Bovine respiratory disease in dairy calves

Costs, impacts, and strategies for mitigation

Dave Renaud

August 7, 2025

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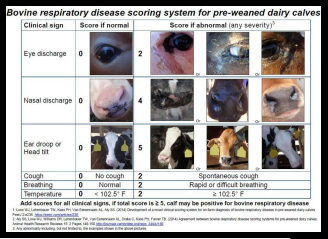
3

Renaud et al. in prep

Respiratory scored 1,100 calves daily after arrival to a calf research facility

Evaluated the impact on mortality and growth in 77 d at facility



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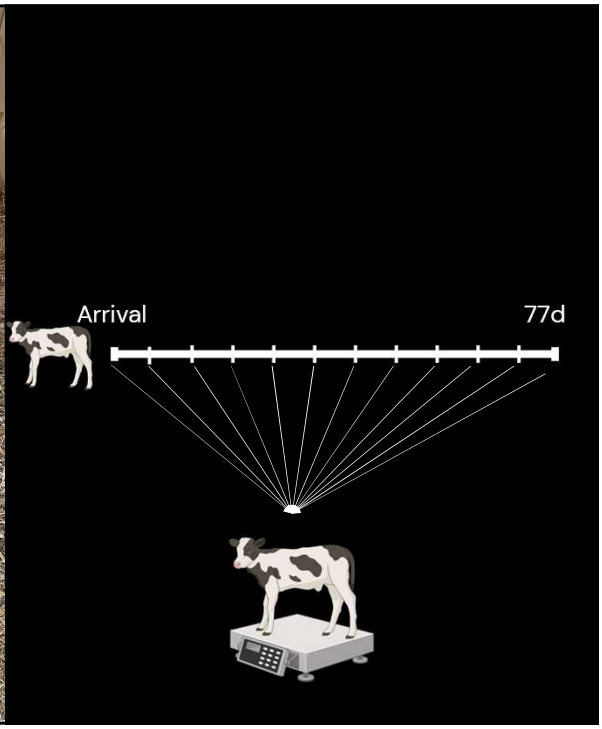

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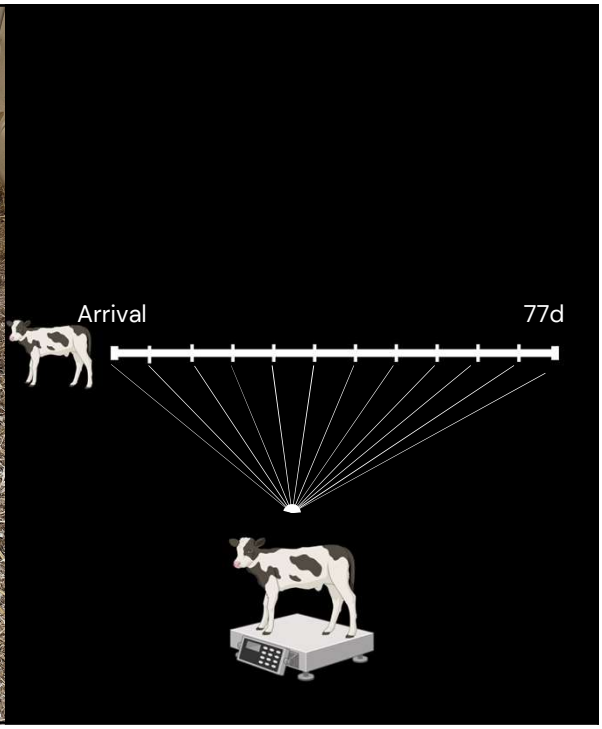

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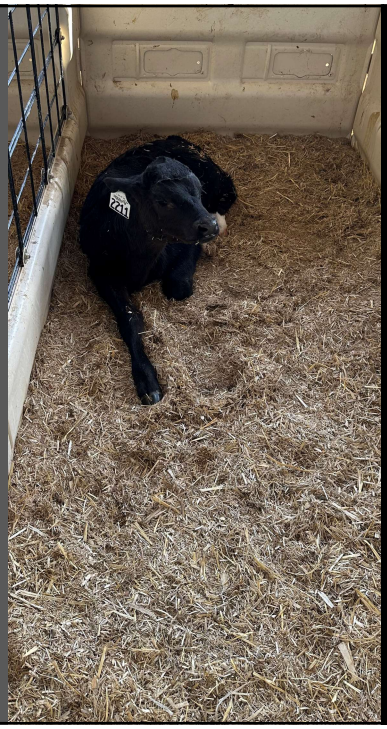

MORTALITY

3%

No Respiratory Disease

+ 14%

Respiratory Disease

7

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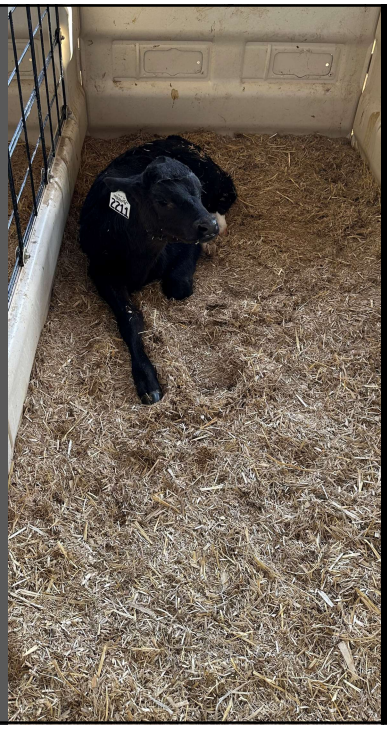

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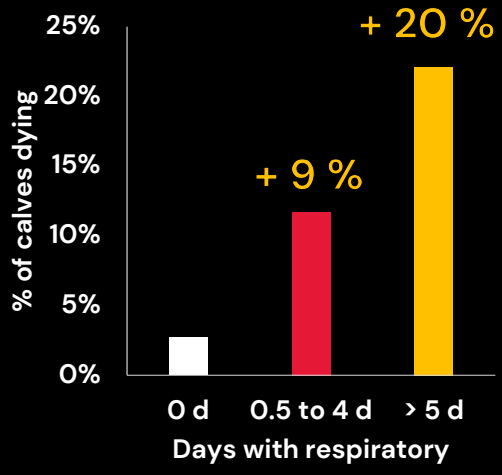

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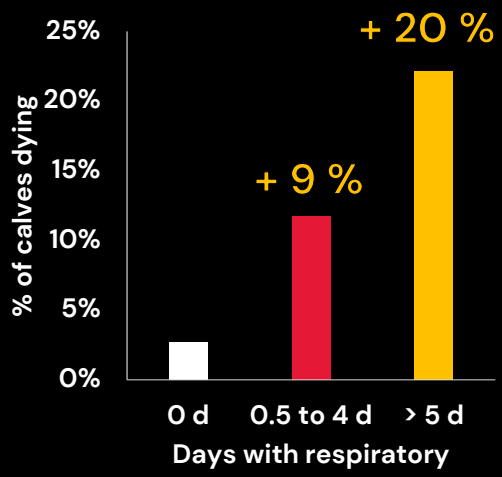

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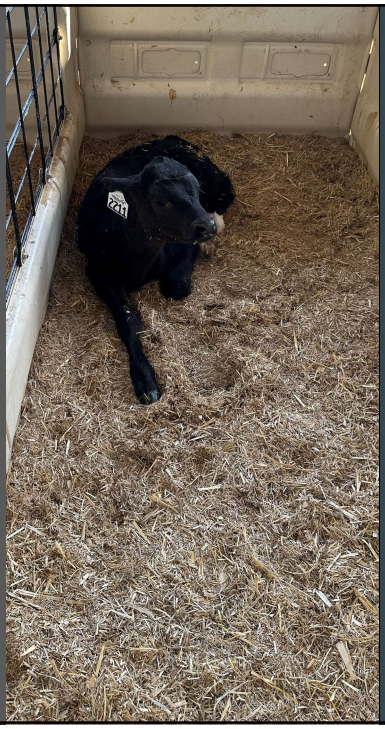

GROWTH

1040 g/d

No Respiratory Disease

– 160 g/d

Respiratory Disease

10

Renaud et al. in prep

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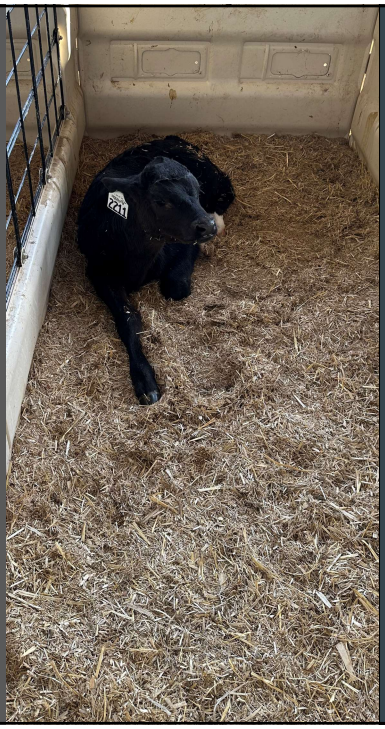

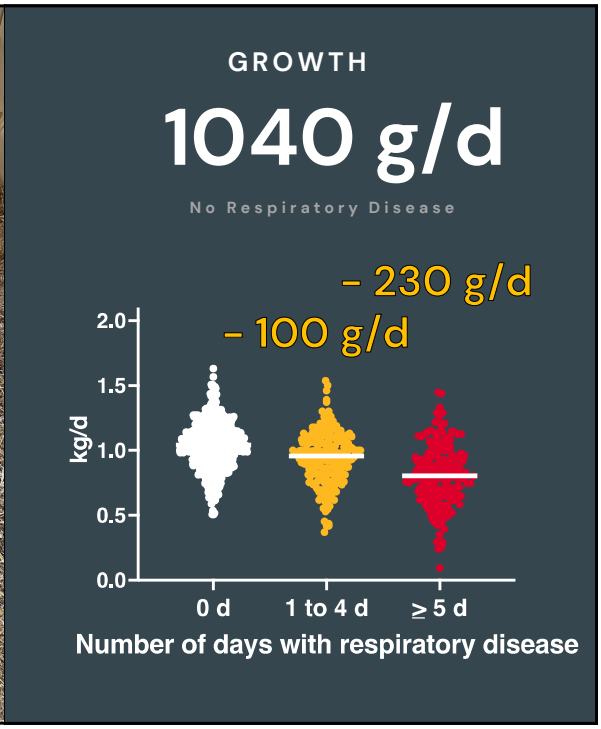

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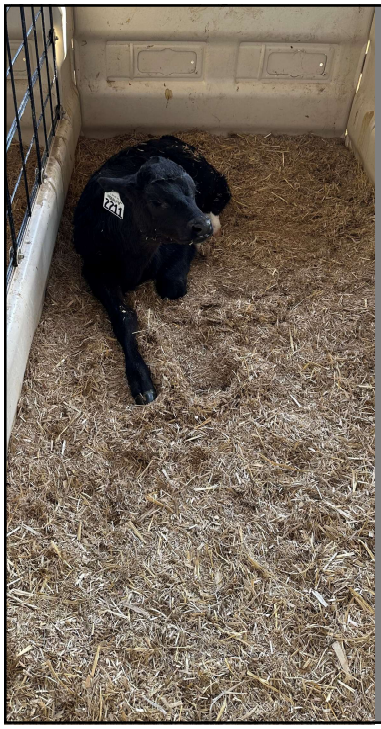
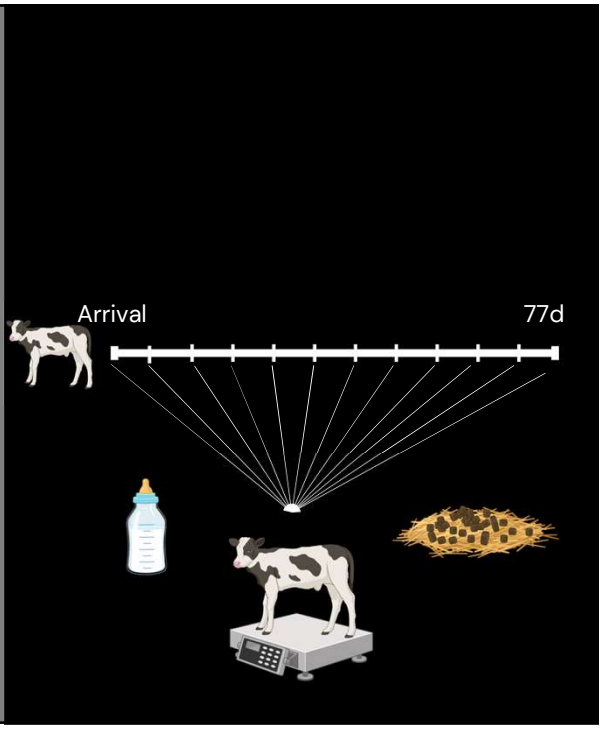


Vandewiel et al. (in prep)

Evaluated the impact of respiratory disease on feed efficiency at a calf raiser



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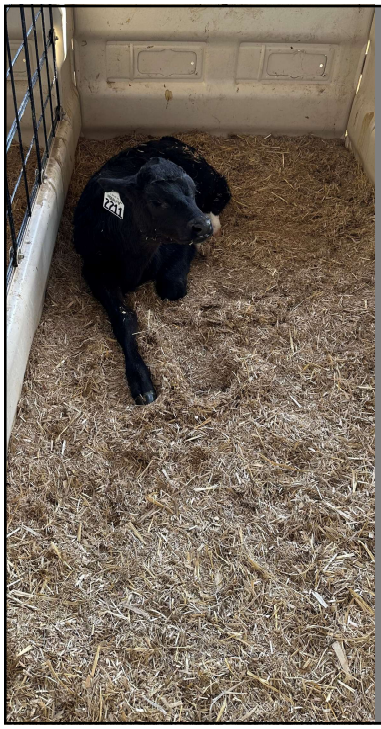

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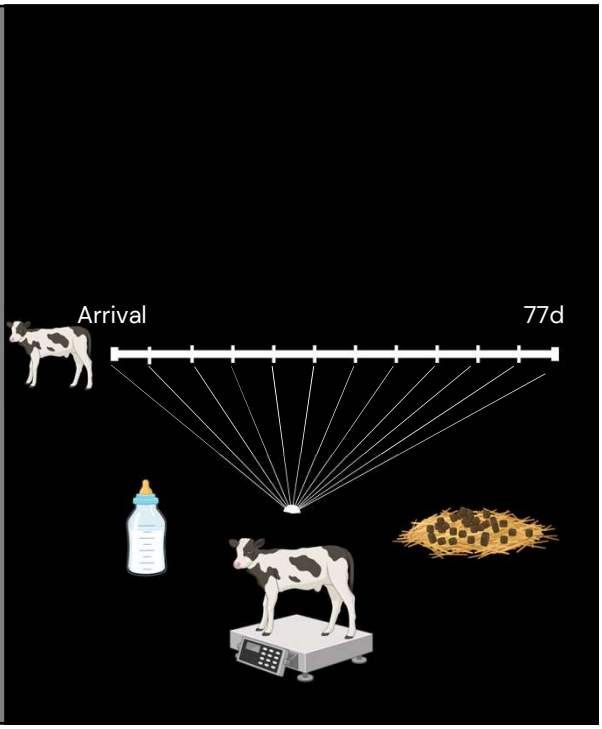

