

Reducing Dairy Calf Mortality

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Abstract

The loss of dairy calves from stillbirths and disease-related deaths places a significant challenge on the producer who wants farm-specific replacement heifers to maintain or expand herd size. Stillbirths are often overlooked as an important cause of calf mortality, as they are on some dairies. With improved record keeping, data analysis, diagnostic testing and herd monitoring, the appropriate risk factors for stillbirth can be broken down and targeted for improvement. The classification of stillbirths will need to be broadened, however, and the role of maternal stress, metabolic disorders, fetal growth factors and environmental exposure may need attention to solve this growing cause of calf mortality. Solving disease related death problems in dairy calves requires a broad approach that looks not only for the disease agents but for the sources of infection, opportunities to improve immunity and changes that can reduce the susceptibility of calves. Once affected, the difference between disease morbidity and calf mortality is early detection and appropriate intervention with effective treatment protocols. Colostrum management, health screening, diagnostic testing, overview of bedding management, feeding consistency, simplicity, as well as the implementation of effective preventive and therapeutic strategies bring the veterinarian to the forefront of reducing calf morbidity and mortality.

Résumé

La perte de veaux de race laitière associée à la mortalité et à la maladie représente un défi de taille pour le producteur qui veut élever des taures de remplacement spécifiques à sa ferme afin de maintenir ou d'accroître la taille du troupeau. Dans certains troupeaux, la mortalité est souvent négligée comme cause importante de mortalité des veaux. Grâce à l'amélioration de la tenue des dossiers, de l'analyse des données, des tests diagnostiques et de la surveillance des troupeaux, les facteurs pertinents de risque de mortalité peuvent être analysés et ciblés en vue de leur amélioration. Toutefois, la classification des mort-nés devra être élargie, et on pourra devoir se pencher sur le rôle du stress maternel, des troubles métaboliques, du facteur de croissance décelé chez le fœtus et du facteur de l'exposition dans l'environnement si l'on veut résoudre cette cause croissante de mortalité des veaux. La

résolution des problèmes de mortalité liée à la maladie chez les veaux laitiers nécessite une vaste démarche pour rechercher, non seulement les agents pathologiques, mais également les sources d'infection, les possibilités d'améliorer l'immunité et les changements pouvant permettre la réduction de la réceptivité des veaux. Une fois le veau atteint, la différence entre la morbidité associée à la maladie et la mortalité est une détection précoce et une intervention appropriée avec des protocoles de traitement efficaces. La gestion du colostrum, le dépistage, les tests de diagnostic, la gestion générale de la litière, la régularité du comportement alimentaire, la simplicité, ainsi que la mise en œuvre de stratégies préventives et thérapeutiques efficaces placent le vétérinaire au premier rang pour la réduction de la morbidité et de la mortalité des veaux.

Introduction

To maintain control over cash flow, herd biosecurity, heifer management and genetic progress, most dairy producers prefer that replacement heifers originate from their dairy. Whether the goal is to maintain or expand herd size, the cost of raising an adequate number of replacement heifers can be a significant challenge for dairies that do not emphasize health, nutrition and management of the young heifer calf. Reducing calf mortality is a starting point for increasing the number of replacement heifers, but reducing the culling rate and decreasing the average age at first calving may have a more profound impact on cost of replacement heifer rearing.¹³ Estimates of replacement heifer raising costs vary with dairy size, age at first calving, calving interval, culling rate, death rate and other variables, but the cost of raising a heifer from birth to calving may range from \$1,200-\$1,600⁴ or from \$1.40-\$1.88 per day, depending on age group.^{13,17} Specialization and outsourcing of dairy heifer calf raising may improve costs by more efficient use of labor, management, feed and facilities but the challenges of reducing stillbirths, pre- and post-weaned heifer deaths remain the same.

With annual herd turnover rates (number of cows leaving the herd/average herd size for the year) averaging between 35 and 38%, the replacement heifer needs and availability by herd size are shown in Table 1.

While the table shows a 3-4% surplus in available replacement heifers for the average US dairy, fewer than

Table 1. Replacement dairy heifer needs and availability by average herd size.

Average herd size	Calves born per year	Calves alive at 24-48 hr	Heifers alive at 24-48 hr	Heifers alive at weaning	Heifers alive at calving	Number of replacement heifers needed
100	94	86	41	37	36	35
250	234	215	103	93	91	88
500	468	432	207	186	183	175
750	701	647	311	280	274	263
1000	935	864	415	374	366	350
3000	2805	2590	1243	1119	1096	1050

Assumptions made in the table:

35% annual herd turnover rate

90% of lactation 2+ cows calve annually (13.3 month calving interval); 100% of lactation 1 heifers calve

Stillbirth rate 11% lactation 1; 5.8% for lactation 2+⁹

48% of calves alive at 24-48 hours are heifers

Prewaning mortality rate 10%; weaning to calving mortality rate 2%

40% of producers report that they have enough replacement heifers to maintain herd size.^{14,15} Recognizing that the most important reasons for dairy calf mortality are stillbirths and disease, the purpose of this talk is to discuss strategies for identifying, analyzing and resolving some of the important calf problems that have a negative impact on replacement heifer rearing.

