

# The Vital 90™ Days and Why It's Important to a Successful Lactation

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## Transition and the Vital 90 Days

The transition period for a dairy cow has traditionally been defined by the dairy industry as the period 3 weeks pre-calving to three weeks post-calving. An expanded period including the entire dry period, i.e., 60 days pre-calving to 30 days post-calving, more completely encompasses the actual period when physiological and nutritional adjustments determine if a successful subsequent lactation will be achieved. For the purposes of this paper, this expanded period will be described as The Vital 90™ Days.

Numerous physiological and metabolic changes (i.e., transitions) occur during the dry and early lactation periods in the dairy cow. These changes include:

- Cessation of milking at dry-off
- Changes in environment and ration composition
- Rapid fetal growth
- Decline in dry matter intake just prior to calving
- Initiation of colostrum production
- Hormonal changes, including declining progesterone and rising estrogen blood levels
- The process of giving birth
- Rapid increase in milk production

Along with physiological adjustments associated with transition, energy requirements essentially double overnight at the time of calving. Reynolds et al. (2003) showed liver glucose output doubling from 1,356 g/d at 11 days pre-calving to 2,760 g/day at 11 days post-calving. Those demands further increased to 3,283 gm/d by 22 days post-calving (Table 1). In addition to the demand for additional glucose for early lactation, energy balance is further compromised by a decline in feed intake in the peripartum cow (Grummer, 1995; Figure 1).

Along with a glucose deficit, the periparturient cow also commonly suffers a deficit in available protein. Much body protein is being used to support fetal growth in late gestation and the amino acid and glucose requirements for early lactation milk production (Overton, 2013). Bell et al. (2000) demonstrated a significant negative metabolizable protein (MP) balance in cows during early lactation. During the first 7 to

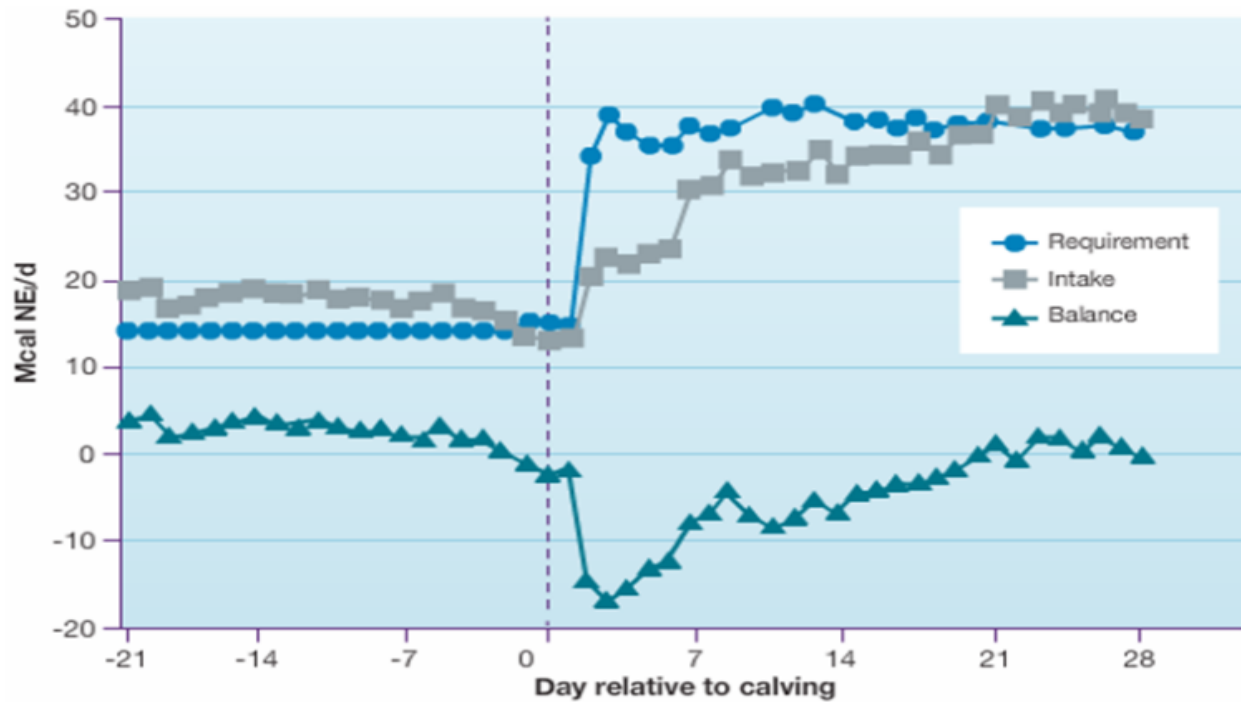
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10 days of lactation, high-producing dairy cows may mobilize as much as 1,000 g of tissue protein/d to satisfy the mammary gland's demand for amino acids and glucose. Bell concluded that a realistic estimate for MP requirements of a late-gestation cow was approximately 1,000 g/d. Because of the significant decline in feed intake just prior to calving, the suggested MP requirement for close-up dry cows is 1,200 g/d (Overton, 2013; Bell et al., 2000).

