OHIO DAIRY VETERINARIANS

2025 Annual Meeting

Dr. Dennis Summers

Utilization of Monitoring Technology in Dairy Production Medicine

Dr. Luis Mendonca

Dr. Kirby Krogstad

Dr. Julio Giordano

JANUARY 9-10, 2025

https://www.ohiodairyvets.org/event-details

Thursday, January 9, 2025

8-9: Summers: HPAI and ODA Updates
9-10: Summers: Experiences from a Veterinarian Whom Managed a HPAI Outbreak
10-11: Break
11-12: Mendonca: Improving Efficiency Through Monitoring Technology and Data Insights
12-1:30: Lunch
1:30-2:30: Mendonca: Incorporating Monitoring Technology in Reproductive Systems
2:30-3:30: Break
3:30-4:30: Mendonca: Incorporating Monitoring Technology in Herd Health Programs
4:30-5:30: Mendonca: Using Group Monitoring as a Management Tool
5:30-6: Dinner
6-6:45: Platinum Sponsor Presentation
6:45-7:30: Producer Roundtable
7:30-10: Rural Practitioners Social

Friday, January 10, 2025

7-7:30: Breakfast with OSU CVM Dean Moore
7:45-10: Giordano: Enhancing Reproductive Performance and Management of Cows with Different Reproductive Potential Through Data-Driven Technology
10-10:30: Break
10:30-12: Giordano: Improving Dairy Herd Health Monitoring and Management Using Automated Technologies
12-2: OSU Lunch with Presentations
2-3: Krogstad: Monitoring Nutrition - Old Classics and New Tech
3-4: Krogstad: The Next Chapter of Rumen Health
4-5: Annual Business Meeting

ohiodairyvets.org/event-details

Meeting Location:
Marriott Columbus OSU
3100 Olentangy River Road
Columbus, OH 43202

Registration: $335 per veterinarian.
Veterinary Students are free.
Register Online at www.ohiodairyvets.org/event-details

By Mail:
Ohio Dairy Veterinarians
Attn: Kevin Jacque
16410 County Home Road
Marysville, OH 43040

Hotel Bookings:
Group Rate: $154/night
BOOK BY DEC. 9th to receive the group rate
https://www.marriott.com/event-reservations/reservation-link.mi?id=1727101834687&key=GRP&guestreslink2=true

odvstatutoryagent@gmail.com

ohiodairyvets.org/event-details

Ohio Dairy Veterinarians 2025 Annual Meeting

UTILIZATION OF MONITORING TECHNOLOGY IN DAIRY PRODUCTION MEDICINE

January 9 & 10, 2025
Marriott Columbus OSU

12.75 HOURS

Dr. Luis Mendonca

Dr. Luís Mendonça received a Doctor of Veterinary Medicine degree in 2006 at Universidade Estadual de Maringá, Brazil. After working in private practice, he conducted research at UC Davis and the University of Minnesota, where he completed his residency in Dairy Production Medicine. He then served as a faculty member for 7 years at Kansas State University before joining Merck Animal Health in 2020 as a Cattle Technical Services Veterinarian. In July 2024, he transitioned to his current role as a Research Scientist at Merck Animal Health Technology Labs.

Dr. Julio Giordano

Julio Giordano, DVM, MS, PhD is a Professor of Dairy Cattle Biology and Management in the Department of Animal Science and Co-Director Cornell Institute for Digital Agriculture (CIDA) at Cornell University. His expertise is in dairy cattle reproduction, health, and dairy herd economics. A major thrust of his research program is the development and on-farm implementation of novel technologies and data-driven solutions for improving reproductive and health management of dairy cattle. Novel methods and technologies are also used to elucidate the fundamental mechanisms controlling reproductive function and the biological alterations caused by health disorders of cattle. Ultimately, Dr. Giordano's research strives to enhance the sustainability of dairy farms through improvements in reproductive performance, health, and productivity of cows.

Dr. Dennis Summers

Dr. Dennis Summers is Chief of the Division of Animal Health, which is charged with protecting and promoting the health of Ohio's livestock and poultry industries. In that capacity, he serves as Ohio's State Veterinarian and oversees all operations for the division. Dr. Summers first joined ODA in 2014 as a field veterinarian for the Division of Meat Inspection, then was transferred to ODA's Division of Animal Health in the same capacity in 2015. He was appointed to the position of Assistant State Veterinarian in 2018 and then Interim State Veterinarian in 2021. Prior to his service at ODA, Dr. Summers was a private practitioner in Vermont, Ohio, and Pennsylvania. His areas of practice focused on large animal medicine and surgery, mainly dairy, equine, and beef, but also some small ruminants and exotics.

Dr. Kirby Krogstad

Kirby was born and raised on a dairy farm – one in Minnesota and one in South Dakota. He went on to graduate from South Dakota State University where he received a BS in Dairy Production. Then, he received an MS from the University of Nebraska – Lincoln and a PhD from Michigan State University, both in Animal Science. Kirby's research included investigations of forage and non-forage feeding strategies, effects of feeding strategies on inflammation and health, and the role of specific nutrients in combatting inflammation in lactating dairy cattle. Currently, he is conducting research investigating tissue resident immune cells in the rumen of dairy cattle and how they respond to dietary changes. His research program at Ohio State will continue to focus on how nutrition affects animal health and gut health, with particular focus on carbohydrate feeding strategies.

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Thank you!

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Improving Efficiency Through Monitoring Technology and Data Insights

Incorporating Monitoring Technology in Reproductive & Herd Health Programs

Luís Mendonça, DVM, MS
Research Scientist
Merck Animal Health

1

Changes in the California Dairy Industry Between 1950 to 2010

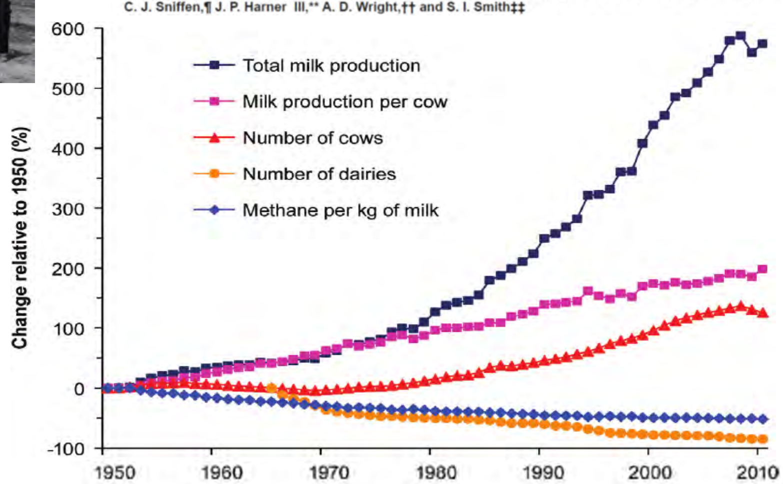
www.ars.usda.gov/

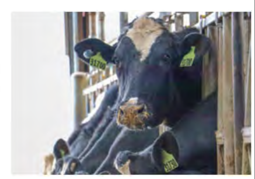
Production per cow:
5,314 lb
2,410 kg

J. Dairy Sci. 96:5405–5425
http://dx.doi.org/10.3168/jds.2012-6354
© American Dairy Science Association®, 2013.

Invited review: **Sustainability of the US dairy industry**

M. A. G. von Keyserlingk,* N. P. Martin,†[1] E. Kebreab,‡ K. F. Knowlton,§ R. J. Grant,# M. Stephenson,‖ C. J. Sniffen,¶ J. P. Harner III,** A. D. Wright,†† and S. I. Smith‡‡





Production per cow:
23,777 lb
10,785 kg

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2

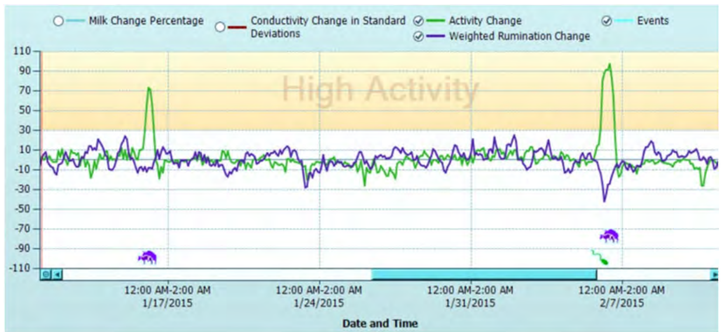
Using Monitoring Technology to Improve Reproductive Efficiency

ESTRUS INTENSITY

TIMING of BREEDING

HEATS BEFORE BREEDING

HEAT DETECTION RATE



HEAT STRESS

OPTIMIZE PROCESSES (labor)

HERD HEALTH

OVERALL MONITORING (nutrition, health)

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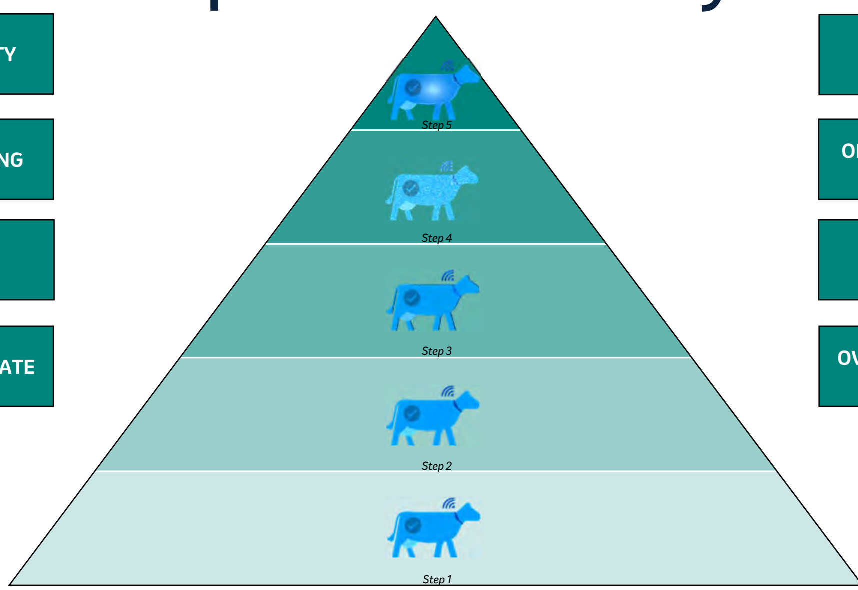
Using Monitoring Technology to Improve Reproductive Efficiency

ESTRUS INTENSITY

TIMING of BREEDING

HEATS BEFORE BREEDING

HEAT DETECTION RATE



HEAT STRESS

OPTIMIZE PROCESSES (labor)

HERD HEALTH

OVERALL MONITORING (nutrition, health)

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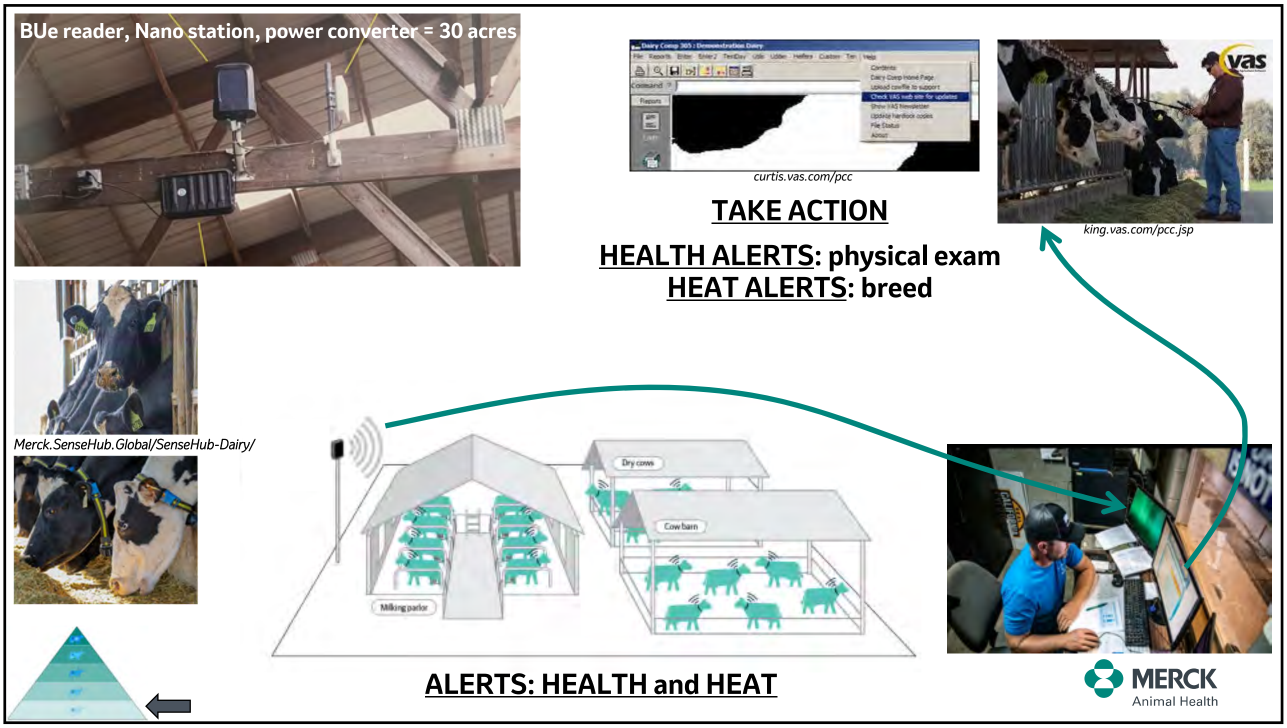


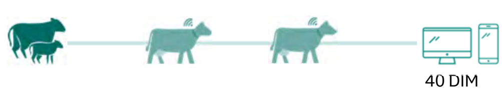
5

Targeted Approach to Increase Reproductive Efficiency – Lactating Cows

Conception rate at first AI

29.4%

37.8%



Borchardt et al., 2021

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J. Dairy Sci. 106
https://doi.org/10.3168/jds.2022-22666

Targeted reproductive management for lactating Holstein cows: Reducing the reliance on exogenous reproductive hormones

Tomas D. Gonzalez,[1] Luana Factor,[1] Ahmadreza Mirzaei,[1] Ana B. Montevecchio,[1] Segundo Casaro,[1] Victoria R. Merenda,[1] Jessica G. Prim,[1] Klibs N. Galvão,[1] Rafael S. Bisinotto,[1] and Ricardo C. Chebel[1,2*]
[1]Department of Large Animal Clinical Sciences, University of Florida, Gainesville, FL 32610
[2]Department of Animal Sciences, University of Florida, Gainesville, FL 32610

Reproductive hormone treatments

CONTROL
100% Double-Ovsynch
(975 cows)

TIMED AI: Double-Ovsynch — BREED

Reproductive hormone treatments: 10

After 1st AI: visual detection

TARGETED REPRO
(955 cows)

40 DIM – Lact>1
55 DIM – Lact=1

No Heat: TIMED AI: Double-Ovsynch — BREED

Heat (Heat index≥70): TIMED AI: Double-Ovsynch — BREED

Reproductive hormone treatments: 4.2

After 1st AI: activity monitors

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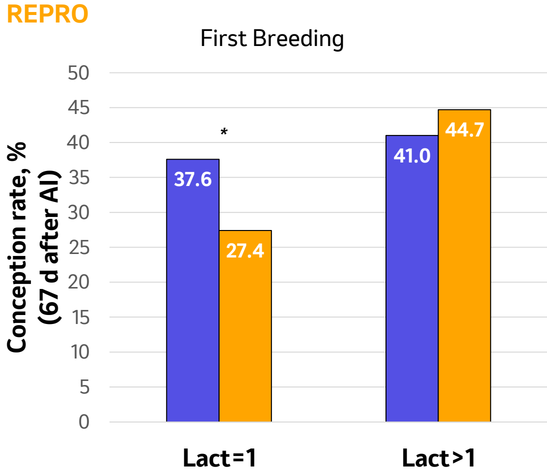
Conception Rate at 1st AI and Percent of Cows Pregnant Up to 305 DIM

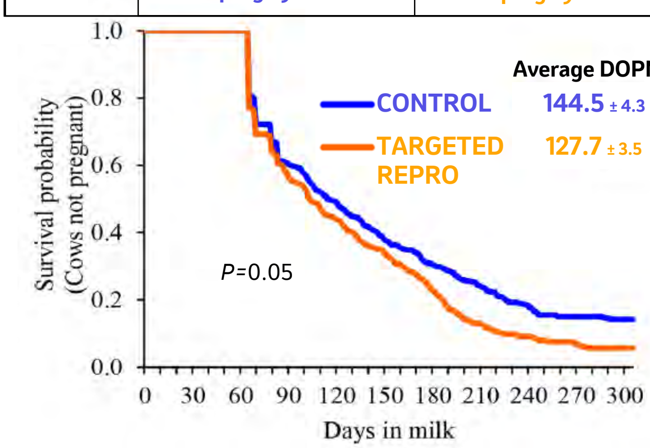
CONTROL
100% Double-Ovsynch

TARGETED REPRO

Treatment – $P = 0.15$
Parity – $P < 0.01$
Treatment x Parity – $P < 0.01$



	CONTROL 100% Double-Ovsynch	TARGETED REPRO
All Cows ¥	84.0% preg by 305 DIM	87.1% preg by 305 DIM
No Heat *	80.8% preg by 305 DIM	88.2% preg by 305 DIM



* Values differed ($P \leq 0.05$)
¥ Values tended to differ ($P = 0.10$)

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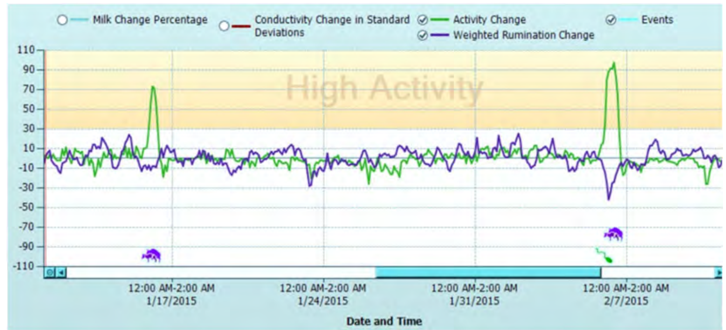
Using Monitoring Technology to Improve Reproductive Efficiency

ESTRUS INTENSITY

TIMING of BREEDING

HEATS BEFORE BREEDING

HEAT DETECTION RATE



Timing of breeding

High heat intensity
Heat index = 100

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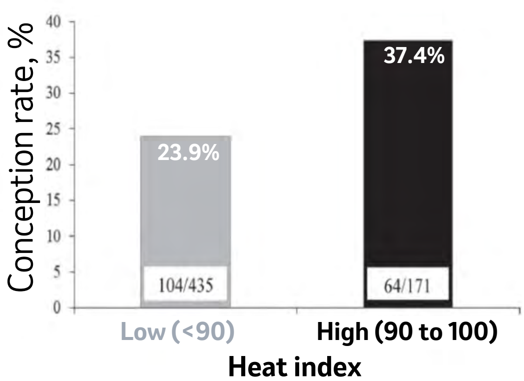
J. Dairy Sci. 98:7003–7014
http://dx.doi.org/10.3168/jds.2015-9672

Factors affecting expression of estrus measured by activity monitors and conception risk of lactating dairy cows

A. M. L. Madureira,*† B. F. Silper,* T. A. Burnett,* L. Polsky,* L. H. Cruppe,‡ D. M. Veira,* J. L. M. Vasconcelos,† and R. L. A. Cerri*[1]
*Faculty of Land and Food Systems, University of British Columbia, Vancouver V6T 1Z4, Canada
†Department of Animal Production, São Paulo State University, Botucatu, Brazil 18168-000
‡Department of Animal Sciences, The Ohio State University, Columbus 43210

HEAT INDEX

Activity Level	95% CI	%Conc	#Preg	#Open	Other	Abort	Total
0	25-35	29	96	230	60	12	386
32	-	0	0	1	2	0	3
36	-	50	1	1	1	0	3
40	-	0	0	1	1	0	2
44	-	0	0	0	1	0	1
48	-	20	1	4	0	0	5
52	1-23	5	1	20	9	0	30
56	8-37	19	5	22	5	1	32
60	6-27	13	5	34	8	0	47
64	10-32	18	8	36	6	1	50
68	13-36	23	12	41	11	0	64
72	20-41	29	19	46	19	0	84
76	21-41	30	25	58	14	1	97
80	18-34	25	30	89	27	4	146
84	28-40	34	79	156	41	8	276
88	31-38	34	218	415	58	13	691
92	32-41	36	171	301	36	16	508
96	39-48	44	238	309	50	16	597



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J. Dairy Sci. 102:6649–6659
https://doi.org/10.3168/jds.2018-15957

Estrous characteristics and reproductive outcomes of Holstein heifers treated with 2 prostaglandin formulations and detected in estrus by an automated estrous detection or mounting device

Anderson Veronese,[1] Odinei Marques,[1] Rafael Moreira,[1] Anna L. Belli,[1] Todd R. Bilby,[2] and Ricardo C. Chebel[1,3*]
[1]Department of Large Animal Clinical Sciences, University of Florida, Gainesville 32610
[2]Merck Animal Health, Madison, NJ 07940
[3]Department of Animal Sciences, University of Florida, Gainesville 32610

Aspects to consider in a heifer reproductive program:

1. Accuracy and efficiency of the heat detection program
2. Response to the prostaglandin treatment
3. Conception rate

- 1,019 Holstein heifers used in the study
- Evaluated the response of prostaglandin formulations
- Cows were fitted with SenseHub Dairy monitoring tags

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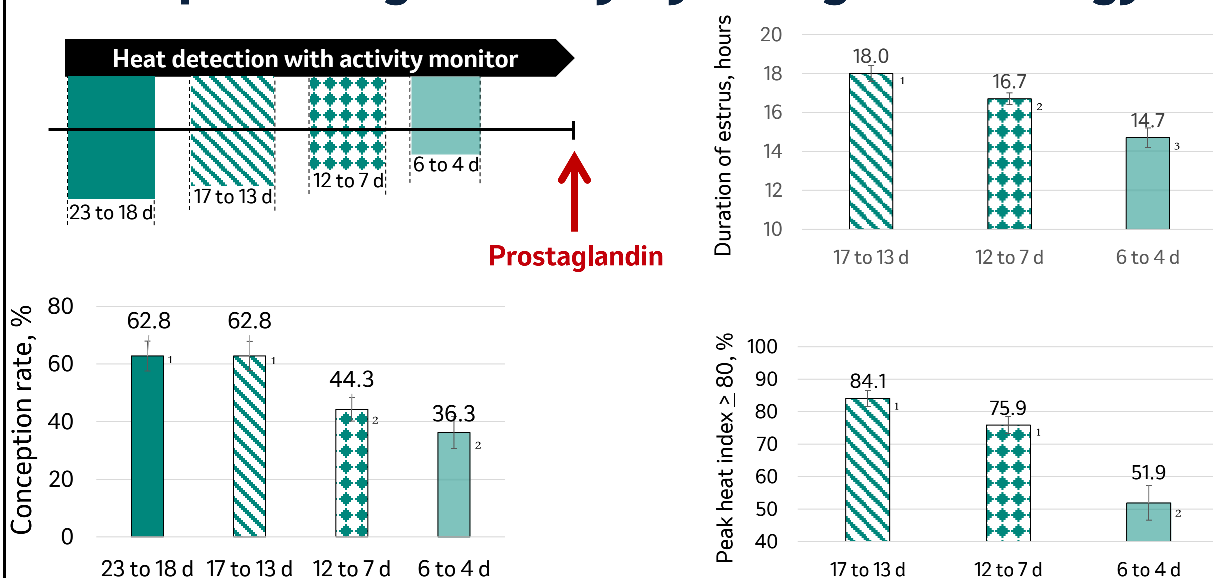
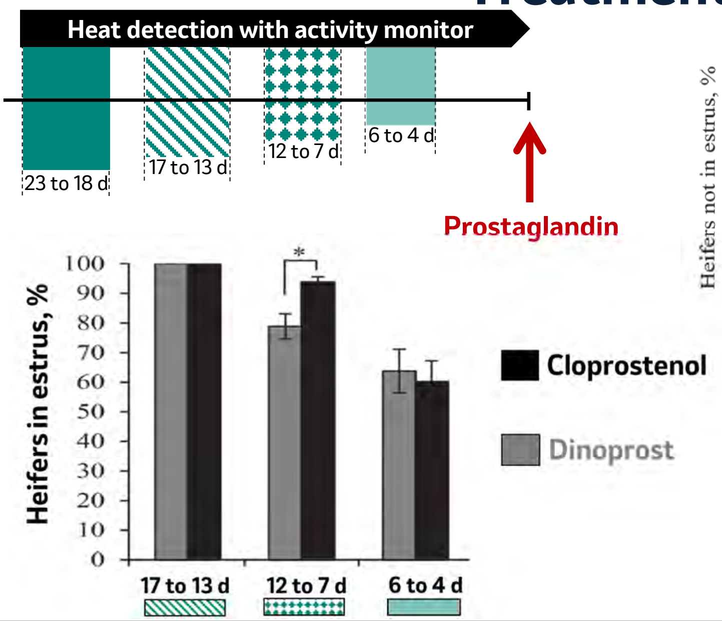
Optimizing Fertility by Using Technology

