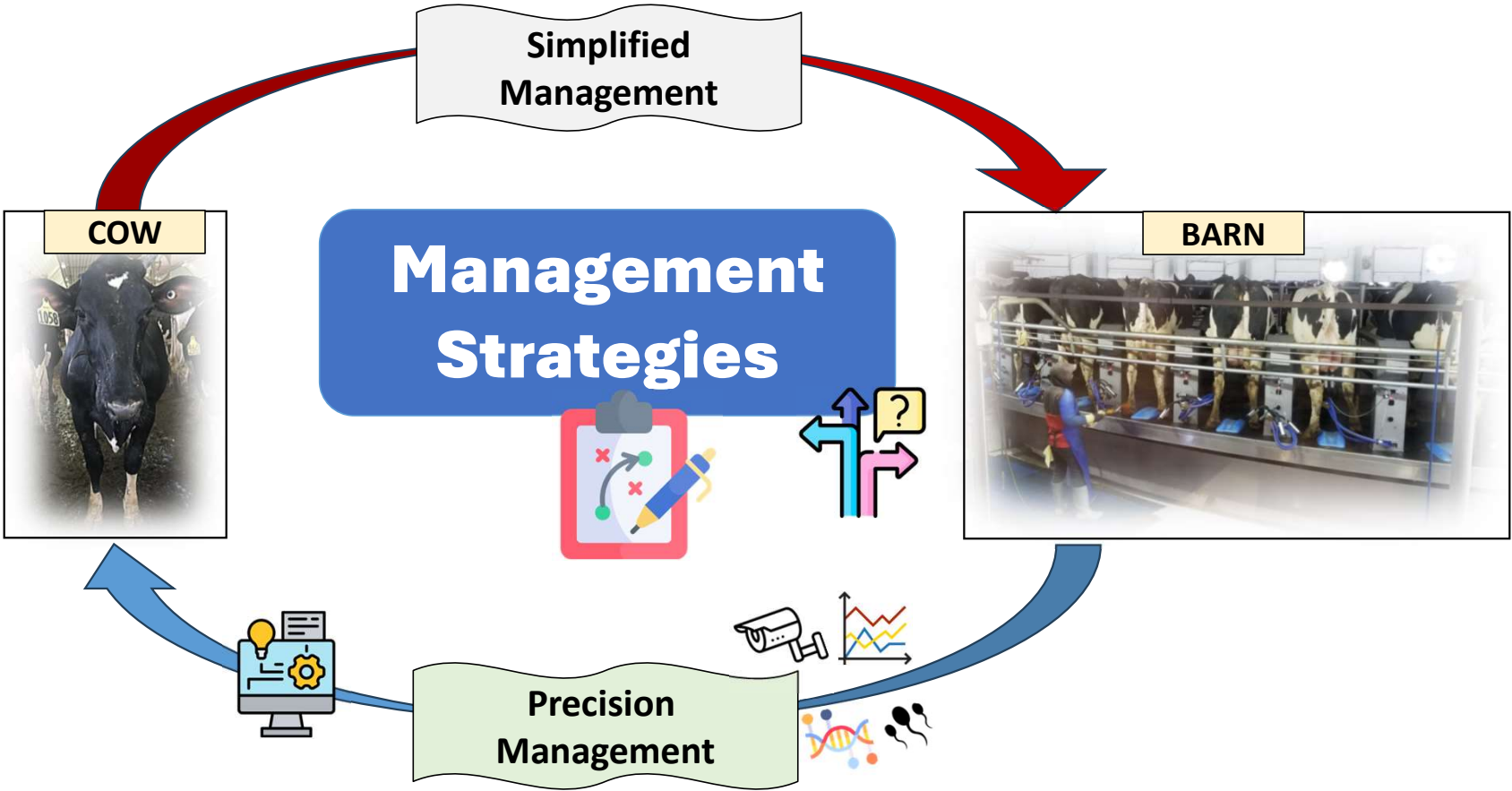


From Sensors to Solutions: Leveraging Dairy Tech Data in the Field

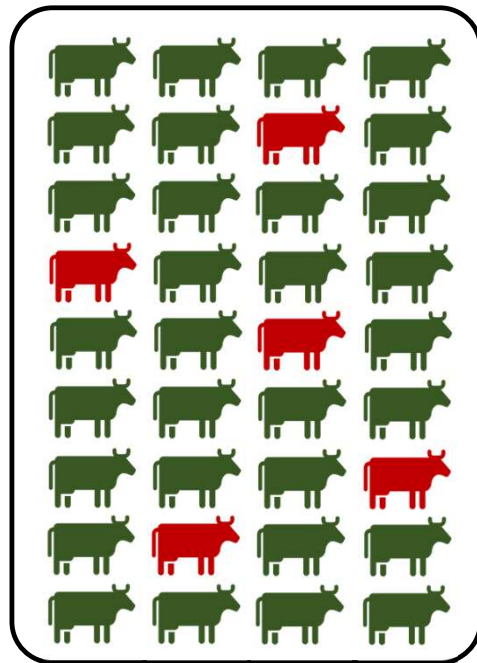


Mark J Thomas, DVM, DABVP-Dairy
Matias Stangaferro, DVM, MS, PhD

Trends in Modern Dairy Farming



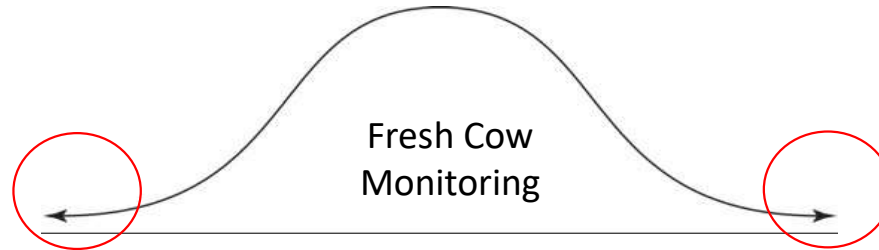
Fresh Cow Monitoring



Healthy



Sick



Low- or no-intervention barns

- Failure to identify sick cows
- Reduced production
- Increased culling rates
- Low animal welfare

Barns with intensive monitoring

- Costly
- Time-consuming
- Affects the normal behavior of Healthy cows
- Poor animal welfare

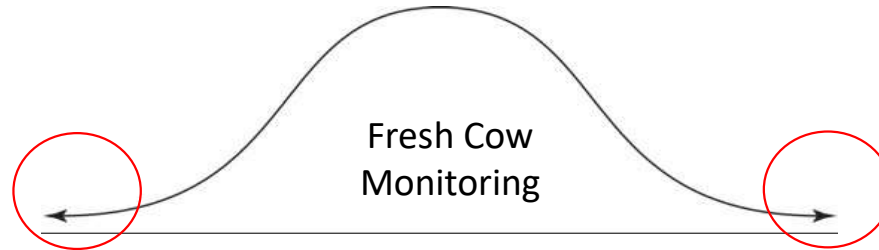
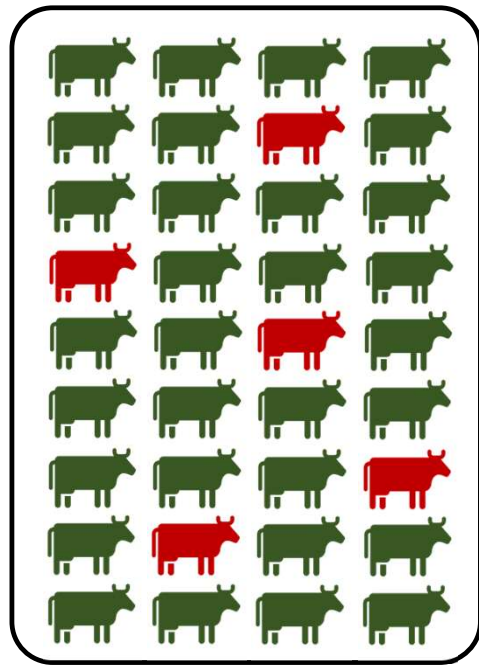
SENSORS



