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## *Calf Note 203 – Preweaning morbidity and mortality in the U.S.*

### Introduction

The U.S. Department of Agriculture National Animal Health Monitoring System (NAHMS) conducts annual surveys of animal agriculture in the U.S. From time to time, they conduct surveys of calf and heifer management practices. It's a fantastic opportunity to understand the "state of the industry" in the U.S. and, using data from previous studies, determine the rate of change in biologically and economically important

In 2018, a series of manuscripts was published in the Journal of Dairy Science that provided results of the most recent NAHMS study on preweaning calf management. These papers report results from the investigation and provide important insights into how we're doing as an industry in the U.S. This Calf Note will review the factors that influence preweaning morbidity and mortality on dairy farms in the U.S

### The Research

During 2014, the USDA surveyed 104 different dairy farms in 13 states. Farms were divided into West (California, Colorado, and Washington) and East (Iowa, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin). The survey lasted over 1.5 years and followed calves from birth to weaning. Data were collected on a total of 2,545 heifer calves. (NOTE: It's important to remember that the data reflect management practices for HEIFER calves and cannot be applied to management of BULL calves, or of farms that raise their bull calves.) The researchers monitored calf survival and health as well as many different management, environmental and feeding practices. Then, they evaluated the data statistically to determine which factors affected important outcomes, including calf morbidity and mortality. Most of the calves were Holsteins (89%) and the remainder were Jerseys or Jersey × Holstein crosses, with a small proportion of other dairy breeds. More information on the methods used to collect information from the dairies is available at Uline et al. (2018a).

### Calf Mortality

Preweaning heifer mortality is an important economic loss to the farm. It is also an important animal welfare consideration. So, understanding the current state of the industry as well as those factors that influence preweaning heifer mortality is essential to improving our management to minimize this economic loss.

Calves were enrolled by the farm and – importantly – calves needed to be alive at 24 hours to be enrolled in the study. Therefore, calves that died prior to 24 hours were excluded from the study. Therefore, these "stillborn" calves were not considered in the statistics.

Of the 2,545 calves enrolled in the study, there were a total of 128 calf deaths prior to weaning (weaning occurred at an average of 66 days of age), or a total of 5% heifer mortality. The causes of death are in Table 1.

| Cause of mortality | No of calves | % of total | Mean age (d) | Min age (d) | Max age (d) |
|---|---|---|---|---|---|
| Digestive | 41 | 32.0 | 18.3 | 6 | 78 |
| Respiratory | 18 | 14.1 | 37.5 | 3 | 70 |
| Dig. & resp. | 9 | 7.0 | 18.6 | 5 | 44 |
| Unknown | 32 | 25.0 | 25.7 | 2 | 71 |
| Other* | 17 | 13.3 | 27.0 | 8 | 75 |
| Not reported | 11 | 8.6 | 23.0 | 5 | 62 |
| Total | 128 | 100.0 | 24.4 | 2 | 78 |

Table 1. Description of cause of mortality in preweaned heifer calves in the U.S. in 2014. Adapted from Urie et al. (2018b).

*Other included infection, injury, or calves that were sold without a recorded reason.

Most mortality (32% of all mortality) was caused by digestive disease, which is typically recorded as calf diarrhea. Some calves also died from a combination of diarrhea and respiratory disease (7% of calf mortality); thus, digestive diseases are an important area for concentration to improve calf health and reduce mortality.

Most calf mortality occurred in the first 3 weeks of age. Calves that died from diarrhea tended to die at an earlier age than those with respiratory or unknown causes. This is probably related to the types of organisms causing the disease and their incubation period. However, it's clear that preweaning mortality is primarily a young animal phenomenon.

The factors that influenced calf mortality in the NAHMS study included birth body weight, serum IgG concentration, amount of fat in the liquid diet (in kg/day), and if the calf also had disease prior to weaning.

Birth BW affected mortality. Smaller calves tended to die at a greater frequency than larger calves. For example, the authors (Urie et al., 2018b) compared calves weighing 35 and 45 kg at birth. Predicted mortalities for these two birth BW in their statistical model were 4.7 and 2.3%, respectively. Within breed, calves that were exposed to stress while in utero (e.g., heat stress) tend to be born smaller and have a greater risk of mortality. Also, calves that have a younger gestational age at birth will have less development of organs and tissues, which may also contribute to increased mortality.

