

Calf Disease Management

Pre and Neonatal

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Introduction

The well being of the day old calf has many contributing causes. We have focused on calving survival, the getting up and about and drinking colostrum out of a bottle as prime indicators of success for a long time. There is now a broader focus on the factors leading up to the viability of this neonate in its first day of life. The metabolic and immune status of the dam, the conditions of her environment as a close-up cow, the stresses associated with birth and the pathogen load of the calving environment are now part of the formula for success or failure.

“Pre-natal care”

This commonly heard phrase rings loud with expectant mothers as a way to insure the birth of a healthy baby. In the dairy business, we have spoken of dry cow nutrition and management as a part of a health program for the cow herself. Considering the impact of what happens to the calf as a result of whatever conditions come to exist for the dam has not been great.

Luckily, the cow puts a high value on fetal well being. Only her maintenance requirements rate higher. The fetus in the last two months of gestation requires as much energy and protein as the cow needs to produce 3-6 kg of milk (Bauman and Currie, 1980). Cows will sacrifice fat stores and muscle mass to meet this demand. Unless the dam is in a near starvation situation the development and birthing of the calf is not affected. Colostrum quality does not appear to suffer as a result either (Grumm et al., 1996). On the other hand, the health status and degree of stress on the dam during the dry and close-up period may have an impact on colostrum quality and quantity (Nardone, 1996). Vitamin and mineral supplementation is considered important to the immune status of the transitioning cow as well.

Cows that suffer from subacute rumen acidosis (SARA), chronic lameness and low level peritonitis from hardware disease or stomach ulcers would be suspect in delivering less colostrum immunity than healthy herdmates. These animals are under stress by definition and will be the first ones to experience immune system failures when further challenged by other stressful scenarios. Heat, overcrowding, uncomfortable resting areas, fly annoyance, poor water availability, bad ventilation, mycotoxins and socialization pressures will result in increased cortisol release as a stress reaction. Cortisol depresses disease resistance as well as response to vaccination.

Healthy, adult cattle harbor many pathogens without any clinical effects. Under stress, clinical disease can emerge. Tremendous numbers of viruses and bacteria are shed from weakened animals with compromised immune systems. *Mycoplasma* and *Salmonella* are two well known examples, both concentrating rather well in colostrum. Coccidia and *Cryptosporidia* rarely affect older cattle, but are often present in the intestines and shed in higher numbers around calving. The area where calves are to be born can be polluted with organisms from normal build up or from massive contributions by weakened or clinically ill mothers-to-be. A dedicated, frequently cleaned and bedded calving area avoids this problem to a great extent.

Pathogens accumulate on the bellies, udders and tails of cattle. These are areas that calves will “investigate” after getting on their feet and in search of their first meal. Reducing shed and build-up on the bedded surfaces where late gestation cows lay down is one control measure. Keeping the surfaces dry and clean is another.

Vaccination programs for dry cows and springing heifers have three benefits. The immunoglobulin or antibody production increases for the vaccinated animal thereby reducing the disease risk for pregnant and fresh cows, boosting the antibody concentration in colostrum and indirectly keeping close-up cows from becoming pathogen factories. The timing and frequency of these vaccinations is important. If given too far in advance of calving, the serum antibody levels will fade before peak demand for dam protection and colostrum accumulation. If given too close to calving (less than 2-3 weeks), cortisol interference may dampen response, the vaccines might act as an appetite suppressant and colostrum production may be past the point of being able to incorporate the extra immunoglobulins.

There is a wide array of vaccines available for immunizing cattle. All cattle should be started with the first or primary immunization at an early age after maternal antibodies have reached low numbers (12-14 weeks of age). Failure to do this leaves the immune system unable to respond properly to subsequent booster shots. It is recognized that modified live viral products are valuable in the degree and longevity of protection. The number and uses of bacteria based vaccines or bacterins are best described as a matter of individual herd need. The custom heifer raiser and open herd will have use for more variety and frequency of vaccination than a closed herd.

Although vaccines are useful tools, excessive use must be avoided in dry cows. The ones derived from Gram-negative bacteria such as *Leptospira*, *Hemophilus*, *Salmonella* and *E.coli* contain compounds known as endotoxins. These poisons cause fever, depression and decreased appetite. No more than 2 of these Gram-negative bacteria should be involved in any one episode of vaccinating a dry cow. Abortion or early calving can result.

