Dairyland Initiative
UNIVERSITY OF WISCONSIN–MADISON

Maximizing a Dairy Cow's Healthspan through Cow Comfort

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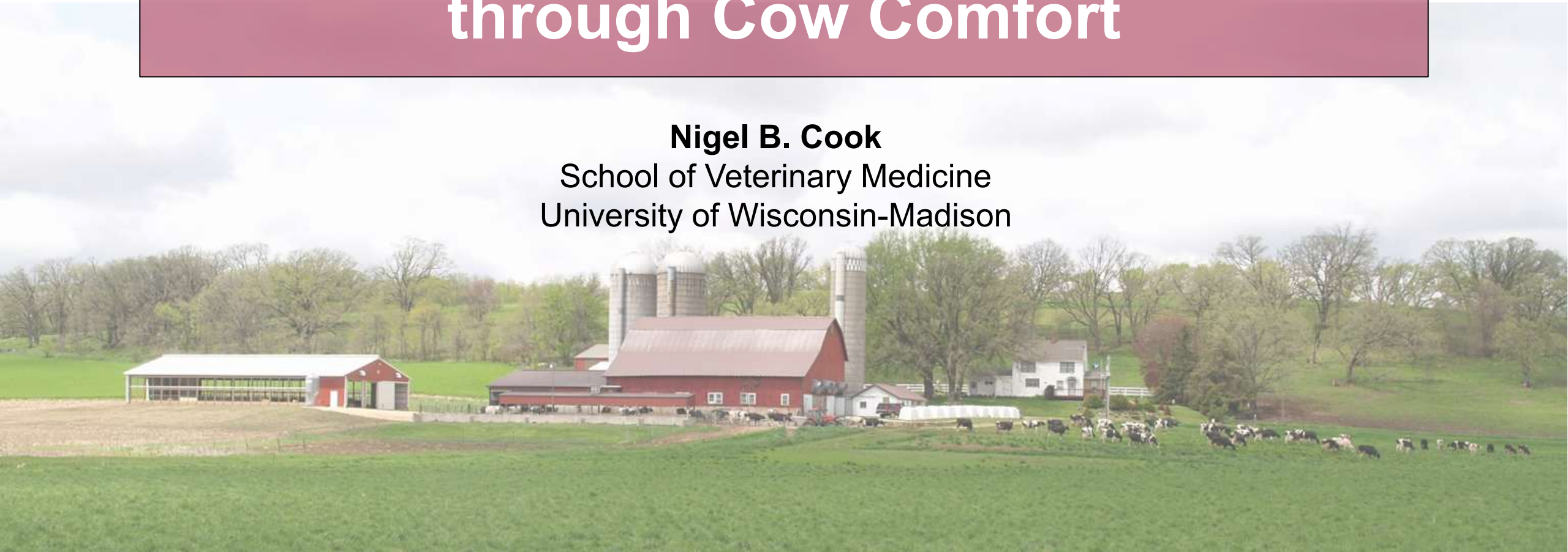
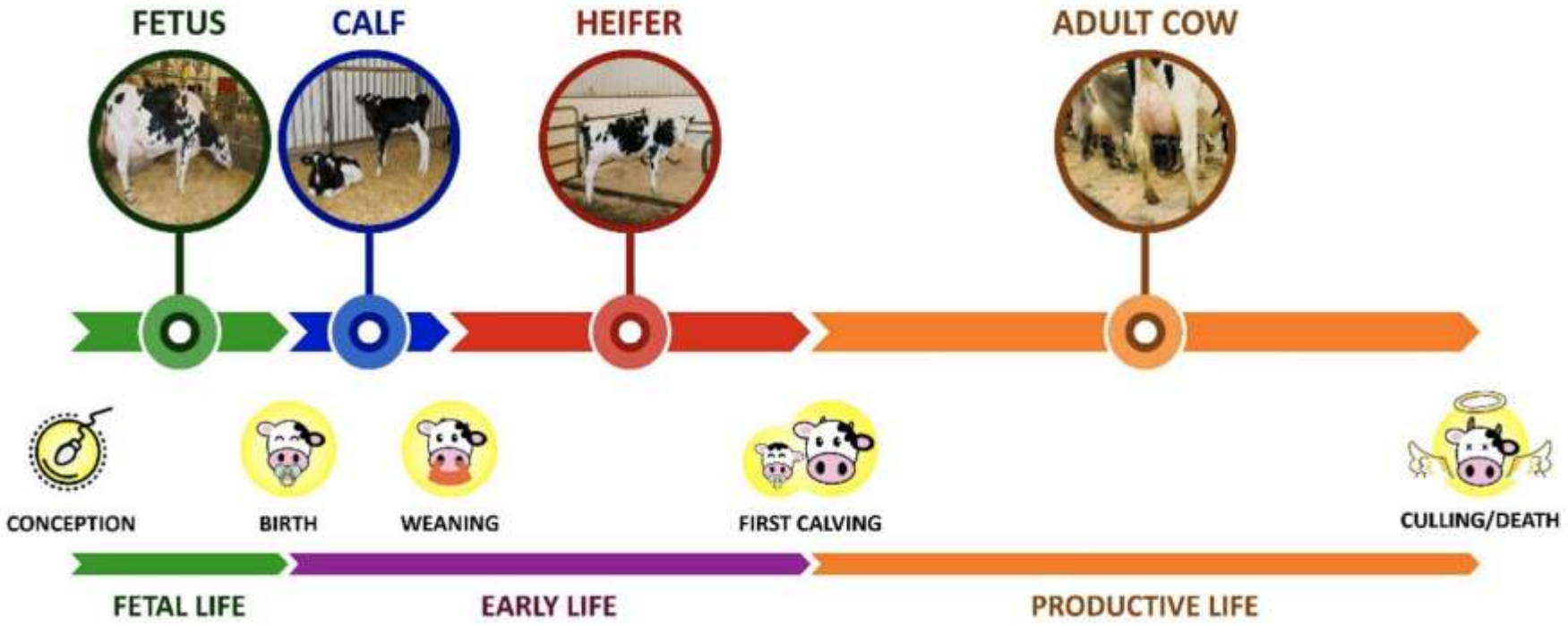
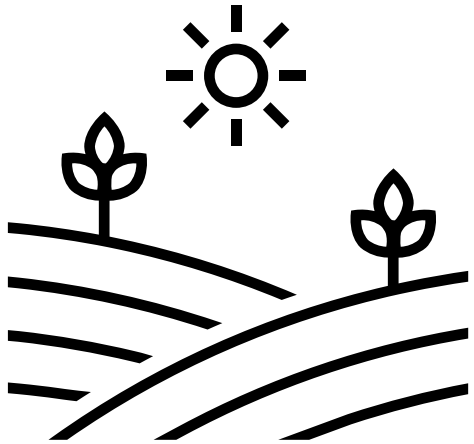


Productive Life …. longevity



‘An early first calving and a long productive life’

From Dallago et al., Animals 11:808, 2021



“Cows need to last 5 lactations!”

(mean herd turnover rate would be 20%)

(on average)

Cluster Analysis of DHI data from 557 Freestall Housed Dairy Herds

(Brotzman et al., J Dairy Sci 98:3059, 2015)

DHI Variable	Group 1 (n = 171)	Group 2 (n = 86)	Group 3 (n = 97)	Group 4 (n = 67)	Group 5 (n = 62)	Group 6 (n = 74)
Herd size, cows, lowest – highest	493^{b}	270^{e}	365^{cd}	270de	403^{bc}	1097^{a}
Milking freq., lowest – highest	3.0^{a}	2.0^{d}	2.9^{a}	2.2^{c}	2.8^{b}	3.0^{a}
% 1st Lactation, lowest – highest	38.4^{b}	38.1^{b}	38.6^{b}	38.0^{b}	37.8^{b}	43.8^{a}
Energy Corrected Milk, kg	41.7^{a}	39.4^{b}	40.0^{ab}	33.9^{d}	36.9^{c}	40.2^{ab}
Days In Milk	182.9^{c}	179.7^{c}	195.5^{a}	189.1^{b}	192.5^{ab}	181.8^{c}
Days Dry	59.4^{ab}	59.4^{ab}	54.7^{c}	60.7^{a}	60.8^{a}	57.0^{bc}
Age at 1st Calving	24.1^{d}	24.5^{dc}	25.3^{ab}	25.6^{a}	24.9^{bc}	23.4^{e}
Transition Cow Index, kg	207.8^{a}	236.1^{a}	-10.9^{b}	-171.8^{c}	-212.9^{c}	-13.9^{b}
Milk Peak Ratio	74.4^{c}	74.1^{c}	77.8^{a}	77.6^{a}	76.4^{ab}	74.9^{bc}
Linear Somatic Cell Score	2.2^{d}	2.3^{d}	2.6^{c}	3.0^{a}	2.8^{b}	2.7^{c}
% New Udder Infections	8.7^{c}	8.9^{c}	11.9^{b}	14.7^{a}	13.9^{a}	12.6^{b}
% Udder Infections 1st test	11.0^{e}	13.7^{d}	15.7^{c}	19.9^{a}	17.8^{b}	14.5^{cd}
% Dry Period Infection Cures	75.5^{a}	66.4^{b}	63.9^{b}	56.5^{c}	63.7^{b}	71.5^{a}
% Turnover Rate, Non-dairy	33.5^{b}	36.1^{b}	35.9^{b}	32.6^{b}	40.0^{a}	43.0^{a}
% Cows Died	5.7^{cd}	5.7^{cd}	6.3^{bc}	4.9^{d}	12.4^{a}	7.6^{b}
% Cows Died by 60 DIM	2.3^{bc}	2.7^{b}	2.4^{bc}	1.8^{c}	5.7^{a}	2.7^{b}

Turnover rate (and productive life) is a poor measure of health!

There are herds with lower turnover rates with great welfare and excellent health and productivity – they sell heifers or build another barn

There are herds with lower turnover rates with poor welfare and poor health, with mastitic high SCC and lame cows that have to be retained in the herd to maintain herd size – due to poor fertility and lack of replacements?

There are herds with higher turnover rates with good welfare and excellent health and productivity that support higher replacements rates though excellent fertility …

Key Performance Indicator Percentiles

(Data from herds recorded by AgSource Cooperative Services)

Monitor	2012 (n=3421)			2022 (n=1693)			Net Top 20%
	80th	50th	20th	80th	50th	20th	
Daily Milk kg	26	31	36	29	35	40	+4
% Fat	3.6	3.8	3.8	3.8	4.0	4.2	+0.4
% Protein	3.0	3.1	3.1	3.1	3.2	3.2	+0.1
Average Days in Milk	208	187	162	195	179	158	-4
Age at First Calving (months)	28	26	24	27	26	23	-1
Pregnancy Rate %	7	12	18	13	20	27	+9
Turnover rate (less dairy sales) %	44	36	27	44	36	27	0
Weighted Average SCC ‘000/ml	341	263	159	263	198	118	-41
Average Days Dry	68	61	51	66	60	52	+1
Transition Cow Index® kg	-345	-8	+325	-170	+154	+500	+175

Mean cow longevity is determined by breeding decisions and semen choice

Individual cow longevity is determined by healthspan!

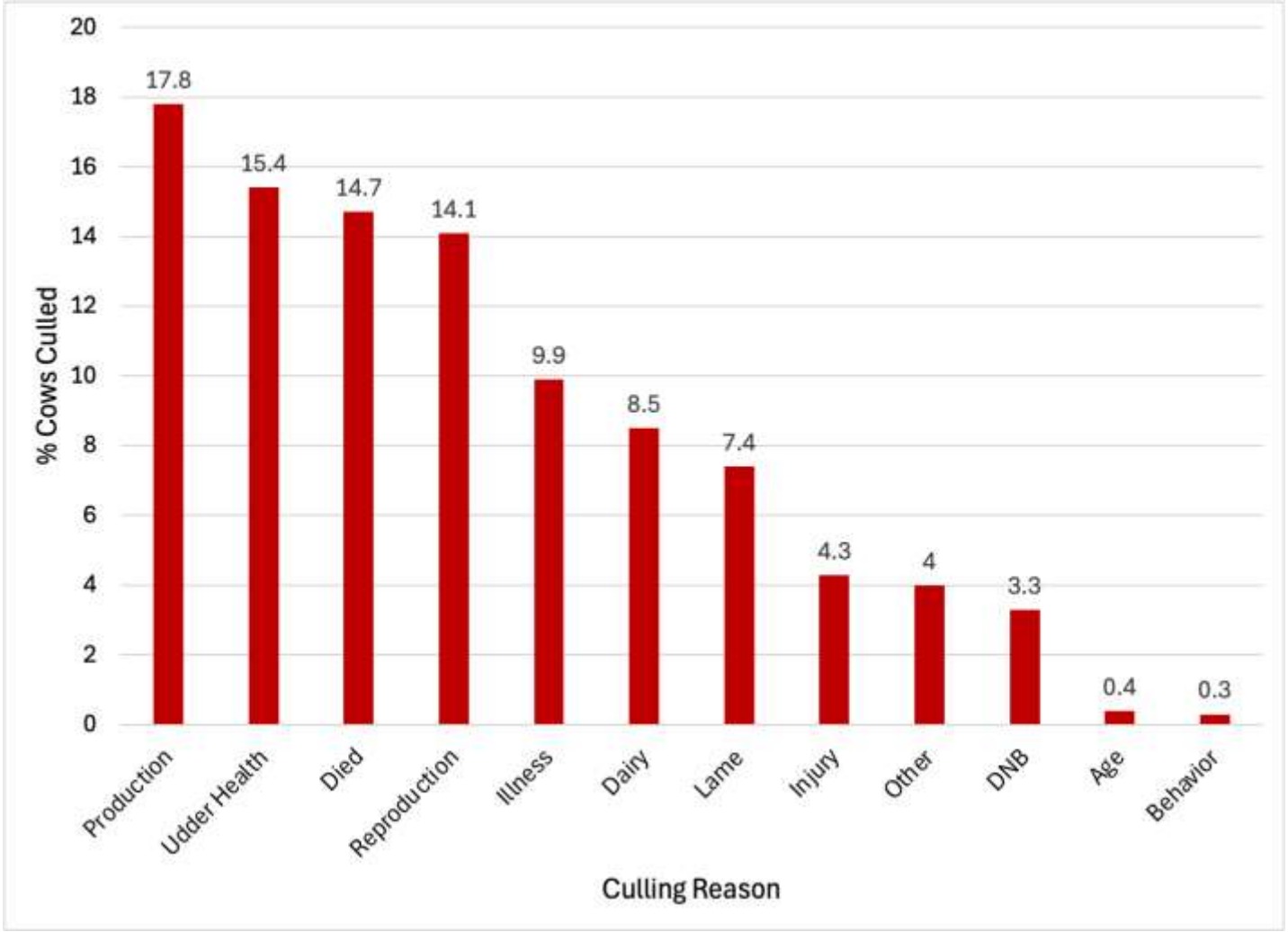
Healthspan vs Lifespan

- **Lifespan** = the total duration a cow lives, which should be driven by profitability
- **Healthspan** = the period of a cow's lifespan when she is in good health and free of illness or chronic conditions (which helps drive profitability!)