Serum IgG affected calf mortality, also. As expected, calves with greater serum IgG concentrations had lower risk of mortality compared to calves with less serum IgG. As noted in the article, calves with 8 g/L of serum IgG (indicative of failure of passive transfer of immunity) had a risk of mortality of 5.2%, whereas calves with 30 g/L (indicative of excellent passive immunity) had a 2.0% risk of mortality. Clearly, the investment in proper colostrum management pays great dividends in reducing the risk of calf mortality.

Increasing the amount of fat fed to calves was also associated with lower risk of calf mortality. Calves fed more fat had lower risk of mortality. However, it's valuable to put this observation into perspective. The amount of fat fed to calves was grouped into one of three categories: ≤0.15 kg/d, 0.16-0.21 kg/d and ≥0.22 kg/d. Let's see what this means regarding amounts of liquid fed to calves. For example, if we feed a milk replacer containing 20% fat on an air-dry basis, feeding 0.15 kg/fat per day is equivalent to feeding 0.750 kg of milk replacer powder per day. When whole milk is fed (3.7% fat on a liquid basis), this is equivalent to approximately 4 kg of whole milk per day.

The authors noted no difference between feeding the moderate amount of fat (0.16 to 0.21 kg/d) and higher amounts of fat (≥0.22 kg/d), suggesting that the key in this observation is when calves

are fed too little fat (≤0.15 kg/d). In this case, there may be too little energy available to support both maintenance and body weight gain. Greater amounts of fat don't seem to continue to reduce risk of mortality. Several studies exist in the literature that suggest when calves are fed too little energy preweaning (i.e., below maintenance intake), immunity can be depressed and the calf is more susceptible to disease. Thus, it seems logical that calf mortality could be increased if the total amount of nutrients is lower than some critical level.

Finally, the incidence of calf mortality increases dramatically when calves experienced a disease incidence prior to death. When a calf became sick prior to weaning, it was about 4.6 times more likely to die than a calf that showed no signs of disease.

| Cause of morbidity | No of calves | % of all calves | No. of cases | % of cases |
|---|---|---|---|---|
| Digestive | 483 | 18.9 | 533 | 48.3 |
| Dull | 330 | 13.0 | 383 | 34.7 |
| Respiratory | 287 | 11.3 | 349 | 31.6 |
| Dehydration | 108 | 4.2 | 112 | 10.2 |
| Lameness | 28 | 1.1 | 29 | 2.6 |
| Neurological | 8 | 0.3 | 8 | 0.7 |
| Other* | 183 | 7.2 | 267 | 24.2 |
| Any | 859 | 33.8 | 1,103 | |

Table 2. Description of cause of morbidity in preweaned heifer calves in the U.S. in 2014. Adapted from Urie et al. (2018b).

*Other included calves reported with infections or injuries.

**Calf Morbidity**

The NAHMS study also evaluated which factors were associated with calf disease (morbidity). Table 2 shows a breakdown of the reported clinical signs associated with morbidity. Note that some calves had more than one incidence of disease and some showed multiple clinical signs.

Of all calves included in the study, 33.8% had at least one reported case of disease and 6% of calves had more than one bout of sickness. Over half (56%) of cases were due to digestive signs (usually scours). Ages at which calves developed disease was also reported and is shown in Figure 1. For digestive disease, the greatest incidences occurred when calves were 1 or 2 weeks old. This I commonly seen on calf operations worldwide. Common viruses (rotavirus and coronavirus) and protozoa (Cryptosporidium parvum) can infect calves early in life and have short incubation periods. So, clinical signs are apparent usually in the first couple of weeks of life. Signs of respiratory disease (orange line in Figure 1) peaked at about 5 weeks of age and then gradually declined to the end of the study at 10 weeks of age.

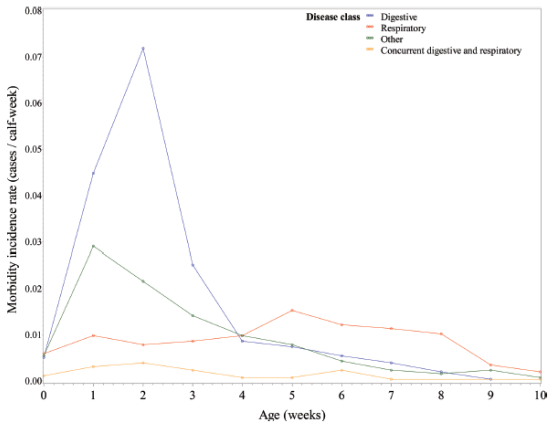


Figure 1. Age incidence for diseases reported in preweaned heifer calves. From: Urie, et al. (2018b).