ALERTS

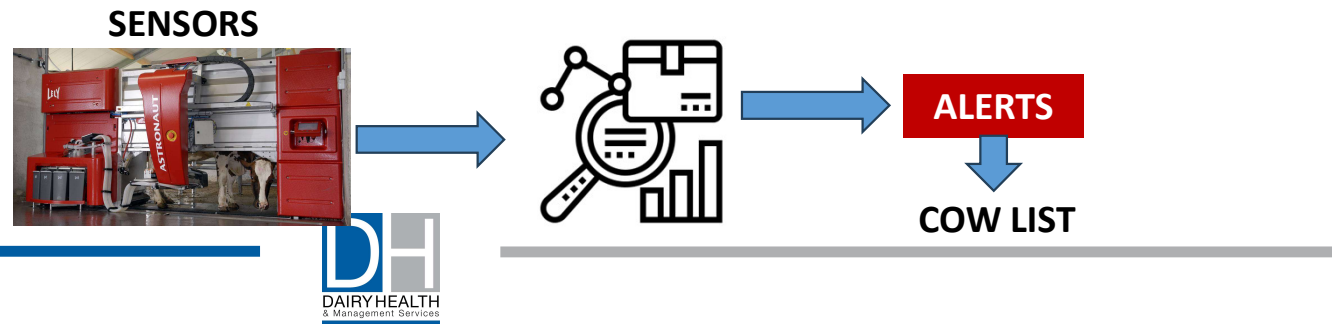
COW LIST

Fresh Cow Monitoring



Barns with intensive monitoring

- Costly
- Time-consuming
- Affects the normal behavior of Healthy cows
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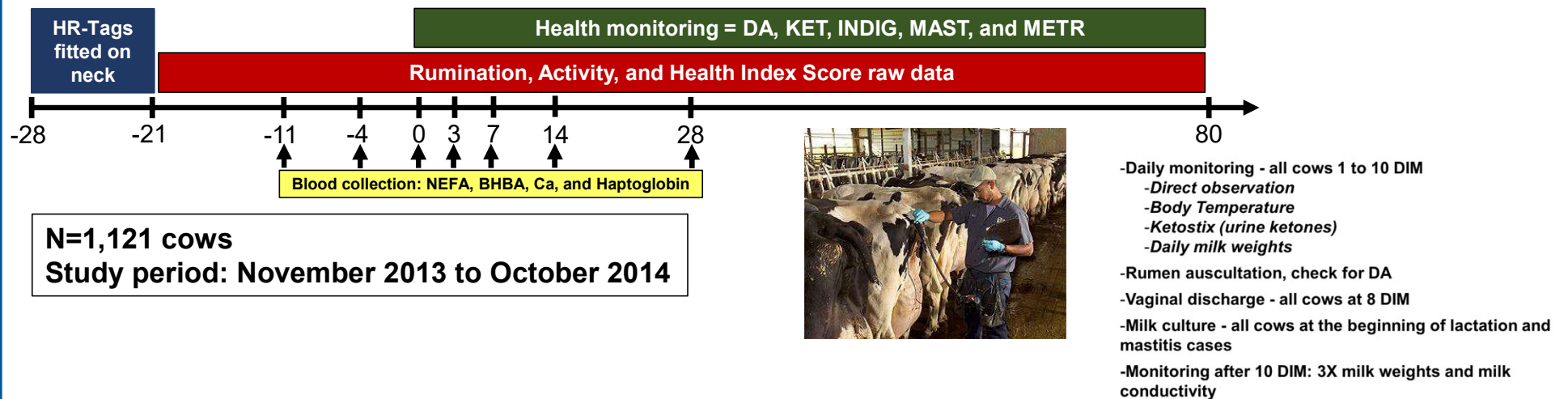


Sensors vs. Intensive Monitoring

(1) **Performance** of system in detecting sick cows (HD).

(2) **When does** the system identify sick cows compared to farm personnel?

Observational Prospective Cohort Study



High sensitivity for detecting metabolic and digestive disorders

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)

Moderate sensitivity for detecting metritis

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

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<i>Rectal temperature</i>		
≤39.4°C (n = 165)	56 (48-64)	
39.5-39.9°C (n = 79)	49 (38-61)	
≥40°C (n = 74)	58 (46-70)	

Stangaferro et al., 2016. JDS

Moderate sensitivity for detecting metritis

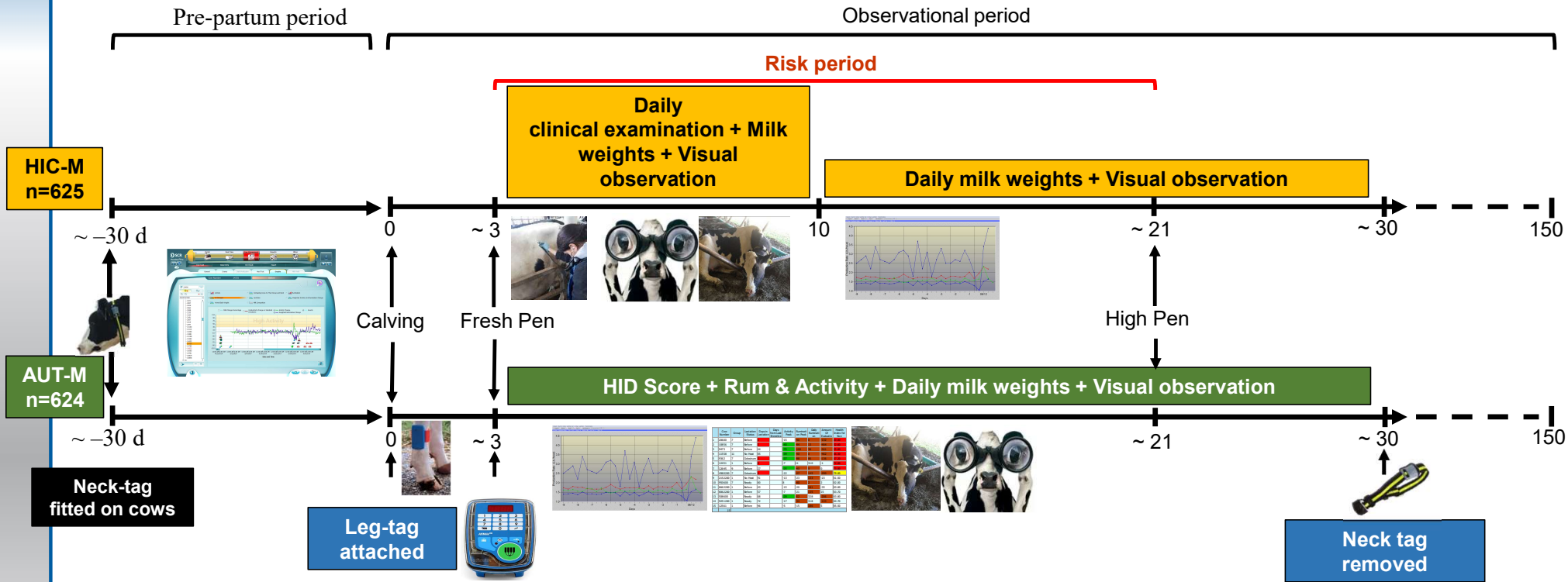
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39.5-39.9°C (n = 79)	49 (38-61)	
≥40°C (n = 74)	58 (46-70)	
<i>Antibiotic treatment</i>		
Cephalosp. (n = 292)	49 ^a (43-55)	Mild Metritis
Ampicillin (n = 57)	83 ^b (70-91)	Severe Metritis

Stangaferro et al., 2016. JDS

Summary

- High sensitivity for metabolic and digestive disorders.
- Moderate sensitivity for metritis and mastitis.
- Should be used in combination with other traditional methods for detecting metritis and mastitis.
- The system identified cows with DA, KET, MET, and MAST earlier than farm personnel.

Sensors vs. Intensive Monitoring: Example 2

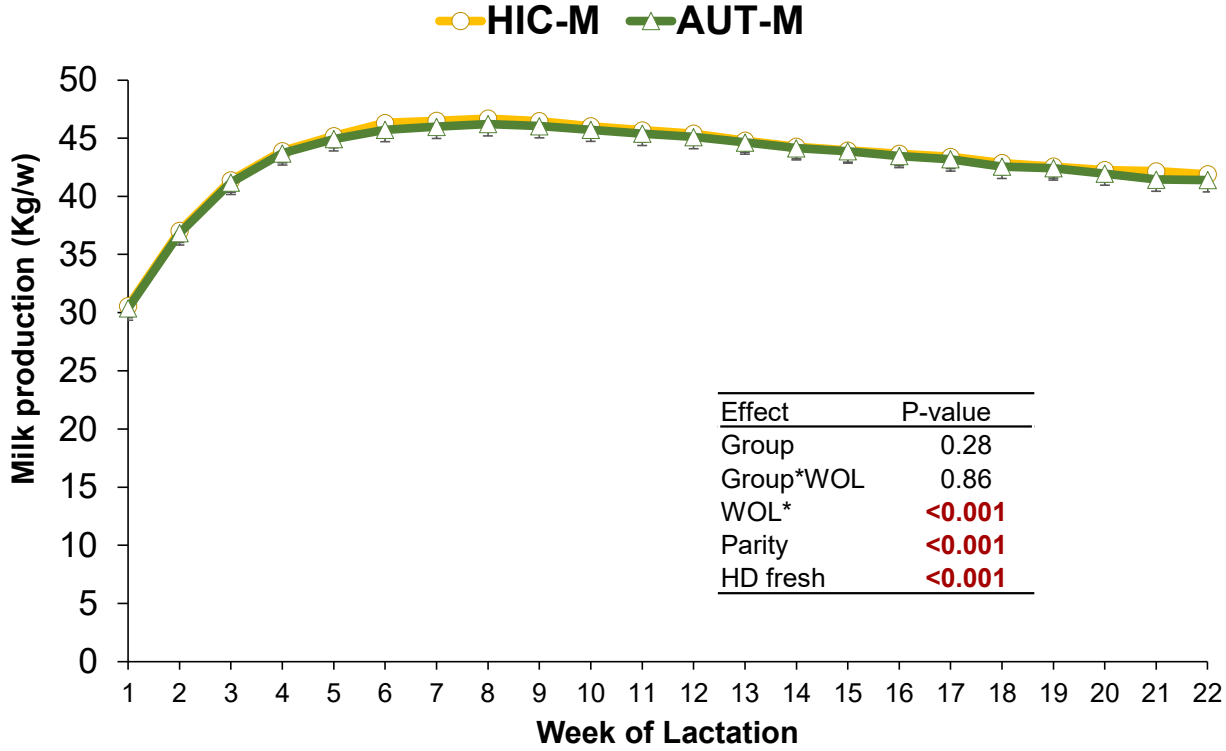


Proportion of cows with health disorders during the risk period and DIM at first diagnosis