- Aim for healthspan = lifespan!

Farms should be held accountable to the quality of the animals leaving the herd, not the quantity

Wisconsin Dairy Herds – Reasons for Removal



Top reasons:
production, udder health, died, repro, illness and lameness

Died – top 3 reasons: illness, injury and ‘other’

8.5% dairy sales – high performance herds market cows to milk in other herds

From 46 WI dairy herds 86,151 culled cows (26% L1, 23% L2, 20% L3, 15% L4, 15% L5+)

How can we improve healthspan?

- Keep her resting!
- Keep her clean and dry!
- Keep her cool!

How can we improve healthspan?

- **Keep her resting!**
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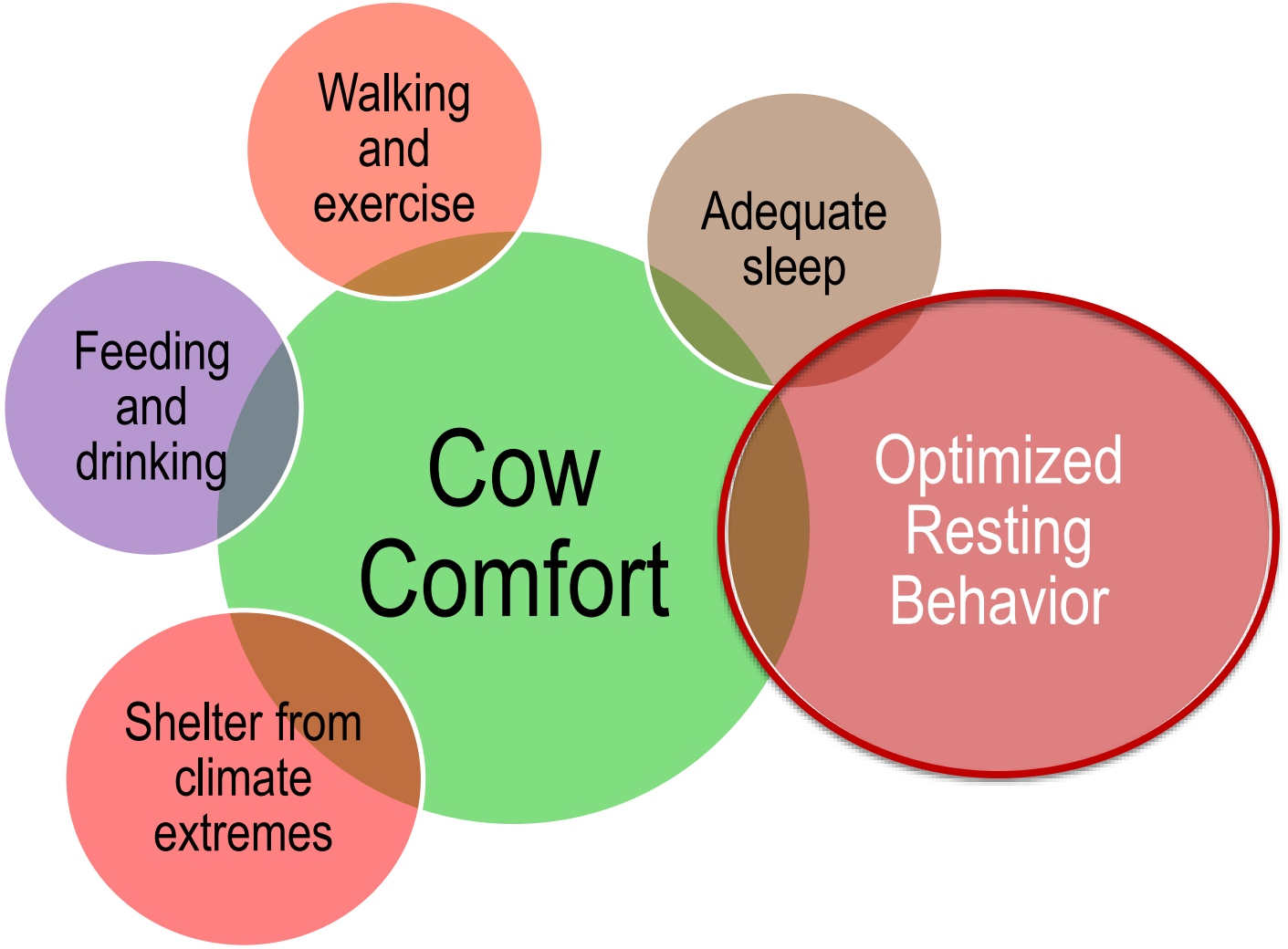
The Components of Cow Comfort



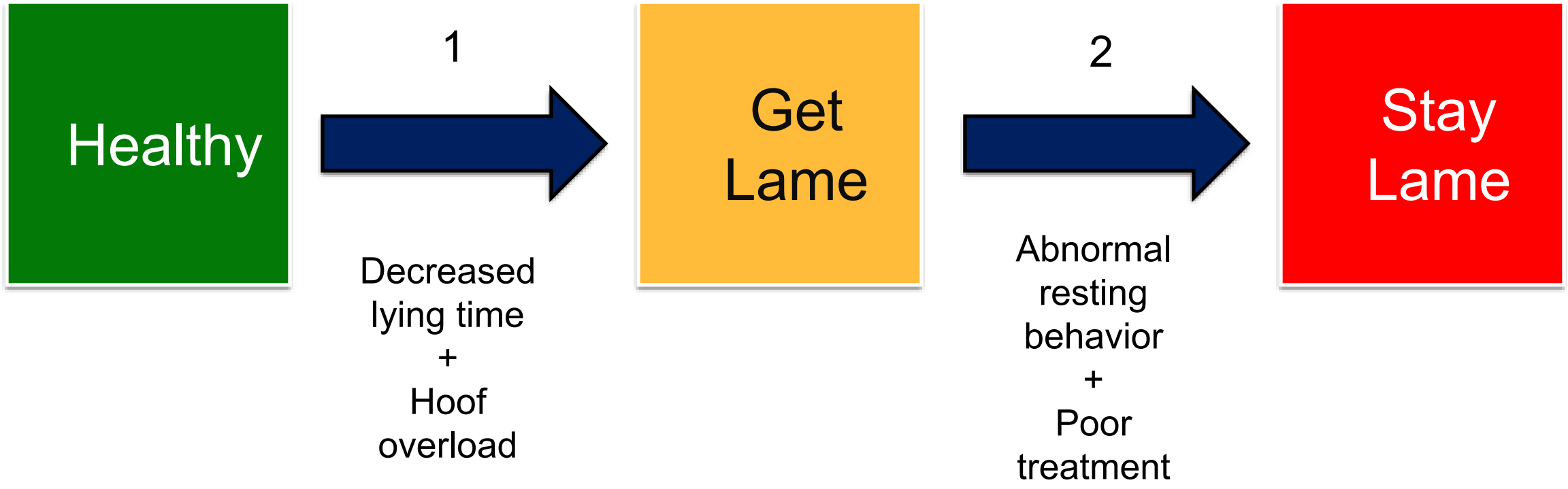
The Importance of Adequate Rest

- By preventing cattle from lying down, deprivation studies demonstrated that lack of rest resulted in:
  - Behavioral changes – signs of frustration:
    - Leg stomping, weight shifting, head swinging, standing without ruminating (Munksgaard et al., 1999 Cooper et al., 2007)
  - Physiological changes:
    - Reduced circulating levels of growth hormone (Munksgaard and Løvendahl, 1993)
    - Changes to the hypothalamo-pituitary adrenal axis (HPAA) (Munksgaard et al., 1999 Fisher et al., 2002)
    - Elevated baseline blood ACTH (Munksgaard and Simonsen, 1996)
    - Increases in pro-inflammatory cytokines (Proudfoot et al. 2021)

  - When allowed to recover, cows prioritized restoration of lost resting time over eating time (Metz 1985 Munksgaard et al., 2005 Cooper et al., 2007 Norring and Valros, 2016)

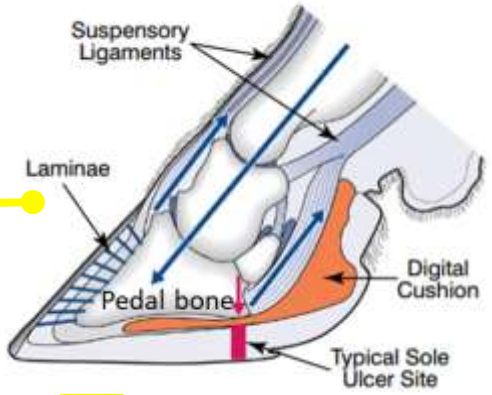
The most obvious manifestation of inadequate rest…..

