

# Precision dairy's future is promising



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**October 1, 2019**  
**World Dairy Expo**  
**Madison, WI**



# What is precision dairy data?

**Wearable Sensors**



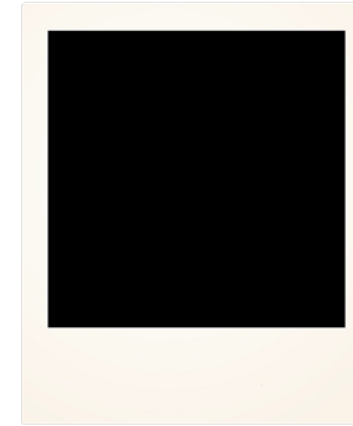
**Every 5 minutes**

**High-throughput lab tests**



**Every milk test**

**Pictures or Video**



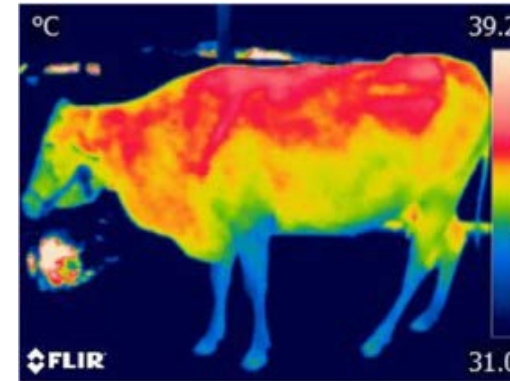
**Every second?**

**Frequently collected measurements on individual cows**

**Often, data available in “real-time”**


**Estrous & Health event detection are among common uses**

# What technologies exist today?





# Milk Spectral Data are another promising information source

 J Dairy Sci. 2018 Mar;101(3):2496-2505. doi: 10.3168/jds.2017-13647. Epub 2017 Dec 28.

## Diagnosing pregnancy status using infrared spectra and milk composition in dairy cows.

Toledo-Alvarado H<sup>1</sup>, Vazquez AI<sup>2</sup>, de Los Campos G<sup>2</sup>, Tempelman RJ<sup>3</sup>, Bittante G<sup>1</sup>, Cecchinato A<sup>4</sup>.

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Electronic address: [alessio.cecchinato@unipd.it](mailto:alessio.cecchinato@unipd.it).

†Schothorst Feed Research, PO Box 533, 8200 AM Lelystad, the Netherlands

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#Quantitative Veterinary Epidemiology Group, Wageningen Institute of Animal Sciences, Wageningen University, PO Box 338, 6700 AH Wageningen, the Netherlands

# And many, many more technologies are out there.....

**What additional (hidden) information can come from all these technologies to help producers?**

**What measurements make good proxies for a trait of interest?  
i.e. Feed Efficiency?**

**Can we combine several types of precision data to better monitor animals?**

**What do we want to achieve with precision technologies?**

# Vision for Precision Data in the Dairy Industry

## *On Farm data:*

Parlor (milk), Feeding (nutrients), Reproduction, Health, Management, Behavior, Genetics, Expenditures/ economic factors

## Data storage & processing



*On Farm view of herd data & decision making tools – actionable items*



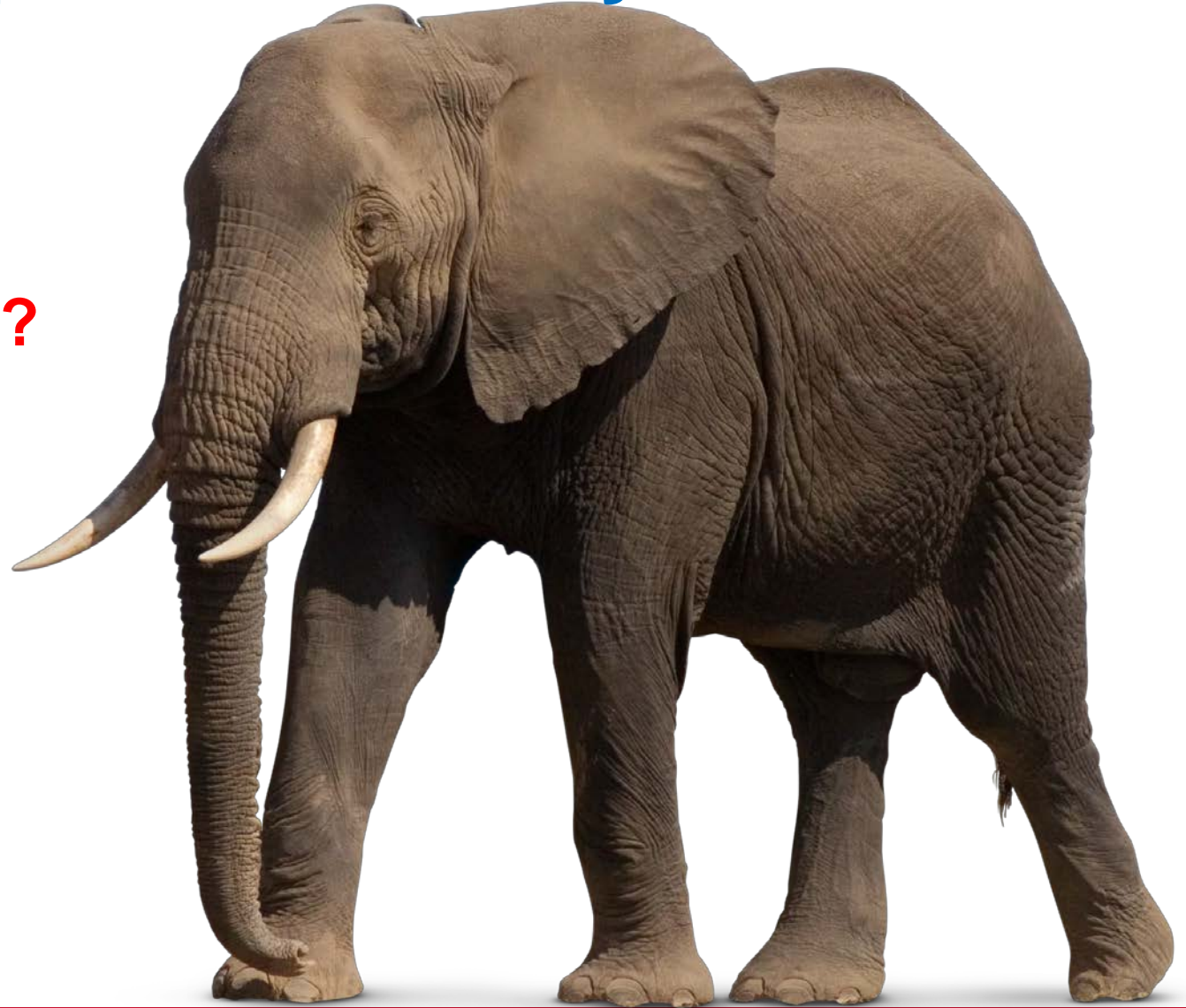
**Data for research to create valuable analytics  
(i.e. improve feed efficiency!)**

**Feedback for response!**

# What is the value of precision dairy data?

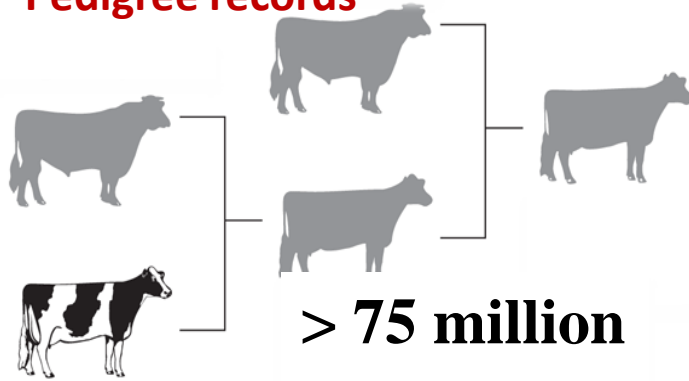
Who benefits from the data?

