

Use of Rumination and Activity Monitoring for the Identification of Dairy Cows with Health Disorders

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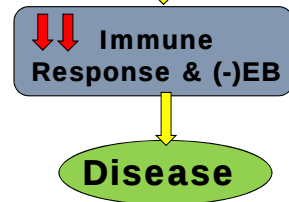
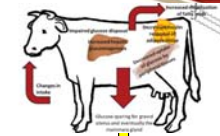


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Early Lactation Challenges

Health conditions to monitor post-partum period:

- ✓ Retained placenta
- ✓ Metritis
- ✓ Mastitis
- ✓ Displaced abomasum
- ✓ Ketosis
- ✓ Hypocalcemia
- ✓ Diarrhea
- ✓ Pneumonia



Identify sick cows

Treatment decisions

Improved well-being and productivity

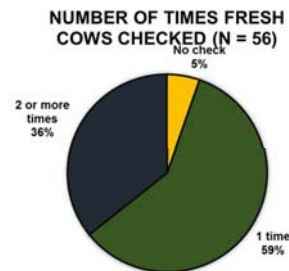
Health Monitoring SOPs

✓ Substantial variation across farms – frequency of checks, type of evaluation, labor demand and aids used

✓ Health monitoring programs –
 ✓ costly
 ✓ time consuming
 ✓ require qualified labor

✓ Monitoring technologies

reduce or eliminate the burden associated with health monitoring programs



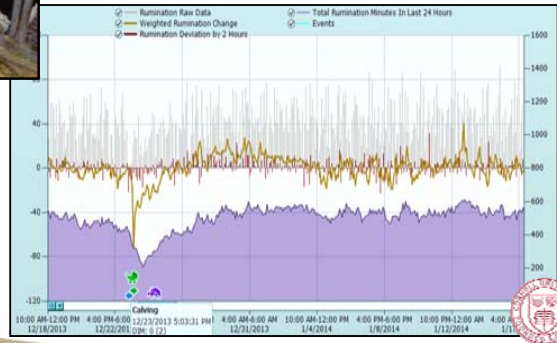
Sensor Data



Rumination-Activity Monitoring



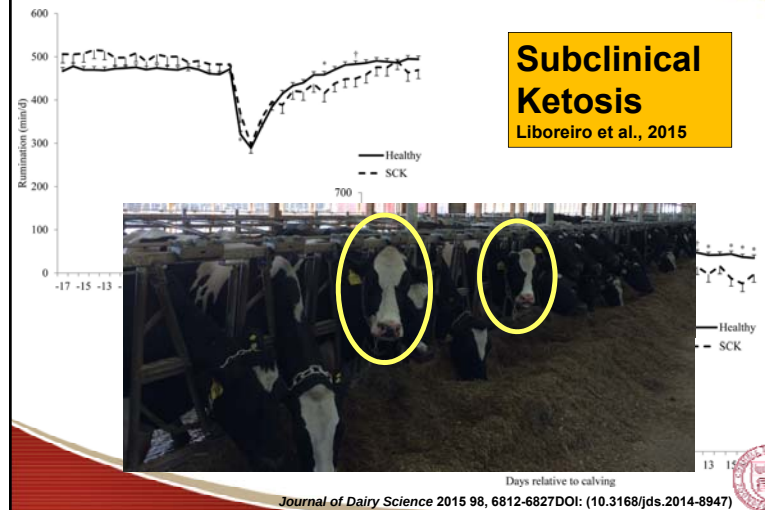
HR-Tag, SCR Dairy



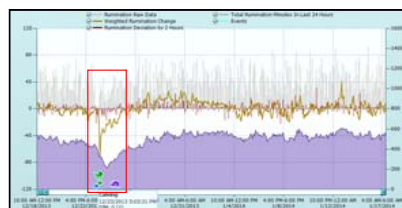
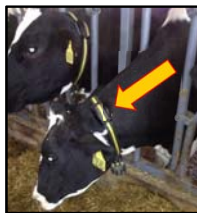
Rum-Act & Disease