**Table 1.** Energy demand: measured glucose supply vs. estimated demands (Reynolds et al., 2003)

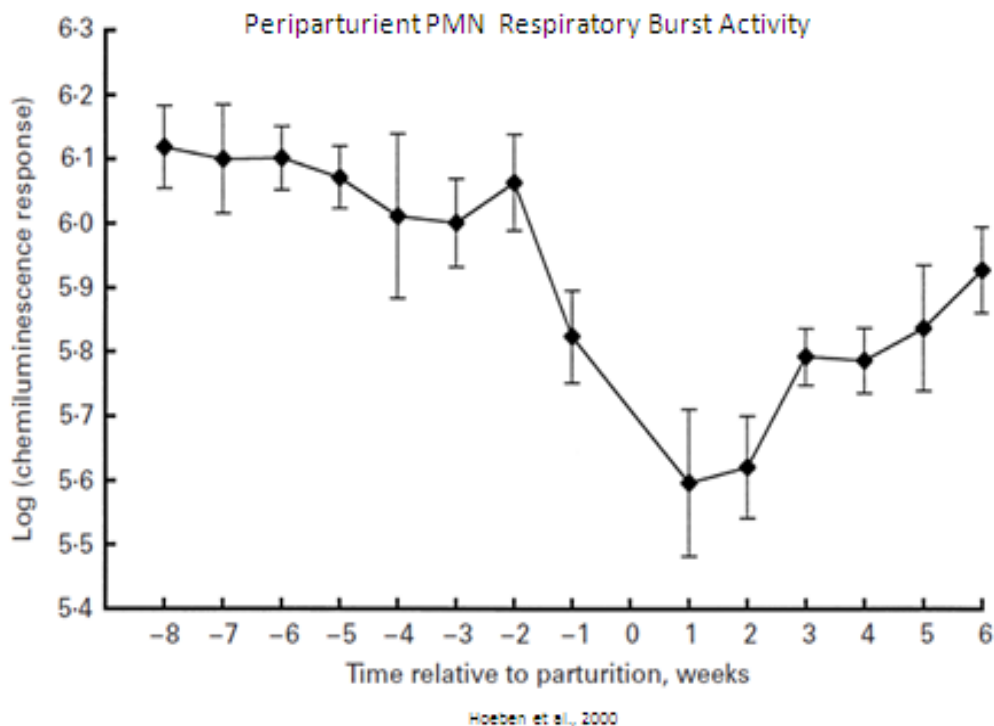
Variable	Day relative to calving					
	-19	-11	11	22	33	83
DMI, kg	9.7	9.8	14.1	16.9	19.4	21.8
Milk, kg	....	....	36.3	41.9	44.0	41.0
Liver net glucose output, g/d	1257	1356	2760	3283	3499	3650



**Figure 1.** Energy requirement, energy intake, and energy balance of control cows during the transition period (Grummer, 1995).

The physiologic and metabolic changes occurring during transition also negatively affects immune function in the periparturient cow. Hoeben et al. (2000) demonstrated that immune response, as measured by neutrophil respiratory burst activity, was significantly reduced in the days just prior to and immediately post-calving (Figure 2). If immune function is impaired or suppressed, the cow becomes more susceptible to a number of periparturient disease conditions, such as retained fetal membranes, metritis, and mastitis.