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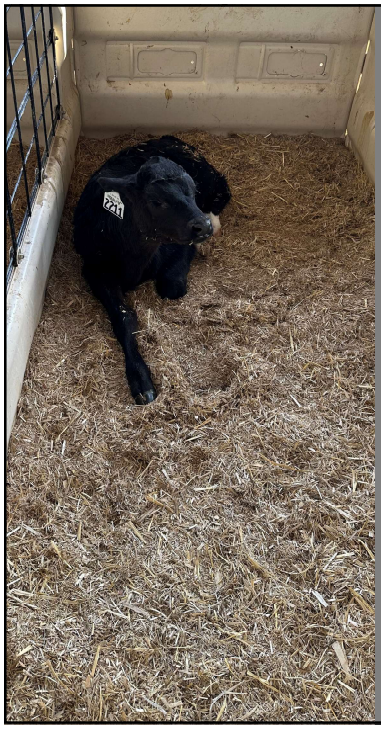

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FEED EFFICIENCY

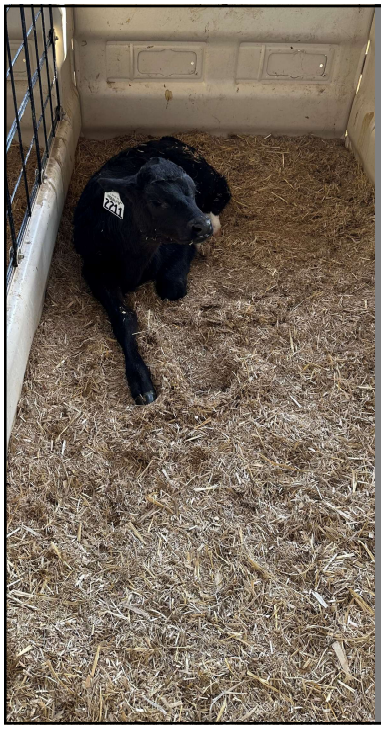
6.84 ME/kg gain

No Respiratory Disease

+ 0.14 ME/kg gain

Respiratory Disease

14



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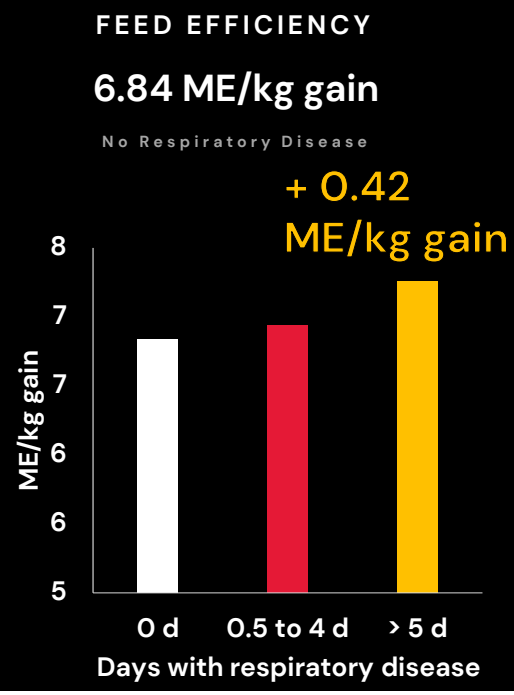

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Schaffer et al. 2016

Data from 14,024 born on a single dairy farm

Evaluated BRD treatment < 120 d with milk production and culling

Abuelo et al. 2021

Evaluated the impact of BRD treatment preweaning on future production on a single dairy farm

16

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SURVIVAL TO FIRST LACTATION

66% vs. 84%

BRD vs. NO BRD

17

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MILK PRODUCTION

–233 to 525 KG

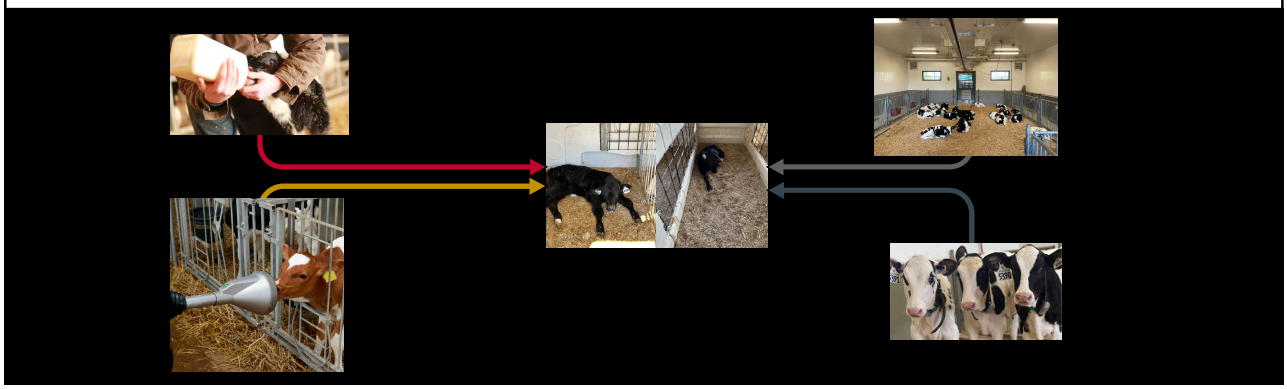
305 MILKING EQUIVALENT

19

20

Setting the Calf Up for Success

1. Colostrum management
2. Plane of milk nutrition
3. Environment
4. Early disease detection



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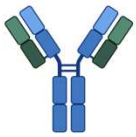
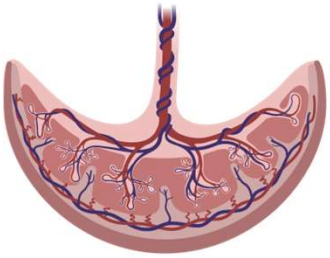
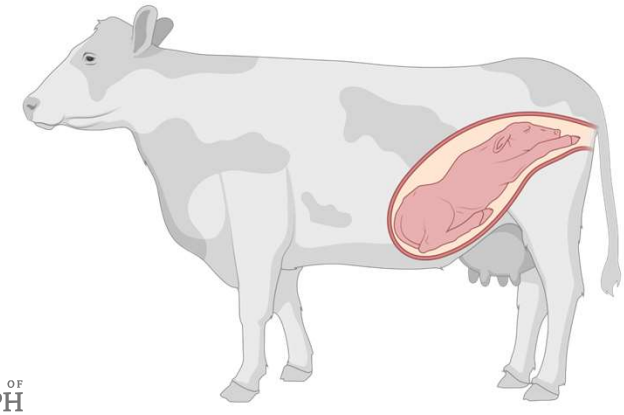
Achieving Passive Immunity.







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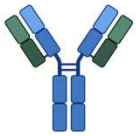

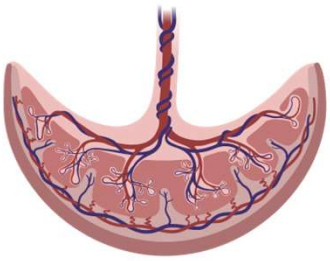

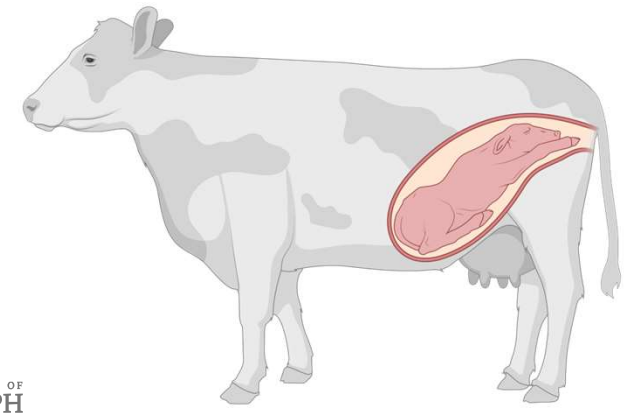

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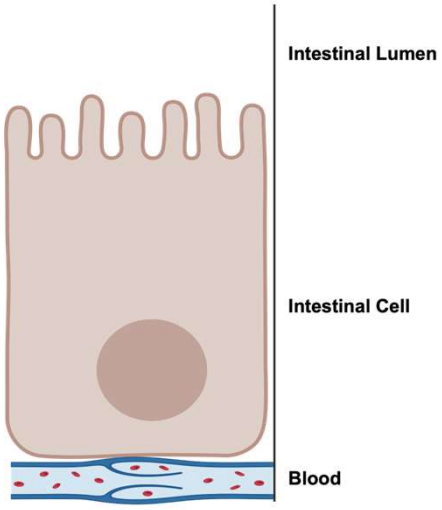

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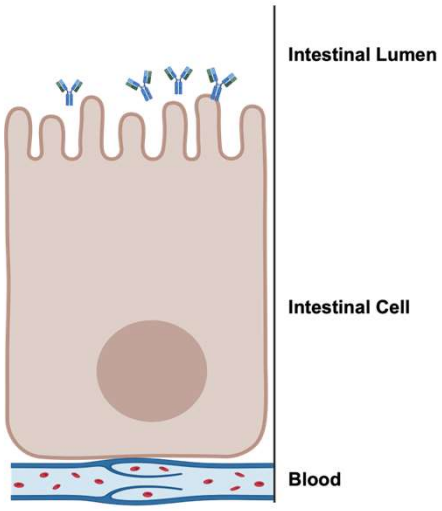

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26

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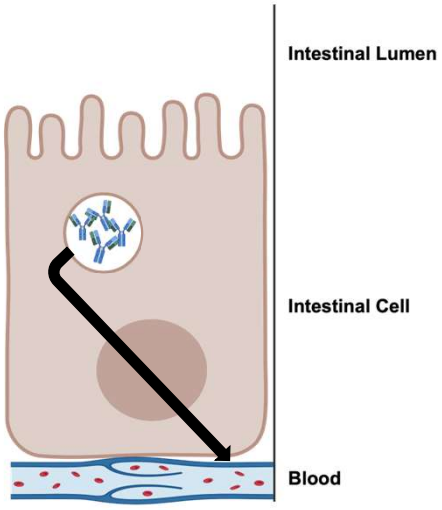

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27

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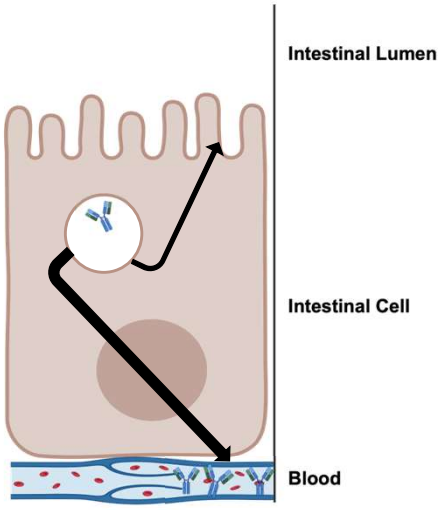

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28

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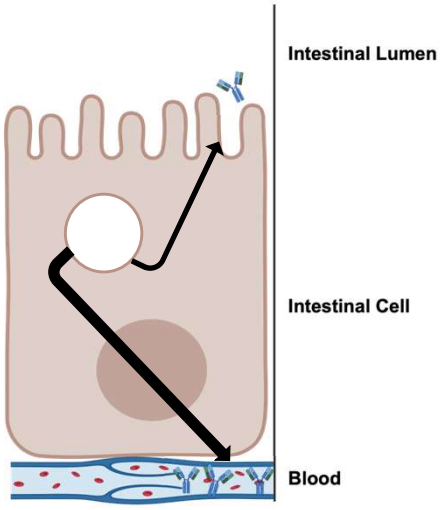

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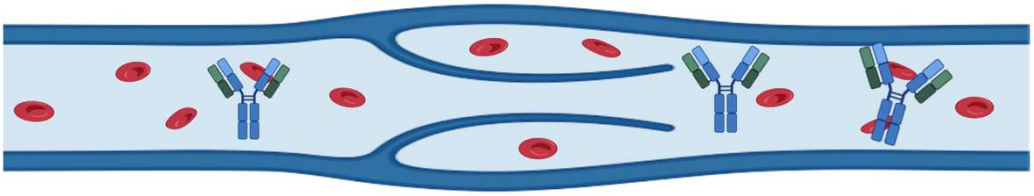

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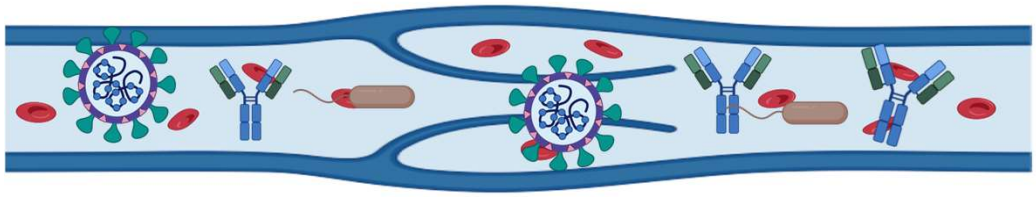

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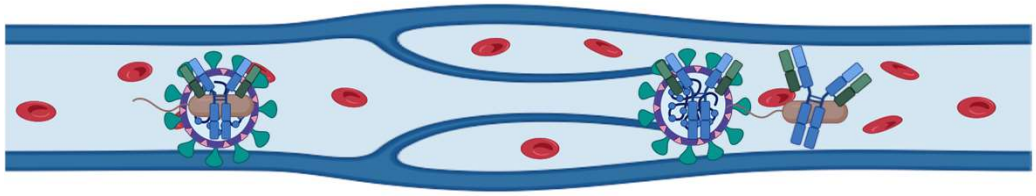

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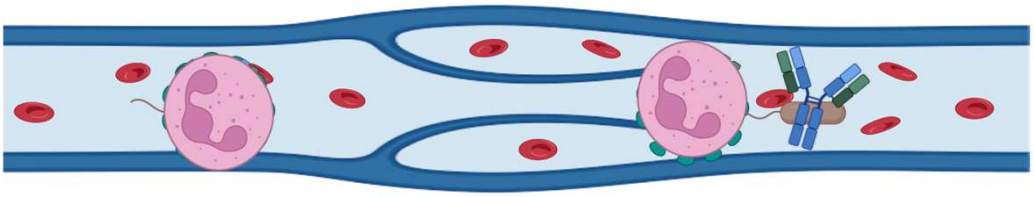

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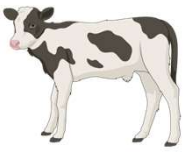

≥ 10 g/L IgG

53% lower risk of mortality
34% lower risk of diarrhea
43% lower risk of pneumonia

Category	Serum IgG (g/L)	Total Protein (g/dL)	% Brix	Target (% calves)
Poor	< 10.0	< 5.1	< 8.1	< 10

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Source: Lombard et al., 2020; Crannell and Abuelo, 2023

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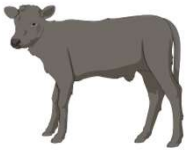
Achieving Passive Immunity.