Subclinical Ketosis

Liboreiro et al., 2015



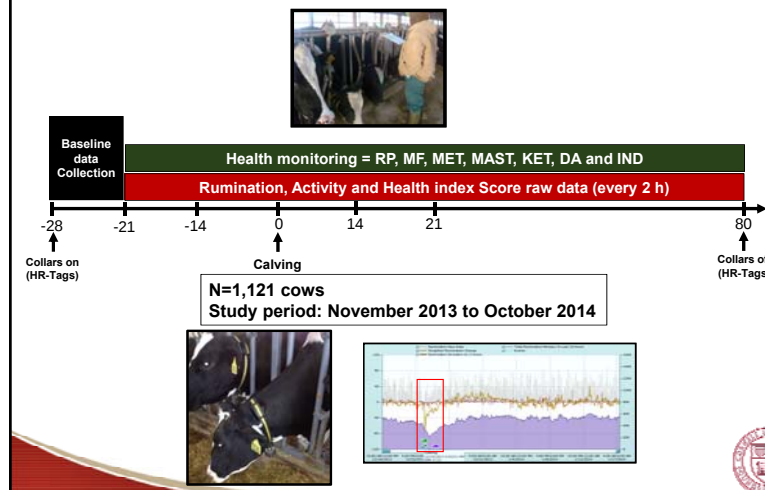
Rumination-Activity Monitoring & Cow Health



(1) Performance of the HR system to identify cows with health disorders (HD).

(2) When does the HR system identify cows with CD compared to farm personnel?

Cornell University Research Observational Prospective Cohort Study



Health Monitoring SOP

-Daily monitoring - all cows 1 to 10 DIM

- Direct observation
- Body Temperature
- Ketostix (urine ketones)
- Daily milk weights

-Rumen auscultation, check for DA

-Vaginal discharge - all cows at 8 DIM

-Milk culture - all cows at the beginning of lactation and mastitis cases

-Monitoring after 10 DIM: 3X milk weights and milk conductivity

Intensive Monitoring Program!!!

Stangaferro et al., 2015 (Abstract: J. Dairy Sci. 98, E-Suppl 1)

Health Index Report

	Cow Number	Group	Lactation Status	Days in Lactation	Days from Last Breeding	Activity Peak	Ruminati on Peak	Daily Ruminati on	Amount Of Evaluation	Health Index for Non
1	20600	7	Before	6		-15	-40	0	-132	20.00
2	10856	7	Before	6		-40	-44	13	-464	31.60
									-561	35.00
									-462	36.30
									-136	37.20
										72.00
										73.00
									-290	79.00
									-23	81.50
									2	82.00
									-35	83.00
12	8062200	1	Before	57		-7	-21	135	15	83.70
13	508600	1	Ready	68		-29	-52	328	-206	83.80
14	9251200	1	Ready	72		-17	-34	318	-133	84.70
15	12561	1	Before	46		-5	-15	186	5	85.50
	15									

Evaluate the ability of Health Index (HI) score to identify cows with health disorders.

Cornell University Research Observational Prospective Cohort Study

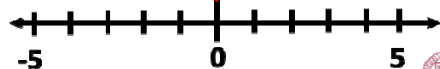
(1) **Performance** of the HR system to identify cows with health disorders (HD).

(2) **When** does HR system identify cows with CD compared to farm personnel?

> Cows grouped based on occurrence of **HD** (health disorder) and **HI** (health index) score

- > **HD+ and HI+ (HI < 86)** → disorder and flagged
- > **HD+ and HI- (HI ≥ 86)** → disorder and NOT flagged
- > **HD- (Healthy)** → healthy

Farm Personnel Clinical Diagnosis



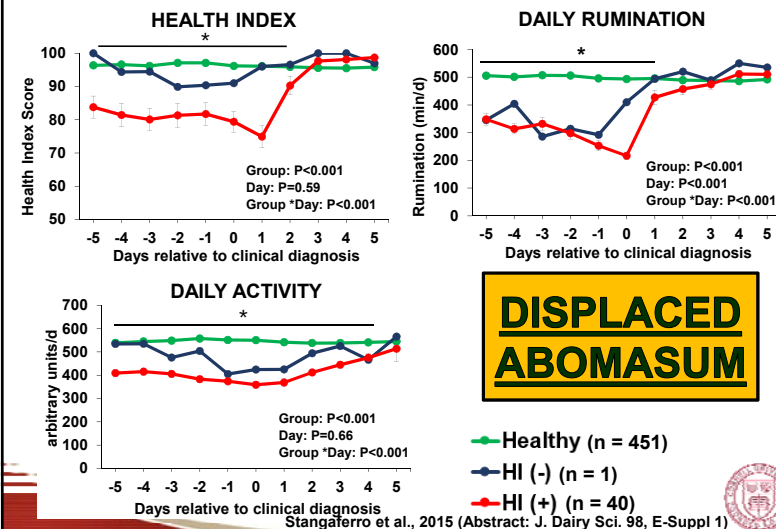
Stangaferro et al., 2015 (Abstract: J. Dairy Sci. 98, E-Suppl 1)

