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TvK CalfLab

ORAL TEMPERATURE AS AN INDICATOR OF FEVER IN PRE-WEANED DAIRY CALVES

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INTRODUCTION:

Change in core body temperature can be an early indicator of disease, but manually assessing individual calf health via rectal temperature is limited on commercial farms, and well validated sensors for estimating body temperature are not currently available.

Objectives:

1. Explore the potential of oral temperature (OT) in detecting fever and disease in dairy calves.

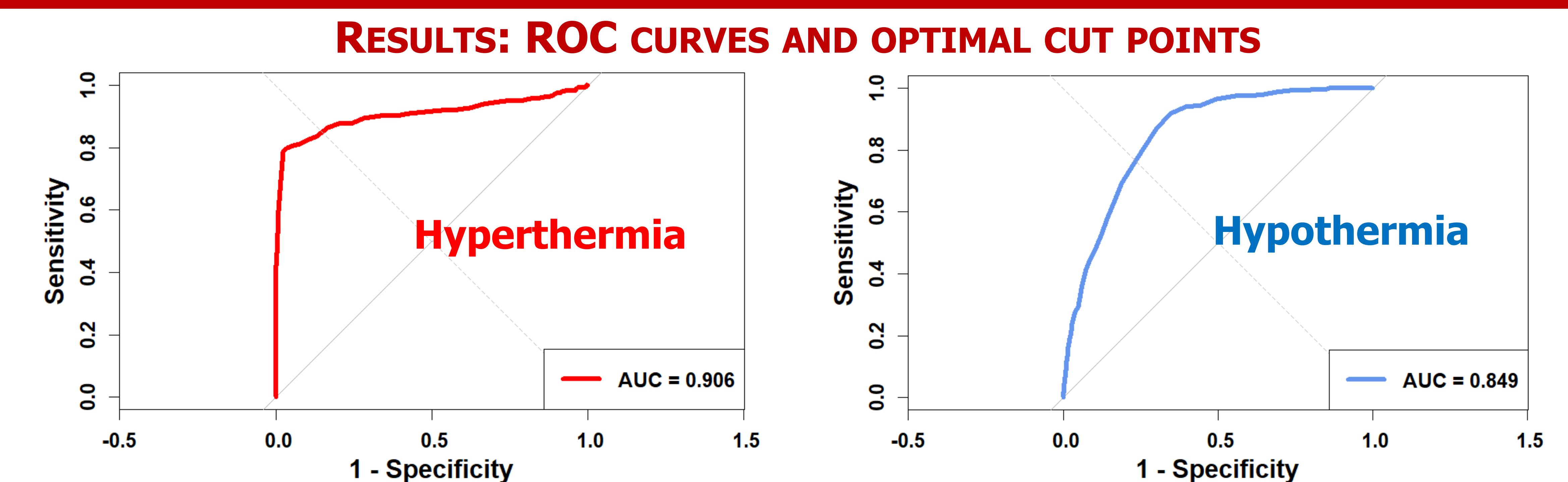2. Inform novel health monitoring sensor design.

METHODS:

- 150 neonatal Holstein replacement heifers at 1 NY herd from February - May. Enrolled at birth, followed through 28 days of life.

- Observations on 1, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26 and 28 days of life. OT and Rectal Temperature (RT) were measured via digital probe thermometers [OT: 10cm (4"); RT: 5cm (2")]

- Health scores were collected via the UW Madison Calf Health Scoring App.
  - Scores on 0-3 scale (0 = healthy; 3 = severe)
  - Disease defined as ≥ 2

- ROC Curves were generated to determine normal ranges for OT based on RT.

- Generalized linear models (GLM) were used to assess the correlation values of OT and RT.

- Multinomial logistic regression models were used to evaluate health outcomes.

Study Limitations:

- Effects of treatment (NSAIDS) on body temperature not yet explored

- Most observations occurred at below thermoneutral environmental conditions.

Oral temperature detects fever in neonatal dairy calves.

Extreme oral temperatures are associated with disease.

RESULTS: OT – RT Correlation

Body Temperature

R = 0.7481.
R-squared = 0.56

Figure: Plot of Linear Regression of OT and RT.

RESULTS: HEALTH EVENTS

Fecal Scores — Total Respiratory Scores

Day of Life

0 | 1 | 2 | 3 | 4+

Figure: Major Health Outcome Frequencies by Age: Fecal Scores and Sum of Respiratory Scores (Eye + Nose + Cough).

