

## **Calf Diseases and Prevention**

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### **Introduction**

The health and management of replacement animals are important components of total herd profitability. The productivity of the herd can be negatively impacted by impaired growth of calves, decreased milk production of animals that experienced chronic illness as baby calves, spread of infectious diseases from calves to adult cows, increased veterinary costs and the limited opportunity for genetic selection due to high mortality of replacement animals. Amongst all animals present on a dairy farm, the highest morbidity and mortality rates generally occur in baby calves prior to weaning. The National Animal Health Monitoring System (NAHMS) estimated preweaning mortality of US dairy calves to be 10.8% and the average age at first calving was reported to be 25.8 months (anonymous, 1996). The National Dairy Heifer Evaluation Project sponsored by NAHMS, reported retrospective data on 1,811 dairy farms and prospective surveillance data on 921 US dairy farms (anonymous, 1994). Preweaning calf mortality was 8.4% and 6.8% for the prospective and retrospective data respectively. Diarrhea accounted for 52.2% of mortality, followed by respiratory problems (21.3%), trauma (2.4%), joint & naval problems (2.2%) and other or unknown causes (21.9%). Morbidity during the first 3 weeks of life was attributed to pneumonia (25%), diarrhea (29%) and umbilical disease (29%) in data obtained from 410 dairy calves born in 1990 on 18 commercial dairy herds located in New York (Virtala et al, 1996). Many diseases of newborn calves can be controlled by well-designed health management programs that define the care and housing of the dam during the periparturient period, standard operating procedures for the calving process and the application of proper preventive measures (including sound nutritional programs) for the newborn calf. Efficient replacement programs endeavour to calve Holstein heifers that weight 550 kg at 22.5 to 25 months of age. Healthy calves can achieve growth rates that allow them to be bred at 13-15 months of age and maximize the potential productivity of the overall dairy herd.

Simple exposure to infectious agents is not sufficient cause for the development of diseases in calves. In calf rearing, the difference between health and disease is very often just a slight tip of a delicate balance that weighs calf and environmental factors with the bacterial, viral or parasitic agents to which the calf will be exposed. The infectious agents that are capable of causing scours, pneumonia or septicemia in young calves are ubiquitous. Calves will inevitably be exposed, several may become infected but only a few should get disease if the relevant risk factors are minimized and the sources of infection are diluted or by-passed.

The three most important disease problems in the young calf are septicemia, diarrhea and pneumonia. The disease problems will be discussed but the focus will be on recognizing the factors that put young dairy calves at risk of developing disease and the locations on the dairy that are most apt to act as the source of infection. Finally, early identification and treatment of sick calves will be discussed.