	Incidence			DIM at 1st diagnosis		
	HIC-M	AUT-M	P-value	HIC-M	AUT-M	P-value
Metabolic & digestive	5.4 (3.7 - 7.9)	4.3 (2.9 - 6.4)	0.27	9.4 ± 1.3	11.5 ± 1.2	0.10
Mastitis	4.2 (2.8 - 6.2)	3.9 (2.6 - 5.8)	0.78	13.8 ± 1.8	13.3 ± 1.6	0.79
Metritis	6.0 (4.3 - 8.3)	3.7 (2.5 - 5.6)	0.07	5.7 ± 0.4	7.6 ± 0.5	<0.01
Other	0.8 (0.3 - 2.0)	0.7 (0.2 - 1.8)	0.76	13.4 ± 6.8	11.3 ± 5.2	0.77
At least 1 HD	17.0 (14.1 - 20.3)	13.6 (11.1 - 16.7)	0.10			

Values for binomial outcomes are presented as LSM (top) and 95% CI (bottom). Values for continuous outcomes are presented as LSM and SE.

Milk production up to 150 days



* Week of lactation



Perez et al., 2023

Culling and Repro

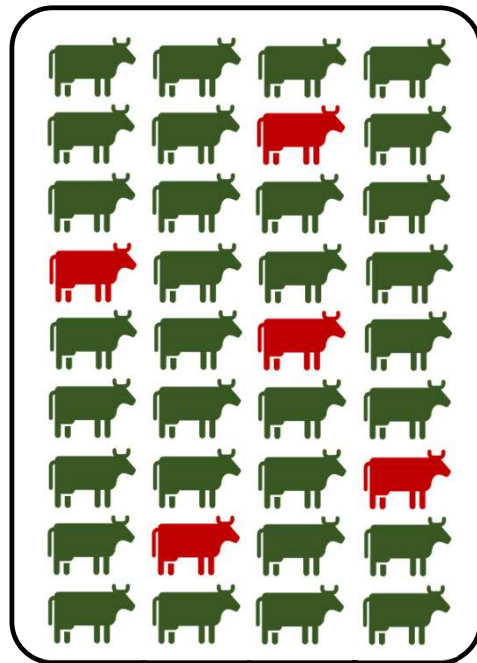
	HIC-M	AUT-M	P-value
Sold and died up to 60 DIM	1.5 (0.7 - 3.0)	2.1 (1.1 - 4.1)	0.34
Sold and died from 61 to 150 DIM	6.6 (4.5 - 9.6)	4.7 (3.0 - 7.1)	0.09
Sold and died up to 150 DIM	8.3 (5.9 - 11.5)	6.9 (4.8 - 9.7)	0.30
P/AI (%) All AI	41.9 (37.7 - 46.3)	39.2 (35.0 - 43.6)	0.38
Preg. Loss (%)	5.4 (3.0 - 9.4)	2.7 (1.2 - 5.9)	0.15

Values for binomial outcomes are presented as LSM (top) and CI (bottom)

Sensors vs. Intensive Monitoring: Conclusions

- Lower detection of sick cows (overall and metritis)
- Similar proportion of culled cows
- Similar productive and reproductive performance

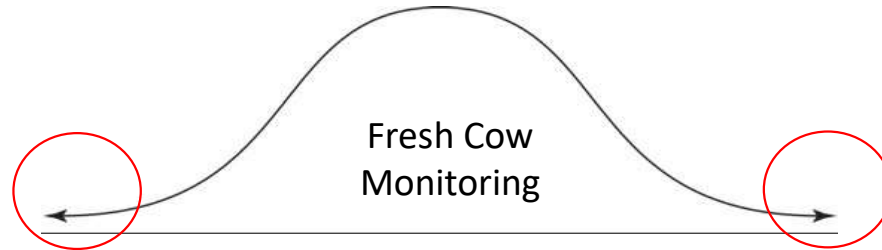
Fresh Cow Monitoring



Healthy



Sick



Low- or no-intervention barns

Failure to identify sick cows
Reduced production
Increased culling rates
Low animal welfare

SENSORS



ALERTS

COW LIST



J. Dairy Sci. 107:11576–11596

<https://doi.org/10.3168/jds.2024-25256>

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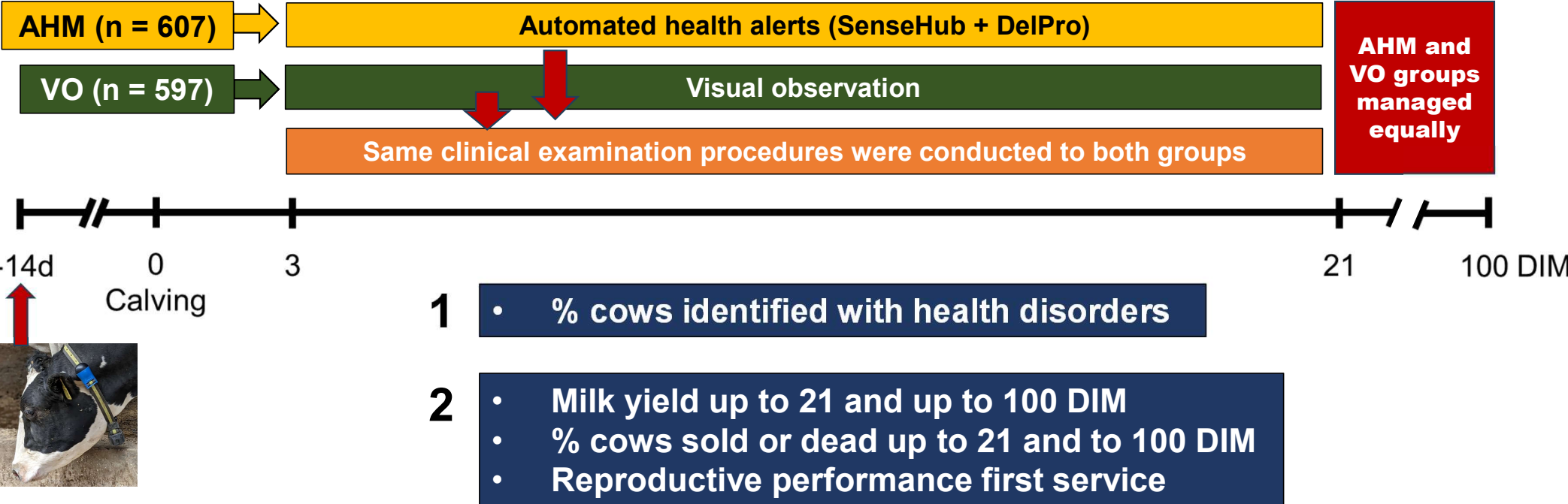
Effect of automated health monitoring based on rumination, activity, and milk yield alerts versus visual observation on herd health monitoring and performance outcomes

C. Rial,¹ M. L. Stangaferro,² M. J. Thomas,² and J. O. Giordano^{1*}

¹Department of Animal Science, Cornell University, Ithaca, NY 14853

²Dairy Health and Management Services, Lowville, NY 13367

Sensors vs. low- or no-intervention



Selecting cows for clinical examination

 The list of cows for examination was created daily at ~5:30 AM and included:



AHM - Alerts

- Health index < 86, or daily rumination < 250 min, or milk reduction > 20%



VO

- Clinical signs of disease
- Daily walk-through of the fresh cow pen after the previous morning milking



Previously diagnosed sick cows – from both groups

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, %	24 ± 2.5	61 ± 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**