Dry cow treatment is a valuable practice to insure less fresh cow mastitis and better availability of quality colostrum. Flaming or clipping udders reduces the amount of filth that the calf might encounter and the risk of contaminating the colostrum harvest.

A listing of dry cow and springer recommendations:

- Feed for maintenance of body condition avoiding moldy and poorly fermented feeds, using appropriate vitamin and mineral supplements and providing adequate metabolizable protein.
- Allow 2.5 feet per cow of bunk space.
- Avoid overcrowding (<one cow per stall), frequent grouping changes and additions, hot and stuffy conditions.
- Provide adequate fresh water (one drinking spot per 15 cows), comfortable and dry areas to rest with 100 square feet per cow.
- Do not vaccinate dry cows and heifers less than 2-3 weeks prior to calving
- Do not vaccinate when the temperature is over 85° F (30° C).
- Do not use more than 2 Gram-negative bacterins at one time. Separate them by one week if necessary.
- Consider pregnancy re-checks before drying off to verify date and presence of calf.
- Trim all late pregnancy cows to assure good foot balance.
- Control and treat cases of foot rot and heel warts.

Preparation for Calving

Cows should be provided with a comfortable place before labor begins in earnest. A clean, well bedded and dry box stall of at least 80 sq. ft., a dedicated pack with 125 sq. ft. per animal or a conventional barn stall with gutter grate in place and lots of bedding will work. Calving areas should be cleaned out weekly and bedded daily. These should pass the “knee drop test” where your pants remain clean and dry after kneeling on these surfaces.

Cows should have access to feed and water although they will not eat or drink much at this time. Making sure the teats are clean is important if newborns might suckle unassisted. If teat dip is used, it should be wiped off after contact for a few minutes.

The Calving Process

Cows that are close to calving must be observed frequently for the first stage of labor. Signs include increased vaginal discharge, restlessness, lying down and standing up frequently, nervousness, kicking at the belly and contractions. Individual animals will vary in the intensity of signs. It is important to exam vaginally ones that do not progress as expected. The onset of milk fever, abnormal presentations and uterine torsions alter the characteristics and the timeline. Stage 1 ends when the cervix is fully dilated. This process should take 2-4 hours in heifers and 2-3 hours in older cows.

Stage 2 of labor involves the appearance of the water bag or feet, strong uterine contractions and the delivery of the calf into the birth canal. It ends with the delivery of

the calf. This period should last less than an hour in heifers and about 30 minutes in older cows.

Calving assistance requires cleanliness, good judgment and consistency. Vaginal exams and manipulations of the calf must be performed only after the tail has been held or tied out of the way, the vulva has been scrubbed with soap and a plastic sleeve has been put on the operators arm. Sterile lubricant, not soap, should be used on sleeves and inside the cow. Soaps are irritating and lead to metritis later on. Dirty techniques will contaminant the uterus and present bacteria to the mouth and nose of the calf. Pulling calves before complete dilation, with too much force or too quickly often leads to increased calf loss and vaginal trauma.

Calving difficulty or dystocia is commonly scored on a 1 to 5 scale. "1" represents no problem whereas "5" represents extreme difficulty. 30% of calvings involve some difficulty. There is a range of effects as a result of this physical trauma. Calves can be stillborn in the worst case scenario. This ranges in prevalence from 5% in older cows to 10% in heifers. Calves will experience metabolic acidosis, low blood oxygen, hypoglycemia and hypothermia with dystocia. Passive transfer failure is common despite proper colostrum management in calves with difficult births. Quantifying the indicators of these metabolic effects such as blood oxygen, CO₂, acid-base balance and cortisol is impractical in the field. Even moderate assistance will cause higher illness and death rates in comparison to normal deliveries. Dystocia calves as a whole will experience 3.8 times more sickness and 4.5 times higher death rates than normal ones. 25% of these die within 48 hours of birth.

It is important to give special attention to dystocia calves. Often their breathing reflexes are poor and the mouth and upper airways can be mucous filled. Vigorous rubbing, poking a piece of straw up a nostril, pouring water in an ear, hanging over a gate, mouth to nose resuscitation and using oxygen resuscitators are ways of stimulating these calves.