Where is value generated?

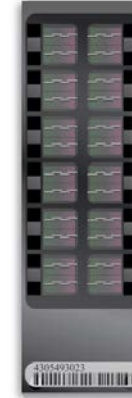


# Data & cooperation has facilitated success in the dairy industry

## Pedigree records



## Genotypes



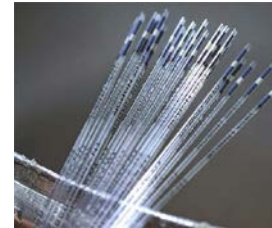
**> 3 million**  
(>60,000 SNP per animal)

## Lactation records



**> 139 million**  
**> 684 million daily**  
**yield records**

## Reproduction records



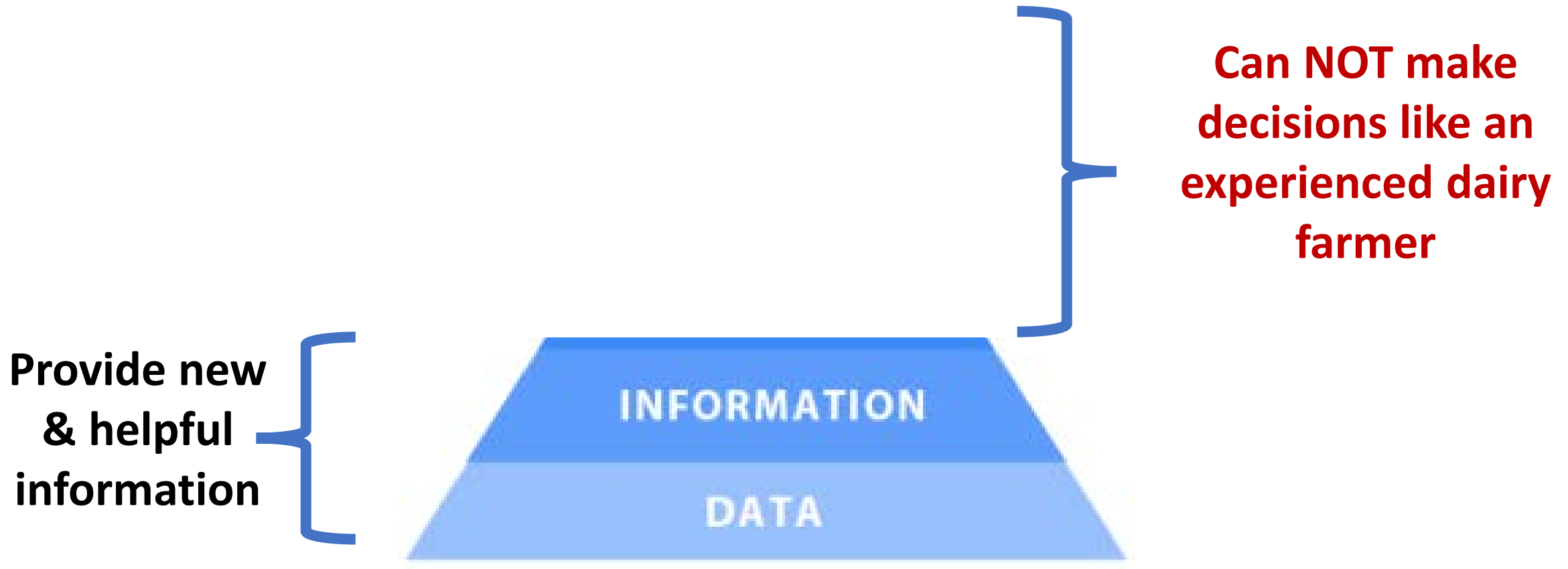
**> 196 million**

*And many other types of data....*

Information courtesy John Cole, USDA-AGIL



# What Precision Technologies can and can't do



# Producer visual analysis > sophisticated algorithms



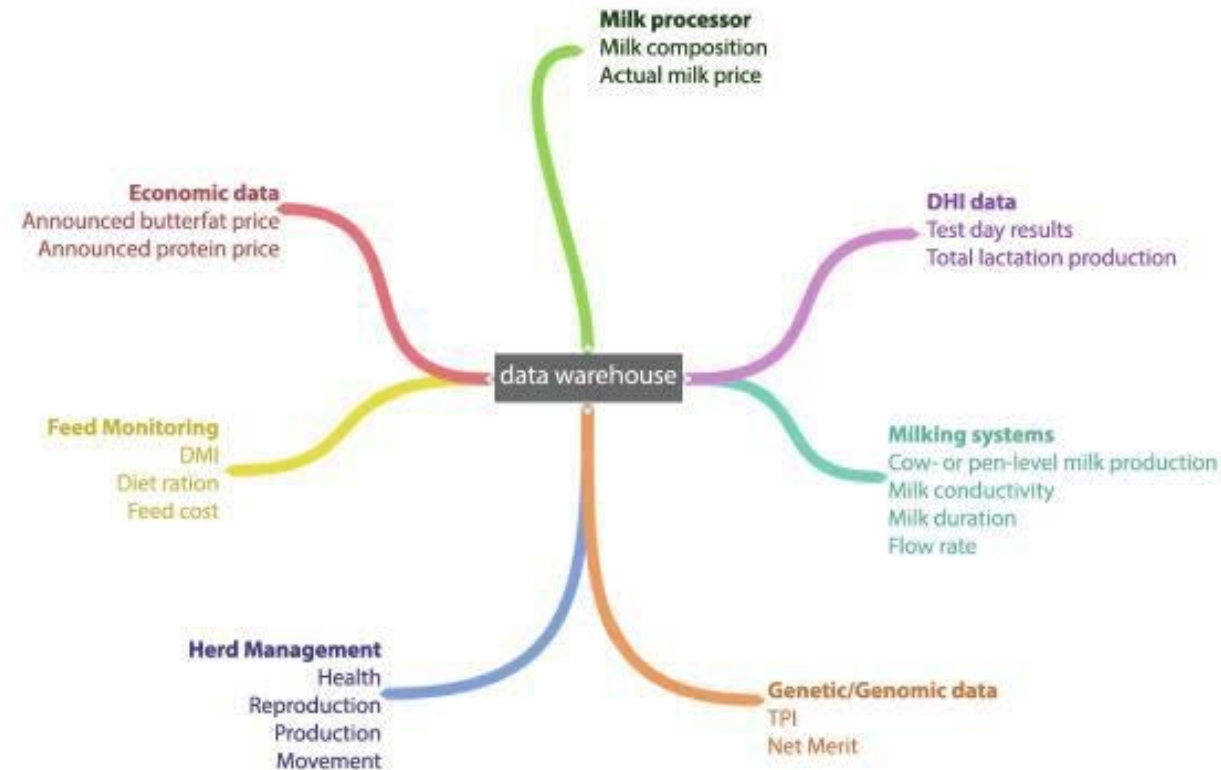
Courtesy Daniel Berckmans, KU Leuven

# Where are Precision technologies headed.....

- Automated Body Condition Score Measurements

## Integrated Information for decision making

- Early detection of Metabolic disease
- Early detection of Mastitis
- Early signs of frailty, need to cull early