≥ 10 g/L IgG

59% lower risk of mortality
67% lower risk of diarrhea

Category	Serum IgG (g/L)	Total Protein (g/dL)	% Brix	Target (% calves)
Poor	< 10.0	< 5.1	< 8.1	< 10

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Source: Lombard et al., 2020; Crannell and Abuelo, 2023

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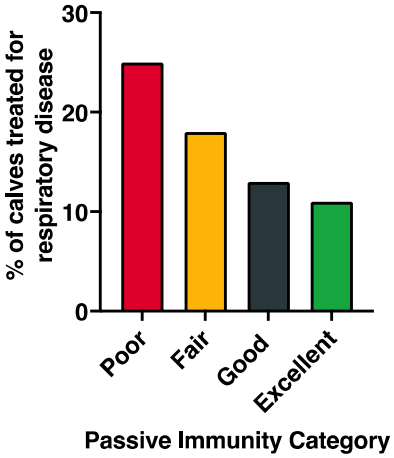
Achieving Passive Immunity.

Category	Serum IgG (g/L)	Total Protein (g/dL)	% Brix	Target (% calves)
Excellent	≥ 25.0	≥ 6.2	≥ 9.4	> 40
Good	18.0 to 24.9	5.8 to 6.1	8.9 to 9.3	~ 30
Fair	10.0 to 17.9	5.1 to 5.7	8.1 to 8.8	~ 20
Poor	< 10.0	< 5.1	< 8.1	< 10



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Source: Lombard et al., 2020; Crannell and Abuelo, 2023

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Challenges quantifying passive immunity

Source: Lopez et al., 2020

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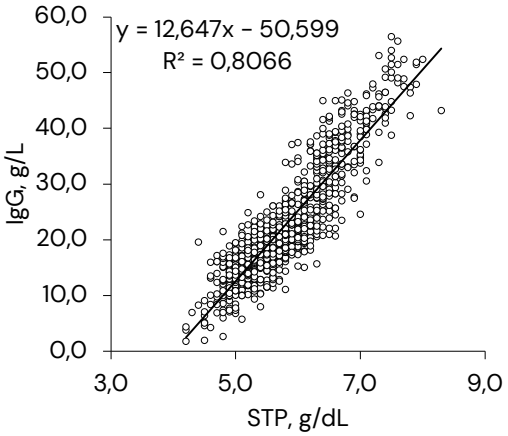
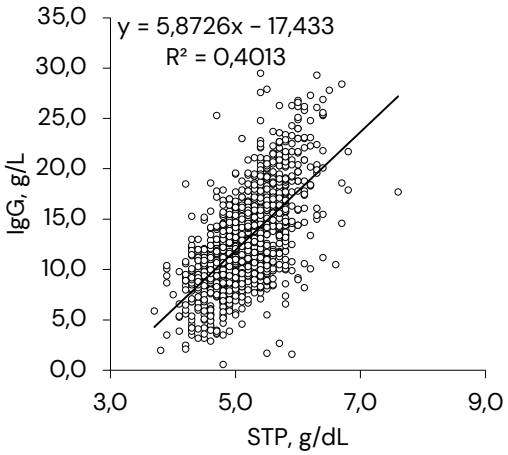
Challenges quantifying passive immunity





Source: Lopez et al., 2020

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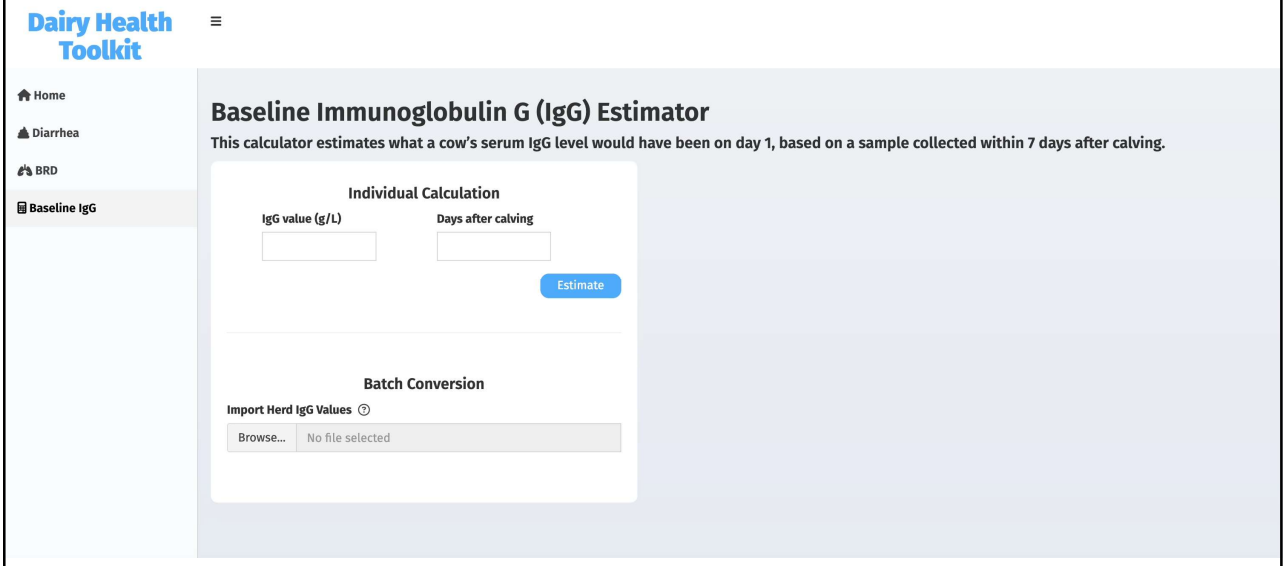
Challenges quantifying passive



Source: Goetz et al. (2025)

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3 to 4 L at first feeding

Quantity	Quality	Quickness	Cleanliness

Achieving passive immunity.

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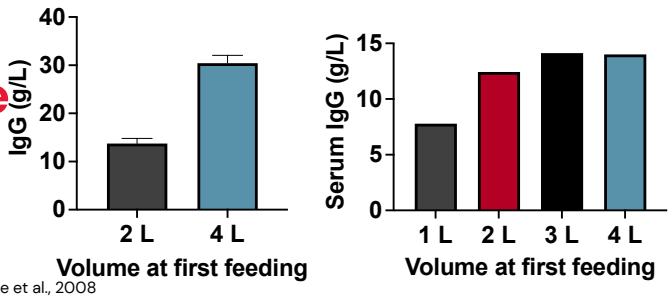

Source: Morin et al., 1997; Chigerwe et al., 2008

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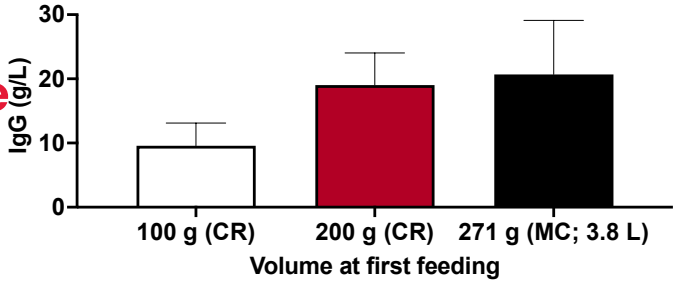
3 to 4 L at first feeding

Quantity | Quality | Quickness | Cleanliness

Achieving passive immunity.



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Source: Godden et al., 2009

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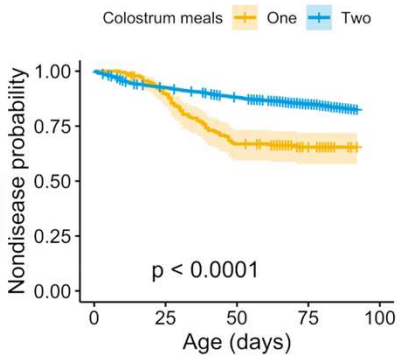
3 to 4 L at first feeding

2 meals of colostrum first 12 hrs

Quantity | Quality | Cleanliness



Achieving passive immunity.

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Source: Abuelo et al., 2019

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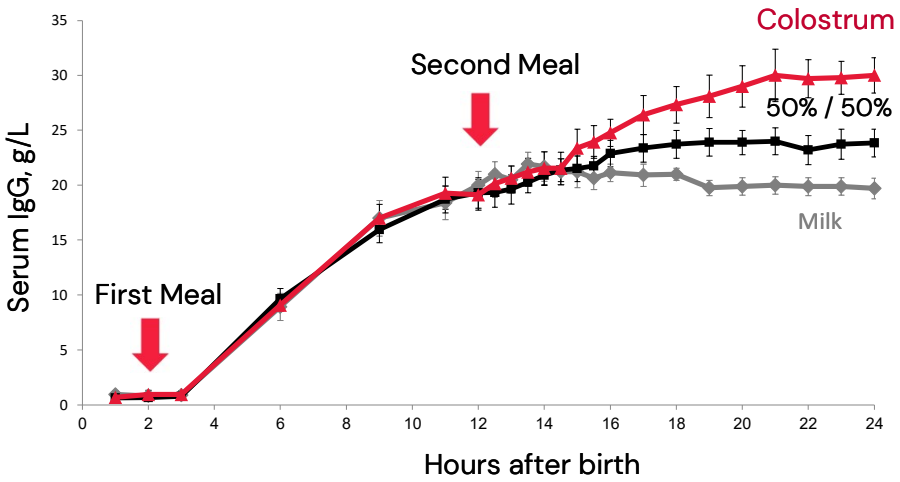
Extended Colostrum Feeding



Source: Hare et al., 2020

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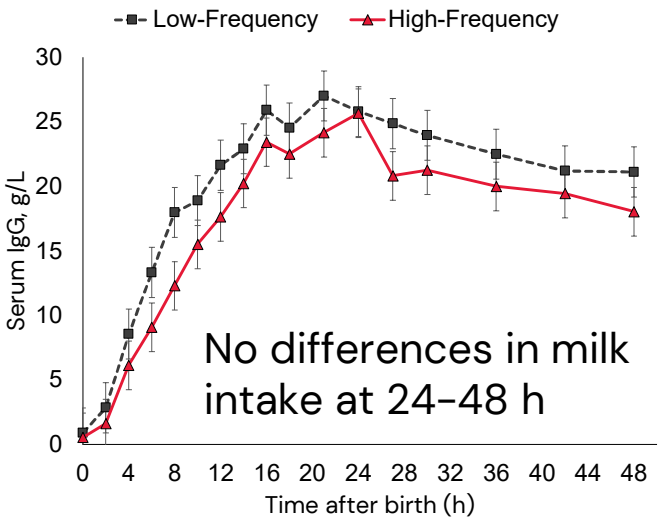
What about more smaller meals?

Low-frequency of colostrum: 8% BW at 1 hour and 4% BW at 12 hours

High-frequency of colostrum: 4% BW at 1 hour, 4% BW at 6 hours, and 4% BW at 12 hours



Source: Lopez et al., 2022

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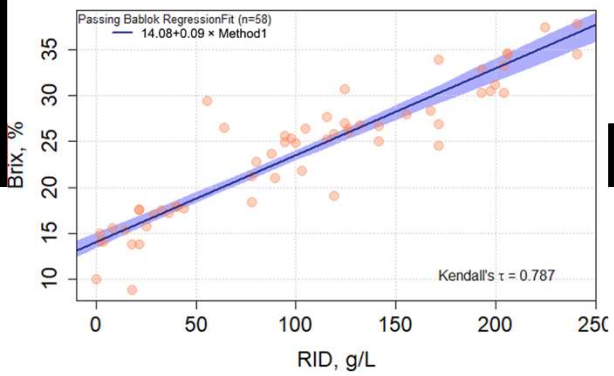
≥ 50 g/L of IgG

OR ≥ 22% BRIX

→ 94.3% probability ≥ 50 g/L

Quantity

Quality



Achieving passive immunity.