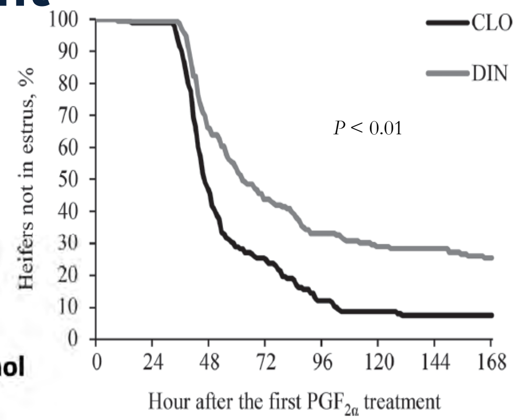


[1,2,3] Different superscripts differ ($P \leq 0.05$)

12

Prostaglandin Formulation Impacts Response to Treatment





Heifers in mid diestrus

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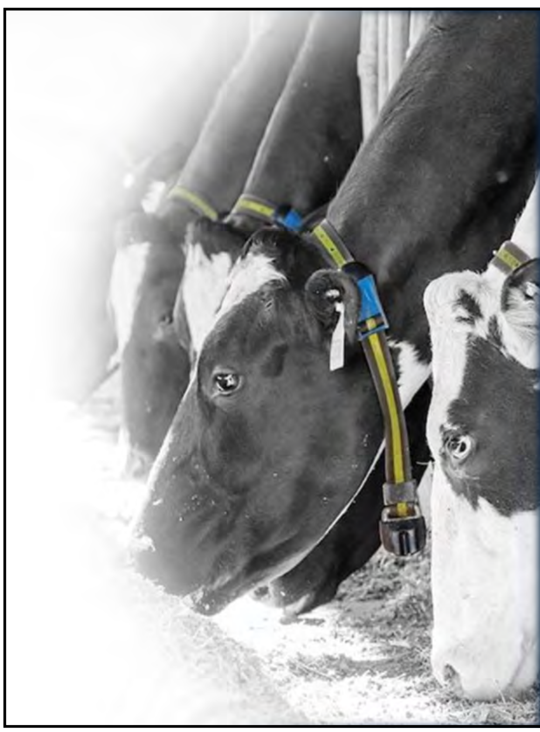

Heat Stress

Heavy Breathing Behavior

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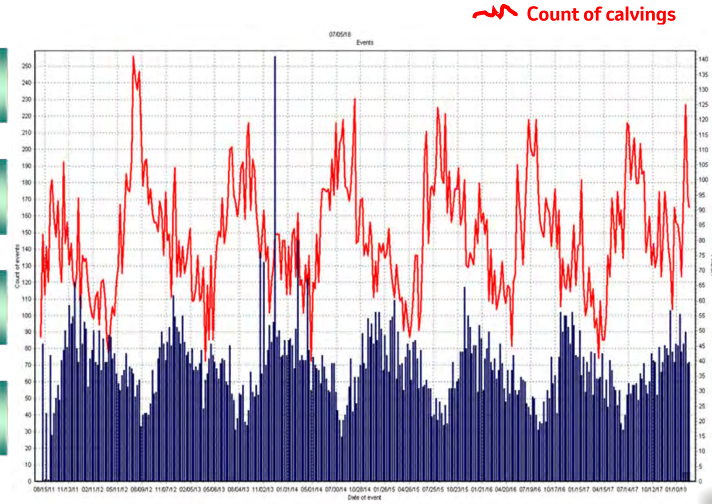
Outstanding Reproductive Efficiency Unlocks a Spectrum of Opportunities

- Beef-on-dairy
- Sexed semen in cows
- Voluntary waiting period
- IVF embryos



Heat Stress

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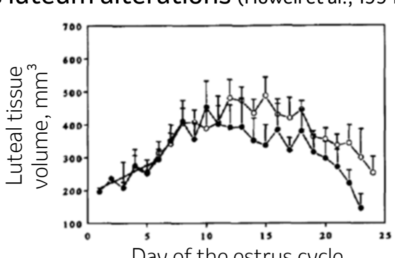
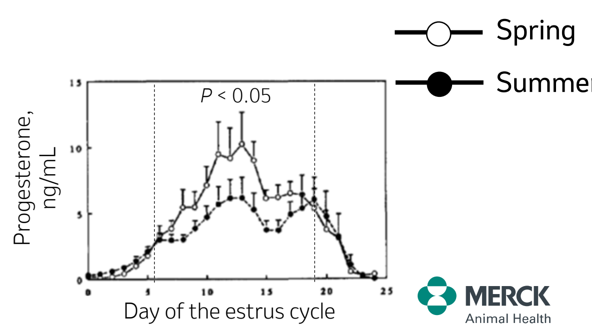
Impact of Heat Stress on Fertility of Lactating Dairy Cows

- Heat stress impacts fertility in a multifactorial manner
- Oocyte quality
  - Impact on nuclear maturation and apoptosis (Roth and Hansen, 2005)
- Fertilization
  - Reduced fertilization rate (Sartori et al., 2002)
- Embryo development
  - Negative effect of heat stress in early embryo development (Putney et al., 1989; Edwards and Hansen, 1996)
- Hormonal profile
  - Corpus luteum alterations (Howell et al., 1994)





Howell *et al.* J. Dairy Sci. (1994)

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Altered Progesterone Concentration by Inducing Ovulation

J. Dairy Sci. 103
https://doi.org/10.3168/jds.2019-16439

Association of pregnancy per artificial insemination with gonadotropin-releasing hormone and human chorionic gonadotropin administered during the luteal phase after artificial insemination in dairy cows: A meta-analysis

M. Besbaci,[1,2]* A. Abdelli,[3] J. J. Minviel,[4,5] I. Belabdi,[1] R. Kaidi,[1] and D. Raboisson[4]
[1]Laboratory of Biotechnology in Animal Reproduction, Institute of Veterinary Sciences, University of Blida 1, 09.000, Blida, Algeria
[2]High National School Veterinary El Harrach, Algers, 16.000, Algeria
[3]Department of Agricultural Sciences, University of Bouira, 10.000, Bouira, Algeria
[4]IHAP, Université de Toulouse, INRA, ENVT, Toulouse, France
[5]Université Clermont Auvergne, INRA, Vetagro Sup, UMR Herbivores, 63122, Saint-Genès-Champanelle, France

- 107 experiments from 52 publications
- 18,082 treated cows vs. 18,385 untreated controls
- “In conclusion, the present meta-analysis showed that the use of GnRH and hCG after AI should be focused on cows expected to have low or moderate fertility”

Reduce Severity of Heat Stress

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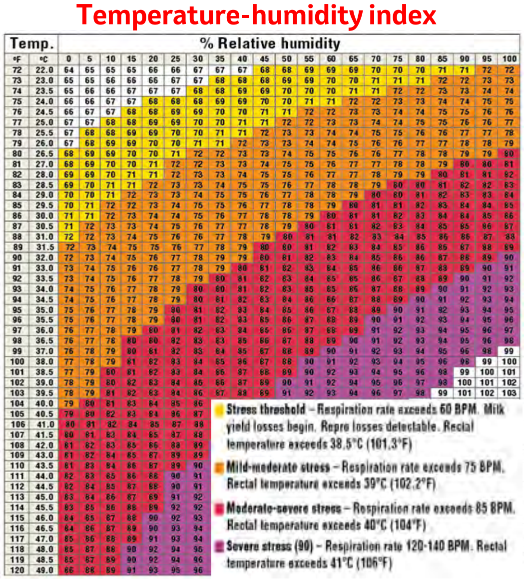
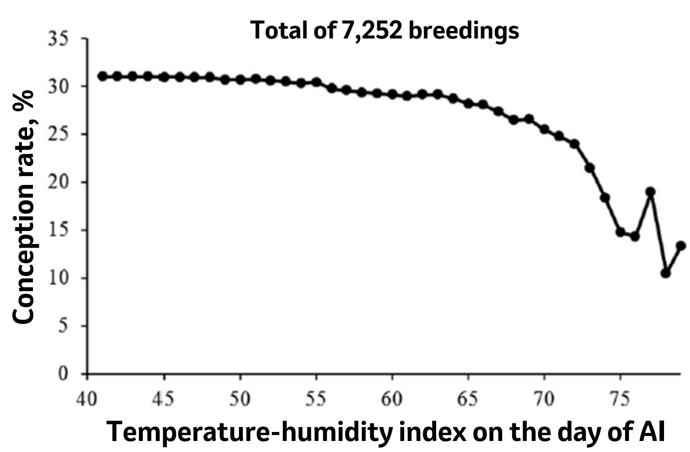
Temperature-Humidity Index and Conception Rate





Schüller et al., 2014

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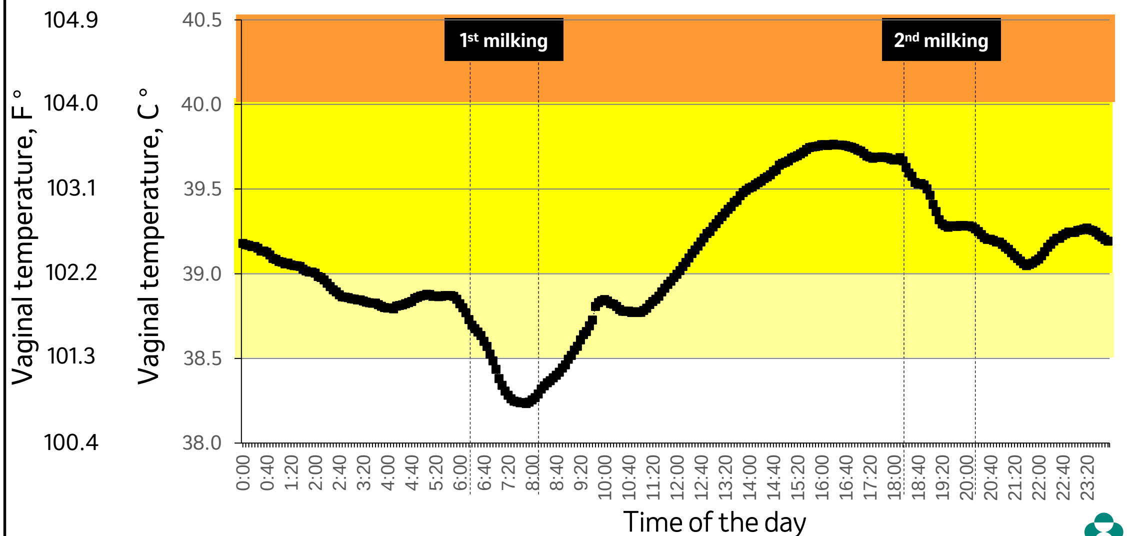
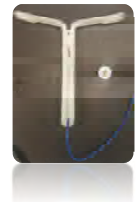
Vaginal Temperature Loggers to Quantify Heat Stress in Lactating Cows





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Rocha et al. (2014) - Kansas Agricultural Experiment Station Research Reports

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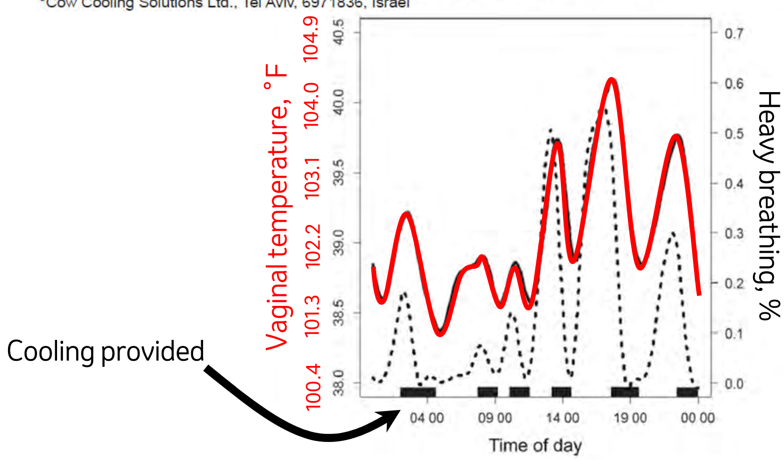
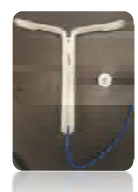
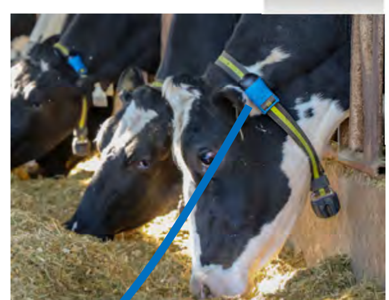
J. Dairy Sci. 102:3480–3486
https://doi.org/10.3168/jds.2018-15186

Technical note: Accelerometer-based recording of heavy breathing in lactating and dry cows as an automated measure of heat load

Doron Bar,[1]* Moshe Kaim,[2] Israel Flamenbaum,[3] Boaz Hanochi,[1] and Rachel L. Toaff-Rosenstein[1]
[1]SCR Engineers Ltd., POB 13564, 18 Hamelacha St., Netanya, 4250553, Israel
[2]Agricultural Research Organization, Institute of Animal Science, Beit Dagan, 5020000, Israel
[3]Cow Cooling Solutions Ltd., Tel Aviv, 6971836, Israel







SenseHub Dairy

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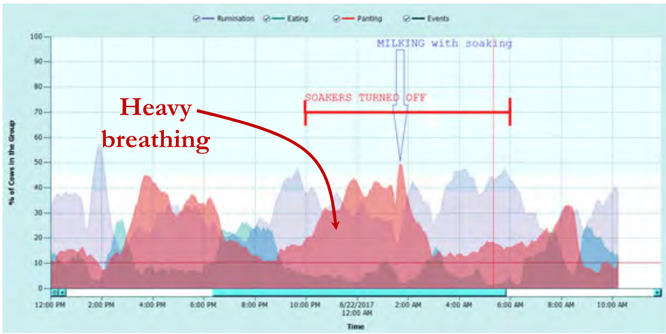
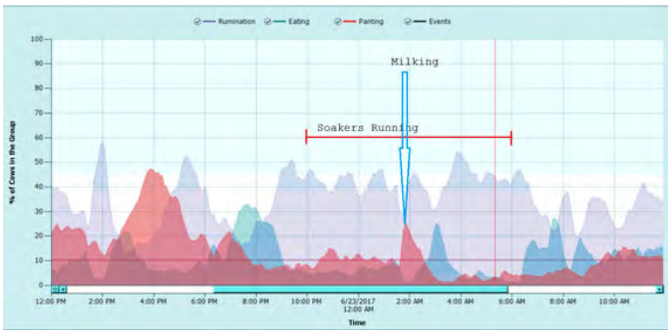


SenseHub Dairy



Group Monitoring Herd-Level Insights

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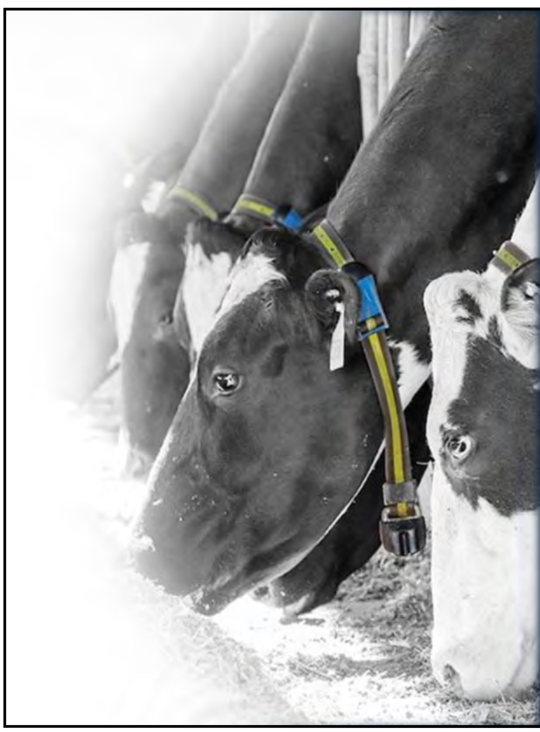

Postpartum Health

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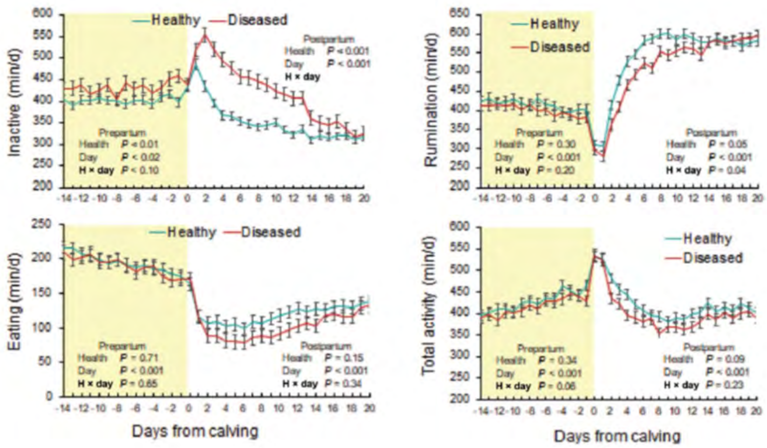
Automated Technologies to Monitor Behavior of Postpartum Cows

J. Dairy Sci. 103
https://doi.org/10.3168/jds.2020-18636

Transition dairy cow health is associated with first postpartum ovulation risk, metabolic status, milk production, rumination, and physical activity*

Jeffrey S. Stevenson,† Sevastian Banuelos, and Luis G. D. Mendonça
Department of Animal Sciences and Industry, Kansas State University, Manhattan 66506-0201



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Integration with On-Farm Management Software

	Cow Number	Health Index for Non
1	1670	46.4
2	9649	66.0
3	1572	69.8
4	1658	71.4
5	1866	74.7
6	1868	79.0
7	1663	82.6
8	1601	83.6
9	3411	84.4
10	2008	85.6

04/07/23	FRESH	Bull Live	04/11/23	ILL	SCR70
04/09/23	ILL	SCR70	04/11/23	METR	
04/10/23	ILL	SCR54			

J. Dairy Sci. 99:7395–7410
http://dx.doi.org/10.3168/jds.2016-10907

Use of rumination and activity monitoring for the identification of dairy cows with health disorders: Part I. Metabolic and digestive disorders

M. L. Stangaferro, R. Wijma, L. S. Caixeta,[1] M. A. Al-Abri,[2] and J. O. Giordano[3]
Department of Animal Science, Cornell University, Ithaca, NY 14853

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Journal of Dairy Science®
Official Publication of the American Dairy Science Association®

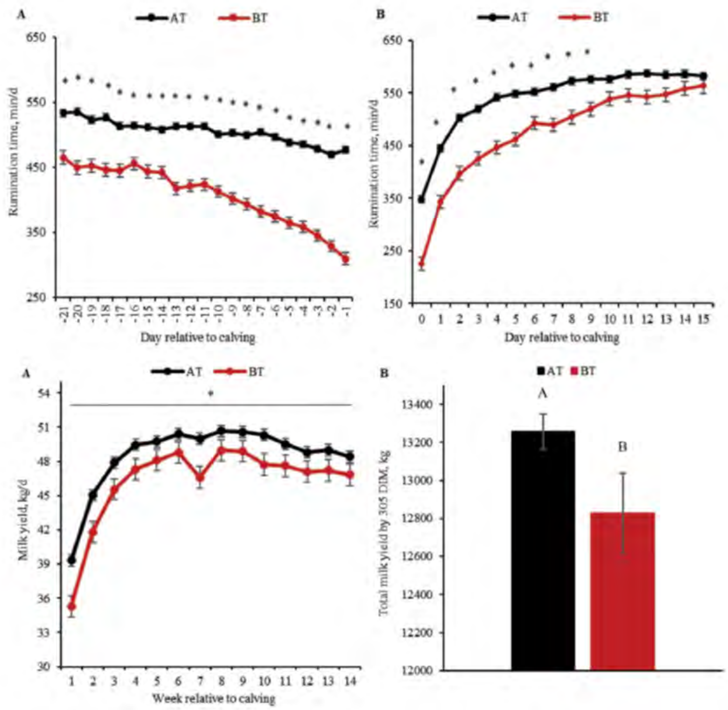
Articles Publish Topics About Contact

RESEARCH ARTICLE | ARTICLES IN PRESS

Use of rumination time in health risk assessment of prepartum dairy cows.

M.G.S. Santos • N. Antonacci • C. Van Dorp • B. Mion • D. Tulpan • E.S. Ribeiro

Open Access • Published: May 30, 2024 • DOI: https://doi.org/10.3168/jds.2023-24610



Prepartum rumination (min/d) deviation from the parity average

AT = above the threshold
BT = below the threshold

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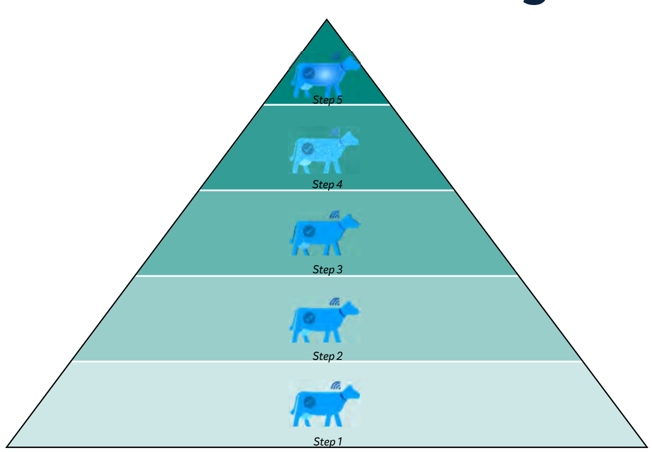
Take Home Message

ESTRUS INTENSITY

TIMING of BREEDING

HEATS BEFORE BREEDING

HEAT DETECTION RATE



HEAT STRESS

OPTIMIZE PROCESSES (labor)

HERD HEALTH

OVERALL MONITORING (nutrition, health)

Prioritize the area that is most relevant for the herd

Technology and algorithms utilized to detect estrus by automated behavior monitoring devices differ by manufacturers

MERCK Animal Health

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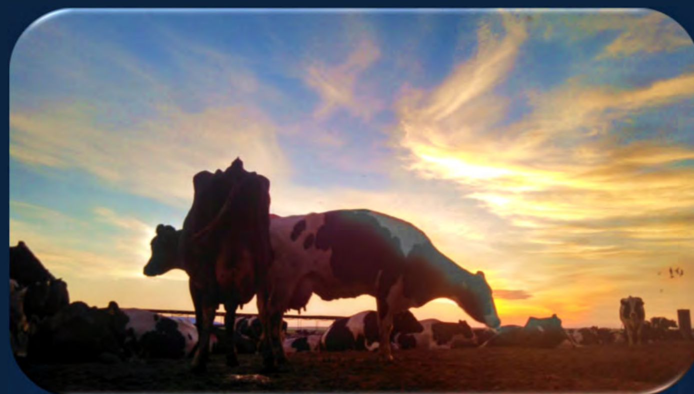
Thank You!



Luis Mendonca, DVM, MS

Merck Co., Inc.

MERCK
Animal Health
The Science of Healthier Animals®

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Enhancing reproductive performance and management of cows with different reproductive potential through data-driven technology

Julio Giordano, Clara Rial, Ana Laplacette, Martin Perez, and Emily Sitko

Dairy Cattle Biology and Management Laboratory
Department of Animal Science
Cornell University

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1

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What?

Targeted management
Precision management
Selective management

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3

Why?

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Why?

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Repro management "bucket"

Why?
- **-Works**
- **-Easy**

Is it the best we can do?

