Management Considerations to Control Calf Diarrhea

William Dee Whittier, *DVM, MS*
Dept of Large Animal Clinical Sciences
VA-MD Regional College of Veterinary Medicine
Virginia Tech, Blacksburg, VA 20461-0442

Introduction

Calf scours continues to be a challenge to cow/calf producers in the United States. In 1997, beef cattle producers in the United States were surveyed by telephone about the causes of death loss in calves during their prior calving season.[1] Producers reported that 14.4% of calves lost in their operations died because of digestive tract problems, principally neonatal diarrhea. This is true despite a considerable increase in our understanding of the causes of calf scours and having much better treatment tools available for the treatment of calf diarrheas. One explanation for these continued losses is the failure to utilize products (vaccines, for example) that have grown out of our understanding of the disease. A better explanation is that management procedures have not been implemented to effectively control this disease complex in many settings.

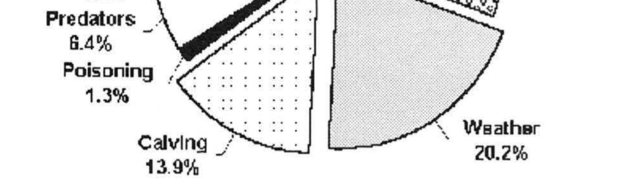

Figure 1. Percent of calf losses by perceived cause in 1996.[1]

Historically, disease was considered to be a state that occurred in a direct cause: effect relationship. That is, animals became sick when and only when they were exposed to a disease agent, and most such exposures resulted in disease. Modern understanding allows us to surmise that most infectious agents are relatively host-adapted, and infection is associated with disease only under unfavorable environmental or nutritional circumstances. Further, in a multi-agent disease complex such as calf scours, no single agent is associated with all cases of the condition, so infection with a particular agent is neither necessary nor sufficient to cause disease. Many infectious agents for cattle diseases, and especially for calf scours, are ubiquitous or nearly so. They exist on farms with high scours rates as well as on those without disease. Dr. Dale Hancock has said, "Saying calves have scours because they became infected with cryptosporidia is like saying the barn burned down and oxygen was the cause".[2]

There may be some value in identifying disease organisms associated with calf-scours outbreaks and applying organism-specific interventions (vaccinations, antibody administration, etc). Evidence suggests, however, that the greatest strides in control of neonatal calf diarrhea result from changes in management that impact the relationship between calves and the diarrhea-associated disease agents that are present in most of their environments. Whether calves develop diarrhea in the first days and weeks of life is most often a result of the balance between resistance of the calves and the nature of their exposure to disease agents. The term "resistance" is utilized in this setting rather than "immunity". This is intentional because immunity tends to connote the presence of antibodies, perhaps supplemented by immune cells, in the fight against scours. While humoral and cell-mediated immunity are certainly part of the resistance of some calves to scours, a number of other components of resistance must exist for successful scours prevention programs. Failures of vaccination programs to effectively control scours provide ample evidence for this argument.

This presentation will discuss a number of interventions believed to influence the rates of neonatal diarrhea. These actions are effective because they either increase the resistance of the calf to disease or decrease the infectious agent challenge. Included are:

- Colostrum provision to calves
- Steps to improve colostrum amount and quality
- Immunological considerations
- Nutritional considerations

- Reducing exposure through housing and grouping management

Colostrum Provision to Calves

Lack of colostral immunity continues to be a major predisposing factor to newborn calf diseases and economic loss in cattle. In recent years, our knowledge of colostrum feeding has advanced, but a completely reliable method for preventing hypogammaglobulinemia has yet to be described. However, much more knowledge is available than is currently being put to practical use. Feeding colostrum provides the newborn with a source of pre-formed immunoglobulin, some of which is actively absorbed across the small intestine and provides passive protection against systemic disease. Part of the immunoglobulin remains in the gut where it can neutralize pathogenic bacteria and help prevent the development of diarrhea.

