

Does your vaccination protocol compromise newborn health?

This white paper was peer reviewed by Dr. Sheila McGuirk, veterinary clinician at the University of Wisconsin School of Veterinary Medicine and Dr. Mark Cook, professor in Animal Sciences at the University of Wisconsin-Madison.

Calves are born without an active immune system and rely on the consumption of antibodies for protection from disease such as scours and pneumonia. A cow provides a calf with nutrients for growth and development during gestation, but she cannot directly provide the calf with antibodies to protect it from diseases. Antibodies must be obtained by drinking colostrum within the first couple hours after birth. Additional immune support can also be provided through USDA approved colostrum derived antibody products (available in bolus, gel, and powder forms)

When the calf drinks colostrum, the maternally derived antibodies are absorbed from the calf's gastrointestinal tract into the blood stream. Some of the immunoglobulins also remain in the gut where they can neutralize pathogenic bacteria and help prevent the development of diarrhea.¹

The absorption of antibodies from the gastrointestinal tract into the bloodstream is called passive transfer. To successfully obtain passive transfer and provide the calf with protection from diseases the calf needs to consume a minimum of 150 grams of immunoglobulins (IgGs) or antibodies.

Getting 150 grams of immunoglobulins into the calf sounds easy, but it can, in fact, be very challenging. The pathway between the gastrointestinal tract and the bloodstream is only open for a short window of time. Research shows that the pathway starts to close shortly after birth and after eight to 12 hours approximately 50 percent of the calf's ability to absorb colostrum antibodies is gone.^{2,3,4} This short time period underscores why it is so important that calves receive at least four quarts of high-quality colostrum within the first six hours after birth.

Colostrum also provides the calf with protein, energy in the form of fat and sugar, and vitamins. Energy is required for all metabolic functions including maintenance of body temperature. One of the leading causes of death in dairy calves is failure to initiate breathing and metabolic processes in the first hours of life.⁵ The newborn calf only has a few hours of energy reserves in stored fat and therefore needs the energy from colostrum. Research also confirms that the sooner a calf consumes colostrum, the more maternal antibodies it can utilize.

In addition to being a critical energy source for newborn calves, colostrum also provides essential fat-soluble vitamins that the calf needs. Some vitamins do not cross the placental barrier and colostrum is the primary source of these nutrients for the calf after birth.⁶

¹ Disease Protection for Baby Calves, Oklahoma Cooperative Extension Service ANSI-3358

² J.D. Quigley, *Calf Notes #11* Timing of Colostrum Feeding, <http://www.calfnotes.com/pdf/CN011.pdf>

³ http://babcock.wisc.edu/sites/default/files/de/en/de_28.en.pdf

⁴ <http://www.dairyherd.com/dairy-herd/health/Colostrum-management-136149103.html>

⁵ http://www.lolmilkreplacer.com/stellent/groups/public/documents/web_content/ecmd0011992.pdf

⁶ J.D. Quigley, J.J. Drewry, 1998. Nutrient and immunity transfer from cow to calf pre- and post-calving. *J. Dairy Sci.* 98, Issue 10.

Dr. Amelia Woolums at the University of Georgia also notes the important role of fat-soluble vitamins, such as A and E which are present and in high concentration in colostrum from healthy cows.⁷ She notes calves that do not ingest an adequate volume of good-quality colostrum will begin life deficient of these vitamins, which will, in turn, make them even less likely to respond to vaccinations.

The downfall is that colostrum isn't always at the quality level it needs to be to protect the calf. High-quality colostrum contains high levels of antibodies and low-quality colostrum has a low level of antibodies. There are many variables that impact colostrum quality from nutrition, the time the cow is milked, to heat stress and stage of lactation.⁸ But one thing is for sure quality colostrum is an issue the dairy industry continues to face. A recent study from Iowa State University⁹ suggests that at a minimum 30 percent of dairy calves in the U.S. are currently being fed colostrum classified below industry standards for IgG content and are at a greater risk of failure of passive transfer, mortality and morbidity. Other research shows that about 50 percent of cows have colostrum with an IgG level below 50 milligrams per milliliter which will not prevent failure of passive transfer.¹⁰

To improve the protection offered to calves, dairy producers often look to various vaccination programs and protocols. While the science of these approaches is sound, there are pitfalls that can put calves at risk.

Pre-calving vaccination

As noted earlier, the calf consumes antibodies from drinking colostrum. The antibodies are generated by a healthy cow as a result of everyday exposure to infectious agents. The cow's natural antibodies to these infectious agents are passed from the cow to the calf through colostrum. The level of antibodies transmitted from the cow through the colostrum can be elevated by a pre-calving vaccination program.