Immunity encompasses a number of complex interactions that are designed to protect the animal from infection by a number of microbial organisms. The immune system is characterized by two primary branches: acquired immunity and innate immunity. Acquired immunity refers to the portion of the immune system that is commonly associated with antibody generation. Immunity is developed in response to first exposure to an antigen (foreign protein), such as a microbial agent or a vaccine antigen. In fact, the term “antigen” is a combination of the words **antibody** and **generator**. The immune response can be cell mediated or humoral and usually requires days to weeks to completely develop. Acquired immunity is generally specific to the microbial agent and has “memory” or tolerance such that it specifically responds to repeated exposure to that agent. The primary defense cell associated with acquired immunity is the lymphocyte, the white blood cell involved in antibody production.



**Figure 2.** Impaired neutrophil function associated with reduced PMN respiratory burst activity in the periparturient cow (Hoeben et al., 2000).

In contrast to acquired immunity, innate immunity is nonspecific and has no memory of prior exposures. However, the innate responses to microbial exposure is

extremely rapid and very consistent. The primary defense cells in the innate system are neutrophils and macrophages. They commonly destroy bacteria by phagocytosis, which involves engulfing and digesting an invading microbe. Macrophages commonly reside in specific tissues such as the mammary gland or lungs and serve as sentinel cells that send out warning signals in the form of cytokines at the first indication of infection. Neutrophils respond to these signals by migrating, in large numbers, from the blood stream to the site of infection. When immune function is impaired, as described in the transition cow, neutrophils demonstrate a reduced ability to destroy bacteria.

Endocrine changes and physiologic stressors during transition contribute to impaired immune responses, but not all stress-related neuroendocrine responses are immune suppressive. The catecholamine response to stressors is, in fact, one of the early innate responses to stress, and is immune stimulatory. As a countermeasure, bacteria within the host, release their own neuroendocrine hormones, potentially initiating and enhancing pathogenic processes (Lyte, 2004).

Immune suppression during The Vital 90™ Days is multifactorial and can be related to hypocalcemia, elevated blood glucocorticoids levels, insufficient energy (hypoglycemia), and elevated ketones (ketosis) and elevated blood non-esterified fatty acids (NEFA) levels. Adequate nutrition, a clean environment, and strategic immunization are key components in restoring normal immune function and disease resistance in the periparturient period.

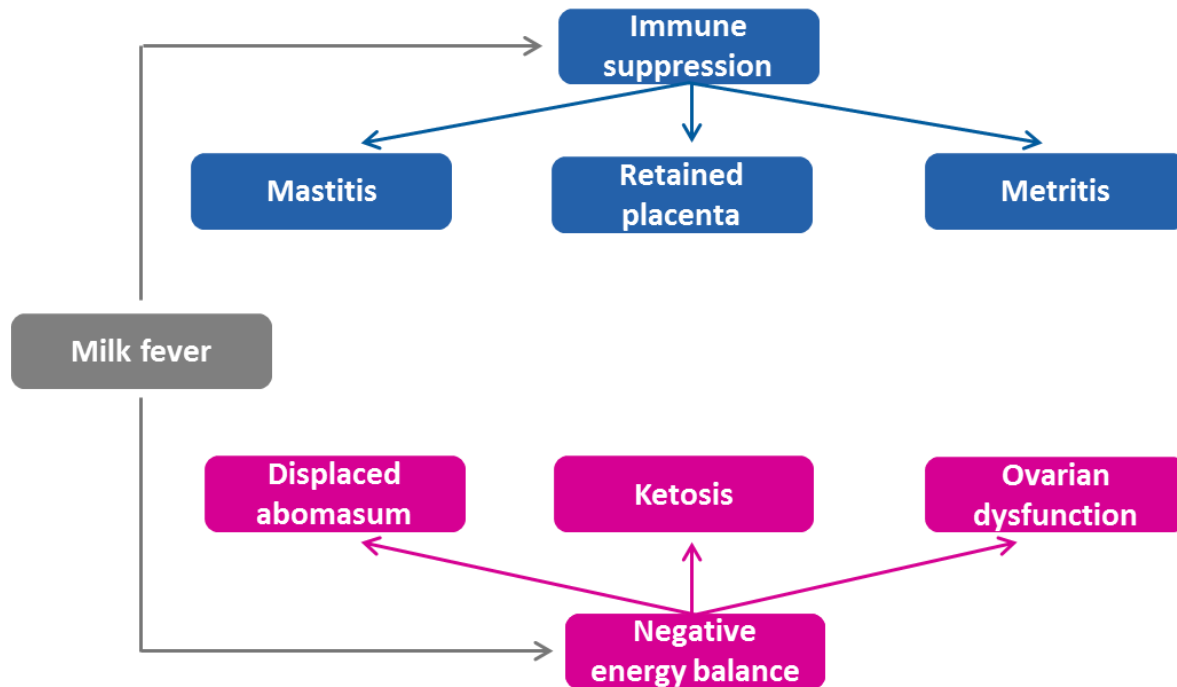
Negative energy balance is a normal physiological phenomenon in the early postpartum dairy cow and numerous other mammals. The primary concerns are the degree (depth) of negative balance and the cow's ability to adapt (duration), thus minimizing the length of time before returning to a positive balance. Successful lactations are dependent on how well energy balance is managed and immune function maintained during transition from pregnancy to lactation. Setting the cow up for a successful transition begins in the dry period, well before the initiation of the next lactation.