Which factors influenced heifer morbidity prior to weaning? The authors considered a large number of potential variables, but four were statistically significant in the analysis – birth BW, serum IgG concentration, ventilation he barn / housing, and environmental temperature.

Higher birth BW was associate with lower mortality. Using the statistical model developed in their analysis, the authors calculated that a 35 kg

calf had a predicted morbidity risk of 40.0%, whereas a calf with a birth weight of 45.0 kg had a predicted morbidity risk of 31.2%. Like the calf mortality model, this is probably due to smaller calves being exposed to uterine stressors or born early.

Increasing serum IgG lowered risk of calves becoming ill. According to the statistical model, a calf with a serum IgG concentration of 8 g/L had a 40.3% risk of becoming ill, whereas a calf with 30 g/L of serum IgG had a 29.3% chance of disease prior to weaning. A good colostrum program is definitely worth the investment! A little planning to develop a protocol that can be easily and consistently implemented on the farm is so important to calf rearing success. It's a good New Year's resolution to develop or review your colostrum program. Your calves will thank you!

An interesting observation in the data was the relationship between ventilation and calf morbidity. The researchers reported that calves that were housed in facilities using mechanical ventilation (not natural ventilation) had 2.218 times higher odds of developing disease compared with calves housed in natural ventilation systems. This observation suggests a few possibilities. First, ventilation could be a proxy for ventilation type – calves in hutches would be included in the natural ventilation category. Calves housed indoors would generally utilize mechanical ventilation and, thus, the potential issues with poor ventilation and crowding in indoor barns could be associated with increased risk of disease.

Finally, environmental temperature affected the risk of disease. The authors used temperature-humidity index to include both temperature and humidity in the calculation. The authors wrote *"The THI accounts for the effects of temperature and relative humidity, and the equation uses dry bulb temperature (T, °F) and relative humidity (RH). The equation used for this analysis was* $THI = T - [0.55 - (0.55 \times RH/100)] \times (T - 58)$*."* They reported that THI was inversely correlated with risk of disease. A THI of 20, below the reported calf thermoneutral zone, was associated with a risk of morbidity of 39.5%, whereas a THI of 70 had a predicted morbidity risk of 29.1%. This is consistent with the idea that calves are more susceptible to disease when their nutrient needs (especially energy) are not being met completely. This reinforces the need to ensure that calves are being fed sufficient calories during cold weather.

**Summary**

Health and survival of preweaned heifer calves are key criteria to monitoring the success of a calf program. When the processes of raising calves are "in control", calf morbidity and mortality should be low (<25% morbidity and <5% mortality) for all animals born alive on the farm. The USDA reported preweaning heifer morbidity and mortality were 33.8% and 5%, respectively in 2014. More work needs to be done in the industry to improve animal health. Continued monitoring of the processes used on the farm and on the outcomes will improve the success of the calf raising operation. The studies published by the USDA NAHMS provides important information on how calves are raised in the U.S. and where improvements can be made in the future.

Important implications regarding the factors affecting preweaning heifer health were presented by the researchers. Clearly, serum IgG concentration – provided to calves during the first 24 hours of life – play an essential role in survival and health. For most producers, establishing and implementing the correct procedures to feed sufficient amounts of clean colostrum at an early age will pay dividends both in terms of improved health and survival, but also future milk production.

Adequate nutrition (as indicated by the increased risk of health problems during cold weather and increased mortality when calves were fed ≤0.15 kg/d of fat in liquid diet) is also essential to calf

health. It appears that when calves are fed insufficient energy relative to nutrient requirements, then health of the calf is jeopardized.

Finally, birth BW seems to be an important criterion to calf health. Small calves appear to have greater risk of disease and death than calves that are more appropriate to their breed average. So, a Holstein calf weighing 35 kg at birth is likely at greater risk compared to a calf that weighed 45 kg at birth. It should be noted that very large calves – e.g., a calf born at 50 kg or more – were likely underrepresented in the dataset. These calves are more likely to experience a difficult birth and were more likely to die within the first 24 hours. Therefore, they wouldn't have been included in the dataset used for analysis. Very small calves could have experienced stress in the uterus or could have been born prematurely; both of these conditions are detrimental to calf health.

**References**

Urie, N. J., J. E. Lombard, C. B. Shivley, C. A. Kopral, A. E. Adams, T. J. Earleywine, J. D. Olson, and F. B. Garry. 2018a. Preweaned heifer management on US dairy operations: Part I. Descriptive characteristics of preweaned heifer raising practices. J. Dairy Sci. 101:9168–9184.

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