In addition, colostrum contains transferrin and lactoferrin, which bind iron and restrict bacterial growth. These factors, together with immunoglobulin, help limit growth of bacteria in the gut.

Cow colostrum contains about 22% solids compared with the 12% solids of normal whole milk. Much of this extra solid is immunoglobulin, but colostrum also is a rich source of casein, energy in the form of fat and sugars, and vitamins, especially A and E. The easily digested energy can be of great importance to the baby calf in inclement weather. Energy is required for all metabolic functions, including maintenance of body temperature. There also is a trypsin inhibitor which helps protect immunoglobulin from digestion in the calf's gut, as well as protein fractions that improve absorption of immunoglobulins in calves.

In cows, immunoglobulin IgG1 is the principal colostral immunoglobulin. Immunoglobulin is concentrated in colostrum from about 5 weeks prepartum, probably in response to rising estrogen concentration in the dam. Special receptors on the mammary epithelium selectively bind serum IgG1, which is taken into the cell by transcapillary exchange and transported to the lumen of the mammary gland, where it is released into colostrum. Serum IgG1 concentrations in cows fall to 50%, as colostral concentrations rise to 3 to 12 times that of serum. Other colostral immunoglobulins, including IgM and IgA, also reach higher concentrations than are found in serum. They are derived partly from the serum pool and partly from local synthesis by lymphocytes within the mammary gland.

Steps to Improve Colostrum Amount and Quality

A number of factors influence the total amount of immunoglobulin found in colostrum. The volume of colostrum produced is affected by breed. For instance, dairy cows and beef breeds that are higher milk producers produce much more colorstrum than other beef cows. Cows produce more colostrum than heifers. Feeding energy-deficient diets markedly reduces colostral volume (Table 1).

Table 1. Volume of colostrum produced by cows as first milking or first suckling by calf.[3]

Breed	Management	Average Colostrum Yield (Liters, first milking)
Beef - Hereford Cross*	Out-wintered: poor nutrition	0.6
	In-wintered: silage ad lib	1.7

Prepartum nutrition of the cow affects colostrum quality as well. Body condition scoring allows the monitoring and assessment of energy and, to a lesser extent, protein nutrition in cows without the need to handle them. Table 2 demonstrates the differences in calf vigor, colostrum production and colostrum quality as it relates to body condition scores of dams. Surprisingly, very thin cows produced quite large quantities of colostrum, but, their calves ended up with lower levels of absorbed colostrum. Longer intervals from calving to standing may have indicated poorer calf vigor and thus, later and less colostrum consumption.

Management should provide for calves to consume about 10% of body weight of colostrum within 12 hours

Table 2. Effect of cow body condition score at calving on interval from calving to standing, colostrum production and immunoglobulin concentration in the baby calves.[4]

Body Condition Score at Calving	3 (very thin)	4 (thin)	5 (average)	6 (good)
Interval from calving to stand (minutes)	59.9	63.6	43.3	35.0
Colostrum Production (ml)	1525	1111.5	1410.9	unknown
IgG1 (mg/dl)*	1998.1	2178	2309.8	2348.9
IgM (mg/dl)*	194.8	173.0	135.6	304.1
Total IG	2192.9	2351.0	2445.4	2653.0

*Concentration of immunoglobulin in serum of calf 24 hours after birth.

of birth. Half of this should be consumed within 2 hours. Cows, and especially heifers, should be observed carefully to see that newborn calves nurse properly. Heifers often lack maternal instincts and may not allow calves to nurse for several hours. The quality of their colostrum may not be as high as adult cows. When in doubt, calves should be tube fed colostrum. This should be given via a clean, sanitized stomach tube. For most calves giving 2 quarts within 2 hours of birth and another 2 quarts in the first 8-10 hours of birth will provide adequate passive transfer.