Get Lame – Stay Lame:
The Dual Roles of Cow Comfort



Modified from Cook and Nordlund, 2009

Get Lame: Standing and hoof lesion development



~2 h/d increase in daily standing time increases risk for sole ulcer/hemorrhage

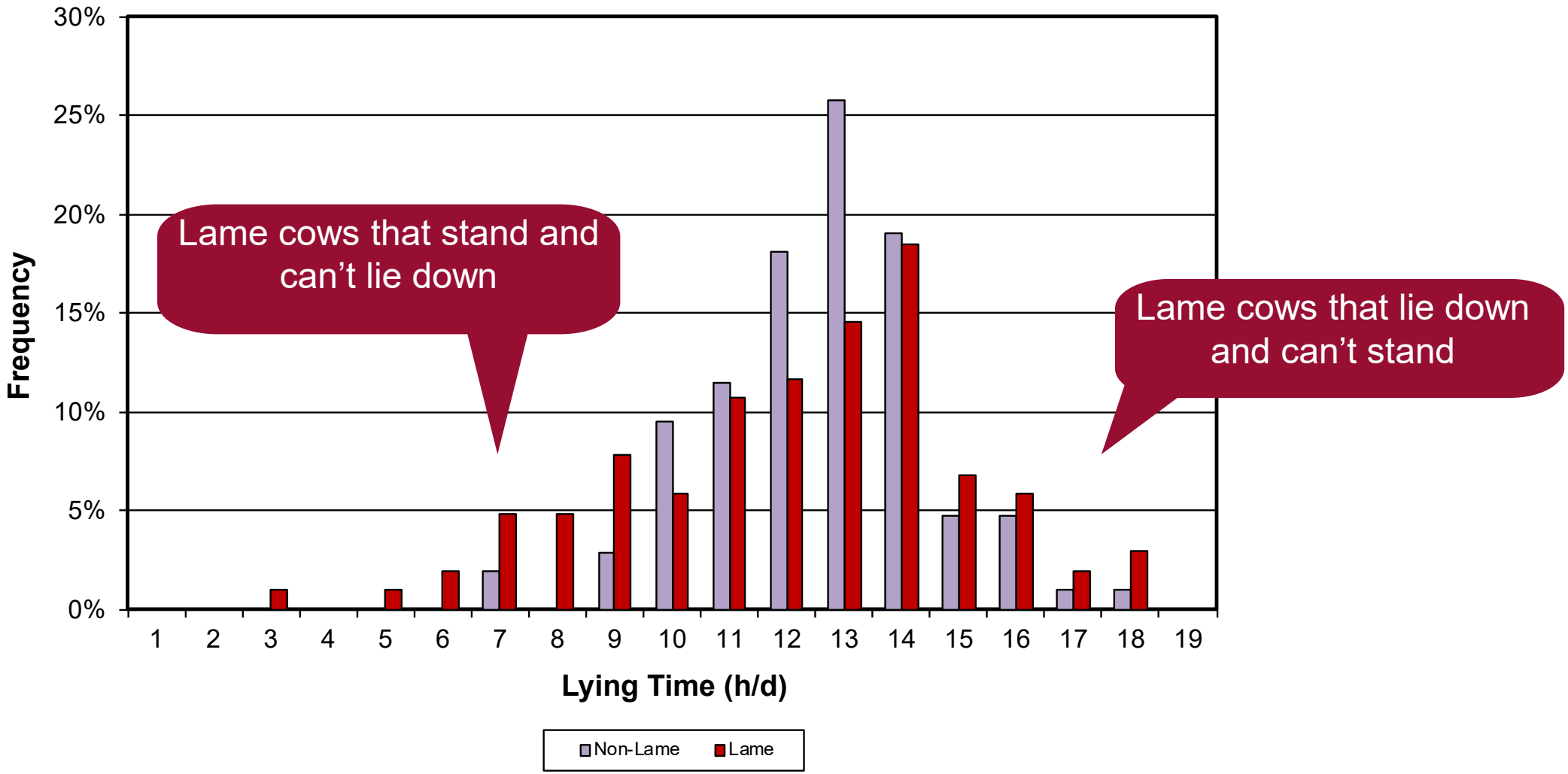
Increased standing time

Transition period

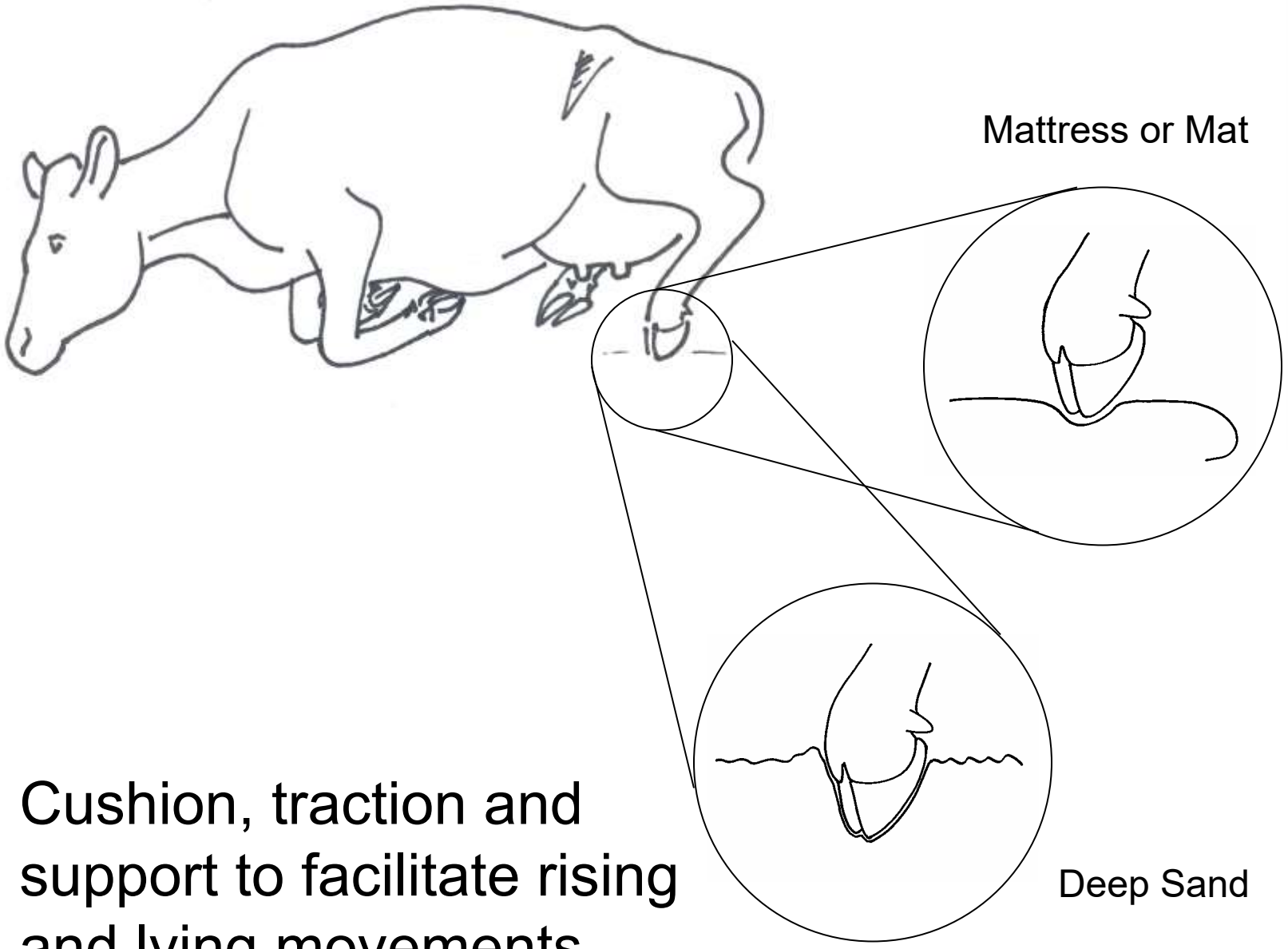
Hoof horn lesions

Chapinal et al., 2009; Proudfoot et al., 2010; Sepúlveda-Varas et al., 2014; Omontese et al., 2020; Eriksson et al., 2021

Effect of Lameness on Lying Time - Bidirectional

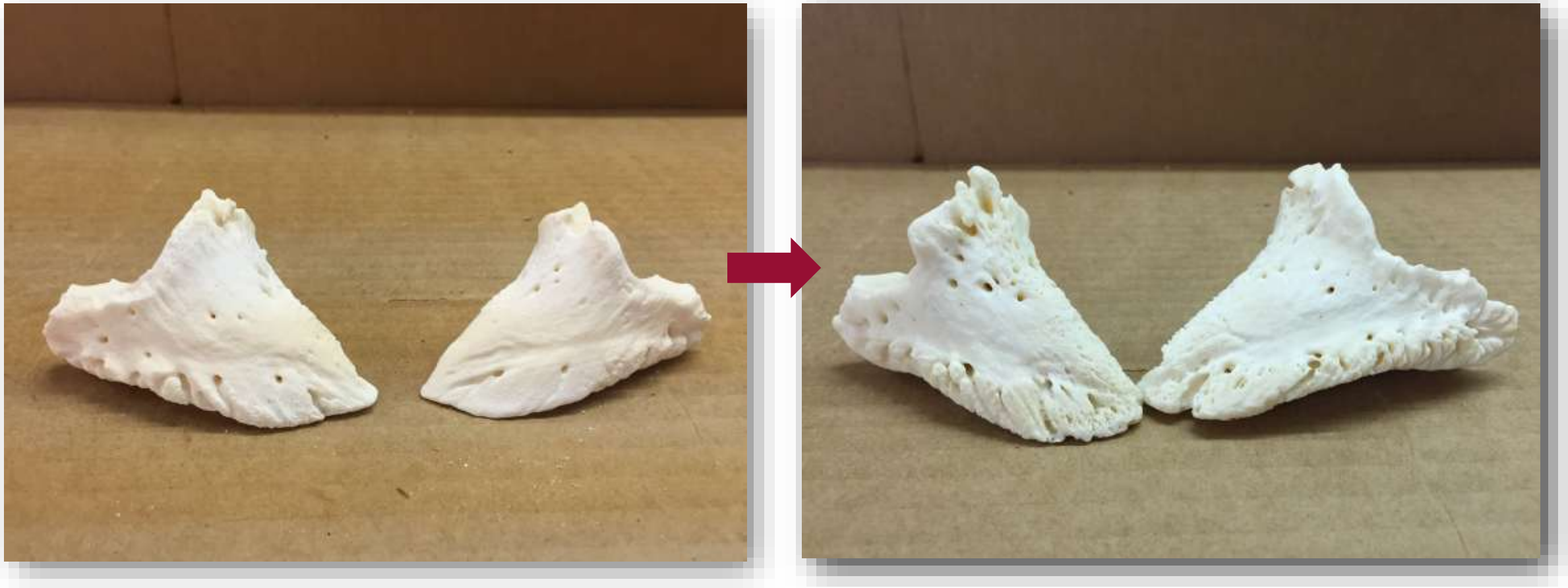


Gomez and Cook, JDS 93:5722, 2010



Cushion, traction and support to facilitate rising and lying movements

Stay Lame: Prior lameness increases risk of future lameness



~80% of lameness cases are attributable to a previous lameness event
A case of lameness lasts 2-5 wks longer in older cows versus 1st parity cows

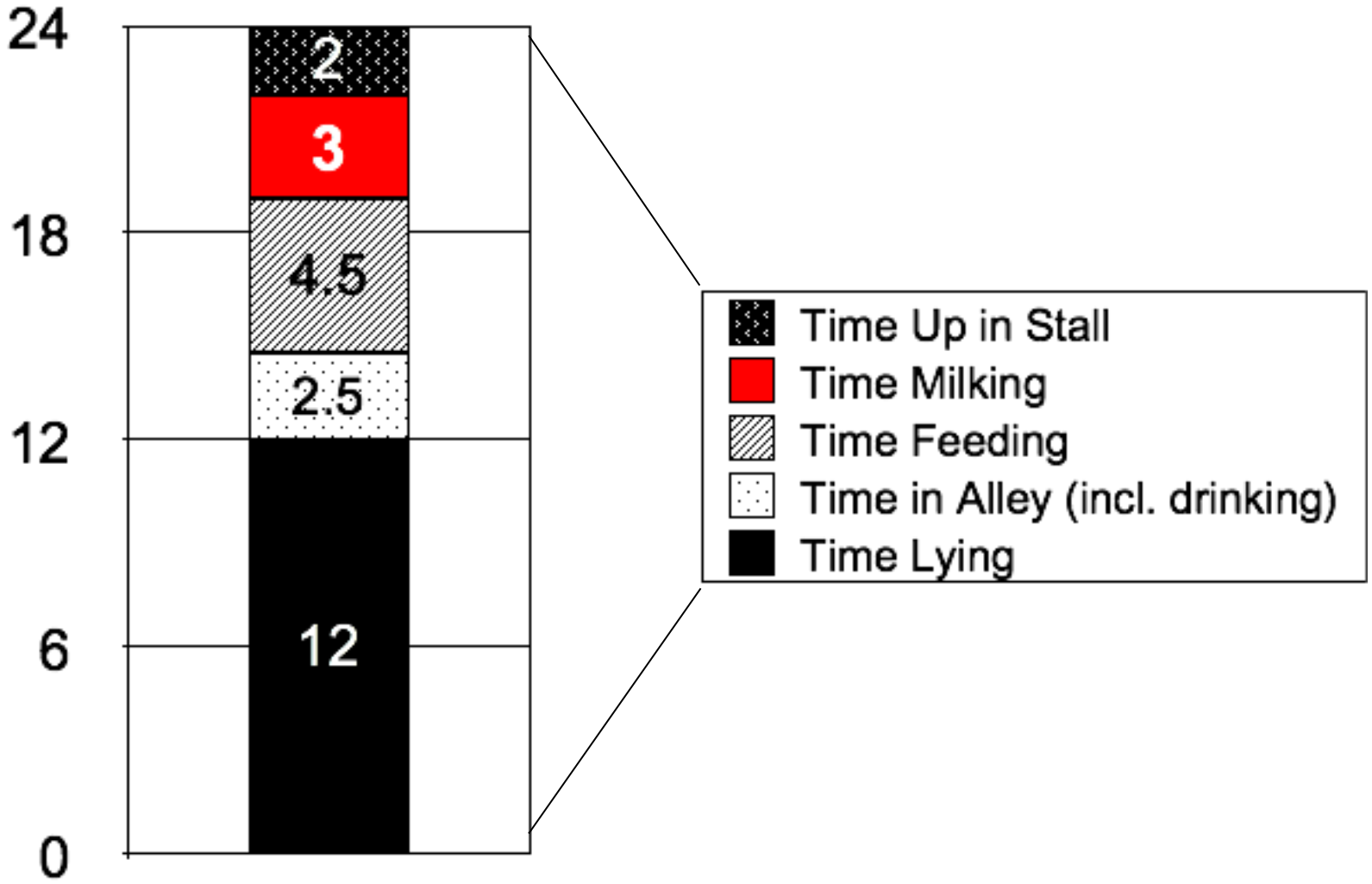
Newsome et al., 2016; Randall et al., 2018; Sahar et al., 2022

Cows need to rest when they want to, for as long as they need to …..

More isn't always better!