Post-calving Care

Post-calving management control points include navel dipping, environmental hygiene (dry and clean), stress avoidance (no rough handling, cold protection), colostrum (quality, quantity and quickness) and nutrient delivery (energy). It has become apparent that the environment of the dam is a difficult one at best to keep calf friendly. Adult cattle can be factories for viruses and bacteria that may cause little if any harm to themselves or pen mates, but could be potentially life threatening to newborns. This includes respiratory pathogens as well as the critical enteric ones. Removing calves from even the cleanest, lowest density calving pen promptly is a sound best management practice.

The navel is a direct pathway for bacteria to invade the blood stream of the calf. Strong 7% tincture iodine should be applied to the navel stump as soon as possible and repeated within 24 hours. Any accumulated organic material should be removed before dipping. Iodine tincture cauterizes, dries and disinfects. Other disinfectants may kill bacteria, but have little drying effect.

Calves are born with temperatures around 103° F (39.5° C). This decreases during the first day of life. If the temperature drops below 101° F (38.5 C), metabolic changes occur which reduce survivability and the absorption of antibodies from colostrum. In cold weather, heat lamps and “hot boxes” are great aids in keeping calves warm. Placing calf jackets on calves after dry off will maintain body temperatures and reduce maintenance energy requirements. Gentle handling of newborns will keep the already elevated levels of cortisol from rising further.

Colostrum

Colostrum is a special secretion of the mammary gland which has attributes far exceeding that of regular milk. It contains high levels of immunoglobulins (antibodies), macro and micronutrients, leukocytes (white blood cells), enzymes, growth factors and hormones.

The placenta of the ruminant does not allow for the transfer of immunoglobulins from the maternal blood to the fetus. If the fetus is challenged directly in utero by pathogens within its own system, it will be born with antibodies of its own. Bovine colostrum contains particularly high levels of IgG1, accounting for greater than 80% of all antibodies present (Barrington, 2001). IgG1 is a commonly used indicator to evaluate overall immunoglobulin status in colostrum and calf blood.

The status of the immune system is a critical component of the early health and growth of calves. Calves are born with a competent but naïve ability to respond to disease challenges. This means that the newborn, compared to the adult, will respond to the entry by pathogens into the body in a less vigorous and speedy manner. Reliance on maternal antibodies (passive immunity) provided by colostrum during this time has been a benchmark of management practices.

Many studies indicate an economic value achieved through treatment cost reductions and more efficient growth that comes with a higher level of passive transfer. Others have not supported this correlation that well. The exception seems to occur when there is complete colostrum deprivation without any passive immunity at all to the newborn. Here the severity and swiftness of infections can be remarkable. Septicemia, joint ill, acute enteritis and mortality are more common than in cases of partial failure of passive transfer. A study by Wells et al., 1996 showed a 74-fold increase in the risk of mortality during the first 21 days of life of such calves as compared to adequately protected ones. Calf survival is general trends with serum IgG concentrations (Figure 1).

The degree of pathogen exposure and the intensity of neonatal stress can tip the balance between health and sickness despite the passive protection achieved. Calves without passive protection shed huge numbers of pathogens, becoming factories for viral and bacterial replication. These calves pollute the environment around them.

Colostrum Formation

The bovine begins the selective secretion of immunoglobulins into the mammary gland between 4 and 5 weeks prepartum. The process continues until a few days before calving although at a declining rate. As with all ruminant species, the cow does not pass any antibodies across the placental membranes to the fetus. The transfer of passive protection via immunoglobulins is solely achieved through ingestion of colostrum by the calf.

The relative value of colostrum appears to be correlated to the length of the dry period. Excessively short dry periods of less than 21-30 days negatively impact the amount of antibodies produced. Similarly, cows with dry periods in excess of 70 days trend towards poorer colostrum quality.

Properties of Colostrum

The first milking colostrum of the cow is a marvelous combination of superior nutrition, antibodies (IgG, IgA, IgM, IgE), immuno-active cells, growth promoters and immune stimulants (Table 1). There is evidence that the development of both the immune and digestive systems are initiated early in the calf's life by the various hormones and growth factors (Barrington and Parish, 2001).

Table 1. The average Holstein “first milking” colostrum compares to normal milk as follows:	
Colostrum contains	2 times the solids
	4 times the protein
	2 times the fat
	65 times the IgG
	2 times the calcium
	10 times the Vitamin A
	3 times the Vitamin D
	10 times the iron

Lactose is usually lower in colostrum, however, the higher fat content puts the gross energy at almost twice that of milk. The profile of early transition period secretion approximates that of milk by about the 5th milking.