Virtual Dairy Brain Project-  
Victor Cabrera

# What precision tools are being developed for use in other industries



Facial recognition, robotics to aid chick vaccination

**Feedstuffs**



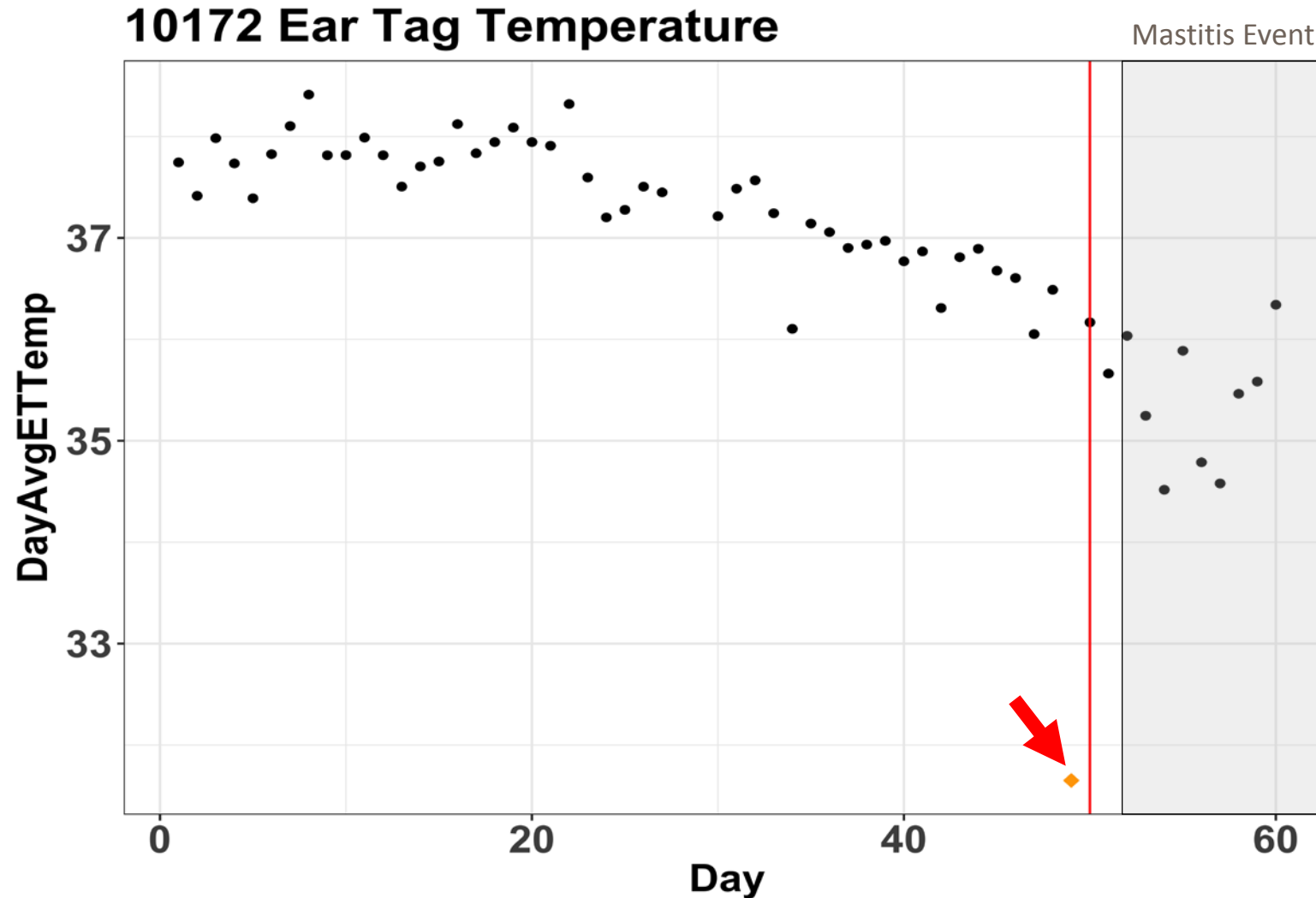
# Image tracking/ phenotyping in swine

NUtrack technology images courtesy: Benny Mote, Ty Schmidt, Eric Psota, Lance Perez, University of Nebraska