Stillbirths

Stillbirths are a growing concern within the dairy industry, with 7-20% of calves born being dead within 24 to 48 hours of birth.^{1,2,6,9} While first-lactation heifer stillbirth rates of 11-15% are significantly higher than the 5.7% reported for multiparous cows, it is not uncommon to find herds with rates close to 20% that have not been recognized or investigated. The relationship of stillbirths with dystocia, calving assistance, calving season, percentage of first-lactation animals in the herd, gestation length (< 270 days and > 293 days carrying calf), and high body condition score provide an opportunity for record review, prospective data collection like heifer growth charts to pinpoint specific herd factors, nutritional consultation, calving assistance guidelines, worker training and sire selection based on genetic ability to produce live calves to remedy the problem. In analyzing stillbirth risk factors in a herd, the following data may be useful:

- All births counted by single or twins
- All single and twin births counted by calf gender
- Counts of single and twin births by calf status (alive or dead)
- Calving ease and dystocia scores
- Stillbirths by single or twin status

- Stillbirths by calving ease and/or dystocia score
- Stillbirths by calf gender
- Stillbirths by lactation number
- Stillbirths by dam's previous days carrying calf
- Stillbirths by month of calving
- Stillbirths by dam's age at first calving.

Infectious causes of stillbirths should always be considered and systematically ruled out, especially when there are known disease problems in the herd, calf death is occurring before birth as evidenced by the presence of cloudy corneas at delivery, or placental presentation or appearance is abnormal. Diagnostic testing to eliminate brucellosis, *Campylobacter fetus venerealis*, *Chlamydophila*, *Coxiella burnetii* (Q Fever), leptospirosis, *Listeria monocytogenes*, mycotoxins, *Neospora caninum* and salmonellosis as causes can be considered. To assist the dairy, train farm personnel or have a technician on-call to collect fresh tissues and fluids from the stillborn calf within an hour or two of death. Have a list of tissues to collect along with containers, blood tubes, swabs, and preservatives, directions for sample handling, packaging, preserving instructions, reporting and/or laboratory submission. A complete list may include the following:

- Placenta, especially areas with lesions and cotyledons
- Brain
- Lungs
- Liver
- Kidneys
- Skeletal muscle
- Thoracic fluid
- Heart blood
- Abomasal contents.

Know what your diagnostic lab requires and how tissues should be preserved and submitted, as shown in Table 2 from the Wisconsin Veterinary Diagnostic Laboratory.

In many cases of stillbirth, the etiology is undetermined, the scope of the investigation is relatively narrow and dairies seem too willing to accept these losses as something that cannot be changed. Beyond the death of the calf, other consequences of stillbirths such as retained placenta, decreased fertility and lower 305-day milk yield¹ serve as a reminder that the problem is significant. Utilizing the experience from the work-up of human stillbirths, we may find better classification schemes and elevate the importance of prepartum stress, increased non-esterified free fatty acids in the dam, other maternal metabolic disorders, fetal growth abnormalities, hormonal triggers, air quality or environmental exposure^{3,11} as other explanations for this important cause of calf mortality.

Disease-related Calf Mortality

The great majority of disease related deaths in preweaned calves are attributed to scours (62.1%) and respiratory problems (21.3%). In weaned heifers the trend is reversed, with respiratory disease being the leading cause of mortality (50.4%).¹⁴ Solving disease related death problems in dairy calves requires a broad approach that looks not only for the disease agents but for the sources of infection, opportunities to improve immunity and changes that reduce susceptibility of the calf. Once affected, the difference between disease morbidity and mortality is early detection and appropriate intervention with effective treatment protocols. The veterinarian plays a key role in training farm person-

nel to detect disease, monitor calves, record health data and implement effective treatment protocols. Without interest and time set aside for consistent monitoring, review of protocols, records and effective communication, calf health will suffer.