Ability of HI Score to Identify Cows with Health Disorders DA, KET, & IND

Disorder	Cows detected Se, % (95% CI)	HI < 86 to CD (d)
DA (n = 41)	98 (93-100)	-3 (-3.7 to -2.3; P<0.01)
Ketosis (n = 54)	91 (83-99)	-1.5 (-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)

Stangaferro et al., 2015 (Abstract: J. Dairy Sci. 98, E-Suppl 1)

Activity, Rumination and HI patterns



Change in Rumination, Activity, HI Score, and Milk 5 d preceding to Nadir

All MET-DIG

Parameter	Percent change 5 d preceding CD to nadir ²			P-value
	Healthy	HI-	HI+	
DRT (min/day)	-0.5 ± 0.6^b	15.8 ± 7.5^a	-31.5 ± 3.9^c	< 0.001
ACT (AU/day)	2.8 ± 0.6^a	-7.2 ± 4.6^b	-13.1 ± 2.0^b	< 0.001
HI Score (AU/day)	-2.0 ± 0.3^a	-1.2 ± 1.2^a	-15.5 ± 3.0^b	< 0.001
Milk (kg/day)	11.1 ± 1.0^a	3.9 ± 24.5^a	-28.6 ± 4.4^b	< 0.001

Healthy: n = 435 HI-: n = 7 HI: n = 92
Stangaferro et al., 2015 (Abstract: J. Dairy Sci. 98, E-Suppl 1)

Conclusions

- ✓ The HR system was **effective** to identify cows suffering **metabolic and digestive disorders (DA, KET, IND)**.
- ✓ Cows with **DA and KET** identified **earlier** than farm personnel.
- ✓ **No difference in milk** for cows not flagged by HR (**HD+ and HI-**) and Healthy cows for 5 d prior to CD

Stangaferro et al., 2015 (Abstract: J. Dairy Sci. 98, E-Suppl 1)

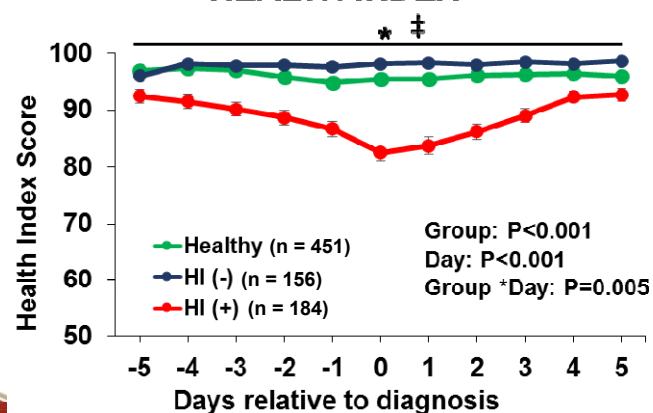
Ability of HI Score to Identify Cows with Health Disorders

Disorder	Cows detected Se, % (95% CI)	HI <86 to DCD (d)
Metritis ALL (n = 349)	55 (49-60)	-1.2 (-1.6 to -0.7; $P < 0.01$)
≤39.4°C (n = 165)	56 (48-64)	-1.4 (-1.9 to -1.0; $P < 0.01$)
39.5-39.9°C (n = 79)	49 (38-61)	-1.3 (-2.9 to 0.4; $P = 0.17$)
≥40°C (n = 74)	58 (46-70)	-0.2 (-0.9 to 0.4; $P = 0.46$)
Antibiotic treatment		
Cephalosp. (n = 292)	49 (43-55)	-1.1 (-1.6 to -0.6; $P = 0.17$)
Ampi./Oxytet. (n = 57)	83 (70-91)	-1.4 (-2.1 to -0.7; $P = 0.17$)

Stangaferro et al., 2015 (Abstract: J. Dairy Sci. 98, E-Suppl 1)

