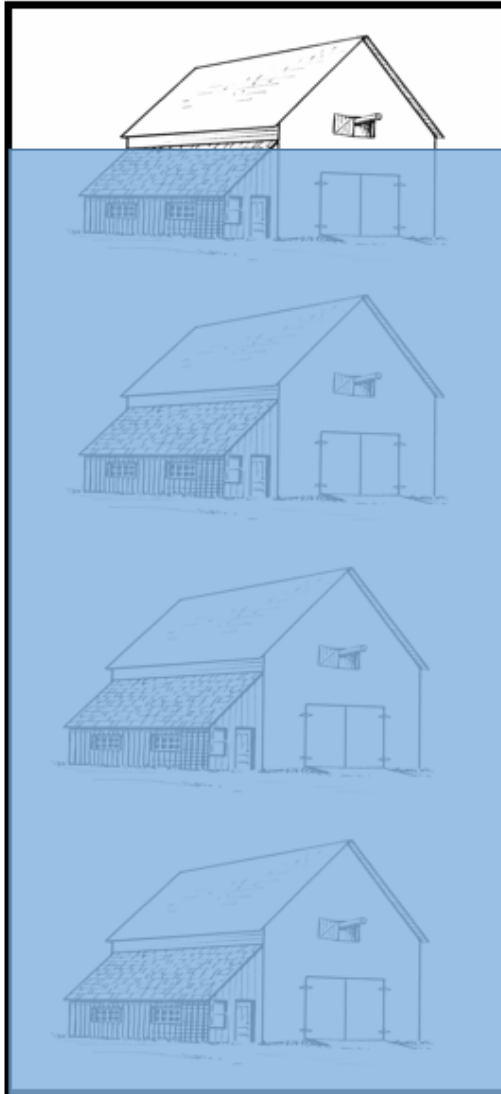
87% of herds infected, out of herds which test for leukosis

39% of cows infected on farms with leukosis present

Leukosis in Canada

Prevalence of Leukosis Within Herd

Bar chart showing Average Prevalence (%) on the y-axis (0 to 100) and Year on the x-axis (2007 to 2021). Approximate values: 2007 ≈ 38, 2008 ≈ 35, 2009 ≈ 41, 2010 ≈ 41, 2011 ≈ 47, 2012 ≈ 44, 2013 ≈ 39, 2014 ≈ 40, 2015 ≈ 40, 2016 ≈ 38, 2017 ≈ 44, 2018 ≈ 29, 2019 ≈ 37, 2020 ≈ 33, 2021 ≈ 38.

