Beef Improvement Federation Bovine Respiratory Disease Guidelines Update

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US Bovine Respiratory Disease Coordinated Agricultural Project
http://www.brdcomplex.org

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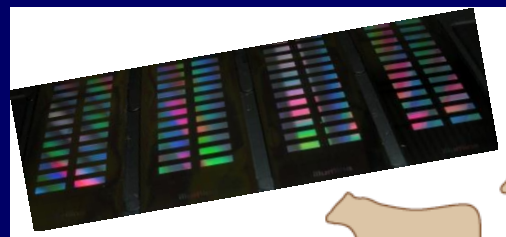
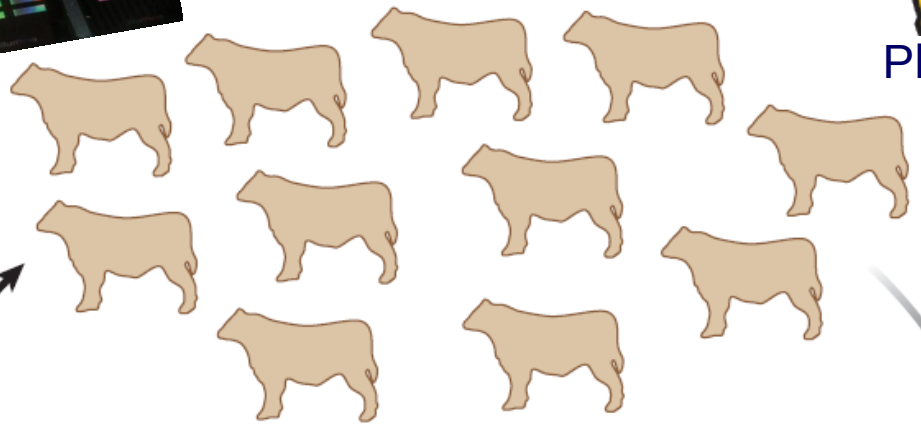


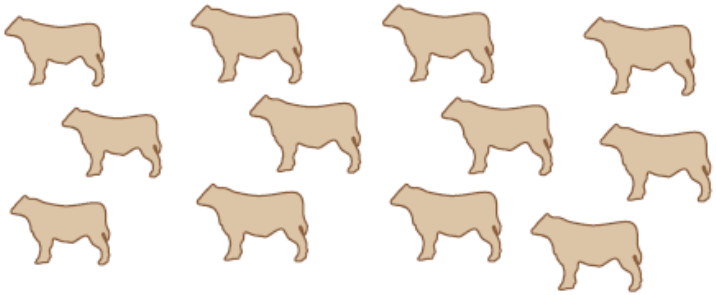
Large training population
- Phenotyped
- Genotyped

Phenotypes



Estimate marker effects for phenotyped traits

Predict genetic merit of selection candidate within breed based on genotype



Selection candidate population
Genotypes used to predict genetic merit

Genotypic and phenotypic information from selected animals used to recalibrate marker effects to maintain prediction equation accuracy

Predict genetic merit of selection candidate within breed based on genotype

Factors that improve accuracy of GS:
- Large number of animals in training population
- Number of SNP markers being genotyped
- Small effective population size
- High heritability of the trait to be improved
- Small number of large-effect QTL influencing trait
- High level of genetic relationship between training and selection candidates

Not predictive in other breeds/strains/lines

Van Eenennaam *et al.* 2014. Annu. Rev. Anim. Biosci. 2: 105-139

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Targeting BRD would be a valuable objective

- The presence of genetic variation in resistance to disease, coupled with the increased consumer pressure against the use of drugs, is making genetic solutions to animal health problems increasingly attractive.
- Even if the markers predict only 20% of the genetic variation for this trait, this is likely to be valuable information given the significant economic costs associated with BRD. This would provide a selection criterion where now we have none.

Newman, S. and Ponzoni, R.W. 1994. Experience with economic weights. Proc. 5th World Congress on Genetics Applied to Livestock Production. 18:217-223.