Colostrum has a somatic cell count of over 1 million leukocytes and epithelial cells. Along with the immunoglobulins, this provides the bulk of the passive immunity derived from colostrum. Both immunoglobulins (Ig) and leukocytes are actively transferred across the gut wall to enter the blood within the first 24 hours of life. Ig has a half-life of 11.5 to 16 days (LeJan, 1996).

Colostrum Harvest and Storage

The calving process initiates a change in the profile of the secretion of the udder. Newly produced transition milk is added to the already existing core of colostrum produced over the preceding three weeks. Since this production is less concentrated in antibodies and white cells, delaying the milk out of the dam to collect colostrum leads to poorer Ig concentrations. Harvest of colostrum at 6 hours post-calving has been shown to reduce antibody levels up to 40% as opposed to removal within 2 hours of parturition (Davis and Drackley, 1998).

Colostrum has had a folklore mystique about it for many years. Dairymen have handled colostrum as though it were “self-sanitizing”. Colostrum can be observed being poured into poorly cleaned pails, stored without lids, subject to dust, wash water splatter, domestic animal intrusion and ambient or higher temperatures. It is only in recent years that a widespread effort has taken place to enlighten the dairy world about the biosecurity aspects of colostrum.

Colostrum is an excellent medium to grow bacteria. Pathogenic coliforms are capable of doubling in numbers every 20 minutes in this environment at temperatures above 70° F. It is impossible to deliver a sterile allotment of colostrum to the calf, but is possible to limit the total number of organisms. The use of sanitized milking equipment and containers and proper udder preparation is often overlooked, but is a key part of the overall plan for pathogen control.

Stabilization by the use of microbial inhibitors such as potassium sorbate has proven useful. These will not reduce the number of bacteria, but will impede the replication. It is very important that colostrum that is to be held for feeding in the future be chilled quickly and thoroughly. Large volumes placed in a refrigerator or even a freezer will not achieve inhibitory temperatures in core areas for many hours. Chilling by placing frozen water jugs in collection pails before storing is recommended. The warming phase can be a growing opportunity for bacteria as well. Stabilizers can be helpful in these situations.

Colostrum for freezing can be efficiently and conveniently placed in Ziploc bags (2 quarts per 1 gallon bag) or 2 quart bottles. Labeling with cow ID, date and quality information is important. Bags and bottles should be placed in the freezer with space in between to insure rapid chilling. Only freezers without a “frost free” feature should be used. The thaw cycle used in removing frost promotes quality deterioration. Frozen colostrum should not be held for more than 12 months before use. It must be noted that all cellular and varying amounts of other immuno-active, colostral components do not survive freezing.

Pasteurization has been a useful tool for many years in lowering the bacteria count of waste milk and controlling associated enteric problems. This process has not been applied to colostrum until rather recently due to the physical characteristics and the heat-labile nature of the immunoglobulins. Specially designed batch pasteurization units with improved temperature control, agitation and cleaning methods have changed this picture.

IgG loss can be limited to less than 25% although cellular immune components are mostly destroyed. Transmission of certain infectious diseases via colostrum from the dam to the newborn can occur. Leukosis, Johnes, BVD, *Mycoplasma* and *Salmonella* are the most commonly encountered. Pasteurization offers a means to take advantage of the low cost, complete nutrition and effective immune protection offered by colostrum with a substantial reduction in the risk of pathogen exposure from the environment or the dam.

Colostrum Quality

The nutrient content of colostrum varies generally by breed and by individuals within that group. This has not appeared to be a major concern for the viability of the calf. The immunological features, on the other hand, have been given a tremendous amount of attention from the perspective of research and management application.

The late gestation cow will produce levels of immunoglobulins or antibodies in her colostrum based on her own response to infectious agent challenge. This is usually a combined result of natural exposure and vaccination administration. Logically, older cattle tend to produce higher levels of antibodies in their colostrum as opposed to first calf heifers. It has been reported that as many as 25% of primiparous dams will have adequate concentrations at calving.

The volume of colostrum obtained from the first milking has been used in the past as a barometer for quality, but generally disregarded today. The “18 pound rule” says that amounts greater than this tend to be inadequate in immunoglobulins. The same rationale applies to lost quality noted when the first milking is delayed and transition milk has been produced. Precalving milking and leaking of milk will reduce colostrum value. Color and consistency have been qualitative measures used to judge antibody content, the thought being the thicker and deeper the yellow color, the better it is. The correlations here are not all that reliable.