HI patterns

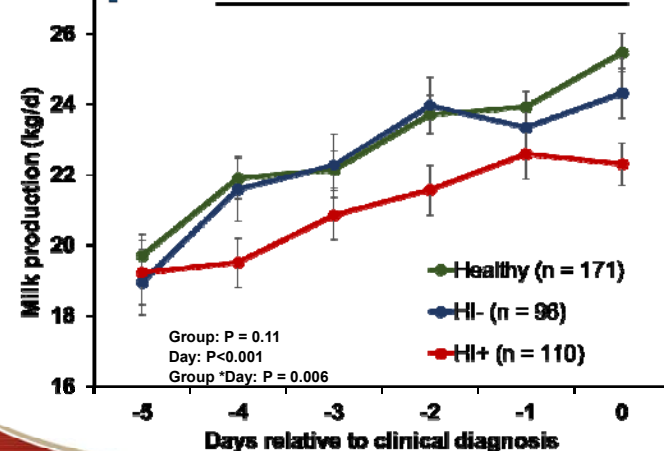
Metritis (Healthy, HI-, HI+)



Stangaferro et al., 2015 (Abstract: J. Dairy Sci. 98, E-Suppl 1)

Milk Production – MET

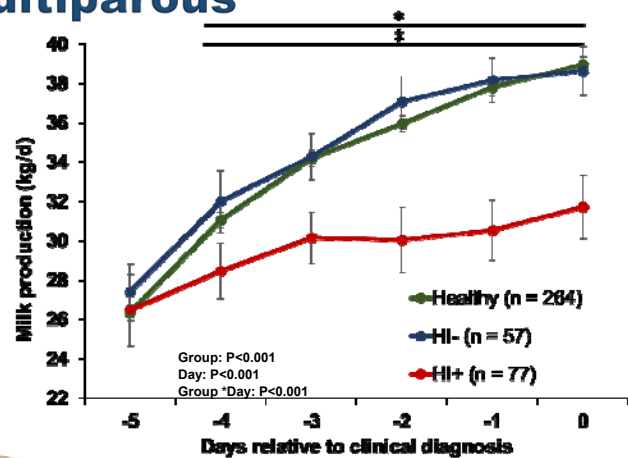
Primiparous



Stangaferro et al., 2015 (Abstract: J. Dairy Sci. 98, E-Suppl 1)

Milk Production – MET

Multiparous



Stangaferro et al., 2015 (Abstract: J. Dairy Sci. 98, E-Suppl 1)

Culling Dynamics and Repro

By HI Score (+ vs -)

Parameter	Differences from 5 d preceding to nadir ¹			P-value
	Healthy	HI-	HI+	
DNB/Sold <60	2.5 ^a	3.3 ^a	7.0 ^b	0.03
DIM, % (n/n)	(11/451)	(5/153)	(13/187)	
DNB/Sold total, %	18.6 ^a	14.4 ^a	31.0 ^b	<0.001
(n/n)	(84/451)	(22/153)	(58/187)	
DIM at 1st AI, days (n)	79	79	80	0.73
(n/n)	(400)	(140)	(157)	
P/AI at 1st AI, %	46.0	42.9	45.9	0.80
(n/n)	(184/400)	(60/140)	(72/157)	

Cows in HI+ group twice as likely to leave the herd than cows in the HI- and Healthy group

Stangaferro et al., 2015 (Abstract: J. Dairy Sci. 98, E-Suppl 1)

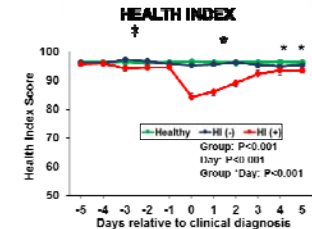
Ability of HR System to Identify Cows with Disease

Disease	Cows detected % Se (95% CI)	HR Flag to DCD (days)
Mastitis (n = 165)	53 (45-61)	-0.6 (-1.1 to -0.2; P<0.01)
Clinical (n = 123)	58 (49-67)	-1.2 (-2.7 to 0.3; P=0.12)
Subclinical (n = 42)	41 (26-57)	-0.5 (-1.0 to -0.1; P=0.02)
By Pathogen		
E. Coli. (n = 31)	81(67-95)	-0.5 (-1.1 to 0.2; P=0.18)
Gram + (n = 39)	49 (32-65)	-0.5 (-1.4 to 0.5; P=0.31)
Staph. Aureus (n = 11)	46 (17-77)	-1.4 (-4.1 to 1.3; P=0.23)
No growth 48 h (n = 25)	48 (28-69)	-0.2 (-1.4 to 1.1; P=0.78)

Gram (+) = Streptococcus agalactiae, Streptococcus dysgalactiae, Streptococcus uberis, Streptococcus species, Staphylococcus species, Actinobacillus pyogenes.