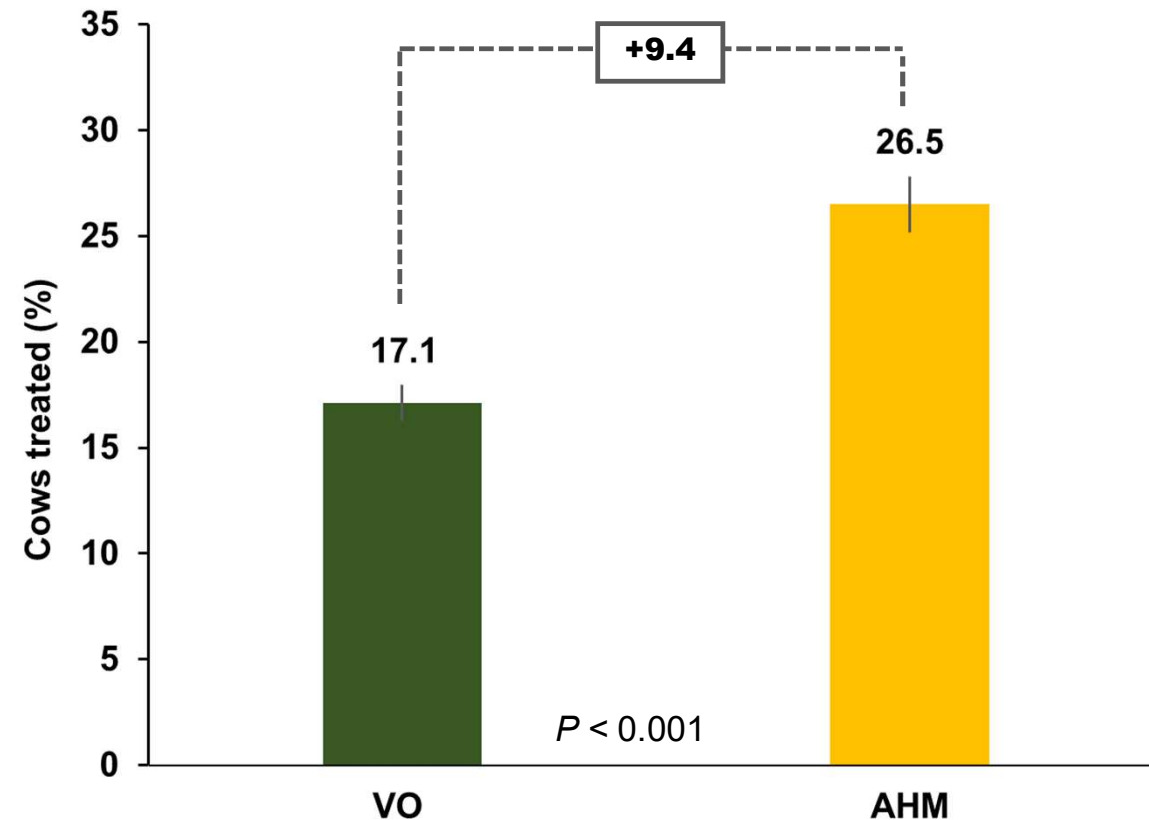
Cows in the AHM group were more likely to be diagnosed with a disease

Outcome, %	Treatment		Diff. % points	P-value	IRR ¹	
	VO (n = 597)	AHM (n = 607)			AHM-VO (Ref)	P-value
Clinical health disorder	22	37	15	< 0.001	1.7	< 0.001

DA = displaced abomasum

Rial et al., 2024

Cows in the AHM group were more likely to receive treatment and spend more time in the hospital pen



↑ **Proportion of cows in the hospital pen:**

- AHM = 15.8% vs. VO = 10.7% ($P = 0.02$)

↑ **Number of cow-days in the hospital pen:**

- AHM = 436 ± 3.4 d vs. VO = 277 ± 4.7 d ($P < 0.001$)

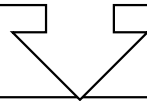
The AHM strategy had...



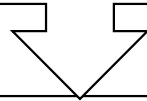
vs.



↑ Cows selected for clinical examination



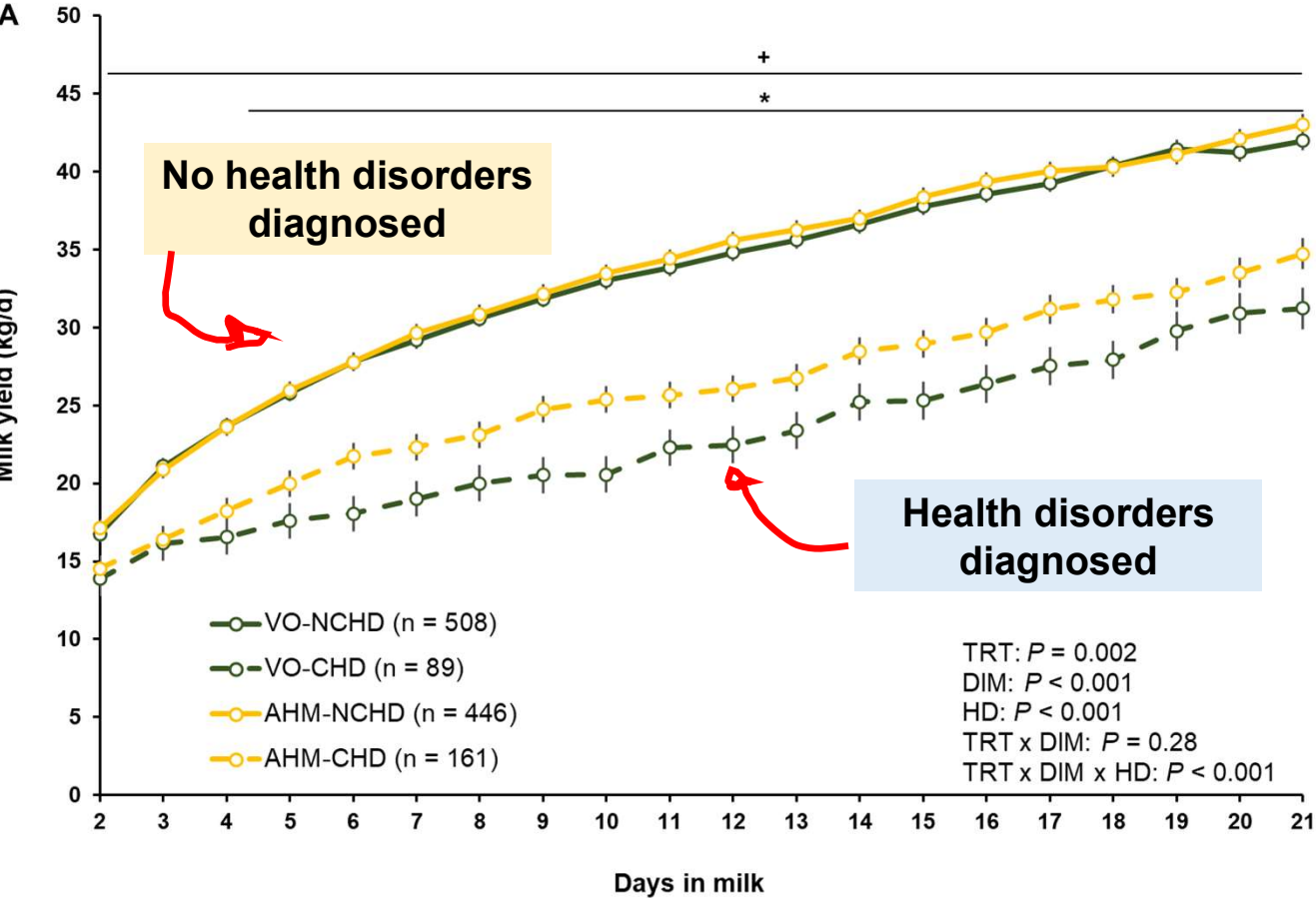
↑ Cows identified with health disorders



↑ Cows received treatment

How do these results impact on performance?