For a pre-calving vaccination program to be successful, a cow must mount an immune response to the vaccine. This requires a healthy dam, which has been fed at a proper nutrition level in the critical period leading up to calving. While this is every producer's goal, feed conditions, age of the dam, and even weather can cause considerable differences in their state of nutrition and the individual cow's health status, even within the same herd.

Outside the nutrition status of the dam, other variables may cause vaccines to fail and impact the immune response of the cow. Administering a vaccine does not guarantee success.

⁷ <http://www.das.psu.edu/research-extension/dairy/nutrition/pdf/woolums-immune-development-2010.pdf>

⁸ Dr. Dale A. Moore, Washington State University, Winter 2011 Veterinary Medicine Extension Newsletter

⁹ K.M. Morrill, E. Conrad, A. Lago, J.D. Quigley, and H.D. Tyler, Iowa State University Ames, Nation-wide evaluation of quality and composition of colostrum fed to dairy calves in the United States. J. Anim. Sci. Vol. 89. E-Suppl. 1/J. Dairy Sci. Vol. 94, E-Suppl. 1: 277

¹⁰ http://www.lolmilkreplacer.com/stellent/groups/public/documents/web_content/ecmd0011992.pdf

Common reasons vaccines¹¹ fail include the wrong vaccine, improper handling, storage, dose, no booster, unhealthy vaccinate, parasites, stress, injection site and injection techniques.

These variables are all too real. A study conducted by the University of Arkansas¹² found that seven out of 10 refrigerators used to store animal health products on farm and at retail locations did not keep proper temperatures. If vaccines are not stored at proper temperatures, they can become inactivated providing zero protection. Results from this study are similar to those conducted in Idaho and Nevada indicating proper storage of vaccines is a concern. Storage is just one of the many variables that can go wrong. In many cases, people put their vaccine in the back of a pickup truck on a hot summer day, then wonder why the vaccine did not work. The vaccine needs to be protected up to the time of delivery.

Concerns also surround the administration of too many gram-negative vaccines. Stacking vaccines with high endotoxin levels can have serious negative side-effects on the animal, including death of the animal.¹³

If the cow does not mount an immune response, or if her immune response is compromised in any way, the amount of antibodies available to pass along to the calf through the colostrum is diminished. Even with healthy, well-nourished cows, colostrum quality can be variable and compromised by circumstances of unexpected stress and health challenges immediately, before or during calving. Something as simple as being off on a breeding date can impact how a cow reacts to a vaccine. These situations will decrease the quality of the colostrum, and limit the transmission of antibodies to the calves. Relying solely on a pre-calving vaccination program to provide protection to calves may be putting all of the farm's eggs in one basket.

Newborn calf vaccines

This is a complex issue. Research continues to evolve in the area of newborn calf vaccinations, and this is an area that farms have looked to for additional protection for calves. Researchers first believed that calves could not be vaccinated effectively while they have circulating maternal antibodies from the colostrum in their system.¹⁴ The maternal antibodies absorbed from colostrum cannot distinguish between the antigens of a natural challenge and the antigens in a vaccine. Therefore, colostrum antibodies can interfere with the immune response to a vaccination. Work continues to be done to develop ways to circumvent maternal antibody interference.

The issue of vaccinating calves for protection is further complicated by the fact that some scours vaccines currently on the market require a delay in colostrum feeding. The delay in colostrum feeding is necessary because, if the vaccine was administered at the same time as colostrum, the maternal antibodies in the colostrum would neutralize the vaccine and compromise the immune response. Immunity obtained through a scours vaccine is also not

¹¹ Dairy Calf and Heifer Association, tip of the week –“ Why vaccination can fail,” Dec. 2011

¹² <https://www.msu.edu/~mdr/vol15no2/vol15no2.pdf>

¹³ <http://www.dairyherd.com/dairy-herd/features/ask-before-you-buy-113914834.html>

¹⁴ Vaccinating Calves – excerpted from Prod Med text, SM McGuirk chapter on pre-weaned calf management.

immediate as the newborn calf must respond to the vaccine to develop antibodies and this takes time.

A delay in colostrum feeding for a vaccination regiment can put the calf at serious risk. In fact, delaying colostrum feeding for any reason is inherently a bad idea since consumption of maternal antibodies immediately after birth is the most important step to obtain passive immunity. Failure of passive transfer has been linked to increased neonatal morbidity and mortality and long-term decreases in productivity. The National Animal Health Monitoring Study for Dairy in 2007 estimated failure of passive transfer to be 19.2 percent.¹⁵ Other studies indicate that failure of passive transfer may be higher. A Washington State study showed that 34 percent of calves evaluated had failure of passive transfer.¹⁶ These studies further underline why delaying colostrum feeding is a bad idea and unnecessary to provide the calf with immediate immunity.

