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Measuring the Prevalence and Impact of Subclinical Ketosis on Lactation Performance in U.S. Dairy Herds

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Critical Transition Period

- Successful transition programs are key to sustained health and peak production
- Increased awareness of subclinical metabolic distress during transition period
- Costly and labor intensive detection methods

Hyperketonemia

Clinical Ketosis

- Blood BHBA ≥ 3.0 mM
- Incidence between 10-15% of cows
- Observable symptoms

Subclinical Ketosis

- Blood BHBA ≥ 1.2 mM
- Incidence between 40-60% of cows
- 85-90% show no symptoms
- "Silent Killer"

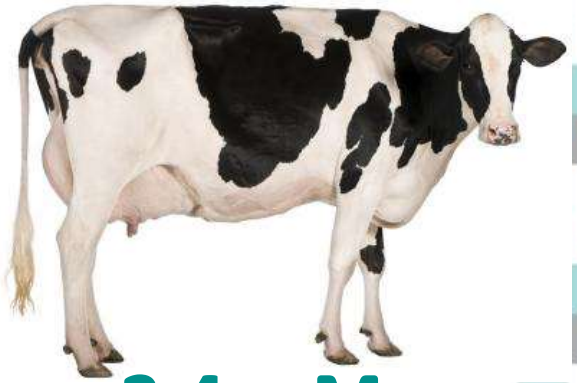
Both can be quantified in milk, urine, or blood

Subclinical Ketosis

- Cumulative Negative Impacts
  - 3x more likely to develop a DA
  - 50x more likely to be culled within 30d
  - less likely to conceive to first service
  - produce approximately 400 lbs less milk in first 30 days and whole lactation

1.2 mM

vs.

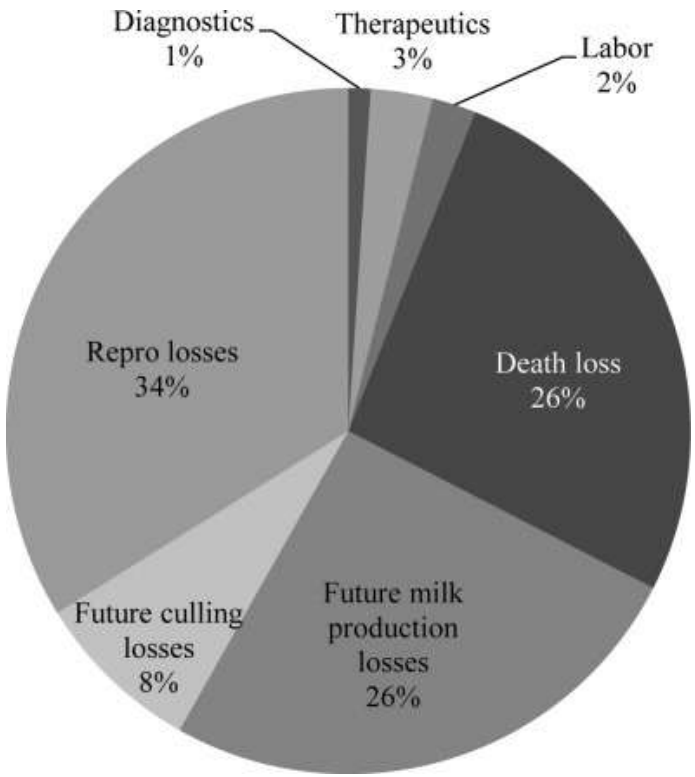


2.4 mM

McArt et al., 2012, Mcart & Nydam, 2014

US$ Cost of Subclinical Ketosis

	LACT=1	LACT>1	Ave
Direct	44	37	38
Production	30	30	30
Culling	19	5	9
Reproduction	41	39	40
Hyperketonemia	134	111	117
Disp Abomasum	101	67	76
Metritis	141	77	95
Total per Case:	**$375**	**$256**	**$289**



Source: J.A.A. McArt, D.V. Nydam, M.W. Overton, Journal of Dairy Science, Volume 98, Issue 3, 2015, 2043–2054

KetoMonitor™

Measure Ketosis Prevalence in Your Herd

- Developed in 2014 in collaboration with University of Wisconsin Dairy Science and Vet School
- Milk sample analysis for ketones combined with 14 other cow parameters
- Most method for predicting blood BHBA levels
- Early Fresh cow prevalence measured at 5-11 DIM; Herd prevalence measured at 2-20 DIM