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Source: Westhoff et al., 2024; Buczinski and Vandeweerd, 2016

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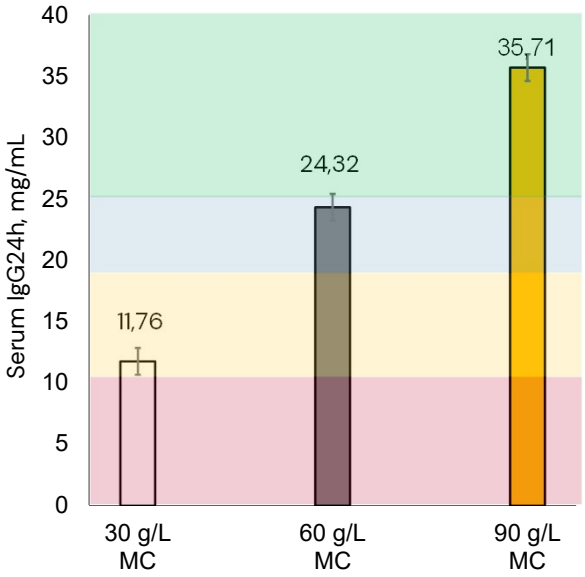
≥ 50 g/L of IgG

OR ≥ 22% BRIX

Quantity

Quality

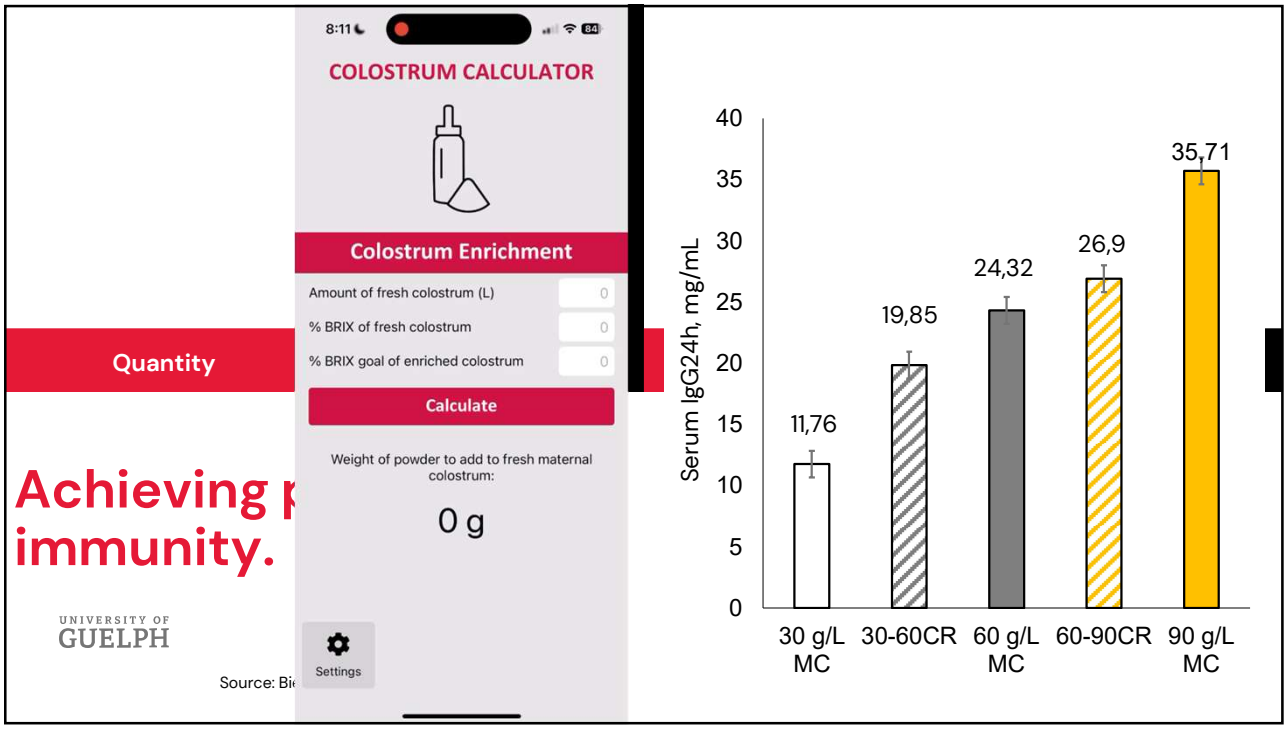


Achieving passive immunity.

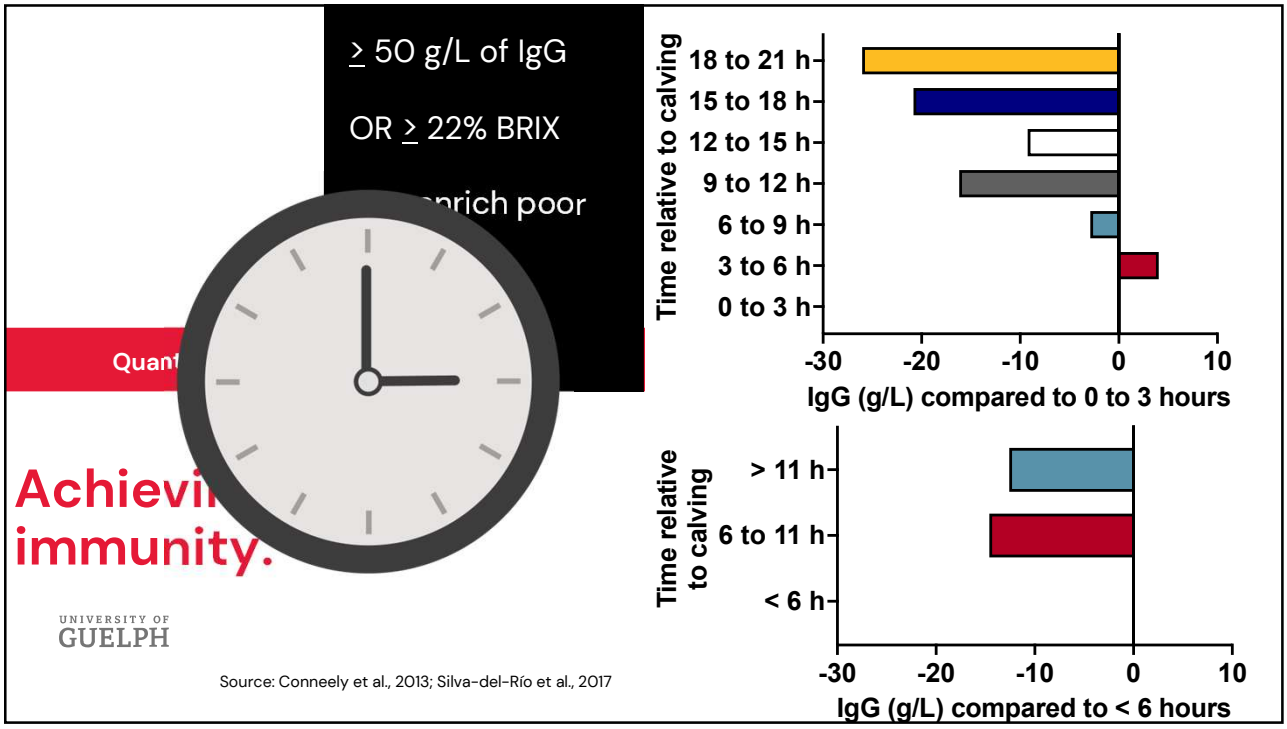
UNIVERSITY OF GUELPH

Source: Lopez et al., 2023

46


8:11
COLOSTRUM CALCULATOR
Colostrum Enrichment
Amount of fresh colostrum (L)
% BRIX of fresh colostrum
% BRIX goal of enriched colostrum
Calculate
Weight of powder to add to fresh maternal colostrum:
0 g
Settings
Quantity
Achieving p
immunity.
UNIVERSITY OF GUELPH
Source: Bi
Serum IgG24h, mg/mL
40
35
30
25
20
15
10
5
0
11,76
19,85
24,32
26,9
35,71
30 g/L MC
30-60CR
60 g/L MC
60-90CR
90 g/L MC

47

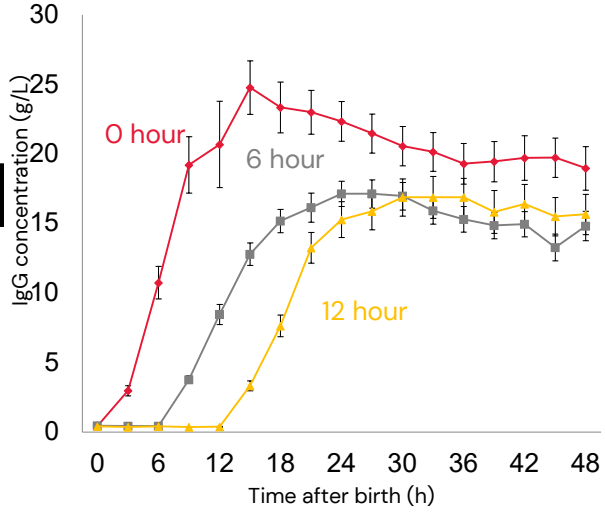

≥ 50 g/L of IgG
OR ≥ 22% BRIX
nrich poor
Quant
Achievi
immunity.
UNIVERSITY OF GUELPH
Source: Conneely et al., 2013; Silva-del-Río et al., 2017
Time relative to calving
18 to 21 h
15 to 18 h
12 to 15 h
9 to 12 h
6 to 9 h
3 to 6 h
0 to 3 h
-30
-20
-10
0
10
IgG (g/L) compared to 0 to 3 hours
Time relative to calving
> 11 h
6 to 11 h
< 6 h
-30
-20
-10
0
10
IgG (g/L) compared to < 6 hours

48

As quick as possible?

Quantity | Quality

Achieving passive immunity.

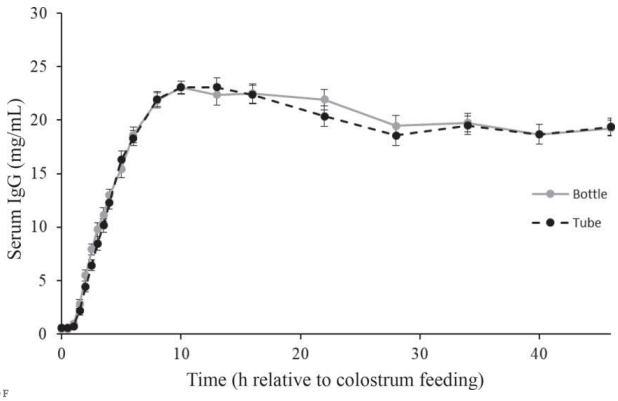


UNIVERSITY OF GUELPH

Source: Fisher et al. 2018

49

Feeding Method?



UNIVERSITY OF GUELPH

Source: Desjardins-Morrissette et al., 2018.

50

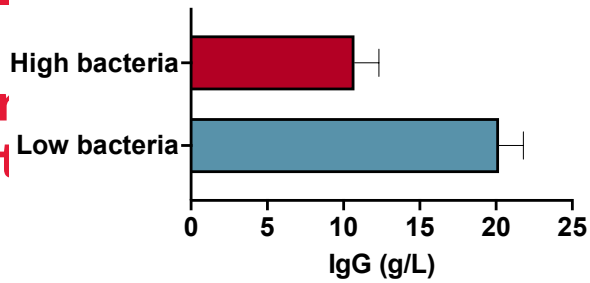
< 100,000 cfu/ml TBC

< 10,000 cfu/ml TCC

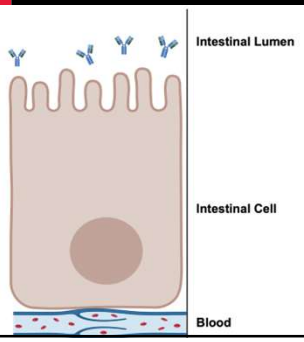
Quantity | Quality | Quickness | Cleanliness

Achievi
immunit

UNIVERSITY OF GUELPH



Source: Gelsinger et al. 2015; James et al., 1981



51

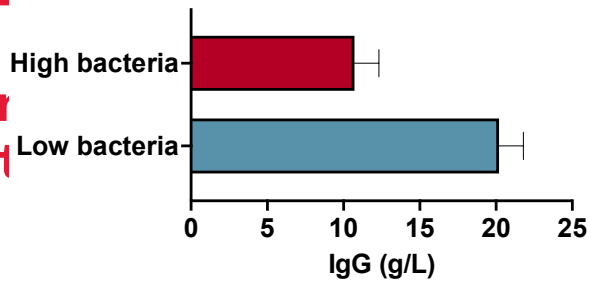
< 100,000 cfu/ml TBC

< 10,000 cfu/ml TCC

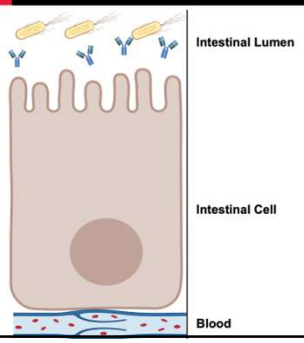
Quantity | Quality | Quickness | Cleanliness

Achievi
immunit

UNIVERSITY OF GUELPH



Source: Gelsinger et al. 2015; James et al., 1981



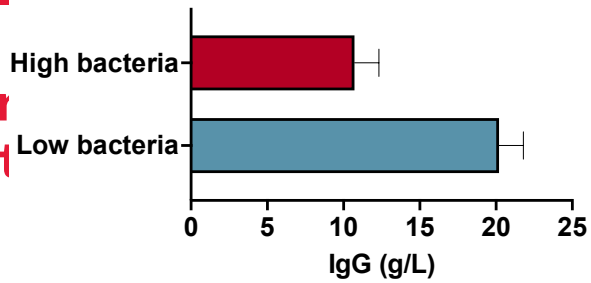
52

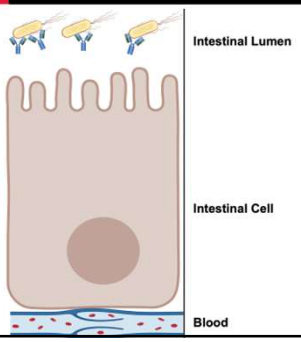
< 100,000 cfu/ml TBC

< 10,000 cfu/ml TCC

Quantity | Quality | Quickness | Cleanliness

Achievi
immunit



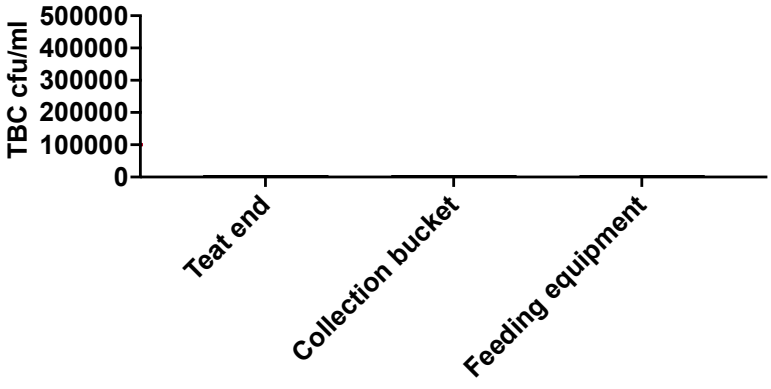


UNIVERSITY OF GUELPH

Source: Gelsinger et al. 2015; James et al., 1981

53

< 100,000 cfu/ml TBC



Quantity | Quali

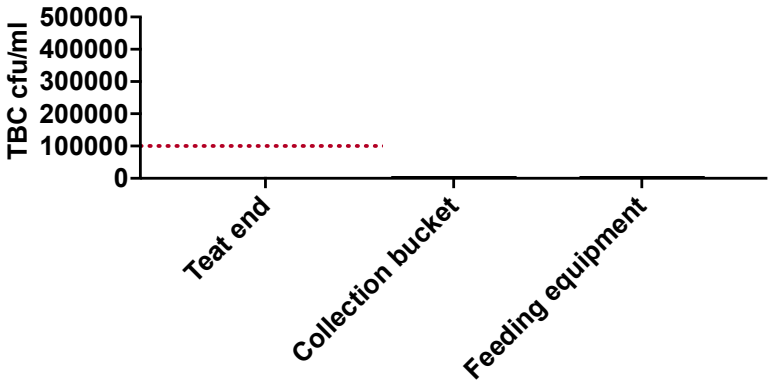
Achieving passive immunity.