### **Periparturient Disease Conditions and The Vital 90 Days**

Disease conditions that occur in the first 30 days of lactation often result from physiological changes and management decisions made during the prior 60 days. These diseases can generally be divided into those associated with negative energy balance or immune suppression. Common peripartum disease conditions associated with immune suppression include retained fetal membranes (RFM), metritis, and mastitis. Those associated with excessive negative energy balance include displaced abomasum, ketosis, and ovarian dysfunction (cystic ovarian disease or prolonged anestrus) (Figure 3).

Calcium can play a role in both categories of periparturient disease complexes. Cows experiencing clinical or subclinical hypocalcemia have impaired muscle function, gastrointestinal stasis, and reduced appetite increasing the risk of a metabolic disease

problem. Erb et al. (1988) showed an association between hypocalcemia and an increase in the chances for a metabolic disease condition, including displaced abomasum.



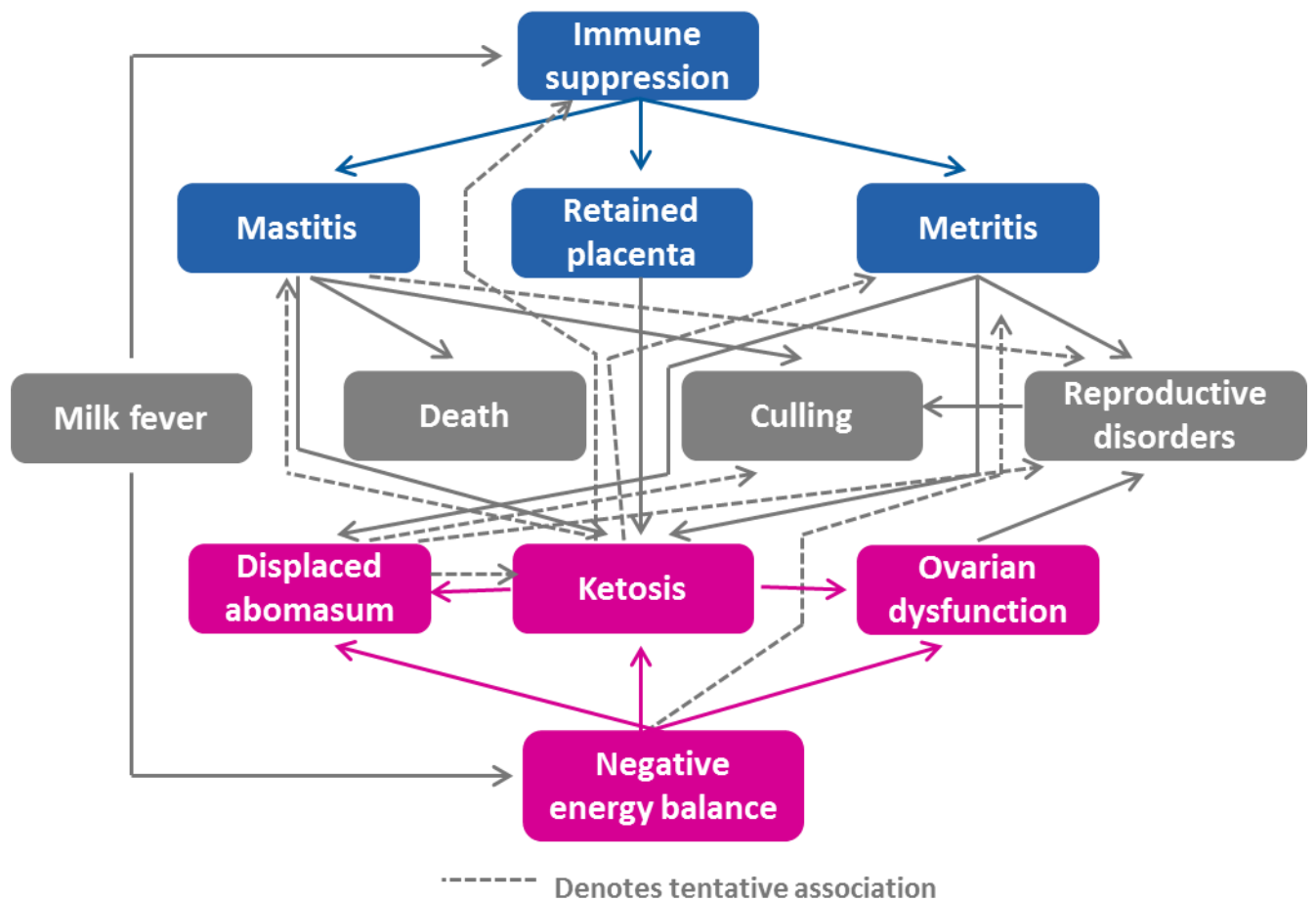
**Figure 3.** Diseases related to immune suppression and energy balance in the transition dairy cow (Duffield et al., 2009; Godden et al., 2006; Huzzey et al., 2007; Kimura et al., 2002; Loeffler et al., 1999).

