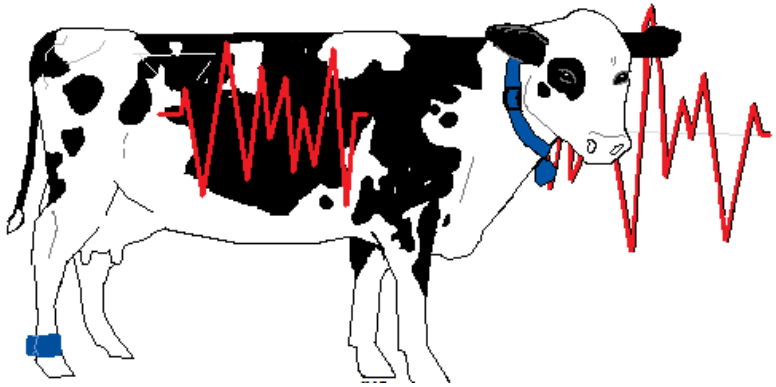
Smart Cow: Precision Ag

Jeffrey Bewley, PhD, Extension Dairy Specialist

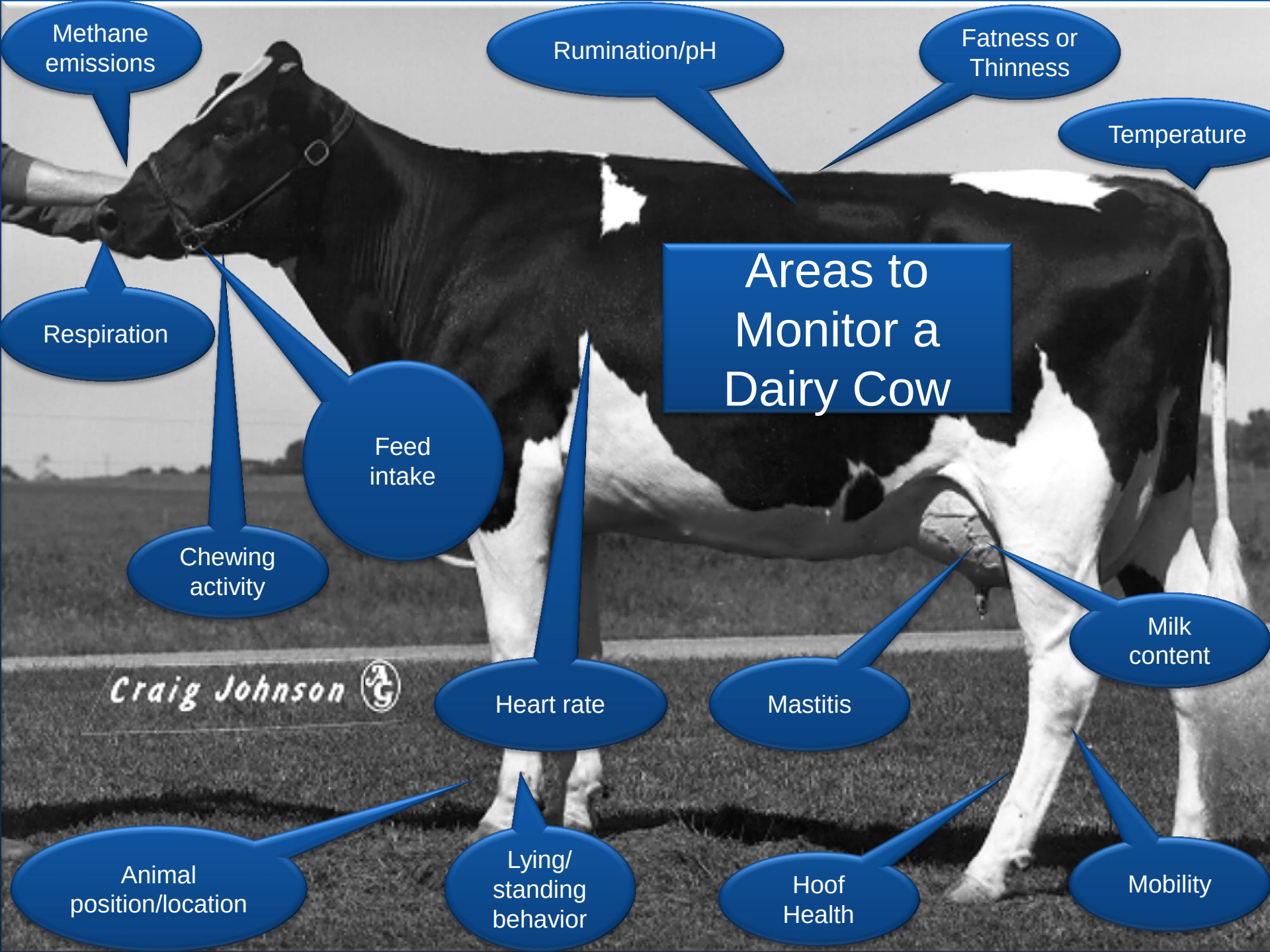
Amanda Stone, Randi Black, Barbara Wadsworth, Di Liang, Karmella Dolecheck, Matthew Borchers, Lauren Mayo, Nicky Tsai, Maegan Weatherly, Melissa Cornett, Samantha Smith, Megan Hardy, Jenna Klefot, Juha Hietaoja, Barbara Wolfger, Elizabeth Eckelkamp, Savannah Meade, Joey Clark, Denise Ray

Precision Dairy Management



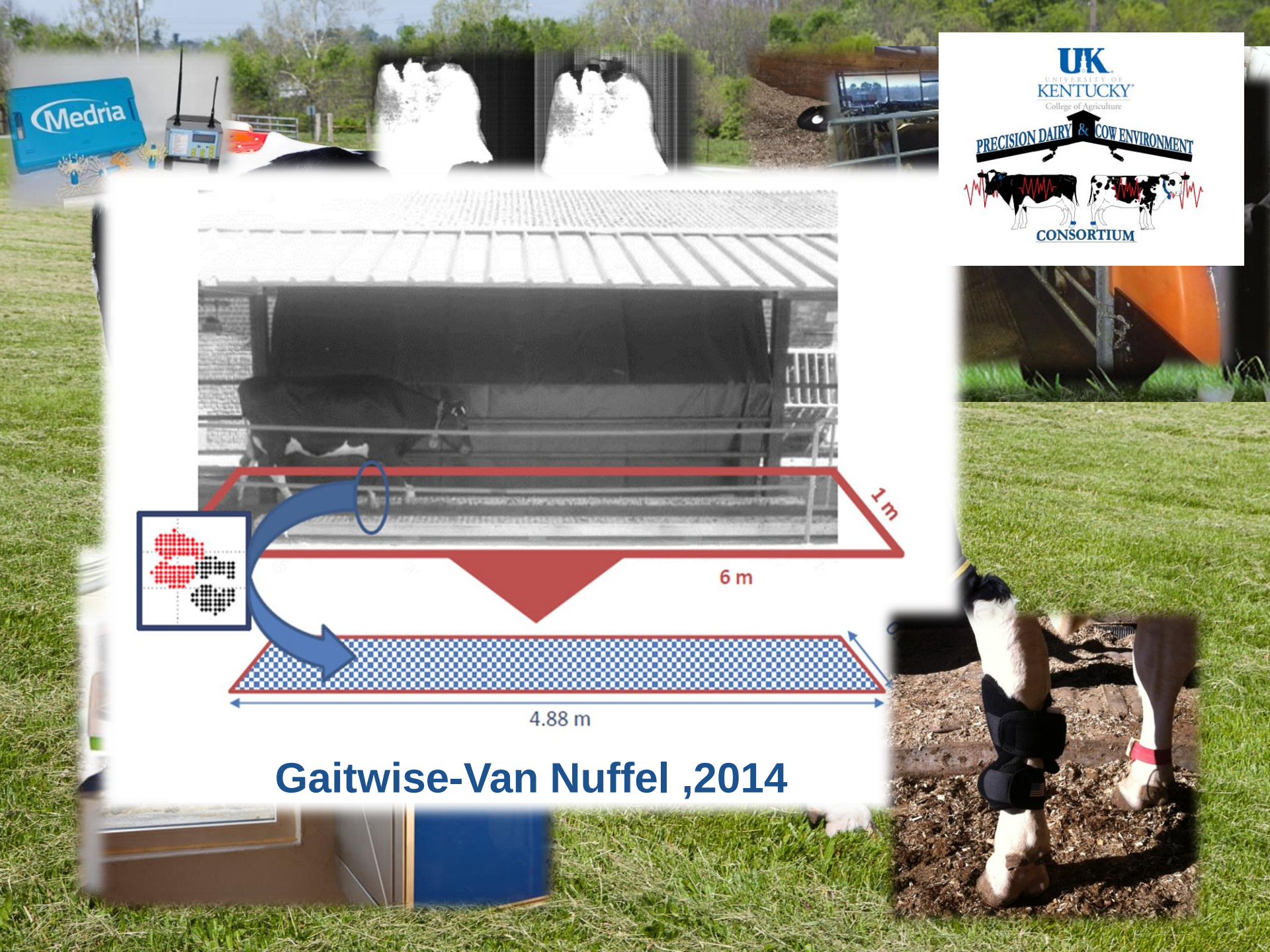
The use of automated, mechanized technologies toward refinement of dairy management processes, procedures, or information collection

Happy Cows via Technology?


Methane emissions
Rumination/pH
Fatness or Thinness
Temperature
Areas to Monitor a Dairy Cow
Respiration
Feed intake
Chewing activity
Craig Johnson
Heart rate
Mastitis
Milk content
Animal position/location
Lying/ standing behavior
Hoof Health
Mobility

Ideal Technology

- Explains an underlying biological process
- Can be translated to a meaningful action
- Cost-effective
- Flexible, robust, reliable
- Simple and solution focused
- Information readily available to farmer
- Commercial demonstrations



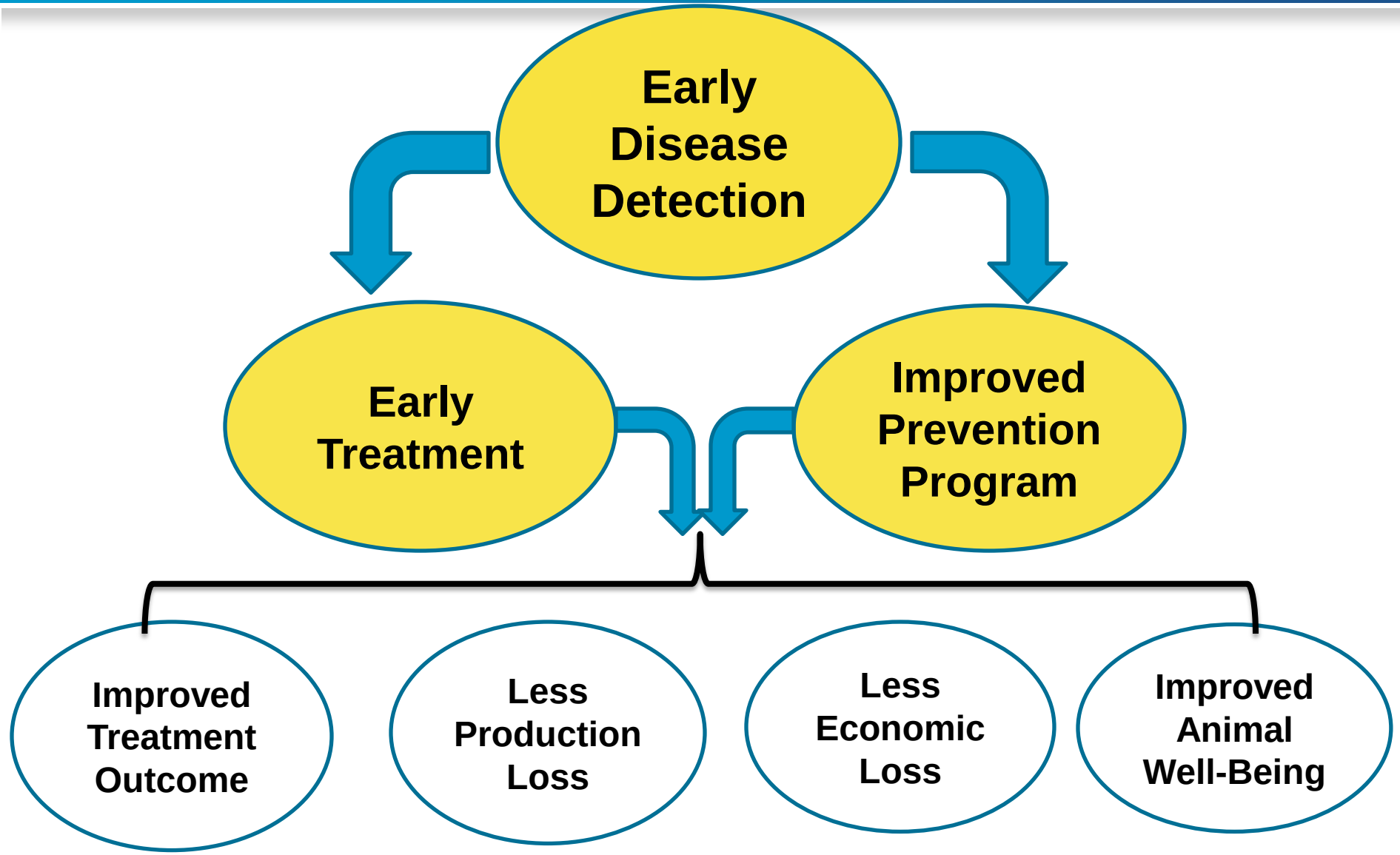
Gaitwise-Van Nuffel ,2014

So Many Options!!!!