# Applications of Precision Technologies for Management

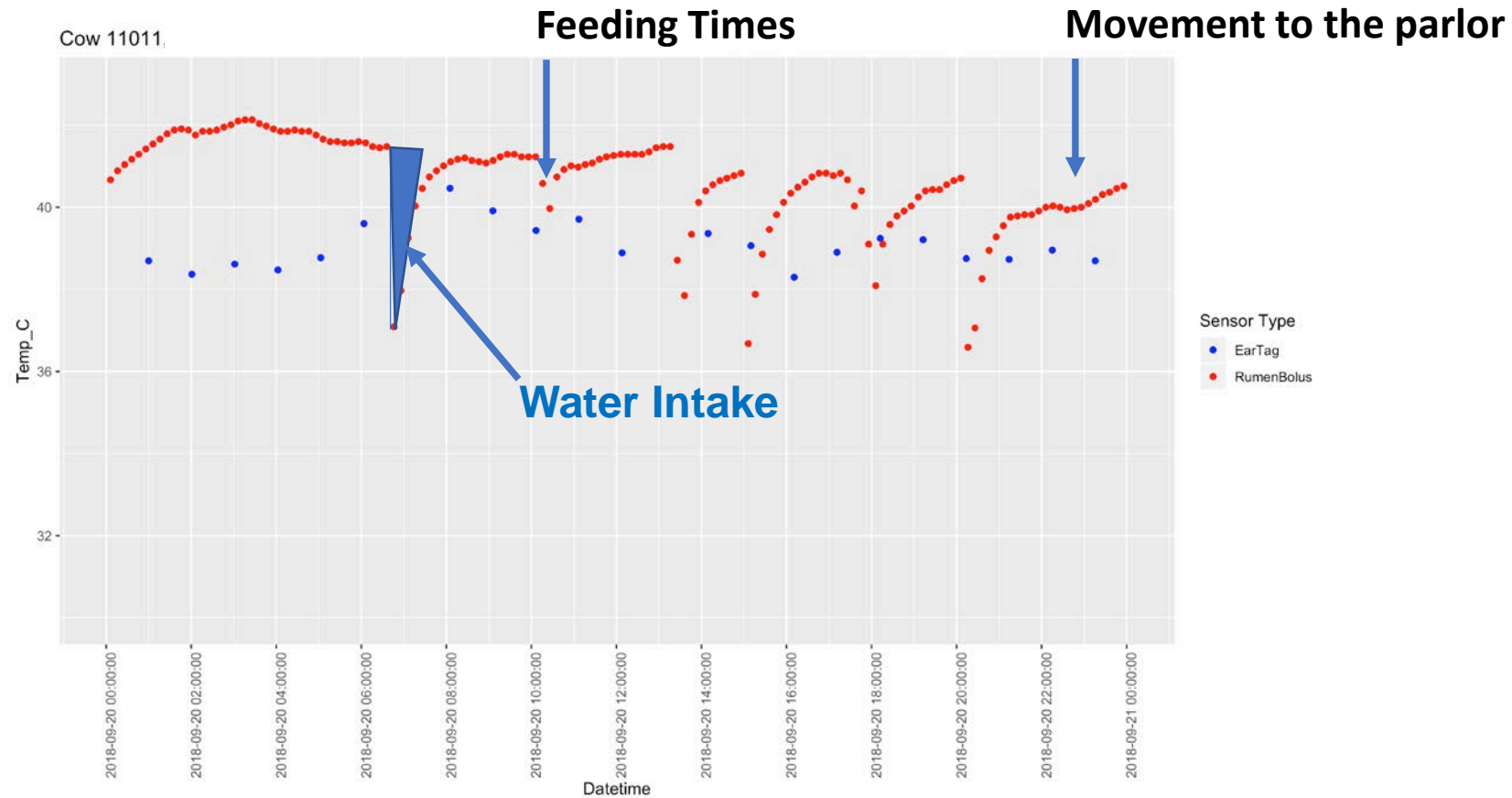


# Early detection of a disease to reduce/ prevent impact



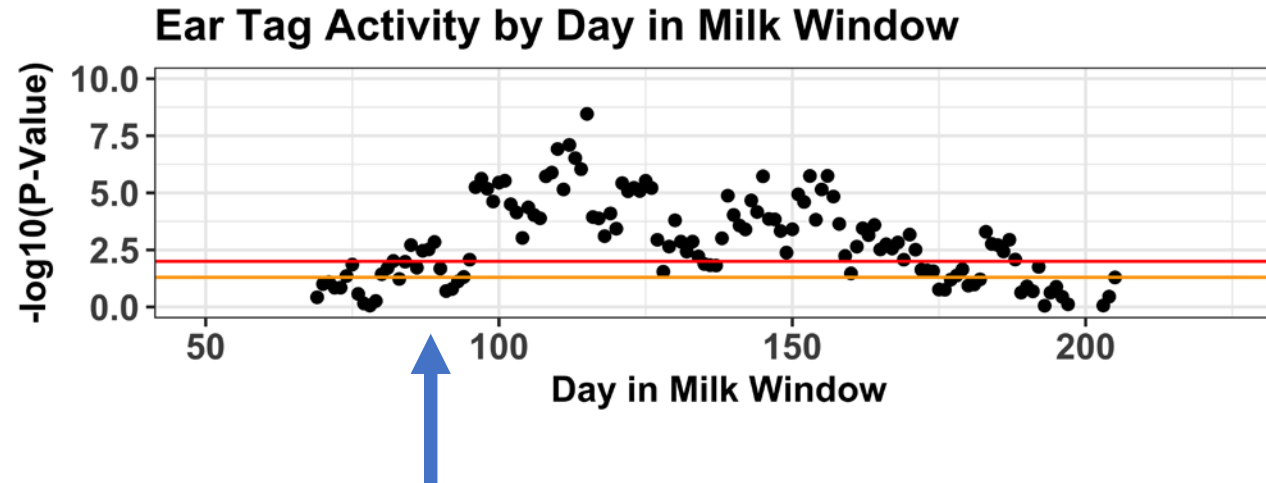
**Goal: Reduce the need for antibiotics.**

# Sensor data can inform on animal behavior's of interest related to management



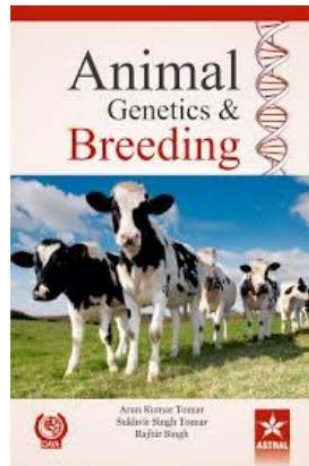
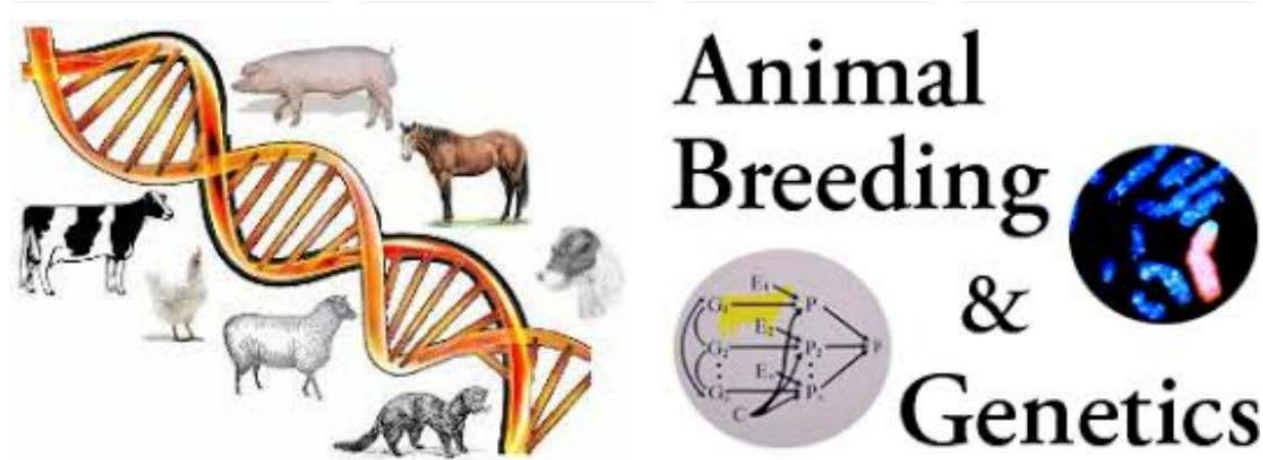


# What would be the value of predicting feed intake?



What if, we could predict Feed Intake at 100 DIM from 90 DIM data?