Cows in the AHM group had higher milk production during the first 21 DIM

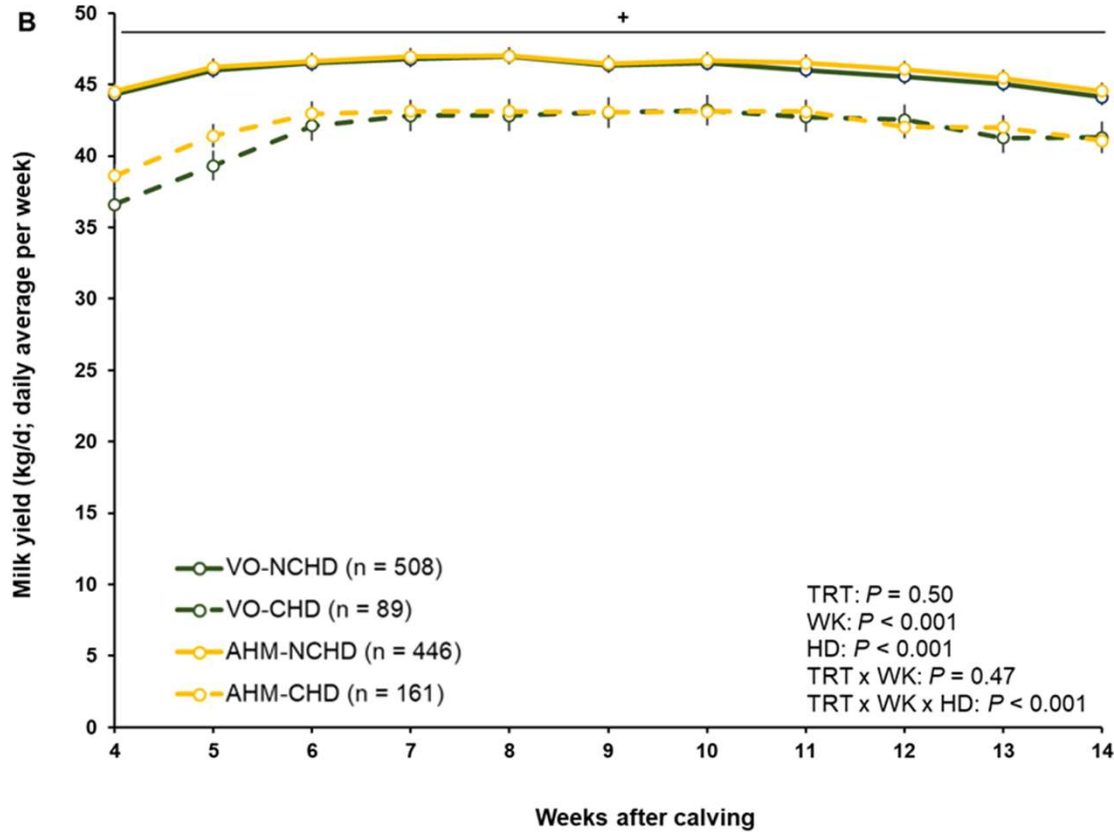


+1.5 kg per cow/day

Group	Estimate	P-value
AHM	548 ± 10	0.001
VO	520 ± 11	

+28 kg per cow

There was no effect of the treatment on milk production from 22 to 100 DIM






Effect of the treatment group on animal culling

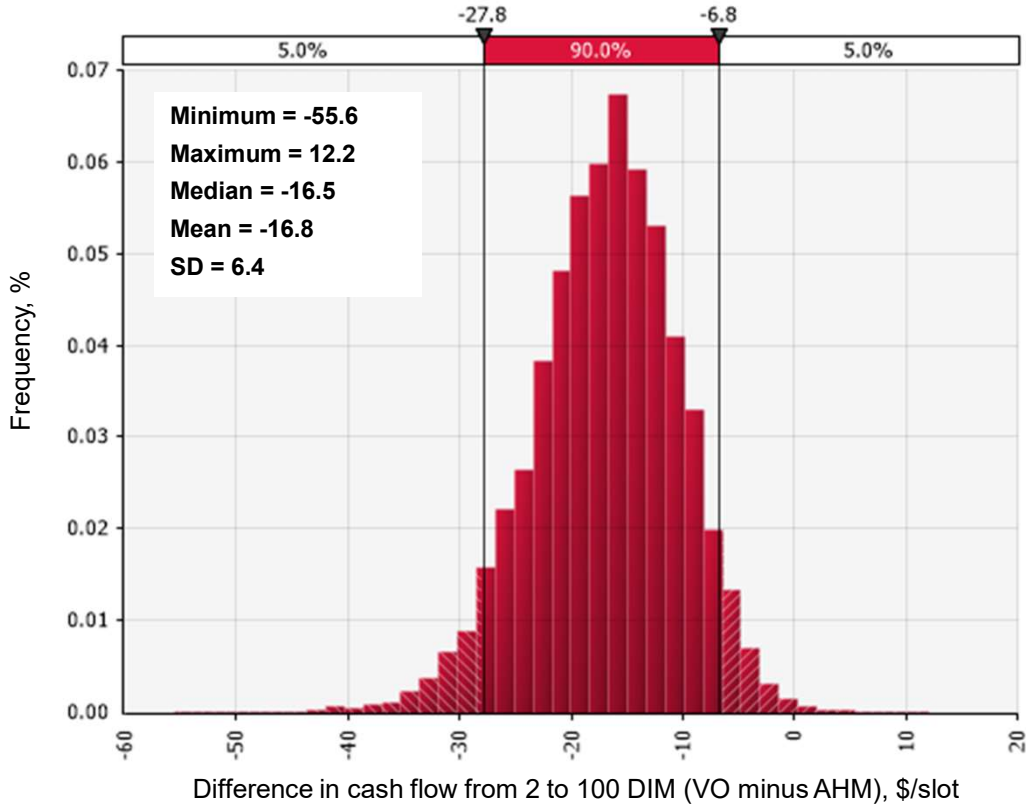
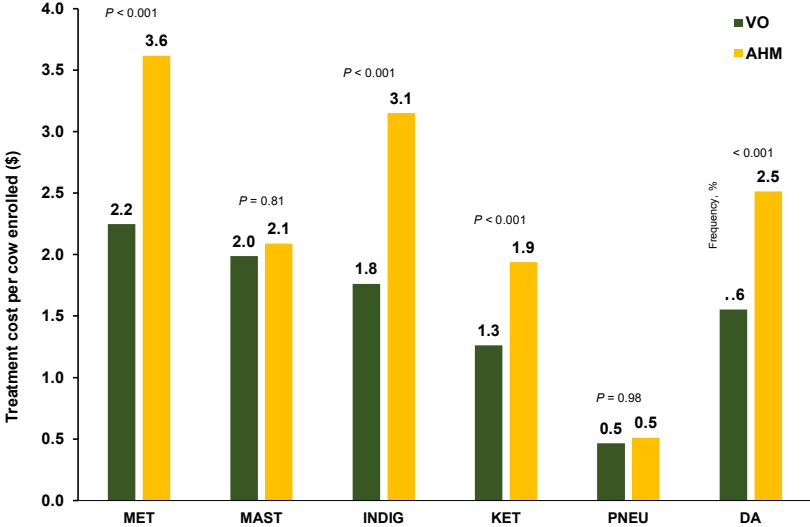
Outcome, %	Treatment		P-value
	VO (n = 597)	AHM (n = 607)	
Sold up to 100 DIM	12.7	9.1	0.11
Died up to 100 DIM	2.8	2.1	0.29
Total Left Herd up to 100 DIM	16.7	11.9	0.05



Conclusions

-  **More cows in the AHM group were identified with health disorders.**
-  **Cows in the AHM group had higher milk production during the first 21 days of lactation.**
-  **Lower proportion of culled cows (sold + dead)**




Economic Analysis






Conclusions



Compared to intensive monitoring, sensor-based monitoring:

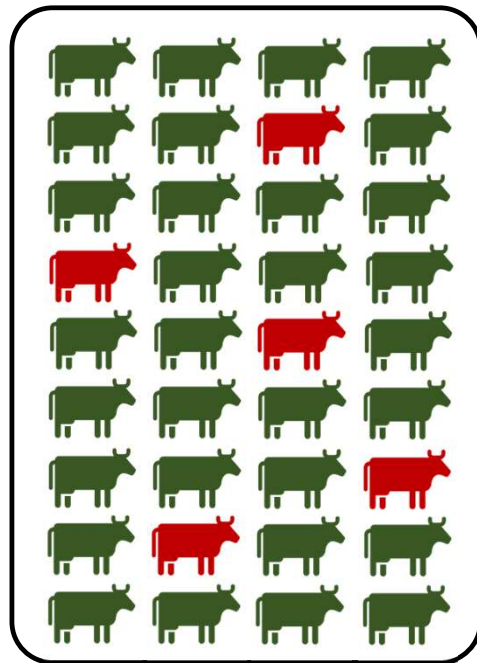
-  Reduces unnecessary handling of healthy cows
-  Detects fewer sick cows (false positives or truly sick?)
-  Similar performance

Compared to visual monitoring, sensor-based monitoring:

-  Increases the number of cows to be examined
-  Identifies more sick cows
-  Better performance (and economically viable)



Use of sensors for monitoring fresh cows




Healthy


Sick



J. Dairy Sci. 107:11576–11596
<https://doi.org/10.3168/jds.2024-25256>

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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*}