- Available time to rest
  - Minimize time milking
  - Minimize competition
- A comfortable resting place
- Minimize heat stress

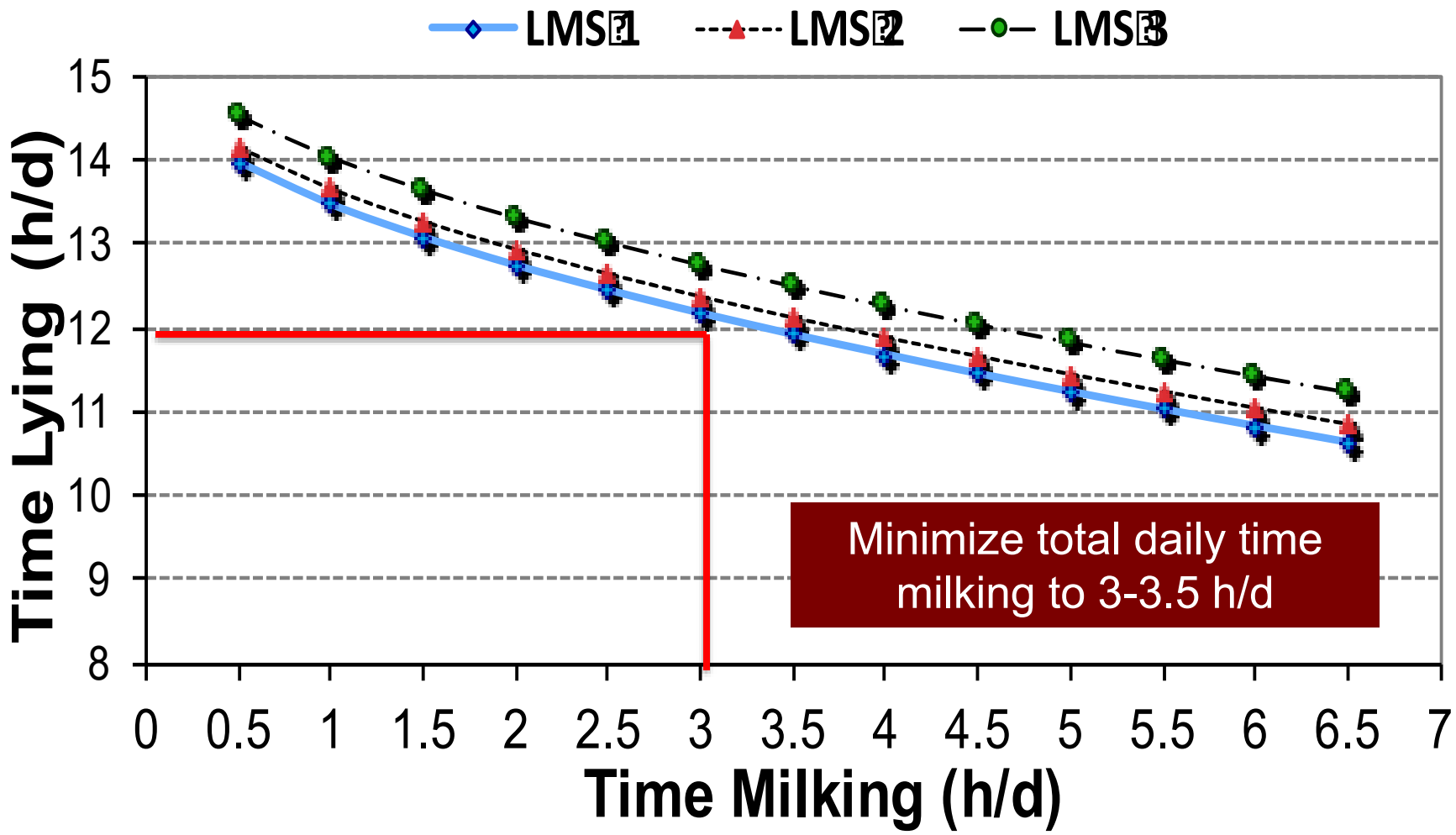
Time Budgets in Freestalls



Recommended target from 205 cows in 16 freestall barns from Gomez and Cook JDS 93:5772, 2010

The Impact of Milking Time on Lying Time

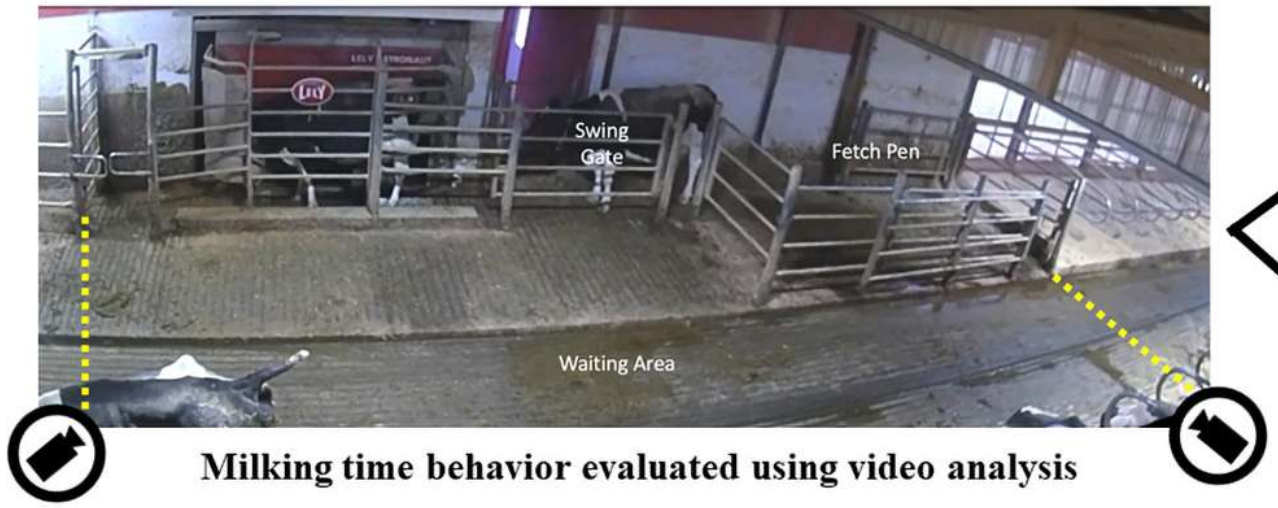
(Gomez and Cook, 2010 J Dairy Sci 93:5772)



Wait Time for Milking in a Free Flow Traffic System

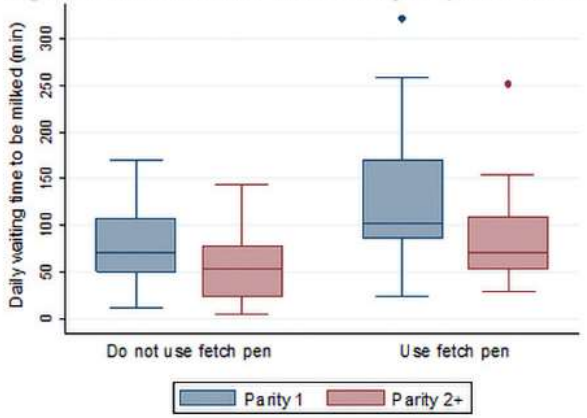
(Solano et al., 2022 JDS Communications 3:426)

Delimited waiting area for the free-flow robotic milking study herd

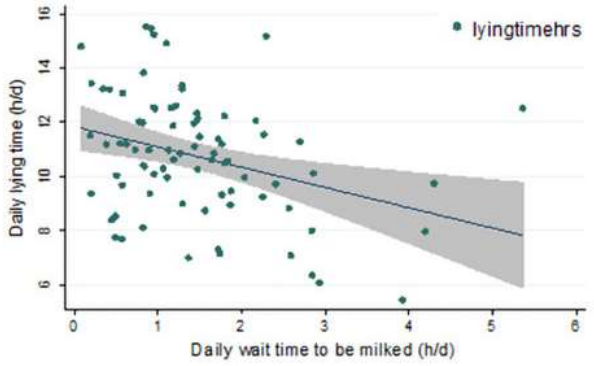


Milking time behavior evaluated using video analysis

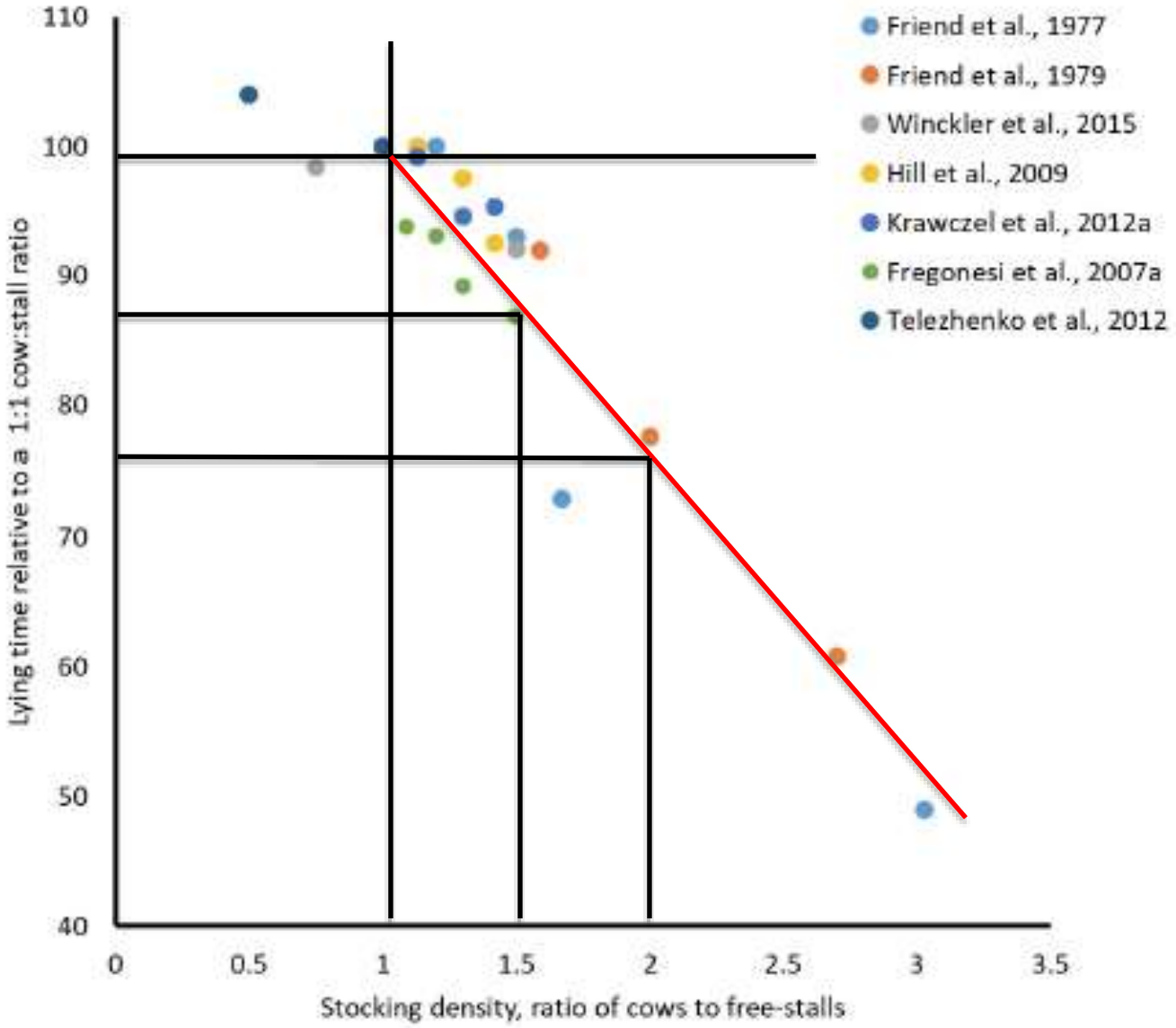
Waiting time was associated with DIM, parity, and voluntary use of fetch pen



Daily lying time decreased with increasing waiting time to be milked



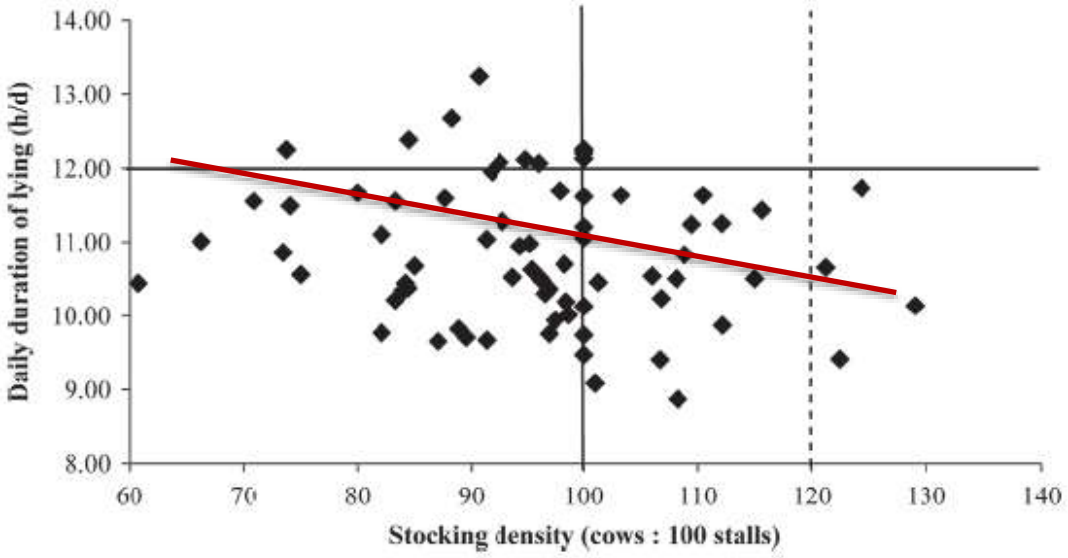
Overstocking and Reduction in Lying Time



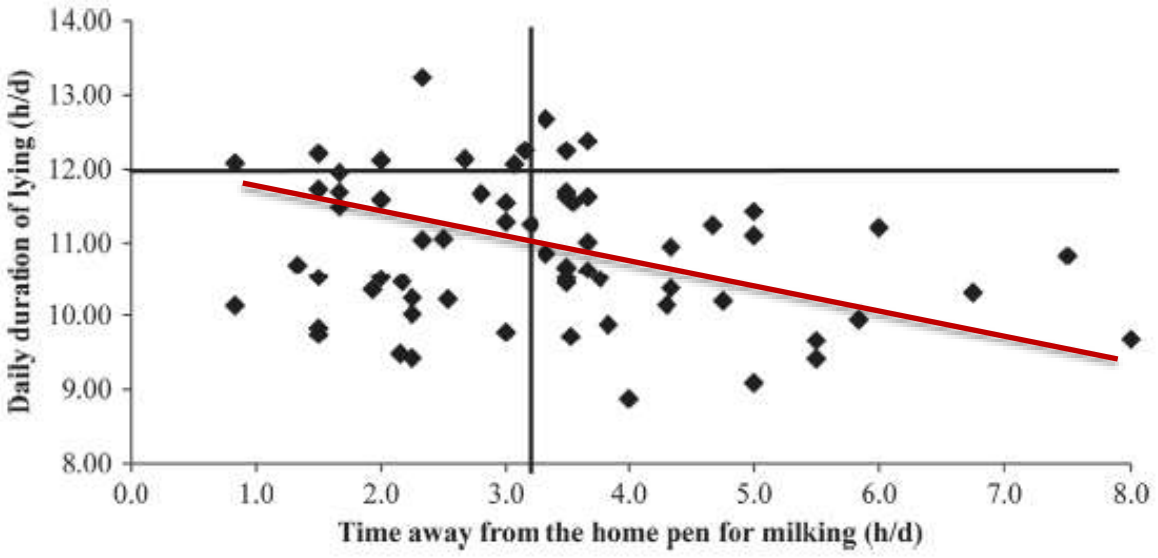
From Tucker et al., JDS 104:20, 2021

Stocking Density and Milking Time Thresholds

(Charlton et al., JDS 97:2694, 2014)