# What opportunities exist to use precision technologies for genetic improvement of dairy cattle?



# What traits could precision technologies deliver for genetic selection?

## Feed & Water Intake



## Cow Health

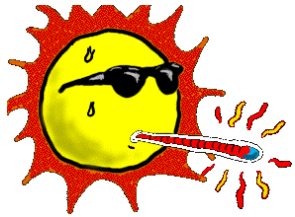


## Calving & Calf health traits



## Accounting for Environmental Differences (GxE)

### Heat Stress related traits



### Altitude impact



**Likely many more....**



# Why use Precision Technologies to Predict Feed Intake?



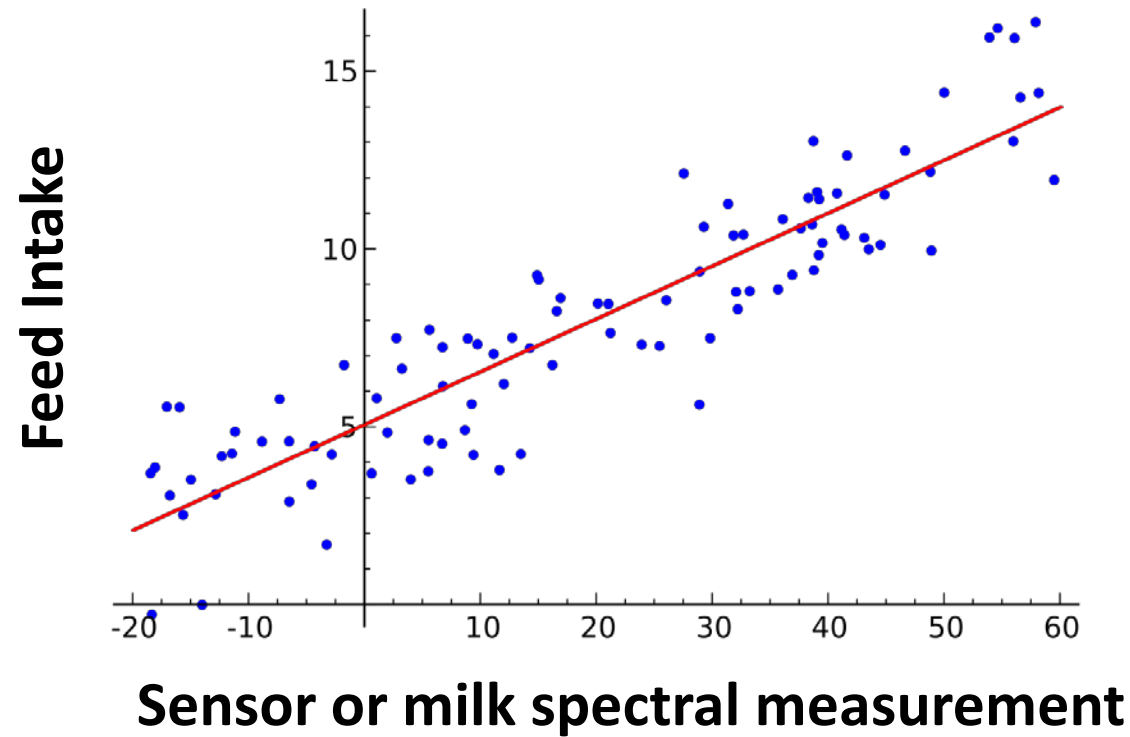


# What is the rationale behind using sensors & milk spectra to predict feed intake?

- Feed represents the highest cost on farm
- Equipment to measure feed intake is extremely expensive
- Ideally, tools are needed that are:
  - portable, inexpensive & available on a large number of commercial dairy farms
- Sensors and milk spectra are widely used in the dairy industry
- Ideally, some precision data could act as proxies (indicator traits) of feed intake
- If sensors & milk spectra are good indicators of feed intake, they would be very helpful because we can measure them on lots of cows
  - **More data on more cows = improved prediction accuracy of feed efficiency**

# What makes a sensor a good indicator of feed intake?

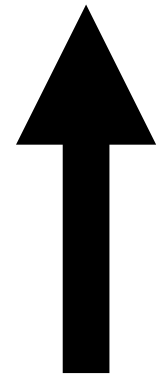
**Consistent association with Feed Intake**



**Favorable relationship with other traits of interest under selection**



**Reduced  
incidence of  
Health problems**



**Increased  
sensor measure**

# Potential Sensor & Milk Proxies for Feed Intake

## Ear Tag Technologies

Temperature  
Activity

## Imaging Technologies

Temperature  
Activity  
Locomotion  
Feed Intake



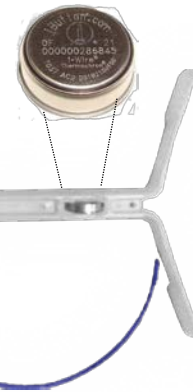
## Body Weight



## Milking System Collar Daily activity, Behavior, Locomotion

## Rumen bolus Rumen temperature Activity

## Thermosensor Vaginal temperature



## Milk Samples Milk spectral data (MIR)



# Milk Spectral Data appears promising



**J. Dairy Sci. 101:5878–5889**  
**<https://doi.org/10.3168/jds.2017-13997>**  
© American Dairy Science Association®, 2018.

## **Mining data from milk infrared spectroscopy to improve feed intake predictions in lactating dairy cows**

**J. R. R. Dórea,\* G. J. M. Rosa,† K. A. Weld,\* and L. E. Armentano\*<sup>1</sup>**

\*Department of Dairy Science, and

†Department of Animal Sciences, University of Wisconsin, Madison 53706



**J. Dairy Sci. 101:6232–6243**  
**<https://doi.org/10.3168/jds.2017-13874>**  
© American Dairy Science Association®, 2018.

## **Milk mid-infrared spectral data as a tool to predict feed intake in lactating Norwegian Red dairy cows**

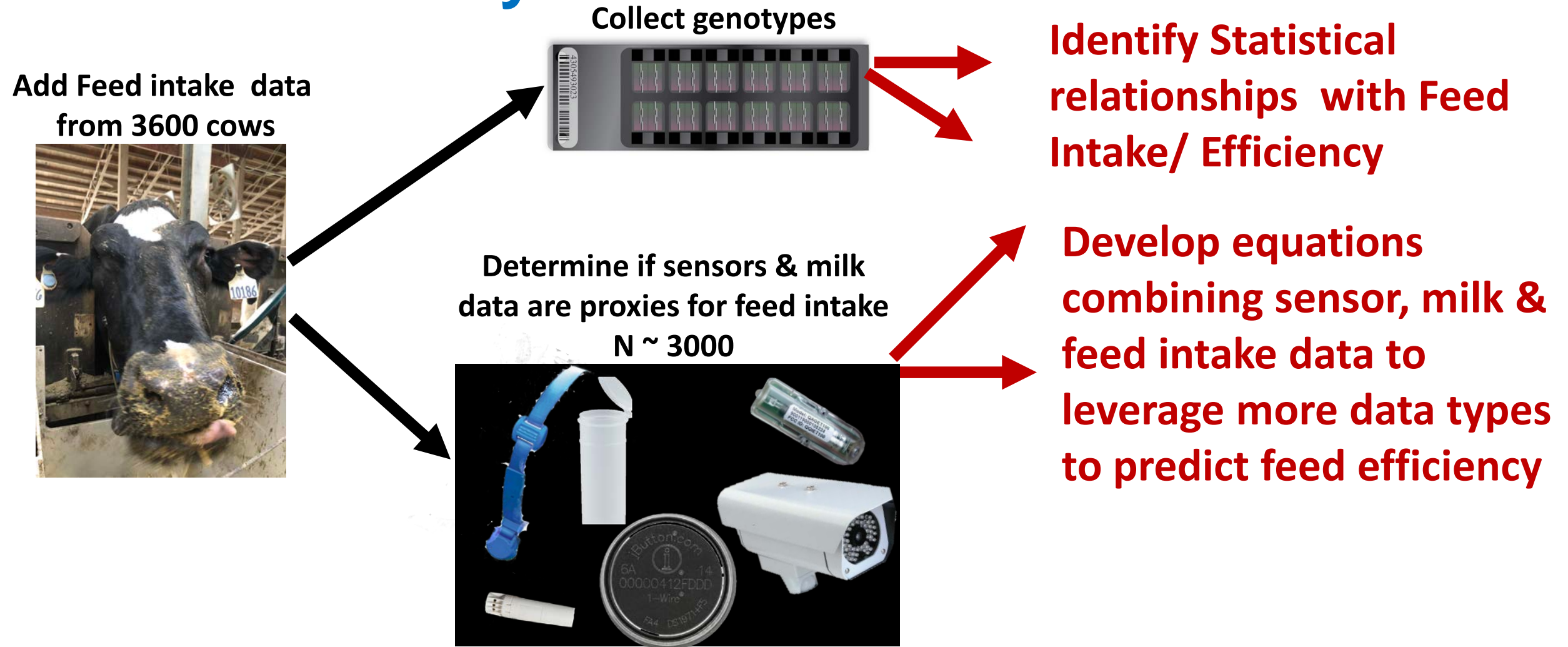
**S. E. Wallén,\* E. Prestløkken,\* T. H. E. Meuwissen,\*<sup>1</sup> S. McParland,† and D. P. Berry†**