Based on current research, it appears that the process of the calf mounting an immune response to a vaccine requires energy that could better be used to fight off disease and gain weight and the response could be detrimental to the early health of that calf.

Research conducted by Dr. Mark Cook¹⁷ at the University of Wisconsin shows that any immune system response can be challenging to the animal. And, the response can be more harmful to the animal than no vaccination at all if the specific immunity is not needed.

Dr. Cook's research shows that when an immune response is effectively achieved, muscle tissues demand more amino acids to create the immunity. These are the same amino acids that could otherwise be used by the muscle tissue to grow and strengthen the calf's overall health, rather than responding to the vaccination. Dr. Cook believes it is important to find ways to limit immune response, and if your calves don't need vaccination, you shouldn't use it.

Immediate protection antibodies

Antibody products do not require the calf to react to a vaccine to develop antibodies. Rather the antibodies are already present, measured and verified to be at a high enough level to protect the calf from scours related diseases, and they can be fed as close to birth as possible. USDA-approved antibody products are available on the market that can be fed in conjunction with colostrum and provide the calf with immediate immunity. These antibodies go to the gut to immediately bind and neutralize diarrhea antigens, while also being absorbed into the blood stream for extended protection. There is a lot of data that suggest antibodies have value at both the gut level and within the circulating blood stream, states Dr. Cook.¹⁸

¹⁵ http://www.aphis.usda.gov/animal_health/nahms/dairy/downloads/dairy07/Dairy07_ir_CalfHealth.pdf

¹⁶ <http://extension.wsu.edu/vetextension/Documents/Winter%202011.pdf>

¹⁷ M.E. Cook, *Conjugated Linoleic Acid Enhances Immune Responses but Protects Against the Collateral Damage of Immune Events*, 2003 Volume 2, CLA book

Antibody products complement colostrum feeding because they can be fed at the same time as colostrum. These products are available in bolus, gel and powder form. They also are included in some colostrum replacer and supplement formulas for added value.

Because antibody boluses can be fed in conjunction with colostrum, they can be a tool to help the calf achieve not only adequate passive transfer but also enough specific antibodies to protect against the most common early calf hood diseases. Studies show that if a calf does not achieve an adequate serum IgG concentration at 24 hours of age, it is up to 9.5 times more likely to become sick and 5.4 times likely to die before weaning.¹⁹

Solution

There is one way to ensure immediate immunity while complementing early colostrum feeding. First Defense, currently the only USDA-approved colostrum derived product to defend against both K99+ *E. coli* and coronavirus, can be delivered at the same time as colostrum. Its two-part mode-of-action delivers immunoglobulins that immediately fight at the gut level to protect against diseases that destroy the intestinal lining while also allowing for antibodies to be absorbed into the bloodstream. It's important to protect the intestinal lining because if the cells that line the digestive tract become damaged milk cannot be digested or absorbed by the calf.²⁰

First Defense does not rely on a vaccine-stimulated immune response by a calf's already stressed immune system. Avoiding vaccine stimulation means the calf conserves its valuable and minimal supply of fat and nutrients that are critical to get that calf through its first few days of life and off to a strong start. When a calf's immune system is not depleted, it is also better able to fight off secondary disease like crypto and respiratory challenges.²¹

Unlike vaccines, there is little room for error with this management solution. One dose per calf delivers an immediate source for immunity. It is the easiest scours product to use with most accurate dosage. It has guaranteed levels of K99+*E. coli* and coronavirus antibodies to prevent disease and no refrigeration is required.

A program should be in place to deliver immediate protection for each calf and be done in a way that also reduces labor, risk and even subsequent treatment costs. While vaccination programs can help, the newborn calf is born vulnerable and needs immunity support as soon as possible. Working closely with a veterinary professional or animal health specialist to develop an appropriate calf disease prevention program providing immediate immunity is strongly advised.

For more information, contact Bobbi Brockmann, Vice President of sales and marketing with ImmuCell Corporation, bbrockmann@immucell.com or go to: www.immucell.com.

¹⁸ Email correspondence with Dr. Mark Cook, Feb. 2, 2012

¹⁹ http://www.lolmilkreplacer.com/stellent/groups/public/documents/web_content/ecmd0011987.pdf

²⁰ <http://www.cattlenetwork.com/cattle-news/latest/Calf-Scours-Management.html>

²¹ T.L. Ollivett <http://www.ansci.cornell.edu/prodairy/HHNC/proceedings/2011CompleteProceedings.pdf>