There is a need for products that can act as colostrum replacements in the frequently encountered situation in which no beef or dairy cow colostrum is readily available. Several colostrum supplement products are available that provide substantial doses of immunoglobulin to newborn calves, although considerably less than that provided by natural colostrum. Approximately 100 grams of immunoglobulin must be available in an initial colostrum meal to provide the best chance that the calf will develop the serum IgG1 concentrations associated with the best passive protection. Previously obtained colostrum must be kept frozen to protect the integrity of the large protein molecules that make up the various immunglobulins.

Calf vigor in relation ease of the birthing process has an important interaction with colostrum absorption. Table 3 compares serum concentrations of IgG1 in calves that had different parturition characteristics and colostrum provision protocols. This demonstrates both the lack of absorption that occurs in calves with difficult births as well as the ability of nursing assistance to partially overcome the problem. This phenomenon has been further defined to be associated with postnatal respiratory acidosis.[5] Table 4 further documents the differences in calf vigor associated with differing degrees of calving difficulty. It becomes clear that avoidance of dystocia is a major emphasis that may be used to decrease scours in calves.

Frequent surveillance of calving cows is a tool to decrease the affects of dystocia. In addition, frequent observation of calving cows and heifers allows for aid in nursing or supplementation of colostrum as needed. The 1997 National Animal Health Monitoring System (NAHMS) survey also queried producers about their protocols for observation of calving females. Figure 2 indicates that 63% of producers checked cows only once or twice a day and 49% checked heifers once or twice. Increasing the frequency of surveillance thus has the potential to decrease scours risk, because it allows more timely intervention in both dystocia and any situation where colostrum absorption may be inadequate.

Table 3. Effect of time of suckling and calf vigor on immunoglobulin absorption.[4]

Suckling Management	No. of calves	Serum concentration of IgG1
Calves born easily or given early assistance; nursed within 6 hours of birth	90	60.89 mg/ml
Calves born to prolonged stage II of parturition and not assisted with nursing until after 6 hours	29	34.41 mg/ml
Calves born to prolonged stage II of parturition and not assisted with nursing at all	8	10.85 mg/ml

Table 4. Effect of calving difficulty on serum immunoglobulin concentration 24 hours after birth, interval from calving to standing, and mothering score.[4]

	Calving Difficulty Score* 1	2	3
Interval from calving to stand (minutes)	39.8	50.9	84.3
Mothering score**	1.2	1.5	1.5
IgG1 (mg/dl)	2401	2191	1918.5
IgM (mg/dl)	194.8	173.0	135.6

*1=unassisted; 2=assisted after at least 1 hour of labor, easy pull; 3=assisted after at least 1 hour of labor, difficult pull

** 1= No hesitation in mothering; 2= Some hesitation in mothering; 3= considerable hesitation in mothering or frank mis-mothering

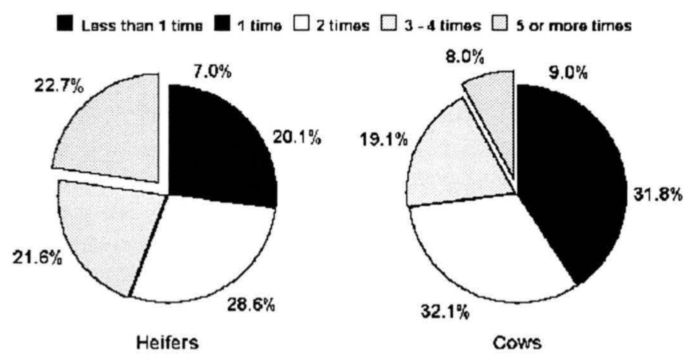

Figure 2. Percent of operations by number of times females were observed per day when calving.[1]

Immunological Considerations

In addition to passive transfer, certain immunological characteristics of calves are believed to influence their tendency to develop scours. Not all of these are well understood. It should be remembered that measuring the IgG level assess only the humoral protion of the immune system-1 of many parts. Cell-mediated immunity also may be important in the prevention of scours. There may be an influence of colostrum consumption on the development of cell-mediated immunity, as lymphocytes from calves that have consumed adequate amounts of colostrum behave differently than those from colostrum-deprived calves.[6]