\*Norwegian University of Life Sciences, Department of Animal and Aquacultural Sciences, Ås, 1432, Norway

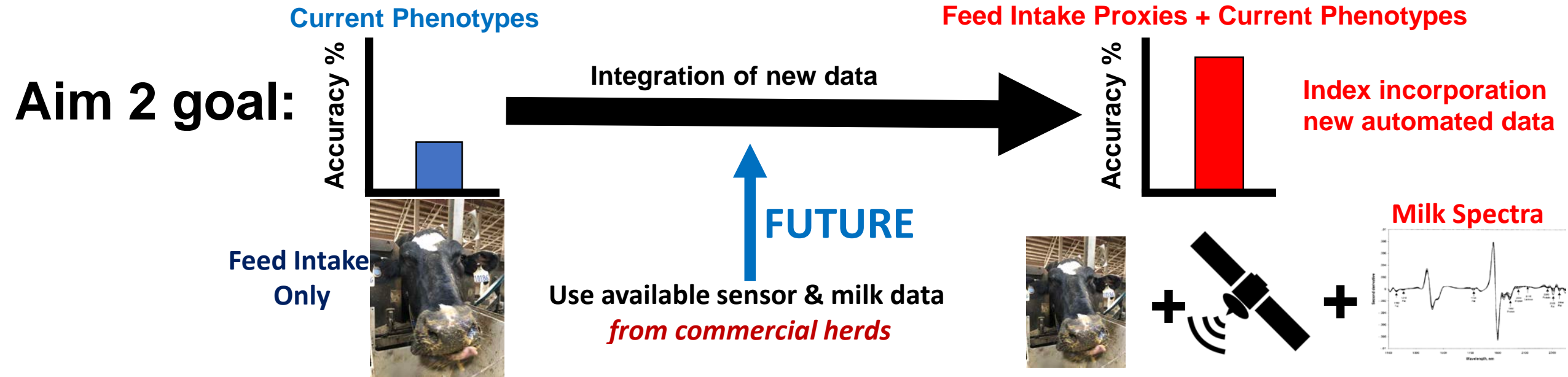
†Animal and Grassland Research and Innovation Centre, Teagasc, Moorepark, Co. Cork, P61C996, Ireland



# Goals for Precision Technologies in Predicting Feed Efficiency

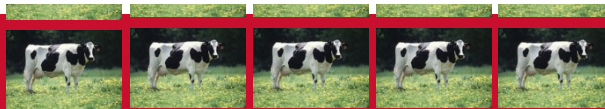


# Goal: Boost Feed Efficiency PTA Accuracy



## Feed Efficiency Index:

$$I = b_f \text{FeedIntake} + b_1 \text{Sensor1} + b_2 \text{Spectra} + \dots b_N \text{SensorN}$$



# Potential for added benefit



# Take Home points

- Uses for sensor data are rapidly evolving & expanding
- Many sensors & milk spectral testing are widely in use in the US
- Prediction tools are being developed to assist in farmer's decision making
- Sensor measurements & milk spectral data are being used to develop feed intake prediction tools
- Milk spectra appear to have predictive ability of feed intake
- Sensor data appears promising
- **Goal:** Develop a selection index PTAs for feed efficiency traits using: feed intake, sensors & milk spectra with higher accuracy than today



# Acknowledgements

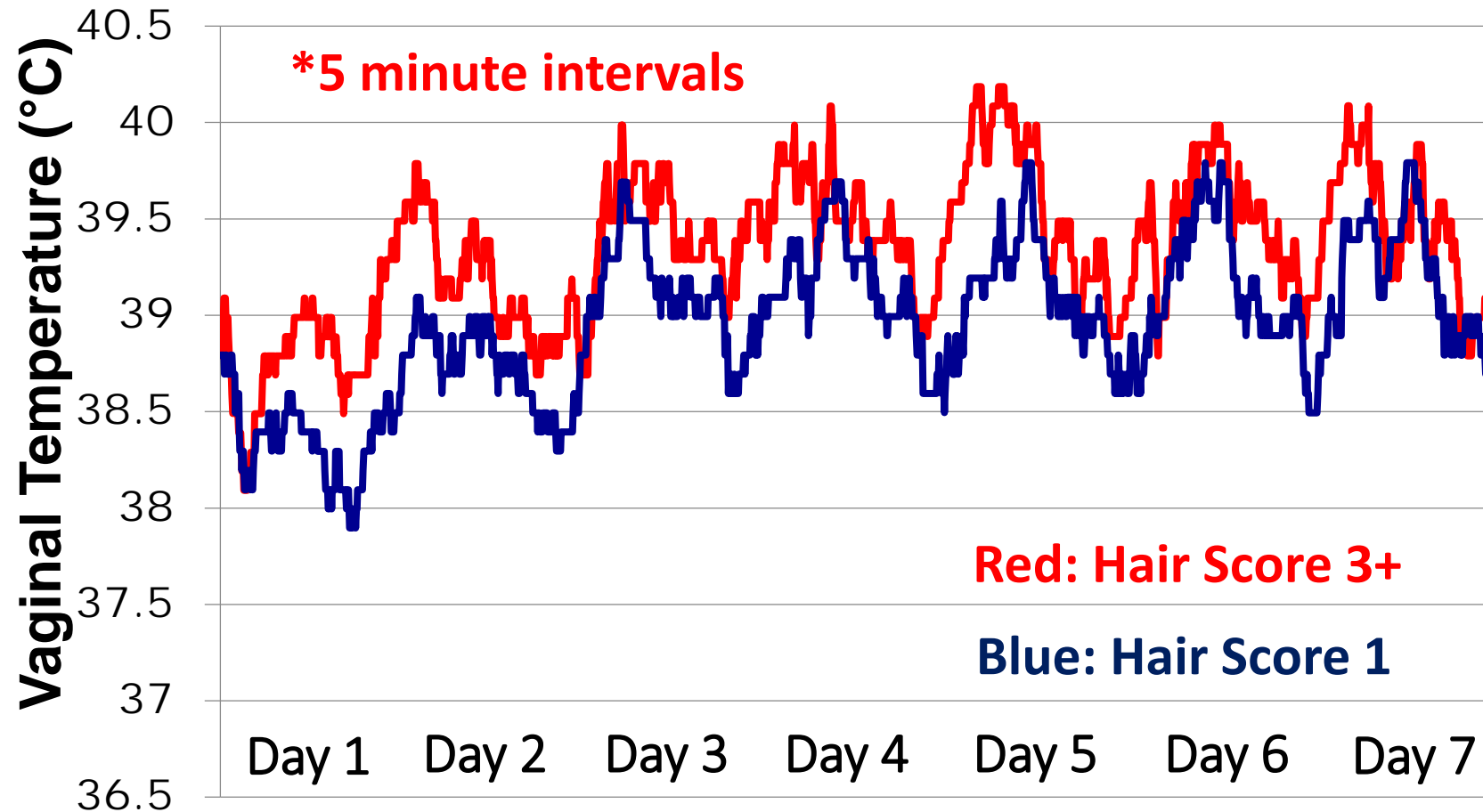
*Improving dairy feed efficiency,  
sustainability and profitability by  
impacting farmer's breeding & culling  
decisions.*