The importance of colostrum immunity to the health of immunocompetent, albeit immunonaive calves, cannot be understated. While most dairy producers recognize that adequate colostrum volume, immunologic quality, timeliness of feeding and cleanliness are the key elements to reducing morbidity and mortality of calves, the industry has struggled to keep the rates of failure of passive transfer (FPT) below 30%. Consistent vigilance by veterinarians with regular herd testing protocols,⁷ colostrum storage or replacement products as back-up for supply shortages is essential to overcome the problem. In order of importance, the author finds that herd FPT problems are usually attributed to one or more of the following problems:

- Failure to separate calf and cow before the calf has suckled an inadequate volume of colostrum (usually occurs within two hours of birth)
- Failure to milk fresh cows before dilution of colostrum with new milk, a time-dependent phenomenon that is enhanced by prior suckling
- Bacterial contamination of colostrum that adversely affects transfer of immunity
- Farm personnel are reluctant to feed four-quart volume at a single feeding, putting the second feeding outside the desired window of absorption efficiency
- The addition of colostrum replacement, supplement or other products to colostrum that may competitively inhibit the absorption of immunoglobulins

Table 2. Stillbirth diagnostic tests and calf specimen requirements.

Agent	Test	Tissue	Submission instructions
<i>Coxiella burnetii</i> (Q Fever)	Complement fixation	5 ml clotted heart blood	Refrigerate, ship on cold packs
<i>Salmonella spp.</i>	Culture	Neonatal lung, liver, abomasal contents	Refrigerate, ship on cold packs
<i>Campylobacter fetus venerealis</i>	Culture	Neonatal lung, liver, abomasal contents	Refrigerate, ship on cold packs
<i>Chlamydophila spp.</i>	Isolation	Placental swab, placenta	Ship placental swab in <i>Chlamydia</i> transport media
<i>Leptospira spp.</i>	Polymerase chain reaction (PCR)	Kidneys	Refrigerate, ship on cold packs
<i>Listeria monocytogenes</i>	Listeria screen	Cotyledons, abomasal contents, uterine discharge	Refrigerate, ship on cold packs
<i>Neospora caninum</i>	Immunohistochemistry, PCR, Serum ELISA	Brain, heart – fresh and fixed	Refrigerate, ship on cold packs
Mycotoxins	Mycotoxin screen	5 lb dry cow feed	Freeze if over 15% moisture

- The colostrum replacement product that is used does not deliver an adequate immunoglobulin mass
- Colostrum is pooled.

Fresh cow health concerns, immunosuppression and poor nutrition are frequently blamed for poor colostrum quality, but more typically reduce the volume of colostrum produced.⁷

To compensate for high rates of FPT, many dairies start vaccinating preweaned calves. Very few studies, however, provide evidence of active immunization of young calves to the diseases of importance prior to anticipated exposure. Moreover, vaccines that contain gram-negative bacterial antigens, contain multiple antigens or are delivered during disease challenge, de-horning, feed change or weaning are at risk of doing more harm than good. Reduced doses, alternative routes of administration, or other strategies that appear to improve the safety of vaccines used in young calves have no guarantee of efficacy. The vaccination protocol should be prescribed and monitored by the veterinarian who knows the colostrum status and health concerns of the dairy.

To determine the effectiveness of sick calf detection on the dairy, we use a calf health scoring tool (<http://www.vetmed.wisc.edu/dms/fapm/fapmtools/calves.htm>) to find calves that should be under treatment. Using the scoring system described, we expect calves with a fecal score of 2 or 3 to be receiving one or two additional feedings of oral electrolyte solution daily. Fever and diarrhea usually triggers a three-day antibiotic protocol. Calves with a total respiratory score ≥ 5 should be on a five to six day antibiotic protocol. The disease detection rate goal is 85%.

For calf diarrhea problem work-ups, fecal screening of untreated calves in the targeted age range, regardless of fecal consistency, are used to determine potential pathogen exposure. When there are any calves with a positive *Salmonella* spp culture or more than 20% of sampled calves are shedding rotavirus, coronavirus or *Cryptosporidium parvum*, find the most

likely points of exposure and implement strategies that dilute contamination, distance the calf from or by-pass the source of infection. The fecal screening data in Table 3 obtained from untreated nine to 11-day-old calves show *Cryptosporidium parvum* and *Salmonella newport* to be the pathogens of most concern on a dairy with 13% calf mortality rate from diarrhea in that age group.

For calf respiratory disease work-ups, nasal swabs, transtracheal washes and bronchoalveolar lavage fluid analysis and culture have been described as diagnostic tests to determine etiology and antibiotic susceptibility patterns. We find that analysis and culture of bronchoalveolar fluid collected from untreated calves with a positive respiratory score is a satisfactory method to determine etiology and determine effective treatment protocols when dealing with herd respiratory disease problems of calves.⁸

Potential sources of calf infections are numerous, including environmental sources, commingled animals, colostrum, feed, equipment, rodents, insect pests and people. Morbidity and mortality in the first five days of a calf's life should focus on the calving area. Without immediate removal or isolation from the occupants of the maternity pen, calves have multiple opportunities for fecal-oral and aerosolized exposure to many disease agents of concern. For calf morbidity and mortality concerns after one week of age, the source of exposure is more likely to be in the calf housing area. Bedding cultures can quantify coliform contamination and/or the presence of *Salmonella* spp. We have described an impaction-type air sampler (airIdeal, bioMérieux, Hazelwood, MO) to determine the level of aerosolized bacterial exposure in the calf environment.⁵ Bulk-tank milk cultures can be used to determine level and type of bacterial contamination of colostrum, milk replacer or milk.