Overview | **Leukosis** | Johne's | Calf health | Conclusions

Leukosis: Animal model

$$y_{ijkl} = ys_j + la_k + hy_i + a_l + e_{ijkl}$$

where

- y_{ijkl} is the leukosis test result (0=healthy, 1=sick)
- ys_j is the fixed effect of year-season of calving (61 levels)
- la_k is the fixed effect of lactation-age class at calving (17 levels)
- hy_i is the random effect of herd-year of calving (2,502 levels)
- a_l is the random additive genetic effect
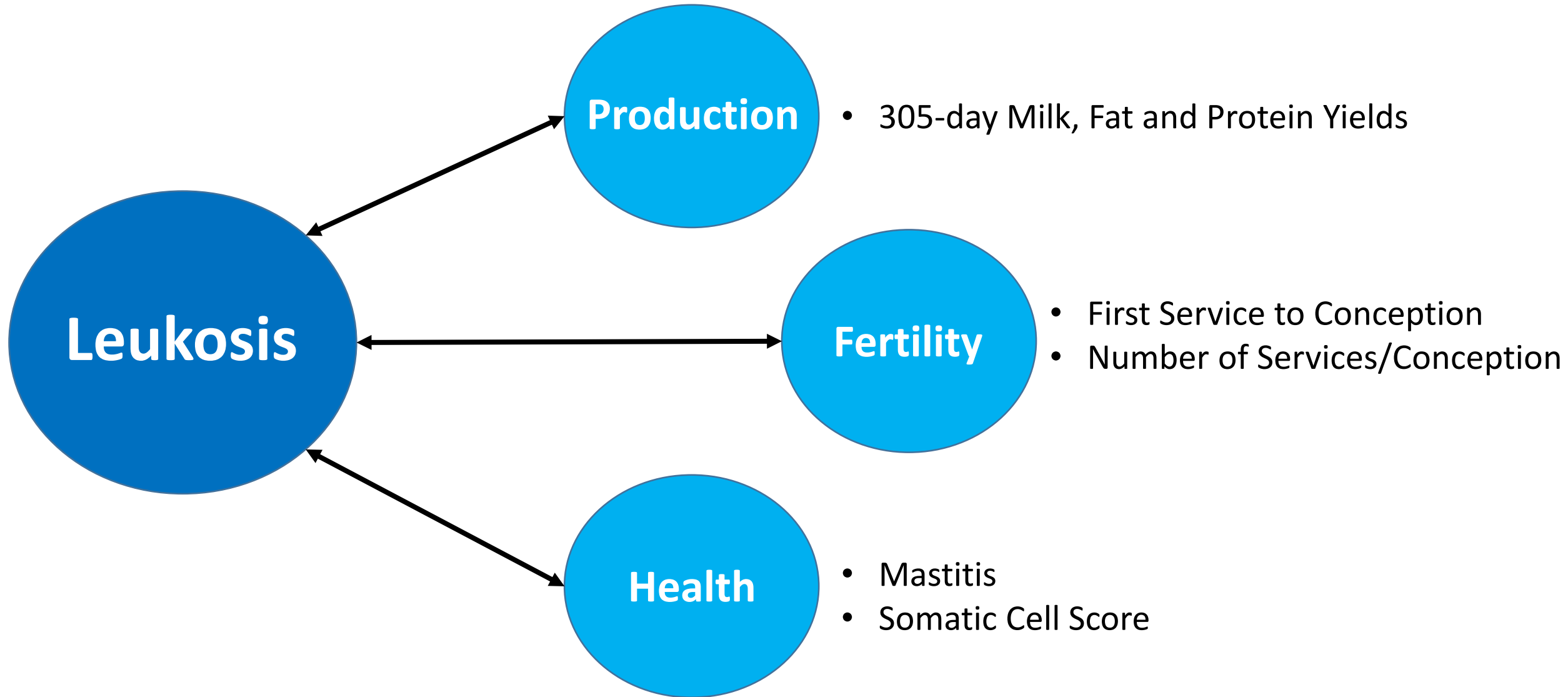- e_{ijkl} is the random residual effect

Leukosis: Results

Variances*	
Genetic	0.02
Herd-Year	0.06
Residual	0.14
Phenotypic	0.22

* All standard errors < 0.01

Leukosis heritability: 0.10 (SE = 0.01)

Leukosis: Next steps

Leukosis

Production
- 305-day Milk, Fat and Protein Yields

Fertility
- First Service to Conception
- Number of Services/Conception

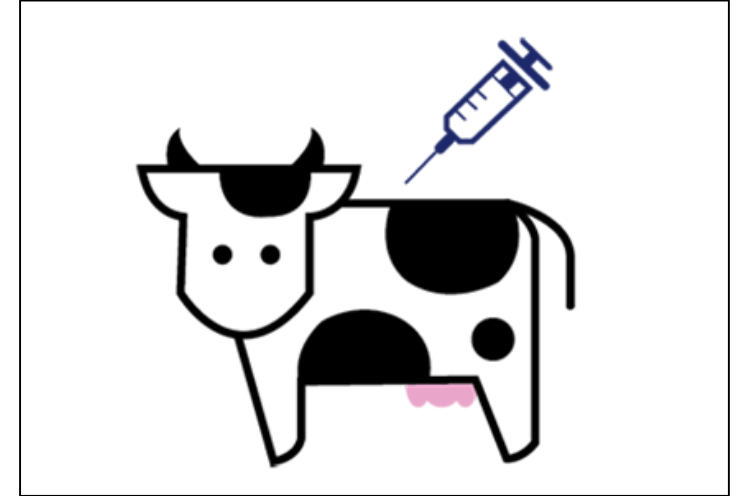**Health**
- Mastitis
- Somatic Cell Score