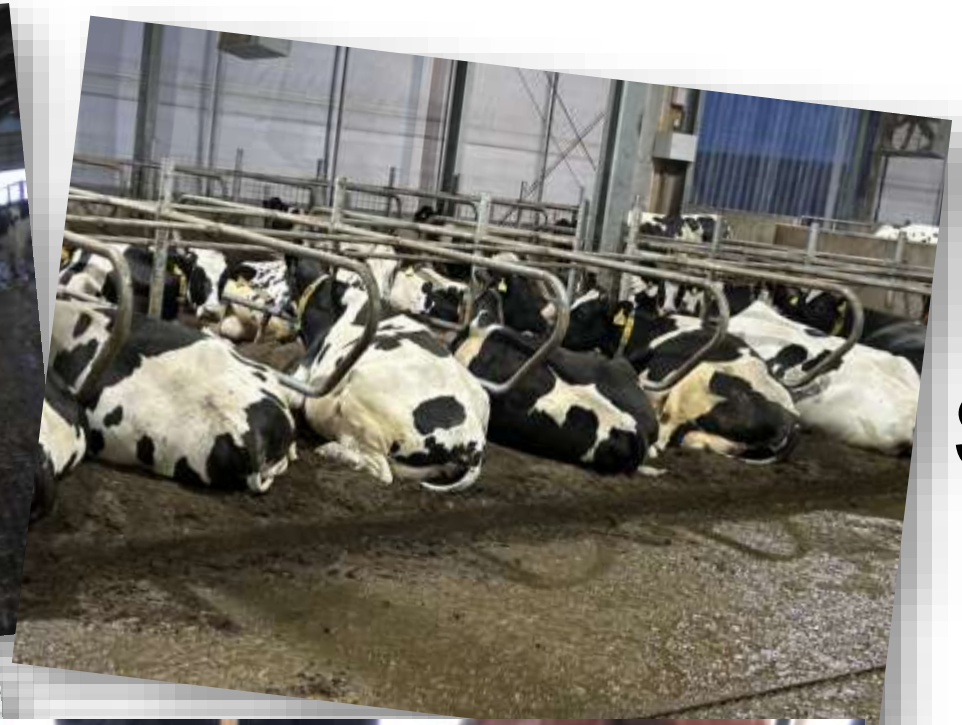


Target 1 cow per stall



Target <3.5 h/d out of the pen milking

Data from 111 Canadian freestall herds

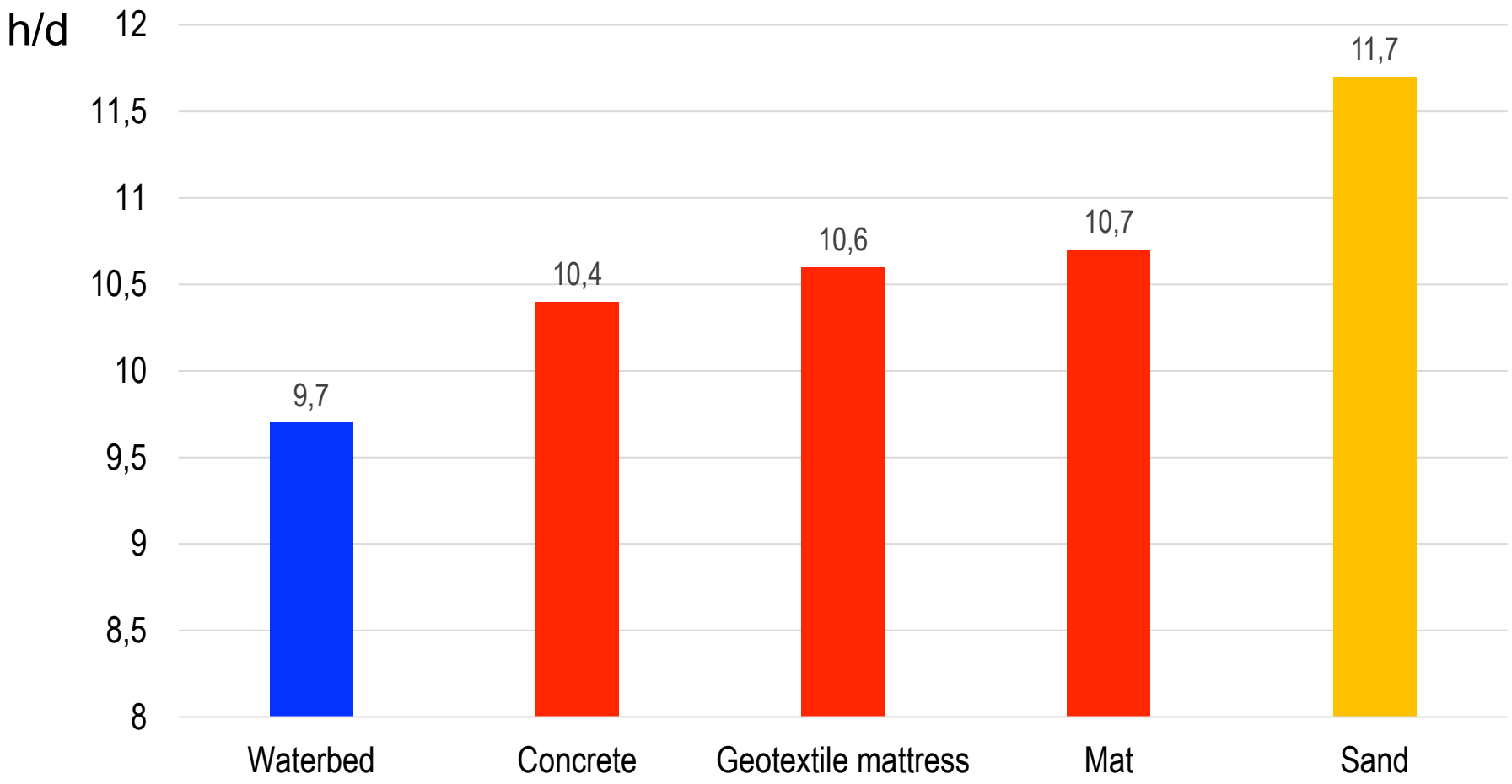


Surface is #1!

Sand
Manure solids
Sawdust
Straw/Lime
Peat moss

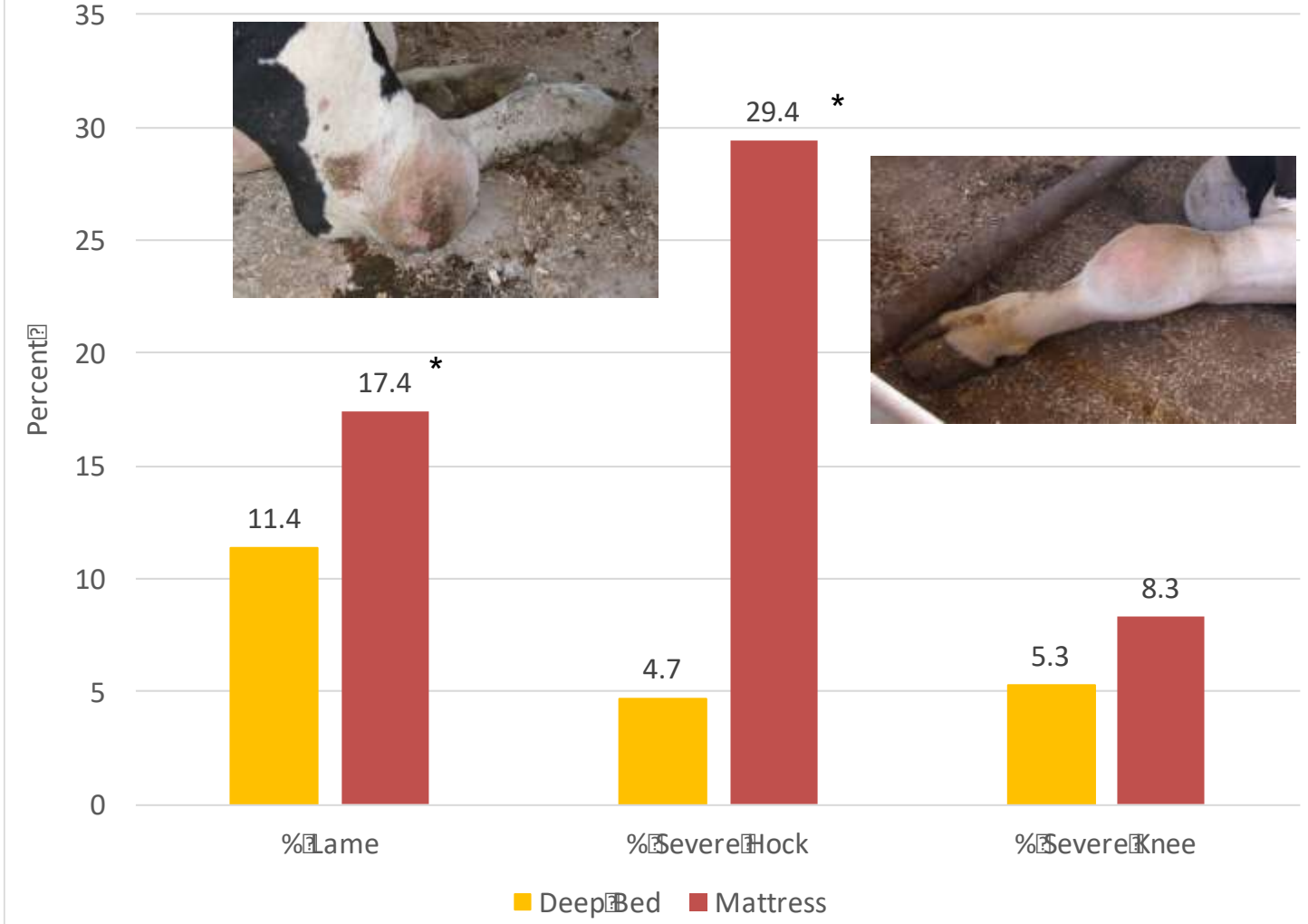
Bed Surfaces and Lying Time

(Solano et al., JDS 99:2086,2016; 141 farms in Alberta, Ontario and Quebec)

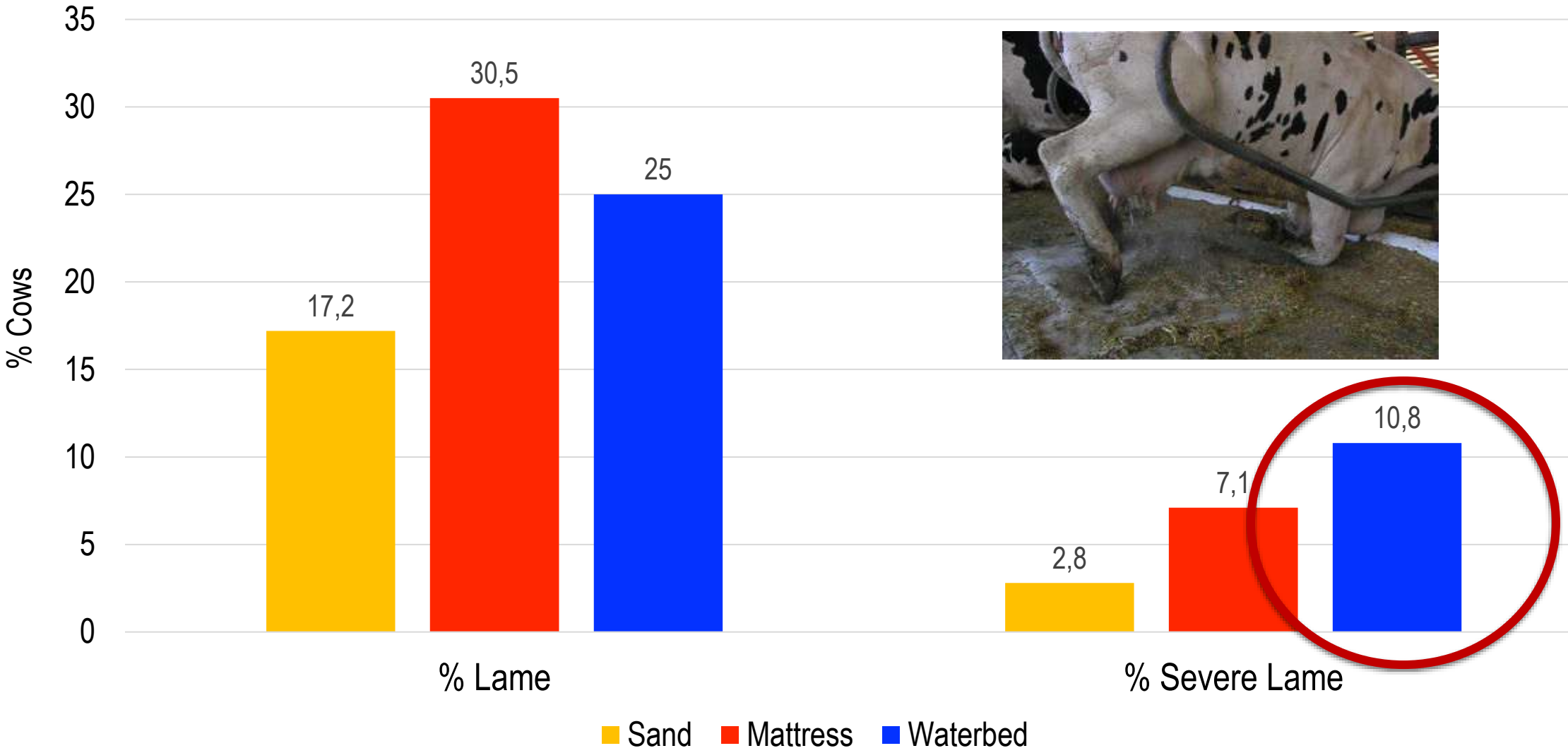


Lameness and Injury

Cook et al, JDS 99:5879, 2016

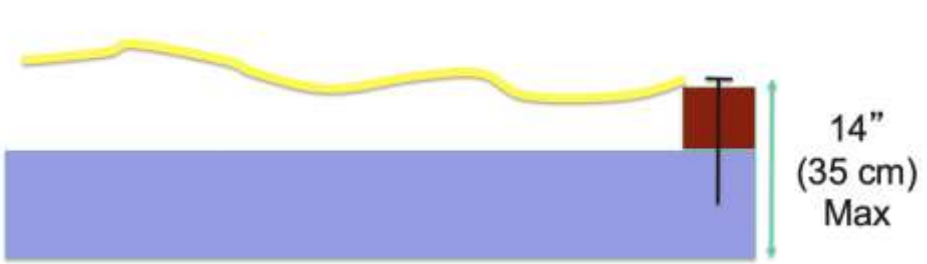


Impact of Stall Base on Lameness in AMS Units



Salfer et al., JDS 101:8586-8594, 2018 from 54 AMS units in Upper Midwest

Mattress to Deep Bed Conversions



New technology from Denmark!…

The sand final output contains less than 3% organics and 5% water.

