Epidemiology of subclinical ketosis in early lactation dairy cattle

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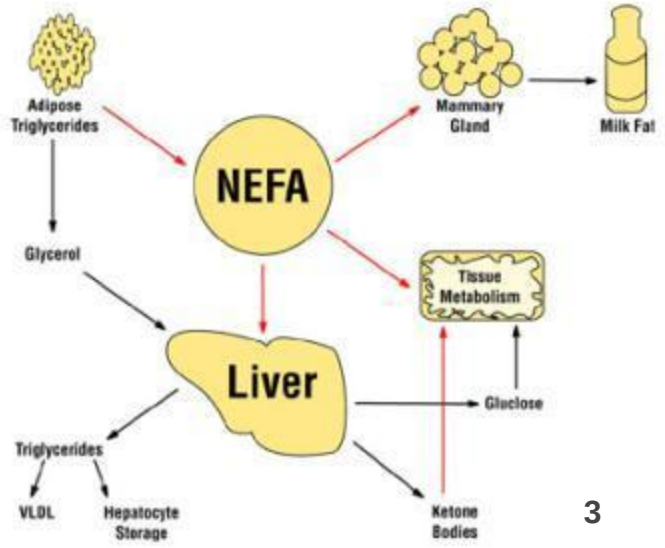
Negative Energy Balance (NEB)

- Dairy cows enter a state of NEB during the transition period
- Increased energy demand in early lactation
- Inability to adapt:
  - Metabolic disorders
  - Infectious disease
  - Decreased milk production

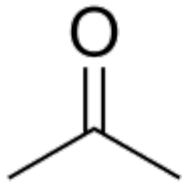
Adaptation to NEB

- Mobilization of fat
- Production of non-esterified fatty acids (NEFA)
- Elevation of blood ketone bodies

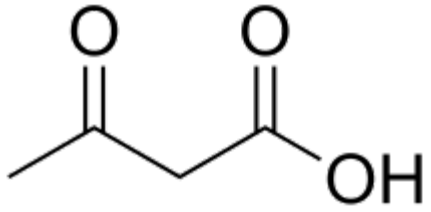


Ketosis

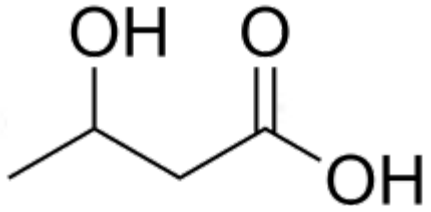
- Ketosis is the elevation of ketone bodies:
  - Acetone
  - Acetoacetic acid
  - ² -hydroxybutyric acid (BHBA)



- Clinical manifestation:
  - Decrease in appetite
  - Weight loss
  - Decrease in milk production



- Subclinical ketosis



Subclinical Ketosis

- Increased risk of displaced abomasa and metritis
  - Duffield et al., 2009; Ospina et al., 2010
- Decrease milk yield in early lactation
  - Dohoo and Martin, 1984; Ospina et al., 2010
- Lactation incidence widely variable ~40%
  - Compared to 2 to 15% found with clinical ketosis

Purpose of Observational Study

- Describe the epidemiology of SCK
- Time of onset
- BHBA concentration at onset
  - Displaced abomasum (DA)
  - Removal from herd
  - Reproduction
  - Milk yield

Precision Xtra® Ketone System

- Requires 1.5 µl of whole blood
- Result in 10 seconds
- 1€ per test

- Compared to serum BHBA
  - Sensitivity: 88 – 96%
  - Specificity: 96 – 98%
  - Iwersen et al., 2009; Konkol et al., AABP 2009

Study Herds

- Two free-stall dairies in NY
  - Farm A: 41.8 kg milk (1900 cows)
  - Farm B: 41.8 kg milk (1825 cows)
- Two free-stall dairies in WI
  - Farm C: 39.1 kg milk (2800 cows)
  - Farm D: 35.0 kg milk (4100 cows)

Study Design

- Data collected from May - August, 2010
- Cows tested 6 times between 3 – 16 DIM
  - M, W, F testing
- Subclinical ketosis 1.2 – 2.9 mmol/L

Statistical Analysis

- Poisson regression
  - DA
  - Removal from herd
  - Conception to 1st service
- Semiparametric proportional hazards model
  - Median time to resolution
- Repeated measures ANOVA
  - Milk weights