Calcium also plays a critical role in immune function in the periparturient dairy cow. Intracellular Ca is an important component in early immune cell activation (Kimura et al., 2006). Activation of immune cells, such as circulating monocytes, is dependent on adequate concentrations of intracellular Ca. Reduced intracellular calcium stores negatively affect immune cells' response following an activating stimulus, thus contributing to the immune suppression seen in these animals. Periparturient hypocalcemia, with a corresponding decrease in monocyte intracellular Ca, results in immune suppression increasing the likelihood of periparturient disease such as mastitis. A New York study (Curtis et al., 1983) involving 2,190 cows demonstrated a very strong association between parturient hypocalcemia (milk fever) and mastitis. The odds ratio suggested that a milk fever cow was 8.1 times more likely to develop mastitis than a cow with normal blood Ca levels.

Lowered circulating Ca can itself contribute to a stress response in periparturient cows. Plasma cortisol typically increases three- to fourfold at the initiation of parturition. In cows with subclinical hypocalcemia, the increase in plasma cortisol may be five- to sevenfold. If a cow develops clinical hypocalcemia, plasma cortisol levels can increase ten- to fifteen fold compared to basal levels (Horst and Jorgensen, 1982).

Research has shown that the incidence of RFM may also be influenced by immune suppression. In a study comparing neutrophil function in cows with RP compared to those without RP, Kimura et al. (2002) demonstrated that neutrophils isolated from blood of cows with RP had a significant reduction in neutrophil function compared to those that did not retain. This impaired function continued for 1 to 2 weeks after parturition. Their work concluded that impaired neutrophil function played a major role in the likelihood of a cow suffering retained fetal membranes.

Periparturient diseases are often multiple entities. There are numerous interactions among the conditions associated with negative energy balance and immune suppression (Figure 4). The development of one disease condition often contributes to another such that conditions associated with negative energy balance contribute to an increased risk for conditions associated with immune suppression and vice versa.



**Figure 4.** Complex interactions among diseases associated with immune suppression and energy balance in the transition dairy cow (Duffield et al., 2009; Godden et al., 2006; Huzzey et al., 2007; Kimura et al., 2002; Loeffler et al., 1999).

## Periparturient Disease Prevention and Recognition during the Vital 90 Days

Dairy producers expend considerable time and financial resources in an attempt to assure the dairy cow has a successful dry period and transition into early lactation. The exact cost of these interventions are often not known, yet when asked to detail them dairy producers soon realize the investment during The Vital 90 Days can be substantial. Failure during this period leads to an increased incidence of disease and death loss. These failures place a significant negative burden on the operation.