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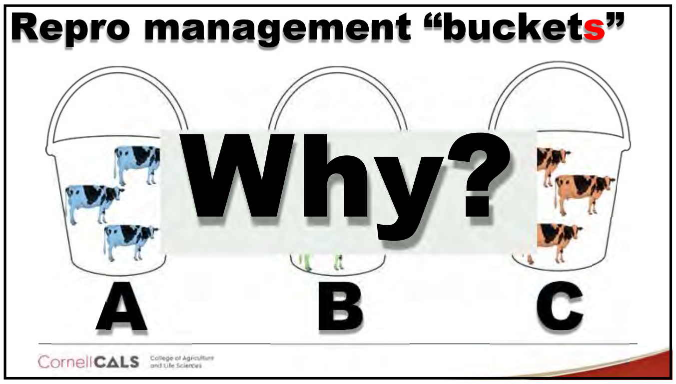
Repro management "buckets"
Why?
A
B
C
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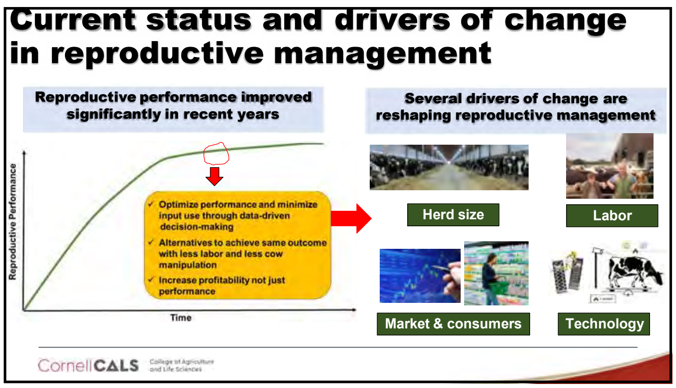
Current status and drivers of change in reproductive management
Reproductive performance improved significantly in recent years
Several drivers of change are reshaping reproductive management
Reproductive Performance
Time
Optimize performance and minimize input use through data-driven decision-making
Alternatives to achieve same outcome with less labor and less cow manipulation
Increase profitability not just performance
Herd size
Labor
Market & consumers
Technology
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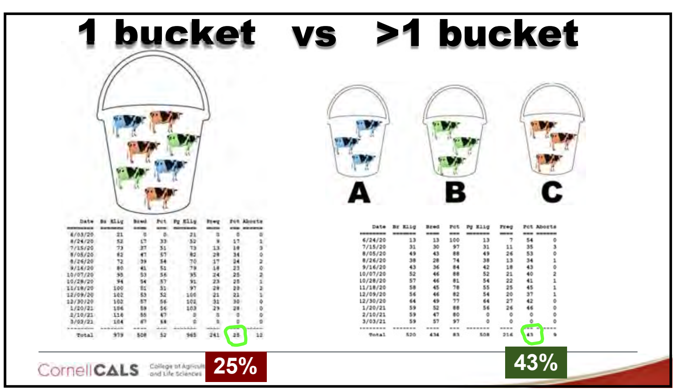
1 bucket vs >1 bucket
A
B
C
25%
43%
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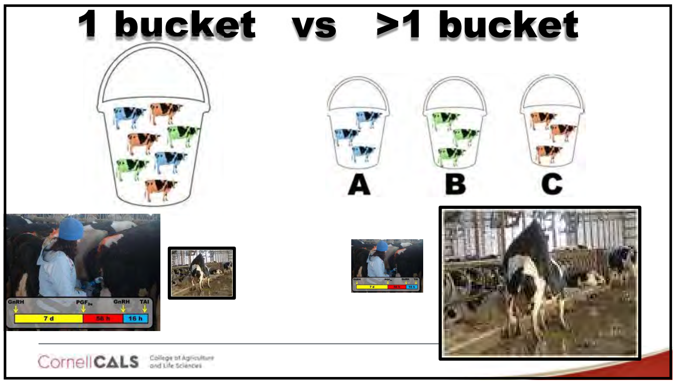
1 bucket vs >1 bucket
A
B
C
CornellCALS

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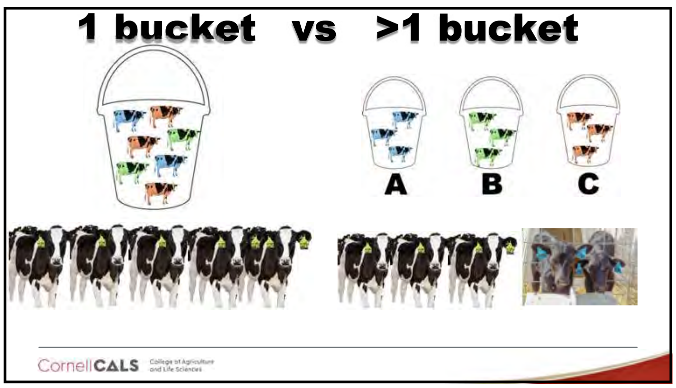
1 bucket vs >1 bucket
A
B
C
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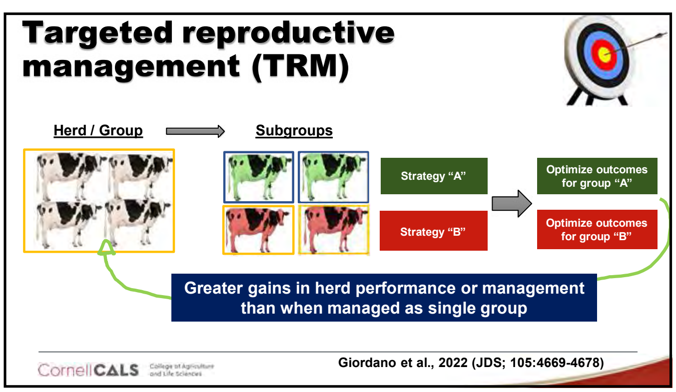
Targeted reproductive management (TRM)
Herd / Group
Subgroups
Strategy "A"
Strategy "B"
Optimize outcomes for group "A"
Optimize outcomes for group "B"
Greater gains in herd performance or management than when managed as single group
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Giordano et al., 2022 (JDS; 105:4669-4678)

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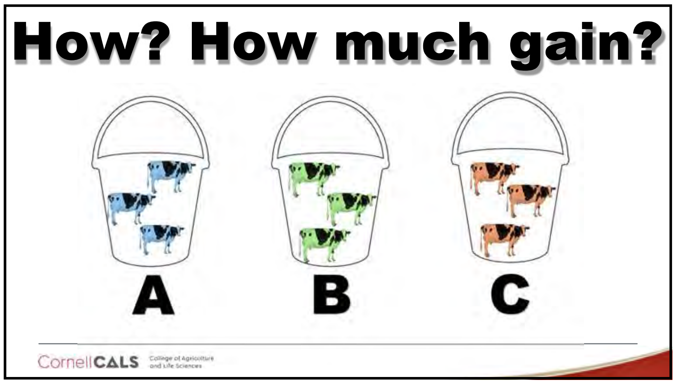
How? How much gain?
A
B
C
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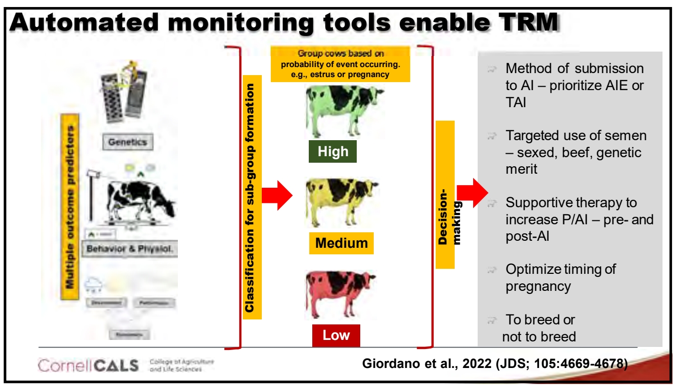
Automated monitoring tools enable TRM
Multiple outcome predictors
Genetics
Behavior & Physiol.
Classification for sub-group formation
Group cows based on probability of event occurring. e.g., estrus or pregnancy
High
Medium
Low
Decision-making
Method of submission to AI – prioritize AIE or TAI
Targeted use of semen – sexed, beef, genetic merit
Supportive therapy to increase P/AI – pre- and post-AI
Optimize timing of pregnancy
To breed or not to breed
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Giordano et al., 2022 (JDS; 105:4669-4678)

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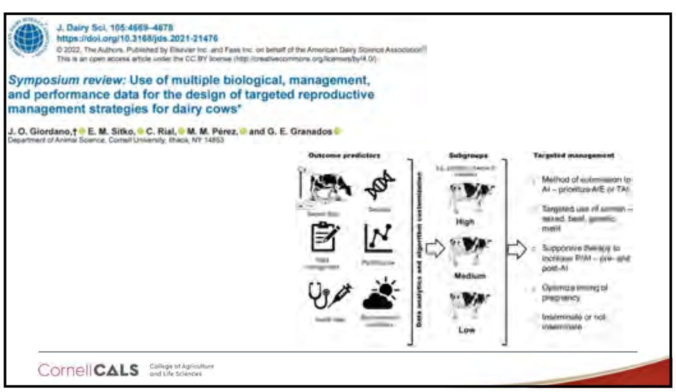
J. Dairy Sci. 105:4669–4678
https://doi.org/10.3168/jds.2021-21476
© 2022, The Authors. Published by Elsevier Inc. and Fass Inc. on behalf of the American Dairy Science Association®.
This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).
Symposium review: Use of multiple biological, management, and performance data for the design of targeted reproductive management strategies for dairy cows*
J. O. Giordano,† E. M. Sitko, C. Rial, M. M. Pérez, and G. E. Granados
Department of Animal Science, Cornell University, Ithaca, NY 14853
Outcome predictors
Subgroups
Targeted management
High
Medium
Low
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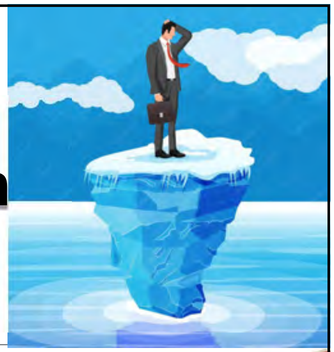
How? How much gain?



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TRM explored so far…

1. Estrus during the VWP

2. Ovarian status

3. Estrus during synch

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Exploring use of estrus (i.e., heat) data:

- **as predictor of reproductive potential**
- **to increase fertility**

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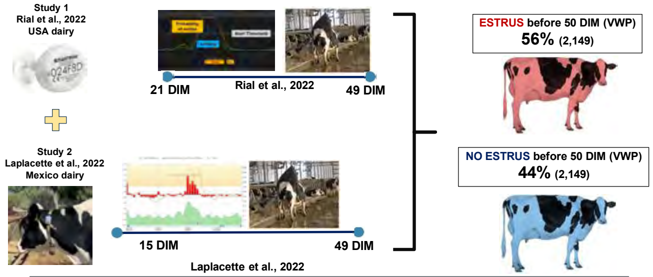
~40-60% have automated estrus alerts (AEA) during the VWP



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Heat during the VWP associated with better reproductive performance

Item	Group: Heat-VWP	Group: No Heat-VWP	Diff. p.p[1]	P-val
AI in heat, % (n)	85 (866)	47 (690)	+38	<0.01
Con. Risk first AI, % (n)	41 (1,433)	32 (1,101)	+9	<0.01
Preg. 150 days, % (n)	78 (1,476)	66 (1,169)	+12	<0.01

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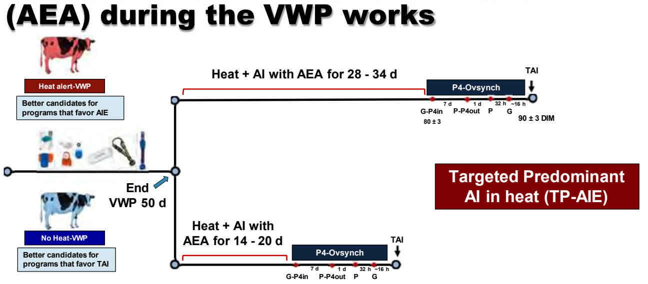
TRM based on automated heat alerts (AEA) during the VWP works



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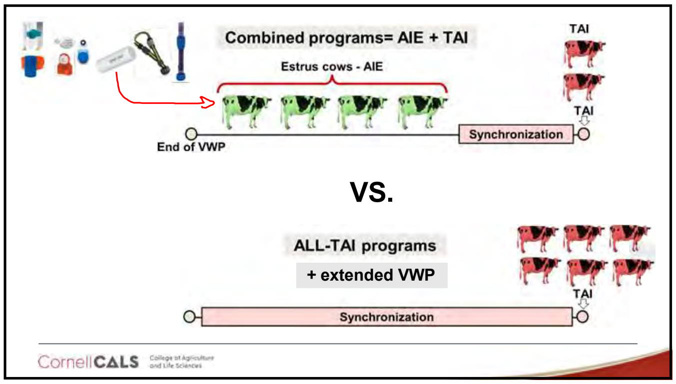
Combined programs= AIE + TAI
Estrus cows - AIE
TAI
TAI
End of VWP
Synchronization
VS.
ALL-TAI programs
+ extended VWP
TAI
Synchronization
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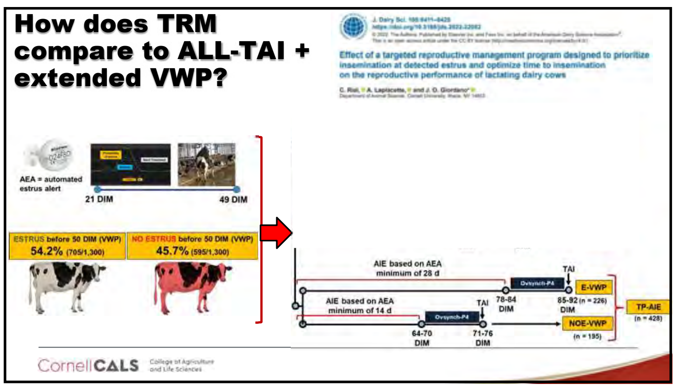
How does TRM compare to ALL-TAI + extended VWP?
Effect of a targeted reproductive management program designed to prioritize insemination at detected estrus and optimize time to insemination on the reproductive performance of lactating dairy cows
AEA = automated estrus alert
21 DIM
49 DIM
ESTRUS before 50 DIM (VWP)
54.2% (705/1,300)
NO ESTRUS before 50 DIM (VWP)
45.7% (595/1,300)
AIE based on AEA minimum of 28 d
Ovsynch-P4
TAI
E-VWP
78-84 DIM
85-92 (n = 226) DIM
AIE based on AEA minimum of 14 d
TAI
Ovsynch-P4
64-70 DIM
71-76 DIM
NOE-VWP
(n = 195)
TP-AIE
(n = 428)
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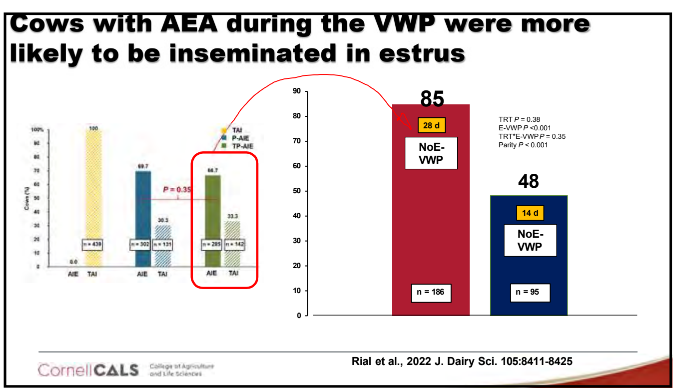
Cows with AEA during the VWP were more likely to be inseminated in estrus
TAI
P-AIE
TP-AIE
100
69.7
66.7
30.3
33.3
0.0
P = 0.35
n = 439
n = 302
n = 131
n = 285
n = 142
AIE TAI
AIE TAI
AIE TAI
85
28 d
NoE-VWP
n = 186
48
14 d
NoE-VWP
n = 95
TRT P = 0.38
E-VWP P <0.001
TRT*E-VWP P = 0.35
Parity P < 0.001
Rial et al., 2022 J. Dairy Sci. 105:8411-8425
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First service P/AI good for cows AI in estrus but better for ALL-TAI + longer VWP

	Treatment			
	TAI	P-AIE	TP-AIE	
	P/AI % (n/n)			*P*-value
Overall	49 (427)	43 (422)	42 (413)	0.08
AIE	N/A	44 (299)	45 (281)	0.93
TAI	49[a] (427)	42[ab] (123)	36[b] (132)	0.03

Parity *P* < 0.001 Primiparous had greater P/AI than multiparous
Season *P* = 0.04 Cold season greater P/AI than warm season

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Rial et al., 2022 J. Dairy Sci. 105:8411-8425

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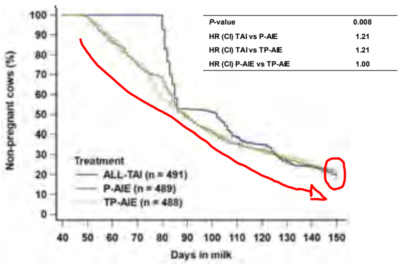
Greater preg. rate for TRM based on AEA and Non-TRM that prioritized AIE than ALL-TAI



Mean d to pregnancy
ALL-TAI 110 d
P-AIE 102 d
TP-AIE 101 d

Pregnant 150 DIM
ALL-TAI 77%
P-AIE 75%
TP-AIE 74%
P = 0.59

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Rial et al., 2022 J. Dairy Sci. 105:8411-8425

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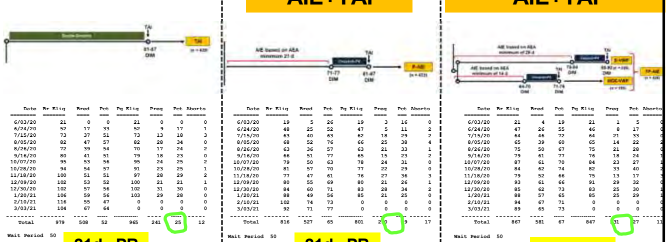
All-TAI	Predominant AIE+TAI	Targeted Predom AIE+TAI



All-TAI	Predominant AIE+TAI	Targeted Predom AIE+TAI
21d –PR 25%	21d –PR 29%	21d –PR 27%

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Rial et al., 2022 J. Dairy Sci. 105:8411-8425

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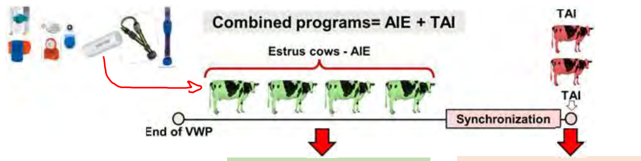
Combining AI based on automated heat alerts (AEA) + TAI works



14-21 d for AIE

+60% AI in estrus

+35% Conception rate

+35% Conception rate

Use protocol that works e.g., Ovsynch+P4 (CIDR)

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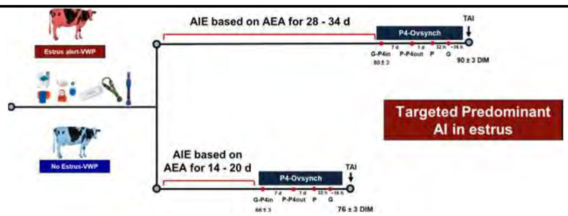

Lower first service conception risk,
BUT SAME pregnancy rate (after calving), days open, and percent pregnant at 150 DIM

VS

ALL-TAI at 84 DIM (Double-Ovsynch)

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Rial et al., 2022 J. Dairy Sci. 105:8411-8425

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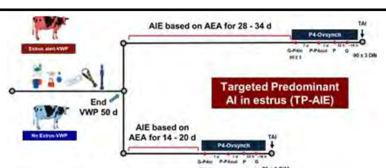

- Strategy to maximize AIE based on cow biology and justify use of synchronization for TAI
- Potential reduction of DIM at first AI – not major, value (?)
- Could improve? more days for AIE, fertility program (Double-Ovsynch?) for cows no estrus VWP cows?

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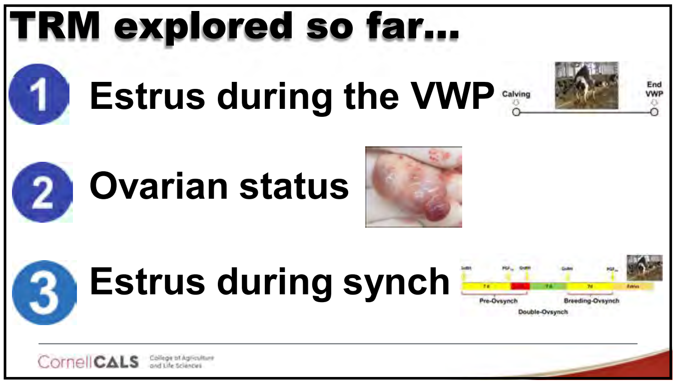
TRM explored so far…
1 Estrus during the VWP
Calving
End VWP
2 Ovarian status
3 Estrus during synch
Pre-Ovsynch
Breeding-Ovsynch
Double-Ovsynch
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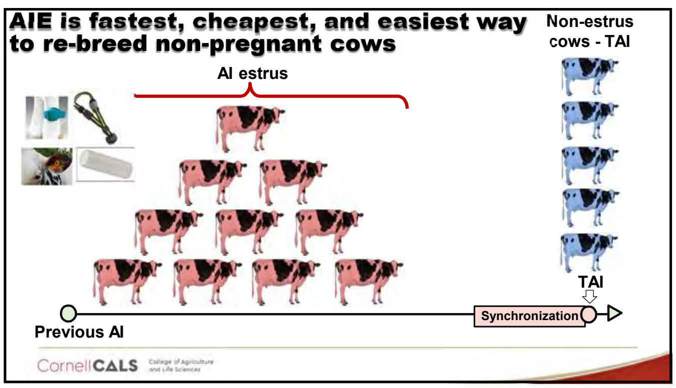
AIE is fastest, cheapest, and easiest way to re-breed non-pregnant cows
Non-estrus cows - TAI
AI estrus
TAI
Synchronization
Previous AI
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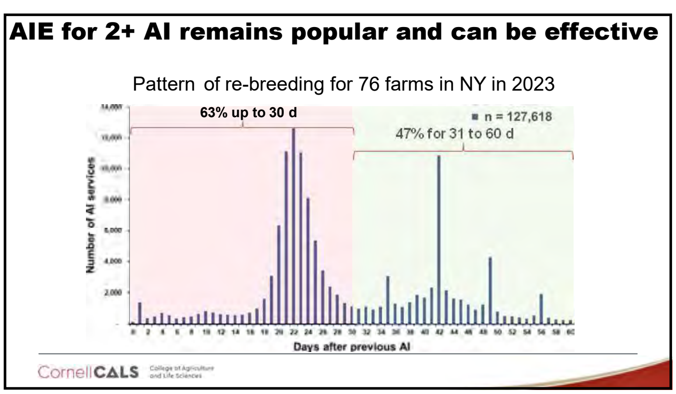
AIE for 2+ AI remains popular and can be effective
Pattern of re-breeding for 76 farms in NY in 2023
63% up to 30 d
n = 127,618
47% for 31 to 60 d
Number of AI services
Days after previous AI
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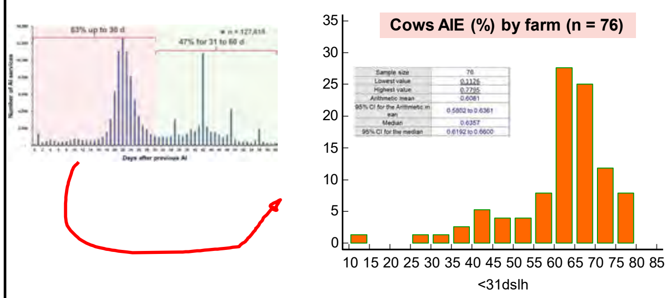
AIE for 2+ AI remains popular and can be effective



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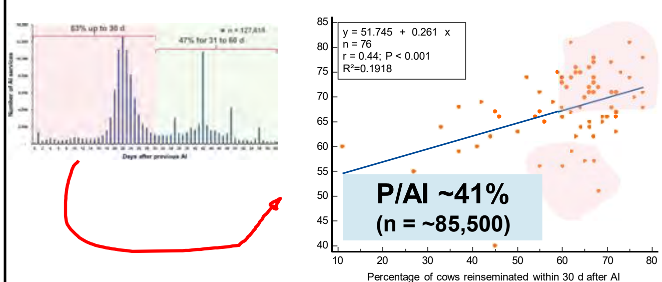
AIE for 2+ AI remains popular and can be effective



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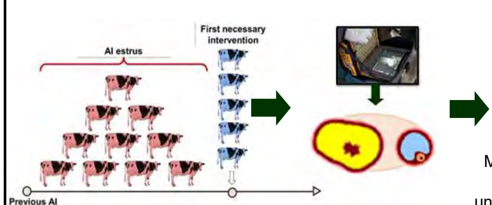
Targeted management for 2+ AI based on ovarian status

Goal – optimize herd performance and management using ovarian status to assign cows to TAI protocols



Minimize the interbreeding interval

+

Maximize P/AI

+

Minimize the number of necessary and unnecessary interventions

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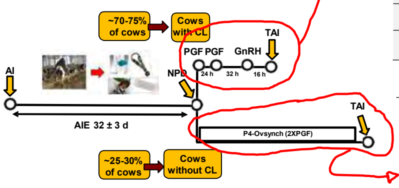
Short Resynch + P4-Ovsynch



Wijma et al., 2018

P/AI (%)	Reference
32% (481)	Wijma et al., 2017
33% (189)	Wijma et al., 2018
33% (737)	Perez et al., 2020
33% (1,407)	Total

	Treatment: NoP4-Ovsynch (1 PGF)	Treatment: P4-Ovsynch (2 PGF)	P-value
NO CL	25 (159)	37 (186)	0.01

Wijma et al., 2018

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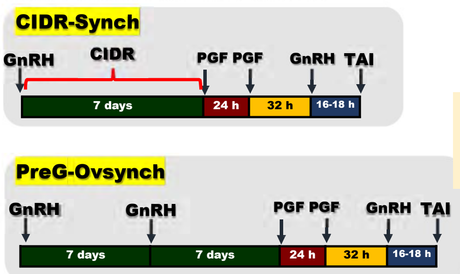
CIDR-Synch or PreG-Ovsynch work well No CL cows



Expected P/AI with both ~35-40%

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Short-Resynch + P4-Ovsynch vs D32-Resynch?