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Some industries have successfully targeted selection for disease

- In dairy cattle, selection programs have been developed to take advantage of genetic variability in mastitis resistance, despite the fact that the heritability of clinical mastitis is low and mastitis resistance has an adverse correlation with production traits
- Chicken breeders have long used breeding to improve resistance to avian lymphoid leucosis complex and Marek's disease
- A large major effect locus for swine porcine reproductive and respiratory syndrome (PRRS) has been identified

Stear, M. J., S. C. Bishop, B. A. Mallard, and H. Raadsma. 2001. The sustainability, feasibility and desirability of breeding livestock for disease resistance. Res Vet Sci 71: 1-7

Genomic selection for producer-recorded health event data in US dairy cattle

Computer records for disease conditions used to develop genomic selection approaches for common health events:

- cystic ovaries (**CYST**),
- displaced abomasum (**DSAB**),
- ketosis (**KETO**),
- lameness (**LAME**),
- mastitis (**MAST**),
- metritis (**METR**)
- retained placenta (**RETP**).

134,226 total first-parity records ,174,069 total records from parities 2 through 5 for 100,635 cows

Parker Gaddis KL, et al. 2014. Genomic selection for producer-recorded health event data in US dairy cattle. J Dairy Sci. 2014 May;97(5):3190-9.

Increase in reliability from genomic information ~ 0.12

PARKER GADDIS ET AL.

Table 6. Mean reliabilities of sire PTA computed with pedigree information and genomic information

	Pedigree information			Blended pedigree and genomic information			
Health event	Overall mean	Unproven sires[1]	Proven sires[2]	Overall mean	Unproven sires	Proven sires	Overall gain[3]
Displaced abomasum	0.44	0.22	0.65	0.55	0.38	0.71	0.11
Ketosis	0.35	0.18	0.52	0.48	0.35	0.61	0.13
Lameness	0.24	0.15	0.32	0.39	0.31	0.47	0.15
Mastitis	0.39	0.26	0.52	0.51	0.40	0.61	0.12
Metritis	0.35	0.24	0.46	0.48	0.38	0.57	0.13
Retained placenta	0.55	0.42	0.67	0.64	0.54	0.73	0.09

[1]Unproven sires considered sires with less than 10 daughters.

[2]Proven sires considered sires with at least 10 daughters.

[3]The increase in mean reliability calculated as the difference in overall mean reliability between the blended model and the traditional (pedigree data only) model.

Parker Gaddis KL, et al. 2014. Genomic selection for producer-recorded health event data in US dairy cattle. J Dairy Sci. 2014 May;97(5):3190-9.

The importance of recording health traits

"*To be successful, there needs to be a* ***balance between the effort required to collect these health data and subsequent benefits****. Electronic systems that make such data capture easy and automated are likely key to the long-term success. The authors concluded that "The development of genomic selection methodologies, with accompanying substantial gains in reliability for low-heritability traits, may dramatically improve the feasibility of genetic improvement of dairy cow health*.

Parker Gaddis KL, et al. 2014. Genomic selection for producer-recorded health event data in US dairy cattle. J Dairy Sci. 2014 May;97(5):3190-9.

Need for careful "case" definition

- For studies of infectious diseases field data sets are often required because challenge experiments of a sufficient scale will not be possible.
- However, such field data is very 'noisy'
  - diagnosis of infection or disease may be imprecise; it can be difficult to determine when infection of an individual occurred
  - it is often unclear whether or not apparently healthy individuals have been exposed to the infection
- These factors add environmental noise to the epidemiological data (i.e. decrease the heritability).

Bishop, S. C., and J. A. Woolliams. 2010. On the genetic interpretation of disease data. Plos One 5: e8940.

