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Calf Note #217– New Recommendations for Passive Immunity in Newborn Dairy Calves

Introduction

Newborn calves need to receive colostrum in the first 24 hours after birth to achieve levels of immunoglobulins in the blood to protect them against disease-causing pathogens such as bacteria, viruses, and protozoa. We've known the importance of feeding sufficient high-quality colostrum for many years, but the extent of failure of passive transfer (FPT; defined as serum IgG concentrations <10 g/L when measured at 24-48 h of age) in the United States was unknown. Also, the effects of FPT on calf mortality in the United States was unclear, although effects of FPT on calf survival had been reported extensively in the research literature.

In 1993, the USDA National Animal Health Monitoring System (NAHMS) reported the results of the first National Dairy Heifer Evaluation Project, which measured 1,811 farms in 28 states and represented 78% of the dairy cow population in the U.S. The NAHMS study reported that 41% of calves had FPT (USDA, 1993). Further, survival of calves with FPT was markedly lower in calves with FPT compared to those with successful passive transfer of immunity (Figure 1). These data had a profound effect on the industry, and efforts by university Extension, veterinarians, nutritionists, and other dairy experts were made to improve on-farm colostrum management and calf survival. Subsequent studies by NAHMS recorded the success of these efforts on rates of FPT and calf survival. The latest NAHMS study, conducted in 2014 (USDA 2016, 2018), indicated that only 13% of heifer calves had FPT and almost 73% of heifers had >15 g of IgG/L of serum (Urie et al., 2018a). Note that the comparison between the various NAHMS studies is a bit "tricky" because different populations of animals were measured. For more information, see Calf Note 143).

The research also indicated that calf mortality had declined also (Urie et al., 2018b), but the overall rate of calf morbidity had changed little since 1993 (Figure 2). In 2014, approximately 38% of calves had at least one sickness event prior to weaning. The lack of change in preweaning morbidity while calf mortality declined suggests that the standards for serum IgG don't adequately account for calf disease events.

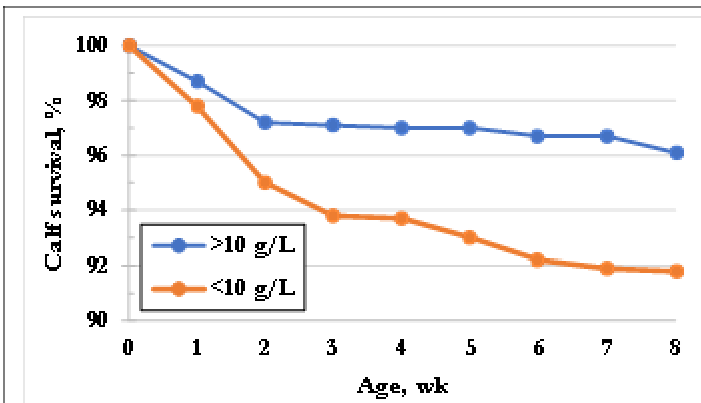

Figure 1. Calf survival by serum IgG concentration at 48 hours of age. USDA, 1993.

Simply put, while the target of 10 g of IgG/L of serum is a good target for *calf mortality*, it seems to have no effect on *calf morbidity*. Think of it this way – the serum of 10 g/L at 24-48 h of age may tell us about the risk of dying, but doesn't really tell us much about when calves get sick. Calves with serum IgG >10 g/L also get sick, but are less likely to die. This suggests that our threshold of FPT may be adequate for predicting calves at greater risk of preweaning mortality, but it is not prescriptive of calf morbidity.

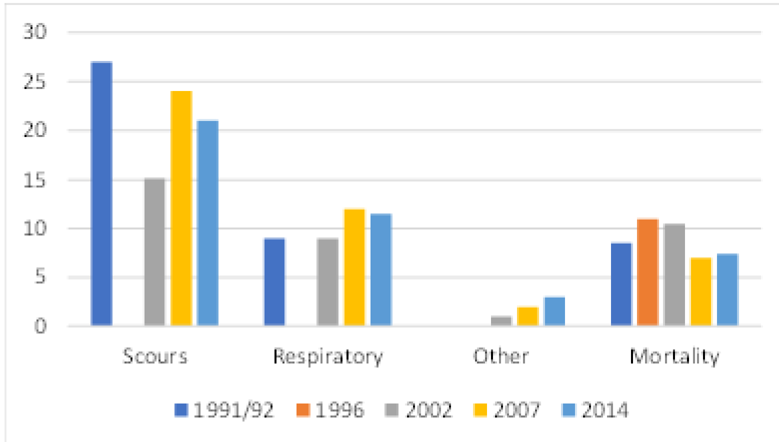

Figure 2. Percentage of morbidity caused by diarrhea, respiratory factors, and other conditions, and preweaning mortality reported by USDA NAHMS studies. Adapted from: Lombard et al., 2020.