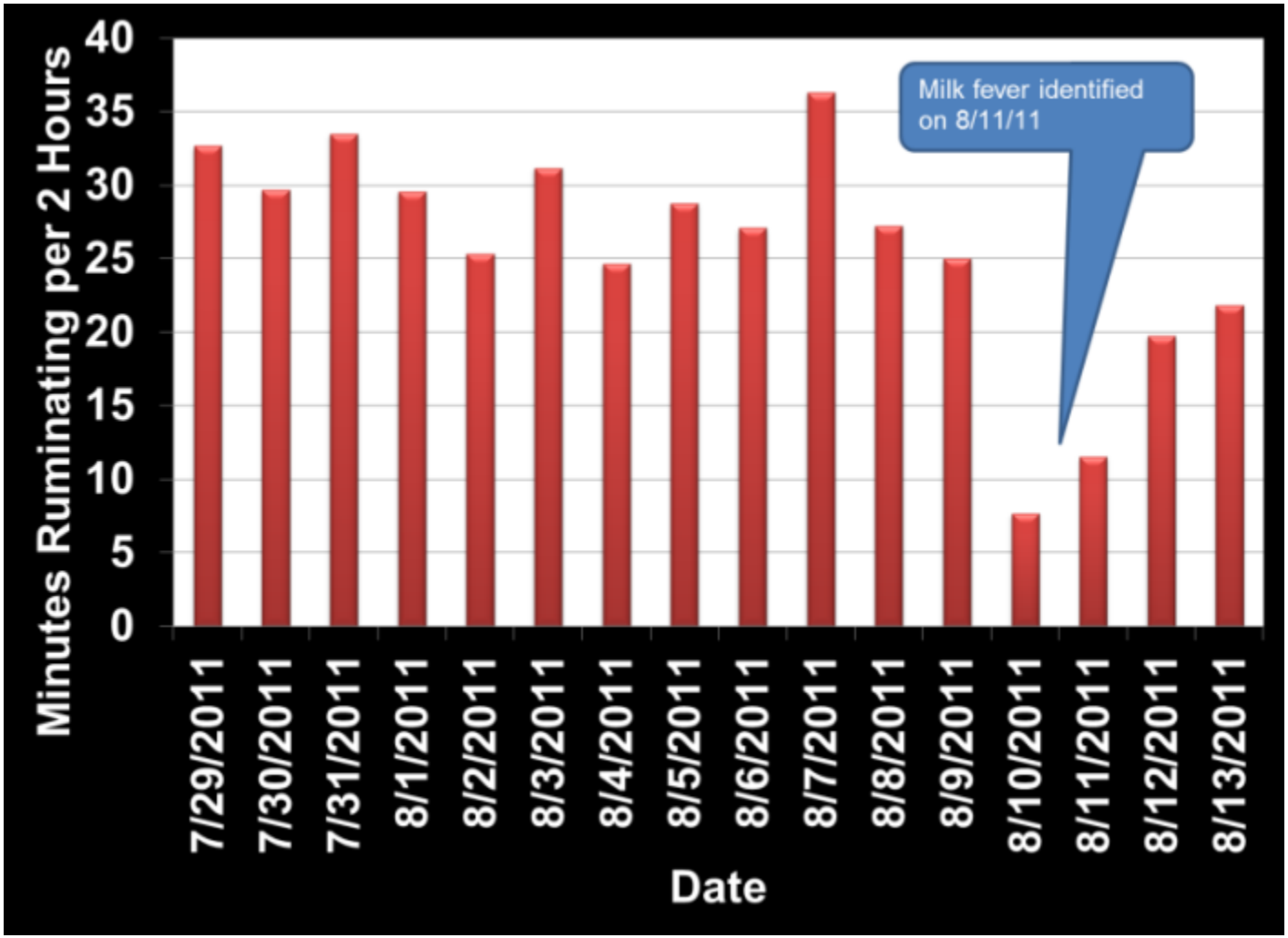
Precision Dairy Farming Benefits

- Improved animal health and well-being
- Increased efficiency
- Reduced costs
- Improved product quality
- Minimized adverse environmental impacts
- More objective