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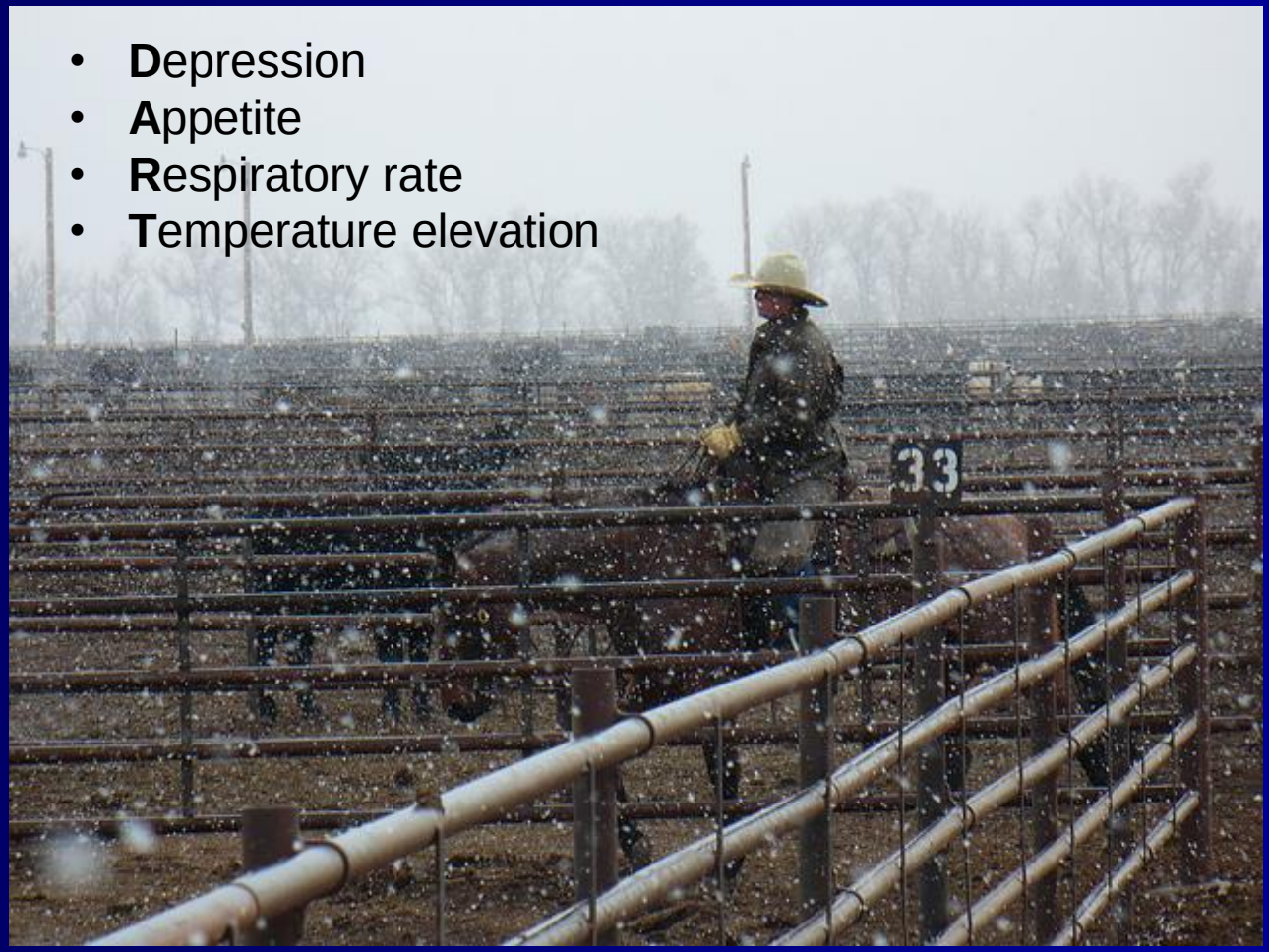
Accurate diagnosis (i.e. case definition) of BRD is critical for success of studies

- **D**epression
- **A**ppetite
- **R**espiratory rate
- **T**emperature elevation



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Accurate diagnosis (i.e. case definition) of BRD is critical for success of studies

- Traditional methods for detecting morbid cattle include visual appraisal once or twice daily.
- Animals displaying nose or eye discharge, depression, lethargy, emaciated body condition, labored breathing or a combination of these, should be further examined
- Symptomatic animals with a rectal temperature ≥ 103°F are usually considered morbid and given treatment.
- Confounding factors include the diligence and astuteness of those checking the animals, the variability and severity of the symptoms the animals experience with chronic and acute BRD, and the disposition of the animals
- All of these diagnostic systems are ***subjective in nature***.