Transition disease problems result in tangible and intangible consequences. The most obvious tangible consequence is financial loss. Beyond the tangible consequences there are also intangible or emotional consequences such as dealing with the stress and emotional frustration associated with higher morbidity and mortality in your client's herd. Furthermore, continually dealing with sick cows can negatively impact the morale of employees. Prevention of disease problems during The Vital 90 Days has the obvious tangible economic benefits but also intangible benefits of improved pride, confidence, and peace of mind.

The degree of success during transition has direct impact at both the cow and dairy level. Several key questions can be asked of dairy producers regarding recovery, future productivity, and/or disposition for cows experiencing any periparturient disease problems. These include:

- How many cows are in the sick pen, how long are they there, and how many make it out?
- How productive are the cows after a stay in the sick pen?
- Do all of your clients have an on-farm euthanasia protocol?
- What is the impact to the welfare of a cow if there is no euthanasia protocol?
- Do we have the medical interventions necessary to save every cow that develops a periparturient disease?

In addition, transition problems impact the dairy operation in general. When problems accumulate, frustration levels increase, and long term success of the operation suffer. Key questions that can be asked at the farm level include:

- What is a typical day like for a member of the hospital-pen treatment crew?
- Do farms experience protocol drift? Why is this?
- Are veterinarians frustrated by some of the treatments they see being used outside of their control?
- With the widespread use of fresh cow monitoring programs (e.g., daily temperatures for 10 to 14 days), has a client ever treated their way out of a transition disease problem?

A key component often lacking or deficient when analyzing the incidence and associated cost of disease is inadequate disease records or no records at all. Kelton et al. (1998) published recommendations on recording and calculating the incidence for

eight clinically identifiable diseases of economic importance to the dairy industry. The diseases addressed were: milk fever, RFM, metritis, ketosis, left displaced abomasum, cystic ovarian disease, lameness, and clinical mastitis. This paper is commonly referenced when introducing guidelines and standards for the reporting of data related to the health of cattle. In addition to the eight conditions identified by Kelton et al. (1998), pneumonia should also be considered an economically important disease condition in some herds.

There continues to be a strong interest within the dairy industry in the recording and analysis of clinical disease data, with the goal of assisting dairy producers and their advisors in making impactful decisions.

Dairy producers and their advisors need to consider two broad categories of medical decisions:

1. Individual cow decisions
2. Herd health program decisions

Using on-farm records facilitates both categories of medical decisions and results in making a positive impact on both the individual cow and the dairy business operation. Having valuable information for making critical management decisions require accurate recording, and the ability to retrieve and analyze health records. Key components of this system are being able to:

- **Define** the conditions (diseases) to be tracked
- **Describe** the clinical signs of the disease
- **Detect and Monitor**
- **Decide (Individual Cow):** Record and Treat
  - Create standard protocols available for treatment options and recording
  - Utilize decision tools to choose specific protocol for a given case
- **Analyze** the available data

Accurate and complete dairy records start with consistent recording of health events. The basis for accurate recording is standardized definitions for common health conditions. The following list provides standardized disease definitions which, if used consistently, should improve the accuracy of disease detection, recording, and analysis. The following diseases commonly occur during The Vital 90 Days:

### **Metritis (METR)**

- Metritis is recognized by an abnormal (smelly and watery) uterine discharge within 21 days of calving. On palpation per rectum, the uterus appears flaccid, not contracting normally, and fluid filled.
  - Mild clinical metritis is metritis without a fever or other clinical signs apart from the uterine changes.
  - Severe clinical metritis is metritis with the presence of clinical signs that may include fever, depression, and lack of strong appetite.



### **Ketosis (KETOSIS)**

- Ketosis is recognized when animals are identified with elevated ketone bodies in the blood ( $> 1,200 \mu\text{mol/L}$ ), milk ( $> 100 \mu\text{mol/L}$ ), or urine in the absence of concurrent disease. The risk period for transition-related ketosis is usually the first 30 DIM, but testing is most commonly performed during weeks 1 and 2 after calving, when the risk is highest.
- Clinical ketosis is a more severe form of ketosis where the cow shows clinical signs of decreased appetite, decreased milk production, or abnormal behavior in the absence of another concurrent disease.
  - Primary clinical ketosis is clinical ketosis that occurs prior to or without any other concurrent disease.
  - Secondary clinical ketosis is clinical ketosis that occurs in conjunction with another disease process.

