Passive immunity related to calf mortality, morbidity, and performance

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Measuring total serum protein has been used as an indicator of adequate colostral antibody transfer in young calves. The cutoff has been a minimum of serum total protein (STP) of 5 or 5.2 g/dL. But more recently, Lombard et al. 2020, proposed 4 categories of: poor < 5.1 g/dL, fair 5.1 to 5.7 g/ dL, good 5.8 to 6.1 g/dl, and excellent ≥ 6.2 g/dL. To evaluate how these categories relate within a herd, a retrospective cohort study (Crannell and Abuelo 2023) was done in one large well-managed herd (which I have been on several times).

This herd has about 3,500 lactating cows and a rolling herd average of 27,000 lb per cow. At birth calves were weighed and given an intranasal vaccine against respiratory virusesan oral vaccine against digestive tract pathogens, and a vitamin E/selenium supplement subcutaneously. All calves received at least 3 L of > 22% Brix fresh or thawed colostrum via an orogastric tube 30 minutes after birth. Until 7 days of age, all calves were housed individually in stalls inside a barn and fed 3 L of 28% protein/20% fat milk replacer mixed at 15% solids, 3 times daily. Then calves were raised either in individual stalls and bucket-fed 3 L of milk replacer 3 times daily until weaning or in groups of up to 22 calves with automatic feeding systems where calves were allowed up to 2 L per feeding over a maximum of 8 feedings daily, with 2 hours between each feeding.

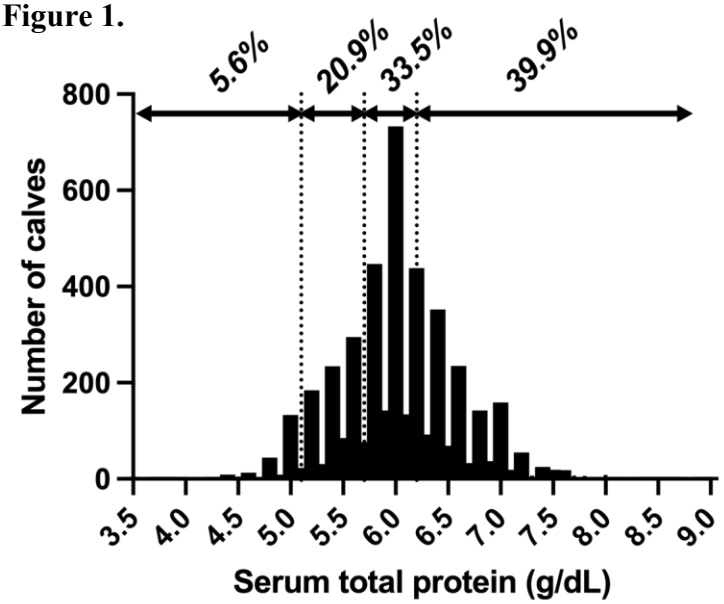
In both feeding systems, calves were weaned using a step-down approach that started gradually decreasing the amount of milk replacer offered at 7 weeks of age for weaning at 10 weeks of age, when calves were weighed again. Ad libitum water was available from birth, and a starter (20% protein, 2.5% fat, 7.5% fiber) was introduced at 1 week of age. After weaning, all heifers were managed together in free stall pens grouped according to age and reproductive status. Heifers were inseminated by trained farm staff based on observed standing estrus once they reached 12 months of age and weighed more than 800 lb. Pregnancy was confirmed via rectal ultrasonography 30 to 40 days after insemination by the herd veterinarians.

The herd veterinarians collected blood sample for STP determination in a weekly random sample of 12 to 20 calves 2 to 7 days old. The STP data were used from January 2014 to April 2017 to ensure that all heifers could have reached first lactation at the beginning of data extraction. Calves were classified into the 4 categories of TPI proposed by Lombard et al. (2020) as noted above. Respiratory and diarrhea scores were noted and calves treated as needed.