Capacity of the sand washer can be increased by mounting a cyclone at the inlet.

By the addition of a second screw conveyer, the sand output capacity increases to 3 tons/h per sand washer.

The washed sand is dried by gravity while conveyed directly to a container – ready for transportation and reuse.

Requirements:

- Round uniform granule sand
- 1-2 gallons (4-8 L) fresh water/cow/day in addition to recycled water
- 98% sand reclamation rates

Influence of Stall Bedding on Milk Production and Udder Health

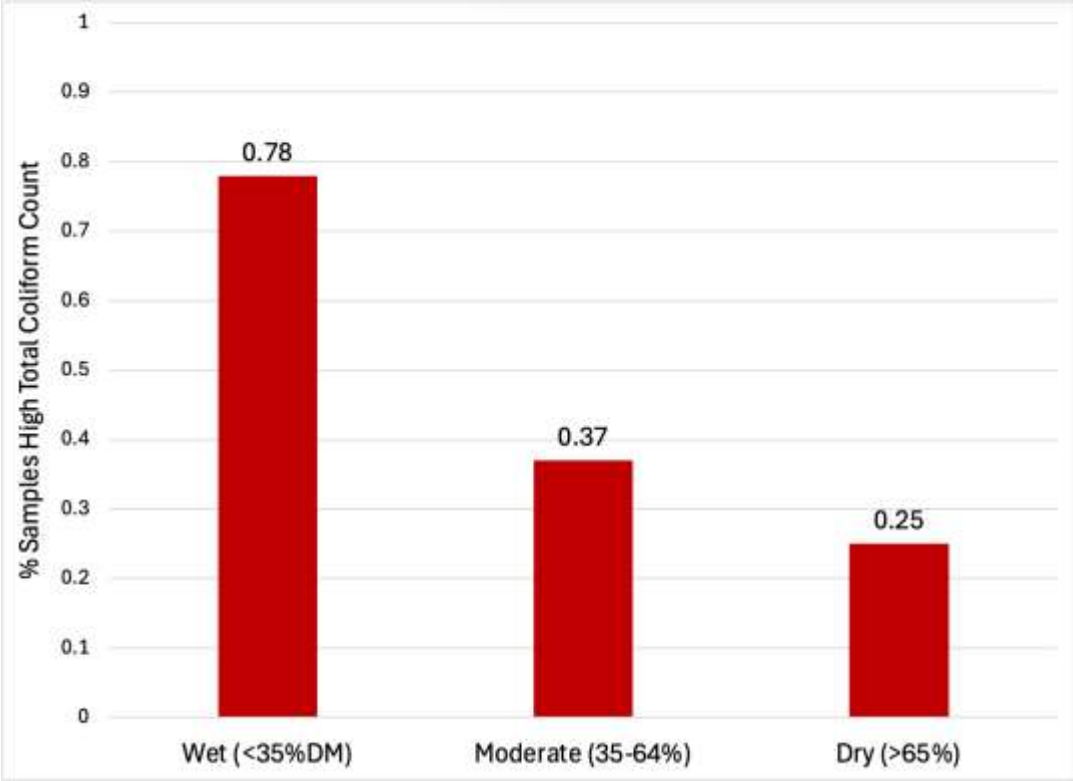
	Inorganic (Sand)	Manure Solids	Organic (over mattress)
N (%) =	156 (60%)	29 (9%)	62 (19%)
Rolling Average Milk kg (lb)	12,870 (28,314)	11,779 (25,913)	12,025 (26,455)
SCC ('000/ml)	198	248	220

Rowbotham and Ruegg, JDS 98:1-21, 2015 WI herds shipping more than 25,000 lb (11,340 kg) per day

Manure Solids - comfortable, but an udder health challenge

Manure Solid Bedding

- Drier the better!
  - Lower coliform and SSLO counts
  - Fewer udder infections
  - Higher milk production
- **Aim 50% DM**
- Need a hot air drier or drum composter
- Fluff and level the top few centimeters of bedding daily