Disease Detection Benefits

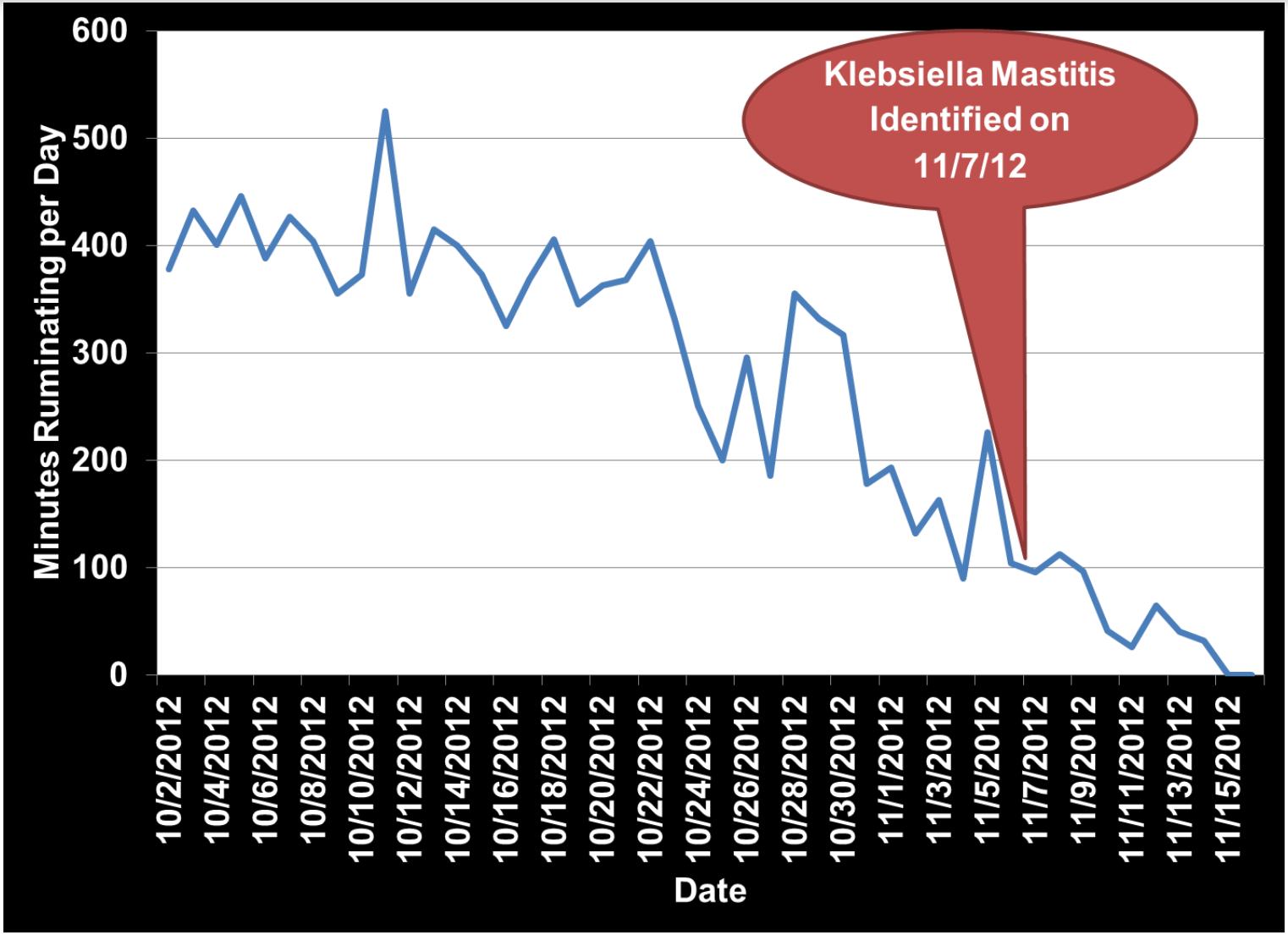


SCR HR Tag for Milk Fever Detection



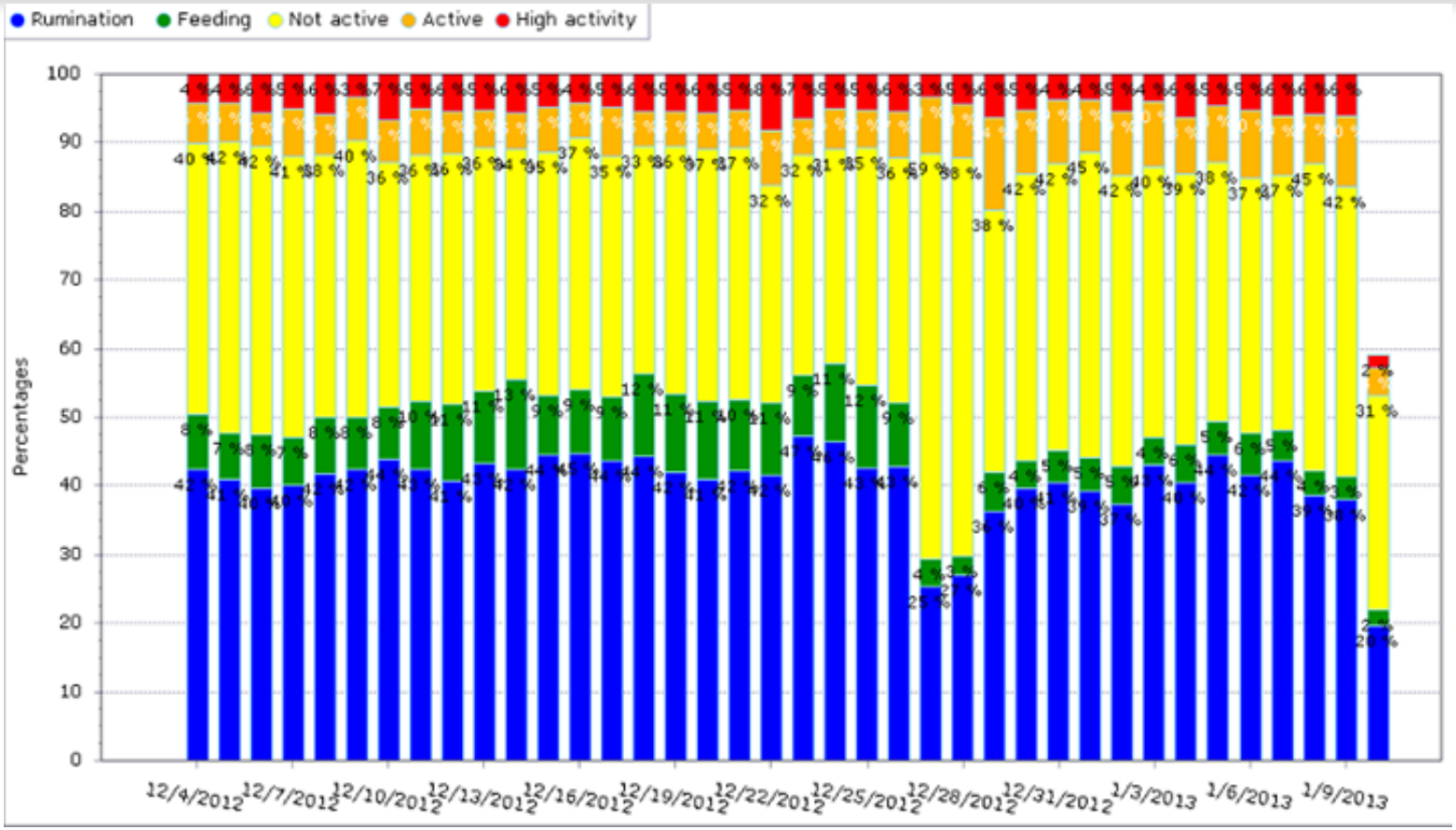
Amanda Stone et al. , Unpublished Data

SCR Rumination Time



Amanda Stone et al. , Unpublished Data

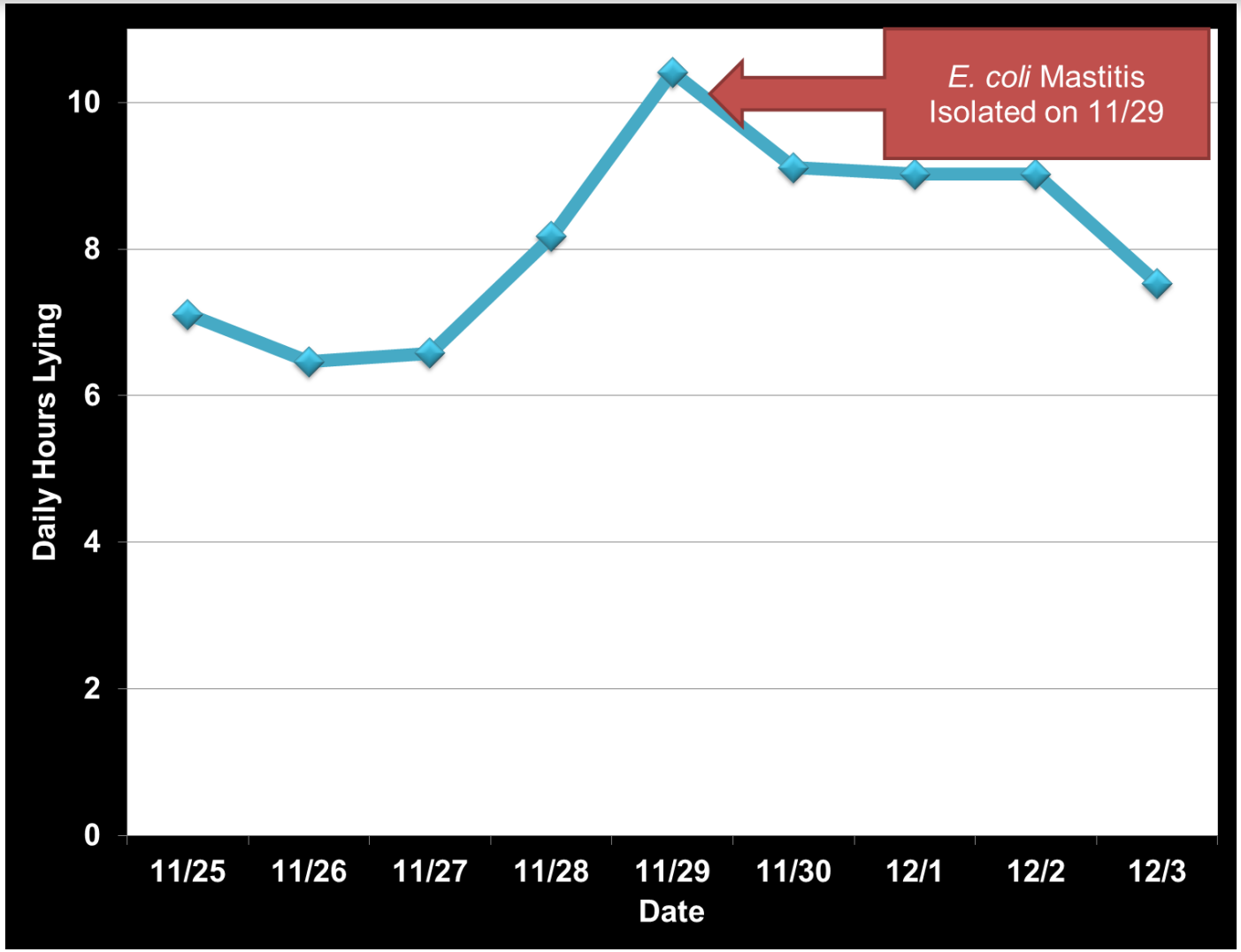
Agis Health Alert



***Staph aureus* isolated on 12/29/12. Health alert on 12/27/12.**

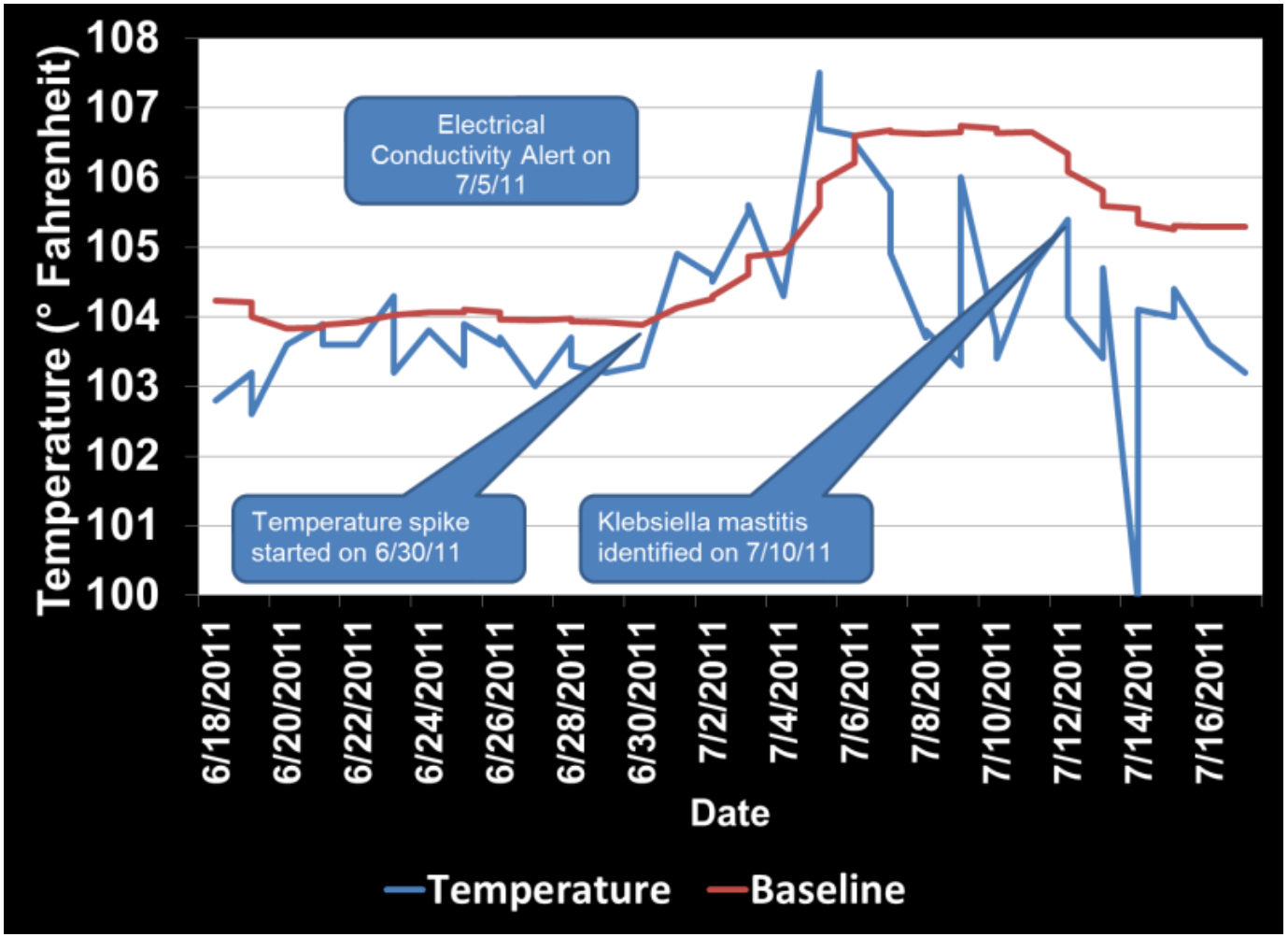
Stone et al. , Unpublished Data

IceQube Lying Time



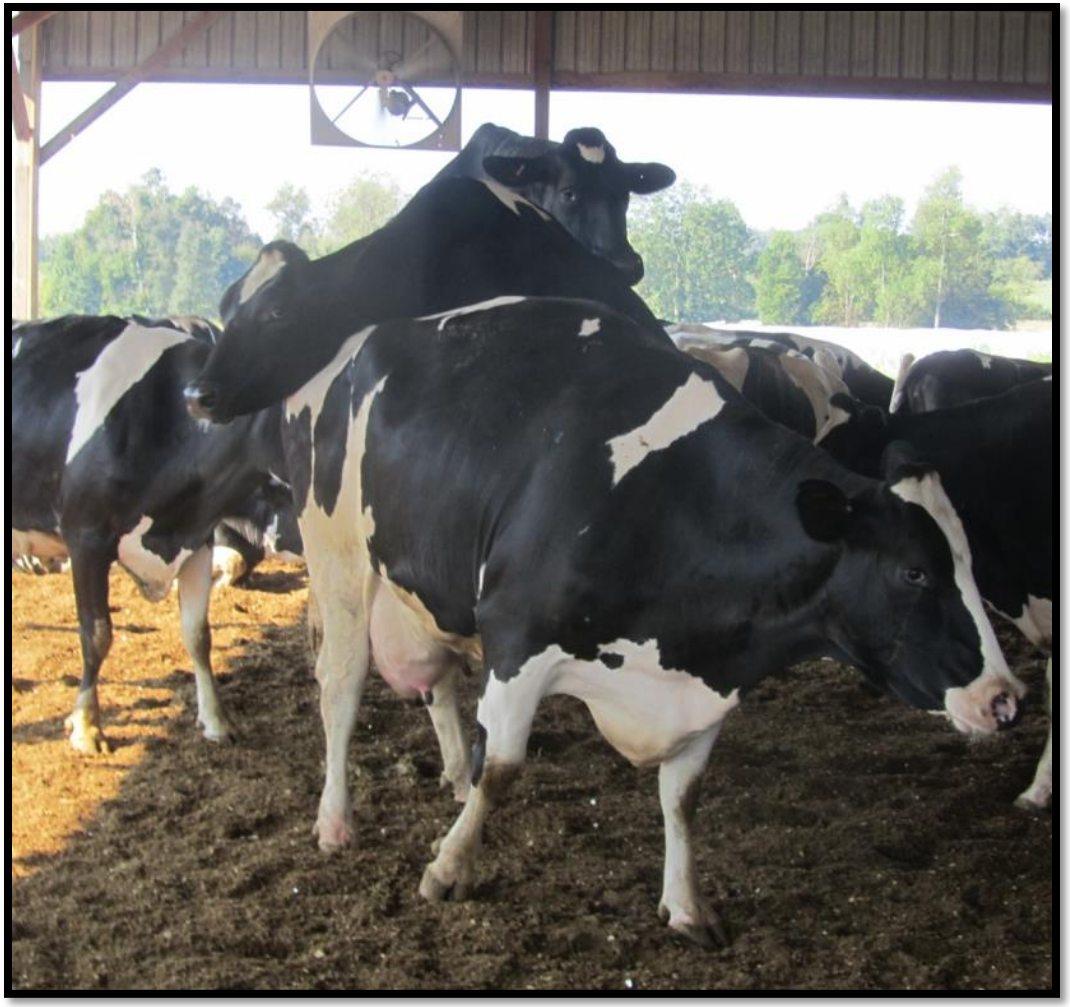
Stone et al. , Unpublished Data

DVM Systems Temperature and Milkline Individual Quarter Conductivity



Stone et al. , Unpublished Data

Estrus Detection



Estrus Detection

- Efforts in the US have increased dramatically
- Satisfaction closely tied to reproductive performance before investment
- Only catches cows in heat
- Balanced approach with selective hormone intervention
- Tag management, data management, and algorithms matter

SCR HR Tag/AI24

GEA Rescounter II

DairyMaster MooMonitor/ SelectDetect

AFI Pedometer +

BouMatic HeatSeeker II

Track a Cow

Comparison of timed artificial insemination and automatic activity monitoring as reproductive management strategies in three commercial dairy herds

K.A. Dolecheck, W.J. Wilvia, G. Heersche Jr.,
C.L. Wood, K.J. McQuerry, and J.M. Bewley

Study Cows

- Three commercial Holstein herds in Kentucky
- No clinical metabolic diseases
- Veterinary check
  - Normal ovarian activity
- Body condition score ≥ 2.50

Dolecheck et al., 2014

Cow Treatment Allocation

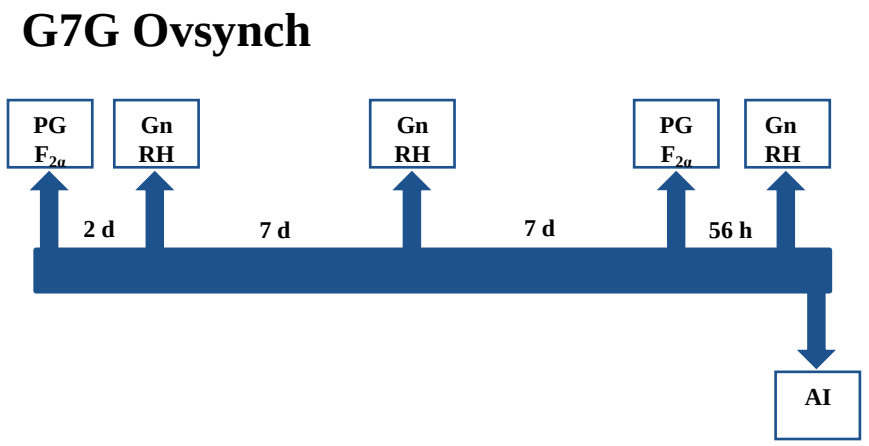
- 90 d study period
  - No visual estrus detection
- Balanced for
  - Parity (primiparous or multiparous)
  - Predicted milk yield (above or below herd average)