Johne's: What is it?
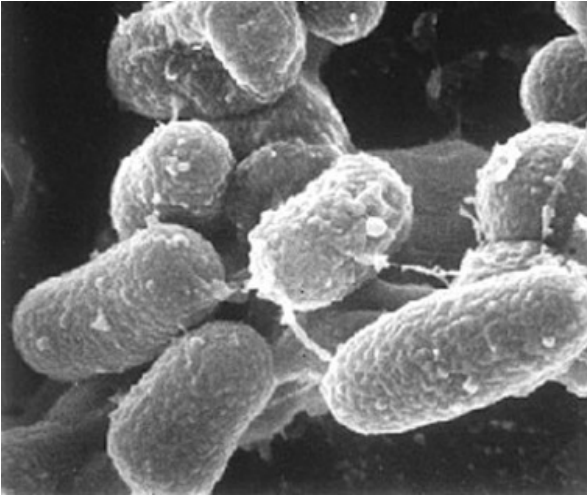
Caused by
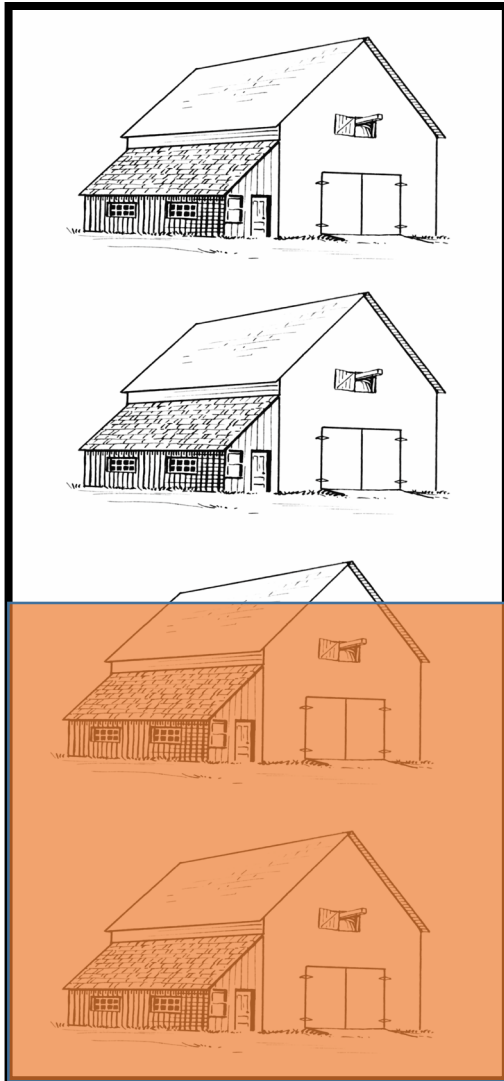*Mycobacterium avium* ssp.
paratuberculosis (MAP)

Wasting disease causing
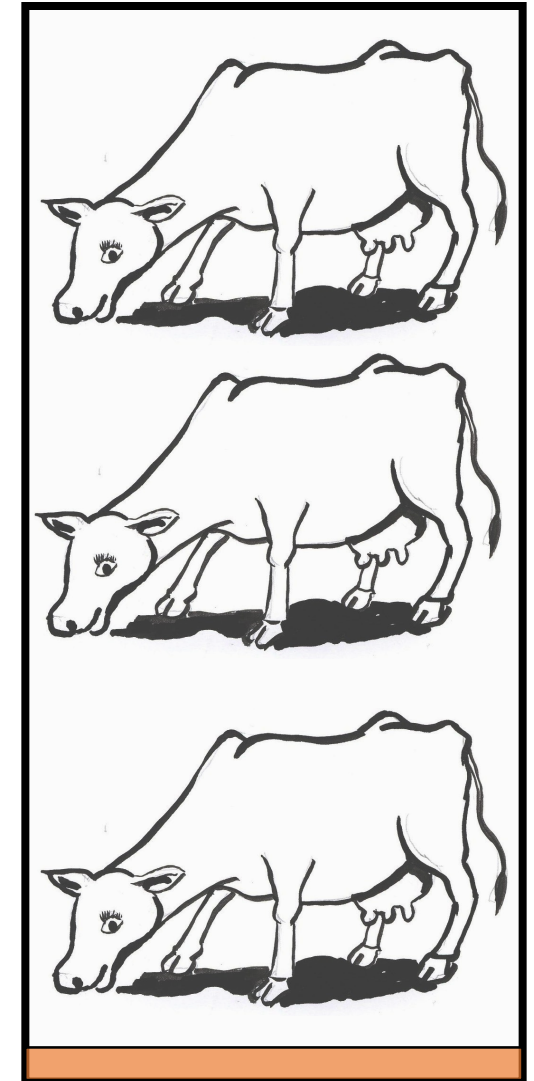chronic intestinal
inflammation