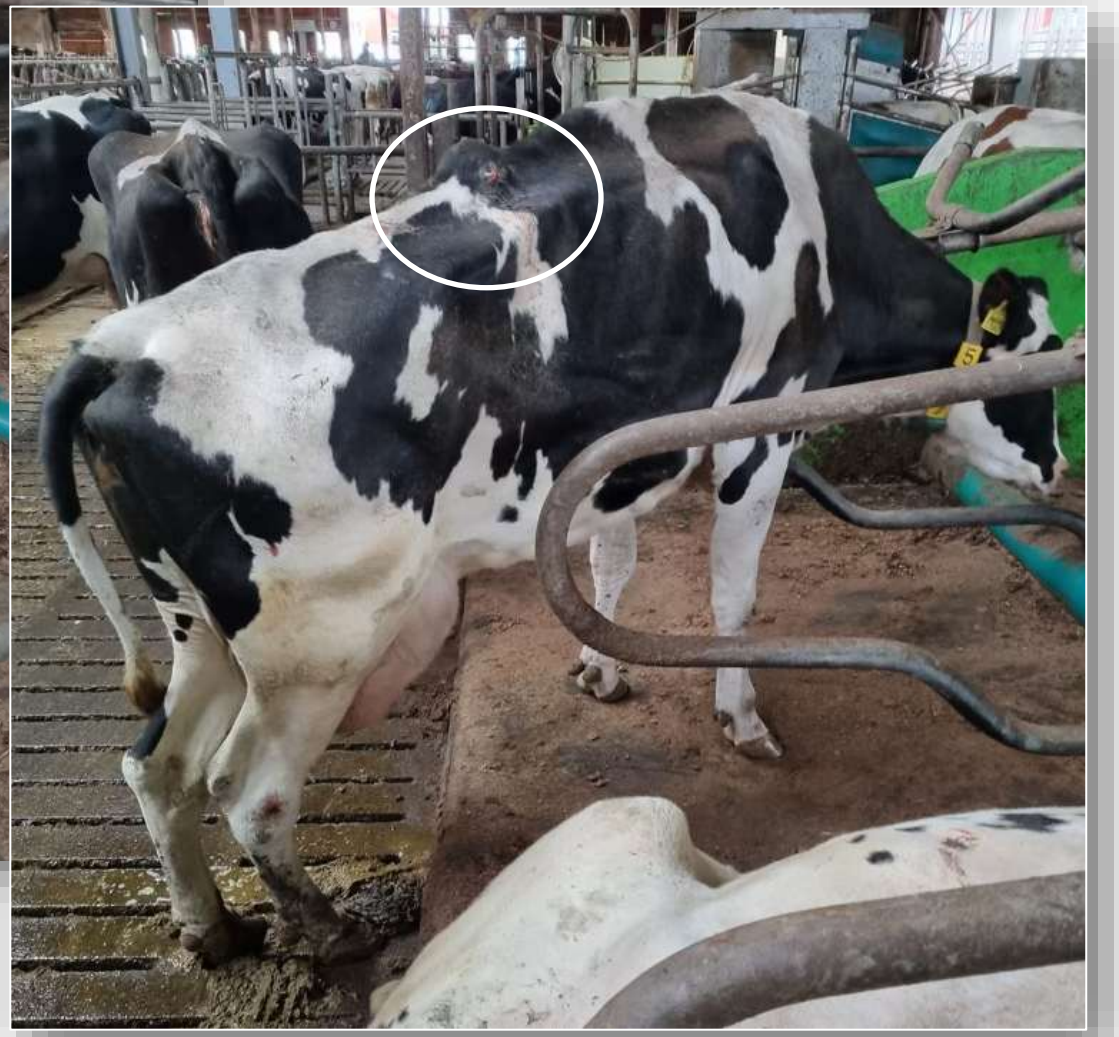


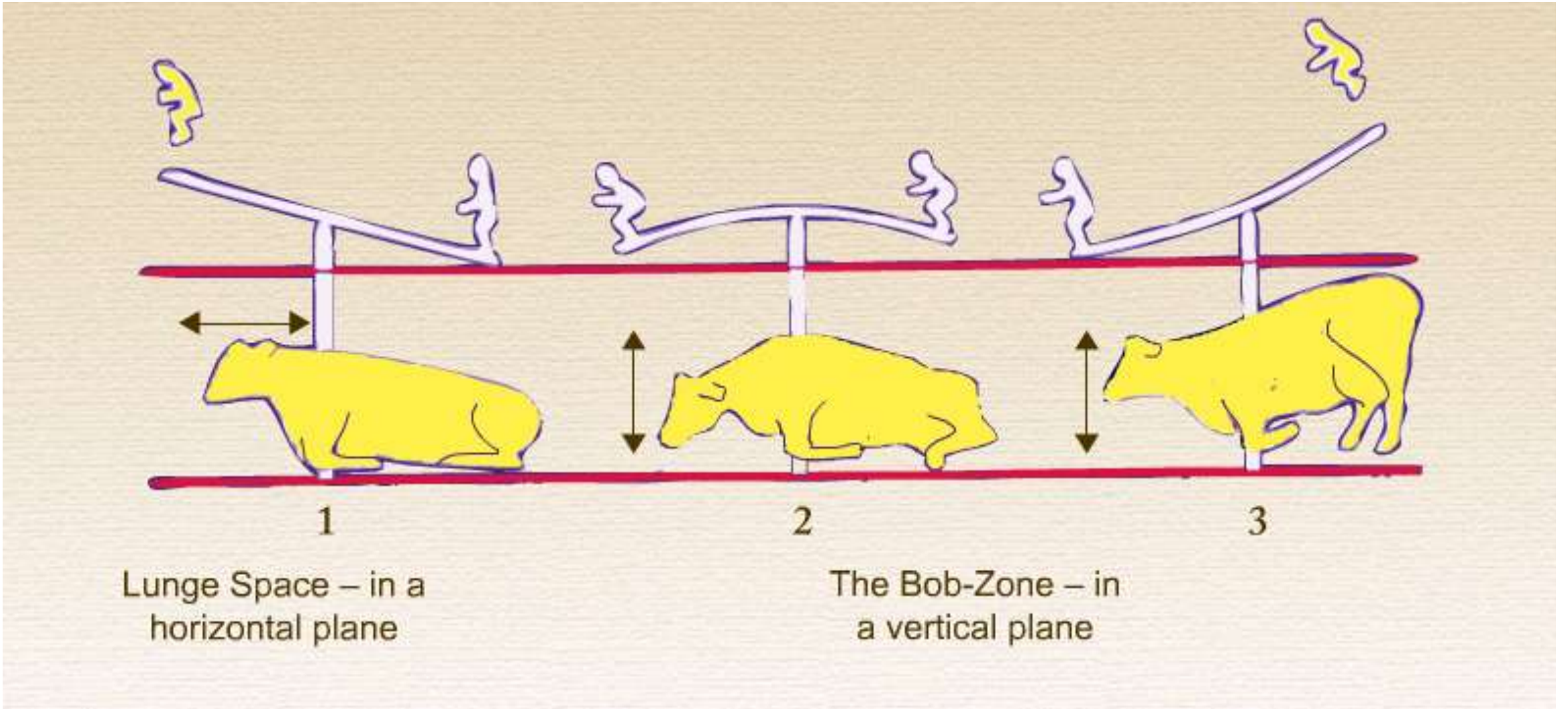
Patel et al., JDS 102:10213, 2019

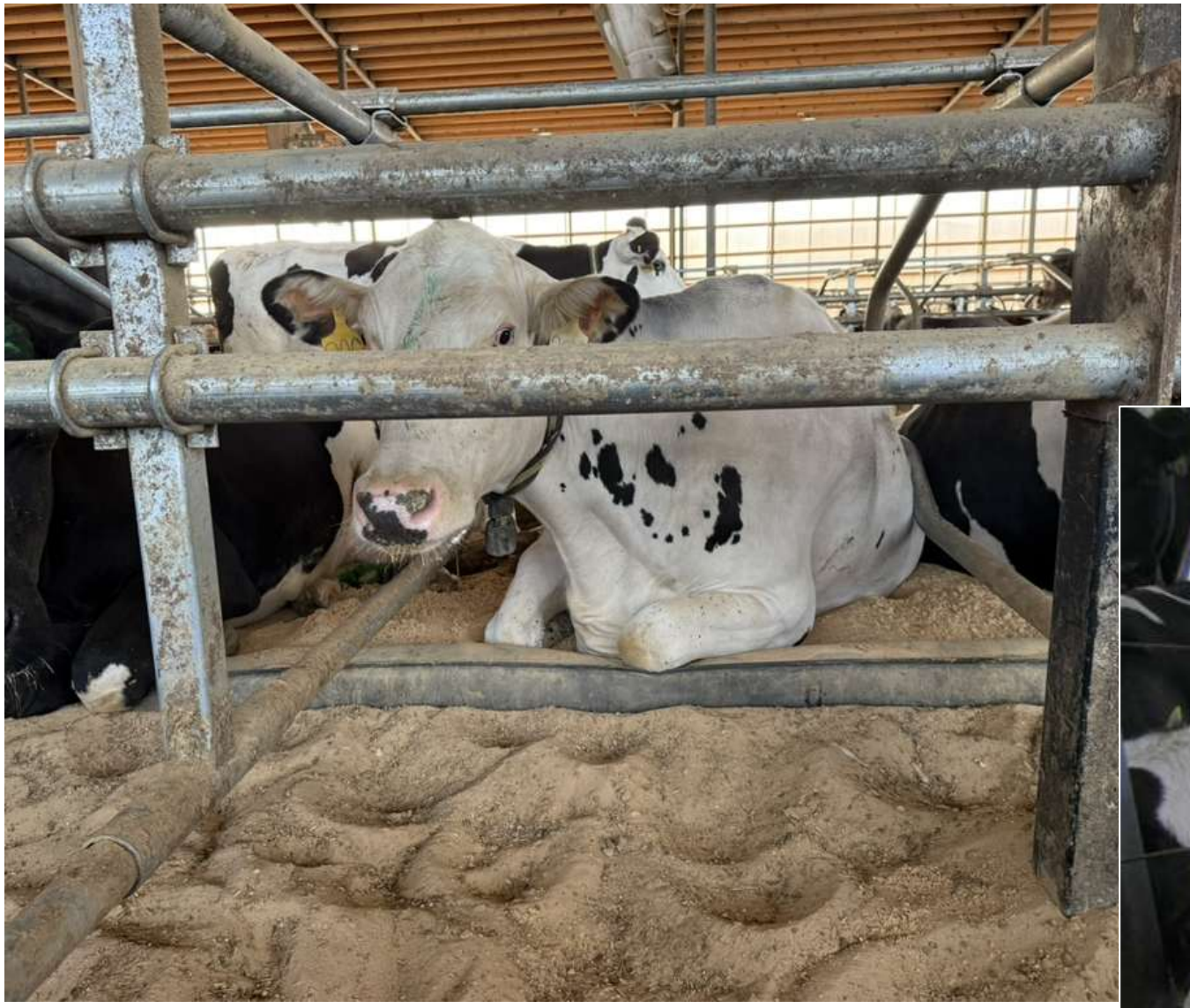
How can we improve healthspan?

- Keep her resting!
- **Keep her clean and dry!**
- Keep her cool!

Diagonal Lying




1
2
3
Lunge Space – in a horizontal plane
The Bob-Zone – in a vertical plane

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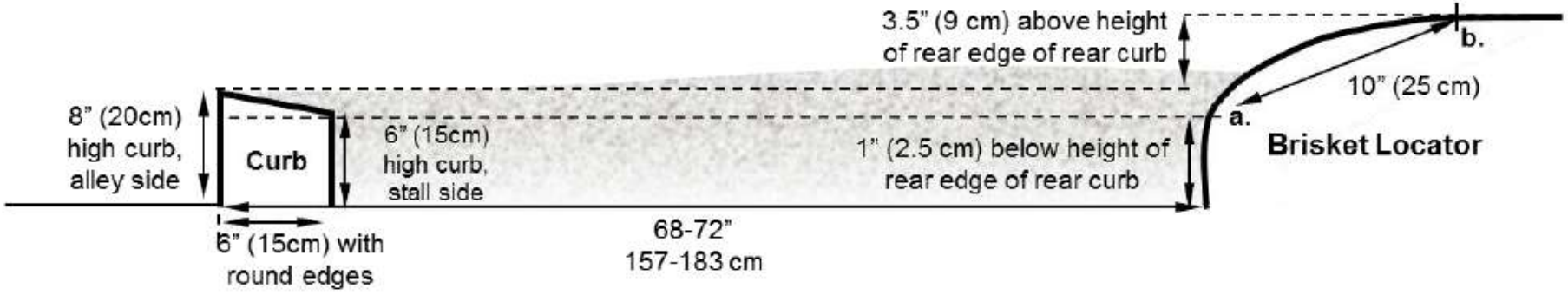
Before

After

"The junk in front"

Cows need to be able to put their front foot over the brisket locator when rising

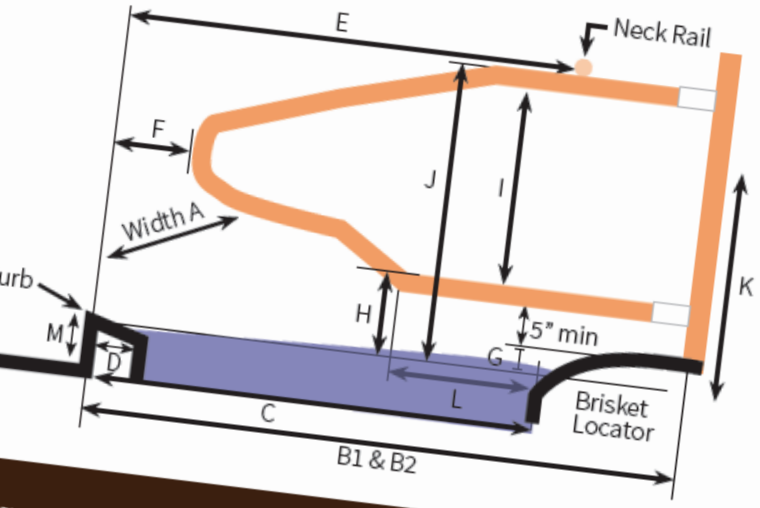
The Brisket Slope



“The Brisket Slope” allows flexibility in positioning, cows to lie with their leg out-stretched and launch their front leg forward when rising

Well designed stalls

TABLE 4. ESTIMATED ADULT COW FREESTALL DIMENSIONS



STALL DIMENSION (INCHES)	BODY WEIGHT ESTIMATE (LBS)					
	1000	1200	1400	1600	1800	2000
nter stall divider placement (Stall width) (A)	42	45	48	50	54	57
gth facing a wall (B1)	96	108	108	120	120	126
utside curb distance for head-to-head platform (B2)	180	192	192	204	204	216
rear curb to brisket locator (C)	64	66	68	70	72	75
urb (D)	6-8	6-8	6-8	6-8	6-8	6-8
n rear edge of neck rail and rear edge of curb for mattress stalls (E)	64	66	68	70	72	75
n rear edge of neck rail and rear edge of curb for deep bedded stalls (E)*	58	60	62	64	66	69
r edge of divider loop to point of curb (F)	9	9	9	9	9	9
e top of curb (loose bedded stall or mat/mattress surface) (G)	3	3	4	4	4	4
e of bottom stall divider rail above top of curb r mat/mattress surface) (H)	10	10	12	12	13	14
of the stall divider loop (I)	30	33	33	36	36	36
o of curb (loose bedded stall or mat/mattress surface) (J)	42	45	48	50	52	54
(K)	5-35	5-35	5-35			
from brisket locator to l						

Longer resting times in wider stalls (Tucker et al., 2004; Solano et al., 2016) and more lameness in stalls that are too narrow for the size of the cows using them (Westin et al., 2016)