**The Dairy Feed Efficiency Team**



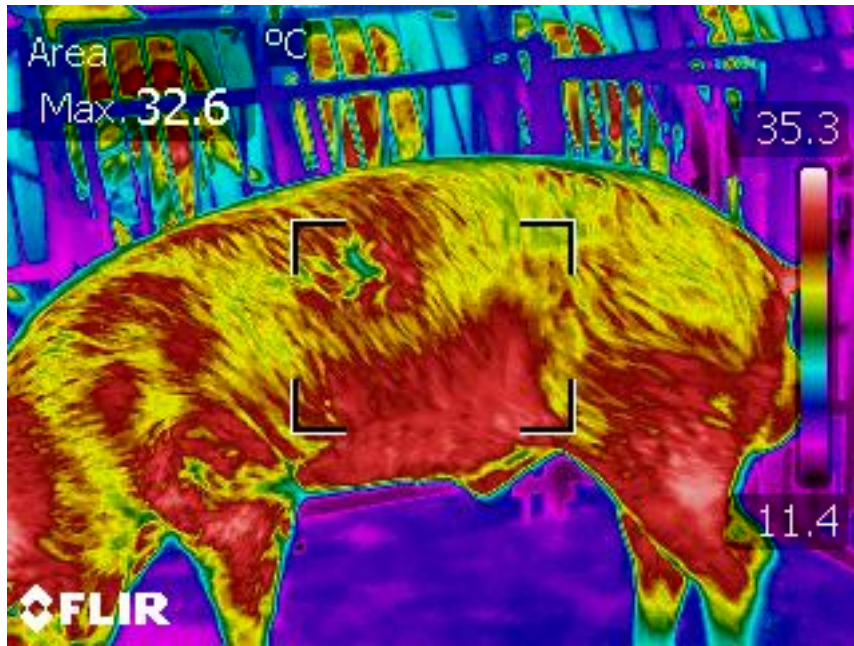
# Serial\* vaginal temperature variation due to differences in hair score<sup>1</sup>



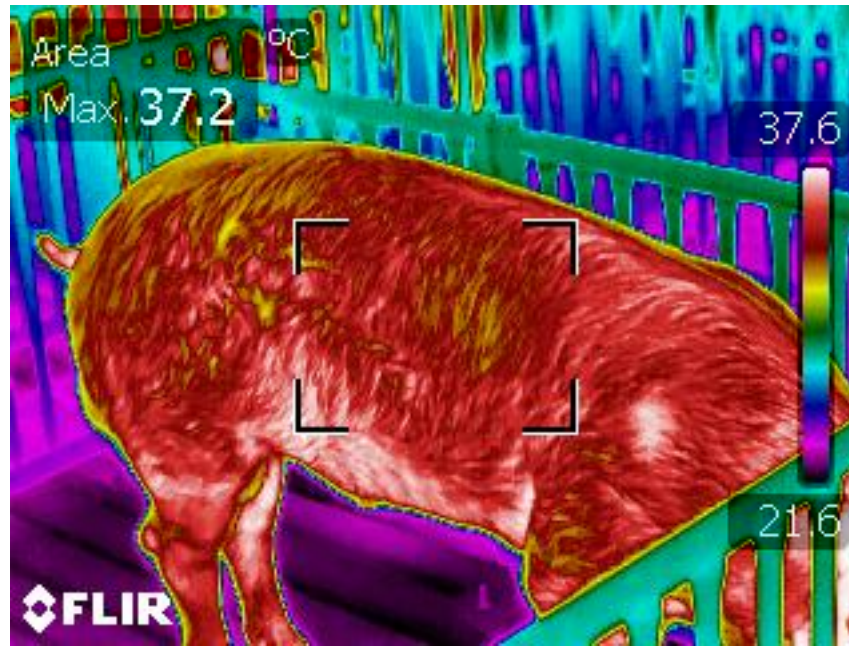
<sup>1</sup>Koltes et al., 2017 (Heat and Toxic Fescue stress research trial)