Nutritional Considerations

There probably are a number of interactions between nutrition of the dam and immunological status of the newborn. The above section documents the influence of energy and protein nutrition on cow body condition on colostrum absorption of calves. Selenium and copper deficiencies are documented as having profound effects on the immunological system.[7]

Reducing Exposure through Housing and Grouping Management

The NAHMS data also sheds some interesting light on housing during the calving season. The degree of exposure to scours pathogens is related to both the kind of housing in which cows and neonates are kept, as well as the density under which they are kept. Table 5 shows the number of females kept per acre during any 1 time of the calving season as reported in the 1997 survey. Nearly half of producers confine cows to less than one-half acre per cow during calving. Figure 3 indicates the type of housing used for calving. Producers are most successful if they can find a balance between close housing, where cows are very accessible for intervention, and extensive housing, where they are less accessible but where disease exposure is minimized.

Other management procedures also will impact on the disease exposure to scours pathogens. In the NAHMS survey, producers were asked about the practice of removing cows that had calved from pregnant cows. They reported that 19.8 (±1.8)operations removed cow-calf pairs on the average of 8.3 (±1.0) days following their calving.[8]

The principles of applying exposure prevention to management of cows are well demonstrated in a 1995 study published by Clement, et al in The Journal of the American Veterinary Medical Association (JAVMA).[9] The 2-year study followed 5 large beef herds in North Dakota during the calving seasons followed 1992 and 1993.

Table 5. Percent of operations by the maximum number of females per acre at any one time in areas where the majority of females calve.[8]

Number Females per Acre	Percent Operations	Standard Error
Less than 0.5	44.4	(±2.9)
0.5 - 0.9	18.5	(±2.1)
1.0 - 4.9	27.3	(±2.6)
5.0 - 9.9	4.2	(±0.6)
10.0 - 19.9	2.0	(±0.4)
20.0 or more	3.6	(±0.9)
Total	100.0	

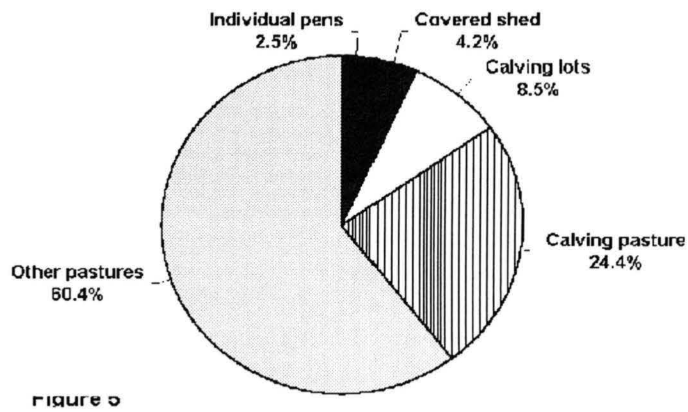

Figure 3. Percentage of calving by calving location.[1]

During these 2 years 2,204 calves were born and 20.9 % of them had scours. Herd scours rates were from 6.7% to 24.9% of calves. In some herds, calves were 6 times more likely to develop scours than in the herds with the lowest number of scours. The study looked at risk factors for scours and results of changing management to see if the rates of scours could be decreased. Figure 4 shows the temporal pattern of days of age at onset of calf scours. Note the broad distribution, suggesting a multifactorial cause of the scours.

Figure 4. Number of cases of calf scours in North Dakota herd, according to the days of age at onset.[9]

Calves born to heifers had a scours rate of 26.2% as opposed to 11.3% for cows. When this information was analyzed, it was determined that calves born to heifers were nearly 4 times as likely to get scours compared to calves born to cows.