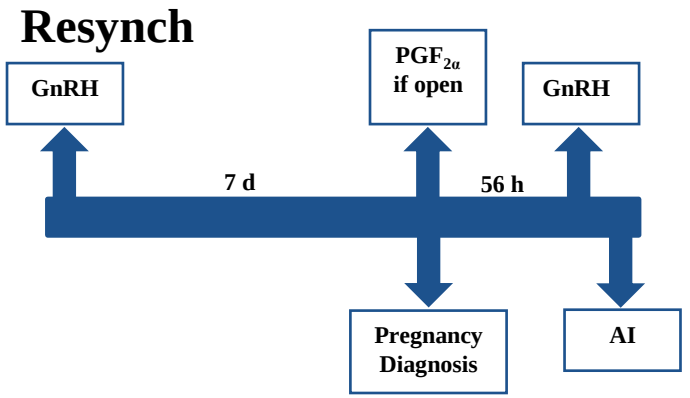
Dolecheck et al., 2014

Timed Artificial Insemination (TAI)

- **Combination of G7G, Ovsynch, and Resynch**

- **Up to three services (maximum possible in 90 d)**





Dolecheck et al., 2014

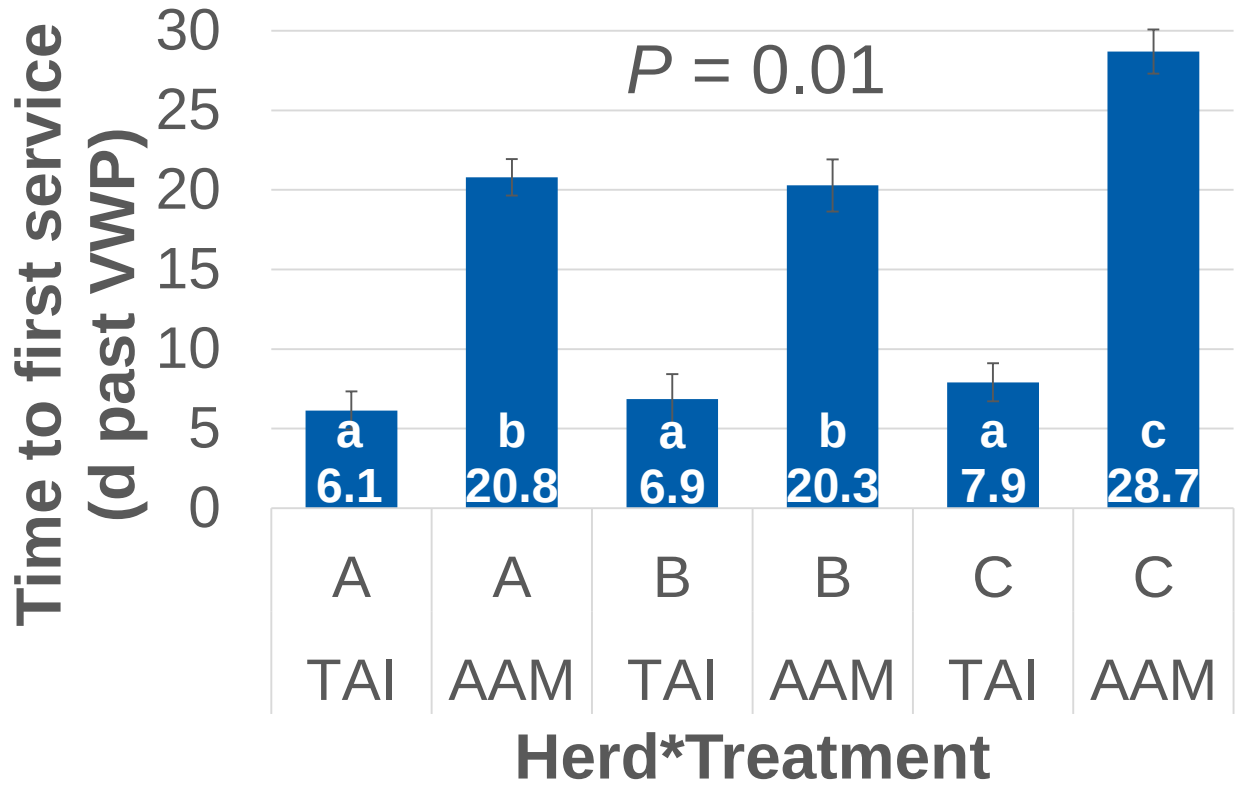
Automated Activity Monitoring (AAM)

- **AfiTag Pedometer™ Plus (Afimilk®, Kibbutz Afikim, Israel)**
  - **Number of steps, rest time, rest bouts**
  - **“Cows to be bred” report**
- **Veterinary examination determined hormone intervention ($PGF_{2\alpha}$ or GnRH) if no alert was created for a cow for > 32 days**

Dolecheck et al., 2014

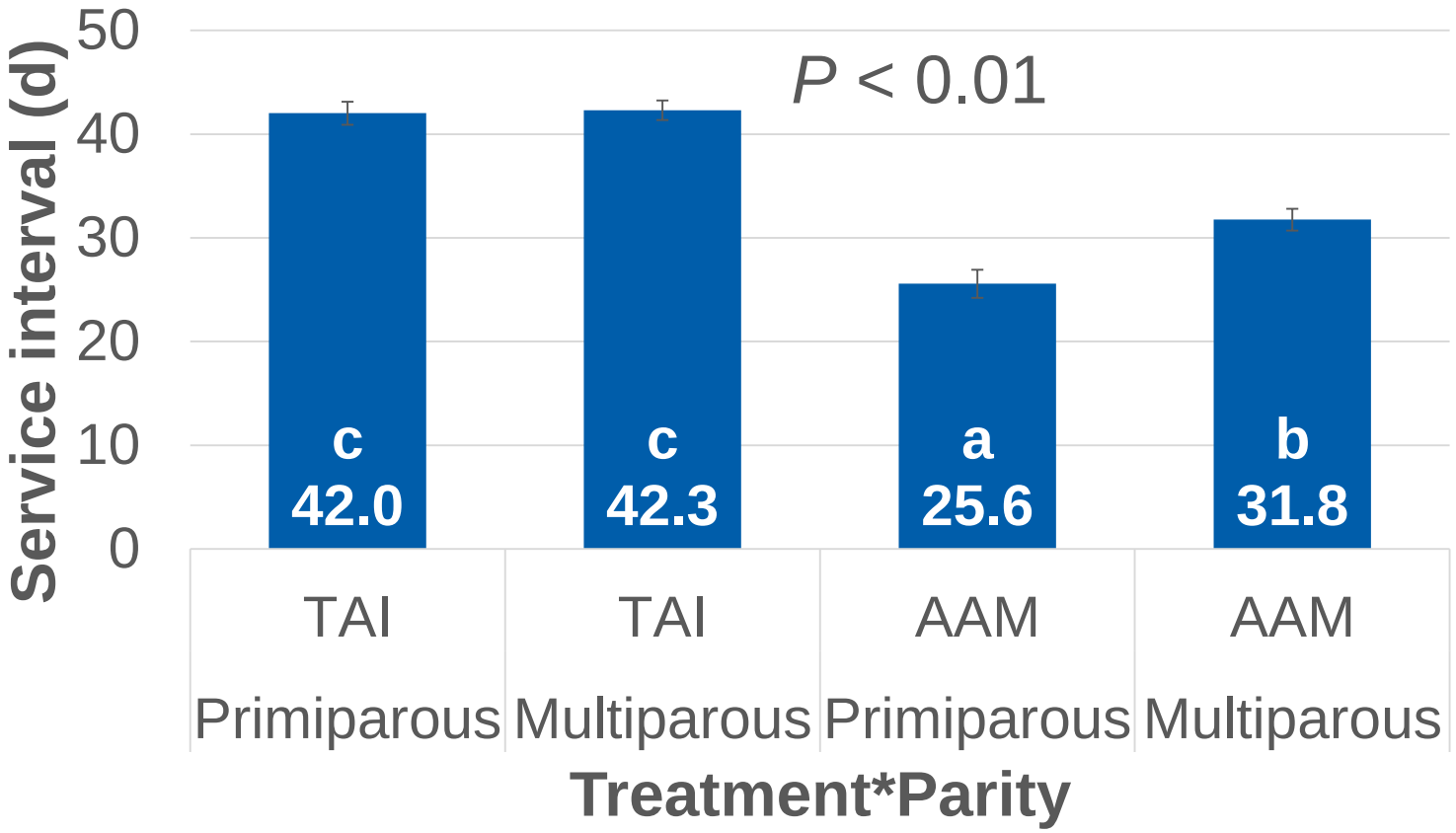
Time to First Service

- **Time to first service was significantly lower for TAI bred cows (15 d); the difference was greatest in Herd C**



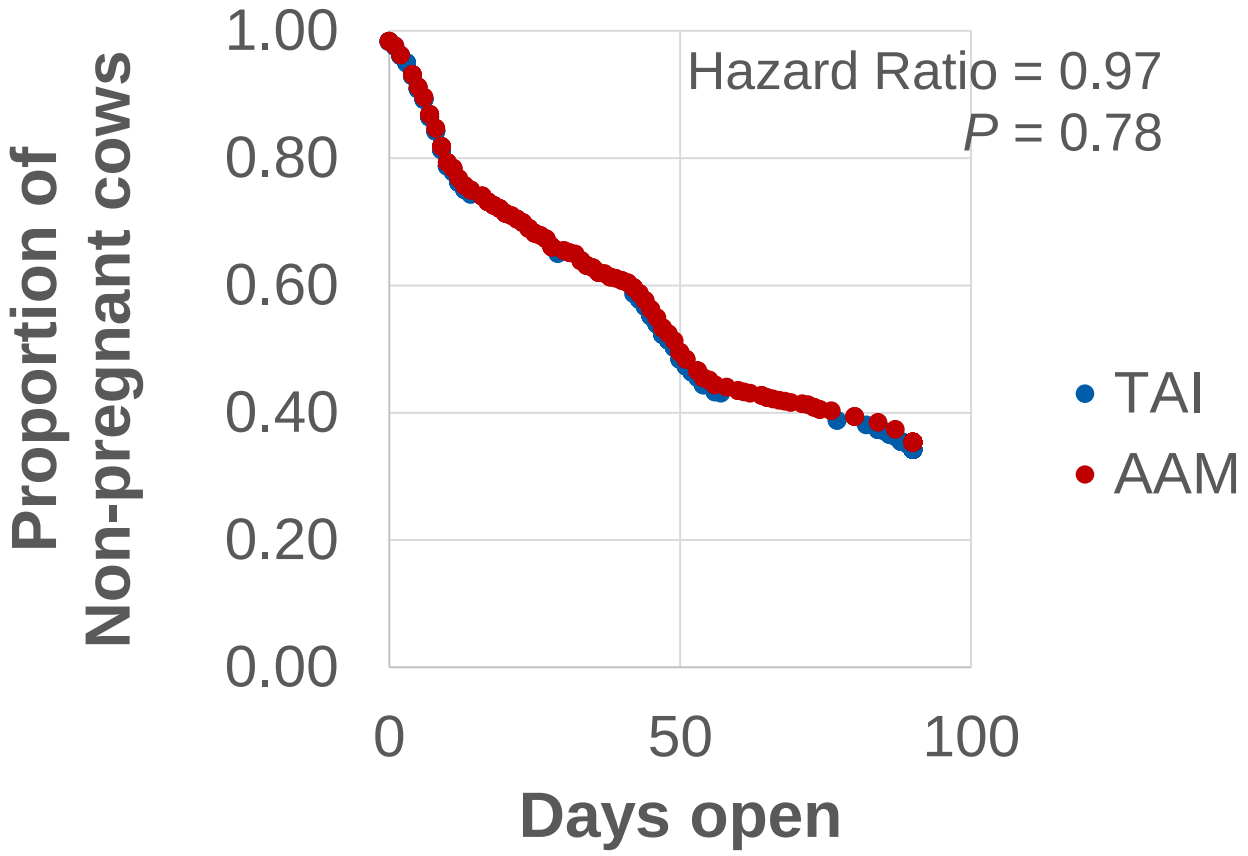
Service Interval

- **Service interval was shorter in AAM cows than TAI cows and shortest in primiparous AAM cows**



Rate of Pregnancy

- **No significant difference**



Dolecheck et al., 2014

Other Analysis

Parameter	n	TAI	AAM	*P*-value
First service conception rate (%)	539	41.5 ± 3.2	41.7 ± 3.5	0.97
Repeat service conception rate (%)	293	41.5 ± 4.4	49.9 ± 5.3	0.12
Services per pregnancy	356	1.58 ± 0.06	1.55 ± 0.06	0.70
Pregnancy loss (%)	397	10.5 ± 2.3	7.1 ± 2.0	0.20
Days open (d past VWP)	356	31.3 ± 1.9	35.3 ± 2.0	0.13
Proportion pregnant at 90 d (%)	543	67.5 ± 3.1	68.3 ± 3.2	0.84

Dolecheck et al., 2014

What Are the Limitations of Precision Dairy Farming?