UNIVERSITY OF GUELPH

Source: Haggerty et al. 2025

54

< 100,000 cfu/ml TBC



Quantity | Quali

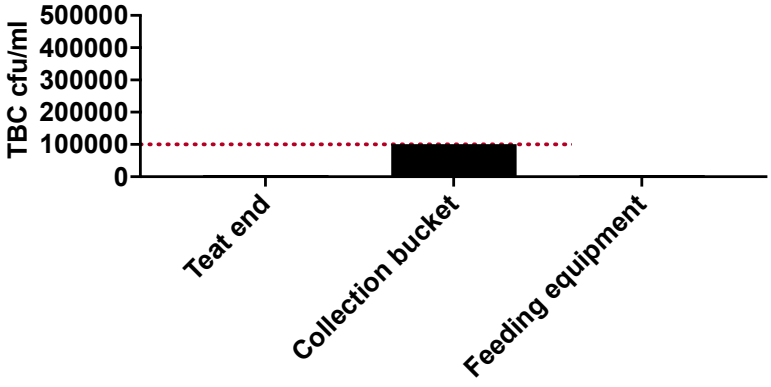
Achieving passive immunity.

UNIVERSITY OF GUELPH

Source: Haggerty et al. 2025

55

< 100,000 cfu/ml TBC



Quantity | Quali

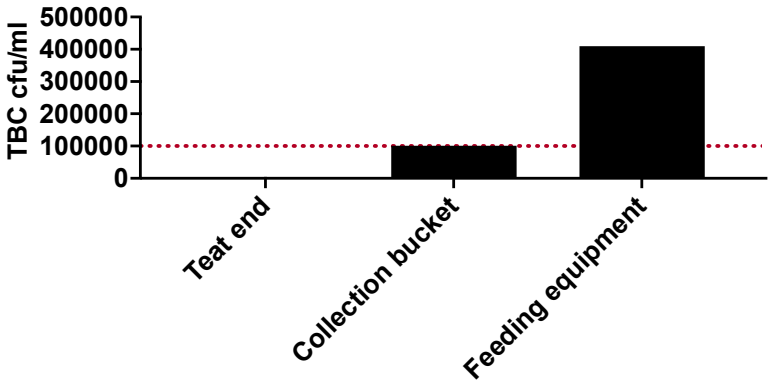
Achieving passive immunity.

UNIVERSITY OF GUELPH

Source: Haggerty et al. 2025

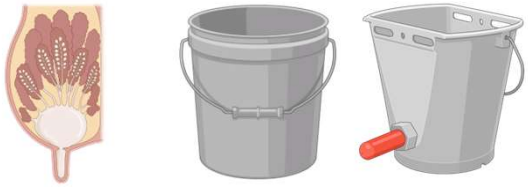
56

< 100,000 cfu/ml TBC



Quantity | Quali

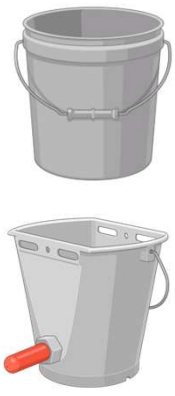
Achieving passive immunity.



UNIVERSITY OF GUELPH

Source: Haggerty et al. 2025

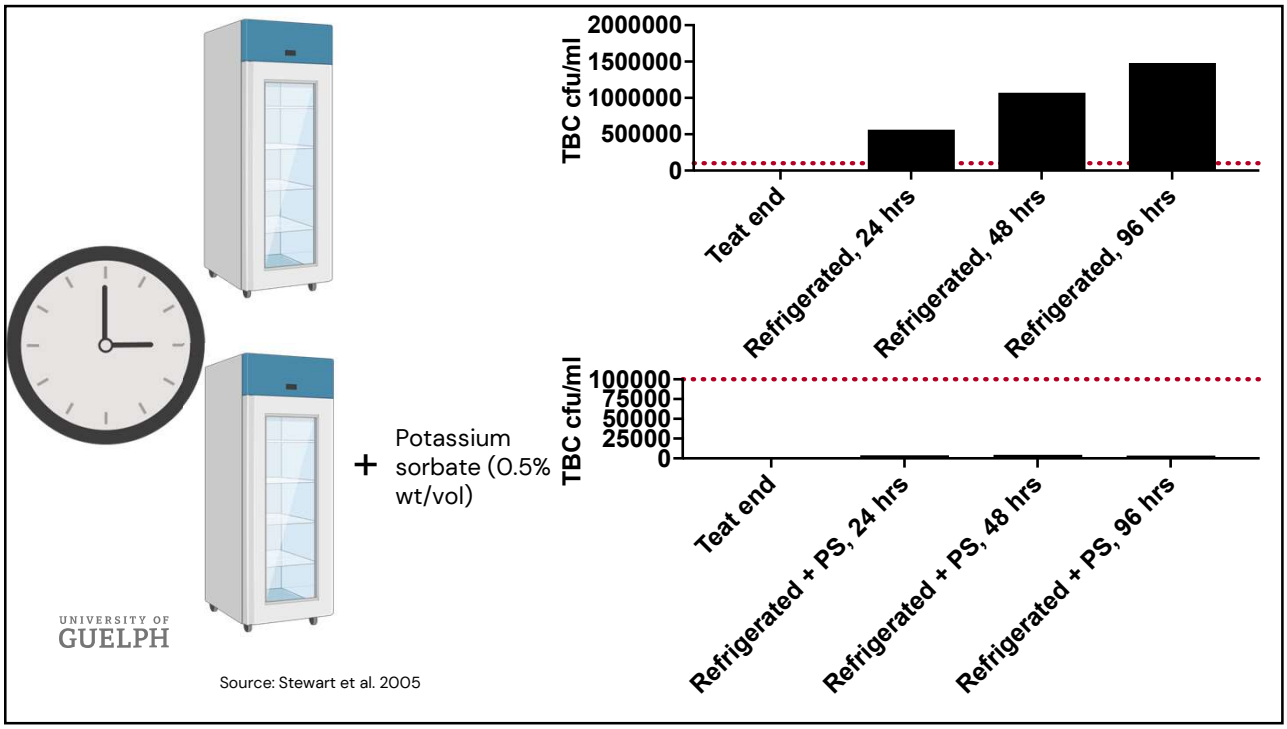
57



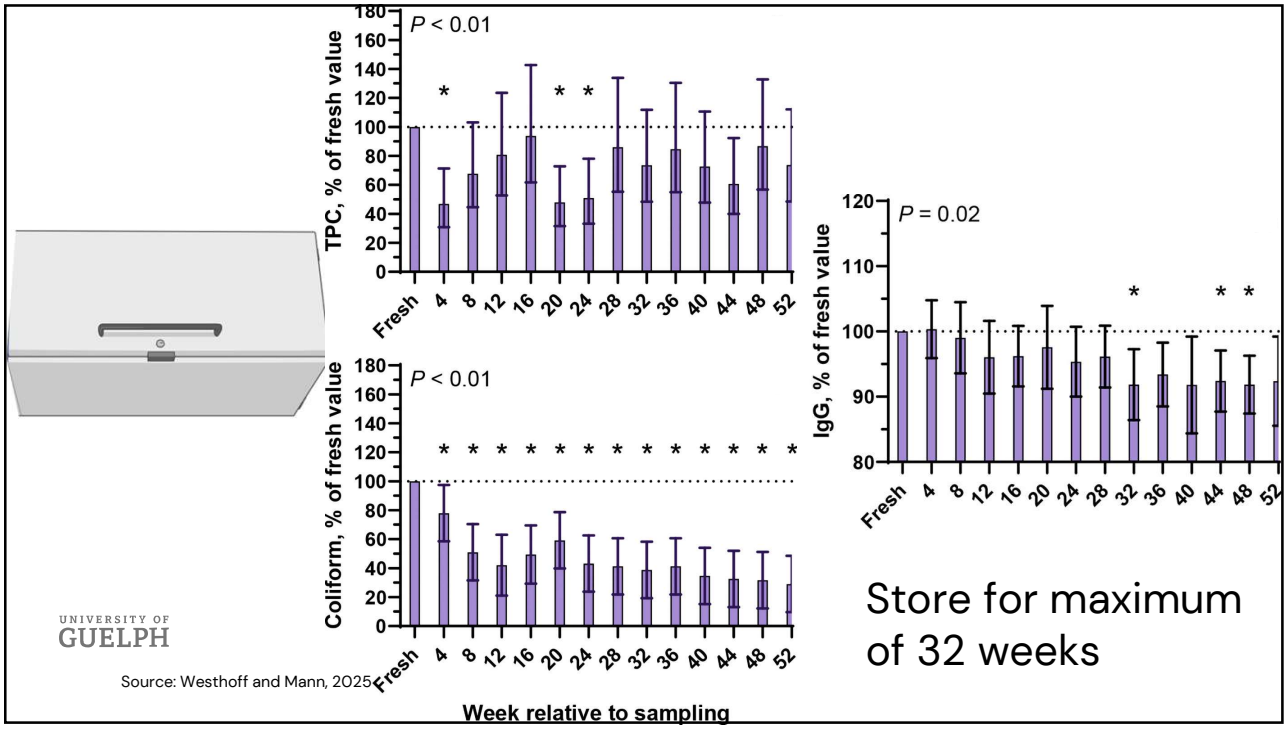
UNIVERSITY OF GUELPH

Source: Renaud et al. 2017

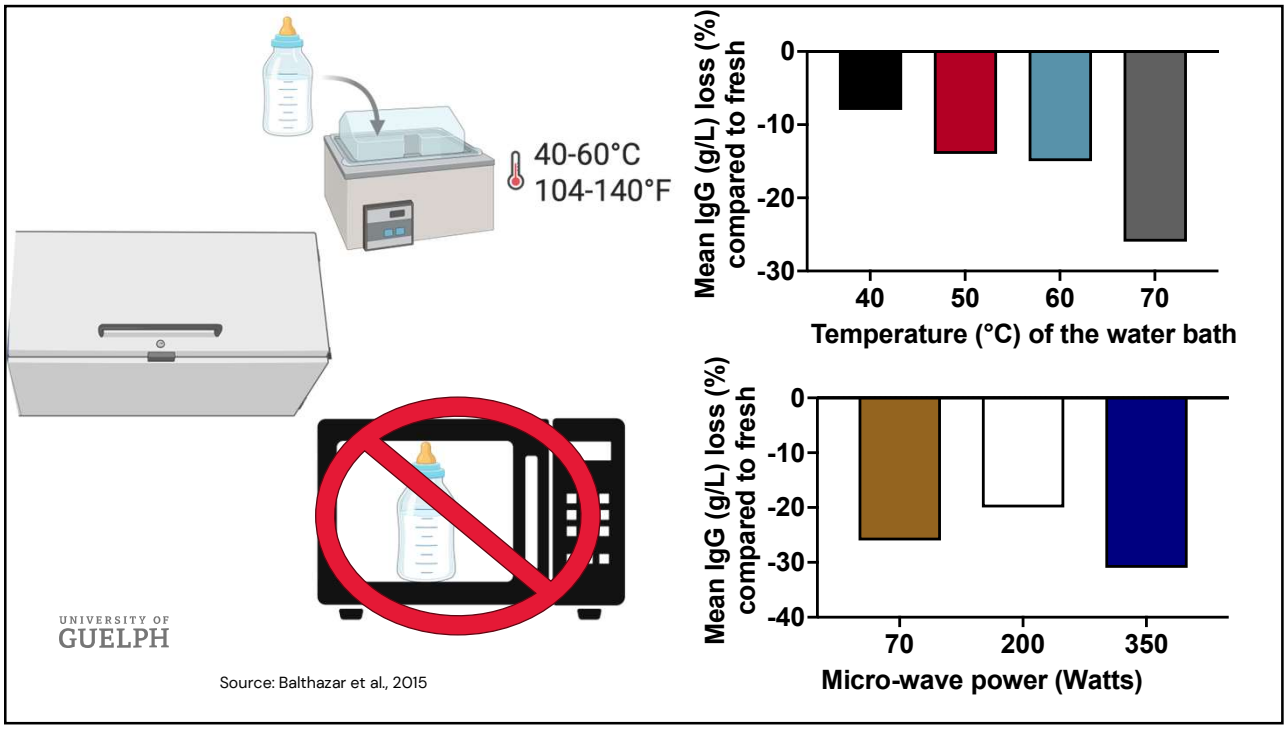
58


+
Potassium sorbate (0.5% wt/vol)
TBC cfu/ml
2000000
1500000
1000000
500000
0
Teat end
Refrigerated, 24 hrs
Refrigerated, 48 hrs
Refrigerated, 96 hrs
TBC cfu/ml
100000
75000
50000
25000
0
Teat end
Refrigerated + PS, 24 hrs
Refrigerated + PS, 48 hrs
Refrigerated + PS, 96 hrs
UNIVERSITY OF GUELPH
Source: Stewart et al. 2005

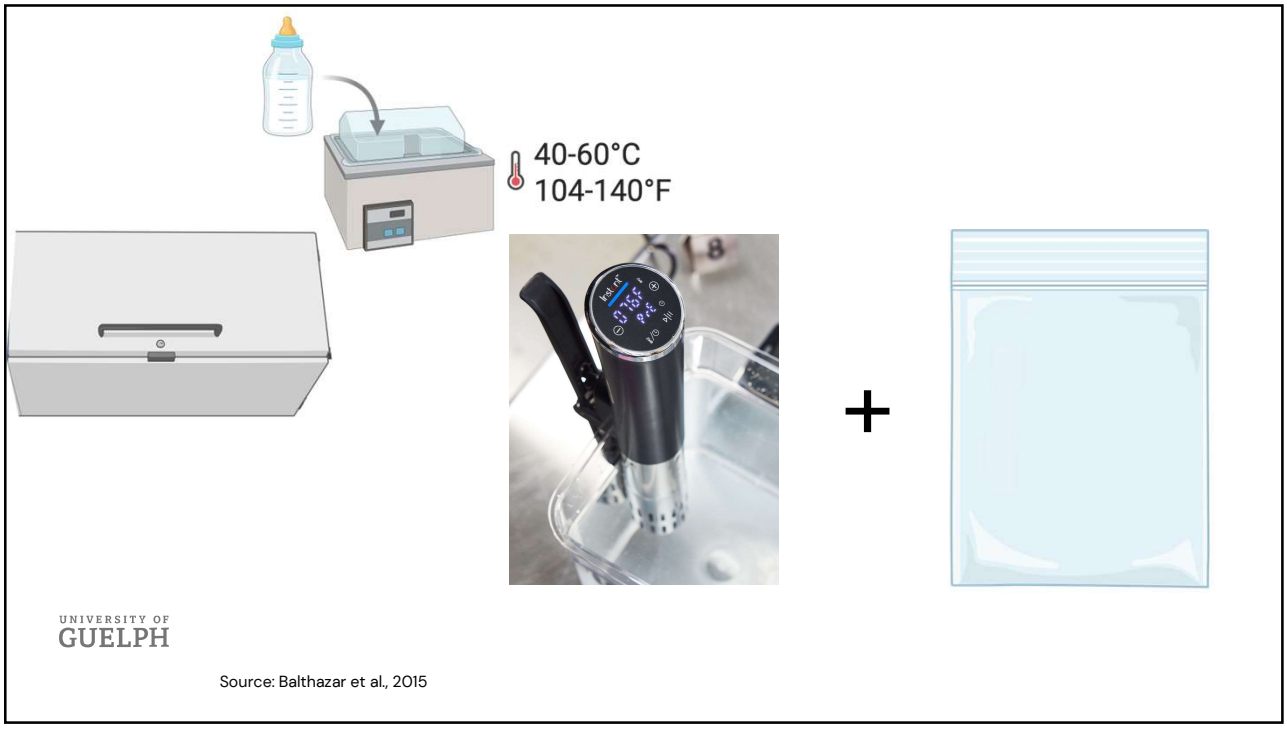
59


TPC, % of fresh value
P < 0.01
Coliform, % of fresh value
P < 0.01
IgG, % of fresh value
P = 0.02
Fresh
4
8
12
16
20
24
28
32
36
40
44
48
52
Week relative to sampling
Store for maximum of 32 weeks
UNIVERSITY OF GUELPH
Source: Westhoff and Mann, 2025

