AG PROUD
Family • Farming • Livestock

www.agproud.com/articles/61279-calf-vaccinations-you-wont-find-all-the-answers-in-a-bottle

Image by Mike Dixon.

Calf vaccinations: You won’t find all the answers in a bottle

Focused cow and calf vaccinations, quality colostrum and herd-specific programs improve calf health.

Bev Berens (/authors/3014-bev-berens)

May 12, 2025

“The solution to poor management usually does not come in a bottle. Vaccines are just one of the tools that we have to prevent diseases; they are not going to overcome poor management. They are not a magic bullet.”
—Dr. Angel Abuelo, DVM

Focused management and care for the pre-weaned calf are priorities to keep cattle healthy, but pathogens are present on most dairies, requiring a vaccination program to boost systemic immunity throughout the herd. However, calves continue to experience high rates of morbidity and mortality (33.9% and 6.4%, respectively). Ten years later, the numbers show little improvement.

During the Great Lakes Regional Dairy Conference on Feb. 6-7 in Mt. Pleasant, Michigan, Abuelo discussed vaccinating cows and calves for improved calf health. Abuelo is an associate professor of cattle health in large animal medicine at Michigan State University.

Apart from the fact that any live calf is the equivalent of a golden egg in today’s market, heifer calves are the future of the herd. Heifers that struggle with diarrhea or respiratory problems pre-weaning are 10%-14% less likely to reach calving, have 5% lowered conception and produce 260 pounds less milk during first lactation.

Immunology basics

There are two barriers of defense (innate immunity) a pathogen must cross before it can successfully attack the animal’s organs. The skin, mucous membranes and their secretions create the first line of defense. Phagocytic leukocytes, antimicrobial proteins, inflammation and fever are the second barriers. Fever and inflammation are often viewed as bad, and they can have consequences. They are also the host’s natural infection-fighting response.

If a pathogen passes through all innate immunity defenses, the third line of defense engages, responding with lymphocytes – antibodies and memory cells that are pathogen-specific, remembering the pathogen they are tasked to attack.

Vaccinations are key to building this third arm of the immune system that generates the memory capacity needed to fight pathogens, whereas the passive immunity available through high-quality colostrum and its consumption gives more immediate, although short-lived, protection. It takes anywhere from two to three weeks after vaccination to develop the immune responses.

Calves are born with a functional immune system but no mature antibodies. Basically, the immune system is in place but simply isn’t able to do the job yet. A calf will be 1 month old before it shows minimal antibody response and 5 to 8 months old to reach the mature immune response found in adult cattle.

“We approach calf health to manage passive immunity by providing maternal antibodies in colostrum to fill the gap until the calf can begin producing its own antibodies,” Abuelo said. “Not surprisingly, at around 14 days of age is when we begin seeing a lot of calf disease.”

Calf response to vaccination

Building memory response through antibodies in the blood takes two vaccine doses.

“The first dose is like our primary exposure to a particular pathogen and gives a small increase in antibodies, then the antibodies stop building,” Abuelo said. “The second, or booster, vaccine is when the memory has been generated, and the response happens faster and in greater magnitude. That is our goal, so when the calf sees the pathogen in real life, they’re able to quickly respond.”

If the vaccination is repeated too soon, the system isn’t building a memory response.

“We are finding that if you wait more than two weeks and vaccinate closer to three or four weeks, the memory response to the pathogens is better. This is relatively recent knowledge from what we traditionally knew about memory response,” Abuelo said.

A longer gap between the initial and booster vaccines may not agree with the label, and changing vaccine labels is complex and slow. Off-label use directed by a veterinarian is a more immediate alternative.

Passive immunity and vaccinating cows

All passive immunity comes directly through colostrum ingested right after birth; passive immunity does not transfer from cow to calf through the bloodstream. Helping the cow maximize the quantity and quality of antibodies she produces is a matter of strategic timing to administer vaccinations to coincide with when she naturally generates more antibodies. In a two-dose program, the booster should be given about a week before calving, which is the peak time in the antibody production cycle. The first dose should happen three to four weeks earlier.

But even the most perfectly executed cow vaccination program is wasted if the calf doesn’t consume enough colostrum within the first few hours of birth.