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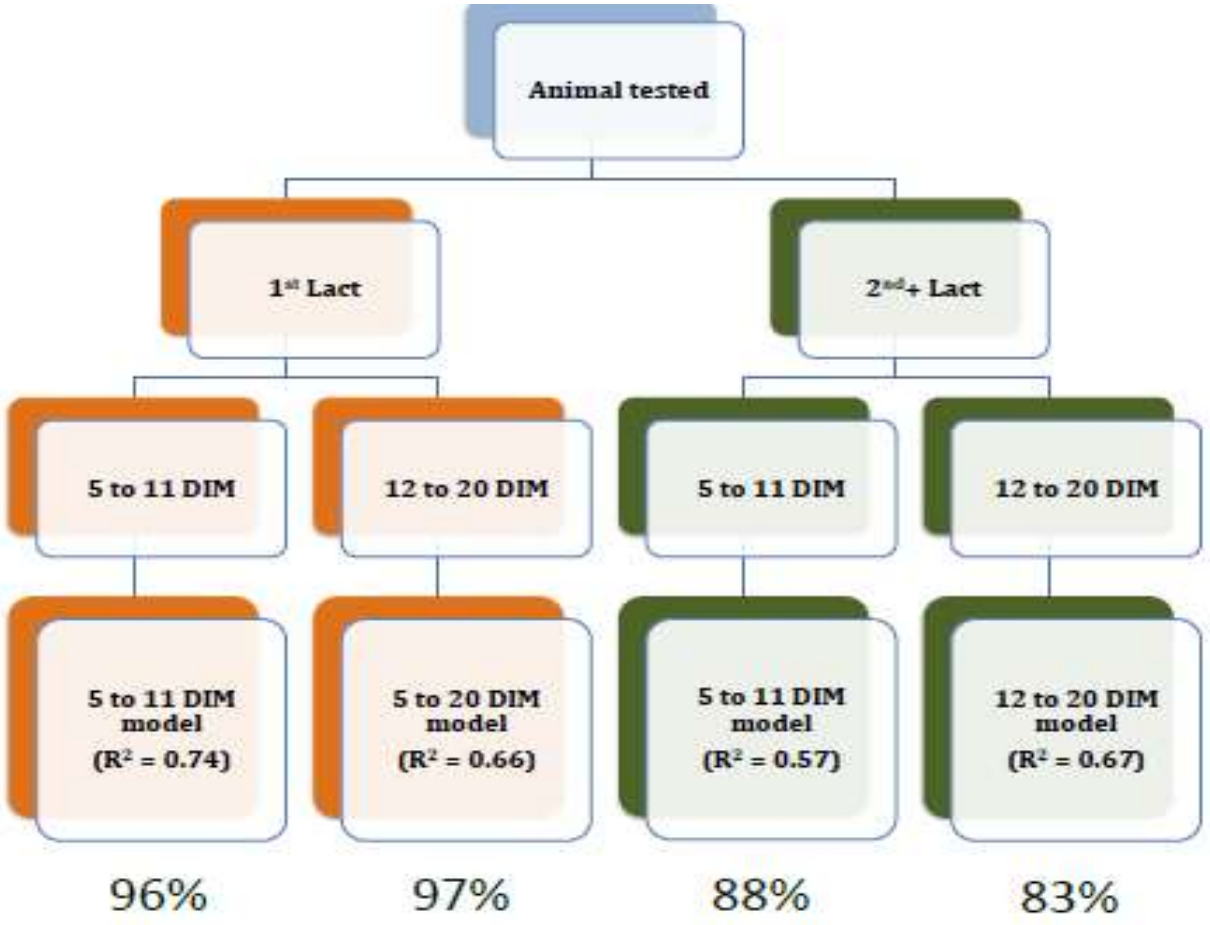
Accuracy of the Models



Accuracy of each model at each stage of lactation

Analysis of AgSource Data

- 3,362 Herds
- 215,344 cows with 398,444 observations
- Milk collected 5-20 DIM
- Primiparous, Multiparous groups

Predicted Blood BHBA

- Positive, 1.2 or higher (SCK=1)
- Negative, <1.2 (SCK=0)