PDF Reality Check

- Maybe not be #1 priority for commercial dairy producers (yet)
- Many technologies are in infancy stage
- Not all technologies are good investments
- Economics must be examined
- People factors must be considered

Technology Pitfalls

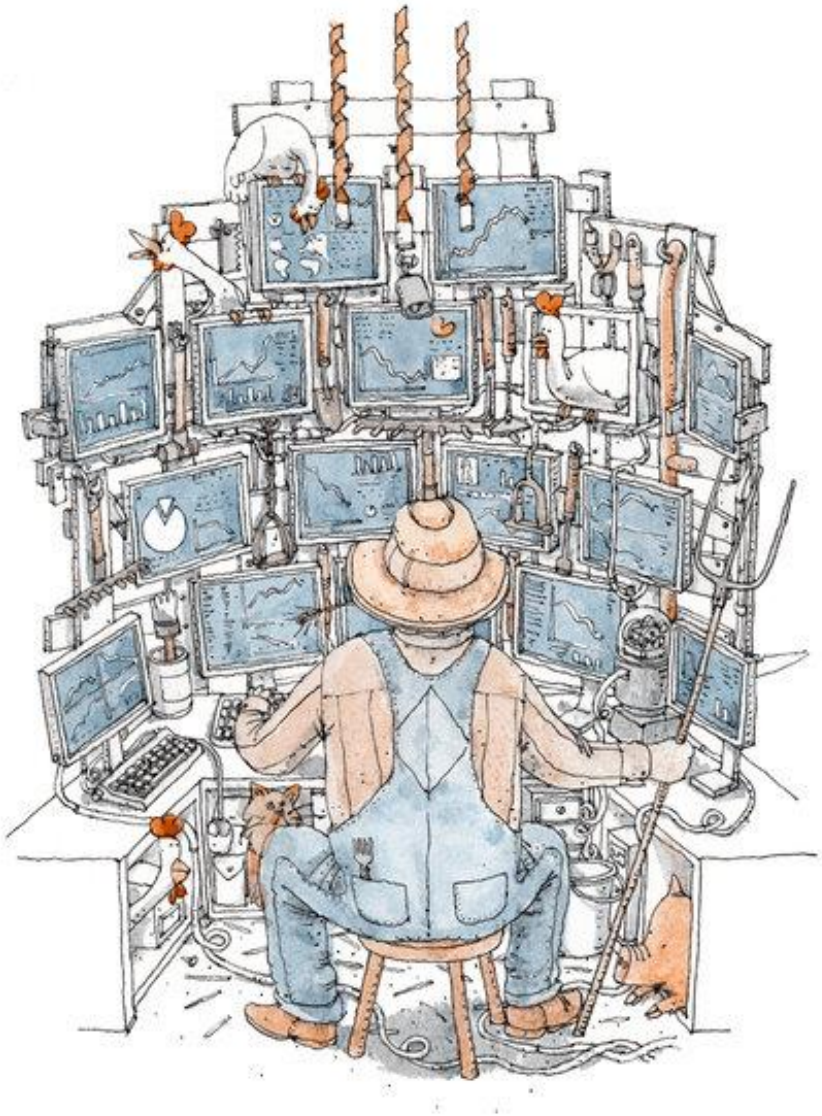
- “Plug and play,” “Plug and pray,” or “Plug and pay”
- Technologies go to market too quickly
- Not fully-developed
- Software not user-friendly
- Developed independently without consideration of integration with other technologies and farmer work patterns

Technology Pitfalls

- Too many single measurement systems
- Lack of large-scale commercial field trials and demonstrations
- Technology marketed without adequate interpretation of biological significance of data
- Information provided with no clear action plan

- Be prepared for little things to go wrong
- Be careful with early stage technologies
- Need a few months to learn how to use data
- Data integration is challenging

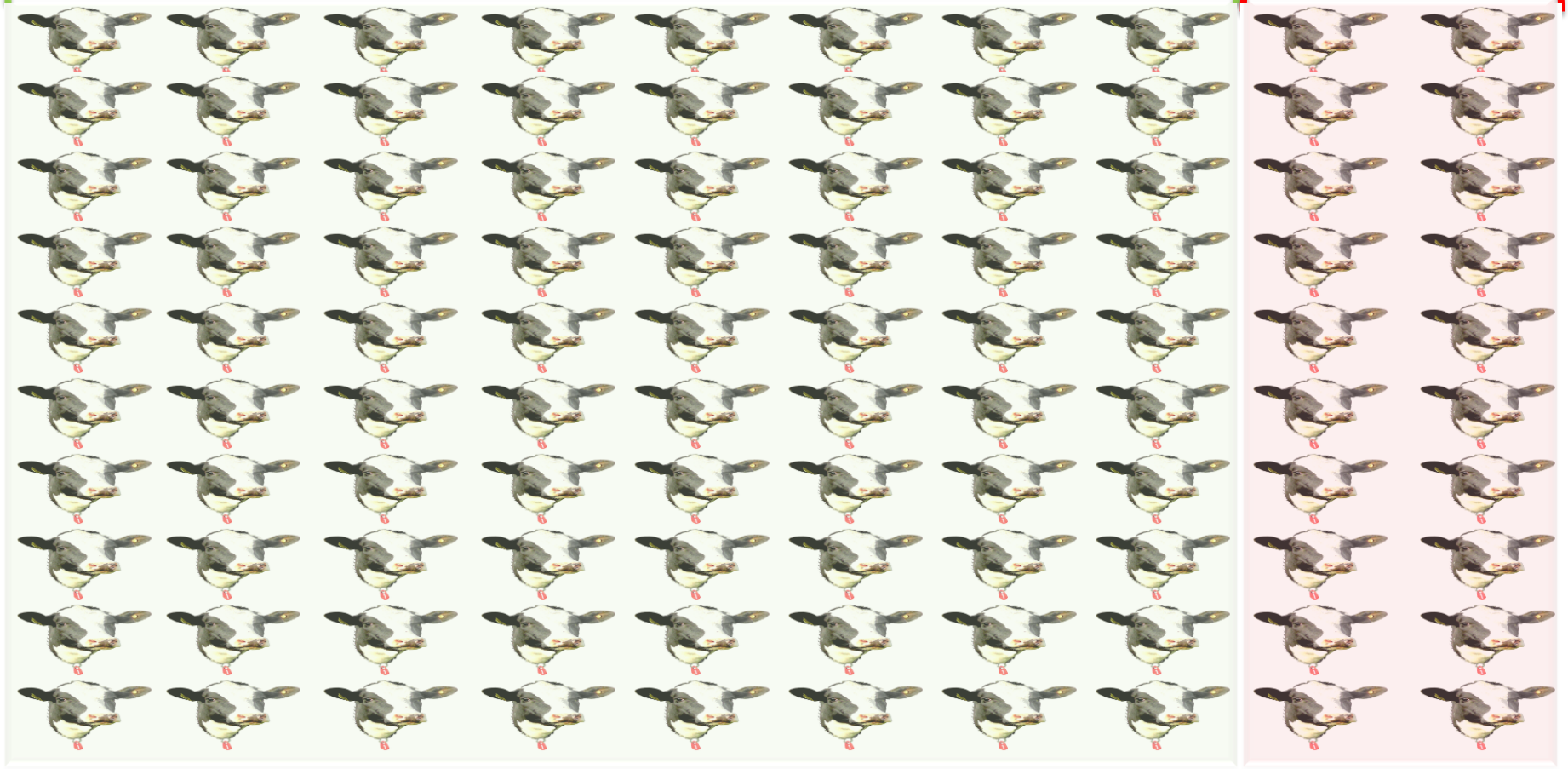
UK Herdsman Office



How Many Cows With Condition Do We Find?

80 Estrus Events Identified by Technology

20 Estrus Events Missed by Technology

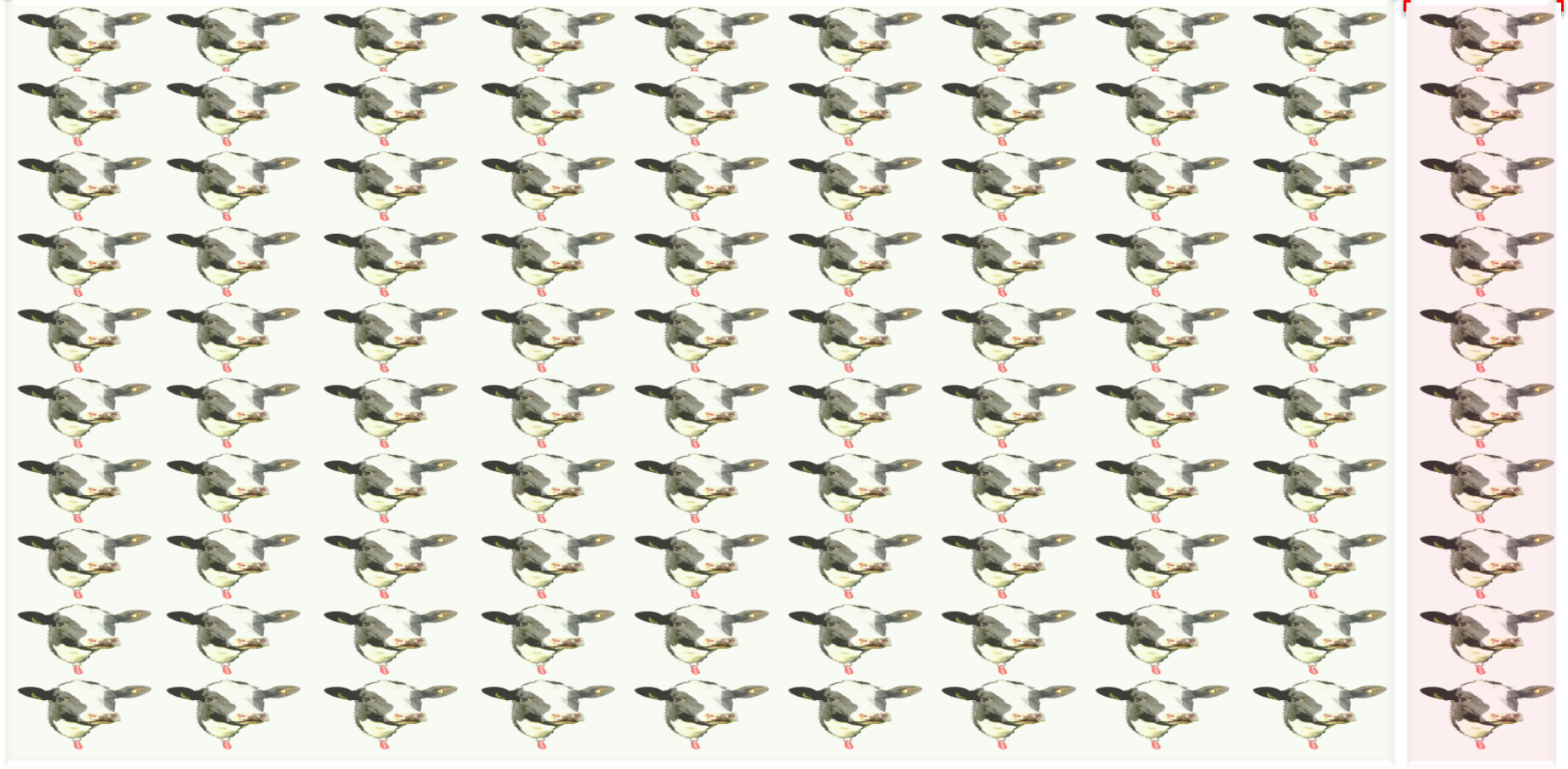


Example: 100 estrus events

How Many Alerts Coincide with an Actual Event?