No treatment or
commercially viable
vaccine

Johne's in Canada

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

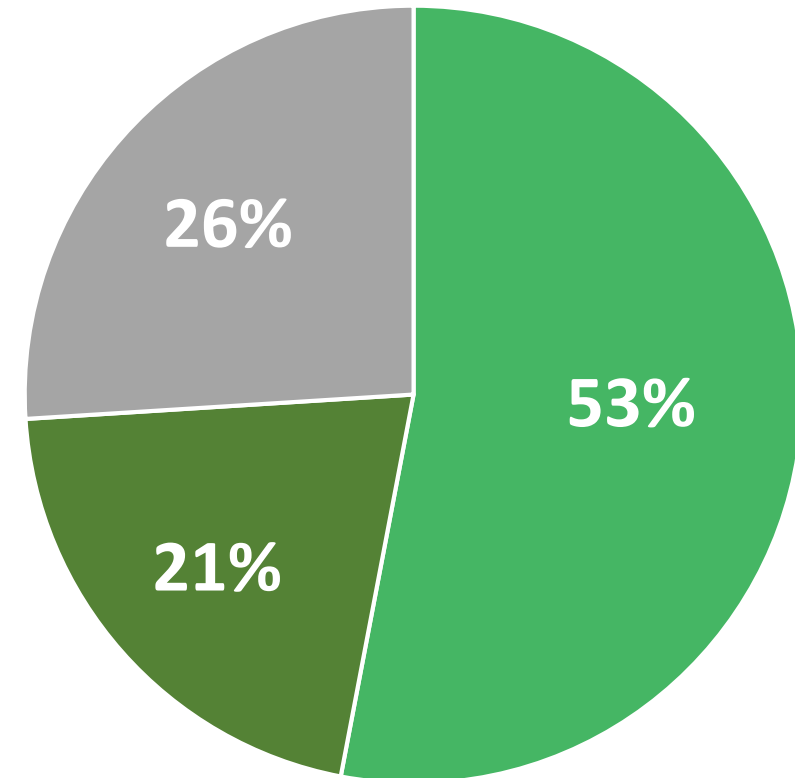**3%** of cows infected on farms with Johne's present

Johne's: Future work

Work is ongoing to estimate heritability for Johne's disease

Calf health: What is it?

Causes of pre-weaning mortality

- 53% Diarrhea
- 21% Respiratory disease
- 26% Other

■ Diarrhea   ■ Respiratory disease   ■ Other

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

Calf health in Canada

	Diarrhea	**Respiratory disease**
Diseased	18,887	43,281
Healthy	101,857	212,502
Total records	120,774	255,783
Number of herds	425	664