In this study, calves born late in the calving season had a scours incidence of 16%, compared to 11.1% for calves born early, before disease organisms had built up in calving pastures. The analysis indicated that late-born calves had twice the risk of developing scours as early-born calves. This suggests that a tightly confined calving season would decrease overall rates of scours in herds.

The study compareed calves that had difficult births to calves born normally. It was found that calves with difficult births had a scours rate of 12.9%, versus 22% for calves without difficult births. The risk of getting scours to a calf that had a difficult birth was 1.9 times that of a calf born without difficulty. Any steps that decrease the rate of difficult births would also be expected to provide the bonus of decreasing calf scours. Bull calves were 1.4 times as likely to get scours as heifer calves. Twin calves were no more likely to get scours than single-born calves.

Protein and copper deficiencies are common in the area in North Dakota where these study herds were located. Evidence suggested that deficiencies of these 2 nutrients may have contributed to the calf scours risk.

Following the first year of the study, producers were informed of the findings, and recommendations were made to help decrease the risk of scours in the second year. The 4 major recommendations were:

- Quarantine scoured calves and their dams
- Calve heifers separately from cows
- Assure adequate copper and protein nutrition
- Improve colostrum management for calves of heifers and difficult births

Scours rates decreased significantly when these recommendations were utilized during the calving season of 1993. The overall rate of scours in calves decreased from 20.9% to 6.7%. Some farms had almost no scours when these practices were employed. Weather conditions were monitored to assure that the difference in rates was not due to a different weather picture. There were no major differences in weather patterns for the 2 years.

This study demonstrates that management practice changes can have an important influence on scours rates. In this study significant decreases in scours rates were achieved without the use of any vaccination or immunity stimulation other than assuring that colostrum feeding was attended.

Summary

Calf scours continues to be a frustrating disease for cattle producers and veterinarians, despite many advances in understanding the etiology of the condition and the treatments available. A number of biological products are available to increase immunity to the condition. Scours occurrence is viewed by some as balance between resistance and challenge. All the medicinal products available to aid in prevention of scours seem unable to create a state of resistance capable of withstanding the challenge created in many environments where neonates are kept.

A number of management approaches have been found to help decrease scours incidence and severity. This presentation discusses colostrum provision to calves, steps to improve colostrum amount and quality, immunological considerations, nutritional considerations and approaches to reduce exposure through housing and grouping management. Evidence suggests that these management approaches are the key to successful scours prevention.

References

1. Calving Management in Beef Cow-Calf Herds, Info Sheet, APHIS Veterinary Services, CAHM. May 1998.
2. Hancock, Dale. Koch is Dead: Why we should discard traditional views of infectious processes. 1995. AABP 28th Annual Proceedings, September 1995, San Antonio, Texas, pp. 115-117.
3. Logan, E.F. 1977. The influence of husbandry on colostrum yield and immuno-globulin concentration in beef cows. Brit. Vet. J. 133:120.
4. Odde, K. G., L. A. Abernathy, and G. A. Greathouse. 1986. Effect of body condition and calving difficulty on calf vigor and calf serum immunoglobulin concentrations in two-year old beef heifers. CSU Beef Program Report, Ft. Collins, CO.
5. Besser, T. E., O. Szenci, and C. C. Gay. 1990. Decreased colostral immunoglobulin absorption in calves with postnatal respiratory acidosis. J. Amer. Vet. Med. Assoc. 196:1239.
6. Beuchner-Maxwell,V. 1999. Personal communication March, 1999.
7. Swecker,W.S. 1997. Selenium and immune function in cattle. Compend. Contin. Educ. Pract. Oct 1997:(10,suppl.) p. S248-S253
8. Part III: Reference of 1997 Beef Cow-Calf Production Management and Disease Control. National Animal Health Monitoring System January 1998.
9. Clement, JC, et al. 1995. Use of epidemiological principles to identify risk factors associated with the development of diarrhea in five beef herds. JAVMA 207(10):1334-1339.