At the present time, two methods of testing colostrum for immunoglobulin quality are prevalent. The colostrometer, an instrument which determines specific gravity, is an easy and inexpensive method of evaluation. One important ground rule for its use is often overlooked, however. The colostrum to be tested must be near “room temperature” (68-72° F) to get a reliable reading. The colostrometer is calibrated in this range and is marked with the correlated level of IgG. Colder product is thicker and will give a falsely elevated reading. Warmer temperatures thin out the liquid and underestimate the immunoglobulin content. Colostrum is classified as poor if it contains <22 mg/ml of IgG (red zone), moderate if between 22 and 50 mg/ml (yellow zone) and excellent if the level is >50 mg/ml (green zone) of IgG. Variations in fat and non-Ig protein content will change the viscosity of colostrum and affect the reliability of this method.

The other more accurate means of evaluating colostrum is through the revamped Colostrum Quik Test™ (Midland BioProducts) which directly and quantitatively measures IgG levels. It is not subject to temperature or component based error. This test has been used in different ways. Some have tested all colostrum deemed appropriate to

consider for feeding. Others use it as a spot check to monitor variations based on a season, parity and performance.

Colostrum supplements and replacements have gained popularity as a result of quality and biosecurity concerns. These products are derived from bovine serum, colostrum or whey. Total replacement preparations must contain greater than 100 grams of IgG, preferably 120 grams. The recommended timing of administration does not differ from that of natural colostrum with regard to antibody absorption characteristics. The efficiency of absorption of natural or supplemented antibodies is determined by elapsed time since birth as well as the Ig mass presented to the gut. Supplemental sources added to adequate or superior colostrum will not change blood Ig concentrations significantly. Addition to poor colostrum raises Ig levels notably. There appears to be a rate limiting factor regulating immunoglobulin uptake (Arthington et al., 2000).

The integrity of colostrum from the bacterial contamination point of view is vital to the newborn calf. It is recommended that routine culturing of colostrum be used to monitor the success of harvesting, handling, storage and sanitation. It may be necessary to culture various articles of feeding, water and the environment to determine the source(s) of the contamination.

Colostrum Administration

Ideally, colostrum should be administered within four hours of birth. Large calves should be fed 4 quarts, small calves 3 quarts. A second feeding of 2 quarts is recommended within 8 hours.

Unlike beef calves, the dairy calf experiences very high rates of failure of passive transfer if left to nurse the dam (Besser and Gay, 1991). Hand feeding with a nipple bottle is the recommended first means of administration. Large volumes may not be consumed readily by some calves. Completing the feeding by use of an esophageal feeder is recommended. Proper positioning of the calf and care in preventing residual colostrum in the tube from being inhaled eliminates any risk associated with “tubing”. Making sure weaker calves do not lay out flat after a large delivery via tube will prevent passive reflux and inhalation problems as well.

Esophageal feeding delivers the liquid into the rumen rather than in a path to the abomasum. There is a 3 hour delay in emptying the colostrum from the rumen into the abomasum. The trade off between the early and high volume delivery of antibodies versus this delay favors the use of the esophageal feeder (Hopkins and Quigley, 1997).

Colostrum should be close to body temperature at feeding. Refrigerated or frozen colostrum must be warmed using water baths no hotter than 140° F to avoid destruction of antibodies. Microwave thawing is time consuming (15-20 minutes) if performed in a non-destructive manner. Care must be taken to administer warmed or recently harvested colostrum quickly to prevent bacterial growth.

Nutritional Impact

The newborn calf is born with relatively little body reserves available for energy metabolism. This neonate's body contains only 3% fat as compared to 18% of the human infant. Glycogen stores average only 180 grams. Without the consumption of feed even in thermo-neutral conditions, the calf only has 18 hours of energy sources. Cold conditions shorten this time frame when the calf must shiver to generate body heat.

Colostrum not only contains superior levels of protein and fat, but higher concentrations of vitamins and minerals. Supplement and replacement products do not have this ideal nutrition or the bioavailability provided by colostrum. It is imperative that calves are provided with adequate nutrients as soon as possible in conjunction with these products.