Calf disease rates in Canada
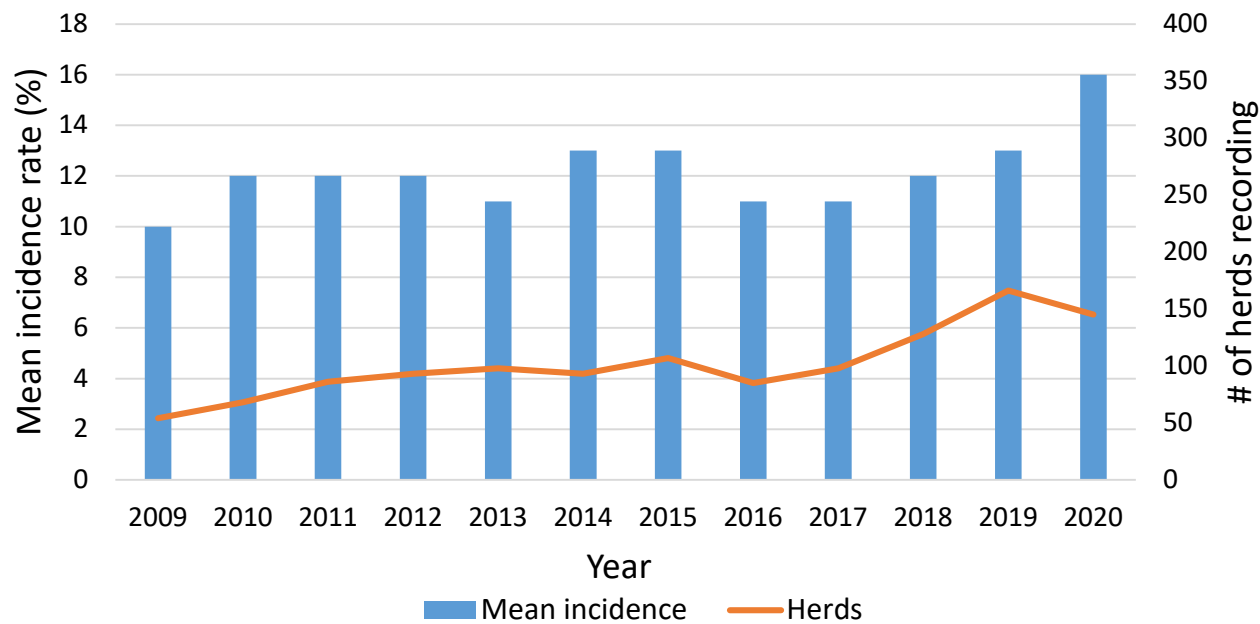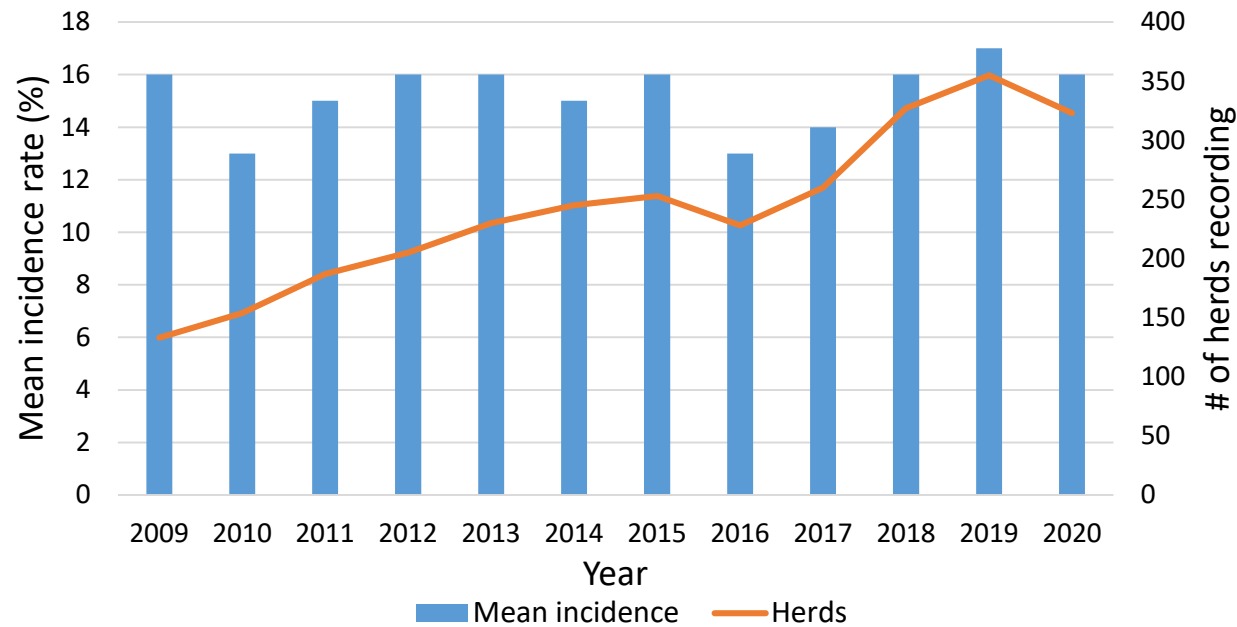
Calf health: Threshold model

$$l = Xb + Za + e$$

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)

Next steps

Further work to be done before this can be implemented into genetic evaluations

Analysis is still ongoing for these novel health traits
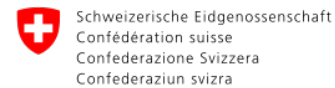
Improved recording needed for calf health

Conclusions

The inclusion of additional health traits into Canadian genetic evaluations would allow the opportunity to select for broader disease resistance

Acknowledgements

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Thank you for listening!

Questions?

For further questions:

Renee Bongers
rbongers@uoguelph.ca

Colin Lynch
clynch@uoguelph.ca