¹Department of Animal Science, Cornell University, Ithaca, NY 14853

²Dairy Health and Management Services, Lowville, NY 13367

**62%
Alerts**

**46%
Sick**

**54% non-
diseased**

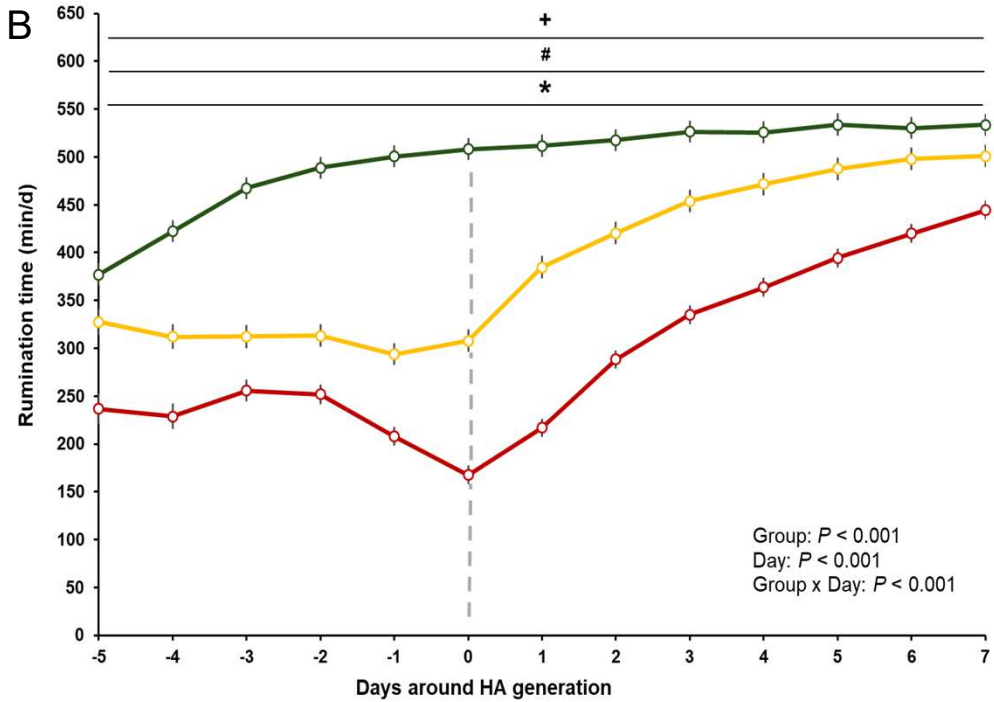
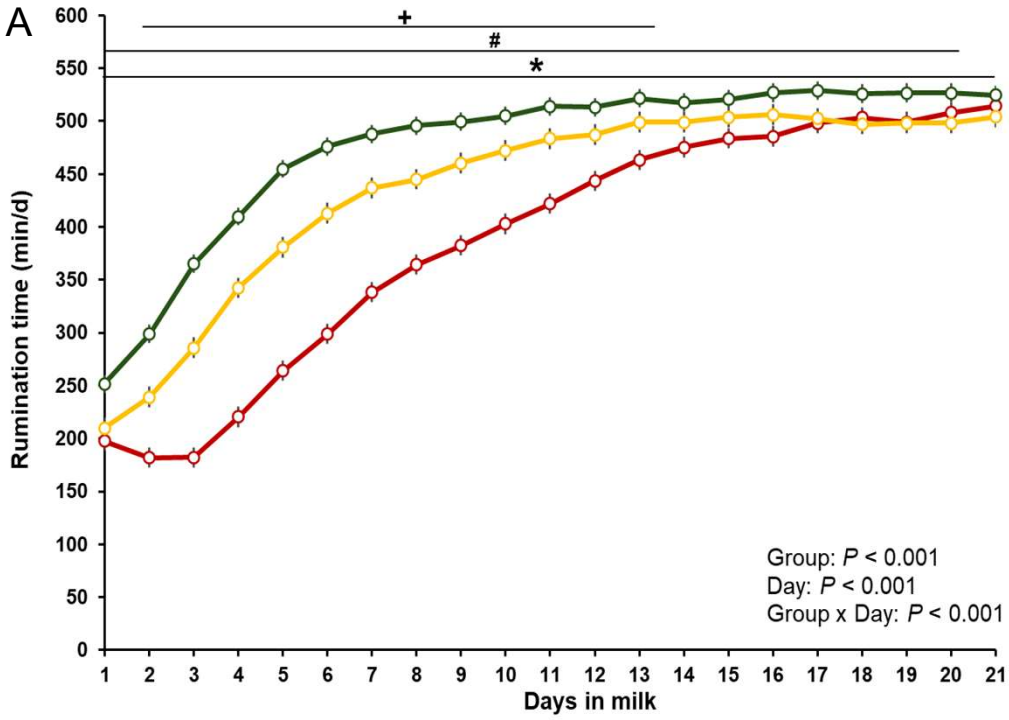
FALSE POSITIVES

Rumination time was different by DIM and around the day of HA generation among groups

HA-CHD
(168/602)

HA-NoCHD
(199/602)

NoHA-NoCHD
(235/602)

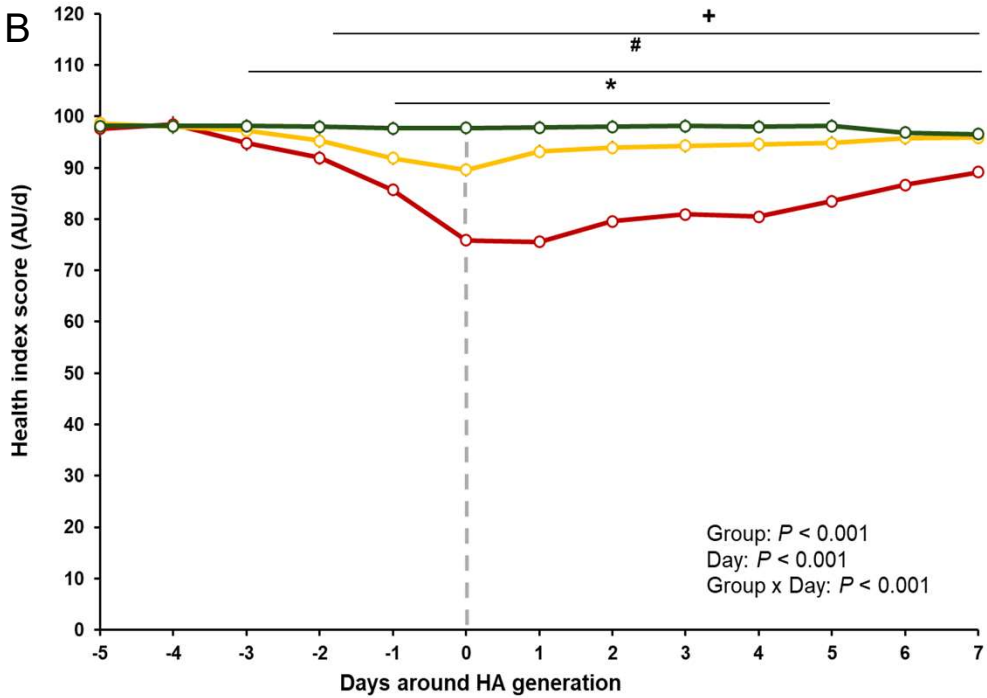
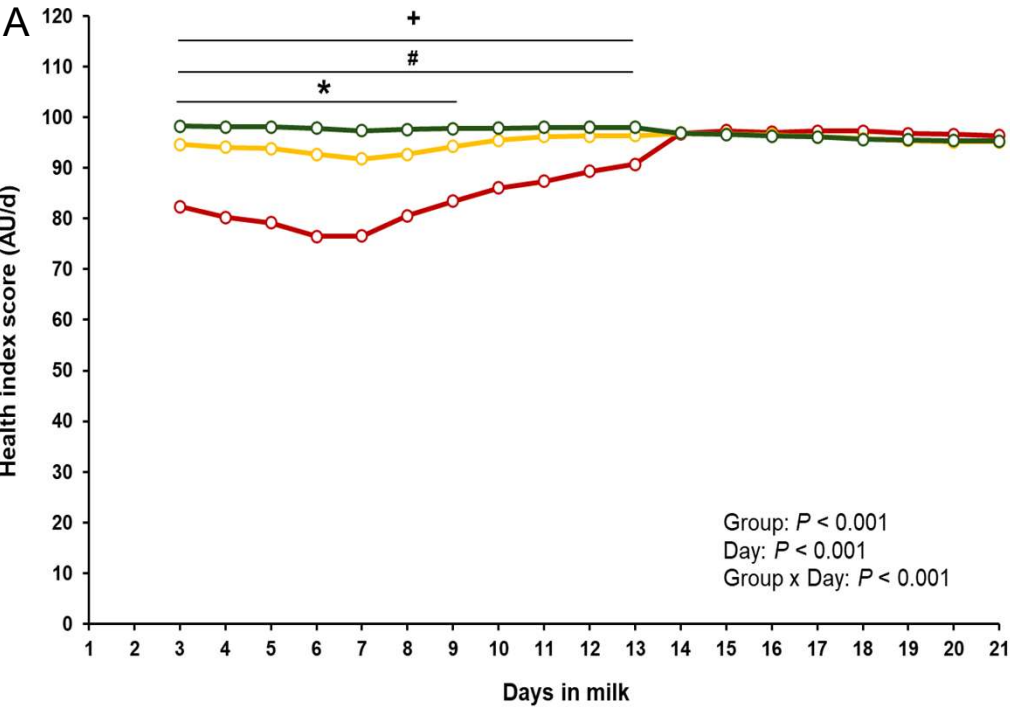


Health index score was different by DIM and around the day of HA generation among groups

HA-CHD
(168/602)

HA-NoCHD
(199/602)

NoHA-NoCHD
(235/602)