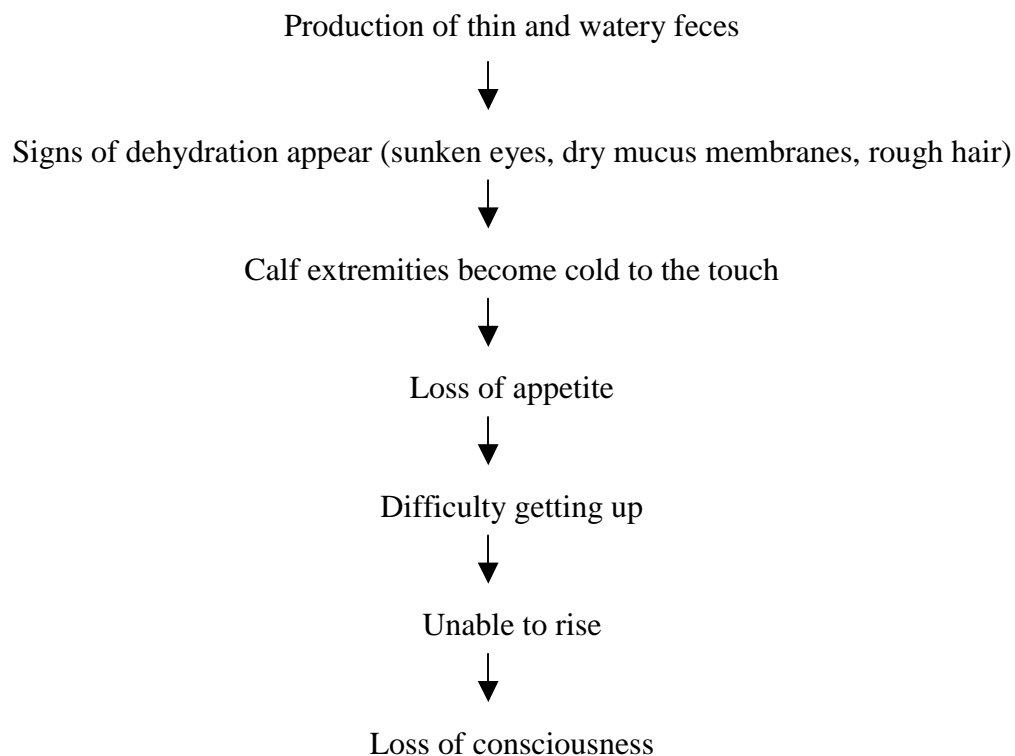
## Septicemia

When a calf has septicemia, it has disease producing organisms or their toxins in its blood. Septicemia in calves is usually the result of a bacterial infection that occurs while the calf is in the uterus, during, at or immediately after birth. The route of infection can be the blood of a sick dam, an infected placenta, the calf's umbilical stump, mouth, nose (inhalation) or wound. Septicemia is the most severe medical problem that a calf can develop because the blood-borne infection disseminates and damages many different organs. The bacteria that cause septicemia in calves, many of which are characterized as gram-negative bacteria like *E. coli* and *Salmonella*, are difficult and expensive to treat, and survival rate is low. Early signs of septicemia may be subtle but affected calves are usually depressed, weak, reluctant to stand, and suckle poorly within 5 days of birth. Swollen joints, diarrhea, pneumonia, meningitis, cloudy eyes and/or a large, tender navel may develop. Fever is not a consistent finding in septicemic calves; many have normal or subnormal temperatures. Most septicemic calves have a history of inadequate colostrum intake.

## Diarrhea

Diarrhea is the most common cause of death in young calves and is almost entirely avoidable by good management. The highest risk period for diarrhea is from birth until about 1 month of age. Clinical signs of diarrhea begin with loose feces and can progress to a semi comatose state (Figure 1).

**Figure 1. Clinical Signs of Diarrhea**



Bacteria, viruses and/or parasites cause diarrhea in calves. Usually, the calf is infected with more than one agent. Typically, the virus, bacteria or parasite is identified from a fecal sample or from the intestines of a dead calf. The agents can be isolated from healthy calves and adult cows as well as calves with diarrhea. Some fecal bacterial isolates, *E. coli*, *Clostridium perfringens*, and *Campylobacter*, are normal intestinal flora. The veterinarian uses the findings from fecal or intestinal exams to determine the most likely cause of the diarrhea problem, to revise vaccination, treatment and disinfection protocols. Knowing the potential pathogen provides insight into the infection source as well as the relevant factors that may have triggered the outbreak. When *Salmonella* is isolated, antibiotic sensitivity patterns guide the treatment protocols. When viruses and parasites are isolated, antibiotics use is not indicated.

The agents commonly incriminated in calf diarrhea outbreaks are listed below. The age of onset of diarrhea can be used as a guide to the agents most likely to be involved. Unfortunately, the color and consistency of the feces is not a reliable indicator of the cause of diarrhea.

- *E. coli*
  - Most calves are affected within the first 3 days of life
  - There are many types of *E. coli* – some are normal flora, different types cause septicemia; others are invasive; enterotoxigenic *E. coli* (ETEC) is the most common cause of newborn calf diarrhea
  - Special tests are needed to identify the *E. coli* as ETEC
  - Dehydration is usually severe and may cause death before diarrhea develops
  - The course of the disease is rapid – from weakness, diarrhea, dehydration to death can be less than 24 hours
  - Antibiotics rarely affect the outcome of this disease; fluid support is critical to survival
  - Vaccination of dry cows and good colostrum feeding can eliminate this problem
- *Salmonella species*
  - This is an important cause of diarrhea and infected calves are at risk of developing septicemia.
  - This bacteria can also cause pneumonia
  - Effective antibiotics should be used to prevent bacteremia.
  - Infections usually occur in 5 to 14 day old calves
  - Blood and casts of intestines may be seen in the feces
  - Calves are slow to respond to treatment and are often sick for 1 to 2 weeks
  - *Salmonella dublin* infection can make cattle carriers/shedders for life
  - This organism may be found in unpasteurized waste milk
  - People (especially children) handling calves that are shedding *Salmonella* can contract Salmonellosis and become ill
- *Clostridium perfringens* type C
  - There are several types of *C. perfringens*; type C can be a cause of diarrhea
  - More typically, this causes sudden onset of weakness or death
  - Colic or nervous system signs may be seen before death
  - Post mortem examination has characteristic hemorrhage in the intestines
- *Campylobacter* spp.
  - This is frequently isolated but rarely the cause of calf diarrhea
- *Rotavirus*
  - Rotavirus is found in feces of many calves between 1 and 30 days of age