Indexing

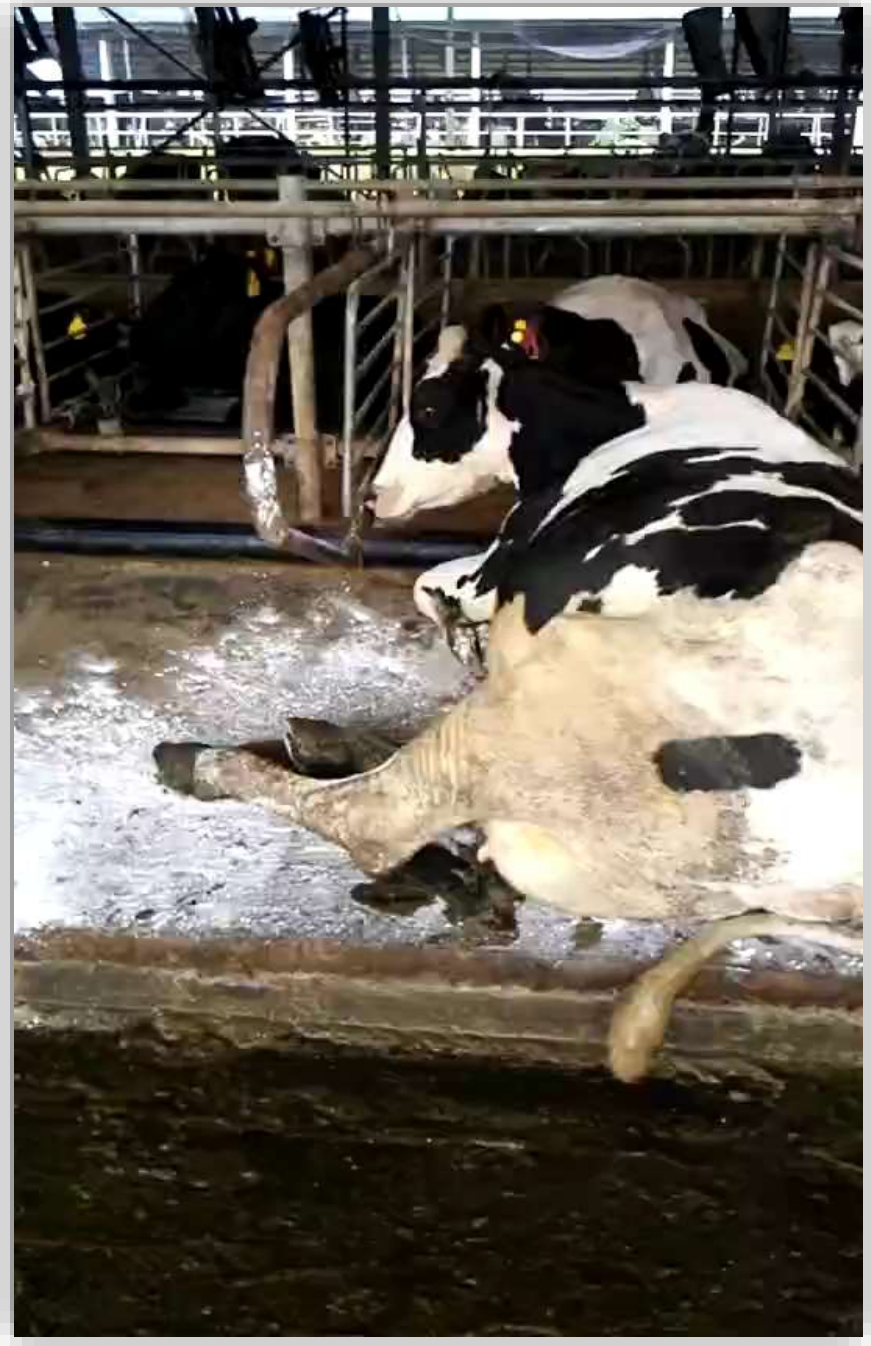
By restraint … or

By design …

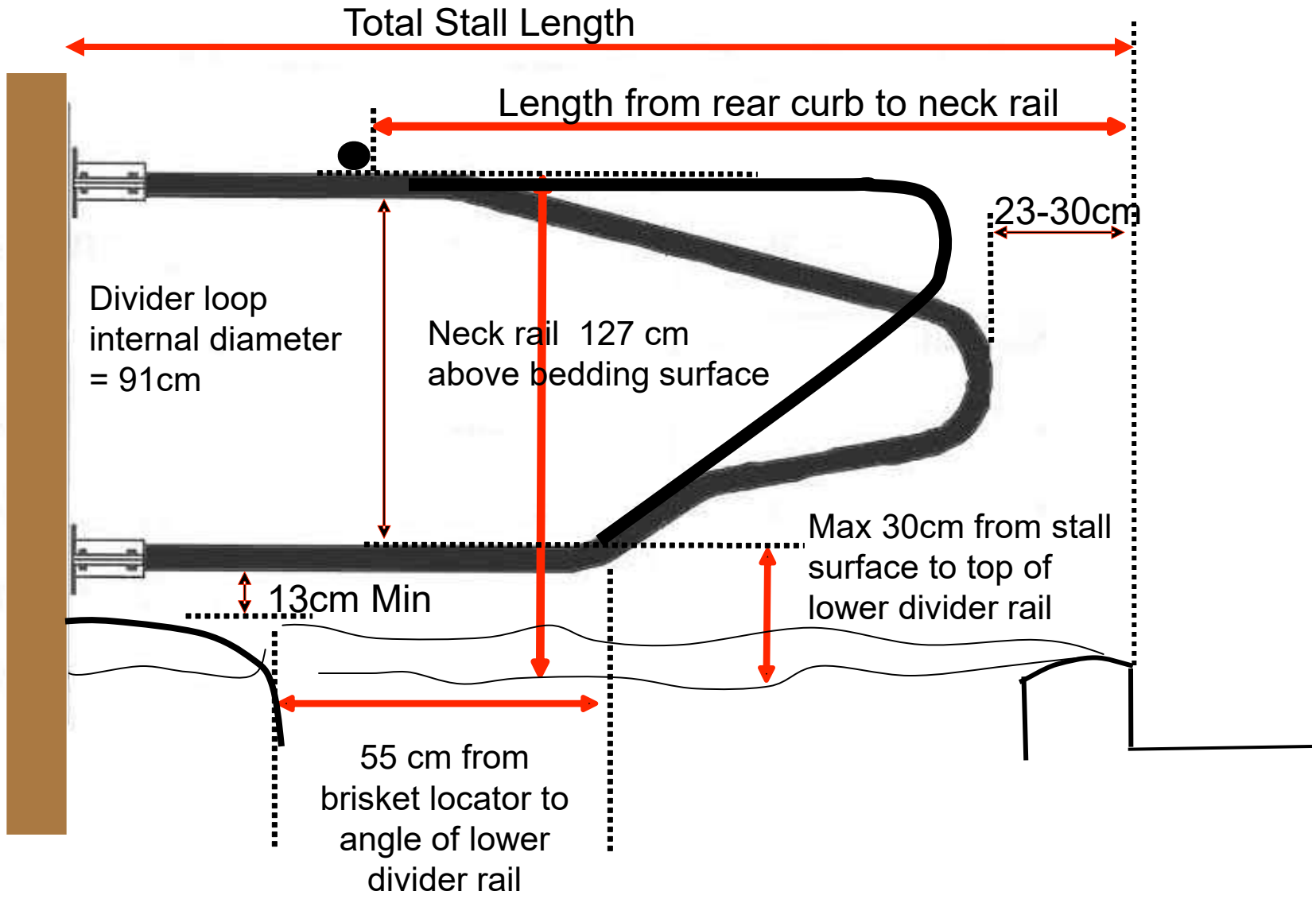

Angle of lower divider rail should be 20-22”
(50-55 cm) behind brisket locator


63 cm

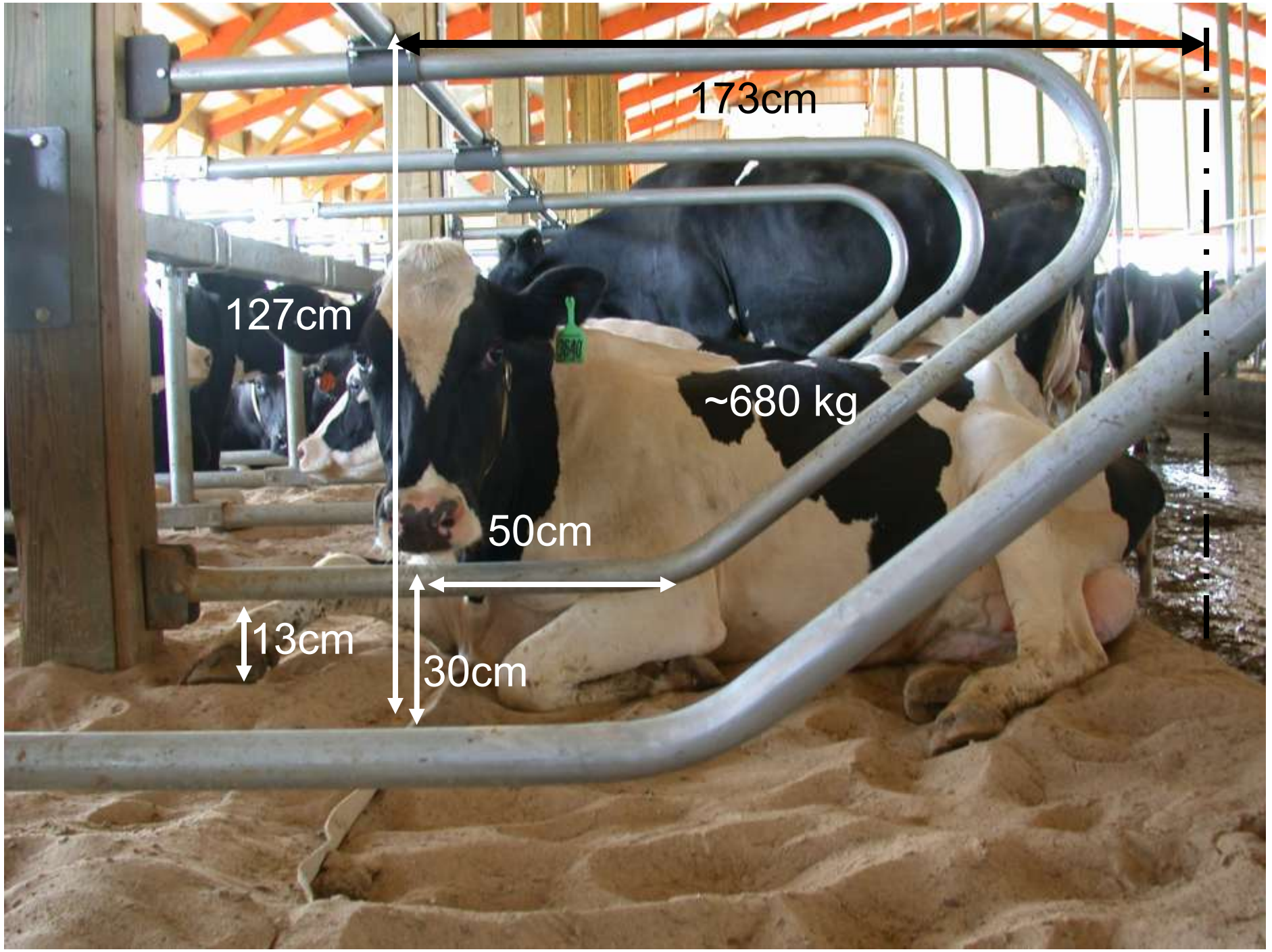
Trying to force a cow to lie straight in the stall is futile!



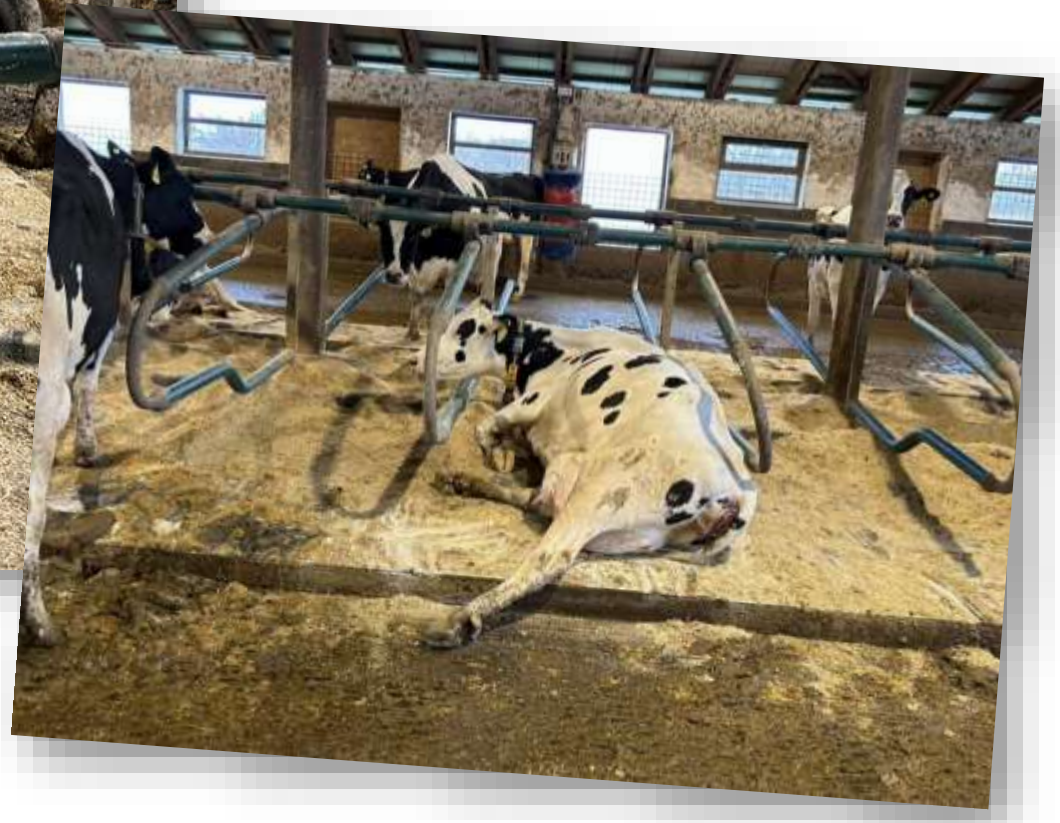
The stall is defined laterally by the divider loop



Dimensions for a 730 kg cow


173cm
127cm
~680 kg
50cm
13cm
30cm

- Stalls too narrow
- Neck rail too low
- Inadequate interior loop diameter
- Lower rail angle too short – allowing diagonal lying



Why do we need fiber glass loops?
Just put the metal in the right place!

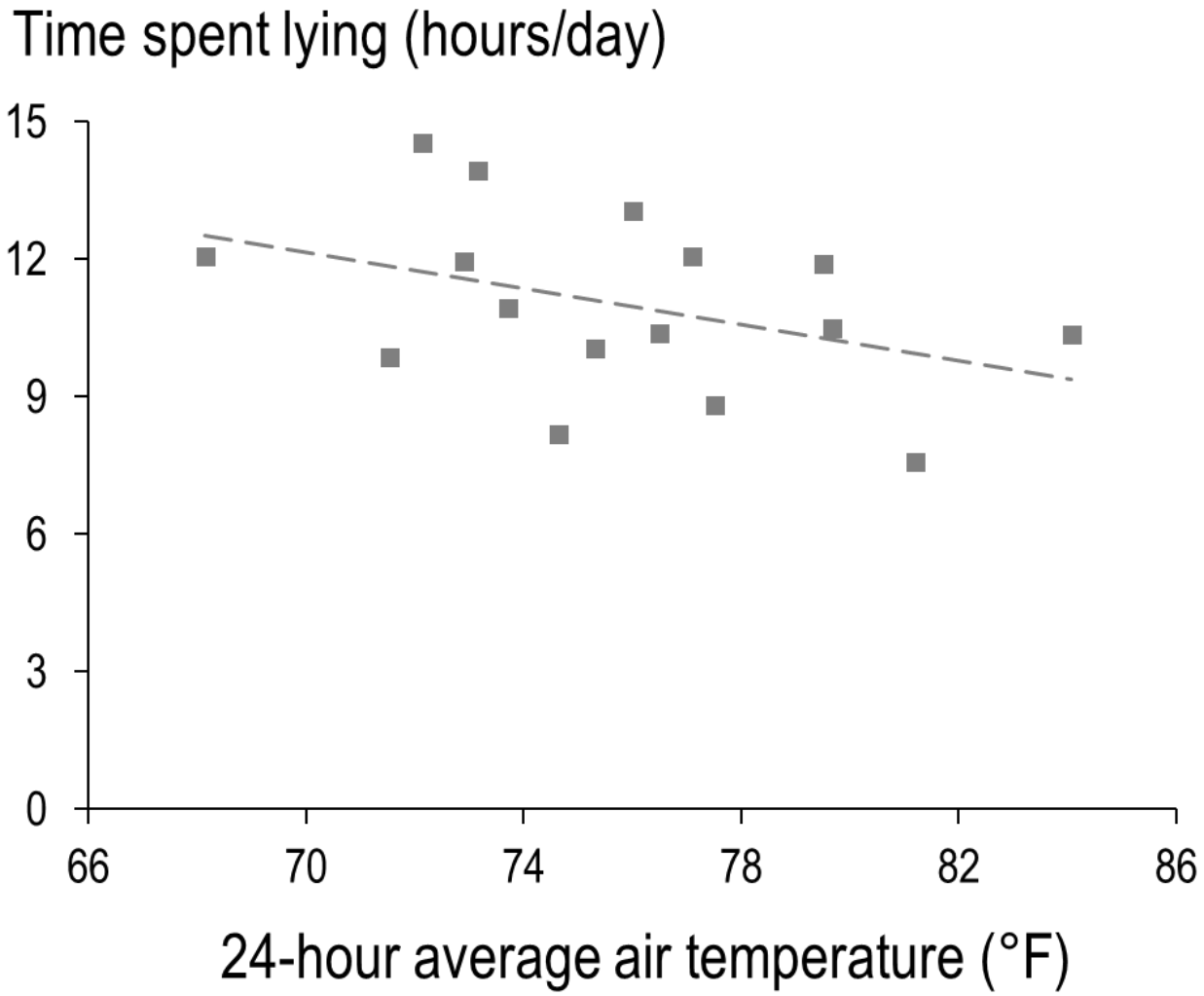
Just right ....

Current designs raise the mounting bars, and provide flexibility in width

How can we improve healthspan?

- Keep her resting!
- Keep her clean and dry!
- **Keep her cool!**

Heat Stress Consequences: Behavioral



Lying time impact: ~3 h/d loss due to heat stress

Chen (Van Os) et al., 2013, 2016, Cook et al, 2007; Tucker et al, 2008; Jensen et al, 2005; Hillman et al, 2005; Ansell, 1981; Legrand et al, 2011; Overton et al. 2002

How can we improve healthspan?

- Keep her resting!
- Keep her clean and dry!
- Keep her cool!

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The Dairyland Initiative serves as a source for ideas and recommendations, developed using clinical and academic research and experience, which aims to optimize dairy cow health, performance, and well-being in order to create an economically viable and competitive dairy industry for all members of a dairy team – the farmer, veterinarian, nutritionist, lender, builder, and other industry consultants.


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