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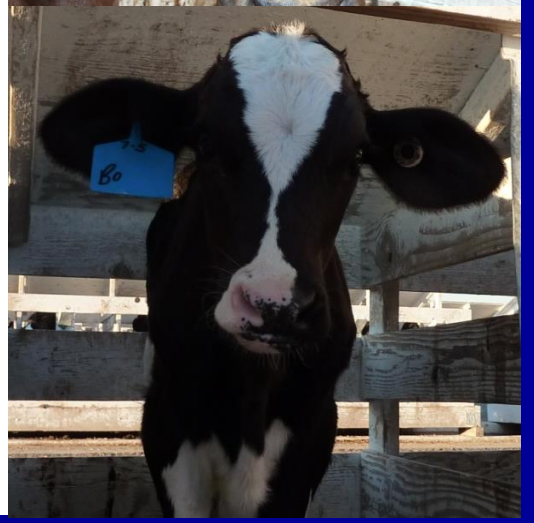
University of Wisconsin-Madison

http://www.vetmed.wisc.edu/dms/fapm/fapmtools/8calf/calf_health_scoring_chart.pdf

Calf Health Scoring Criteria

0	1	2	3
Rectal temperature			
100-100.9	101-101.9	102-102.9	≥103
Cough			
None	Induce single cough	Induced repeated coughs or occasional spontaneous cough	Repeated spontaneous coughs
Nasal discharge			
Normal serous discharge	Small amount of unilateral cloudy discharge	Bilateral, cloudy or excessive mucus discharge	Copious bilateral mucopurulent discharge
			
Eye scores			
Normal	Small amount of ocular discharge	Moderate amount of bilateral discharge	Heavy ocular discharge
			
Ear scores			
Normal	Ear flick or head shake	Slight unilateral droop	Head tilt or bilateral droop
			



http://www.vetmed.wisc.edu/dms/fapm/fapmtools/8calf/calf_health_scoring_chart.pdf

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Incorporating of BRD into genetic evaluations

Approach will likely depend upon the genetic architecture of trait

- If there are large effect causative (functional) mutations then their effect should persist across breeds
- Otherwise will need to develop prediction equations for all breed and develop ongoing phenotyping program
- Need to develop a standardized set of practical guidelines for BRD scoring that could be used in industry herds with the data to be used for genetic evaluation – phenotyping effort cannot be greater than subsequent benefit

Need guidelines to standardize collection of BRD phenotypes

- Enable production of EPD
  - Add accuracy to selection
- Allow validation of newly developed genomic panels
  - Currently this is problematic—who has data for testing?

BRD phenotype presents challenges

- Number of different ways to record BRD
  - Binary – treated or not
  - Based on DART (pen rider skill level)
  - Based on an objective scoring system (e.g. McGuirk)
  - A combination of symptoms
  - More sophisticated measurements such as the Whisper stethoscope system
- There needs to be a **balance** between the effort required to collect these health data and subsequent benefits.

BRD Guidelines Committee

- Dr. Dee Griffin, University of Nebraska
- Larry Kuehn, USDA MARC
- Dr. Jim Lowe, University of Illinois
- Holly Neibergs, Washington State University
- Chris Seabury, TAMU
- Alison Van Eenennaam, UC Davis
- R. Mark Enns, Colorado State University

What are feedlots recording now?

- Drs. Lowe and Griffin
- Two widely-used feedlot software programs
  - Animal Health International
  - Micro Technologies (Micro Beef Technologies)
- Production Animal Consultation provided summaries of reporting rates

Data reporting rates for 2 feedlot recording systems

- Lot info
  - In date (100%)
  - Out date (100% if closed)
  - Sex (100%)
  - Owner (74%)
  - Buyer (41%)
  - Origin (71%)
  - Starting average weight (100%)
  - Ending average weight (100% if closed)
  - Starting head (100%)
  - Ending head (100% if closed)
  - Risk (1%)
  - Breed (0%)

Treatment information and recording rates

- Date (100%)
- Weight (99%)
- Temperature (74%)
- Severity score (41%)
- Products applied (100%)
- Cost of products applied (69%)
- Pen rider (6%)
- Doctor (4%)
- Diagnosis (100% - doesn't mean it isn't unknown or other occasionally)

Phenotypic data

- The data is being recorded at the feedlot level
- How can we use/leverage this for genetic improvement?