- There are more than one group and serotypes of rotavirus; the conventional vaccine covers most important one. A newer product offers some additional strains
- Not all calves with rotavirus have diarrhea
- Diarrhea usually develops between 3 and 7 days
- Colostrum from vaccinated cows make protect calves for up to 4 days
- The infection may be short lived but the intestinal lining has to recover from damage
- *Coronavirus*
  - Like rotavirus, it is commonly found in calves, not all of which have diarrhea
  - Intestinal lining damage is more severe with Coronavirus than rotavirus; because of this, other pathogens can collaborate to produce a severe diarrhea episode
  - Fecal shedding pattern and diarrhea onset is similar to rotavirus
  - Colostrum from vaccinated dams will help prevent the disease in calves up to 4 days of age
  - This has been implicated as a cause of winter dysentery in adult cattle
- *Bovine Diarrhea Virus (BVDV)*
  - This virus can cause diarrhea in young calves but it is rarely the cause of young calf diarrhea
  - One of the strains is capable of producing a bleeder syndrome in calves between 4 and 10 weeks of age if they are infected shortly after birth
  - The virus may also be a factor in pneumonias that develop after weaning
- *Cryptosporidium parvum*
  - This is an important parasite that is very prevalent on dairies and is capable of producing diarrhea by itself or in combination with other agents
  - Calves usually are infected shortly after birth and develop diarrhea about 5 or 7 days of age
  - Organisms can be found in a fecal smear
  - The organisms survives well in the environment
  - Calves that do not have good colostrum immunity or that are stressed by cold or inadequate nutrition are particularly susceptible
  - Colostrum immunity is not completely protective
  - A commercial vaccine is not readily available
  - Currently, there is no treatment that “kills” the organism in an infected calf
  - Many infections are inapparent
  - Some preventative treatments can delay shedding of the oocyst in feces
  - This small parasite can cause diarrhea in humans
- *Eimeria spp. (coccidiosis)*
  - Two species are considered important in cattle
  - Calves between 7 days and 4 to 6 months are considered to be at risk
  - 4 products commonly used in calves are amprolium (Corid®), decoquinate (Deccox®), Lasalocid (Bovatec®) and Monensin (Rumensin®)
  - Products work at different stages of the life cycle and stop development or kill the organism
  - Once calves develop diarrhea, this is a very difficult disease to treat

- Subclinical infections impair the calf's resistance to other infections and decrease growth
- *Giardia spp.*
  - Under unusual circumstances, this protozoa may cause diarrhea in 2 to 4 week old calves; it is not a major pathogen
  - The organism can be found in the feces of normal calves

Despite the fact that the agents differ, the resulting enteritis is remarkably consistent in terms of the presenting clinical picture. Calves with diarrhea consistently have some degree of dehydration. Dehydration may be life threatening and can be assessed by observation of typical clinical signs (Table 1).

Table 1. Assessing Dehydration

Clinical Sign	Percent Dehydrated
Few clinical signs	<5%
Sunken eyes, skin tenting for 3-5 seconds	6-7%
Depression, skin tenting for 8-10 seconds, dry mucous membranes	8-10%
Recumbent, cool extremities, poor pulse	11-12%
Death	>12%

In most cases of fatal diarrhea, the calf dies of dehydration and loss of electrolytes – not from the infectious agents that triggered the diarrhea. Blood glucose levels are low and hypoglycemic coma can develop in calves that are in cold housing and have milk or milk replacer withheld for more than one feeding. Electrolyte abnormalities involving potassium, bicarbonate and sodium are frequently found but these resolve rapidly when fluids are given to correct the dehydration and calves have access to water. For this reason, treatment of calves with diarrhea is primarily supportive. The most important aspects are early recognition and aggressive fluid therapy. Prompt treatment with oral fluids and electrolytes is necessary for successful treatment of diarrhea (Table 2).