Passive immunity has traditionally been measured on a pass/fail system based on serum total protein or Brix, used as a proxy to IgG, measured with a refractometer. Failed colostrum was less than or equal to 10 grams per liter of IgG; anything above it was acceptable.

An upgraded standard creates new categories to quantify the value of colostrum. New categories add a score of Fair for 10-17.9 grams per liter of IgG, Good is 18-24.9 grams per liter of IgG and Excellent is anything above 25 grams per liter of IgG.

Abuelo has completed a retrospective cohort study of more than 4,100 calf records, looking at disease rates compared to the quality of colostrum received immediately after birth. As the quality of passive immunity in the colostrum declined, the risk of diarrhea increased. The observed risk for pneumonia was not as strong as the diarrhea correlation, but it followed the same pattern.

Passive immunity longevity varies depending on the pathogen(s) present but normally provides about 21 days of protection, which is why diarrhea usually shows up after 3 weeks of age.

Some pathogens can be transmitted from cow to calf before birth, including bovine viral diarrhea virus (BVDV), bluetongue and salmonella. Vaccinating dams can prevent or decrease their transmission and are already standard in many vaccination programs.

The *S. Dublin* salmonella strain is one example of a high-impact strain. Farms will have high numbers of sick and dying calves. It is zoonotic, with a human mortality rate four times higher than other salmonella strains.

“To make things even more complicated, we are finding multidrug resistance to antimicrobials in the U.S., so most drugs do not work against it,” Abuelo said.

Silent carriers in the cow herd don’t show clinical infection signs and share the pathogen by shedding bacteria into feces and colostrum or by infecting the fetus. Abuelo’s recent research found that 17% of calves born to identified carrier cows were born infected. Other research indicates as many as 50% of silent carriers pass the strain before a calf is born. But calves born to cows vaccinated at dry-off were five times less likely to be infected from a carrier female.

Vaccinating calves

Internasal vaccines work with immune cells already in the calf’s mucosal tract and generate immunoglobulin antibodies that attach to a pathogen and keep it from entering the calf’s system. It is localized immunity, but there is also crosstalk between it and systemic, long-term immunity because they connect through the bloodstream.

“But just because you put the vaccine up the nose of the calf in that moment, we are still talking about weeks before the vaccine has effect,” Abuelo said.

The duration of the immunity is also shorter with nasal vaccines, maxing out at about six weeks before immunity begins to decline. Nasal vaccines provide about 12 weeks of varying degrees of immune protection.

Because the calf’s systemic immune system is immature, Abuelo said that vaccinating during the first week of life is not a good idea, especially if vaccinating against something that is already an immunosuppressant, such as bovine viral diarrhea. Modified-live vaccines should

wait until a calf is 2 months old.

Vaccination programs

Abuelo recommended a farm-specific pathogen test to know exactly what threats are within the herd. The vaccination program can then be built around the results. He said testing should be done often, and vaccines can be dropped or added accordingly.

Vaccinations always come at a cost to the animal. Energy is used to create an immune response that would otherwise be used for milk production or growth. Reactions to vaccines are rare, but the more they are used, the more frequently they happen.

A vaccination program is one part of a comprehensive disease control and prevention program. However, keeping pathogens from entering the herd is always preferred over protection that comes in a bottle.

Types of vaccines for cattle

Modified-live vaccines (MLVs)

- Longer duration with more complete immunity
- May be better for cellular and secretory immunity
- Better for building immune memory
- May cause disease signs
- Can cause abortions, not recommended for pregnant animals

Inactive/killed vaccines (includes toxoids)

- Short-lived, systemic immunity
- Boosters are more necessary
- Does not lead to signs of disease

Adjuvant technology is improving response for all types of vaccines.

Vaccine tradeoffs

Live vaccines

- Fewer doses
- Adjuvants not needed
- Less chance of hypersensitivity
- Relatively cheap

- Requires smaller doses
- Both humoral- and cell-mediated response
- Longer-lasting protection

Inactive vaccines

- Stable storage
- Less (almost zero) chance of virulence
- Does not replicate in host
- Will not spread to other animals
- Safe for immune-compromised animals