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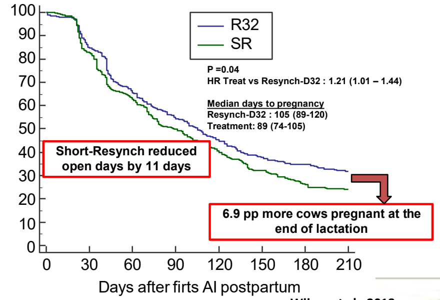
Short-Resynch + P4-Ovynch reduced days open and increased the percentage of pregnant cows



Wijma et al., 2018

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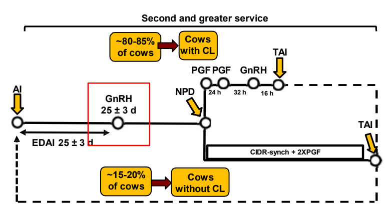
D25-Resynch + P4-Ovsynch is an Effective Program for 2+ AI Service



Perez et al. (2020) JDS 103:10769-10783

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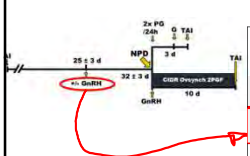
GnRH 7 d before induction of luteolysis (D25-Resynch) improves P/AI for CL cows



Item	Treatment: D25-Resynch+ P4-Ovsynch	Treatment: Short-Resynch + P4-Ovsynch	P-value
Cows with CL (%)	84 (990/1,178)	76 (737/969)	0.01
P/AI CL at NPD (%) (D25-Resynch or Short Resynch)	41 (410/990)	33 (243/737)	0.01
P/AI NO CL at NPD (%) (P4-Ovsynch)	+8% more P/AI wit h GnRH at 25 ± 3 d after AI		
Overall cows pregnant through TAI	43 (483/1,178)	37 (345/969)	0.01

Perez et al. (2020) JDS 103:10769-10783

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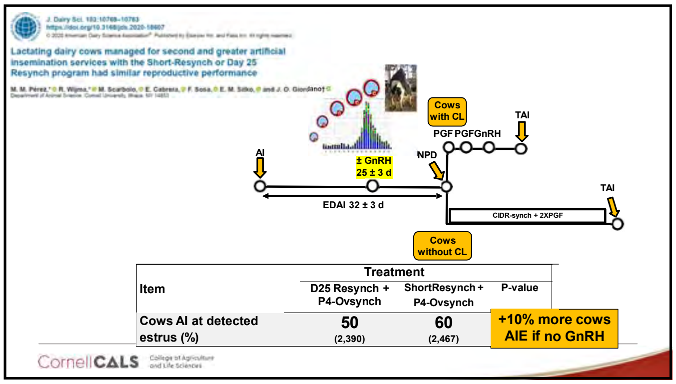

Lactating dairy cows managed for second and greater artificial insemination services with the Short-Resynch or Day 25 Resynch program had similar reproductive performance
Cows with CL
TAI
PGF PGF GnRH
AI
NPD
± GnRH
25 ± 3 d
EDAI 32 ± 3 d
TAI
CIDR-synch + 2XPGF
Cows without CL
Treatment
Item
D25 Resynch + P4-Ovsynch
ShortResynch + P4-Ovsynch
P-value
Cows AI at detected estrus (%)
50
(2,390)
60
(2,467)
+10% more cows AIE if no GnRH
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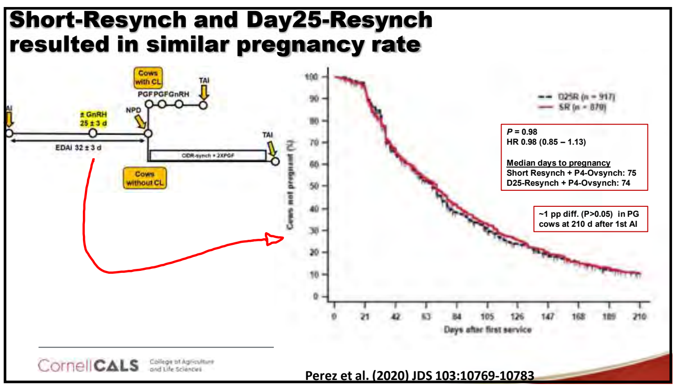

Short-Resynch and Day25-Resynch resulted in similar pregnancy rate
Cows with CL
TAI
PGF PGF GnRH
AI
± GnRH
25 ± 3 d
NPD
EDAI 32 ± 3 d
TAI
CIDR-synch + 2XPGF
Cows without CL
Cows not pregnant (%)
Days after first service
P = 0.98
HR 0.98 (0.85 – 1.13)
Median days to pregnancy
Short Resynch + P4-Ovsynch: 75
D25-Resynch + P4-Ovsynch: 74
~1 pp diff. (P>0.05) in PG cows at 210 d after 1st AI
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Perez et al. (2020) JDS 103:10769-10783

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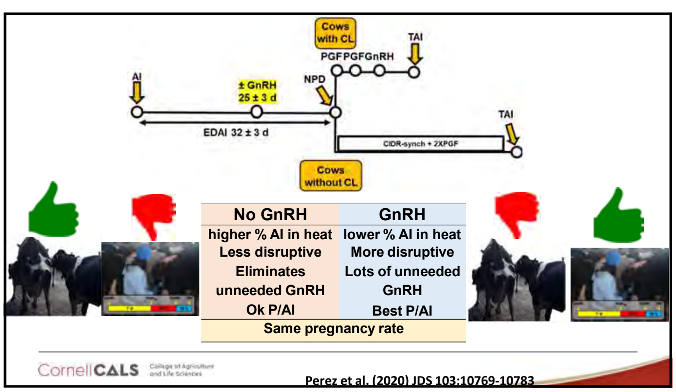

Cows with CL
TAI
PGF PGF GnRH
AI
± GnRH
25 ± 3 d
NPD
EDAI 32 ± 3 d
TAI
CIDR-synch + 2XPGF
Cows without CL
No GnRH
higher % AI in heat
Less disruptive
Eliminates unneeded GnRH
Ok P/AI
GnRH
lower % AI in heat
More disruptive
Lots of unneeded GnRH
Best P/AI
Same pregnancy rate
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Perez et al. (2020) JDS 103:10769-10783

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Treatments for 2+ AI based on Ovarian Status

- Maximize insemination of cows at detected estrus through induction of estrus after non pregnancy diagnosis (NPD)

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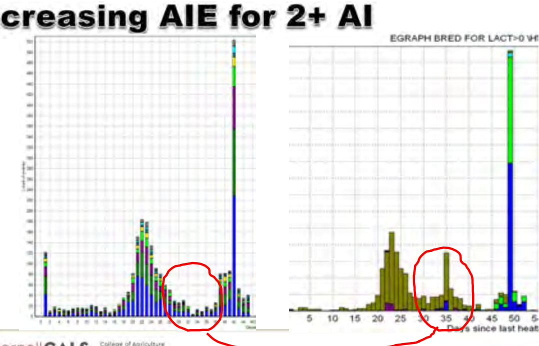
Increasing AIE for 2+ AI



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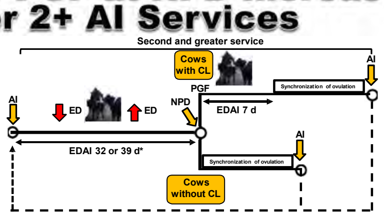
Use of PGF at NPD Increases AIE For 2+ AI Services



Key facts:
- increases cows EDAI after non-pregnancy diagnosis
- treatment adapted to cow physiological status
- must use synch protocol after PGF treatment

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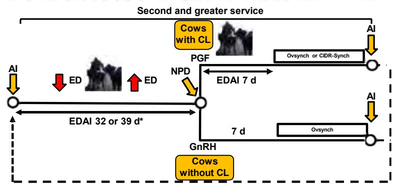
Use of PGF at NPD Increases AIE For 2+ AI Services



Key facts:
- increases cows EDAI after non-pregnancy diagnosis
- treatment adapted to cow physiological status
- must use synch protocol after PGF treatment

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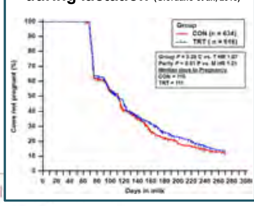
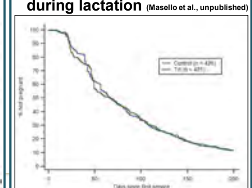
Programs that Increase AIE for 2+ AI Resulted in Similar Performance than AIE + Ovsynch

PGF + AIACT + TAI based on Ovarian status versus a Day32 Resynch
- Same time to pregnancy during lactation (Giordano et al., 2015)



PGF + EDAI + TAI based on Ovarian status versus Day32 Resynch for CL cows + PreG-Ovsynch for NoCL cows
- Same time to pregnancy during lactation (Masello et al., unpublished)



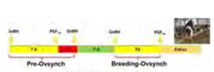
50

TRM explored so far…

1. Estrus during the VWP

2. Ovarian status

3. Estrus during synch



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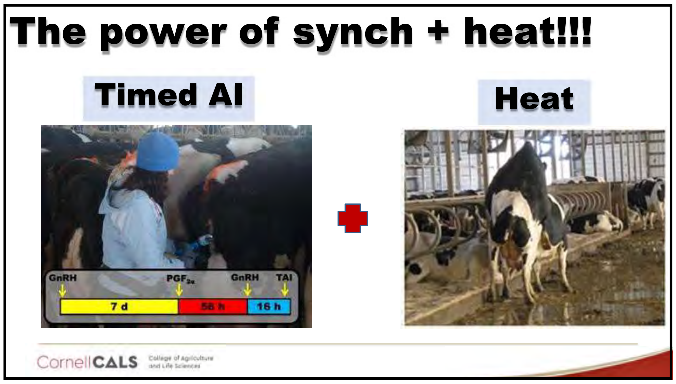
The power of synch + heat!!!
Timed AI
Heat
GnRH
PGF2α
GnRH
TAI
7 d
56 h
16 h
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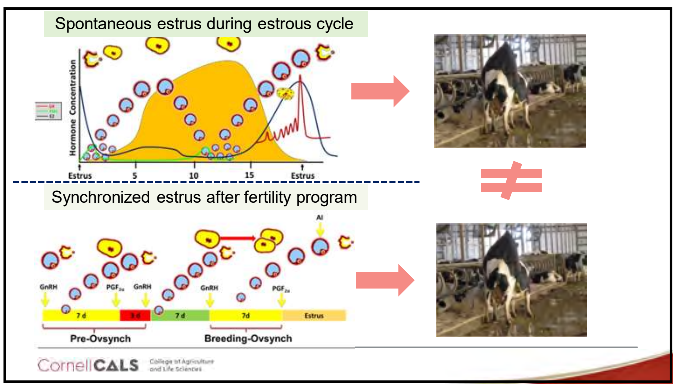
Spontaneous estrus during estrous cycle
Hormone Concentration
Estrus
5
10
15
Estrus
Synchronized estrus after fertility program
AI
Pre-Ovsynch
Breeding-Ovsynch
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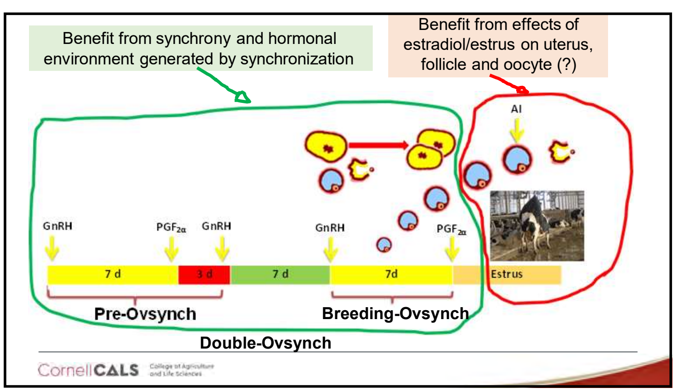
Benefit from synchrony and hormonal environment generated by synchronization
Benefit from effects of estradiol/estrus on uterus, follicle and oocyte (?)
AI
GnRH
PGF2α
GnRH
GnRH
PGF2α
7 d
3 d
7 d
7d
Estrus
Pre-Ovsynch
Breeding-Ovsynch
Double-Ovsynch
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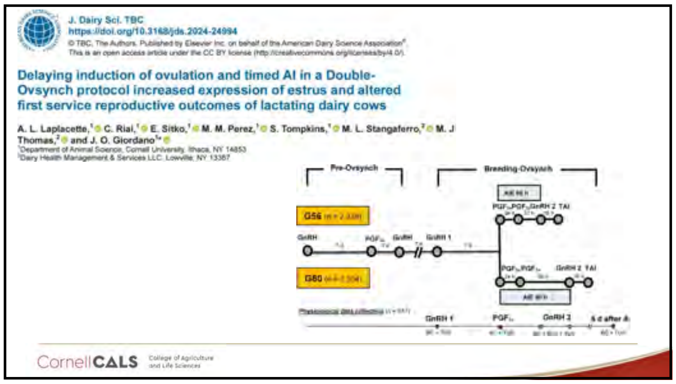
J. Dairy Sci. TBC
https://doi.org/10.3168/jds.2024-24994
© TBC, The Authors. Published by Elsevier Inc. on behalf of the American Dairy Science Association®.
This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).
Delaying induction of ovulation and timed AI in a Double-Ovsynch protocol increased expression of estrus and altered first service reproductive outcomes of lactating dairy cows
A. L. Laplacette, C. Rial, E. Sitko, M. M. Perez, S. Tompkins, M. L. Stangaferro, M. J. Thomas, and J. O. Giordano
Department of Animal Science, Cornell University, Ithaca, NY 14853
Dairy Health Management & Services LLC, Lowville, NY 13367
Pre-Ovsynch
Breeding-Ovsynch
G56
G80
GnRH
PGF
GnRH 1
GnRH 2
TAI
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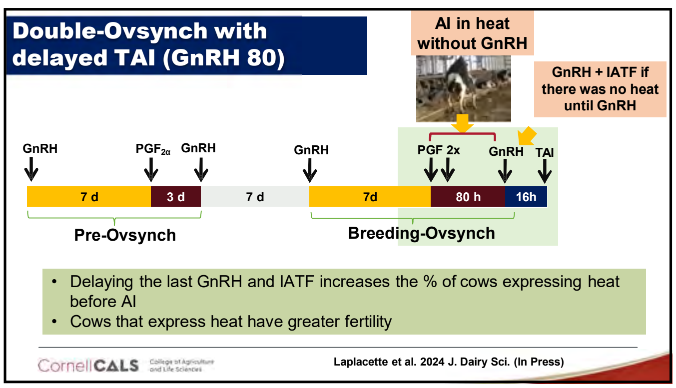
Double-Ovsynch with delayed TAI (GnRH 80)
AI in heat without GnRH
GnRH + IATF if there was no heat until GnRH
GnRH
PGF2α
GnRH
GnRH
PGF 2x
GnRH
TAI
7 d
3 d
7 d
7d
80 h
16h
Pre-Ovsynch
Breeding-Ovsynch
• Delaying the last GnRH and IATF increases the % of cows expressing heat before AI
• Cows that express heat have greater fertility
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Laplacette et al. 2024 J. Dairy Sci. (In Press)

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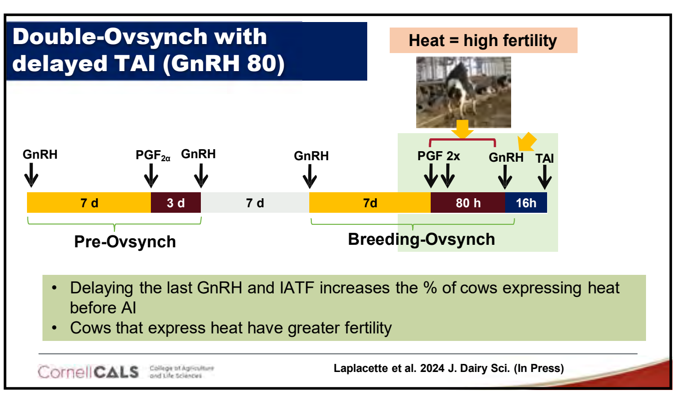
Double-Ovsynch with delayed TAI (GnRH 80)
Heat = high fertility
GnRH
PGF2α
GnRH
GnRH
PGF 2x
GnRH
TAI
7 d
3 d
7 d
7d
80 h
16h
Pre-Ovsynch
Breeding-Ovsynch
• Delaying the last GnRH and IATF increases the % of cows expressing heat before AI
• Cows that express heat have greater fertility
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Laplacette et al. 2024 J. Dairy Sci. (In Press)

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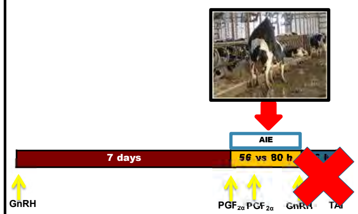
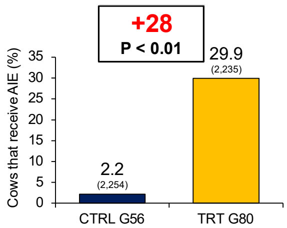
More cows AI in estrus with GnRH at 80 h





AIE: artificial insemination after estrus detection - Cows did not receive GnRH

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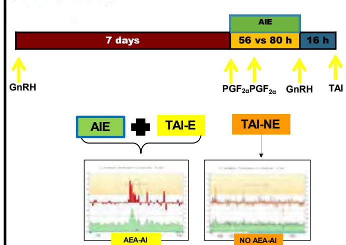
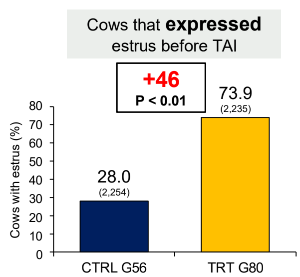
More cows expressed estrus with GnRH at 80 h





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Laplacette et al., 2022 J. Dairy Sci. Volume 105, E-Supplement 1

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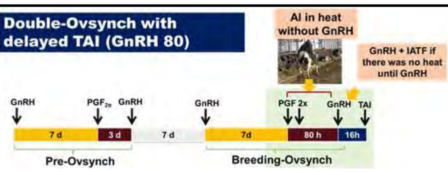
Overall conception risk not different but…

	Treatment		% points diff.	*P*-value
	G56	G80		
	P/AI % (n)			
All	51 (2,191)	53 (2,178)	2	0.36

60



Promoting AI at detected estrus at the end of the protocol

Double-Ovsynch can be used to:

- Identify cows with different reproductive potential for targeted management: sexed semen, embryos, post-AI therapy.
- Improve management aspects: distribute inseminations, reduce the use of GnRH, reduce the need to give GnRH in the afternoon to a good number of cows

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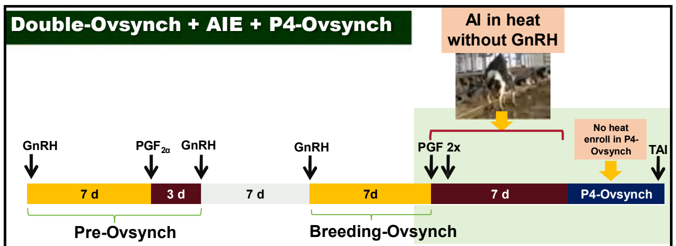
Double-Ovsynch + AIE + P4-Ovsynch



- Maximizes heat insemination after Doble-Ovsynch
- May increase fertility

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Laplacette et al. 2024 (JDS Abstract)

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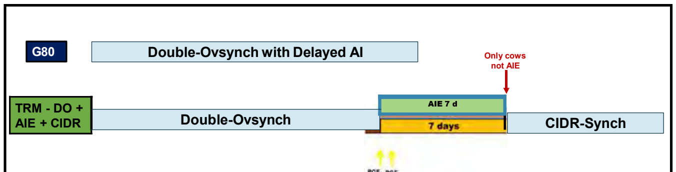

	Treatment		Diff p.p	*P*-value
	G80	DO + AIE + CIDR-Synch		
AIE % (n/n)	45 (1,030)	88 (1,032)	+43	< 0.001

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Laplacette et al., (unpublished)

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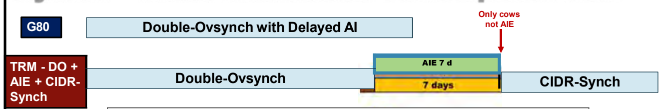
Synch + Heat increased conception risk



	TRT		Diff p.p	P-value
	DTAI	DO + AIE + CIDR-Synch		
	P/AI % (n/n)			
Overall				
AIE				
TAI				

Laplacette et al., (unpublished)

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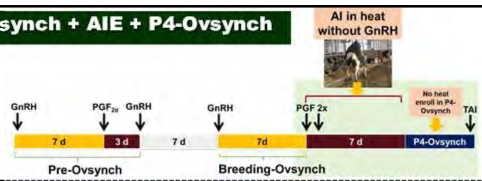
Double-Ovsynch + AIE + P4-Ovsynch



- Increase fertility by up to 7 percentage points
- Identify cows with different reproductive potential for targeted management: sexed semen, embryos, post-AI therapy.
- Improve management aspects: distribute inseminations, reduce the use of GnRH, reduce the need to give GnRH in the afternoon to a good number of cows

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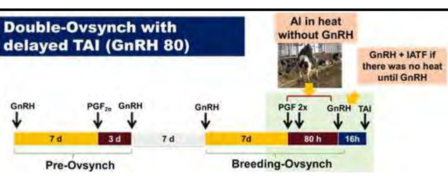
Double-Ovsynch with delayed TAI (GnRH 80)



Promoting AI at detected estrus at the end of the protocol Double-Ovsynch can be used to:

- Identify cows with different reproductive potential for targeted management: sexed semen, embryos, post-AI therapy.
- Improve management aspects: distribute inseminations, reduce the use of GnRH, reduce the need to give GnRH in the afternoon to a good number of cows

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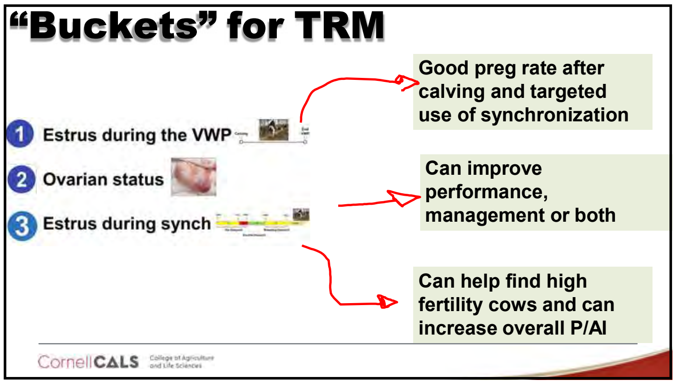
“Buckets” for TRM
1 Estrus during the VWP
2 Ovarian status
3 Estrus during synch
Good preg rate after calving and targeted use of synchronization
Can improve performance, management or both
Can help find high fertility cows and can increase overall P/AI
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Thanks!