90 Alerts for Cows Actually in Heat

10 Alerts for Cows Not in Heat

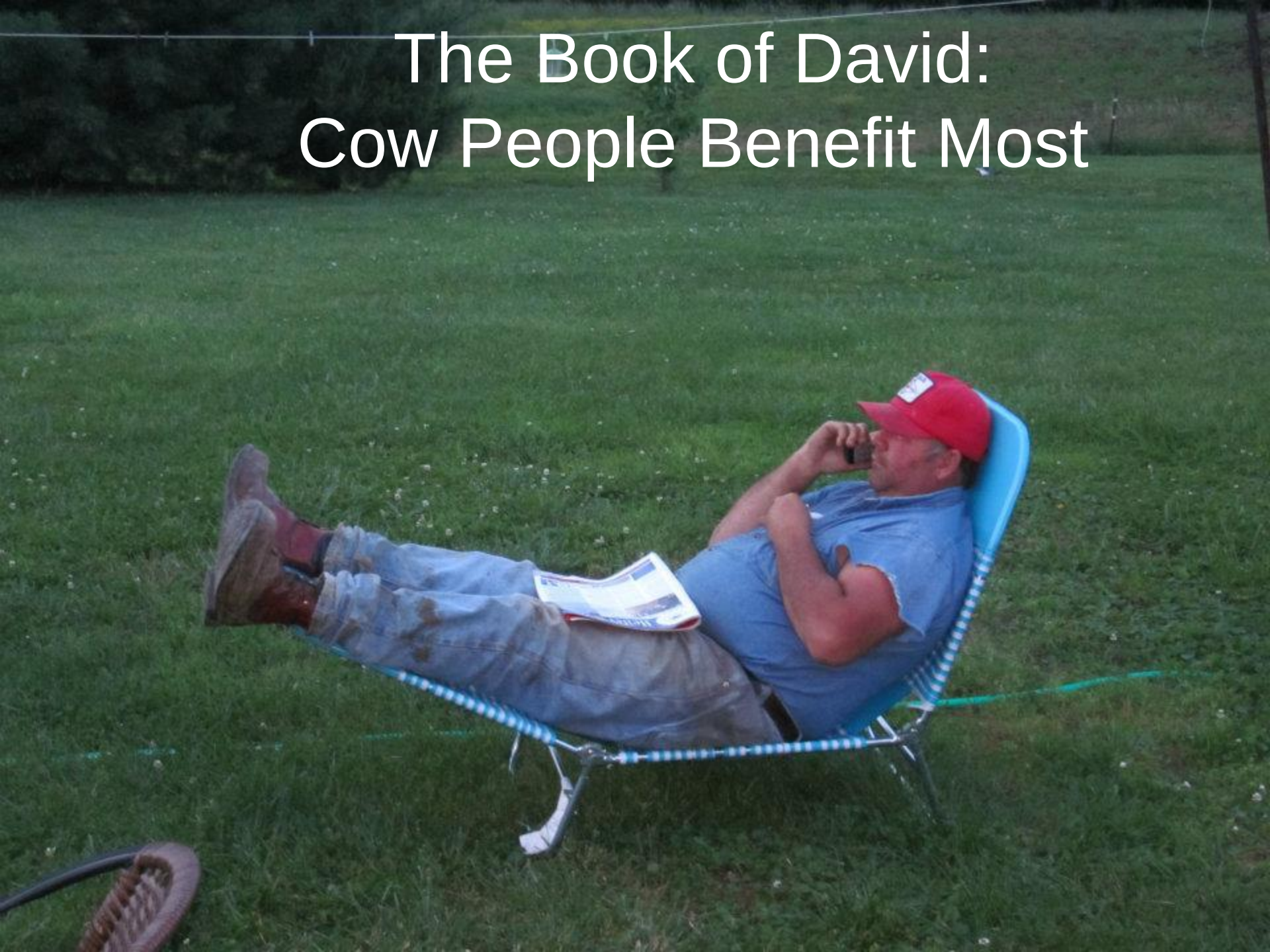


Example: 100 estrus events

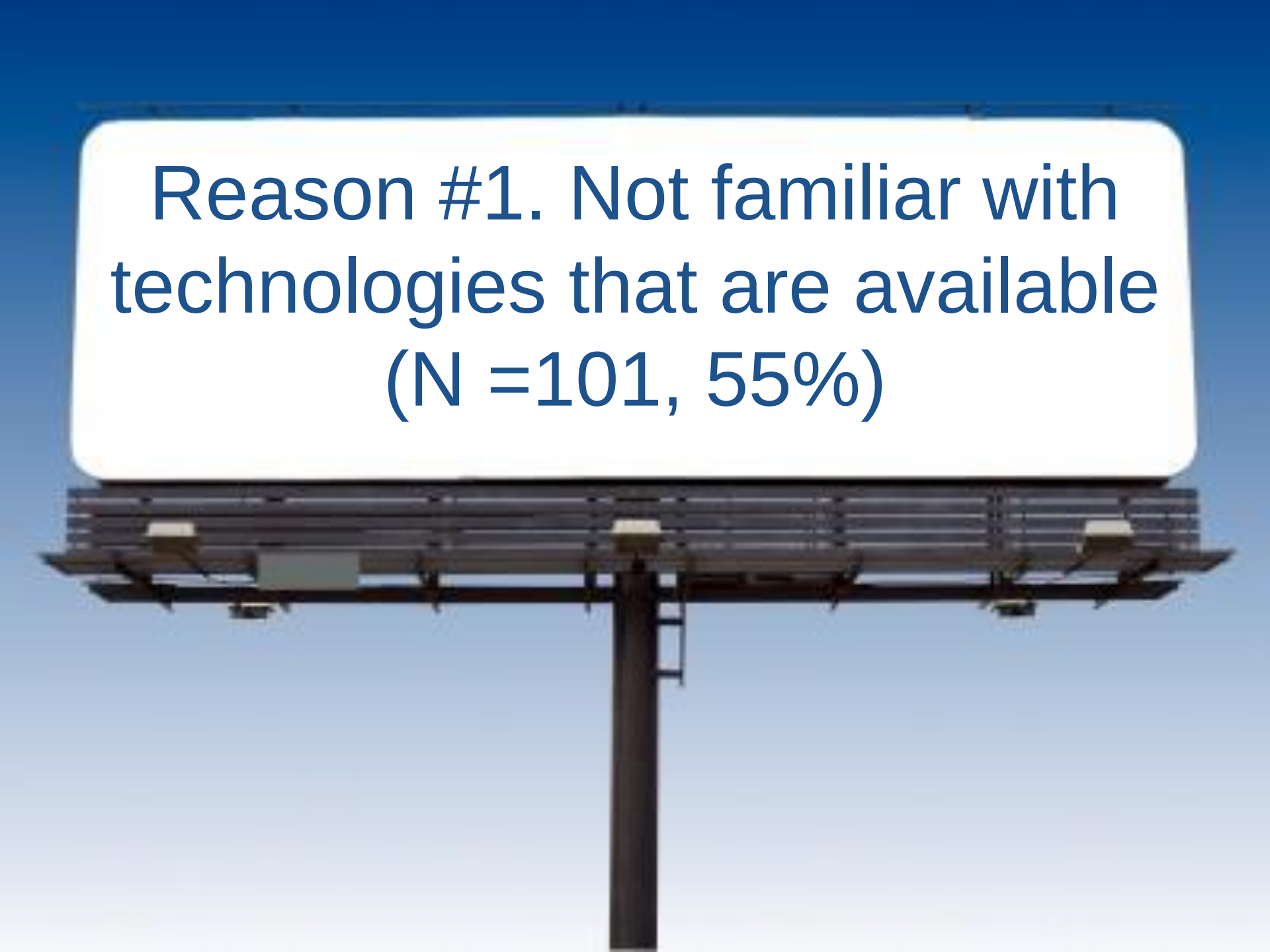
What's the Sweet Spot?

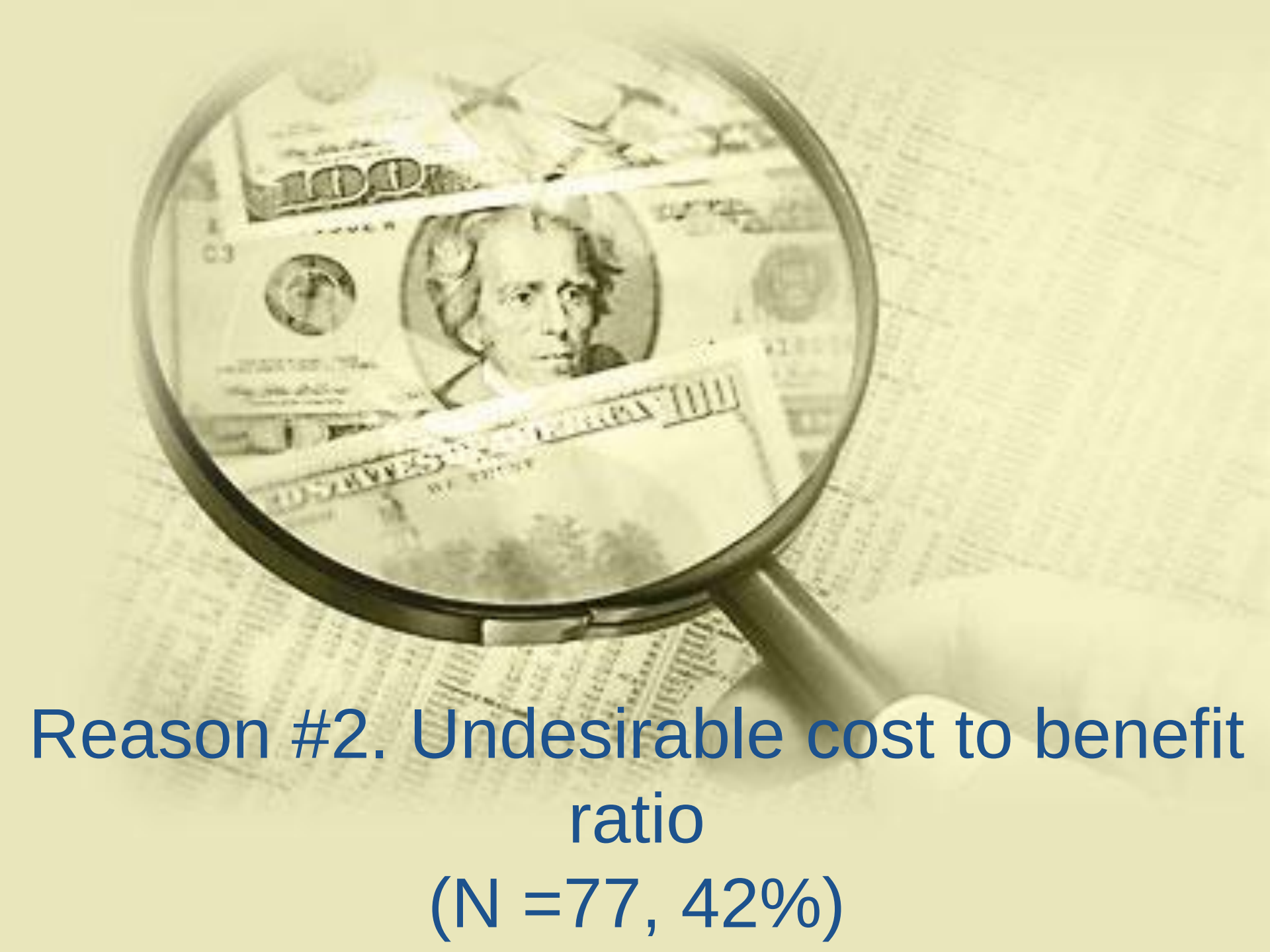
- Cost of missed event
  - High for estrus
  - Lower for diseases?
- Cost of false positive
  - Low for estrus
  - High for mastitis
- Farm dependent

The Book of David:
Cow People Benefit Most



Why Have Adoption Rates Been Slow?

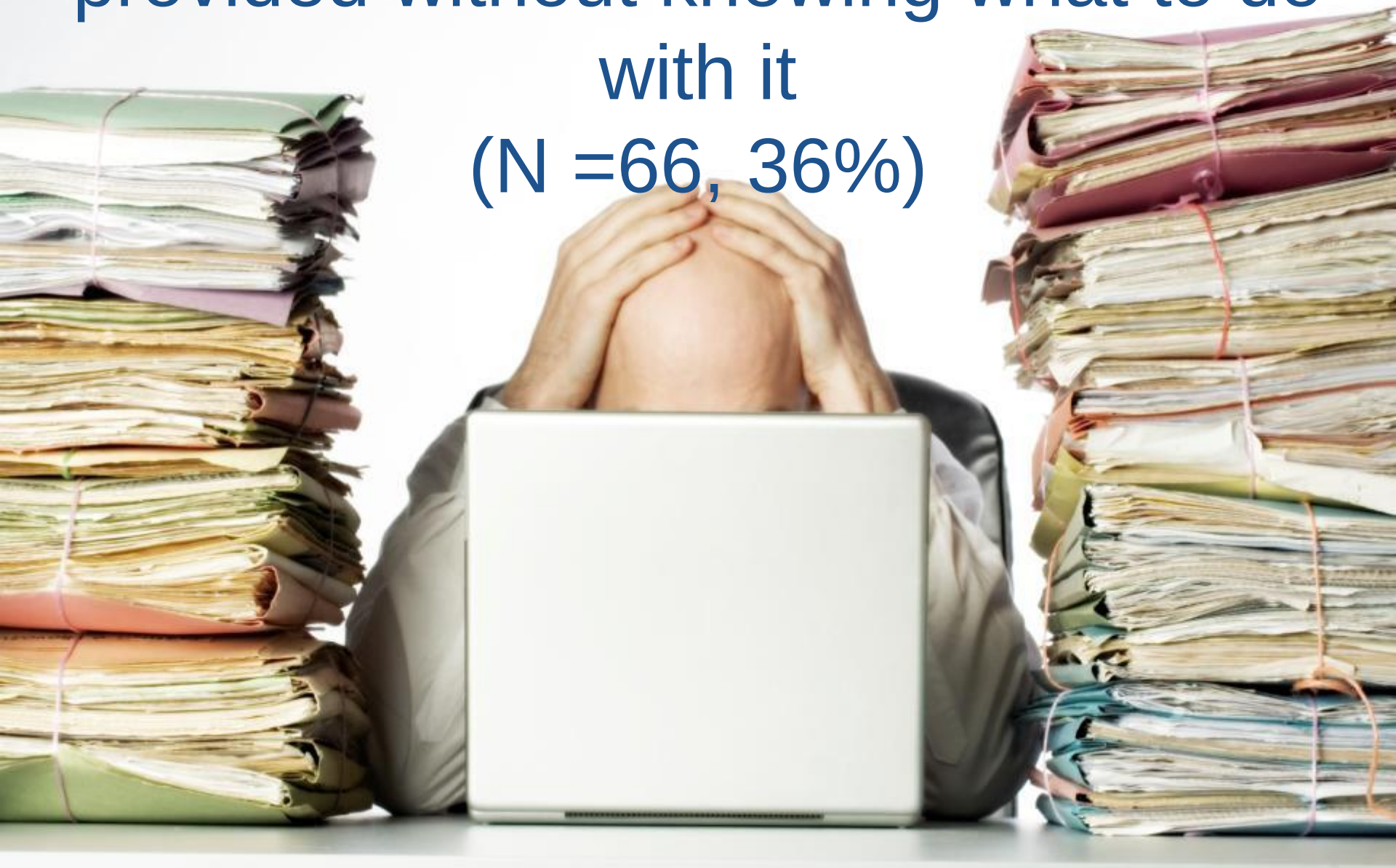

Reason #1. Not familiar with technologies that are available (N =101, 55%)