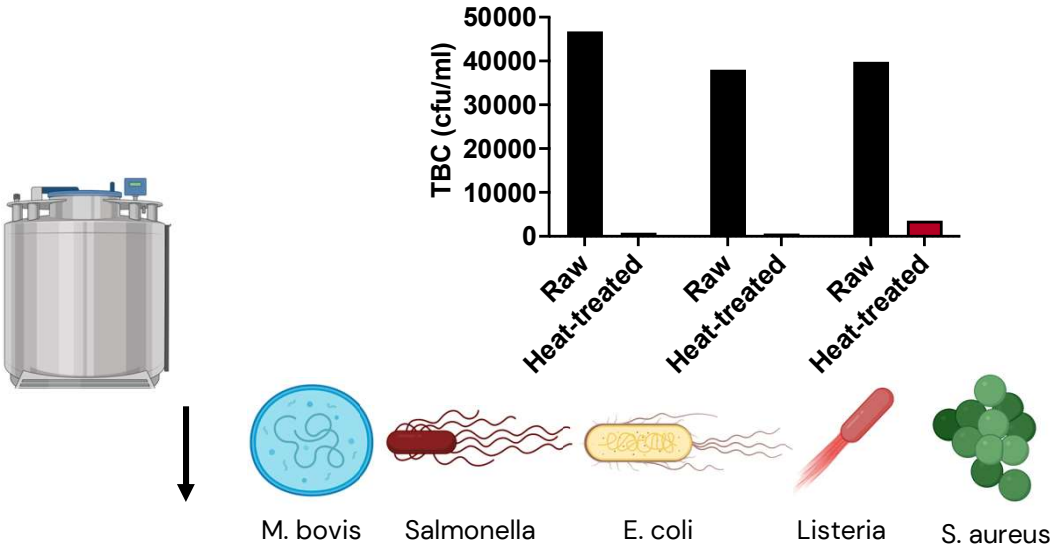
60


40-60°C
104-140°F
UNIVERSITY OF GUELPH
Source: Balthazar et al., 2015
Mean IgG (g/L) loss (%) compared to fresh
0
-10
-20
-30
40
50
60
70
Temperature (°C) of the water bath
Mean IgG (g/L) loss (%) compared to fresh
0
-10
-20
-30
-40
70
200
350
Micro-wave power (Watts)

61


40-60°C
104-140°F
+
UNIVERSITY OF GUELPH
Source: Balthazar et al., 2015

62

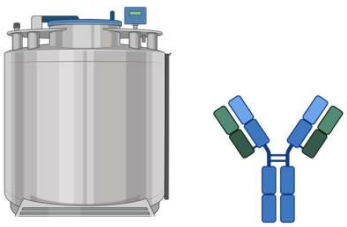


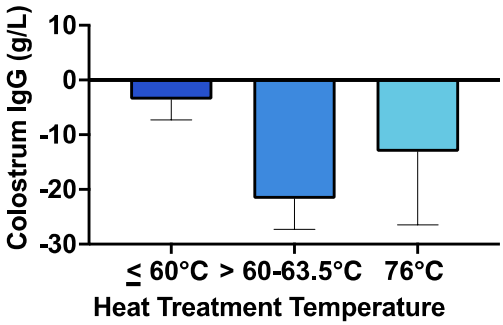
UNIVERSITY OF GUELPH

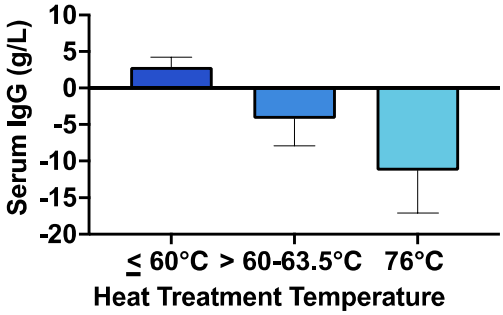
Source: Johnson et al. 2007, Gelsinger et al. 2015, Elizondo-Salazar et al., 2010, Godden et al., 2006

63

≤ 60°C



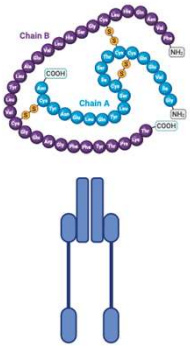


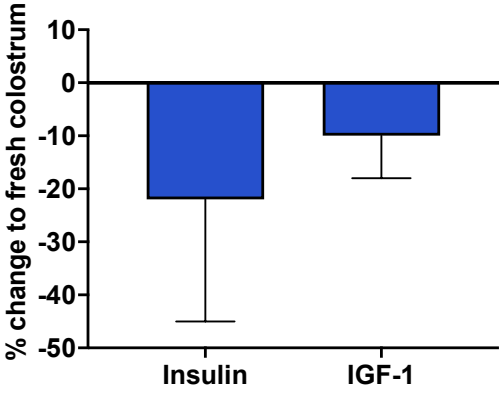


UNIVERSITY OF GUELPH

Source: Rabaza et al., 2023

64





UNIVERSITY OF GUELPH

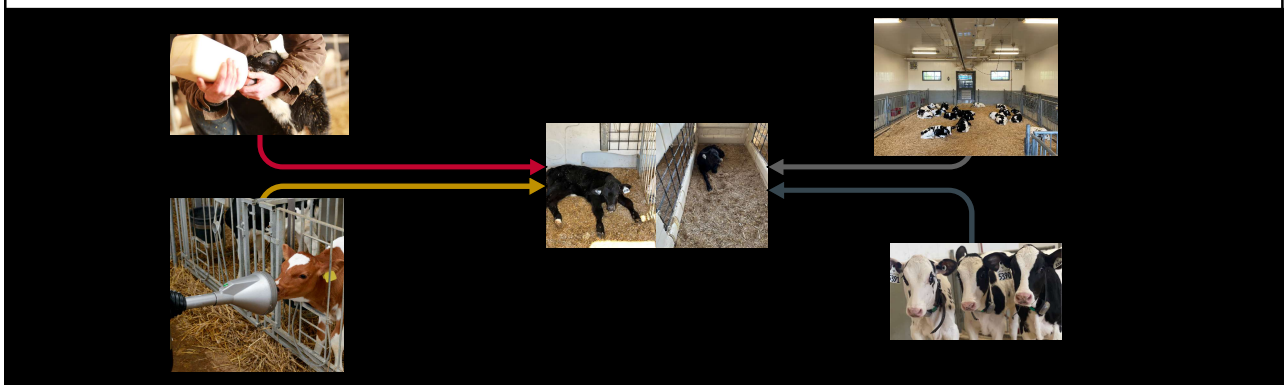
Source: Mann et al., 2020

65

66

Setting the Calf Up for Success

1. Colostrum management
2. Plane of milk nutrition
3. Environment
4. Early disease detection



67

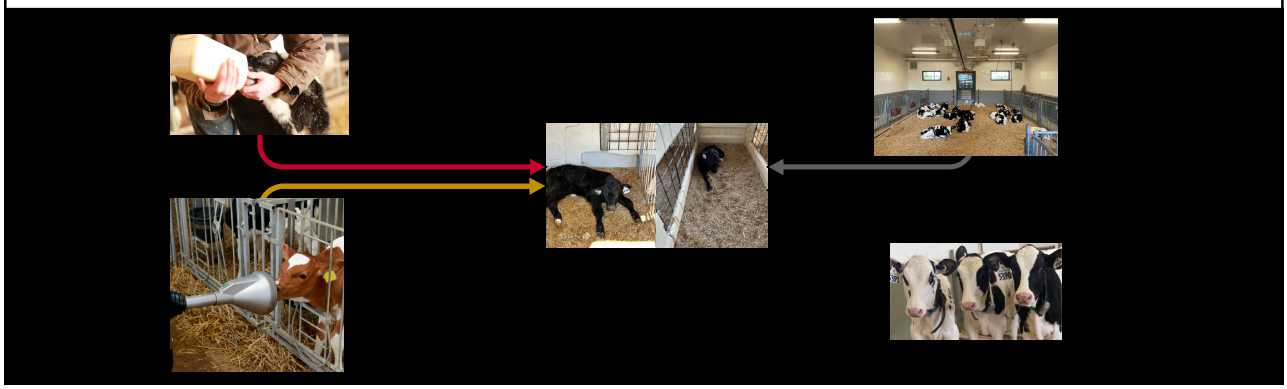
Settin for Su

ement
ion
ction

68

Setting the Calf Up for Success

1. Colostrum management
2. Plane of milk nutrition
3. Environment
4. Early disease detection



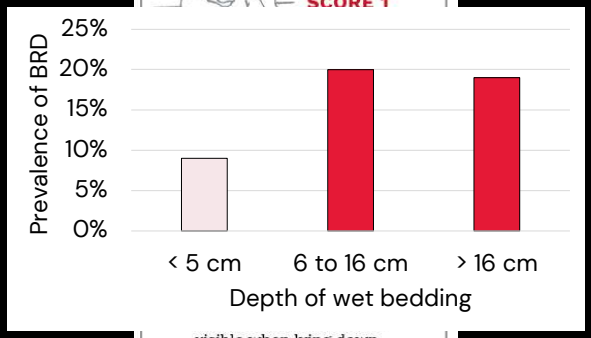
69

70

Managing the environment

1. Bedding

Source: Norlund, 2008; Medrano-Galarza et al., 2018



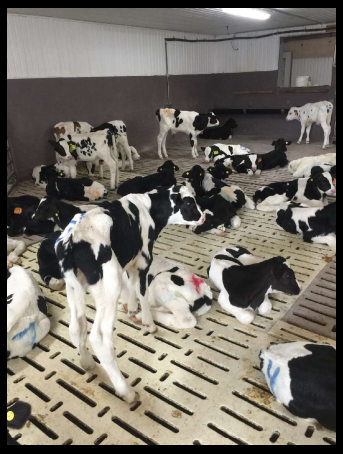
visible when lying down

71

Managing the environment

1. Bedding
2. Stocking density

Source: Norlund and Halbach, 2019; Medrano-Galarza et al., 2018



35 sq ft (3.25 sq m) / calf

≤ 10 calves per group

72

Managing the environment

1. Bedding
2. Stocking density
3. Ventilation

Deliv < 0.8

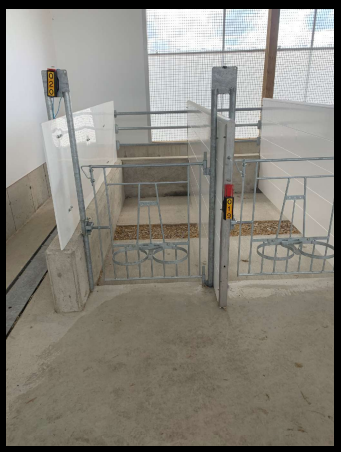
K

Source: Norlund and Halbach, 2019; Medrano-Galarza et al., 2018; van Leenen et al. (2020)