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Improving dairy herd health monitoring and management using automated technologies

Julio Giordano, Clara Rial, Ana Laplacette, Martin Perez, and Emily Sitko

Dairy Cattle Biology and Management Laboratory
Department of Animal Science
Cornell University

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1

Integrating automation into herd health monitoring and management

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2

Automated monitoring valuable if accurate for identifying cows with health disorders

Ideally the list of potentially sick cows is created COMPLETELY based on AHM system(s) data

ID	PEN	LACT	DIM	EVT	EDAT	REM	MAVG	MTOT	RUM	ACT	BTEMP	ALERT
1958	8	1	8	FRESH	6/28/2016	BS	46	59	378	465	101	CHECK
8681	9	6	5	MET	3/21/2010	EXN5#30	46	59	423	494	102	CHECK
8999	9	5	5	TREAT	10/24/2010	CAPUMP	31	49	270	370	104	CHECK
9395	9	5	4	FRESH	7/14/2011	HR	38	70	431	402	102	CHECK
9418	9	5	9	FOOTROT	7/26/2011	EXN5#20	77	80	351	460	104	CHECK
1617	9	4	9	TREAT	8/31/2016	EXN2#20	32	45	344	328	104	NOCHECK
1747	9	3	6	FRESH	8/31/2016	HR	57	82	579	436		NOCHECK
1860	9	2	7	TREAT	8/31/2016	CAPUMP	35	50	517	587		CHECK
1956	8	1	6	TREAT	6/28/2016	IMR1#2.7	41	46				
1957	8	1	10	FRESH	6/28/2016	BS	47	5				
1958	8	1	8	FRESH	6/28/2016	BS	46	5				
8681	9	6	5	MET	3/21/2010	EXN5#30	46	5	423	494	102	CHECK
8999	9	5	5	TREAT	10/24/2010	CAPUMP	31	49	270	370	104	CHECK
9395	9	5	4	FRESH	7/14/2011	HR	38	70	431	402	102	CHECK
9418	9	5	9	FOOTROT	7/26/2011	EXN5#20	77	80	351	460	104	CHECK

Cows with health disorders only

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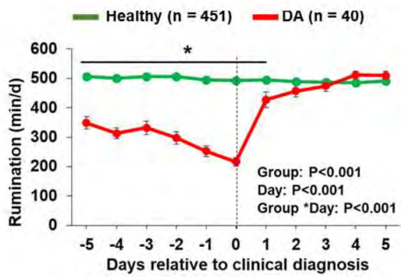
3



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4

Disorder	Cows detected Se, % (95% CI)	HI+ to CD (d)
DA (n = 41)	98 (93-100)	-3 (-3.7 to -2.3; P<0.01)
Ketosis (n = 54)	91 (83-99)	-1.6 (-2.3 to -1.0; P<0.01)
Indig. (n = 9)	89 (68-100)	-0.5 (-1.5 to 0.5; P=0.28)
All metabolic & dig. (n = 104)	93 (89-98)	-2.1 (-2.5 to -1.6; P<0.01)

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-8,760 clinical exams/year for 1,850 cow dairy using automated vs intensive traditional health monitoring

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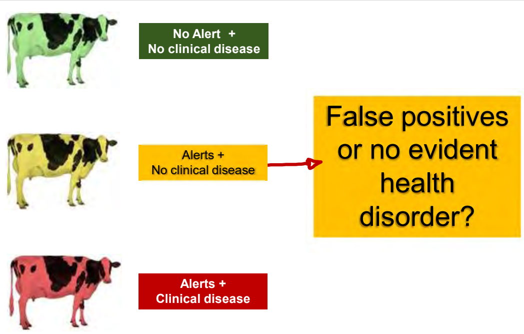
+1.5 kg per cow per day and fewer cows sold to 21 DIM for cows under AHM vs VO

7



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8

Do sensor-monitored parameters change when cows are affected by clinical health disorders?

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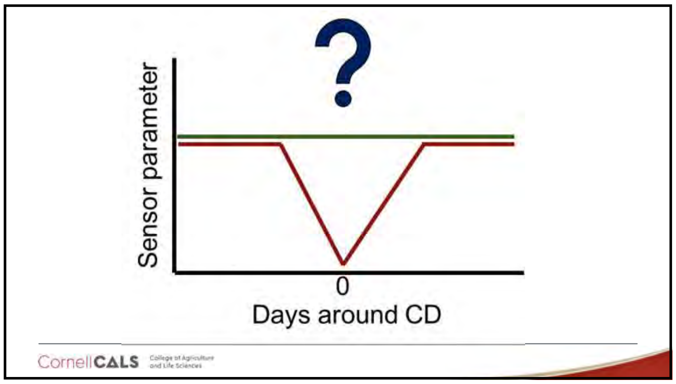
9


?
Sensor parameter
0
Days around CD
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10


Use of rumination and activity monitoring for the identification of dairy cows with health disorders: Part I. Metabolic and digestive disorders
Use of rumination and activity monitoring for the identification of dairy cows with health disorders: Part II. Mastitis
Use of rumination and activity monitoring for the identification of dairy cows with health disorders: Part III. Metritis
J. Dairy Sci. 106:9323–9344
https://doi.org/10.3168/jds.2022-23156
Metabolic-digestive clinical disorders of lactating dairy cows were associated with alterations of rumination, physical activity, and lying behavior monitored by an ear-attached sensor
C. Rial, A. Laplacette, L. Caixeta, C. Florentino, F. Peña-Mosca, and J. O. Giordano
J. Dairy Sci. 106:9345–9365
https://doi.org/10.3168/jds.2022-23157
Metritis and clinical mastitis events in lactating dairy cows were associated with altered patterns of rumination, physical activity, and lying behavior monitored by an ear-attached sensor
C. Rial, A. Laplacette, L. Caixeta, C. Florentino, F. Peña-Mosca, and J. O. Giordano
J. Dairy Sci. 106:9474–9493
https://doi.org/10.3168/jds.2023-23477
Effects of targeted clinical examination based on alerts from automated health monitoring systems on herd health and performance of lactating dairy cows
M. M. Perez, E. M. Cabrera, and J. O. Giordano
J. Dairy Sci. TBC
https://doi.org/10.3168/jds.2024-25256
Effect of automated health monitoring based on rumination, activity, and milk yield alerts versus visual observation on herd health monitoring and performance outcomes
C. Rial, M. L. Stangaferro, M. J. Thomas, and J. O. Giordano
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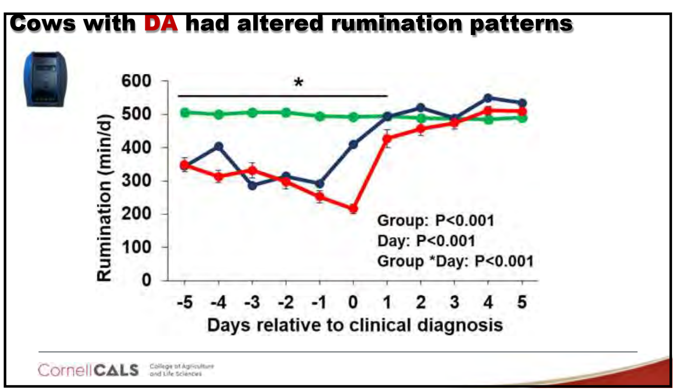
Cows with DA had altered rumination patterns
Rumination (min/d)
600
500
400
300
200
100
0
*
Group: P<0.001
Day: P<0.001
Group *Day: P<0.001
-5 -4 -3 -2 -1 0 1 2 3 4 5
Days relative to clinical diagnosis
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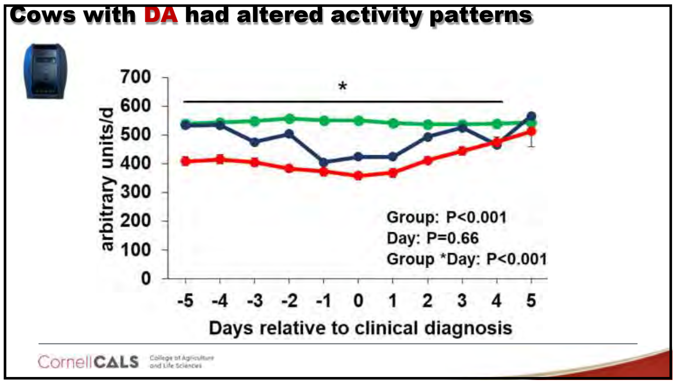
Cows with DA had altered activity patterns
700
600
500
400
300
200
100
0
arbitrary units/d
*
Group: P<0.001
Day: P=0.66
Group *Day: P<0.001
-5 -4 -3 -2 -1 0 1 2 3 4 5
Days relative to clinical diagnosis
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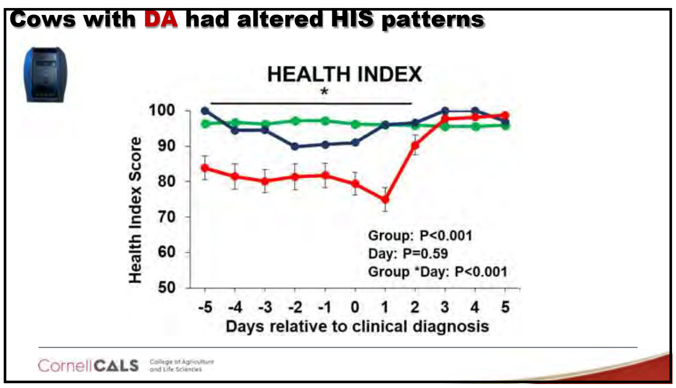
13


Cows with DA had altered HIS patterns
HEALTH INDEX
*
100
90
80
70
60
50
Health Index Score
Group: P<0.001
Day: P=0.59
Group *Day: P<0.001
-5 -4 -3 -2 -1 0 1 2 3 4 5
Days relative to clinical diagnosis
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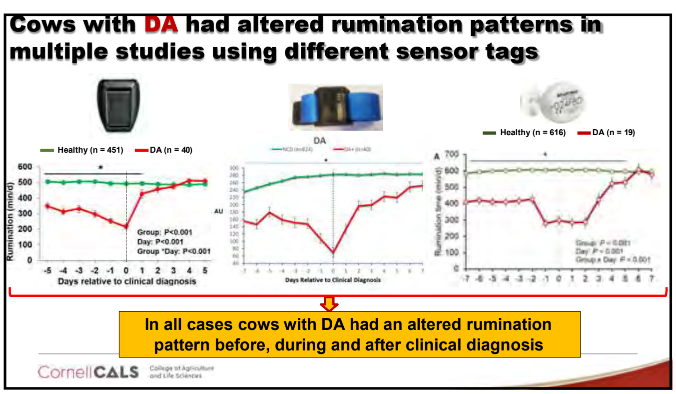
Cows with DA had altered rumination patterns in multiple studies using different sensor tags
Healthy (n = 451)
DA (n = 40)
Rumination (min/d)
Group: P<0.001
Day: P<0.001
Group *Day: P<0.001
-5 -4 -3 -2 -1 0 1 2 3 4 5
Days relative to clinical diagnosis
DA
AU
Days Relative to Clinical Diagnosis
Healthy (n = 616)
DA (n = 19)
Rumination time (min/d)
-7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7
In all cases cows with DA had an altered rumination pattern before, during and after clinical diagnosis
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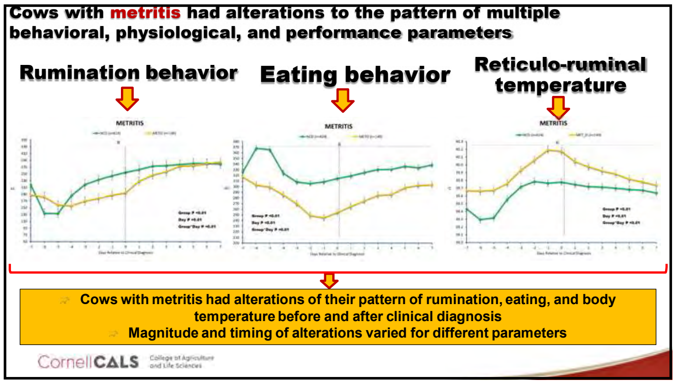
15


Cows with metritis had alterations to the pattern of multiple behavioral, physiological, and performance parameters
Rumination behavior
Eating behavior
Reticulo-ruminal temperature
METRITIS
Cows with metritis had alterations of their pattern of rumination, eating, and body temperature before and after clinical diagnosis
Magnitude and timing of alterations varied for different parameters
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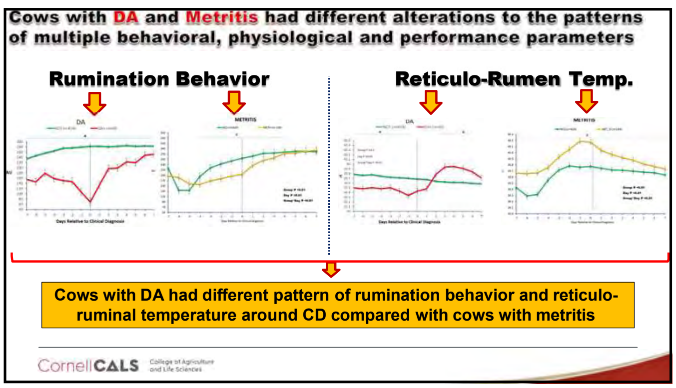
Cows with DA and Metritis had different alterations to the patterns of multiple behavioral, physiological and performance parameters
Rumination Behavior
Reticulo-Rumen Temp.
Cows with DA had different pattern of rumination behavior and reticulo-ruminal temperature around CD compared with cows with metritis
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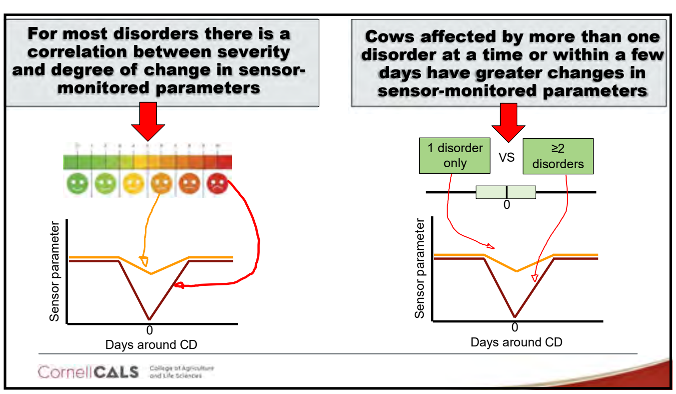
17


For most disorders there is a correlation between severity and degree of change in sensor-monitored parameters
Cows affected by more than one disorder at a time or within a few days have greater changes in sensor-monitored parameters
1 disorder only
VS
≥2 disorders
0
Sensor parameter
Days around CD
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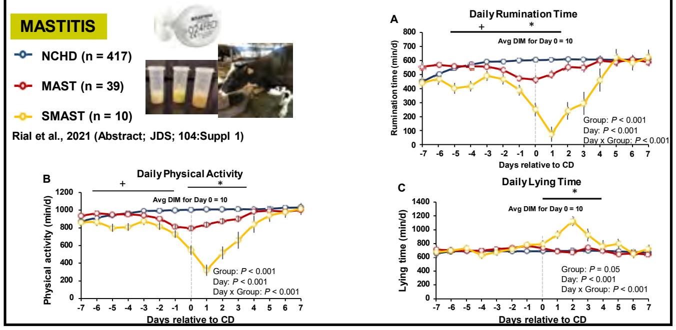
Cows with more severe cases of disease present sensor parameter changes of greater magnitude



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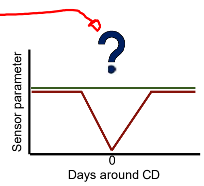
Sensor-monitored parameters are affected by clinical health disorders

Do sensor-monitored parameters change when cows are affected by clinical health disorders?

1. Most sensor-monitored parameters change when cows are affected by clinical health disorders
2. Same disease causes changes to more than one sensor-monitored parameter
3. Different diseases causes different changes to sensor-monitored parameters
4. Disease severity and concomitant disorders cause more dramatic changes in sensor parameters



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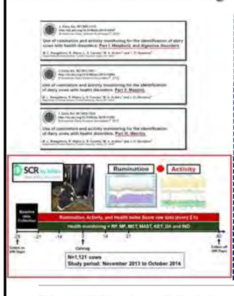
20

Most cows with metabolic and digestive disorders were identified by an AHMS that used rum+act



Disorder	Cows detected Se, % (95% CI)	HI+ to CD (d)
DA (n = 41)	98 (93-100)	-3 (-3.7 to -2.3; P<0.01)
Ketosis (n = 54)	91 (83-99)	-1.6 (-2.3 to -1.0; P<0.01)
Indig. (n = 9)	89 (68-100)	-0.5 (-1.5 to 0.5; P=0.28)
All metabolic & dig. (n = 104)	93 (89-98)	-2.1 (-2.5 to -1.6; P<0.01)

- Majority of cows had alerts around CD of metabolic digestive disorders
- Alerts were observed earlier or at same time as CD
- AHMS that used rum+act might be effective for identifying cows with metabolic and digestive disorders

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Ability to identify cows with metritis and mastitis based on alerts from an AHMS was moderate overall but more effective for cows with severe cases

Disorder	Cows detected Se, % (95% CI)	HI+ to DCD (d)
Metritis ALL (n = 349)	55 (49-60)	-1.2 (-1.6, -0.7; P<0.01)
Metritis only (n = 322)	53[a] (47-58)	-1.2 (-1.6, -0.7; P<0.01)
Metritis + other HD (n = 27)	78[b] (62-91)	-1.3 (-2.4, -0.2; P=0.03)

Disorder	Cows detected % Se (95% CI)	HR Flag to DCD (days)
Mastitis (n = 123)	58 (49-67)	-0.5 (-1.0 to -0.1; P=0.02)
By Pathogen		
E. Coli (n = 31)	81[a] (67-95)	→ Severe toxic mastitis
Gram + (n = 39)	49[b] (32-65)	
Staph. Aureus (n = 11)	46[b] (17-77)	→ Chronic mild mastitis
No growth 48 h (n = 25)	48[b] (28-69)	

- Slightly over half the cows had HI score alerts
- More effective to identify cows affected by another disorder or more severe cases
- Alerts for cows flagged were observed earlier than clinical diagnosis

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Stangaferro et al., 2016 (JDS 99:7422-7433)

22

Automated monitoring valuable if accurate for identifying cows with health disorders

Ideally the list of potentially sick cows is created COMPLETELY based on AHM system(s) data

ID	PEN	LACT	DIM	EVT	EDAT	REM	MAVG	MTOT	RUM	ACT	BTEMP	ALERT
1958	8	1	8	FRESH	6/28/2016	BS	46	59	378	465	101	CHECK
8681	9	6	5	MET	3/21/2010	EXN5#30	46	59	423	494	102	CHECK
8999	9	5	5	TREAT	10/24/2010	CAPUMP	31	49	270	370	104	CHECK
9395	9	5	4	FRESH	7/14/2011	HR	38	70	431	402	102	CHECK
9418	9	5	9	FOOTROT	7/26/2011	EXN5#20	77	80	351	460	104	CHECK
1617	9	4	9	TREAT	8/31/2016	EXN2#20	32	45	344	328	104	NOCHECK
1747	9	3	6	FRESH	8/31/2016	HR	57	82	579	436		NOCHECK
1860	9	2	7	TREAT	8/31/2016	CAPUMP	35	50	517	587		CHECK
1956	8	1	6	TREAT	6/28/2016	IMR1#2.7	41	46				
1957	8	1	10	FRESH	6/28/2016	BS	47	5				
1958	8	1	8	FRESH	6/28/2016	BS	46	5				
8681	9	6	5	MET	3/21/2010	EXN5#30	46	5	423	494	102	CHECK
8999	9	5	5	TREAT	10/24/2010	CAPUMP	31	49	270	370	104	CHECK
9395	9	5	4	FRESH	7/14/2011	HR	38	70	431	402	102	CHECK
9418	9	5	9	FOOTROT	7/26/2011	EXN5#20	77	80	351	460	104	CHECK

Cows with health disorders only

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Automated health monitoring systems can help with herd health monitoring and management

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Potential value of AHMS varies largely for different farms

Farms with little-to-no intervention and not well-defined programs
Accurate and timely identification of "more" cows of interest
Improved diagnosis

Everything in between…large variation for AHMS use and value

Farms with intensive and systematic monitoring programs
Reduce labor needs & cow manipulation at same level of detection

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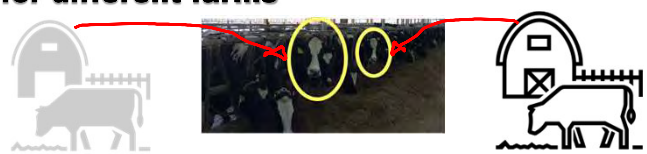
Potential value of AHMS varies largely for different farms



Everything in between…large variation for AHMS use and value

Farms with intensive and systematic monitoring programs
Reduce labor needs & cow manipulation at same level of detection

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J. Dairy Sci. 106:9474–9493
https://doi.org/10.3168/jds.2023-23477

Effects of targeted clinical examination based on alerts from automated health monitoring systems on herd health and performance of lactating dairy cows

M. M. Perez, E. M. Cabrera, and J. O. Giordano*
Department of Animal Science, Cornell University, Ithaca, NY 14853

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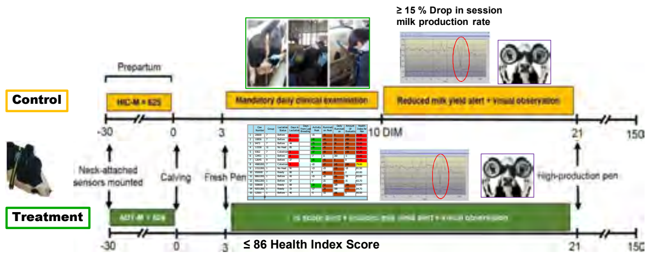
27

Compared program based primarily on AHM systems alerts vs traditional monitoring



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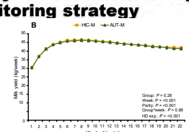
Same or a slightly smaller proportion of cows with HD detected with a program that prioritized AHM systems alerts

Item[1]	Proportion HIC-M (n = 600)	Proportion AUT-M (n = 605)	P-value	Incidence Rate Ratio HIC-M (n = 600)	Incidence Rate Ratio AUT-M (n = 605)	P-value
Before risk period	7.2 (5.3 - 9.6)	7.1 (5.3 - 9.6)	0.97	0.9	Ref.	0.45
AMS risk period	17.0 (14.1 - 20.3)	13.6 (11.1 - 16.7)	0.10	1.3	Ref.	0.05
Experimental period	23.9 (20.5 - 27.6)	20.5 (17.4 - 24.0)	0.16	1.14	Ref.	0.2 3

% cows that left the herd not affected by monitoring strategy

Item[1]	Group HIC-M (n = 600)	Group AUT-M (n = 605)	P-value
Sold and died up to 60 DIM	1.5 (0.7 - 3.1)	2.1 (1.0 - 4.0)	0.38
Sold and died up to 150 DIM	8.4 (6.0 - 11.6)	6.9 (4.8 - 9.8)	0.28

Milk yield not affected by monitoring strategy



First service outcomes not affected by monitoring strategy

Item[1]	Group HIC-M	Group AUT-M
DIM 1st AI AIE only	75.0 ± 0.27	75.0 ± 0.28
P/AI (%) All AI	41.9 (37.7 - 46.3) (538)	39.2 (35.0 - 43.6) (536)
P/AI (%) AIE	38.9 (33.5 - 44.7) (367)	35.4 (30.0 - 41.3) (345)
P/AI (%) TAI	45.5 (37.8 - 53.4) (171)	45.5 (38.3 - 52.9) (191)
Pregnancy Loss (%)	5.4 (3.0 - 9.4) (219)	2.7 (1.2 – 5.9) (212)

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Perez et al., 2023 JDS:106:9474-9493

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MOST but NOT ALL cows with health disorders might be identified with AHM systems

Combining AHM with some level of traditional health monitoring might be necessary for some herds

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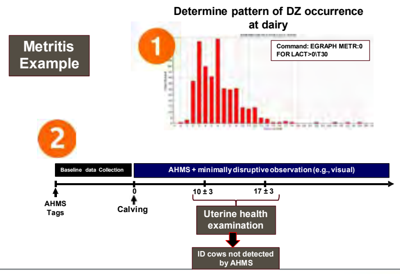
Combining AHMS with traditional health monitoring to avoid missing cows of interest