### **Displaced Abomasum (DA)**

- Displaced abomasum (DA) is recognized when a ping is detected by thumping or tapping the cow's body wall while simultaneously listening with a stethoscope in the area between the 9<sup>th</sup> and 12<sup>th</sup> ribs above and below an imaginary line extending from the hip to the elbow on each side of the animal on the abdominal wall. DA can occur on either the right or left side.

### **Retained Fetal Membranes (RFM)**

- Retained fetal membranes is recognized when the fetal membranes (placenta) are still visibly hanging from the cow's vulva 24 hours or more after calving.

### **Milk Fever (MF)**

- Milk fever is identified if a cow of lactation 2 or more displays clinical signs that include muscle weakness, nervousness, muscle shaking, cold ears, and eventually the cow being unable to rise. This condition is caused by low blood calcium levels and usually occurs within 3 days of calving.

### **Mastitis (MAST)**

- Clinical mastitis is recognized by visually observing abnormal milk from a quarter. Clinical mastitis can be classified as mild, moderate, or severe based on whether the cow shows any additional clinical signs beyond abnormal milk.
  - Severity score of 1, or Mild mastitis: Abnormal milk only
  - Severity score of 2, or Moderate mastitis: Abnormal milk + inflammation of udder (e.g., redness or swelling)
  - Severity score of 3, or Severe mastitis: Abnormal milk + inflammation of udder + sick cow (e.g., depression, poor appetite)
- Note that clinical mastitis can occur both within The Vital 90 Days and at other points in the lactation.

### **Ovarian Dysfunction (OVDYSF)**

- Ovarian dysfunction is recognized when a cow is examined and determined to have ovarian problems that are causing abnormal patterns of heat expression (showing heat too often or not showing heat at all).
- While ovarian dysfunction can certainly impact the future reproductive performance, its definition is not a specific disease, and it typically is not diagnosed during The Vital 90 Days. In most cases it will not be tracked as an independent event.

### **Lameness (LAME)**

- Lameness is recognized when a cow is observed walking or standing abnormally due to a problem in the foot, leg or hip.
- Note that lameness can occur both within The Vital 90 Days and at other points in the lactation.

### **Pneumonia (PNEU)**

- Pneumonia is recognized when a cow is observed with altered breathing patterns and/or respiratory sounds due to a respiratory infection. Most cases of pneumonia have a fever but some do not.
- Note that pneumonia can occur both within The Vital 90 Days and at other points in the lactation.

When a disease condition is accurately detected, an appropriate treatment decision can be made. An important role of on-farm management software should be to facilitate guiding the delivery of treatments to the correct cows and compliance to prescribed therapies. Transition disease event entry should be promoted by veterinarians, consultants, and farm managers because it facilitates the delivery of the proper treatments to the correct cows. Farm management must define the approved treatment protocols to be used working with their farm's Veterinarian of Record. The Veterinarian of Record is the responsible party for providing appropriate oversight of drug use on the farm operation. Written protocols should include a protocol name, medications used, and specific directions for use (including duration of therapy and any milk and/or meat withdrawal periods). The primary purpose of data entry is to capture the data needed to guide the implementation of approved treatment protocols. With the supervision of the Veterinarian of Record, on-farm software can assist the animal care workers in delivering the highest quality medical and supportive care to the animals in their production unit.

Monitoring of disease consequences that occur during The Vital 90 Days can be utilized by the Veterinarian of Record, other consultants, and the farm management team to evaluate compliance to the approved herd strategy for the necessary medical treatment of clinical disease events when they occur. In addition, complementary reports related to transition disease incidence risk may be used to provide feedback to the management team about the herd health program strategy for managing negative energy balance and immune suppression during The Vital 90 Days.

## Conclusion

The intent of this paper was the review of numerous concepts related to the modern dairy cow during the transition from dry to early lactation. Transition is not a single event or period but rather a progression through a multitude of events over approximately a 90-day period, thus the phrase “The Vital 90 Days.” Veterinarians and other dairy consultants should work with the producer in developing herd specific strategies for cows in this important period.