Bovine Respiratory Disease

OT Range	RR	p-value	95% CI 2.5	97.5
NORMAL	0.34	<0.001	0.29	0.38
LOW (<38.2C)	0.71	0.007	0.56	0.91
HIGH (>39.1C)	3.53	<0.001	2.62	4.75

Neonatal Calf Diarrhea

OT Range	RR	p-value	95% CI 2.5	97.5
NORMAL	0.42	<0.001	0.37	0.48
LOW (<38.2C)	1.38	<0.001	1.12	1.71
HIGH (>39.1C)	1.4	0.03	1.04	1.9

Figure: Multinomial Logistic Regression Models of Health Outcomes based on OT Range

RESULTS: ROC CURVES AND OPTIMAL CUT POINTS

Hyperthermia — AUC = 0.906

Hypothermia — AUC = 0.849

Body Temperature Status	(F)	OT Cut-points	N	Se	Sp	PPV	NPV	AUC	AUC 95%CI
Hyperthermia (RT>39.5C)	103.1	39.1C (102.4F)	234	0.79	0.98	0.80	0.97	0.906	(0.877, 0.936)
Hypothermia (RT<38.4C)	101.1	38.2C (100.7F)	467	0.75	0.77	0.49	0.92	0.849	(0.832, 0.867)
Severe Hypothermia (RT<35.0C)	95.0	34.0C (93.2F)	3	1	0.99	0.5	1	1	(0.999, 1.001)