73

Managing the environment

1. Bedding
2. Stocking density
3. Ventilation
4. Drainage

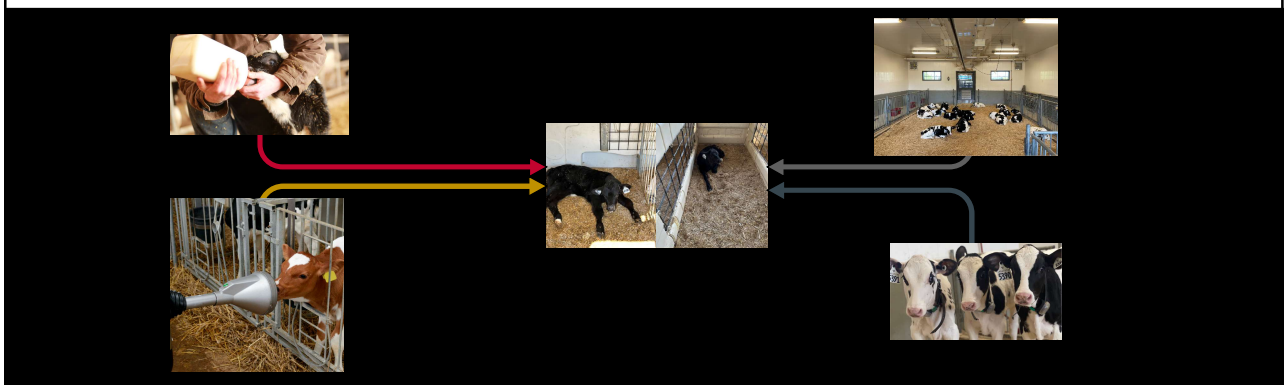


Source: Norlund and Halbach, 2019; Medrano-Galarza et al., 2018

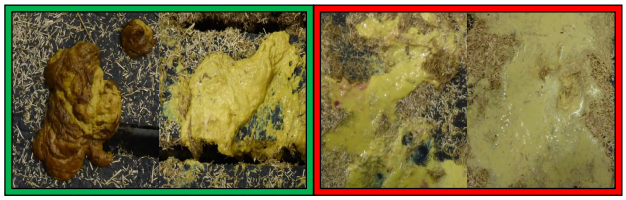
74

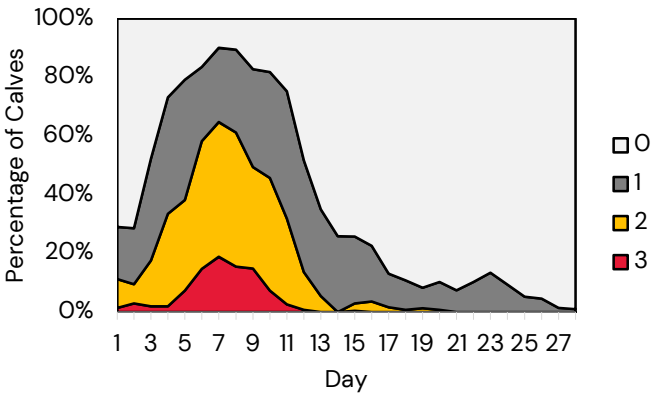
Setting the Calf Up for Success

1. Colostrum management
2. Plane of milk nutrition
3. Environment
4. Early disease detection

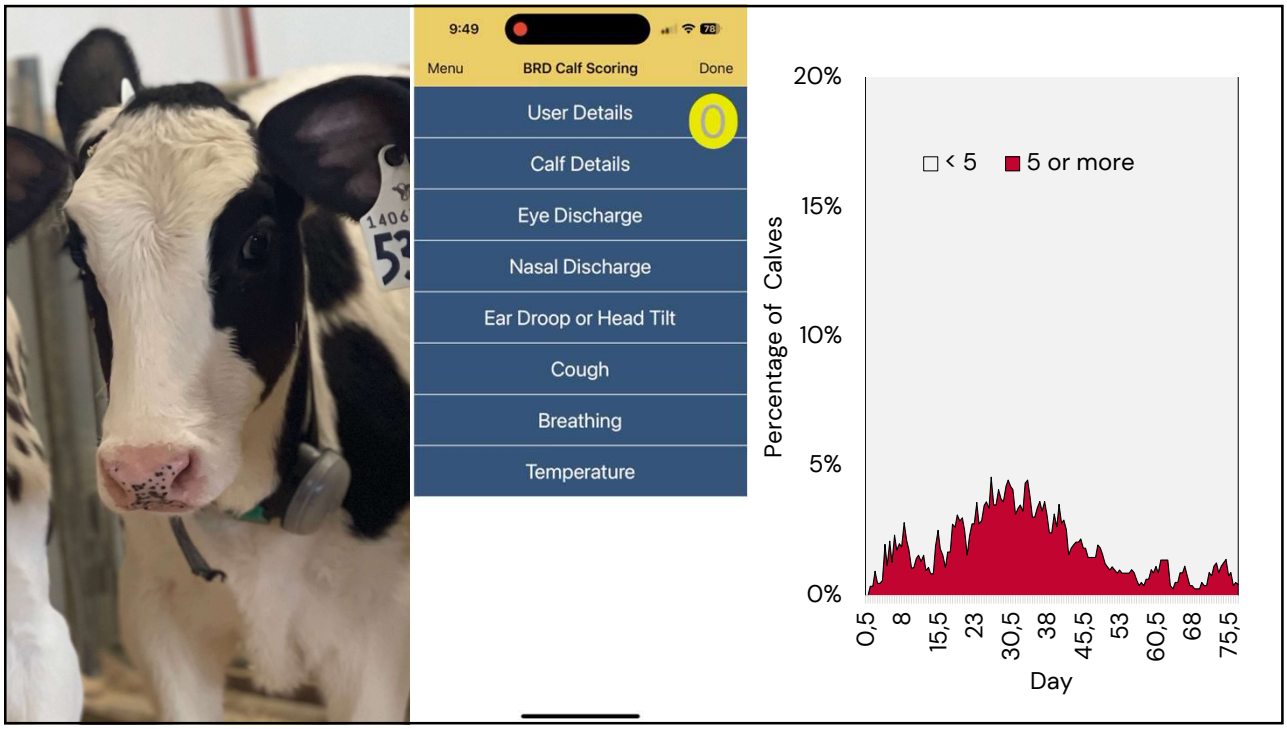


75

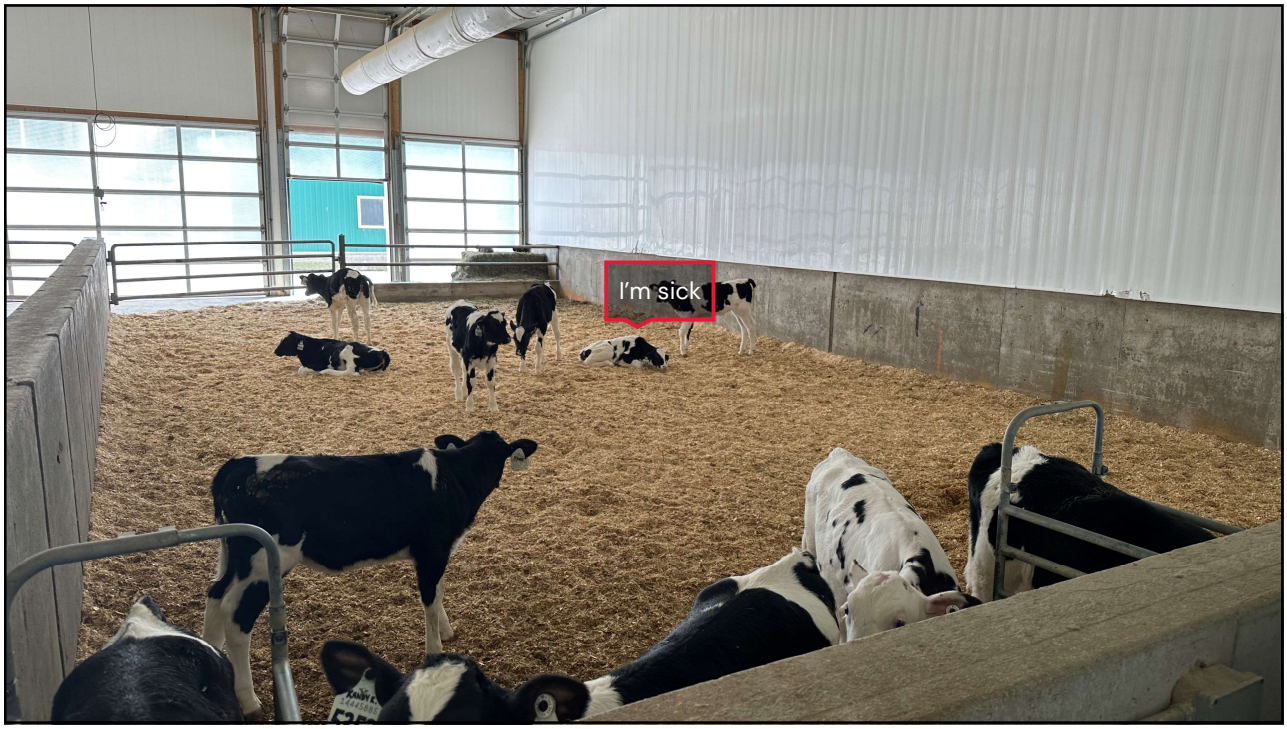




76


9:49
Menu
BRD Calf Scoring
Done
User Details
Calf Details
Eye Discharge
Nasal Discharge
Ear Droop or Head Tilt
Cough
Breathing
Temperature
20%
15%
10%
5%
0%
Percentage of Calves
< 5
5 or more
0,5
8
15,5
23
30,5
38
45,5
53
60,5
68
75,5
Day

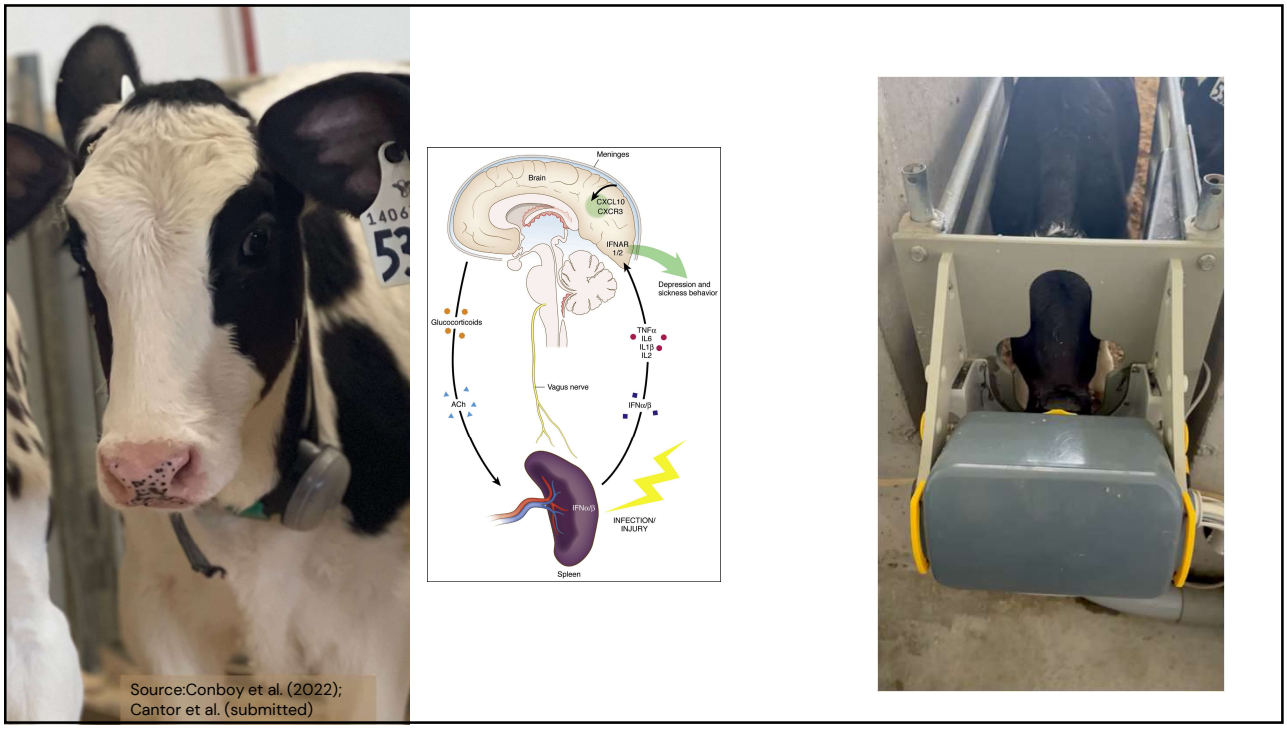
77


I'm sick

78


I'm sick

79


Meninges
Brain
CXCL10
CXCR3
IFNAR
1/2
Depression and
sickness behavior
Glucocorticoids
TNFα
IL6
IL1β
IL2
Vagus nerve
ACh
IFNα/β
IFNα/β
INFECTION/
INJURY
Spleen
Source:Conboy et al. (2022);
Cantor et al. (submitted)

80

Conboy et al. 2021

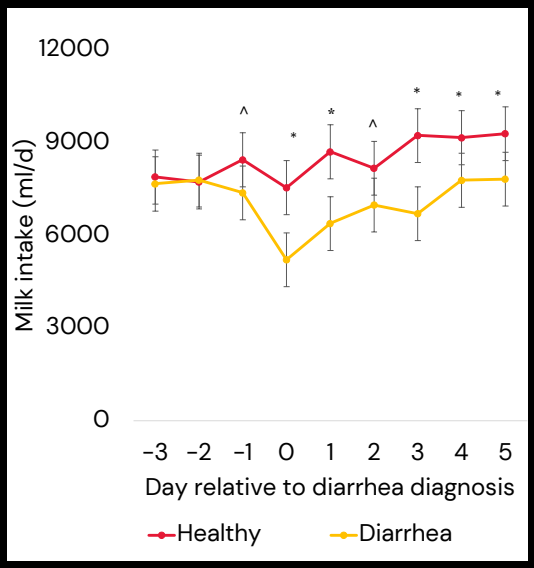
Calves with NCD were pair matched to healthy controls (31 pairs) by farm, gender, and age at case diagnosis to assess for differences in feeding behavior between case and control calves.

81

Conboy et al. 2021

Calves with NCD were pair matched to healthy controls (31 pairs) by farm, gender, and age at case diagnosis to assess for differences in feeding behavior between case and control calves.

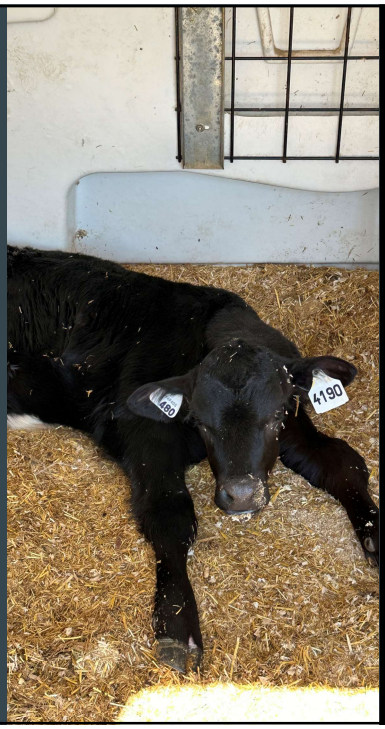
MILK INTAKE

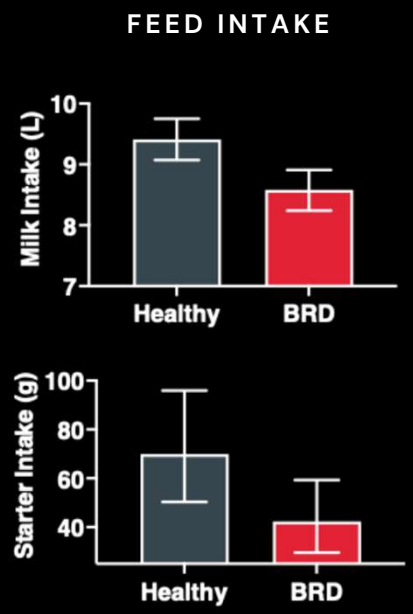


82

Cantor and Costa, 2022

Calves with BRD were pair matched to healthy controls (33 pairs) by sex and age at diagnosis to assess for differences in feeding behavior between case and control calves.