Most metabolic and infectious diseases occurring during early lactation are directly or indirectly attributable events during The Vital 90 Days. Dairy producers spend considerable time, effort, and resources during this period, yet rarely do they quantify their total economic investment or the financial consequences of failure during this period. Besides the direct costs, there are also intangible consequences impacting them and their herd. The last concept addressed identifies a practical process for identifying, treating, and recording disease problems. Management decisions during the high-risk period are key drivers for a cow’s health, well-being, and success in the subsequent lactation. Focusing on The Vital 90 Days can lead to a higher likelihood for reduced frustrations, higher profitability, and long-term success in a dairy operation.

## References

- Bell, A.W., W.S. Burhans, and T.R. Overton. 2000. Protein nutrition in late pregnancy, maternal protein reserves and lactation performance in dairy cows. *Proc. Nutr. Soc.* 59:119-126.
- Curtis, C.R., H.N. Erb, and C.J. Sniffen. 1983. Association of parturient hypocalcemia with eight periparturient disorders in Holstein cows. *J. Am. Vet. Med. Assoc.* 183:559-61.
- Duffield, T.F., K.D. Lissemore, B.W. McBride, and K.E. Leslie. 2009. Impact of hyperketonemia in early lactation dairy cows on health and production. *J. Dairy Sci.* 92:571-580.
- Erb, H.N., and Y.T. Grohn. 1988. Symposium: Health problems in the periparturient cow. Epidemiology of metabolic disorders in the periparturient dairy cow. *J. Dairy Sci.* 71:2557-2571.
- Godden, S. et al. 2006. Mastitis control and the dry period: what have we learned? In: *Proceedings from the National Mastitis Council Regional Meeting; August 2006; Charlotteville, Canada.* Pages 56-70.
- Grummer, R.R. 1995. Impact of changes in organic nutrient metabolism on feeding the transition dairy cow. *J. Dairy Sci.* 73:2820-2833.
- Hoeben, D., E. Monfardini, and G. Opsomer. 2000. Chemiluminescence of bovine polymorphonuclear leucocytes during the periparturient period and relation with metabolic markers and bovine pregnancy-associated glycoprotein. *J. Dairy Res.* 67:249-259.

- Horst, R.L., and N.A. Jorgensen. 1982. Elevated plasma cortisol during induced and spontaneous hypocalcemia in ruminants. *J. Dairy Sci.* 65:2332.
- Huzzey, J.M., D.M. Veira, D.M. Weary, and M.A.G. von Keyserlingk. 2007. Prepartum behavior and dry matter intake identify dairy cows at risk for metritis. *J. Dairy Sci.* 90:3220-3233.
- Kelton, D.F., K.D. Lissemore, and R.E. Martin. 1998. Recommendations for recording and calculating the incidence of selected clinical diseases of dairy cattle. *J. Dairy Sci.* 81:2502-2509.
- Kimura, K.J., J.P. Goff, M.E. Kehrli, Jr., and T.A. Reinhardt. 2002. Decreased neutrophil function as a cause of retained placenta in dairy cattle. *J. Dairy Sci.* 85:544-550.
- Kimura, K.J., T.A. Reinhardt, and J.P. Goff. 2006. Parturition and hypocalcemia blunts calcium signals in immune cells of dairy cattle. *J. Dairy Sci.* 89:2588–2595.
- Loeffler, S.H., M.J. de Vries, and Y.H. Schukken. 1999. The effects of time of disease occurrence, milk yield, and body condition on fertility of dairy cows. *J. Dairy Sci.* 82:2589-2604.
- Lyte, M. 2004. Microbial endocrinology and infectious disease in the 21st century. *Trends Microbiol.* 2:14-20.
- Overton, T.R. 2013. Keys to transition success. [http://www.ccenny.com/wp-content/uploads/2011/12/Keys-to-transition-success-Overton-6\\_111.pdf](http://www.ccenny.com/wp-content/uploads/2011/12/Keys-to-transition-success-Overton-6_111.pdf). Accessed February 12, 2013.
- Reynolds, C.K., P.C. Aikman, B. Lupoli, D.J. Humphries, and D.E. Beever. 2003. Splanchnic metabolism of dairy cows during the transition. *J. Dairy Sci.* 86:1201-1217.

# **SESSION NOTES**