Stangaferro et al., 2015 (Abstract: J. Dairy Sci. 98, E-Suppl 1)

Change in Rumination, Activity, HI Score, and Milk 5 d preceding to Nadir

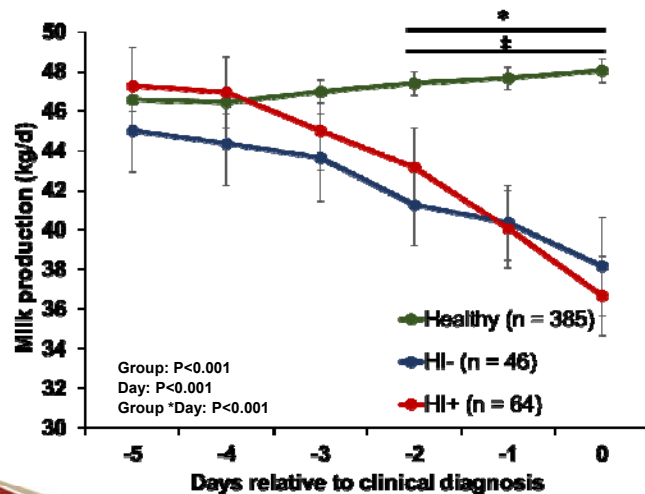


Clinical Mastitis

Parameter	Percent change 5 d preceding CD to nadir ²			
	Healthy	HI-	HI+	P-value
DRT (min/day)	0.6 ± 0.9 ^a	-6.3 ± 3.7 ^b	-27.8 ± 5.1 ^c	<0.001
ACT (AU/day)	4.0 ± 1.2 ^a	3.3 ± 2.9 ^a	-15.0 ± 2.6 ^b	<0.001
HI Score (AU/day)	0.4 ± 0.2 ^a	-1.4 ± 0.8 ^a	-13.4 ± 1.9 ^b	<0.001
Milk (kg/day)	4.1 ± 0.8 ^a	-9.2 ± 3.2 ^b	-21.9 ± 3.3 ^c	<0.001

Stangaferro et al., 2015 (Abstract: J. Dairy Sci. 98, E-Suppl 1)

Milk Production - MAST



Group: P<0.001
Day: P<0.001
Group *Day: P<0.001

Stangaferro et al., 2015 (Abstract: J. Dairy Sci. 98, E-Suppl 1)

Health Index Score Performance

	% (n/n)	95% CI
False positives	2.4 (1,955/72,423)	2.6-2.8
Specificity	97.6 (70,695/72,423)	97.2-97.4
Accuracy	95.6 (73,111/76,519)	95.4, 95.7

• Each day was considered a new test

• Total number of days in the study was determined for individual cows until 80 DIM or DIM at which cows left the herd (sold or died)

Stangaferro et al., 2015 (Abstract: J. Dairy Sci. 98, E-Suppl 1)

Tag Misplacement and Malfunction



3.7% tags malfunctioned or misplaced

Stangaferro et al., 2015 (Abstract: J. Dairy Sci. 98, E-Suppl 1)



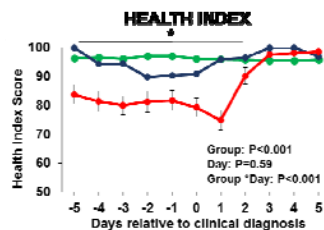
Conclusions

- ✓ The HR system is most **effective** to identify cows suffering **metabolic and digestive disorders**.
- ✓ A relatively **lower Se** to identify cows with MET and MAST might be explained by **less severe systemic illness** and type of mastitis-causing pathogen.
- ✓ The HR system identified cows with **DA, KET, MET and MAST earlier** than farm personnel.

Stangaferro et al., 2015 (Abstract: J. Dairy Sci. 98, E-Suppl 1)



Challenges and Opportunities of Early Dz Detection



Opportunities

Earlier treatment:
-improved response
-improved well-being
-prevent associated disorders

Challenges

Treatment decisions in the absence of clinical signs?
Prophylactic treatment?



On-farm use...

NUMBER OF TIMES FRESH COWS CHECKED (N = 56)



Farms with little-to-no intervention

identify more cows with health disorders

Farms with intensive health monitoring

reduce labor & cow manipulation



- **Add HI report to fresh cow check list**
 - **Greatest benefit for DZ that occur after 3 DIM**

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Acknowledgements

- ✓ Collaborating dairy farm
- ✓ SCR Dairy
- ✓ Students and technicians



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