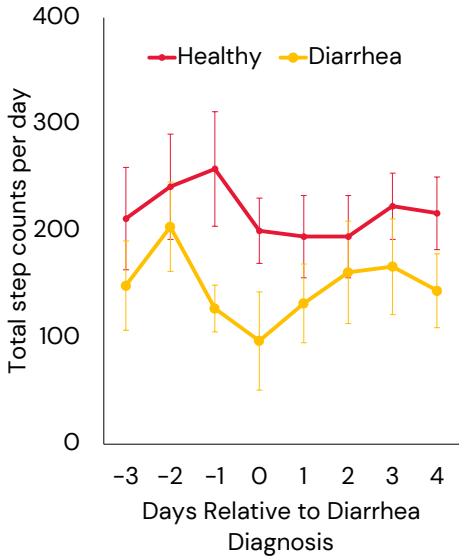




83

Guevara-Mann et al. (2023)

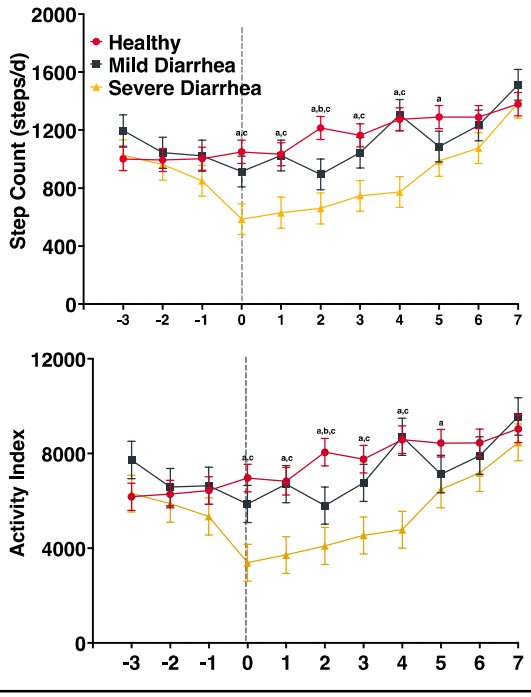
Case-control study where 13 calves with diarrhea matched to 13 healthy control calves. All calves were individually housed



84

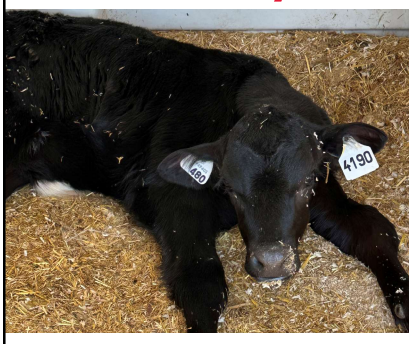
Welk et al., in prep

Compared calves had severe (n = 11; dehydrated/depressed) and mild diarrhea (n = 11) to healthy calves using pedometers



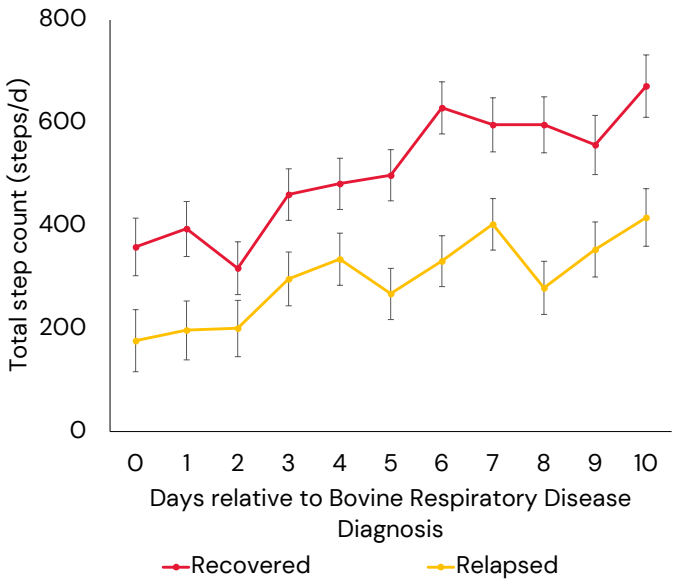
85

Can it be used for recovery?



Compared calves that recovered from BRD (n =19) with calves that relapsed (n = 19)

Source: Cantor et al., 2022



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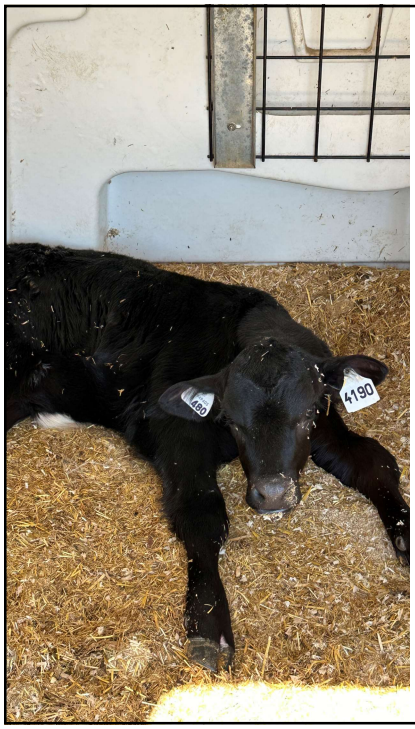

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Bovine respiratory disease scoring system for pre-weaned dairy calves[1,2,3]

Clinical sign	Score if normal		Score if abnormal (any severity)[4]	
Eye discharge	0		2	 Or  Or 
Nasal discharge	0		4	 Or  Or 
Ear droop or Head tilt	0		5	 Or  Or 
Cough	0	No cough	2	Spontaneous cough
Breathing	0	Normal	2	Rapid or difficult breathing
Temperature	0	< 102.5° F	2	≥ 102.5° F

Add scores for all clinical signs, if total score is ≥ 5, calf may be positive for bovine respiratory disease[3]

1. Love WJ, Lehenbauer TW, Kass PH, Van Eenennaam AL, Aly SS. (2014) Development of a novel clinical scoring system for on-farm diagnosis of bovine respiratory disease in pre-weaned dairy calves. PeerJ 2:e238. https://peerj.com/articles/238
2. Aly SS, Love WJ, Williams DR, Lehenbauer TW, Van Eenennaam AL, Drake C, Kass PH, Farver TB. (2014) Agreement between bovine respiratory disease scoring systems for pre-weaned dairy calves. Animal Health Research Reviews 15: 2 Pages 148-150 http://journals.cambridge.org/repo_A94AFI50
3. Love WJ, Lehenbauer TW, Van Eenennaam AL, Drake CM, Kass PH, Farver TB, Aly SS. Sensitivity and specificity of on-farm scoring systems and nasal culture to detect bovine respiratory disease complex in preweaned dairy calves. J Vet Diagn Invest. 2016 Mar;28(2):119-28. http://www.ncbi.nlm.nih.gov/pubmed/26796957
4. Any abnormality including, but not limited to, the examples shown in the above pictures.

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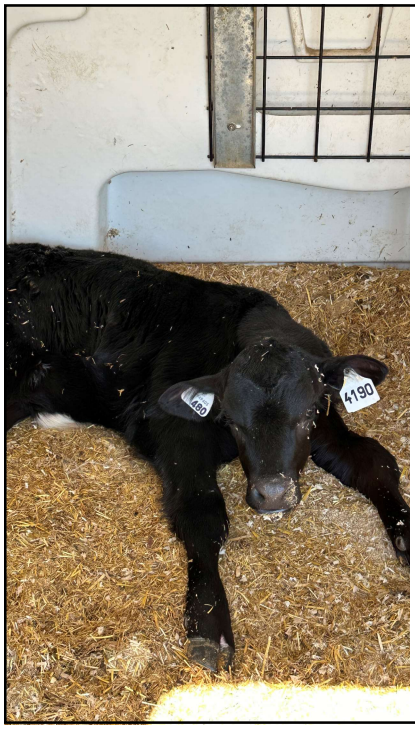

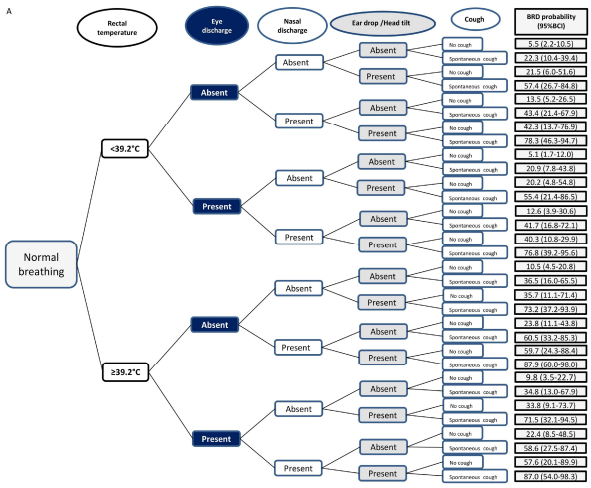

Source: Buczinski et al., 2018

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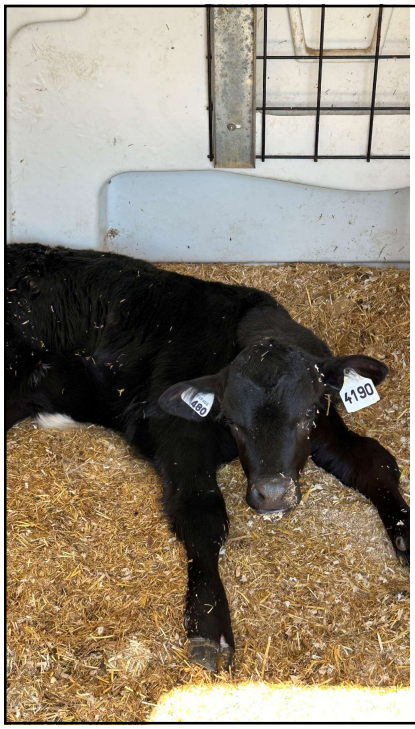

	Modified scoring rule	UC Davis score
Presence of dyspnea	20	2
Temperature ≥ 39.2°C	7	2
Eye discharge	1	2
Nasal discharge	10	4
Ear drop/Head tilt	16	5
Spontaneous cough	16	2
Maximal score	70	17

Source: Buczinski et al., 2018

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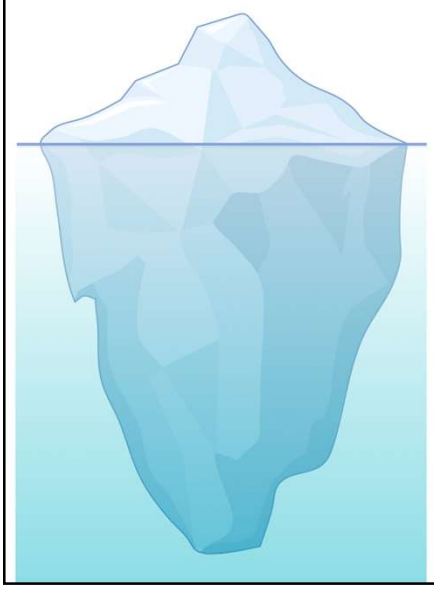

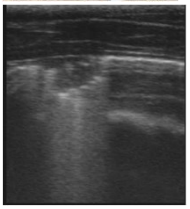

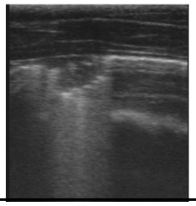

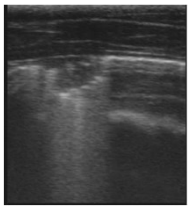

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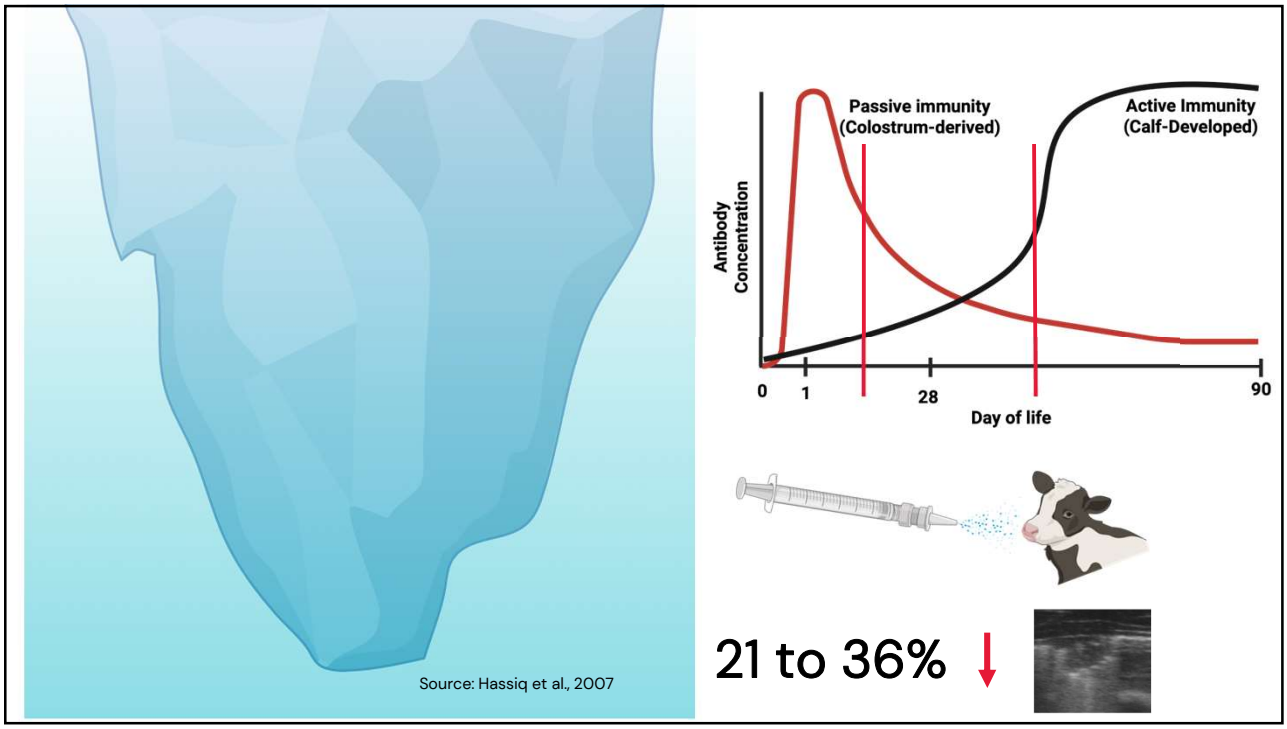
Source: Hassiq et al., 2007
Passive immunity
(Colostrum-derived)
Active Immunity
(Calf-Developed)
Antibody Concentration
0
1
28
90
Day of life
21 to 36%

91


Take Home Messages
Respiratory disease in early life very detrimental
Need to think about colostrum, nutrition, and the environment for prevention
Critical to evaluate feeding behavior in calves
Think about key symptoms in disease diagnosis
6-12-21
6A

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