Guidelines

- Recommendations for "performance" recording
- Recommendations for use of data in genetic evaluation
- First attempt at BIF Guidelines for a disease trait

Guidelines for BRD recording

- Suggesting a tiered approach to recording
  - Different levels of data "comfort"
- Enables flexibility in use of data for genetic evaluation
  - Will enable more detailed genomic research should DNA samples be available
- Envision use of both phenotypic and genomic data in the genetic evaluation

Tier 1

- Animal ID (need IDs of all animals in lot)
- Lot information: In and out dates, sex, owner/origin, breed
- Treatment information (tied to animal)
  - Date pulled, temperature (if available, 74% recording rate), diagnosis
  - Animal info: date died/railed
- Used to create a "binary" observation
  - Treated→ yes/no

Tier 2: Detailed classifications

- Presumed BRD (pBRD):
  - Increased respiratory rate and/or effort, depression, lack of gut fill (reduced feed intake)
- Active BRD (aBRD):
  - pBRD plus temperature over 104—active inflammatory response
- Chronic BRD (cBRD):
  - pBRD plus temperature below 104—lack of active inflammatory response
- Confirmed BRD (oBRD):
  - aBRD or cBRD pluse evidence of lung pathology consistent with pneumonia
    - Thoracic ultrasound
    - >1 score on Whisper automated auscultation system
- Not levels of severity, but levels of specificity—may be a different trait analysis
- Other contemporary group information

Contemporary group dilemma

- Pen will likely be important environmental factor
  - Most likely vectors for shedding and transmission will be pen mates
  - Historically, add pen to contemporary group definition
    - Birth weight CG + weaning CG + arrival date + origin + pen
- Concern: overspecifying/subdivising CG so that little variability exists.

Contemporary group approaches

- Fit pen(lot) as separate main effect outside of contemporary group structure
- Fit pen(lot) as a random rather than fixed effect
  - Pen effects will be regressed relative to the information content
  - Epidemiology is not completely understood
    - This approach would allow correlations to be fit based on pen proximity (if that data were available)
    - Larry Kuehn

Summary

- There is opportunity for genetic improvement in susceptibility to bovine respiratory disease.
- Considerable data is currently being recorded in the feedlot – none is going back to inform genetic improvement
- Guidelines committee will submit final recommendations to the board for approval
- Goal: An phenotype that enables the development of an EPD for selection of animals with reduced susceptibility to BRD

Bovine Respiratory Disease Complex
Coordinated Agriculture Project

http://BRDComplex.org

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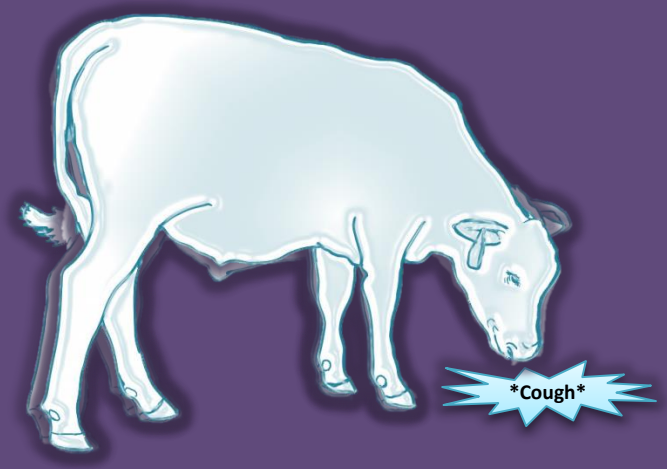
Questions?



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USDA United States Department of Agriculture National Institute of Food and Agriculture

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