Table 2. Fluid Requirements for Treatment of Diarrhea

Calf Health	% Dehydrated	Daily Milk	Oral Fluids
Healthy calf	0%	4.4 kg	0 kg per day
Mild diarrhea	2%	4.4	1.1 kg per day
Mild diarrhea	4%	4.4	2.2 kg per day
Depressed	6%	4.4	3.3 kg per day
Very Ill	8%	4.4	4.4 kg per day
Recumbent	>10%	4.4	Need intravenous fluids

<sup>a</sup>should be fed separately from electrolytes

## **Pneumonia**

Pneumonia is an inflammation of the lungs. Clinical signs of pneumonia include nasal discharge, dry cough, body temperature of  $>41$  C, respiratory distress, and decreased appetite. Calves that develop pneumonia prior to weaning frequently share the same risk factors as those that develop diarrhea – failure or incomplete transfer of immunity from colostrum, prolonged exposure to adult cattle, and/or the ventilation limitations of warm housing. Large diurnal temperature variations and transportation or grouping stress can contribute to the development of pneumonia. As with diarrhea, frequently more than one agent is identified in an outbreak. Herds often experience outbreaks of pneumonia occurring in a number of calves at the same time. Antibiotic therapy is necessary but frequently yields disappointing results. Because of the significant impact that dairy calf pneumonia has on growth and future productivity, early identification and treatment is important but resolution of significant risk factors is imperative! Calves that develop chronic pneumonia seldom recover completely and should be culled. Early vaccination is not an effective means of prevention.

- Agents are usually one or a combination of the following:
  - *Pasteurella haemolytica*
  - *Pasteurella multocida*
  - *Mycoplasma dispar*
  - *Mycoplasma bovis*
  - *Hemophilus somnus*
  - *Actinomyces pyogenes*
  - BVDV
  - BRSV
  - IBR/PI<sub>3</sub>
  - *Salmonella Dublin*

The first 3 agents listed are the most important in the young dairy calf. Frequently pneumonia is first recognized right after weaning when calves are grouped for the first time. In many herds, the first episode that occurs prior to weaning and as early as 2 weeks of age is missed. In large herds or groups of calves, ear infections can be a sequella to respiratory disease and are frequently caused by the same agents.

### *Risk Factors*

While the immune system of a calf is functional at birth, it is less responsive than an adult cow, naive and easily overwhelmed by the bacteria, viruses or parasites in the environment. Prolonged exposure or an increased level of exposure occurs when susceptible dairy calves remain in the calving area, have continued contact with adult cattle, are in contact with affected calves, commingle with sick cows, or are housed in facilities that are under-bedded, warm, damp, humid, or poorly ventilated. Noxious gases, dusts and molds in the air put calves at significant risk for developing pneumonia. Cold housing can reduce the risk of infection, provided calves can be dry and draft-free. Calf to calf contact, crowding, or continuous use of facilities prolongs the survival rate and increases the numbers of pathogens in the environment of the calf, even with cold housing.

Inadequate colostrum intake or absorption puts calves at significant risk of infection – septicemia, enteritis (diarrhea) or pneumonia. Dairy calves should be hand fed 3 liters (Jerseys, Guernseys, Ayrshires) or 4 liters (Holsteins, Brown Swiss) of colostrum. The entire volume should be from the first milking of a single cow. Colostrum can be delivered in one or two feedings prior to the calf reaching 12 hours of age. The entire volume can be delivered safely and effectively in a single feeding. Calves can suckle, be fed by esophageal feeder or receive colostrum by a combination of the two methods.

Colostrum should be collected from appropriately prepared cows within 6 hours of freshening. Collection and storage containers should be sanitized between sequential uses. For effective cooling, colostrum should be placed in 2 or 4-liter containers that can be clearly labeled with cow identification and date of collection. Fresh or refrigerated colostrum provides the best combination of antibodies (immunoglobulins), immune cells, other important immune factors (lactoferrin, lysozyme, complement), vitamins and minerals important to the immune system of the calf. The availability of frozen colostrum allows the producer to discard colostrum from cows with mastitis, bloody milk, diarrhea, or Johnes disease and supplement the colostrum from a first calf heifer, purchased animals, or incompletely transitioned cows. Refrigerated colostrum should be used within 1 week and frozen colostrum within 1 year of collection. The use of mastitic or antibiotic containing waste milk has been related to high mortality rates (Losinger and Heinrichs, 1997). Many producers feed milk replacer to decrease the potential transmission of infectious disease. Colostrum absorption may be compromised in calves born in extreme heat or cold, calves that have difficult deliveries, abnormal gestational length or those exhibiting respiratory difficulty. Other non-colostral factors that impair immunity of calves are inadequate caloric intake, crude protein deficiency, selenium deficiency, low levels of vitamins A, C or E, reduced stores of copper, manganese, zinc or iron and coccidiosis. Inadequate caloric intake puts calves at risk for disease.