31

Potential value of AHMS varies largely for different farms

Farms with intensive and systematic monitoring programs

Reduce labor needs & cow manipulation at same level of detection

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Potential strategies for AHMS use vary by farm

Generate list through AHMS data – List generated COMPLETELY based on AHMS data

ID	PEN	LACT	DIM	EVT	EDAT	REM	MAVG	MTOT	RUM	ACT	BTEMP	ALERT
1958	8	1	8	FRESH	6/28/2016	BS	46	59	378	465	101	CHECK
8681	9	6	5	MET	3/21/2010	EXN5#30	46	59	423	494	102	CHECK
8999	9	5	5	TREAT	10/24/2010	CAPUMP	31	49	270	370	104	CHECK
9395	9	5	4	FRESH	7/14/2011	HR	38	70	431	402	102	CHECK
9418	9	5	9	FOOTROT	7/26/2011	EXN5#20	77	80	351	460	104	CHECK
1617	9	4	9	TREAT	8/31/2016	EXN2#20	32	45	344	328	104	NOCHECK
1747	9	3	6	FRESH	8/31/2016	HR	57	82	579	436	102	NOCHECK
1860	9	2	7	TREAT	8/31/2016	CAPUMP	35	50	517	587	101	CHE
1956	8	1	6	TREAT	6/28/2016	IMR1#2.7	41	46	351	360	102	NOCH
1957	8	1	10	FRESH	6/28/2016	BS	47	59	327	311	104	NOCH
1958	8	1	8	FRESH	6/28/2016	BS	46	59	378	465	101	CHE
8681	9	6	5	MET	3/21/2010	EXN5#30	46	59	423	494	102	CHE
8999	9	5	5	TREAT	10/24/2010	CAPUMP	31	49	270	370	104	CHE
9395	9	5	4	FRESH	7/14/2011	HR	38	70	431	402	102	CHE
9418	9	5	9	FOOTROT	7/26/2011	EXN5#20	77	80	351	460	104	CHE

Will likely help reduce number of cows to monitor

May miss cows that need attention depending on type of AHMS used and performance (+reference test)

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AHMS may help reduce labor needs and cow manipulation

~1,840 milking
~2,450 calvings/yr

Item	CON	TRT	Diff.
Cows checked per day	40 (20-66)	16 (4-22)	24
Cows treated per day	8	8	0
Time spent per cow per day (min)	2.92	2.92	0
Cows checked per year	14,600	5,840	8,760
Hours checking cows per year per wkr	711	284	426

- Did not account for labor required to replace collars

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Perez et al., (unpublished)

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Potential value of AHMS varies largely for different farms

Farms with little-to-no intervention and not well-defined programs
⬇
Accurate and timely identification of "more" cows of interest
Improved diagnosis

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J. Dairy Sci. TBC
https://doi.org/10.3168/jds.2024-25256

Effect of automated health monitoring based on rumination, activity, and milk yield alerts versus visual observation on herd health monitoring and performance outcomes

C. Rial,[1] M. L. Stangaferro,[2] M. J. Thomas,[2] and J. O. Giordano[1]*
[1]Department of Animal Science, Cornell University, Ithaca, NY
[2]Dairy Health and Management Services, Lowville, NY

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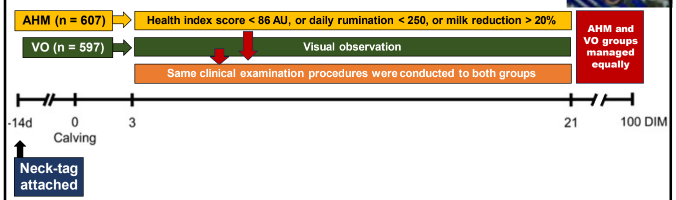
Compared

Rial et al. JDS 2024 (In Press)



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Cows in the AHM group were more likely to be selected for clinical examination

Outcome	VO (n = 597)	AHM (n = 607)	P-value
Cows examined, %	30 ± 2.5	62 ± 2.8	< 0.001
Times examined	1.4 ± 0.6	2.1 ± 0.5	< 0.001

Cows selected per day: 5.3 ± 2.5

Cows selected per day: 15.5 ± 3.5

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Rial et al. 2024 JDS (In Press)

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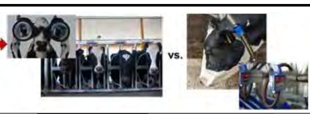
Compared



From 3 to 21 DIM	VO (n = 595)	AHM (n = 602)	Diff.	P-value
Cows with HD, %	21 ± 2.5	35 ± 2.9	+14	< 0.001
Cows treated, %	17 ± 2.2	26 ± 1.9	+9	< 0.001
Cows in hospital, %	11 ± 1.7	16 ± 2.1	+5	0.02
Number of cow-days in hospital, d	277 ± 4.7	436 ± 3.4	+159	< 0.001

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Rial et al. 2024 JDS (In Press)

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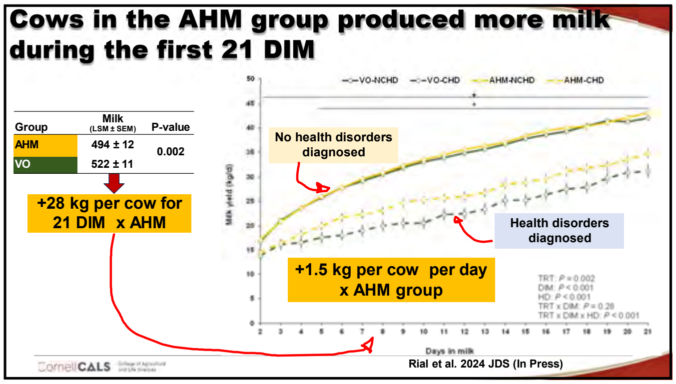
Cows in the AHM group produced more milk during the first 21 DIM
VO-NCHD
VO-CHD
AHM-NCHD
AHM-CHD
Group
Milk (LSM ± SEM)
P-value
AHM
494 ± 12
VO
522 ± 11
0.002
+28 kg per cow for 21 DIM x AHM
No health disorders diagnosed
Health disorders diagnosed
+1.5 kg per cow per day x AHM group
Milk yield (kg/d)
TRT: P = 0.002
DIM: P < 0.001
HD: P < 0.001
TRT x DIM: P = 0.28
TRT x DIM x HD: P < 0.001
Days in milk
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Rial et al. 2024 JDS (In Press)

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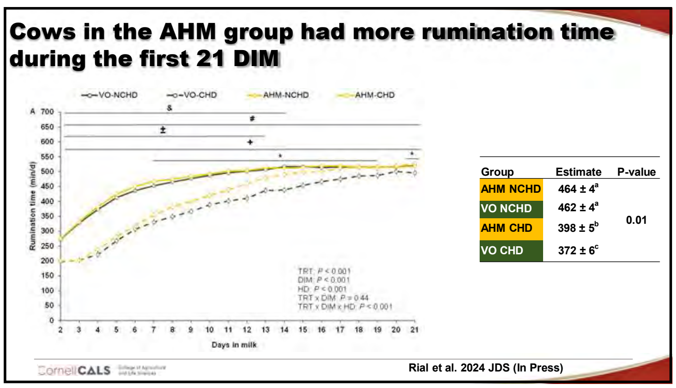
Cows in the AHM group had more rumination time during the first 21 DIM
VO-NCHD
VO-CHD
AHM-NCHD
AHM-CHD
Rumination time (min/d)
TRT: P < 0.001
DIM: P < 0.001
HD: P < 0.001
TRT x DIM: P = 0.44
TRT x DIM x HD: P < 0.001
Days in milk
Group
Estimate
P-value
AHM NCHD
464 ± 4a
VO NCHD
462 ± 4a
AHM CHD
398 ± 5b
VO CHD
372 ± 6c
0.01
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Rial et al. 2024 JDS (In Press)

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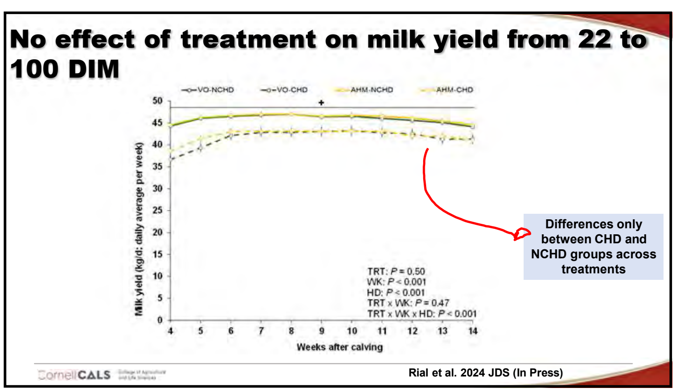
No effect of treatment on milk yield from 22 to 100 DIM
VO-NCHD
VO-CHD
AHM-NCHD
AHM-CHD
Milk yield (kg/d; daily average per week)
Differences only between CHD and NCHD groups across treatments
TRT: P = 0.50
WK: P < 0.001
HD: P < 0.001
TRT x WK: P = 0.47
TRT x WK x HD: P < 0.001
Weeks after calving
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Some effects of treatment group on herd exit

	Outcome, %	VO (n = 597)	AHM (n = 607)	*P*-value
Left herd	1 to 21 DIM	12	10	0.54
	22 to 100 DIM	9	7	0.26
	1 to 100 DIM	22	18	0.22
Died	1 to 21 DIM	1.7	2.3	0.31
	22 to 100 DIM	2.6	1.5	0.28
	1 to 100 DIM	2.5	2.6	0.82
Sold	1 to 21 DIM	6	3	0.06
	22 to 100 DIM	8	7	0.48
	1 to 100 DIM	15	10	0.12

Treatment

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Rial et al. 2024 JDS (In Press)

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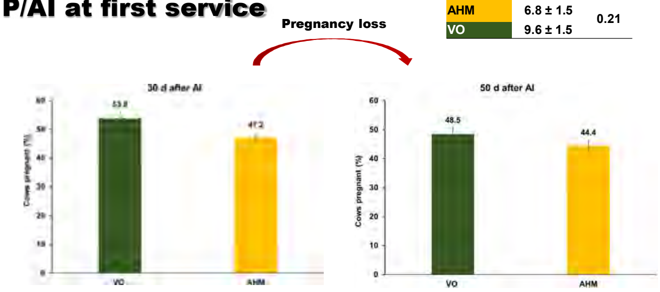
No effect of treatments on P/AI at first service

Group	Estimate	P-value
AHM	6.8 ± 1.5	0.21
VO	9.6 ± 1.5	



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Rial et al. 2024 JDS (In Press)

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Conclusions

- More cows in the AHM group were identified with health disorders
- Cows in the AHM group had greater milk yield in the first 21 DIM
- Some differences observed in the herd exit dynamic

More cows examined ------------------------ ⬆ LABOR COST ?

More cows treated ---------------------------- ⬆ LABOR AND TREATMENT COST ?

Automated monitoring systems --------- ⬆ AMS COST ?

More milk for cows in AHM group ----- ⬆ Income ?

…… **PROFITABILITY?** $

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Rial et al. 2024 (Unpublished)

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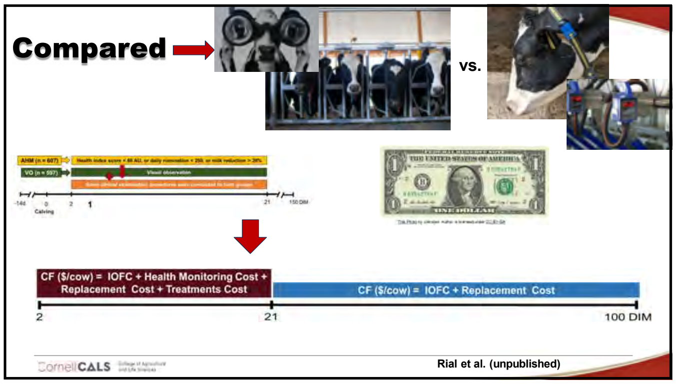
Compared
vs.
CF ($/cow) = IOFC + Health Monitoring Cost + Replacement Cost + Treatments Cost
CF ($/cow) = IOFC + Replacement Cost
2
21
100 DIM
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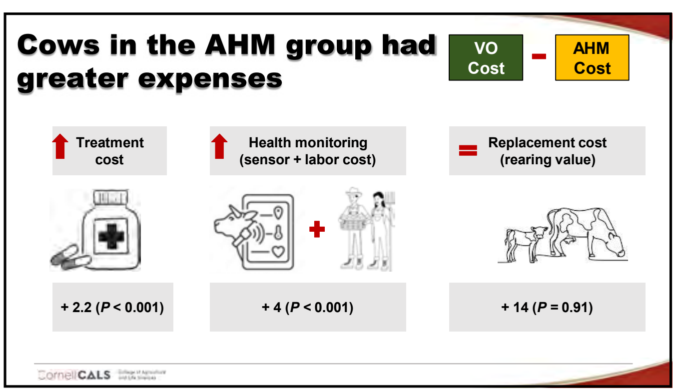
Cows in the AHM group had greater expenses
VO Cost - AHM Cost
Treatment cost
Health monitoring (sensor + labor cost)
Replacement cost (rearing value)
+ 2.2 (P < 0.001)
+ 4 (P < 0.001)
+ 14 (P = 0.91)
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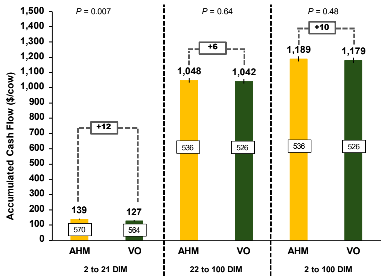
Cows in the AHM group had greater income over feed cost and cash flow for cows that stayed in the herd



Economic benefit for AHM for 21 DIM was offset thereafter

Still positive but not statistically significant

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No difference in cash flow for cows that exited the herd

	VO	AHM	Diff.	P-value
2 to 21 DIM ($/cow)	(n = 31)	(n = 32)		
CF – RPC rearing	-1170 ± 128	-1289 ± 146	119	0.97
CF – RPC market	-109 ± 67	-197 ± 76	88	0.37
22 to 100 DIM ($/cow)	(n = 38)	(n = 34)		
CF – RPC rearing	-636 ± 140	-642 ± 142	6	0.75
CF – RPC market	-41 ± 140	-47 ± 143	6	0.97

No overall difference but slightly greater cost for AHM could offset gain for cows that stayed

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Summary for cash flow of AHM vs VO

- Cows in AHM group had greater (numerical) cash flow to 100 DIM compared with the VO group – effect only for up to 21 DIM
- Despite greater expenses associated with greater labor, sensor and treatment cost, enhanced milk yield was sufficient to cause greater IOFC and consequently cash flow
- Outcomes may change if the use of AHMS to select cows for clinical examination is compared with more intense health monitoring programs
- DID NOT account for any other uses of automated monitoring

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Specificity is also relevant but we know less about

Sensitivity   Specificity

If specificity of AHM systems alerts is low, a lot of healthy cows are added to the list of cows for clinical examination

ID	PEN	LACT	DIM	EVT	EDAT	REM	MAVG	MTOT	RUM	ACT	BTEMP	ALERT
40	9	6	8	TREAT	9/17/2009	IMR1#2.7	82	105	386	384	104	CHECK
679	9	5	5	TREAT	3/3/2011	CAPUMP	48	71	355	463	101	CHECK
759	9	5	10	COM	3/13/2013	PROP1.0	55	76	415	398	104	CHECK
1538	9	5	4	RESULT	8/31/2016	B#.6	28	45	394	496	104	CHECK
1617	9	4	9	TREAT	8/31/2016	EXN2#20	32	45	344	328	104	CHECK
1747	9	3	6	FRESH	8/31/2016	HR	57	82	579	436	102	CHECK
1860	9	2	7	TREAT	8/31/2016	CAPUMP	35	50	517	587	101	CHECK
1956	8	1	6	TREAT	6/28/2016	IMR1#2.7	41	46	351	360	102	CHECK
1957	8	1	10	FRESH	6/28/2016	BS	47	59	327	311	104	CHECK
1958	8	1	8	FRESH	6/28/2016	BS	46	59	378	465	101	CHECK
8681	9	6	5	MET	3/21/2010	EXN5#30	46	59	423	494	102	CHECK
8999	9	5	5	TREAT	10/24/2010	CAPUMP	31	49	270	370	104	CHECK
9395	9	5	4	FRESH	7/14/2011	HR	38	70	431	402	102	CHECK
9418	9	5	9	FOOTROT	7/26/2011	EXN5#20	77	80	351	460	104	CHECK

Unnecessary work and cow disruption!!!

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Cows in the AHM group were more likely to be selected for clinical examination and diagnosed with a disorder

Outcome, %	VO (n = 597)	AHM (n = 607)	P-value
Cows examined	30	62	< 0.001
Clinical health disorder	21	35	< 0.001

VO = 66% cows diagnosed with disorder / cows examined

AHM = 46% cows diagnosed with disorder / cows examined

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Rial et al. 2024 JDS (In Press)

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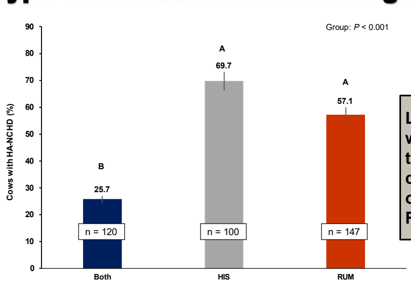
Type of alert and clinical diagnosis outcomes



Lower proportion of cows with Alert and NCHD when the cow is selected for clinical examination based on both (his<86 and RUM<250)

Rial et al. 2024 (Unpublished)

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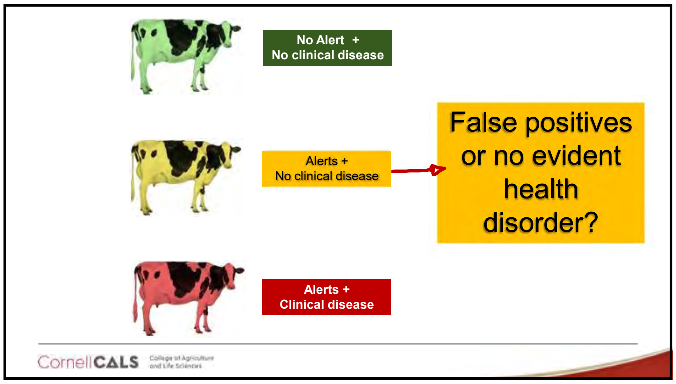

No Alert +
No clinical disease
Alerts +
No clinical disease
False positives or no evident health disorder?
Alerts +
Clinical disease
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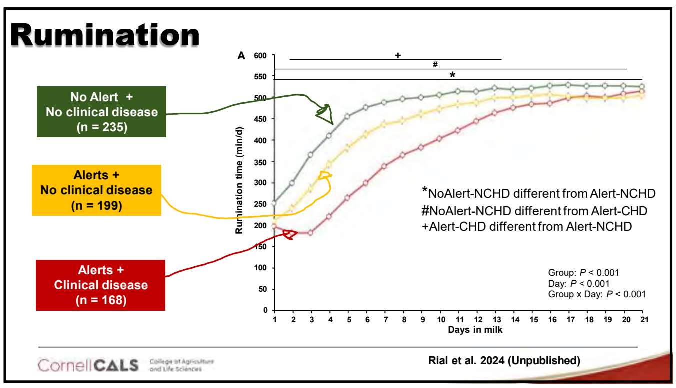
55



Rumination
A
No Alert +
No clinical disease
(n = 235)
Alerts +
No clinical disease
(n = 199)
Alerts +
Clinical disease
(n = 168)
Rumination time (min/d)
*NoAlert-NCHD different from Alert-NCHD
#NoAlert-NCHD different from Alert-CHD
+Alert-CHD different from Alert-NCHD
Group: P < 0.001
Day: P < 0.001
Group x Day: P < 0.001
Days in milk
Rial et al. 2024 (Unpublished)
Cornell CALS College of Agriculture and Life Sciences

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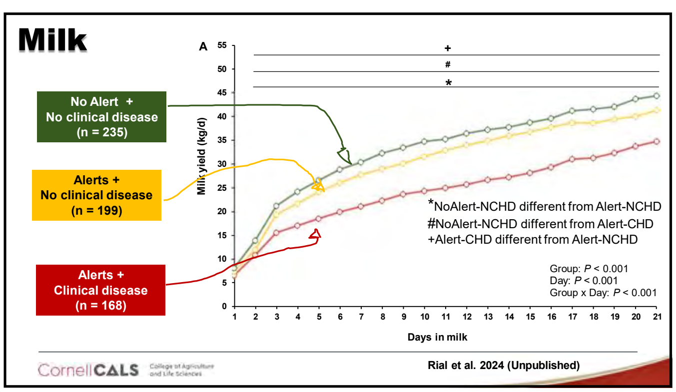

Milk
A
No Alert +
No clinical disease
(n = 235)
Alerts +
No clinical disease
(n = 199)
Alerts +
Clinical disease
(n = 168)
Milk yield (kg/d)
*NoAlert-NCHD different from Alert-NCHD
#NoAlert-NCHD different from Alert-CHD
+Alert-CHD different from Alert-NCHD
Group: P < 0.001
Day: P < 0.001
Group x Day: P < 0.001
Days in milk
Rial et al. 2024 (Unpublished)
Cornell CALS College of Agriculture and Life Sciences

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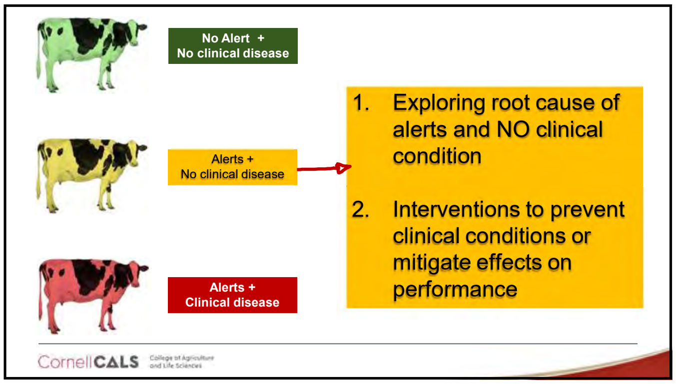
No Alert +
No clinical disease
Alerts +
No clinical disease
Alerts +
Clinical disease
1. Exploring root cause of alerts and NO clinical condition
2. Interventions to prevent clinical conditions or mitigate effects on performance
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GEA
Automated health monitoring systems can help with herd health monitoring and management
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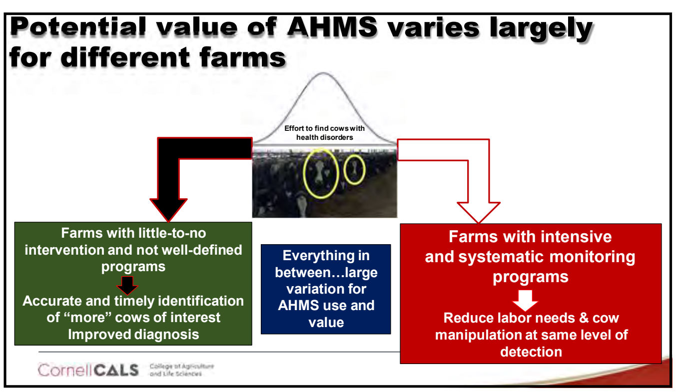
Potential value of AHMS varies largely for different farms
Effort to find cows with health disorders
Farms with little-to-no intervention and not well-defined programs
Accurate and timely identification of "more" cows of interest
Improved diagnosis
Everything in between…large variation for AHMS use and value
Farms with intensive and systematic monitoring programs
Reduce labor needs & cow manipulation at same level of detection
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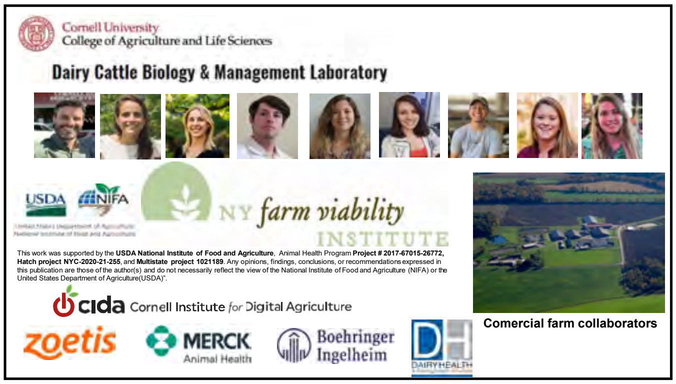

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Dairy Cattle Biology & Management Laboratory
USDA
NIFA
NY farm viability INSTITUTE
This work was supported by the USDA National Institute of Food and Agriculture, Animal Health Program Project # 2017-67015-26772, Hatch project NYC-2020-21-255, and Multistate project 1021189. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the National Institute of Food and Agriculture (NIFA) or the United States Department of Agriculture(USDA)".
cida Cornell Institute for Digital Agriculture
zoetis
MERCK Animal Health
Boehringer Ingelheim
DAIRYHEALTH
Comercial farm collaborators

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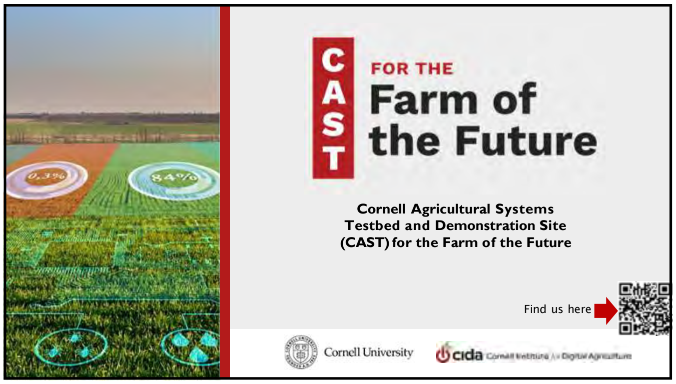

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Farm of the Future
Cornell Agricultural Systems Testbed and Demonstration Site (CAST) for the Farm of the Future
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Thanks!