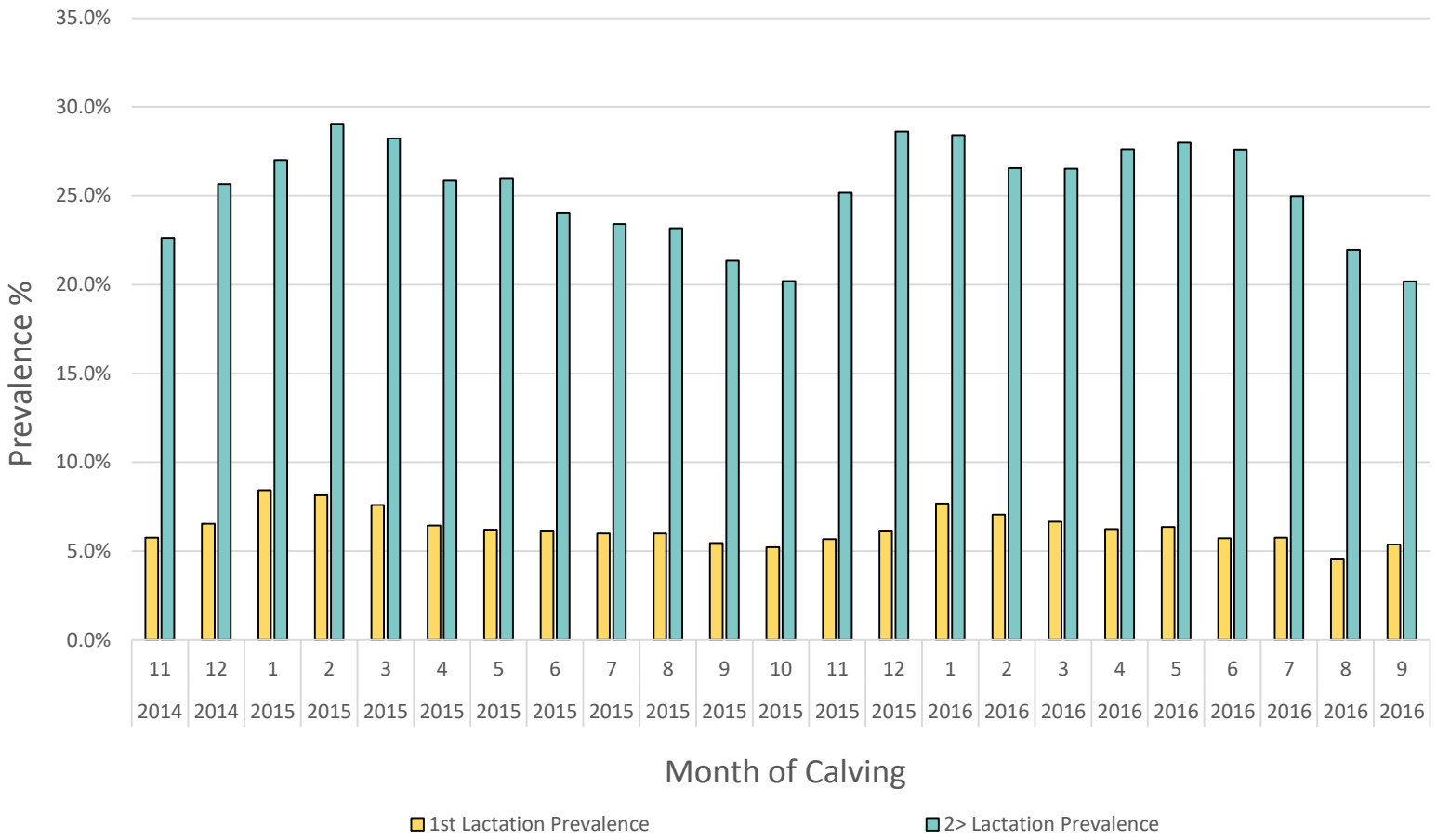
Analyze differences for

- Peak milk production
- Average lactation somatic cell score
- First service conception rates
- Culling rates

Lactation	# of Cows
1	70,452
2	52,020
3	33,571
4	18,728
5	8,758
6	3,735
7	1,394
8	489
9	161
10+	80

SCK Prevalence by Month of Calving

1st Lactation Overall Prevalence: 6.5%, 2nd> Lactations: 25.9%



Impact on Production

Subclinical ketosis had a significant negative impact on peak milk production regardless of parity