In an article published in 2020 in the Journal of Dairy Science (Lombard et al., 2020), a group of calf experts reviewed the existing research literature, the results of the 2014 NAHMS dairy calf study, and provided their own professional expertise to propose new recommendations on herd-level passive immunity in dairy calves. These recommendations should improve on-farm management of newborns and give producers, veterinarians, Extension agents, and other professionals benchmarks to which we can determine a farm's performance.

The expert group reanalyzed results of the 2014 NAHMS study, specifically around options for various cut-points for adequate serum IgG concentrations. There were four options considered, and morbidity and mortality data were reanalyzed using several statistical approaches and groupings. Statistics for the option ultimately adopted by the group is in Table 1.

Serum IgG, g/L	Calves, %	Morbidity, %	Mortality, %	Standard, % calves
<10.0	12.0	46.1	7.4	10.0
10.0 – 17.9	26.8	36.1	3.8	20.0
18.0 – 24.9	25.7	34.8	1.5	30.0
≥25.0	35.5	28.5	2.5	40.0

Table 1. Percentage of calves in the 2014 NAHMS study by serum IgG category and reported morbidity and mortality (Lombard et al., 2020).

As you can see, the % morbidity declined with increasing serum IgG above 10 g/L. There was generally little difference in calf mortality above 18 g/L. Note that the current proportion of calves in each group. Since these were the actual data from the 2014 study, the expert group considered that standards should be aspirational… that is, a goal for producers to achieve.

The last column in Table 1 shows the new recommendation for the percent of calves in a herd that fall into the new categories. These represent a significant departure from the yes/no calculation of success / failure of passive transfer (< or > 10 g of IgG/L of serum) that we've relied on for many years.

Note that these new recommendations are based on *herd-level* measures. What is the difference between calf-level and herd-level measures? A *calf-level* measure is the specific measurement of an individual calf, and *herd-level* measure is the proportion of calves on the farm that fall into specific categories. Measuring individual calves can tell you if that calf is at greater risk, but it's necessary to truly understand the overall farm (i.e., herd-level) risk, to measure a subset to calves to know what percent fall into the relevant categories. This is more informative and useful than simply looking at individual animal values.

It's important to understand that, because of the many factors that affect an individual calf's ability to ingest and absorb IgG, not every calf will achieve serum IgG concentrations above a critical threshold. Even in highly controlled research trials wherein calves were fed >200 g of IgG within the first 2 hours of life, some calves may fail to absorb much IgG into their bloodstream. Thus, it is expected that at least a small percentage of calves will have failure of passive transfer.

Applying on Farm

To implement this new *herd-level* recommendation, producers must establish a routine to monitor enough calves to calculate the % of the herd in the various categories. I suggest that producers should establish a schedule to collect blood from calves within the first 48 hours, if possible. Generally, blood can be taken up to 5 days after birth, but recognize that accuracy of BRIX measurements decline as the calf gets older.

For smaller herds, it makes sense to sample all the heifers. If you're not familiar with blood collection, centrifugation and measurement, work with your vet to set up a regular program of blood collection. If you're monitoring each heifer calf, you may be sampling individual calves. It's not a good idea to try to preserve whole blood, and the process after centrifugation is very simple, so it's best just to analyze each calf when it is 1 or 2 days old.

For larger herds (greater than, say 500 cows), you can sample every heifer (or every other heifer) as they're born, or you could select one or two days per week and sample all the calves that are 1-3 days of age on that day of the week.

It's logical to select a time increment to evaluate your program. Let's say, to start, that you'll evaluate your profile once per month. Large herds, collecting more than 100 samples per month could evaluate their program weekly. You'll measure the serum BRIX values and enter them into a database (e.g., Excel spreadsheet). Then, you can calculate the % of each category. Be sure to look at the data periodically so you can see if changes occur.

In a future Calf Note, I'll make an Excel spreadsheet available for producers who would like to monitor their programs.

Summary

The consensus recommendation is that herds attempt to reach the following targets to reduce both calf mortality AND calf morbidity:

- 40% of the herd achieves >25 g of IgG/L of serum when measured at 24-48 h of age
- 30% of the herd achieves 18.0 to 24.9 g/L
- 20% of the herd achieves 10.0-17.9 g/L

- <10% of the herd achieves <10.0 g/L

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