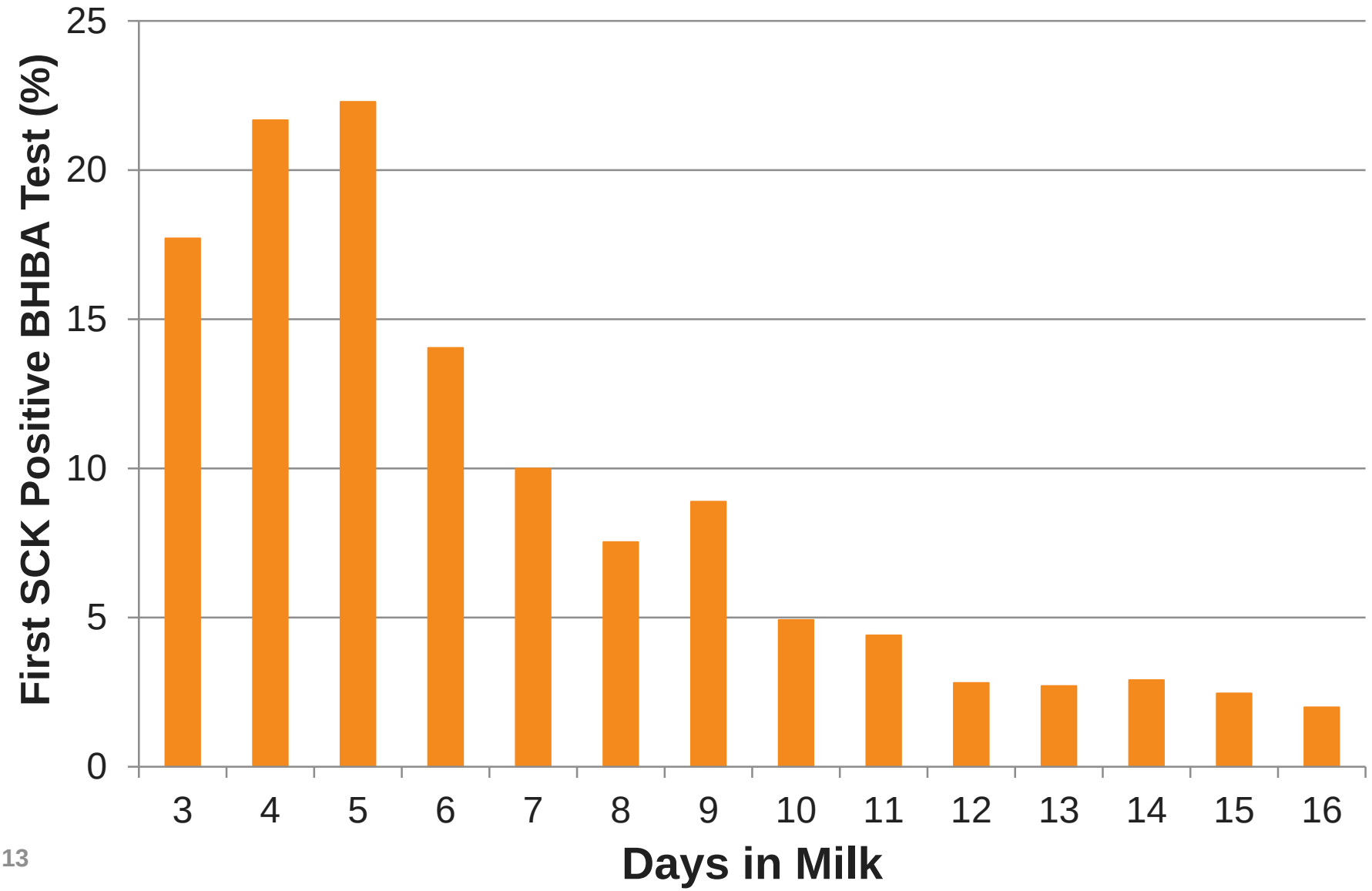
Cow Enrollment

- 2115 cows enrolled
  - Removed from analysis
    - Gestation length < 260 d
    - Died/sold
    - Farm ketosis treatment
    - Improper identification
    - Fewer than 5 tests
- 1717 cows in final analysis
  - 976 non-ketotic cows
  - 741 ketotic cows