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CFAES

Monitoring Nutrition: Old Classics and New Tech

Kirby Krogstad
Assistant Professor

Jason Hartschuh
Extension Specialist

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1

What is on the agenda?

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- My Goals when monitoring a Nutrition Program
- Review "The Classics"
- Using New Technology

2

My goals for nutritional Monitoring?

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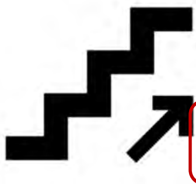
1. Quality Control
2. Personnel Accountability
3. Setting Transparent & Achievable Goals
4. Updating Benchmarks

3

CFAES

Focus on 1 or 2 goals at a time

I move up or down this as a ladder



4. Update Benchmarks
3. Set Transparent Goals
2. Personnel Accountability
1. Quality Control

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The Classics for Nutrition Monitoring

- Body Condition
- Milk Composition
- Feed Efficiency (Raw and Adjusted)
- Fecal Scores
- Fecal Starch
- Penn State Particle Separator

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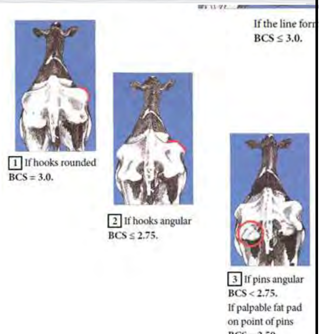
Body Condition Score

Stage of Lactation	Recommended BCS
Fresh Cow (~30 DIM)	3.00 (Lose ~0.25 units of BCS)
@ 1st Breeding	3.00
@ Dry off	3.25-3.50
@ calving	3.25-3.50



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6

Thin cows = problems

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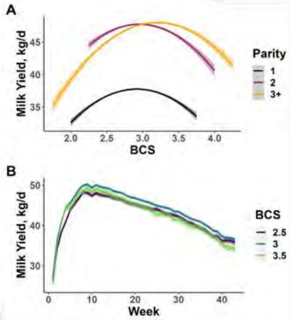
BCS	Culling	P-value
LOW (<2.75; n = 169)	2.19 (1.50-3.20)	<0.01
MID (2.75≤X<3.25; n = 564)	REF	-
HIGH (≥3.25; n = 223)	0.56 (0.35-0.87)	0.01



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Krogstad and Bradford, *Accepted*

7

Milk Composition: Stay up to Date!

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What are the Top OH Herds Doing?

Item	Holstein (Top 15 % of OH herds)	Jersey (Top 15% of JE Herds)
Test day milk	95	65
Test day fat %	4.3	5.4
Test day protein %	3.2	3.8
Test day SCC	141	183

Shoot for >7.2 lbs of Solids/cow/d

Shoot for >6 lbs of Solids/cow/d

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https://www.drms.org/Reports-Data-Tools/DairyMetrics

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Component Ratios Matter

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- Fat:Protein ~ 1.3-1.4
- Protein:Fat ~ 0.7-0.8

If outside of range, you may be missing on opportunities for more component production

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Milk Urea Nitrogen

Shoot for 10-12 mg/dL

- Too High
  - Excess RDP?
  - Inadequate fermentable CHO?
- Too Low?
  - Inadequate RDP?
  - Excess fermentable CHO?

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Feed Efficiency

Unadjusted

- Calculation: FE = ECM/DMI

Adjusted

- Calculation: Adj FE = FE × CF
- Determine CF
- Adj FE

Deviation = 167-150 * 0.001
= 0.017

CF = 1+0.017 = 1.017

11

Recommended FE benchmarks

Group	Recommended FE	Recommended Adj FE	Current OSU Dairy (FE)	Current OSU, adj FE
High mature cows	1.7-1.8	1.7-1.8	1.73	***1.83***
High group, 1st Lactation	1.6-1.7	1.6-1.7	1.70	1.66
Low group, all parity	>1.4	>1.5	1.26	1.45
Whole herd, 1 group TMR	>1.5	>1.6	-	-

Adapted from Hutjens

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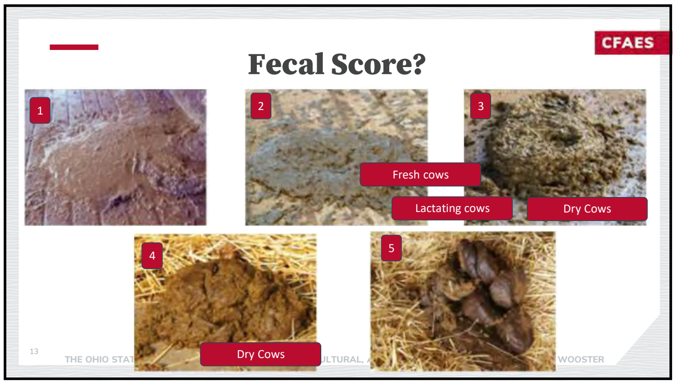
Fecal Score?
CFAES
1
2
3
Fresh cows
Lactating cows
Dry Cows
4
5
Dry Cows
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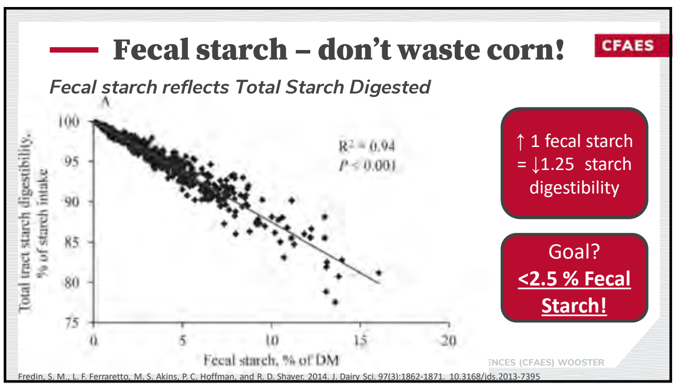
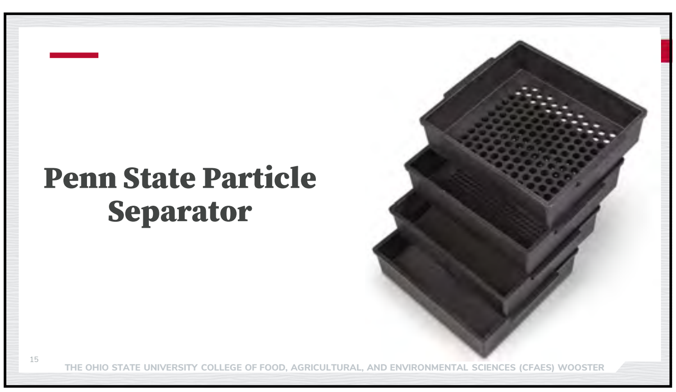

Fecal starch – don't waste corn!
CFAES
Fecal starch reflects Total Starch Digested
Total tract starch digestibility, % of starch intake
Fecal starch, % of DM
$R^2 = 0.94$
$P < 0.001$
↑ 1 fecal starch = ↓1.25 starch digestibility
Goal?
<2.5 % Fecal Starch!
Fredin, S. M., L. F. Ferraretto, M. S. Akins, P. C. Hoffman, and R. D. Shaver. 2014. J. Dairy Sci. 97(3):1862-1871. 10.3168/jds.2013-7395

14


Penn State Particle Separator
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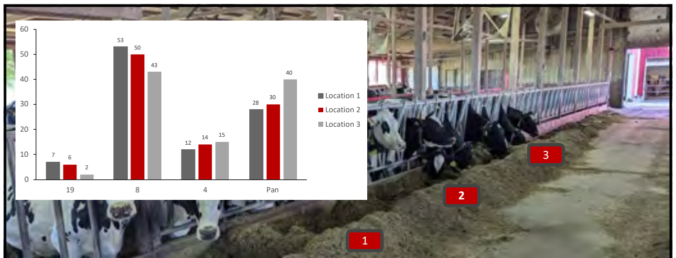

Deliver a consistent mix!

Use of PSPS to monitor within bunk consistency!

Goal: Less than 5% CV for middle, bottom, and pan of PSPS

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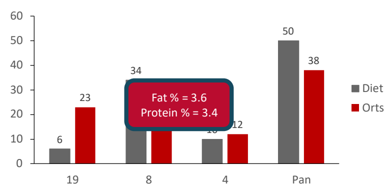
Evaluate sorting?

What is this cow doing?



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How to evaluate sorting?

1. Shake out diets immediately after delivery
2. Shake out the refusal the next morning
3. Compare the particle size distributions

Layer	% of TMR
19 mm	2-5
8 mm	>50
4 mm	10-20
Pan	25-30

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Grant, R. J. and K. W. Cotanch. 2023. Applied Animal Science 39(3):146-155. https://doi.org/10.15232/aas.2022-02371

18

CFAES

The "New Tech" For Monitoring Nutrition

- TMR Software
- Cameras
- Rumination Monitors
- Rumen Boluses
- Equipment monitors

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TMR Software

USE THEM TO THEIR FULL VALUE!

1. Track Inventory
2. Monitor mixing accuracy per batch
3. Monitor mixing accuracy per ingredient
4. Monitor mixing accuracy per user

TMR Tracker

milc group

EZfeed

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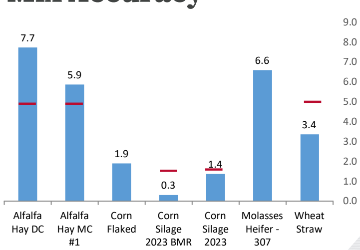
CFAES

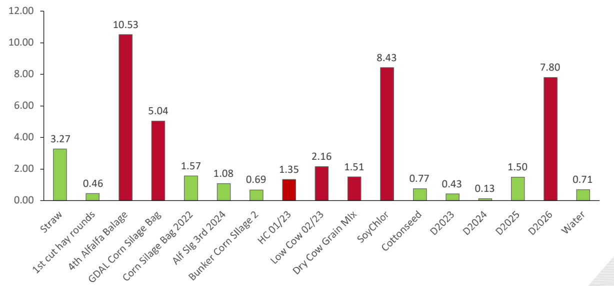
Monitor Mix Accuracy

Goals:

1. Overall Accuracy: >98%
2. <1.5% deviation on Corn Silage
3. <5% deviation on dry forage (especially at low inclusions)
4. <1% on premixes, VTM, $$ ingredients



21



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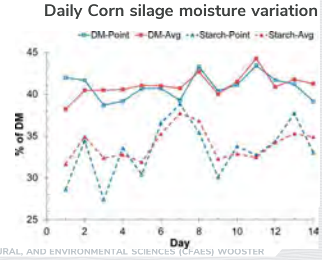
On-Loader silage moisture analysis

Italian Study with Constant Moisture Correction

- Feed costs were $0.09 per cow per day less
- Milk production was **5.6 pounds more** per cow per day (65.9 vs. 71.5 pounds/cow per day)
- 400-cow dairy at $18/cwt would result in approximately $147,168 of increased revenue
- $13,140 savings in feed cost per year.

Daily Corn silage moisture variation



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Barn Cameras – what for?

MONITOR DELIVERY TIMES

MONITOR FEED PUSH UP TIMES

MONITOR COW BEHAVIOR

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Image provided by Don Martell

- Poor feed distribution
- Feed pushup procedure?
- Feed amount?
- Refusal Target?
- Eating behavior

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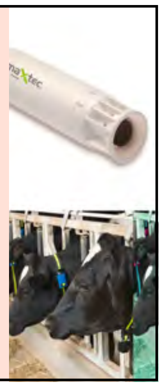
Monitor rumination and eating behavior

- Holsteins > 600 min/d (collars)
- Jerseys > 500 min/d (collars)
- Variance farm-to-farm and tech-to-tech



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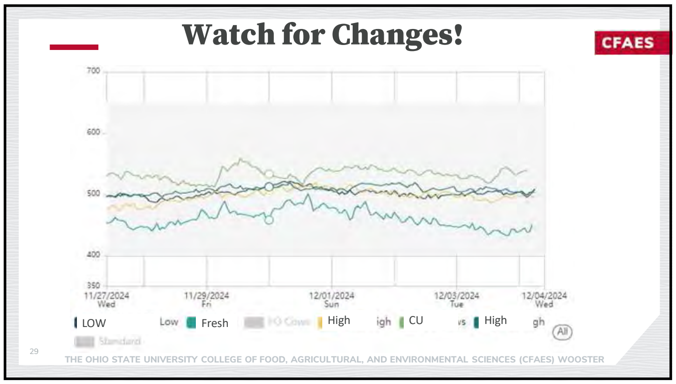
Rumen Bolus monitoring?

- Monitors…
  - Rumination
  - Rumen temperature
  - Activity
  - Water intake
  - Rumen pH (only 90-120 d of data)
- Small versions for calves, sheep, goat

Pros	Cons
• Intuitive • "Actual" rumination	• Costly • Single use

27


Watch for Changes!
CFAES
700
600
500
400
350
11/27/2024
Wed
11/29/2024
Fri
12/01/2024
Sun
12/03/2024
Tue
12/04/2024
Wed
LOW
Low
Fresh
High
CU
High
All
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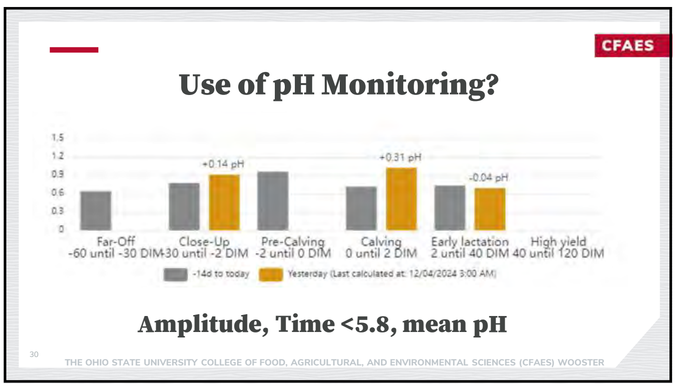
29


CFAES
Use of pH Monitoring?
1.5
1.2
0.9
0.6
0.3
0
+0.14 pH
+0.31 pH
-0.04 pH
Far-Off
-60 until -30 DIM
Close-Up
-30 until -2 DIM
Pre-Calving
-2 until 0 DIM
Calving
0 until 2 DIM
Early lactation
2 until 40 DIM
High yield
40 until 120 DIM
-14d to today
Yesterday (Last calculated at: 12/04/2024 3:00 AM)
Amplitude, Time <5.8, mean pH
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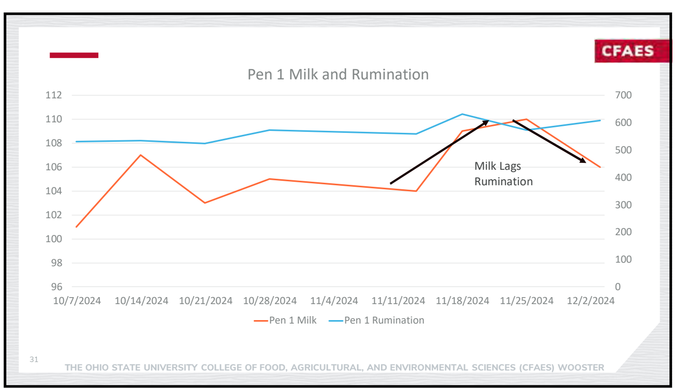
CFAES
Pen 1 Milk and Rumination
112
110
108
106
104
102
100
98
96
700
600
500
400
300
200
100
0
10/7/2024
10/14/2024
10/21/2024
10/28/2024
11/4/2024
11/11/2024
11/18/2024
11/25/2024
12/2/2024
Milk Lags
Rumination
Pen 1 Milk
Pen 1 Rumination
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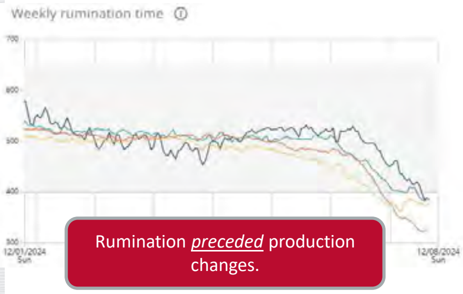
CFAES

Large Herd Example



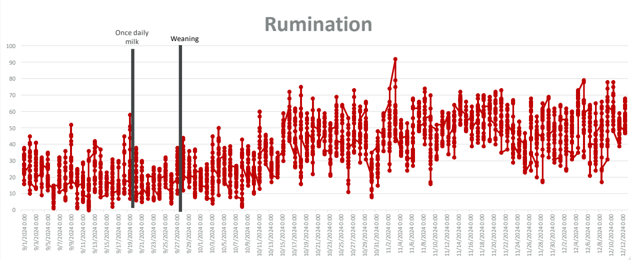
Rumination *preceded* production changes.

- Ration change made Friday 12-6
- Ruminations dropped fast!
- Milk drop by Monday.

32

CFAES

Don't Forget about the Calves!



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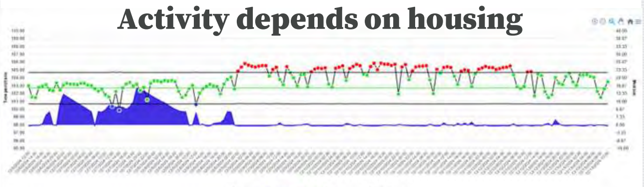
CFAES

Activity depends on housing



Activity spikes before fever in group-housed calves as they want to be left alone, so they move away when approached by other calves

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Equipment Monitoring

CFAES

- Equipment Monitoring allows for tracking….
  - *When* equipment ran
  - *Who* ran it
  - How *long* it ran
  - *Where* it ran

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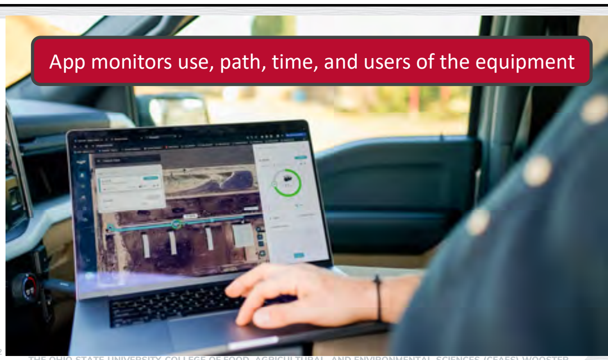
App monitors use, path, time, and users of the equipment



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AI changed Dairy once and it's changing it again this time with sensors, not semen

Sensors tell us a group of problems may be present, and people find the problem and correct it!!

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Assistant Professor of Dairy Nutrition
Wooster, OH

Email:
krogstad.6@osu.edu

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CFAES

The Next Chapter of Rumen Health

Kirby Krogstad
Assistant Professor

The Ohio State University
College of Food, Agricultural, and Environmental Sciences
WOOSTER

WE SUSTAIN LIFE
EST. 1870
COLLEGE of FOOD, AGRICULTURAL, and ENVIRONMENTAL SCIENCES

1

What is on the agenda?

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- Dairy cow gut anatomy and functions
- What we know about "rumen health"
- What were working on at OSU

2

The gut has 2 major functions

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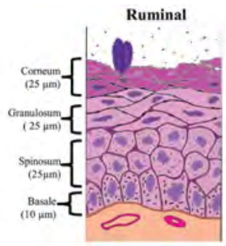
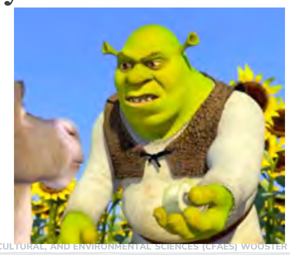
Transport	Protection
	

3

CFAES

The rumen is like an onion – it has layers





Steele, et al. 2016 *J. Dairy Sci.* 99:(6): 4955-4966.

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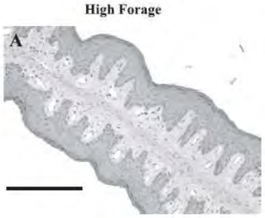
CFAES

Acidosis damages the rumen and result in inflammation

High Forage

High Grain



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Steele, et al. 2011 *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology* 300:(6): R1515-R1523.

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Current Understanding of Rumen Health

Its not much….

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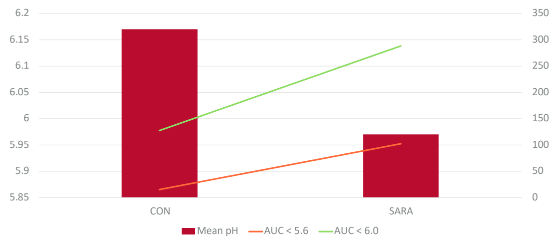
CFAES

Grain Challenges reduce ruminal pH



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Khafipour, E., D. O. Krause, and J. C. Plaizier. 2009. J. Dairy Sci. 92(3):1060-1070. https://doi.org/10.3168/jds.2008-1389

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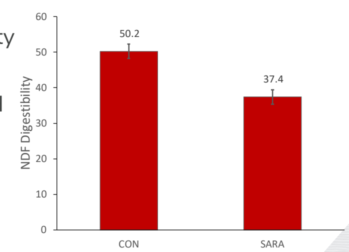
CFAES

Reduced pH associated with….

- Reduced fiber digestibility
- Alteration in microbiome
- Altered volatile fatty acid profile
- Increase in LPS and -amine compounds



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Plaizier, J. C., J. E. Keunen, J. P. Walton, T. F. Duffield, and B. W. McBride. 2001. Canadian Journal of Animal Science 81(3):421-423. 10.4141/A00-106; Plaizier, J. C., F. J. Mulligan, E. W. Neville, L. L. Guan, M. A. Steele, and G. B. Penner. 2022. J. Dairy Sci. 105(9):7141-7160. 10.3168/jds.2022-21960

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CFAES

Thresholds for "SARA"?

- Rumen pH < 5.6 for 3 h/d
- Rumen pH < 5.8-6 for 5 h/d

Zebeli, Q., J. Dijkstra, M. Tafaj, H. Steingass, B. N. Ametaj, and W. Drochner. 2008. J. Dairy Sci. 91(5):2046-2066. https://doi.org/10.3168/jds.2007-0572; Plaizier, J. C., D. O. Krause, G. N. Gozho, and B. W. McBride. 2008. Vet. J. 176(1):21-31. https://doi.org/10.1016/j.tvjl.2007.12.016

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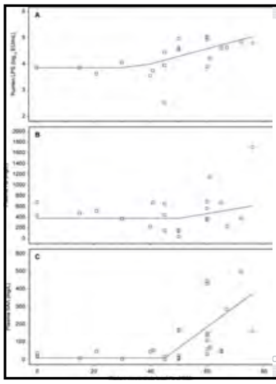


CFAES

Is acidosis related to inflammation?