Figure: ROC Curves and cut point descriptions of OT detecting Hyperthermia, Hypothermia, and Severe Hypothermia.
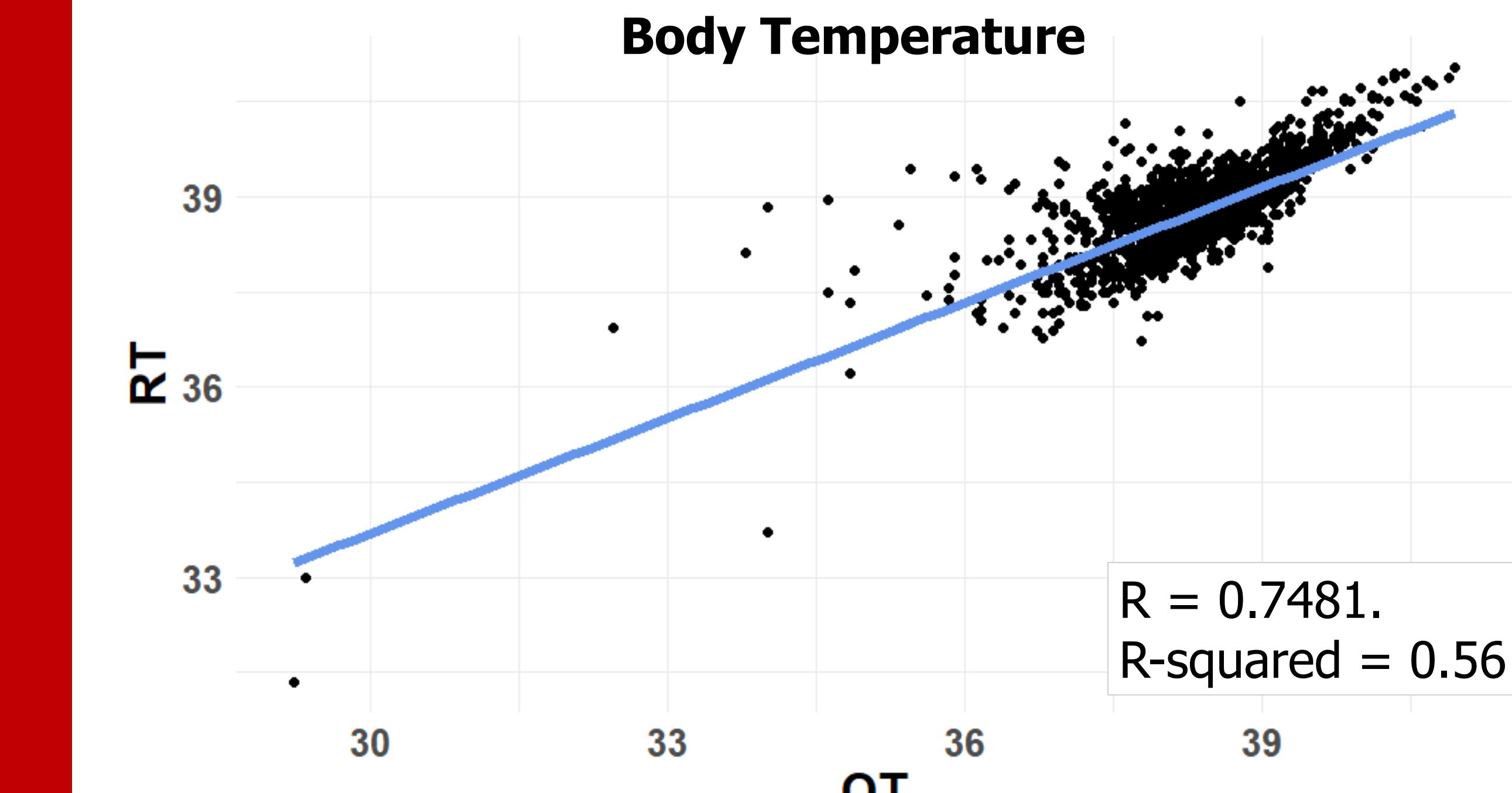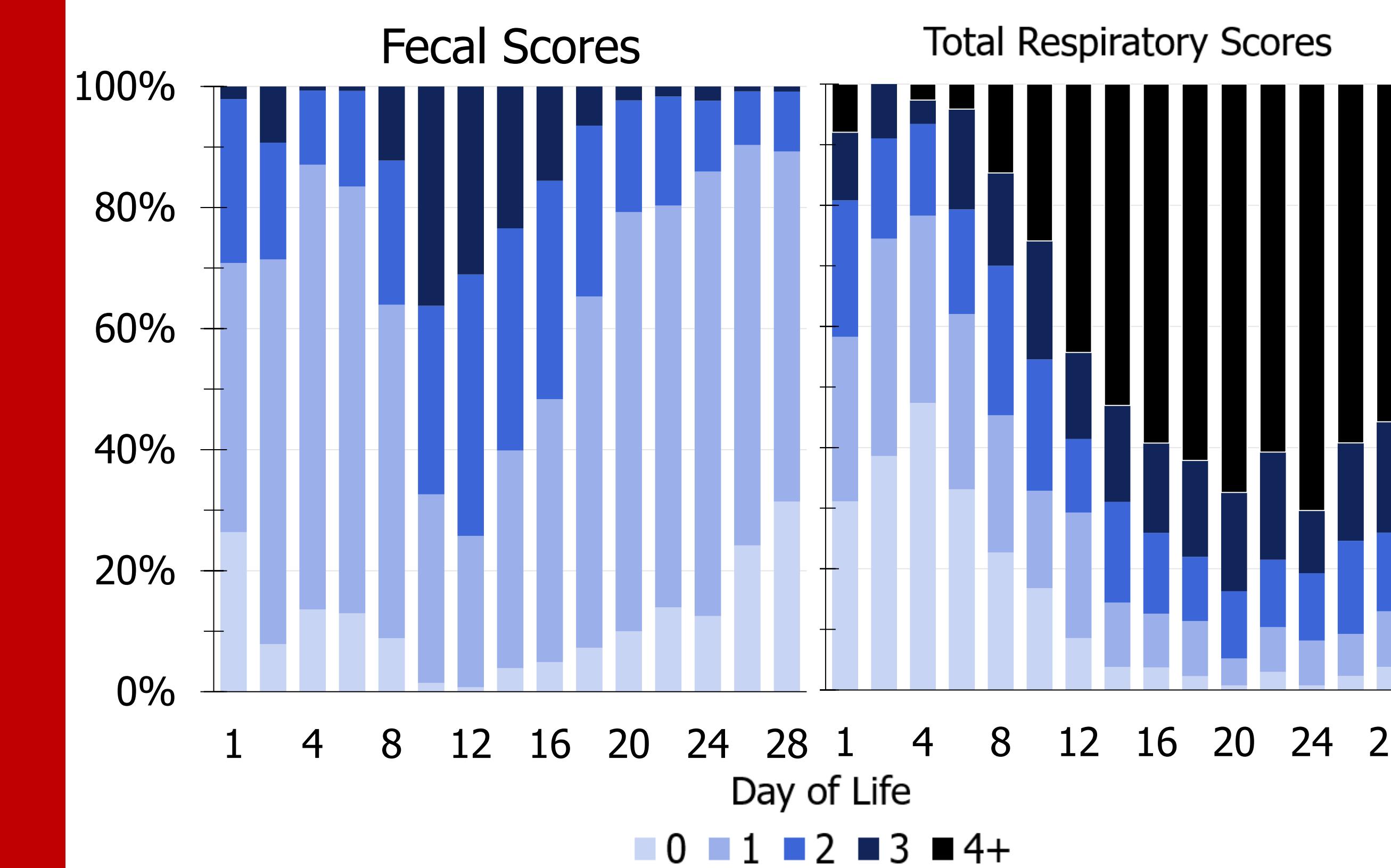
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