	Lactation	Change in peak milk (kgs per day)	SE	P-value
Herd Prevalence	1	-1.53	0.14	<0.00001
	2+	-1.80	0.09	<0.00001
Fresh Cow Prevalence	1	-1.56	0.18	<0.00001
	2+	-3.71	0.17	<0.00001

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Impact on Udder Health

- Cows with SCK had more test days LS-SCC>4
- For example, using fresh cow prevalence data, SCK positive multiparous cows had 4.94% more tests with a Linear Score greater than 4

	Lactation	Change in %LS > 4	SE	P-value
HERD PREVALENCE	1	1.70	0.05	0.00021
	2+	3.81	0.29	<0.00001
FRESH COW PREVALENCE	1	2.12	0.56	<0.0001
	2+	4.94	0.51	<0.00001

Impact on Udder Health

- The change in Average Linear Scores (AVLS) between SCK positive and SCK negative cows was significant regardless of parity.
- SCK positive cows consistently show higher amounts of somatic cells in their milk, indicating a potential infection or issue.

	Lactation	Change in AVLS	SE	P-value
Herd Prevalence	1	0.29	0.02	<0.00001
	2+	0.31	0.01	<0.00001
Fresh Cow Prevalence	1	0.28	0.03	<0.00001
	2+	0.48	0.02	<0.00001

Impact on Reproduction

Conception rates at first breeding (FBCR) were significantly lower for SCK positive cows than for negative for both primiparous and multiparous cows

	Lactation	FBCR % (SCK=0)	FBCR % (SCK=1)	Z-score	P-value
Herd Prevalence	1	68.83	62.29	4.95	<0.0001
	2+	61.46	59.73	2.83	0.0023
Fresh Cow Prevalence	1	68.76	61.75	4.64	<0.0001
	2+	61.35	56.33	4.44	<0.0001

Impact on Culling

There was a significant difference in culling rates for cows that were SCK positive versus those that were SCK negative.

	Lactation	% Cull Rate (SCK=0)	% Cull Rate (SCK=1)	Z-score	P-value
Herd Prevalence	1	20.48	26.33	9.40	<0.0001
	2+	25.87	30.81	16.61	<0.0001
Fresh Cow Prevalence	1	20.08	25.41	7.16	<0.0001
	2+	25.65	33.90	15.39	<0.0001

Other Findings

Follow-up study, matching recorded health events

- Milk sample collected 5-20 DIM
- Health event recorded during first 40 DIM
- 312 herds; 122,352 cows
  - 46,637 first lactation
  - 75,612 second and later lactation
  - 51,897 cows at 5-11 DIM (42% at 5-11 DIM for both parity groups

	LACT=1	LACT>1
Mean BHBA	0.784	0.997
SCK Prevalence, 5-20 DIM	6.1%	21.9%
SCK Prevalence, 5-11 DIM	10.6%	13.3%

SCK Impact on Cow Health

Frequency of Ketosis, DAs and Metritis increases as predicted BHBA values increase

Frequency of Observations in First Lactation Cows

	No Event	Ketosis	DA	Metritis	Mastitis	RP
All Cows	92%	0.8%	0.4%	2.0%	1.2%	0.2%
pBHBA <1.0	94%	0.5%	0.2%	1.5%	1.1%	0.2%
pBHBA ≥1.0	85%	2.8%	2.0%	5.7%	1.4%	0.5%
pBHBA ≥1.2	82%	3.7%	3.0%	6.5%	1.7%	0.6%

Frequency of Observations in Second and Later Lactation Cows

	No Event	Ketosis	DA	Metritis	Mastitis	RP
All Cows	92%	0.8%	0.4%	2.0%	1.2%	0.2%
pBHBA <1.0	94%	0.5%	0.2%	1.5%	1.1%	0.2%
pBHBA ≥1.0	85%	2.8%	2.0%	5.7%	1.4%	0.5%
pBHBA ≥1.2	82%	3.7%	3.0%	6.5%	1.7%	0.6%