Reason #2. Undesirable cost to benefit ratio

(N =77, 42%)

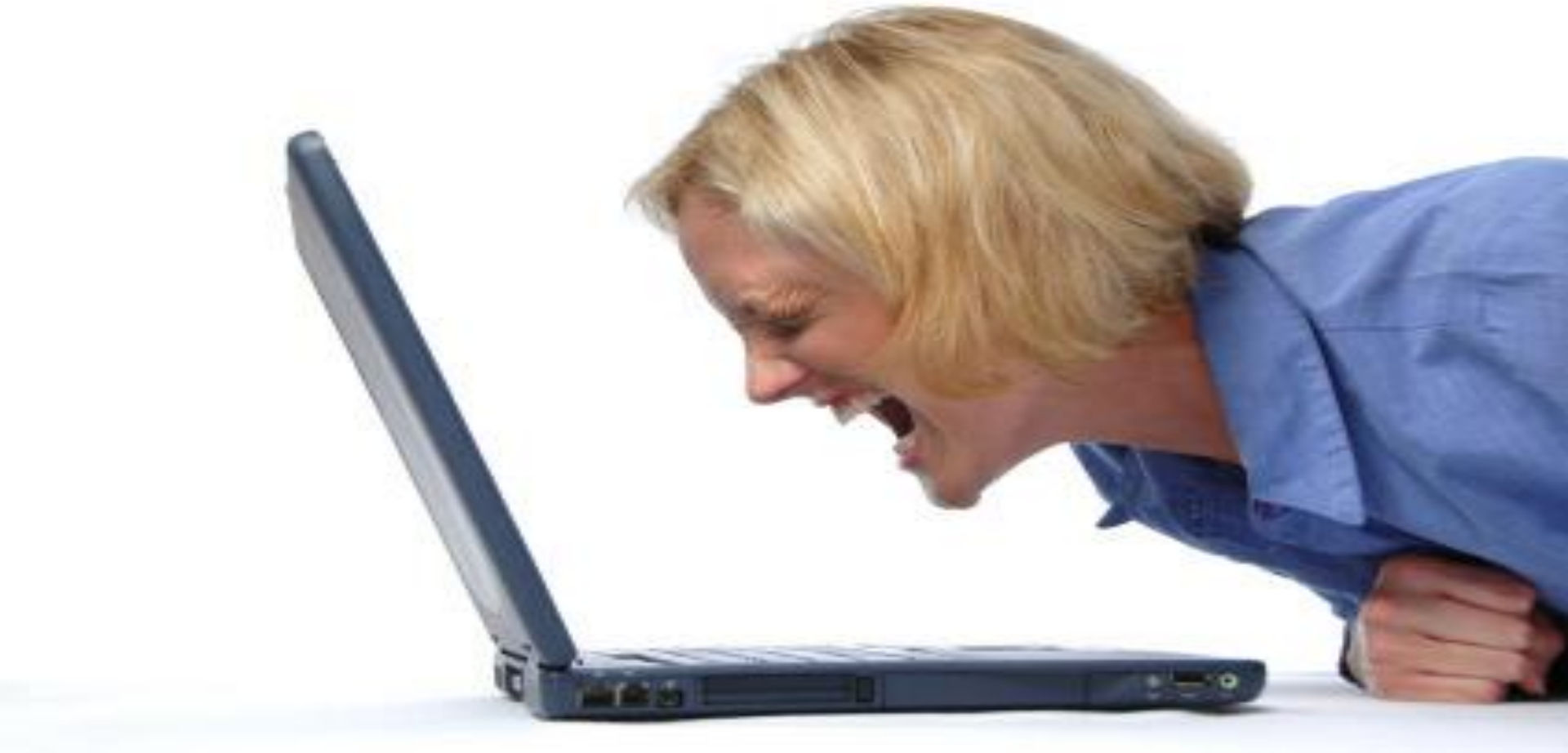
Reason #3. Too much information provided without knowing what to do with it (N =66, 36%)



Reason #4. Not enough time to spend on technology (N =56, 30%)

Reason #5. Lack of perceived economic value (N =55, 30%)

Reason #6. Too Difficult or Complex to Use (N =53, 29%)



Reason #7. Poor technical support/training (N =52, 28%)

Reason #8. Better alternatives/easier to accomplish manually (N =43, 23%)

Reason #9. Failure in fitting with farmer patterns of work (N =40, 22%)

Reason #10. Fear of technology/computer illiteracy (N =39, 21%)

Reason #11. Not reliable or flexible enough (N =33, 18%)

Reason #99. Wrong College Degree (N =289, 100%)

Precision Dairy Technologies: A Producer Assessment

Matthew R. Borchers and Jeffrey M. Bewley
University of Kentucky
Department of Animal and Food Sciences

What do producers consider before purchasing one of these technologies?

Consideration #1.
Benefit: cost ratio
(4.57 ± 0.66)

Matthew Borchers, 2014

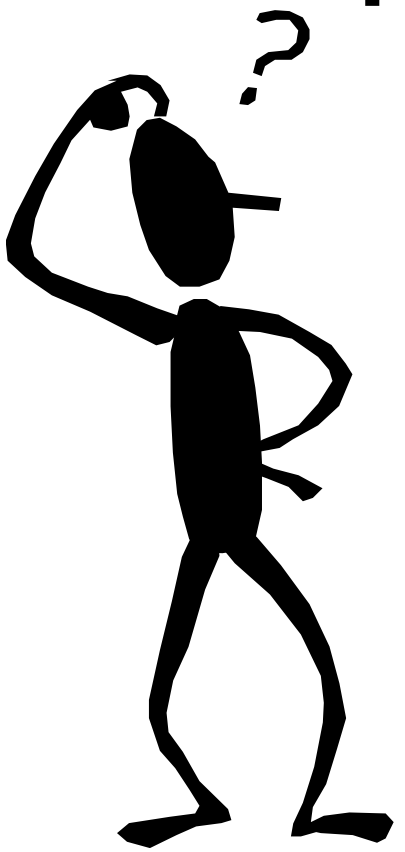
Consideration #2
Total investment cost
(4.28 ± 0.83)

Matthew Borchers, 2014

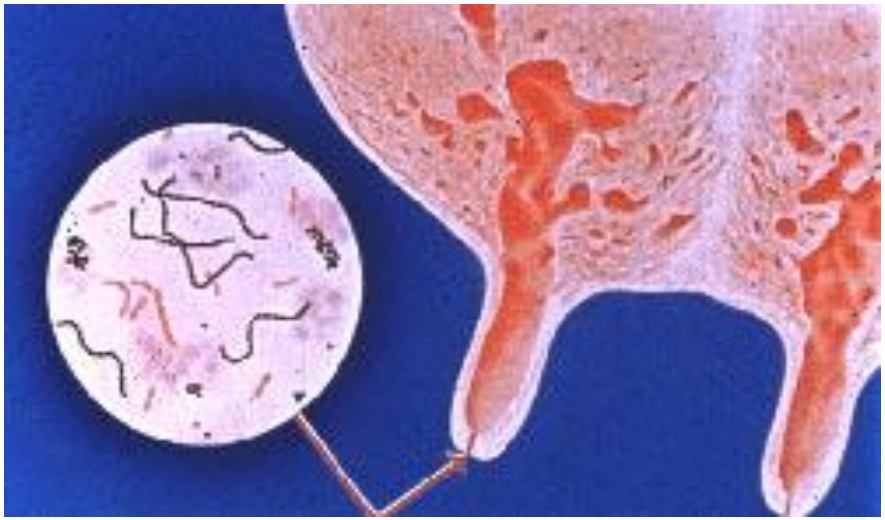
Consideration #3. Simplicity and ease of use (4.26 ± 0.75)

Matthew Borchers, 2014

What parameters do producers find most useful in technologies?



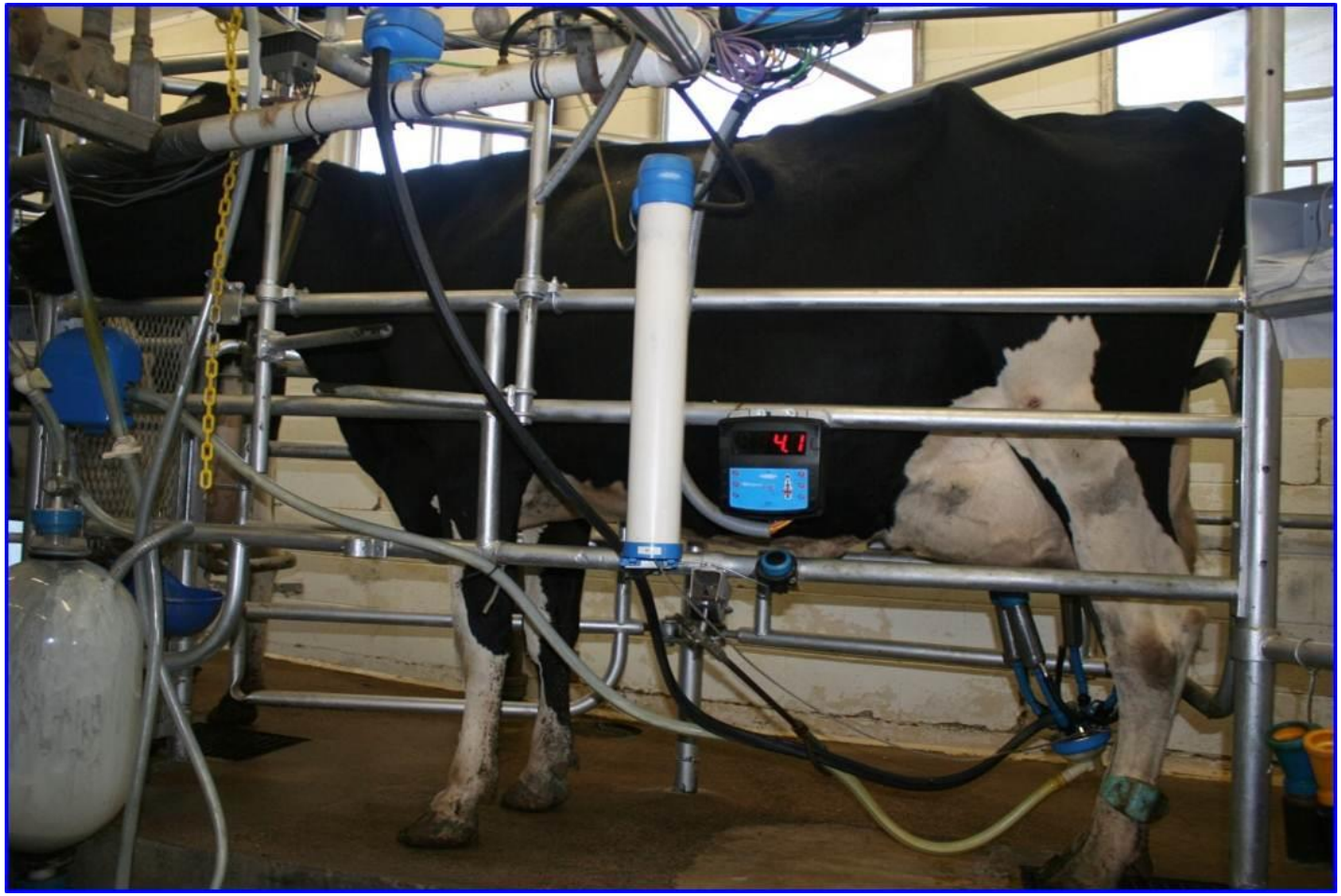
Important Parameter #1. Mastitis (4.77 ± 0.47)



Matthew Borchers, 2014

Important Parameter #2
Standing heat
(4.75 ± 0.55)

Matthew Borchers, 2014



Important Parameter #3 Daily milk yield

(4.72 ± 0.62)