A total of 4,480 STP records from calves were available. An extensive statistical analysis is explained in the paper.

The STP ranged from 3.6 to 8.8 g/dL and are depicted in **Figure 1**. Overall, 246 (5.6%), 905 (20.9%), 1,456 (33.5%), and 1,729 (39.9%) of calves were classified as poor, fair, good, and excellent, respectively; and closely mimics the Lombard et al. (2020) consensus recommendation for the percent of a farm's calves in each category (poor 40%), indicating that the colostrum feeding management at this farm was satisfactory.

Figure 1.



Averages were:

- birth weight 88.5 lb with an intra quartile range of 15.9 lb
- median weaning age was 72 with an intra quartile range of 58–83 days
- most calves (90.9%) were bucket-fed
- only 1.45% were twins
- overall prevalence of preweaning BRD (bovine respiratory disease) in the data set was 17.6% with a median (interquartile range) age at first disease diagnosis of 30 (41) days.
- prevalence and median ages at diagnosis for diarrhea and any preweaning disease were 38.0%, 9 (3) days, and 48.4%, 9 (5) days, respectively
- preweaning mortality was 1.36%, with a median (interquartile range) age at death of 17 (32) days.
- a total of 415 (9.25%) calves experienced both diarrhea and BRD.
- Overall, risks of BRD, diarrhea, and morbidity in this herd were greater than reported in the last national survey as 9.5, 17.2, and 33.8%, respectively (Urie et al., 2018),
- the preweaning mortality of 1.36% was lower than the 5 to 11% US national averages reported in previous US studies (NAHMS, 1994, 2007; Urie et al., 2018).

Data in **Table 1** indicate that as transfer of passive immunity decreased, the likelihood (hazards ratio) of diarrhea, respiratory disease, and any disease increased accordingly. That same relationship did not hold for mortality until poor transfer of passive immunity category was reached. Of course, the mortality in this herd database was quite low at 1.36%, so only the poor category had real impact.

Table 1. Relationship of transfer of passive immunity categories to preweaned health events and mortality.

Variable	Hazard ratio	*P*-value
Diarrhea (n = 1,706)		
Excellent	Referent	
Good	1.14	0.02

Fair	1.32	<0.001
Poor	1.49	<0.001
Respiratory disease (n = 790)		
Excellent	Referent	
Good	0.88	0.15
Fair	1.17	0.11
Poor	1.39	0.02
Any disease (n = 2,173)		
Excellent	Referent	
Good	1.07	0.19
Fair	1.21	<0.001
Poor	1.51	<0.001
Mortality (n = 61)		
Excellent	Referent	
Good	1.05	0.89
Fair	1.50	0.26
Poor	4.29	<0.001

During subsequent calf growth, breeding, and first lactation milk yield (**Table 2**), there was little difference among passive immunity transfer categories except first lactation yield tended to be lower at Excellent and Poor categories. This is inexplicable. Authors speculated than no difference in daily gain post-weaning may have been due to the high milk feeding program resulting in 1.54 daily gain for 74% of all heifer calves preweaning.

Table 2. Calf subsequent performance related to passive immunity transfer categories.

Category	Excellent	Good	Fair	Poor	*P*-value
Disease events	0.30	0.34	0.35	0.55	0.02
Daily gain, lb	1.70	1.74	1.72	1.72	0.39
No inseminations	1.84	2.04	2.00	1.95	0.42
First lactation, 305ME, lb	33,219	34,208	35,263	33,587	0.20

Authors noted some limitations with this study.

- The herd was large and well-managed so results only applied to this herd.
- Health scoring may not have been specific enough so some calves may have been misclassified.
- Since this was an observational study, no cause and effect could be determined.

The Bottom Line

This large well-managed herd study found some differences among passive transfer immunity categories in health for young preweaned Holstein heifer calves when most diarrhea

and respiratory diseases occur, Colostrum is influenced by so many factors that it must be well-managed and recorded to minimize potential health issues related to colostrum quantity, quality, and administration.

References

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