For dairy calves, inappropriate volume, concentration, fat or protein content, mixing or feeding temperature of milk or milk replacer can compromise the immunity of the calf. Failure to provide fresh water and a palatable calf starter that is supplemented with a coccidiostat and presented in a clean feeder will enhance their susceptibility to disease. Consistent feeding practices – timing, presentation, temperature and quality of feeds, personnel and management practices enhance the non-specific immunity of the calf. Make sure that there are adequate feeding utensils to be able to clean and disinfect between uses on sick calves. A dedicated utensil for sick calf use is ideal. This means that there are enough esophageal feeders to dedicate one to each sick calf for that feeding or that day. Contain risk by reducing calf stress. Stress is imposed when calves are asked to adapt to change. Feed changes – colostrum to whole milk to milk replacer, dilute milk replacer to concentrated milk replacer, milk withdrawal and reintroduction create stress. Each time there is a housing change – maternity pen, warming area, calf hutch, group pen, or transport to a different location – the calf is more susceptible to disease. Depending on timing, amount and type, vaccinations or medications can impose significant health risk to young calves. Keep things simple for calves. Feed a single, large volume feeding of colostrum. At the second feeding, begin feeding the milk replacer or milk that will be the mainstay of the calf's pre-weaning diet. Feed the liquid feed at a consistent time, temperature and concentration throughout the pre-weaning period. Make adjustments in volume or number of feedings for cold temperatures or illness. Provide calf starter within the first week of life.

Move the dairy calf from its calving area and place it in its permanent preweaning home as soon as possible after birth. Avoid crowding and competition, particularly before, during and immediately after weaning. Under most circumstances, dairy replacement heifers that receive adequate colostrum from vaccinated dams have little or no need to be vaccinated before weaning.

### *Infection Source*

Persistence of the agents that cause diarrhea, pneumonia and septicemia in the environment is the major reason for outbreaks of calf problems on the dairy. Usually the source of infection is feces (diarrhea and septicemia) – from normal adult cows into shared housing and calves that are non-immune shedders or aerosol (respiratory disease pathogens). Occasionally, water, feeding utensils, rodents, birds, pets, or people can be the source of infection for calves. Depending on the time of onset of disease, the most likely source of infection can be identified. Problems that occur within 5 days of birth usually have their source as the dam or the calving environment. After 7 days of age, problems develop from a source in the calf environment. If the source of infection can be identified, it can be diluted or by-passed, using one of these strategies:

- Ventilation
- Bedding changes
- Sunlight
- Freezing
- Disinfectants
- Time between occupancy
- Space between occupants
- Change calving areas
- Change location of hutches or calf housing
- Eliminate overcrowding

### *Early identification of sick calves*

Successful treatment protocols for diarrhea and pneumonia depend on early identification of sick calves. These criteria can be used to trigger a treatment intervention:

- Early morning rectal temperature (taken at the same time everyday for the first week of life or identified risk period) that exceeds 39.4° C for 2 successive mornings or is accompanied by slow, reduced or no milk intake that feeding.
- Slow, reduced or no milk/milk replacer intake
- Watery and/or bloody diarrhea
- Cough, nasal discharge or labored breathing
- Head tilt, umbilical or joint swelling
- Weakness, inability or reluctance to rise
- Lameness



Supportive care is more valuable than antibiotics. Sick calves must be able to stay clean and dry. Keep it in its own housing area but put fresh bedding down. Administration of warmed fluids is an effective way to raise body temperature. Make sure fresh water is available at least twice daily. Offer milk/milk replacer at the usual dilution and temperature but reduce volume (to 1 liter, for example) and feed more frequently (4 times/day, if needed). What liquid feed isn't consumed, administer by an esophageal feeder that has been cleaned, disinfected and rinsed between calves. Oral fluids are an effective way to correct dehydration provided that the calf is strong enough to stand and has no abdominal distension. Non-steroidal anti-inflammatory drugs like aspirin, banamine or ketoprofen can keep calves eating. Supplementation with probiotics may help restore the intestinal environment, especially after antibiotic use. Use antibiotics when they are known to be effective for the problem that is identified. Antibiotic selection should be based on culture of the bacterial organism from the premises or during the outbreak. The veterinarian should advise you on route, dose and duration of therapy. Responsible use of antibiotics is a must!

In conclusion, the five C's provide an effective formula for managing the young dairy calf.

- Colostrum
- Cleanliness
- Comfort
- Calories
- Consistency

While the agents that cause disease are always there and can be extremely important in a disease outbreak, a comfortable, clean calf with good colostrum management, consistent feeding and management practices and plenty of calories in the diet can be disease free even if they become infected.