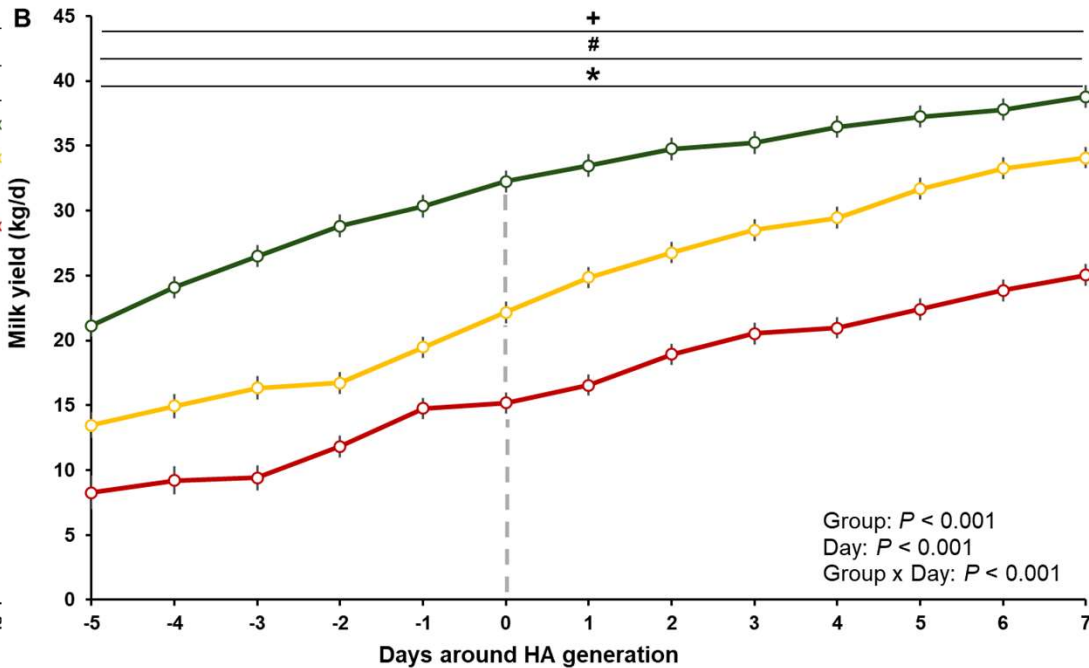
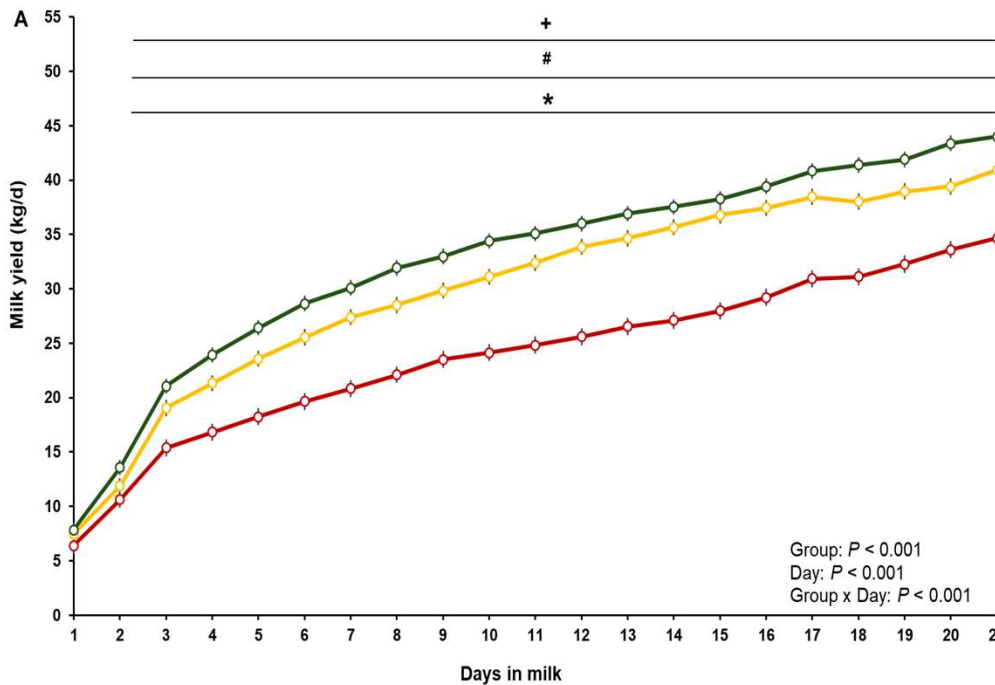
Milk yield was intermediate for cows in the HA-NoCHD group

HA-CHD
(168/602)

HA-NoCHD
(199/602)

NoHA-NoCHD
(235/602)

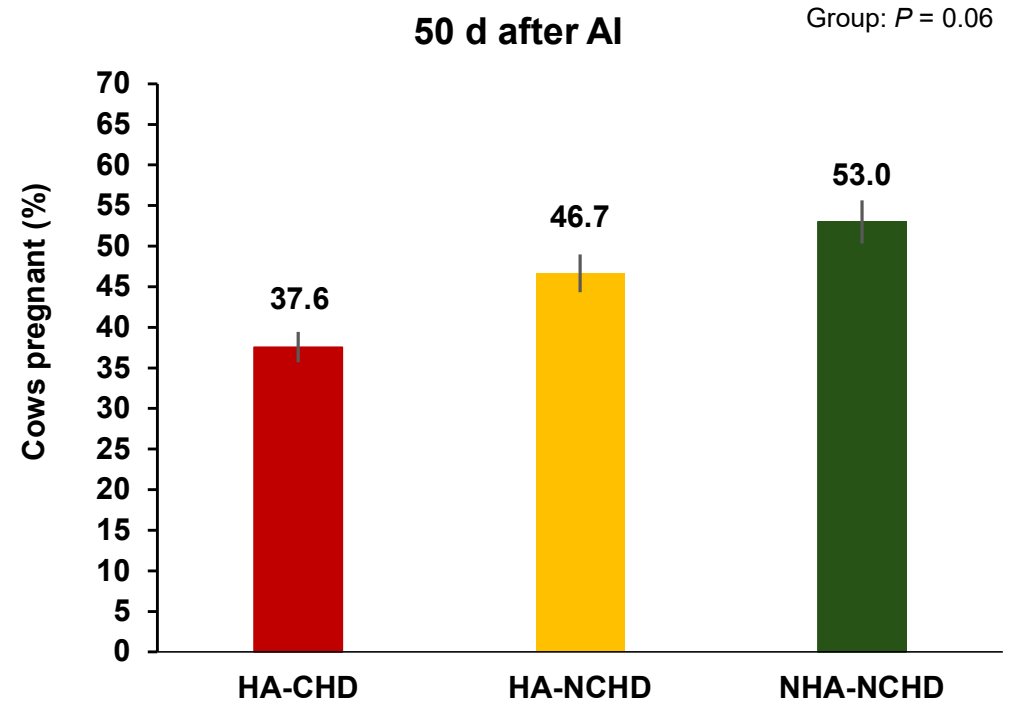
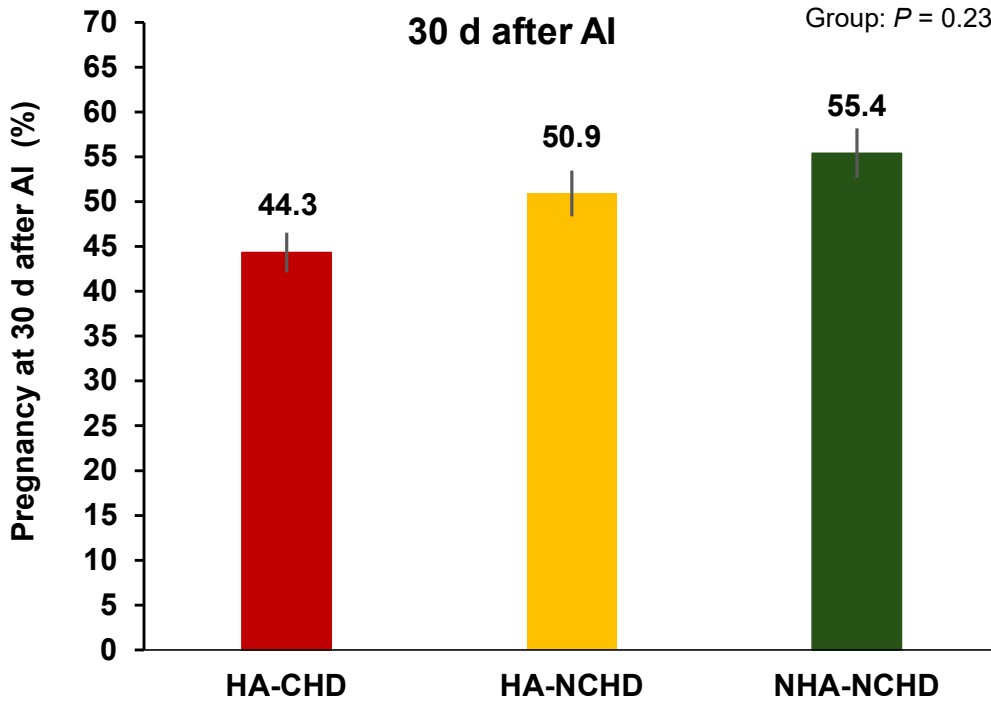
Group	Estimate	P-value
HA-CHD^C	3,578 ± 65	
HA-NCHD^B	3,944 ± 64	< 0.001
NHA-NCHD^A	4,107 ± 65	



Pregnancy per AI at first service

Group	Estimate	P-value
HA-CHD	12.5 ± 3.2	0.13
HA-NCHD	7.5 ± 1.8	
NHA-NCHD	3.8 ± 1.6	

Pregnancy loss



Conclusions

- 🐮 Cows with health alerts but no evident clinical signs may represent a distinct subgroup
 - 🐮 Lower milk yield, rumination, and activity than healthy cows, but higher than sick cows
- 🐮 Automated monitoring can help identify these cows with no evident clinical signs of disease but with reduced performance

The effect of treating hyperketonemic cows with different rumination behavior with propylene glycol on milk yield

Cainan C. Florentino¹, Luciano S. Caixeta¹, Rita Couto Serrenho^{2,3}, Tracy Potter³, Mark Thomas³, Matias Stangaferro³

¹Department of Veterinary Population Medicine, University of Minnesota; ²Department of Population Medicine, University of Guelph; ³Dairy Health & Management Services, LLC.