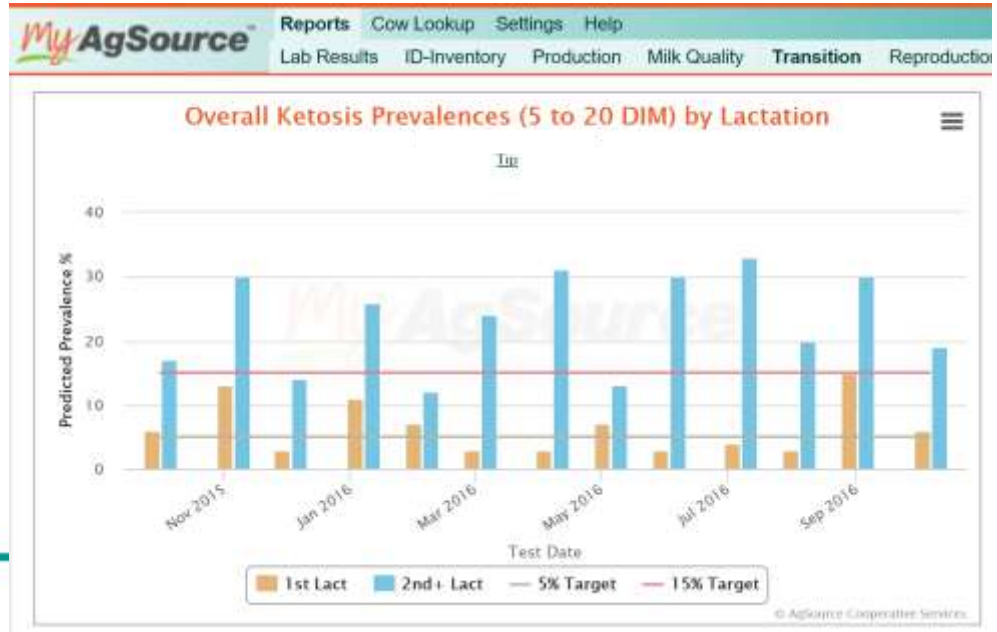
How Repeatable is SCK?

- Evaluated 39,444 cows that have had 2 lactations with SCK results
- Is 1st to 2nd different then older cow transitions?

	Lactation		
SCK diagnosis	**Any**	**1st - 2nd**	**2> - Later**
Negative to Negative	79.4%	86.2%	72.7%
Negative to Positive	20.6%	13.8%	27.3%
Positive to Positive	41.5%	22.6%	45.1%
Positive to Negative	58.5%	77.4%	54.9%

Using KetoMonitor® to Manage Transition

- Monitoring of subclinical ketosis prevalence
  - <7%, periodic monitoring with monthly milk sampling
  - 7-25%, test cows 3-9DIM twice per week for blood BHBA
  - >25%, consider blanket treatments



Overall Ketosis Prevalences

Tip

Overall (for cows 5 to 20 DIM)				
Group	Cows Tested	Predicted Ketosis	Ketosis Prevalence (%)	Target
1st Lact	34	2	6	<5%
2nd+ Lact	72	14	19	<15%
All	106	16	15	<10%

Early Fresh Ketosis Prevalences

Herd Code: 35050295

Tip

Early Fresh (for cows 5 to 11 DIM)				
Group	Cows Tested	Predicted Ketosis	Ketosis Prevalence (%)	Target
1st Lact	10	1	10	<5%
2nd+ Lact	34	3	9	<15%
All	44	4	9	<10%

Management with Genetic Selection

- GWAS to identify SNP markers (UW DASC):
  - Collected hair samples and genotyped cows
  - Collected repeat blood samples
  - Found several markers for Holstein and Jerseys
- Phenotypic data – KetoMonitor® estimated blood based BHBA values
  - Better then Ketosis event data
  - Continuous data
- Develop Breeding Values for SCK in Holsteins (CRI-ICB)
  - Heritability of .11, published December 2016
  - Incorporate into selection index based on economic impact

Conclusions

- Early detection of subclinical ketosis is important to prevent negative effects on lactation performance
- KetoMonitor® milk-based BHBA values are a useful indicator of cows at high risk for future metabolic disease
- Considerable value in collecting milk samples on all cows under 20 DIM to monitor herd prevalence of SCK
- Herds may realize the greatest benefit by implementing monthly (or even semi-monthly) milk sampling frequencies
- Combining use of KetoMonitor® tool and genetic selection for whole herd and generational improvement

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Questions or Comments?

Thank You to ICAR and Congress Organizers