# Thermal imaging (not IR) of body temperature in pigs\*

Early in the Day

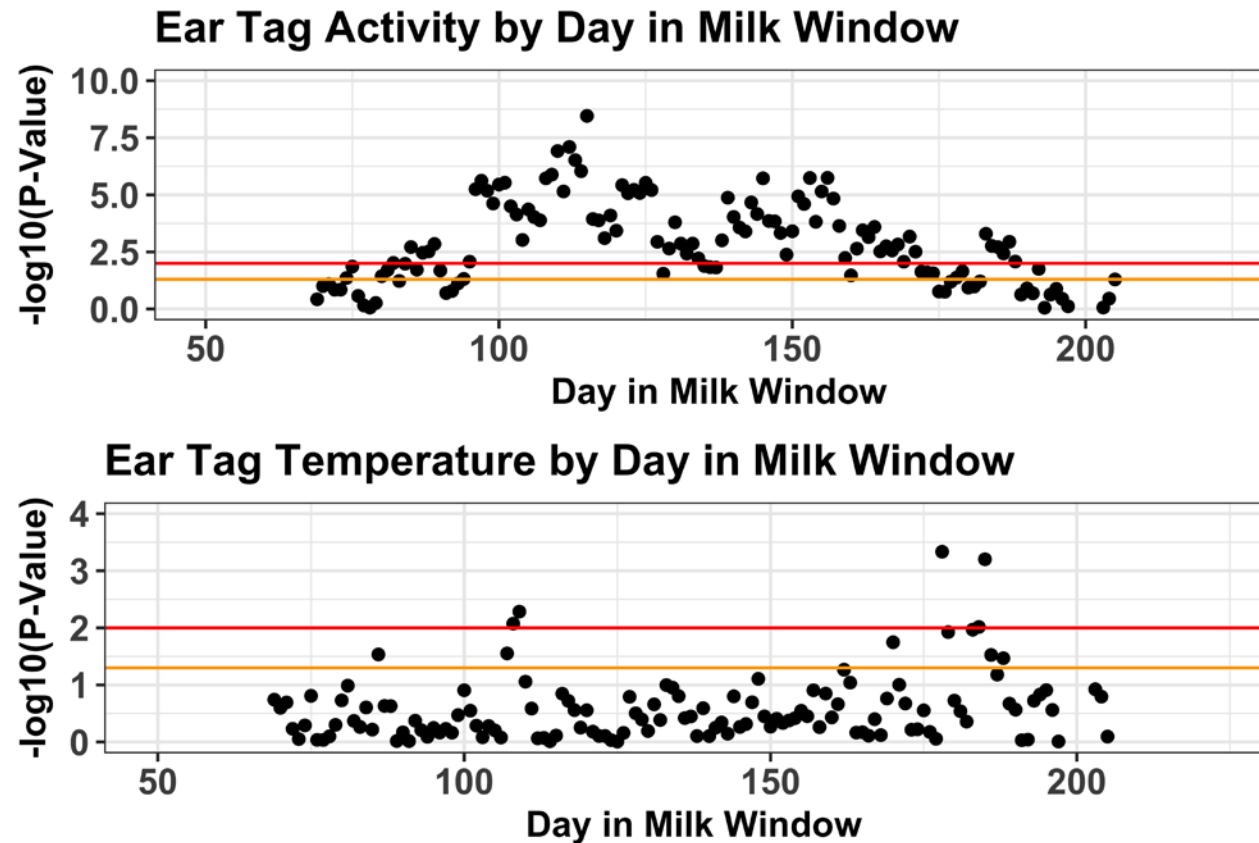


Mid to late Day

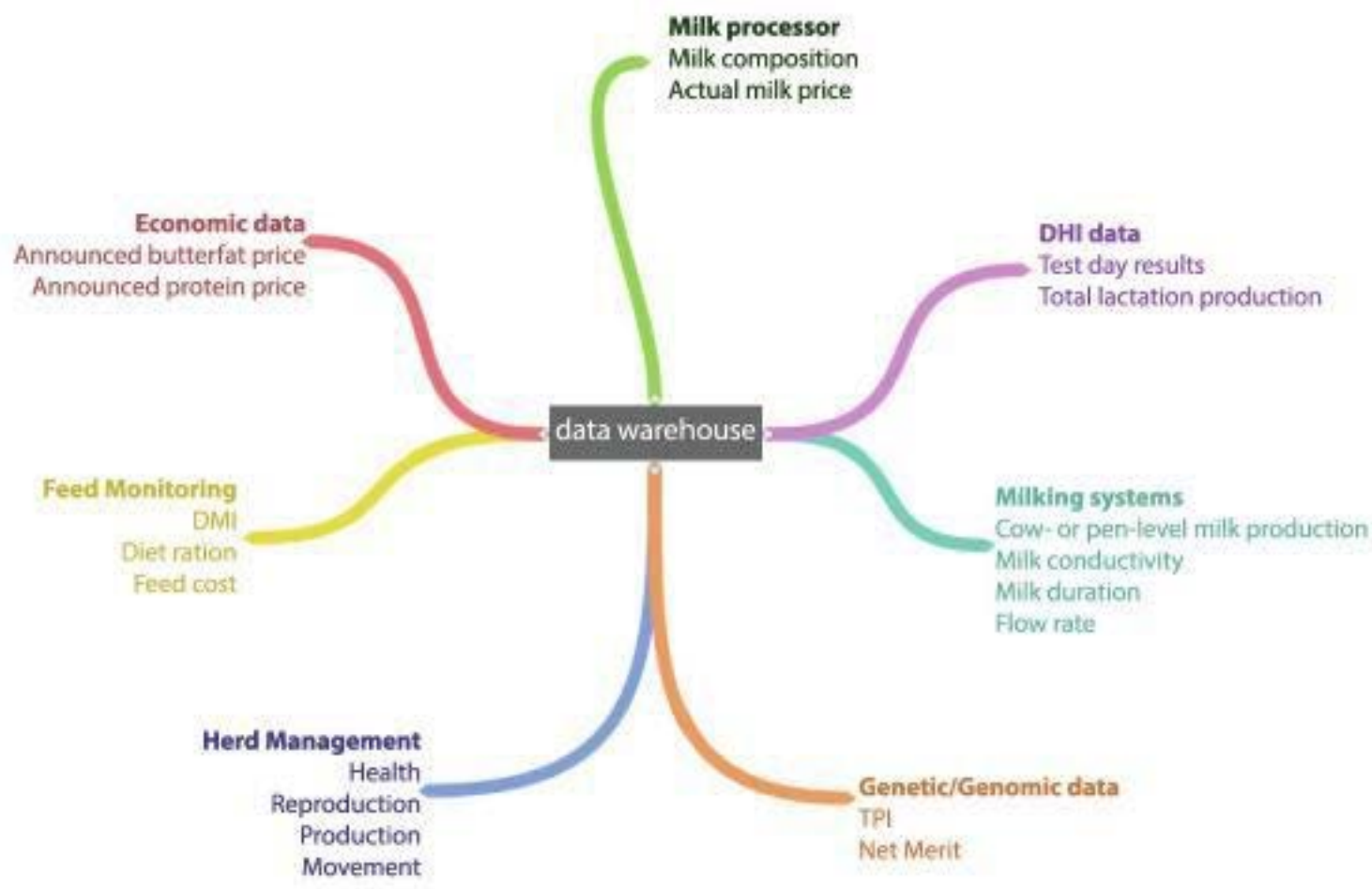


\*Courtesy Dr. Benny Mote: University of Nebraska

# Ear Tag Data - By DIM Analysis



# Where are we going in precision dairy



- What is your current Mastitis risk for each cow?
- How should you group cows to maximize productivity & health while minimizing feed needed.
- What is your current cost of production per cow, given current milk prices, cow performance, cull prices, etc.?
- Where are the places on farm that could be adjusted that might be hard to find but may facilitate opportunities to increase on farm profitability?

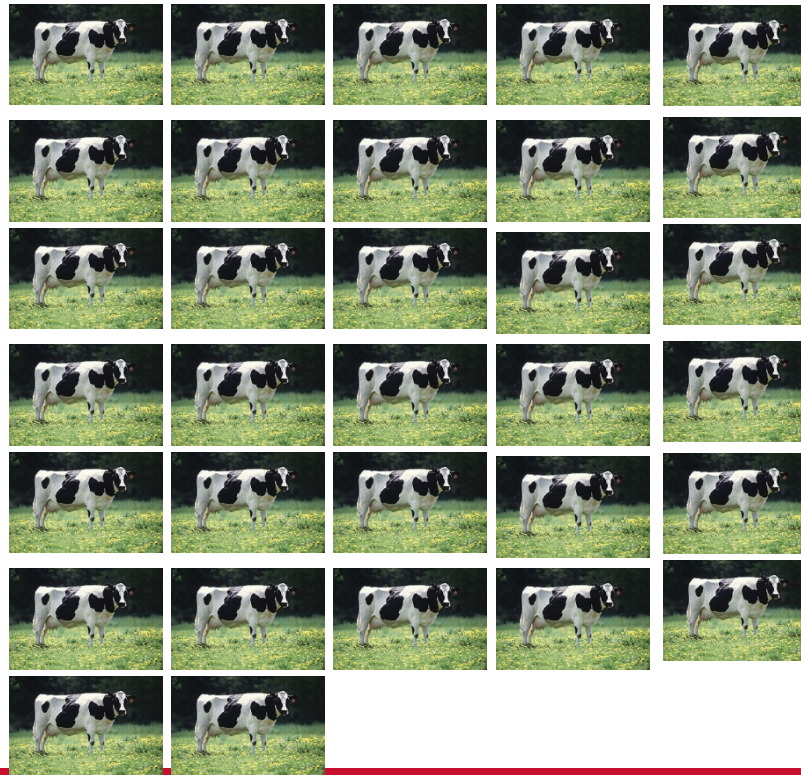
Image from AgUpdate.com (June 2018) about the Virtual Dairy Brain project at UW-Madison



# What's a single SNP genotype worth?



Pedigree is equivalent to information on **~7** daughters



For protein yield ( $h^2=0.30$ ), the SNP genotype provides information equivalent to an additional **~32** daughters