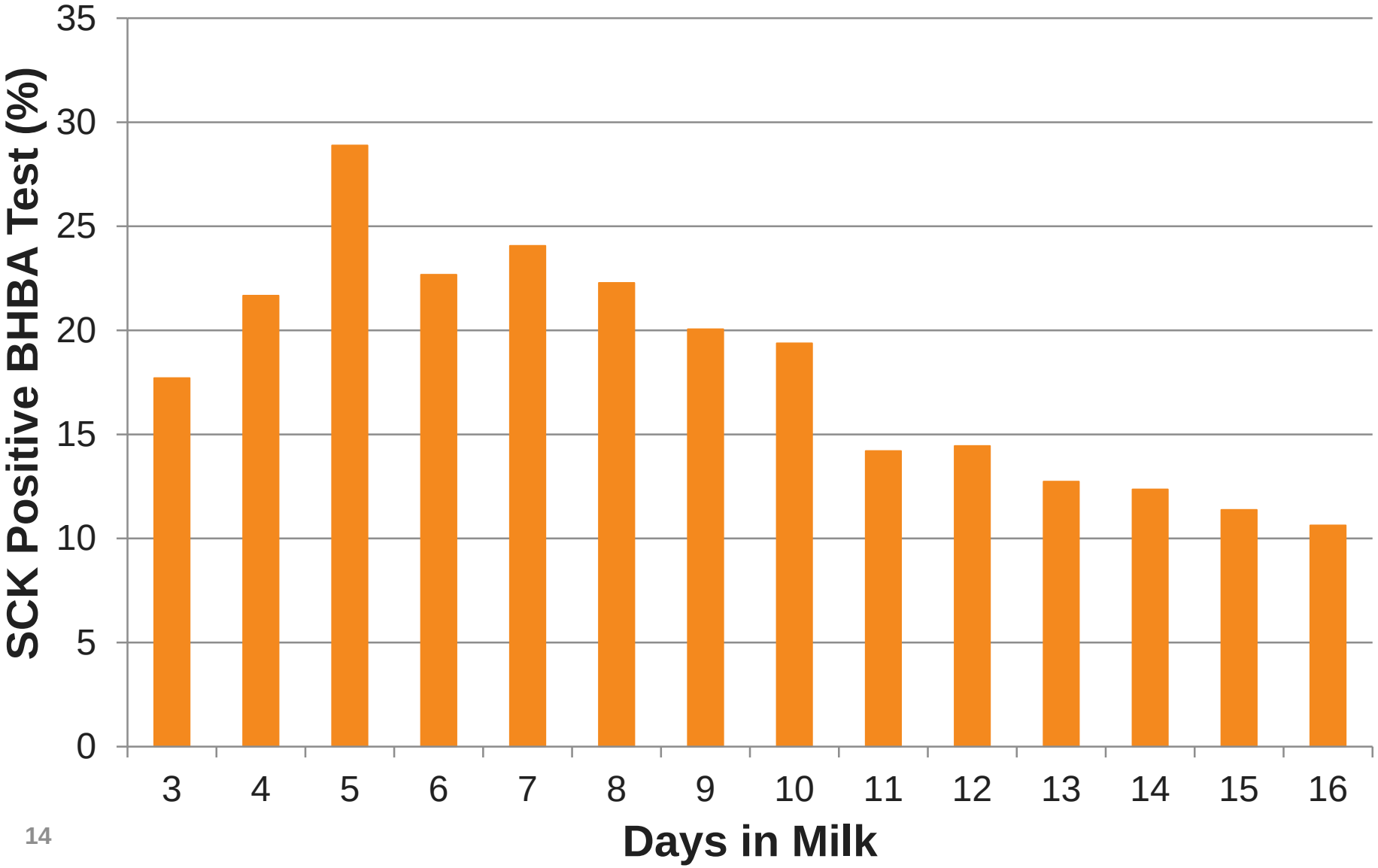
Subclinical Ketosis Incidence

Herd	Location	Cows	SCK (%)
A	NY	354	40.4
B	NY	402	26.4
C	WI	291	40.9
D	WI	670	55.7
All	---	1717	43.2