Background

- Hyperketonemia (HYK) cases that remain untreated has been linked to decrease in milk production (-0.5 kg/milking) during the first 30 days in milk (DIM; McArt et al., 2011).
- Rumination time during first wk postpartum has been associated with greater milk yield (Peiter et al., 2021).
- Rumination behavior might play a role in the association between early milk yield and HYK.

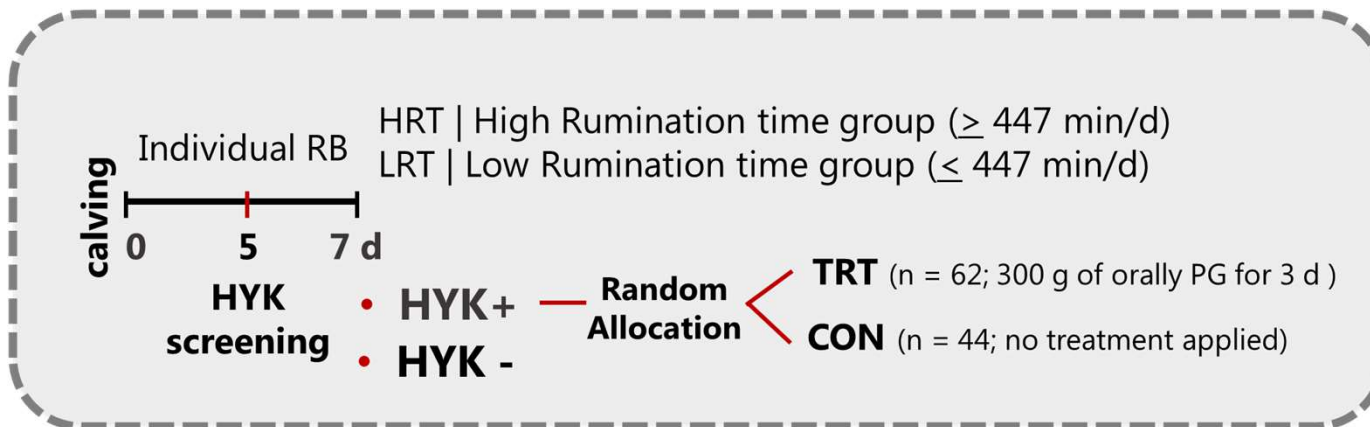
Objective

Evaluate the effects of propylene glycol (PG) treatment on HYK cows, with different rumination behavior (RB), in milk yield during the first 18 wk of lactation.

- **HYPOTHESIS** PG treatment would yield a greater benefit when administered to HYK+ cows with lower RB than to HYK+ with greater RB.

Study Design

- Multiparous cows (n=565) were screened for HYK (blood BHB ≥ 1.2 mmol/L) at 5 DIM
- HYK cows (n=106) were randomly assigned to receive or not PG
- Rumination behavior (RB) was recorded continuously during the first wk postpartum (min/d., SenseHub Dairy, Merck Animal Health)
- Cows were then categorized as High (above median) vs. Low (under median) rumination behavior (RB)



Groups

- LRT HYK+ TRT
- LRT HYK+ CON
- LRT HYK-
- HRT HYK+ TRT
- HRT HYK+ CON
- HRT HYK-

Outcome of Interest

- Average milk yield within each week for the first 18 wk (recorded daily, kg/d).

Demographics

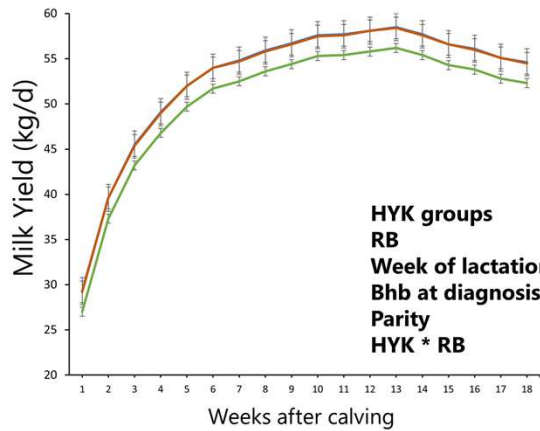
Descriptive statistics by propylene glycol and rumination behavior group

	LRT (n=283)			HRT (n=282)		
	HYK+ CON	HYK-	HYK + TRT	HYK+ CON	HYK-	HYK + TRT
Average RB ± SD (min./d)	365 ± 44.3	393 ± 35.7	381 ± 41.5	455 ± 21.5	476 ± 33.4	469 ± 27.1
Number of cows enrolled (%)	26 (9)	219 (77)	38 (14)	18 (6)	240 (85)	24 (9)
Parity Group (n; %)						
2 lactation	8 (30.8)	92 (42.0)	9 (23.7)	4 (22.2)	99 (41.3)	6 (25.0)
≥ 3 lactation	18 (69.2)	127 (58.0)	29 (76.3)	14 (77.8)	141 (58.8)	18 (75.0)
Median BHB at 5 DIM (mmol/L.; min - max)	1.4 (1.2, 3.7)	0.8 (0.1, 1.1)	1.4 (1.2, 2.9)	1.2 (1.2, 2.0)	0.8 (0.1, 1.1)	1.3 (1.2, 1.9)

Milk Production

Figure 1. Milk yield during the first 18 weeks postpartum per HYK group. (Error Bars = SE)

A) High Rumination (HRT) Group



Type III P Values

$P = 0.26$
 $P < 0.01$
 $P < 0.01$
 $P = 0.97$
 $P = 0.77$
 $P = 0.04$

HYK groups
RB
Week of lactation
Bhb at diagnosis
Parity
HYK * RB

B) Low Rumination (LRT) group

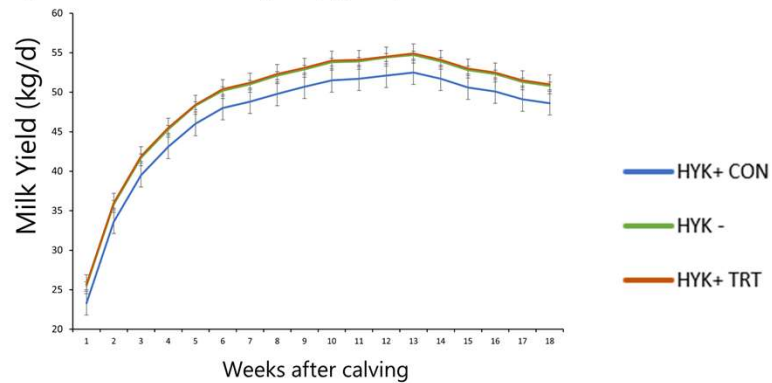
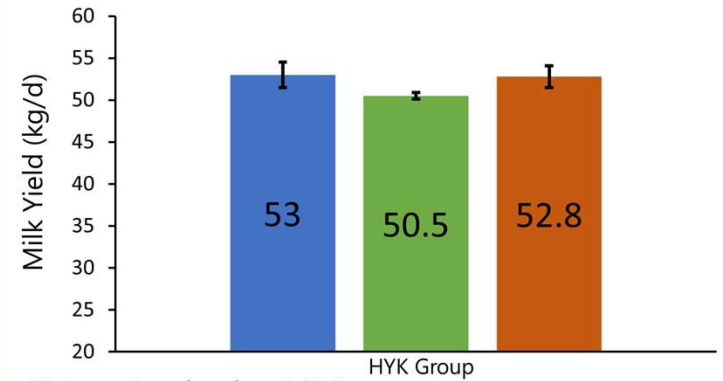
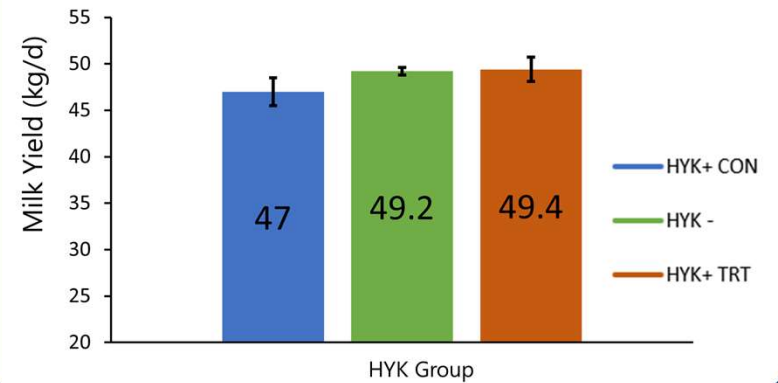


Figure 2. Average milk yield for the first 18 weeks postpartum per HYK group. (Error Bars = SE)

A) High Rumination (HRT) Group



B) Low Rumination (LRT) group



Conclusion

The findings from this exploratory study suggested that treating HYK+ cows with low rumination behavior helps recover milk yield during the first initial 18 weeks of their lactation.

Questions?

Thank you!

mark.thomas@telusagcg.com