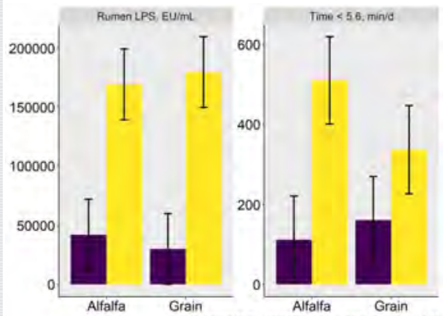
Increased grain related to…

- Increase plasma Hp
- Increased SAA

.....at 45% of diet as concentrates

Zebeli, Q., B. U. Metzler-Zebeli, and B. N. Ametaj. 2012. J. Dairy Sci. 95(5):2662-2672. 10.3168/jds.2011-5080

10



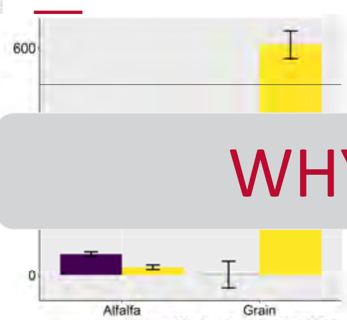
CFAES

Different ways to cause acidosis

What about inflammation?

Khafipour et al., 2009 Appl. Env. Micr. 75:7115-7124

11



CFAES

WHY?

Khafipour et al., 2009 Appl. Env. Micr. 75:7115-7124

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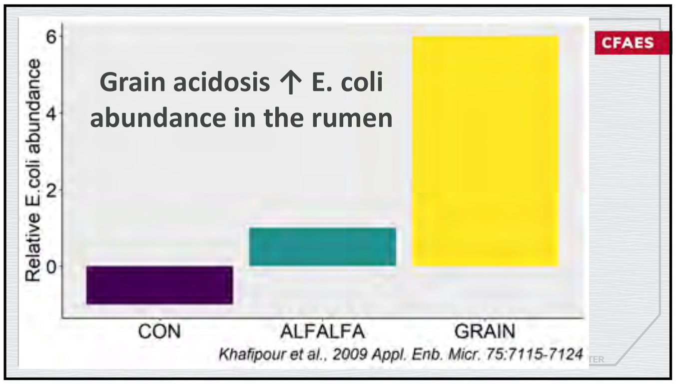
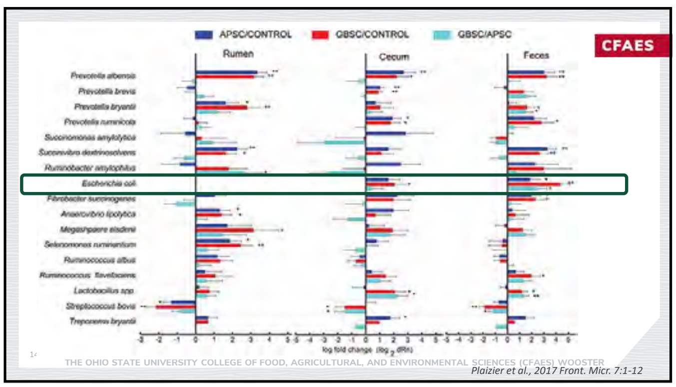

CFAES
Grain acidosis ↑ E. coli abundance in the rumen
Relative E.coli abundance
6
4
2
0
CON
ALFALFA
GRAIN
Khafipour et al., 2009 Appl. Enb. Micr. 75:7115-7124

13


CFAES
APSC/CONTROL
GBSC/CONTROL
GBSC/APSC
Rumen
Cecum
Feces
Prevotella albensis
Prevotella brevis
Prevotella bryantii
Prevotella ruminicola
Succinomonas amylolytica
Succinivibrio dextrinosolvens
Ruminobacter amylophilus
Escherichia coli
Fibrobacter succinogenes
Anaerovibrio lipolytica
Selenomonas ruminantium
Ruminococcus albus
Ruminococcus flavefaciens
Lactobacillus spp.
Streptococcus bovis
Treponema bryantii
log fold change
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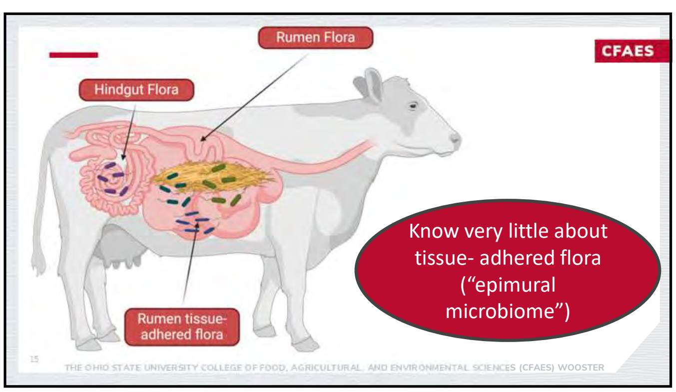
Plaizier et al., 2017 Front. Micr. 7:1-12

14


CFAES
Rumen Flora
Hindgut Flora
Rumen tissue-adhered flora
Know very little about tissue- adhered flora ("epimural microbiome")
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CFAES

Grain challenge: sudden increase in starch

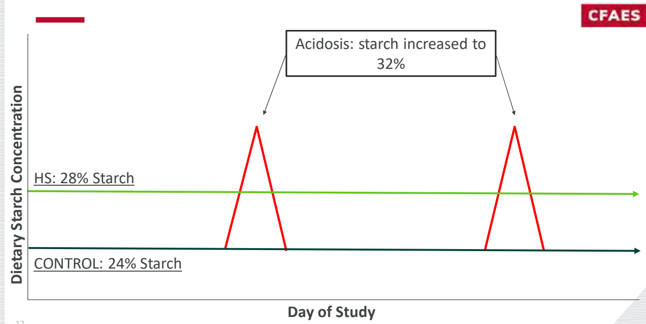
Week 1 to Week 5	Week 6
Control Diet (50% Forage, 26% Starch)	SARA Diet (40% Forage, 33% Starch)

Alfalfa pellet challenge: steady increase in pellets over 6 weeks

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
0% Alfalfa pellets	8% Alfalfa pellets	16% Alfalfa pellets	24% Alfalfa pellets	32% Alfalfa pellets	40% Alfalfa pellets

16

CFAES



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Gott, et al. 2015 *J. Dairy Sci.* 98:(3): 1786-1796

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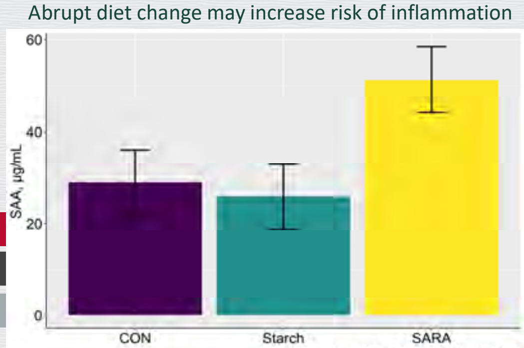
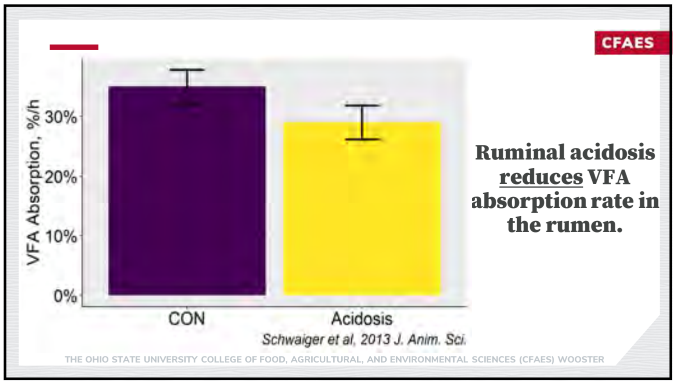
Abrupt diet change may increase risk of inflammation



18


CFAES
VFA Absorption, %/h
30%
20%
10%
0%
CON
Acidosis
Ruminal acidosis reduces VFA absorption rate in the rumen.
Schwaiger et al, 2013 J. Anim. Sci.
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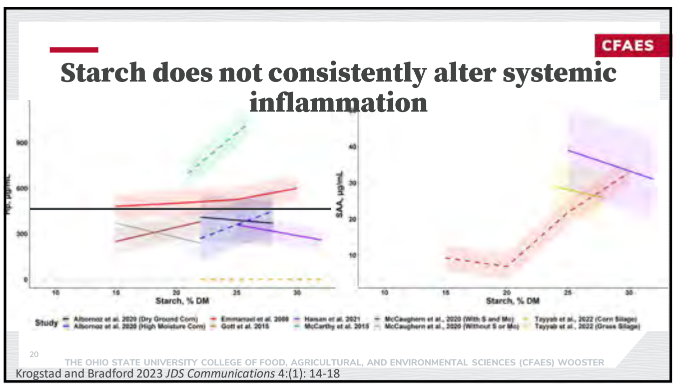
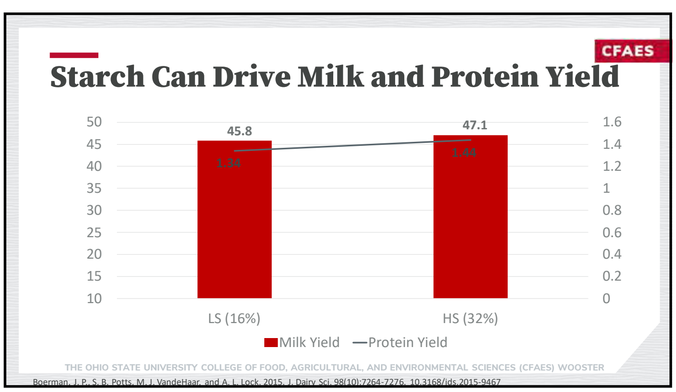
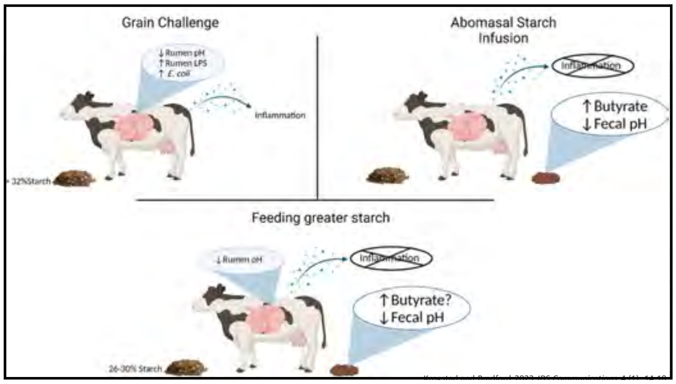

CFAES
Starch does not consistently alter systemic inflammation
Starch, % DM
SAA, µg/mL
Starch, % DM
Study
THE OHIO STATE UNIVERSITY COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES (CFAES) WOOSTER
Krogstad and Bradford 2023 JDS Communications 4:(1): 14-18

20


CFAES
Starch Can Drive Milk and Protein Yield
50
45
40
35
30
25
20
15
10
45.8
47.1
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
LS (16%)
HS (32%)
Milk Yield
Protein Yield
THE OHIO STATE UNIVERSITY COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES (CFAES) WOOSTER
Boerman, J. P., S. B. Potts, M. J. VandeHaar, and A. L. Lock. 2015. J. Dairy Sci. 98(10):7264-7276. 10.3168/jds.2015-9467

21



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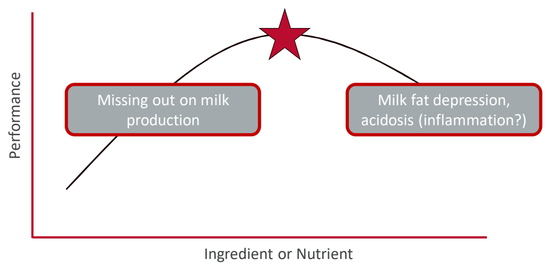
CFAES

Find the optimum concentration!



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CFAES

What Were Working on at OSU?!!

25

What did we observe?

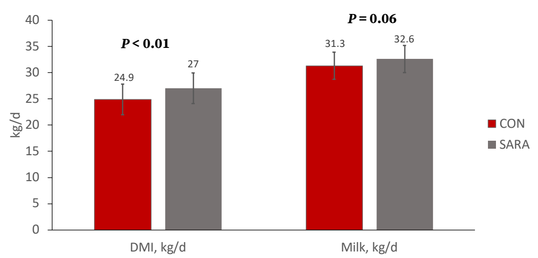
CFAES

Item, % DM unless otherwise stated	Treatment			
	CON		SARA	
	Mean	SD	Mean	SD
DM, % as is	44.2	0.57	50.1	3.61
aNDFom	30.9	1.20	28.3	1.13
fNDF, % DM	23.6	1.88	16.4	1.37
Starch	26.6	0.14	32.2	2.19
CP	16.7	0.78	16.3	1.20
Ash	8.3	0.44	7.3	0.37
Particle size[2], % as is				
19 mm sieve	7.7	2.39	4.3	1.20
8 mm sieve	61.6	0.43	51.5	0.98
Pan	30.7	1.96	44.3	0.22

26

↑Starch = ↑Feed intake and Milk yield

CFAES



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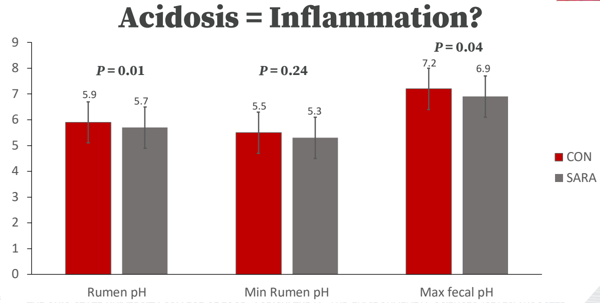
Krogstad et al., *unpublished*

27

Acidosis = Inflammation?

CFAES



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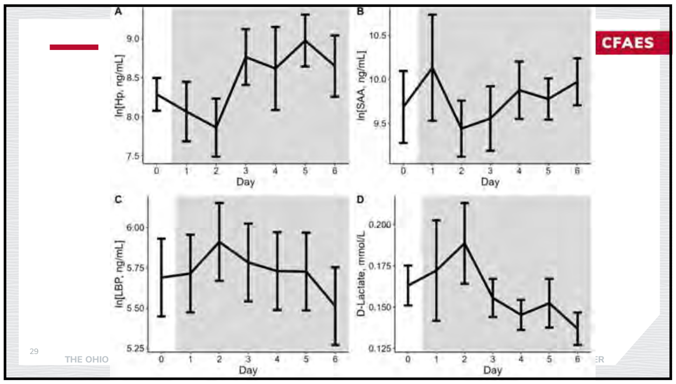
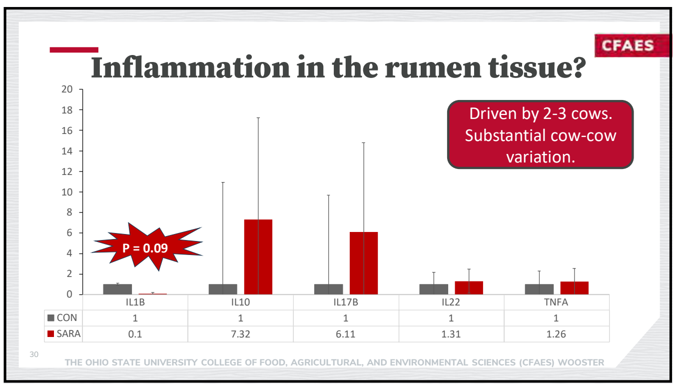
Krogstad et al., *unpublished*

28


CFAES
A
ln[Hp, ng/mL]
Day
B
ln[SAA, ng/mL]
Day
C
ln[LBP, ng/mL]
Day
D
D-Lactate, mmol/L
Day
THE OHIO

29


CFAES
Inflammation in the rumen tissue?
Driven by 2-3 cows. Substantial cow-cow variation.
P = 0.09
	IL1B	IL10	IL17B	IL22	TNFA
CON	1	1	1	1	1
SARA	0.1	7.32	6.11	1.31	1.26
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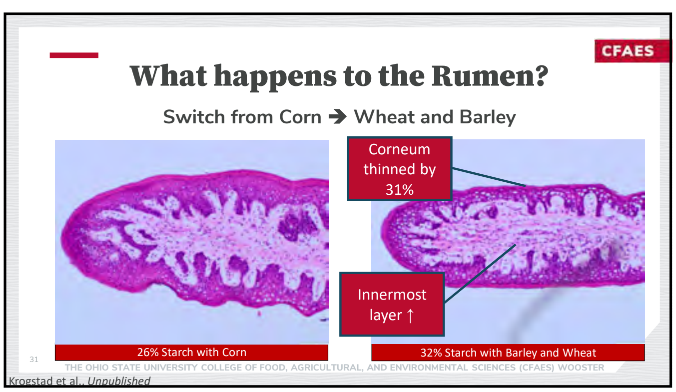
CFAES
What happens to the Rumen?
Switch from Corn → Wheat and Barley
Corneum thinned by 31%
Innermost layer ↑
26% Starch with Corn
32% Starch with Barley and Wheat
THE OHIO STATE UNIVERSITY COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES (CFAES) WOOSTER
Krogstad et al., Unpublished

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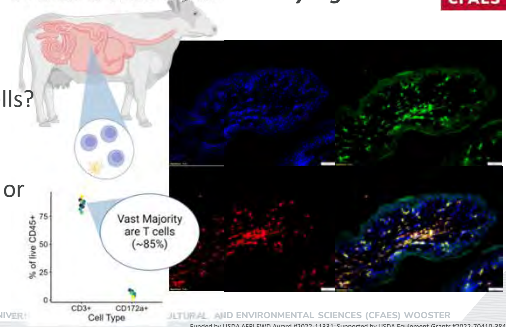
What would drive inflammatory signals?

CFAES

- Immune cells?
- Epithelial cells?
- Other cells or signals?



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Krogstad et al., *unpublished*

Funded by USDA AFRI EWD Award #2022-11331; Supported by USDA Equipment Grants #2022-70410-38419

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Next question: Low Forage Diets?

CFAES

How much starch can we feed in low-forage diets?

Item, % DM	Low (~20% Starch)	Mid (~25% Starch)	High (~30% Starch)
aNDFom	37%	33%	28%
fNDF	***12.6%***	***12.6%***	***12.6%***
Starch	23%	28%	33%
CP	16.3	16.1	15.9
FA	4.3	4.5	4.8

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Low Starch = ↑ Milk Yield

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Item	LS (20%)	MS (25%)	HS (30%)	SEM	Linear	Quadratic
DMI, kg/d						
Milk yield, kg/d	48.9	47.4	49.9	3.01	0.52	0.15
Milk fat, %	**3.93**	**3.72**	**3.34**	**0. 313**	**0.03**	**0.20**
Milk fat yield, kg/d	1.91	1.55	1.63	0.087	0.04	0.06
Milk protein, %	3.45	3.35	3.23	0.124	0.07	0.90
Milk protein yield, kg/d	1.67	1.58	1.60	0.071	0.16	0.15
ECM, kg/d	52.8	47.0	48.9	1.63	0.08	0.05

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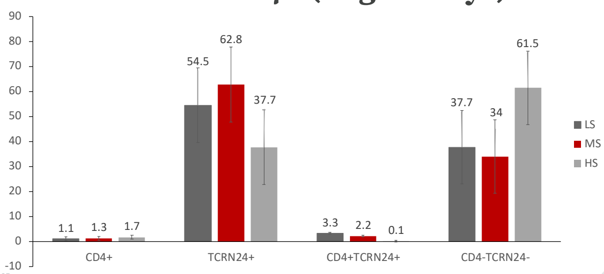
CFAES

T Cells are γδ (Regulatory?)



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CFAES

The Next Chapter of Rumen Health?

- Role of ruminal immune cells?
- Signals to maintain rumen wall?
- Dietary constraints?

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CFAES

Bonus: What about Rumen Health after calving?

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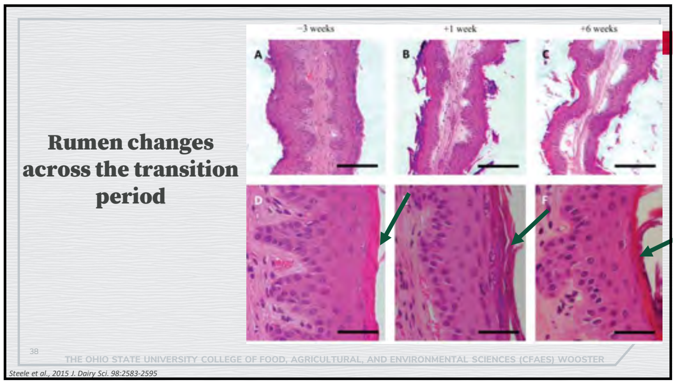
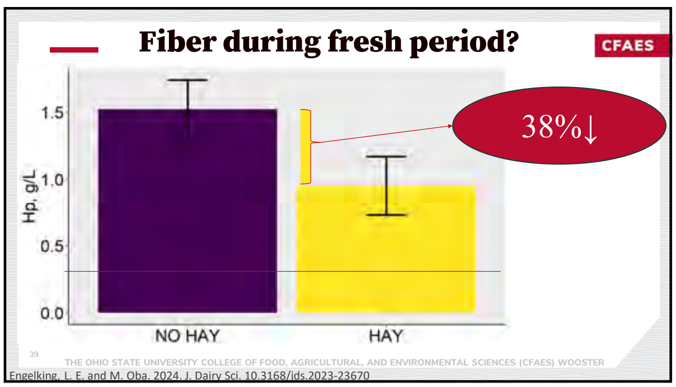
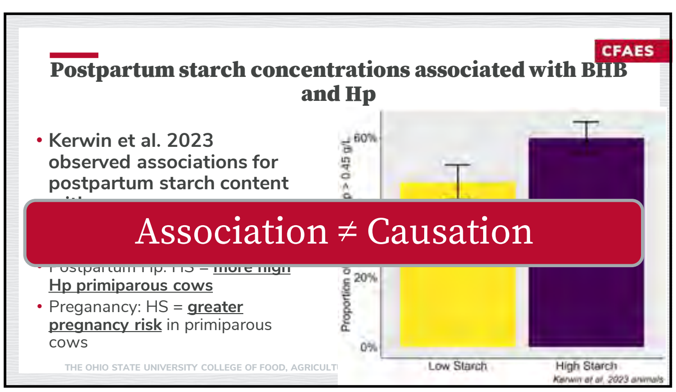

Rumen changes across the transition period
−3 weeks
+1 week
+6 weeks
A
B
C
D
F
THE OHIO STATE UNIVERSITY COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES (CFAES) WOOSTER
Steele et al., 2015 J. Dairy Sci. 98:2583-2595

38


Fiber during fresh period?
CFAES
38%↓
Hp, g/L
1.5
1.0
0.5
0.0
NO HAY
HAY
THE OHIO STATE UNIVERSITY COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES (CFAES) WOOSTER
Engelking, L. E. and M. Oba. 2024. J. Dairy Sci. 10.3168/jds.2023-23670

39


CFAES
Postpartum starch concentrations associated with BHB and Hp
• Kerwin et al. 2023 observed associations for postpartum starch content
Association ≠ Causation
Hp primiparous cows
• Preganancy: HS = greater pregnancy risk in primiparous cows
60%
20%
0%
Low Starch
High Starch
Kerwin et al. 2023 animals
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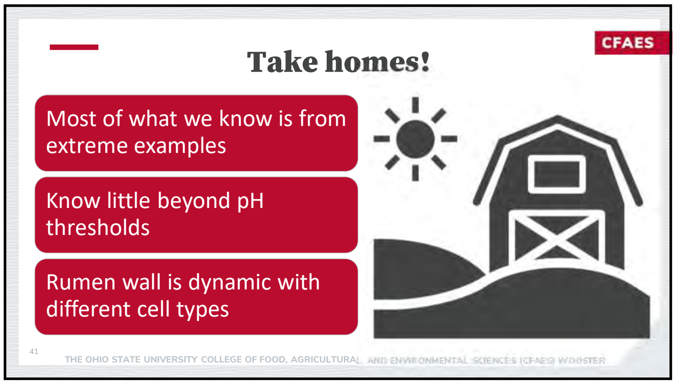
40


CFAES
Take homes!
Most of what we know is from extreme examples
Know little beyond pH thresholds
Rumen wall is dynamic with different cell types
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Assistant Professor of Dairy Nutrition
Wooster, OH
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Beat BRD with Pradalex
[1]Elanco Animal Health. Data on File.
[2]Blondeau, J.M.; Fitch, S.D. Comparative In Vitro Killing by Pradofloxacin in Comparison to Ceftiofur, Enrofloxacin, Florfenicol, Marbofloxacin, Tildipirosin, Tilmicosin and Tulathromycin against Bovine Respiratory Bacterial Pathogens. Microorganisms 2024, 12
[3]Elanco Animal Health. Data on File.
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