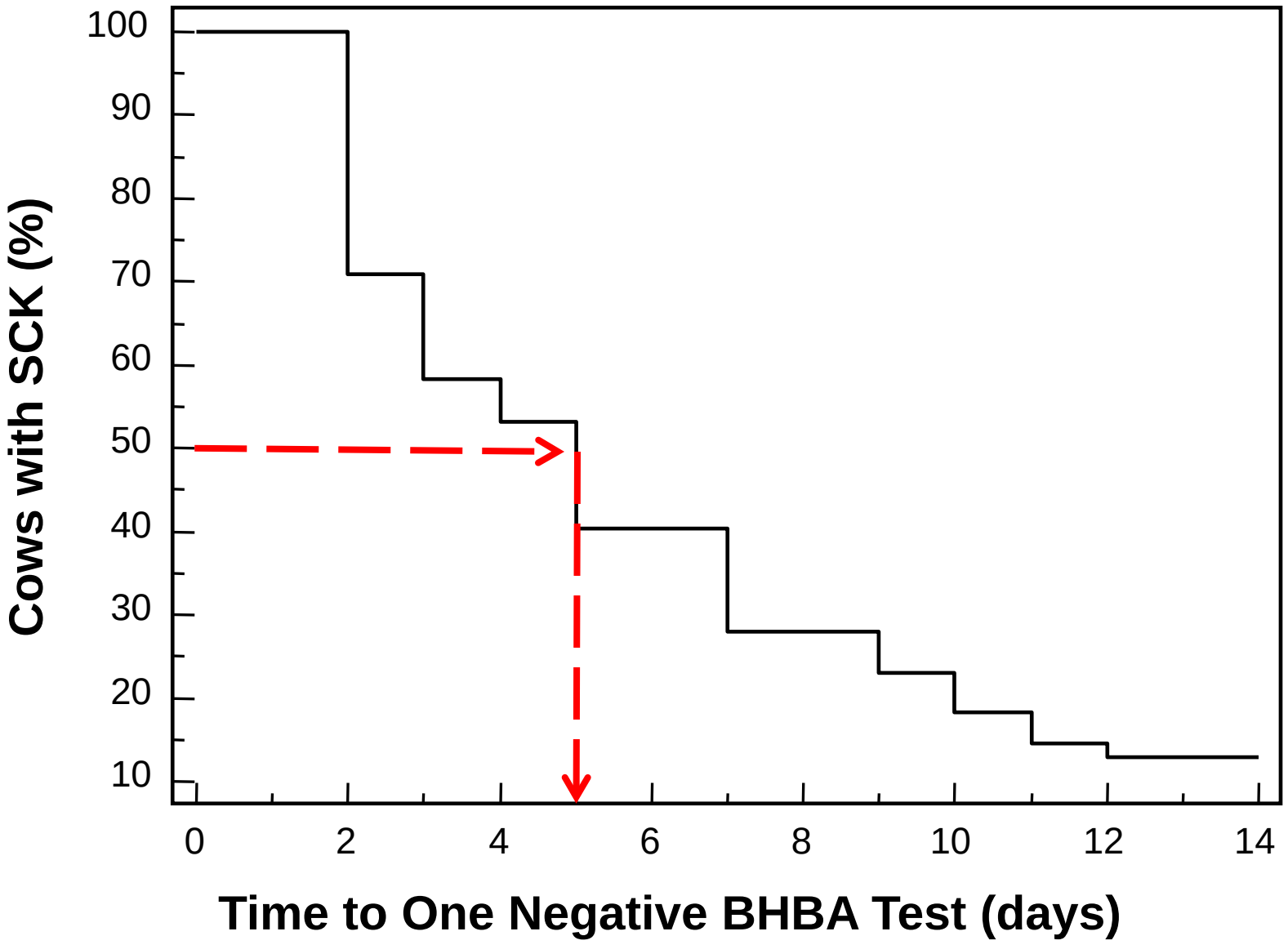
Incidence of SCK by DIM



Prevalence of SCK by DIM

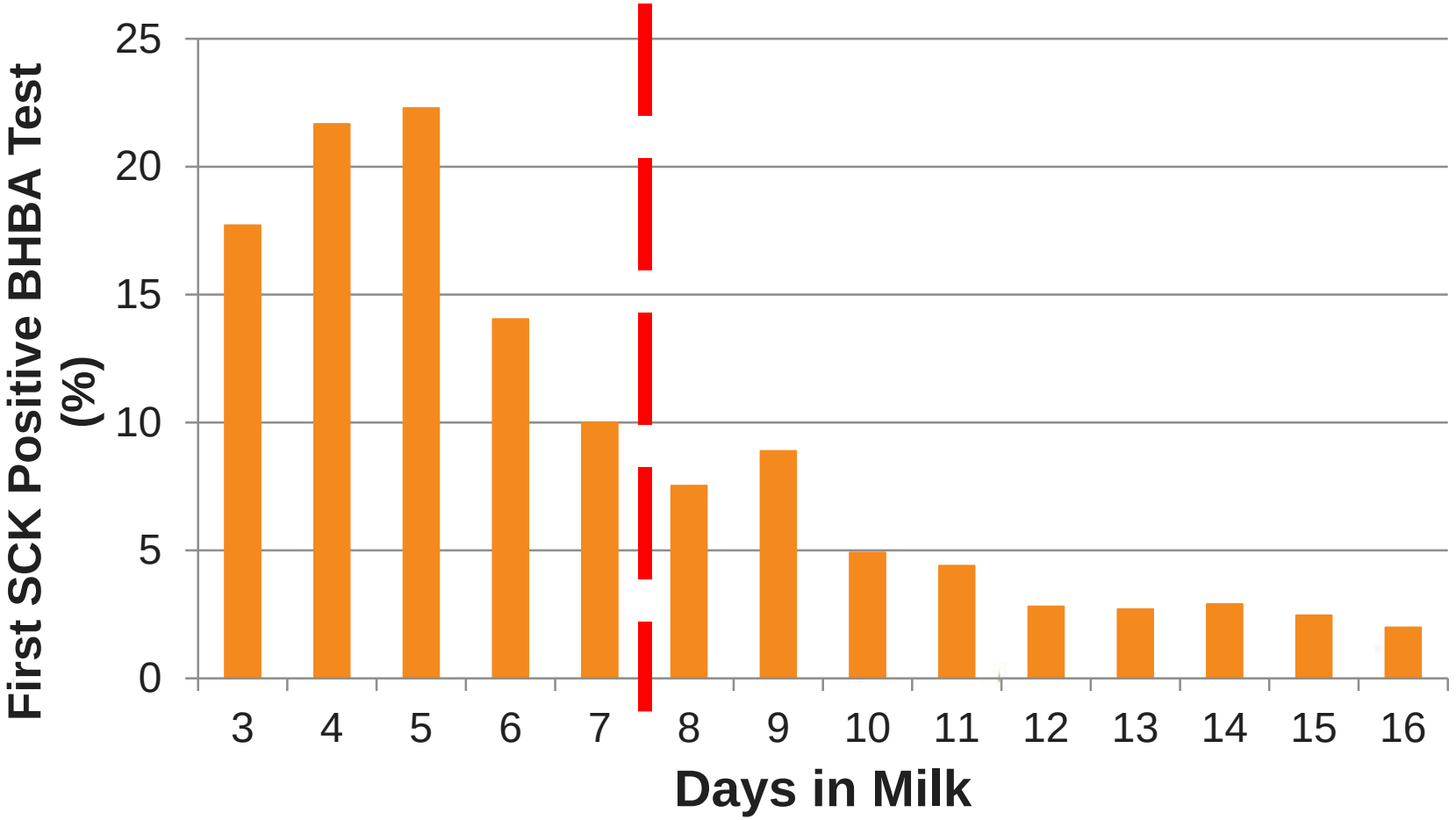


Median Time to Resolution



Association of DIM at Onset

- Compared cows first SCK positive from 3 to 7 DIM with cows first positive from 8 to 16 DIM



Association of DIM at Onset

- Compared cows first SCK positive from 3 to 7 DIM with cows first positive from 8 to 16 DIM

Outcome	Response	95% CI[1]	*P*-value
DA[2]	RR[3] = 6.1	2.3 to 16.0	< 0.001

[1] CI = Confidence interval
[2] DA outcome tested between cows first positive from 3 to 5 DIM versus 6 to 16 DIM
[3] RR = Risk ratio

Association of BHBA at Onset

- Each 0.1 mmol/L increase in BHBA concentration:

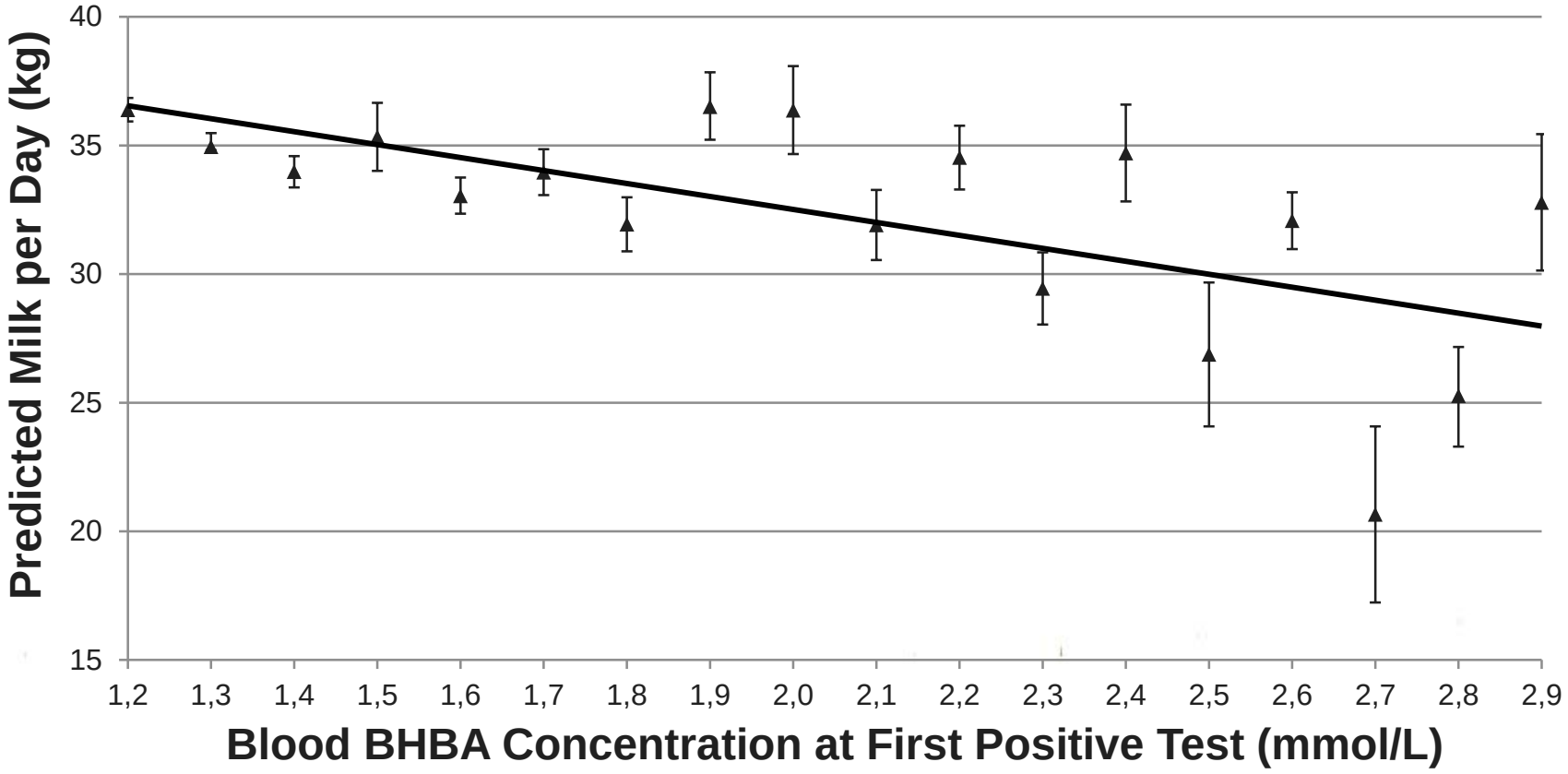
Outcome	Risk Ratio	95% CI	*P*-value
DA	1.1	1.0 to 1.2	0.002
Early removal	1.4	1.1 to 1.8	0.01

  - e.g. 1.2 mmol/L vs. 2.4 mmol/L:
    - 3.1 times more likely to develop a DA (1.1^{12})
    - 56.7 times more likely to be removed from the herd (1.4^{12})

- No difference in conception to 1st service

Association of BHBA at Onset

- Each 0.1 mmol/L increase in BHBA concentration:
  - Associated with a 0.5 kg per day decrease in milk ($P < 0.001$)



Conclusions

1) SCK occurs early in lactation!

2) Cows that develop SCK within 7 DIM are at a much higher risk for adverse events.

3) This risk increases as the BHBA concentration at first positive test increases.

Acknowledgements

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