Success of Passive Transfer

There are three aspects of transferring antibody protection from the dam to the calf that must be considered in evaluating the resulting Ig status.

1. *Grams of immunoglobulins delivered to the calf*

A 90 lb calf requires about 36 grams of IgG to acquire a blood serum level of 10 gm/ml or 1000 mg/dl which is roughly equivalent to 5.2 gm/dl of total serum protein. This level is considered the break point between adequate and insufficient passive protection. The average absorption rate of colostral antibodies is estimated to be 35% with a range of 25-65% (Quigley, 2001). This means that this average calf must ingest 104 grams of IgG to be marginally protected. If the IgG concentration of the colostrum is an average 50 mg/ml or 50 grams/liter, the calf must consume a bit over 2 liters to achieve this. If the IgG concentration is poor at 25 grams/liter and the absorption rate remains the same at 35%, the calf must consume over 4 liters to achieve equal protection. More than 40% of calves were found to have inadequate levels of IgG in a 1992 NAHMS study (Figure 2).

2. *Timing of colostrum feeding*

A special window of opportunity for absorption of large molecules such as immunoglobulins, white blood cells and unfortunately bacteria exists in the first 24 hours of the calf's life. The efficiency of absorption of the critical antibodies is greatest right after birth, decreases 10% by 4 hours of age, decreases by 50% at 12 hours of age and is completely gone by 24 hours after birth (Davis and Drackley, 1998).

3. *Metabolic status of the calf*

Despite the delivery of high levels of immunoglobulins in a timely fashion to the calf, failure of passive transfer (FPT) can occur. The consequences of dystocia on the newborn can be severe. The NAHMS or National Dairy Heifer Project has reported stillborn rates of near 8% and mortality rates within 48 hours of a difficult birth of 25%. Common systemic problems affecting key metabolic pathways have already been described. The impact on calf viability and health are generally proportional to the calving ease score.

The net effect of failure in any one or more of these three categories results in the poor absorption of immunoglobulins regardless of the amount and time of ingestion. A poor swallowing reflex and accumulation of fluid in the dependent side of the lung in the case of inactive newborns promotes early pneumonia as well.

Monitoring Passive Transfer

It becomes apparent that the real measure of success of passive transfer lies with the testing of the calf. Calves should be at least 24-36 hours old and no more than 5 days for testing. Direct measurement of circulating IgG levels is the ideal method. Commercial tests are available for use on whole blood or serum (Midland BioProducts). These rapid tests quantitatively determine IgG levels. Indirect methods such as the zinc sulfate turbidity test and total blood protein determination with a refractometer are cheaper, but less accurate at evaluating IgG status. The calf's hydration status will alter refractometer results. Dehydration can move the total protein reading higher while anemia from naval stump blood loss will depress it. It is important that calves are always sampled at the same time related to liquid feeding to minimize this error. Refractometer readings can also be elevated by the presence of fibrinogen, a blood protein transferred to the calf through colostrum. Fibrinogen is produced in greater quantity by the cow experiencing chronic infection.

Other Management Practices

The use of vitamin and mineral supplementation by injection is a common practice in newborn calf care. Colostrum has concentrations of these micronutrients at levels many times that of milk or milk replacer. Since prolonged feeding of colostrum or transition milk is not as common today as it once was, the availability of these trace nutrients may be lacking.

The supplemental use of vitamins A, D, E and B-complex and minerals iron and selenium is commonly adopted for newborns while use of products with manganese, copper and zinc are less utilized.

Intranasal vaccines can be used during the first day of life. These IBR-PI3 live virus vaccines provide quick, broad spectrum, surface antibody protection against common pathogens of the respiratory tract with some spill over into the digestive tract. These are not subject to the cortisol interference that blocks injectable vaccine efficacy.

Immune stimulating products (Immuboo®) and endotoxin vaccines (ENDO-VAC Bovi®) are commonly used beginning on the first day of age on calf ranches and veal operations. These bypass the regular route of immune response and will not be blocked by calving-induced cortisol release. Both types are injectable. The early use of these agents is aimed primarily at enteric disease caused by coliform bacteria although protection against respiratory pathogens is additionally achieved.

Summary

Achieving high rates of survivability and health in newborn calves involves a comprehensive management program that starts with the dam and continues through the first day of age. The day of calving is the most critical point in the life of the bovine as well as one of the greatest opportunity areas presented to the industry as a whole.

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