Matthew Borchers, 2014

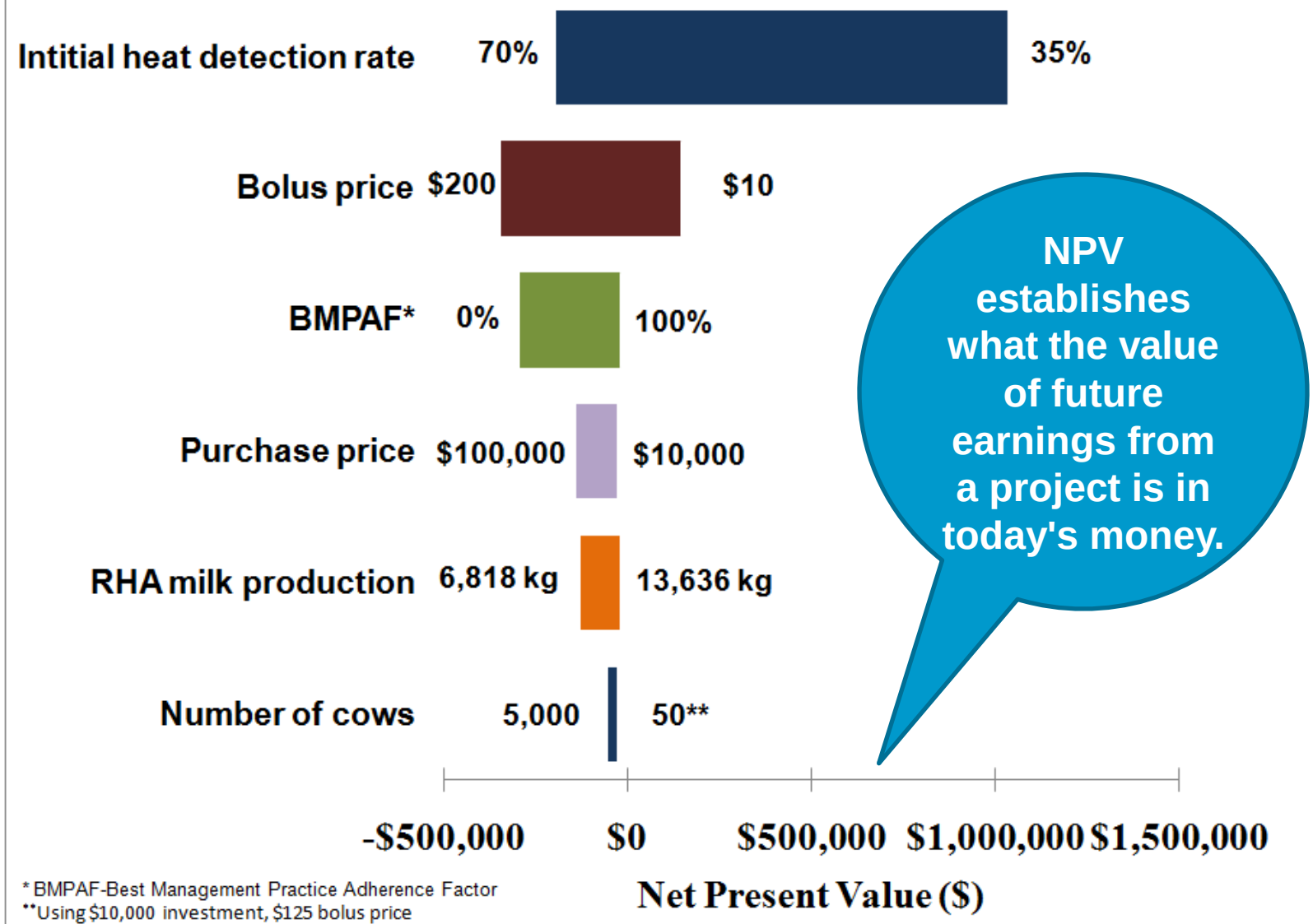
Economic Considerations

- Need to do investment analysis
- Not one size fits all
- Economic benefits observed quickest for heat detection/reproduction
- If you don’t do anything with the information, it was useless
- Systems that measure multiple parameters make most sense
- Systems with low fixed costs work best for small farms

Purdue/Kentucky Investment Model

- Investment decisions for PDF technologies
- Flexible, partial-budget, farm-specific
- Simulates dairy for 10 years
- Includes hundreds of random values
- Measures benefits from improvements in productivity, animal health, and reproduction
- Models both biology and economics

Tornado Diagram for Deterministic Factors Affecting NPV



Sheldon's Friendship Flowchart
(as Modified by Wolowitz)

Place Phone Call

Home

No

Leave Message

Wait for Callback

Would You Like to Share a Meal

What Is the Response?

No

Yes

Dine Together?

Do You Enjoy a Hot Beverage?

What Is the Response?

No

Case:
Tea
Coffee
Cocoa

Have Tea
Have Coffee
Have Cocoa

n = No

Recreational Activities! Tell Me One of Your Interests?

No

ESC

Yes

LOA

n = 3

Do I Share That Interest?

Yes

Why Don't We Do That Together?

Partake in Interest

Begin Friendship

Investment Analysis of Automated Estrus Detection Technologies

K.A. Dolecheck, G. Heersche Jr., and J.M. Bewley

University of Kentucky

Investment Analysis of Heat Detection Technologies

Heat detection is a major concern on many dairies today.

Recently, technologies used to monitor activity levels and other cow parameters have been applied to manage heat detection.

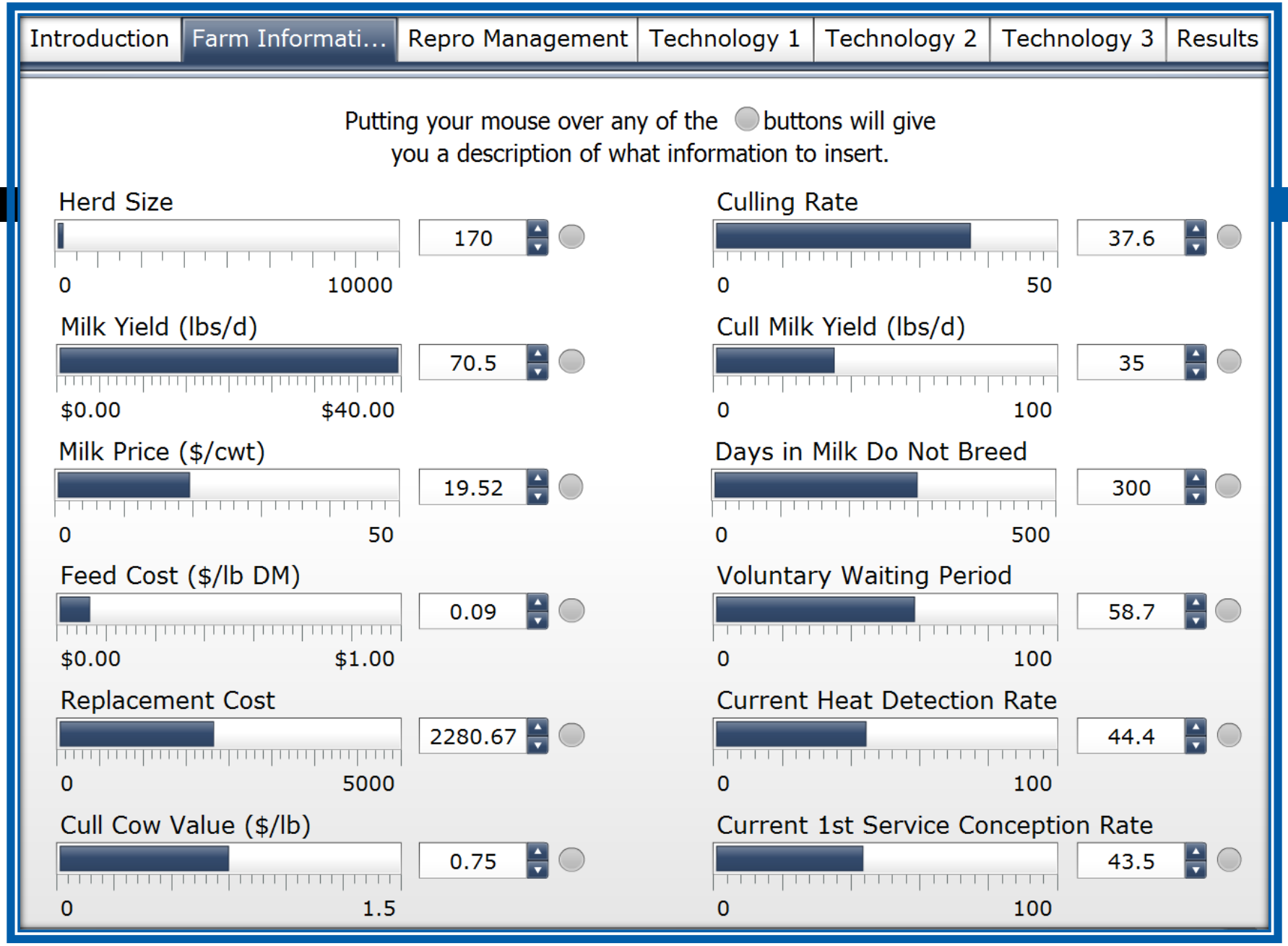
This net present value tool can be used to compare up to 3 different heat detection technologies in order to determine which might work best economically on a specific dairy.

To use, change herd and technology information in the input tabs and then review the outcome in the "Results" and "Before vs. After" tabs.

Developed by Karmella Dolecheck and Jeffrey Bewley
Animal & Food Sciences Department
University of Kentucky College of Agriculture

UK University of Kentucky College of Agriculture
PRECISION DAIRY & COW ENVIRONMENT CONSORTIUM

Dashboard available at: www2.ca.uky.edu/afsdairy/HeatDetectionTechnologies



Dashboard available at: www2.ca.uky.edu/afsdairy/HeatDetectionTechnologies

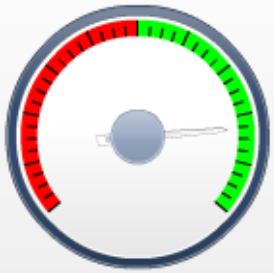
Introduction | Farm Informati... | Repro Management | Technology 1 | Technology 2 | Technology 3 | Results

Pedometer Plus

Days Open
116.09

Years to Break Even
3.32

Net Present Value



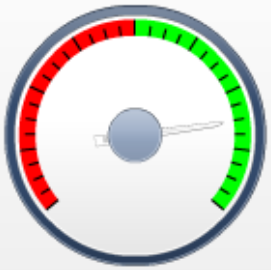
$32,590.73

Select Detect

Days Open
107.77

Years to Break Even
3.36

Net Present Value



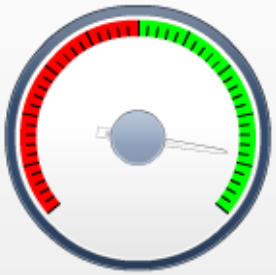
$31,294.10

Track a Cow

Days Open
111.87

Years to Break Even
3.00

Net Present Value



$37,924.65

BEST OPTION

Dashboard available at: www2.ca.uky.edu/afsdairy/HeatDetectionTechnologies

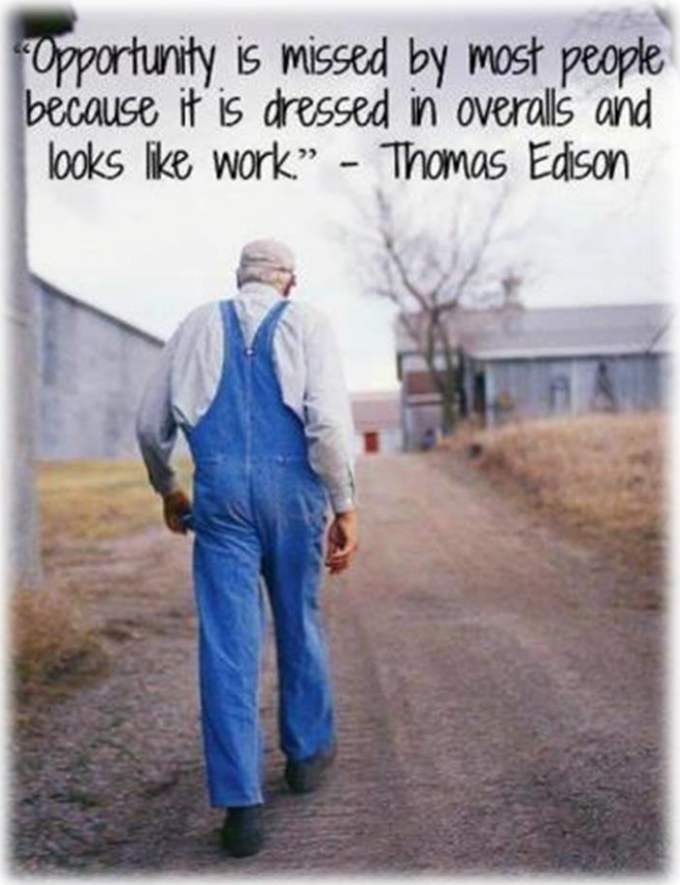
Customer Service is Key

- More important than the gadget
- Computer literacy
- Not engineers
- Time limits
- Failure of hardware and software

"Can I return these?...They're nice and all, but they just scare the snot out of me."

Cautious Optimism

- Critics say it is too technical or challenging
- We are just beginning
- Precision Dairy won't change cows or people
- Will change how they work together
- Improve farmer and cow well-being



Path to Success

- Continue this rapid innovation
- Maintain realistic expectations
- Respond to farmer questions and feedback
- Never lose sight of the cow
- Educate, communicate, and collaborate

Future Vision

- New era in dairy management
- Exciting technologies
- New ways of monitoring and improving animal health, well-being, and reproduction
- Analytics as competitive advantage
- Economics and human factors are key

Questions?

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