Because young dairy calves spend 70-80% of the time lying down,¹⁰ bedding management is an essential aspect of calf health. The bedding type, maintenance, depth, dry matter and loft will influence the level of bacterial exposure, calf nesting score, thermoregulation and respiratory disease prevalence.^{5,10} A deep bed of long

Table 3. Fecal screening test results from untreated 9-11 day old calves.

Calf ID	Rota virus	Corona virus	<i>Cryptosporidium parvum</i> smear	<i>Salmonella</i> culture
2793	Negative	Negative	Moderate	Negative
2800	Negative	Negative	Moderate	Negative
2803	Negative	Negative	Heavy	<i>S. newport</i>
2807	Positive	Negative	Moderate	Negative
2816	Positive	Negative	Negative	Negative
2822	Negative	Negative	Heavy	<i>S. newport</i>
2828	Negative	Negative	Negative	Negative

wheat straw for young calves and calves housed at temperatures less than 50° F (10° C) is preferred. Feed and water refusals should be removed from the calf housing area to reduce bedding and aerosolized pathogen contamination. Solid pen barriers that limit contact between calves on two sides is an effective way to reduce aerosolized bacterial counts within a pen and prevalence of respiratory disease within a calf barn, but additional barriers create a contaminated pen microenvironment, even with adequate barn ventilation.⁵

Non-infectious Causes of Calf Mortality

While less important than disease related causes of death, there are a number of avoidable causes of calf mortality that may resemble disease outbreaks. Young calves that develop seizures, become comatose, show opisthotonus, strabismus or die suddenly are usually thought to have meningoencephalitis from FPT, bilateral otitis media/otitis interna, polioencephalomalacia, bovine viral diarrhea, or a congenital defect. Lasalocid or salt toxicity has a similar clinical manifestation in preweaned calves. Lasalocid (Bovatec®), which is regularly included in many calf starter and grower feeds as a coccidiostat, may be added to milk or milk replacer in response to presumed coccidiosis or cryptosporidiosis. A low threshold for safety poses a high risk of accidental overdose with imprecise dosing of lasalocid, intentionally high rates of inclusion, or *ad lib* consumption of treated milk. We have encountered mortality rates close to 90% within 12 hours of first exposure when lasalocid was overdosed. Neurologic death due to salt toxicity (hypernatremic syndrome) is not uncommon in dairy calves with multiple supplements added to the milk or milk replacer, with abnormally high milk replacer powder-to-water ratios, oral electrolyte powder added to milk or milk replacer, diarrhea, force feeding and/or limited water availability. Consumption of fluids with a sodium concentration exceeding 120 mEq/L puts calves at risk of developing hypernatremia, particularly with limited access to water.

Nutritionally related concerns make up the final category of concern for calf mortality. The importance of maintaining consistency in feeding practices from ingredients to temperature at mixing and delivery, concentration, additives, volume, quality, method of delivery and timing of water feeding can reduce changes in motility, intestinal flora and rate of intestinal transport. The delivery of warm water within 20 to 30 minutes of milk or milk replacer consumption should begin by the third day of life. Calf starter consumption will begin at an early age, with access to a small volume of a high quality starter by day 3. In cold weather, consumption of starter may be the only way to meet maintenance energy and protein needs of a young dairy calf on a con-

ventional milk replacer diet. Caloric intake in cold weather or under disease conditions must be accelerated, especially in young calves whose starter intake is less than 0.5 lb (0.2 kg) per day. Routine milk or milk replacer restriction during diarrhea episodes is not recommended and may result in hypoglycemic coma and death. As long as calves with diarrhea can stand, can suckle or have no abdominal distension, milk feeding should be maintained, even if force feeding is required. In addition to milk or milk replacer, diarrheic calves require additional fluids to correct dehydration.

Conclusions

Loss of dairy calves from stillbirths and disease-related deaths places a significant challenge on the producer who wants farm-specific replacement heifers to maintain or expand herd size. The veterinarian who works closely with the dairy to investigate calf health concerns, monitor calf performance, disease detection rates in calves, treatment protocols, feeding, management and vaccination protocols will reduce calf mortality and increase the number of replacement heifers available to maintain herd size, expand the dairy or improve profitability through heifer culling and dairy sales.

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