

Vaccines and Immunity

By Dr. John Campbell

Most cattle producers rely on their veterinarians to advise them about which vaccines to use and how and when to administer them. However, having a better understanding of how vaccines work can help you understand the importance of proper administration and timing to these disease prevention tools.

To understand how vaccines work we must first learn a little about immunology, the study of the immune system.

Antigen: Any substance that can cause an immune response in an animal. Bacteria, viruses, and parasites could be classified as antigens, as well as small portions of them such as a particular protein from the cell wall of a bacteria.

Antibody: Blood proteins produced in response to an antigen that bind to a particular infectious agent such as a virus and help to kill it. Antibodies are very specific and can only bind with one particular antigen or one closely associated with it. Passive immunity is when antibodies pass directly from one animal to another.

In the calf, this occurs with its first drink of antibody-rich colostrum. The calf's stomach can only absorb these antibodies for a short time after birth, which is why it needs to receive approximately two litres of colostrum within six hours of birth. Once these antibodies are absorbed into the calf's bloodstream they can provide immediate protection for the calf in its early life.

When we vaccinate cows with scours vaccines, we are relying on this passive transfer of antibodies to protect the calf from infectious disease agents that cause diarrhea in early life. This passive immunity gives immediate protection but doesn't last forever. Eventually the calf has to rely on its own immune system creating antibodies to fight off infections.

Active immunity is when an animal makes its own antibodies in response to a natural infection or vaccine. It takes one to two weeks the first time, but if the animal is exposed to the same antigen at a later date by exposure to the same bacteria, or the same vaccine, then a secondary response occurs and the antibodies rise more quickly to much higher levels. This form of "memory" in the immune system is one of the reasons some vaccines utilize two doses to boost immunity.

Vaccines that stimulate active immunity are usually classified as killed or modified live vaccines.

Killed vaccines contain dead organisms or specific proteins from the virus or bacteria. Usually they're safe for pregnant cows and stable in storage. *Modified live vaccines* contain living organisms that are altered so they can stimulate an immune response but can't cause disease. They're slightly more fragile in storage but generally stimulate higher levels of immunity. Some modified lives cannot be given to pregnant animals.

Veterinarians are often asked to investigate apparent vaccine failures when vaccinated animals do not seem to be adequately protected by the vaccine they were given. Although very few vaccines can guarantee 100 per cent protection, many cases of vaccine failure are caused by one of three reasons:

- The animal was already incubating disease when the vaccine was administered. Remember, the lag time for the immune system to start producing antibodies is one to two weeks following administration. If the animal is exposed to the virus or bacteria prior to the vaccine being administered or even shortly afterwards the vaccine may appear to be ineffective. But the reason is the animal has been incubating the disease before the immune system could respond to the

vaccine.

- The vaccine was administered incorrectly. Read the label! Consult your veterinarian! Many vaccines can be given subcutaneously (under the skin) but some can only be given intramuscularly. Improper administration or less than adequate dosages may not stimulate an adequate immune response.
- It was not stored properly. Most vaccines must be stored at cool temperatures. Freezing or high temperatures may inactivate the immunity. An insulated cooler helps maintain the right temperature. Don't leave vaccines sitting on the dash of your truck while you're doing errands in town!

Some important points to remember when using vaccines:

- Read the label! The dose, withdrawal times, expiration date, timing, route of administration and safety information are all there.
- Don't combine vaccines! Mixing various vaccines together in one syringe can inactivate both vaccines. Follow the label directions.
- Mix enough vaccine for only one hour or less. Keep the vaccine away from extreme heat or cold.
- Get the air out of your automatic syringe. Trapped air can dramatically affect the amount of vaccine you actually administer.
- Keep your equipment clean. Use hot water only for cleaning automatic syringes. Disinfectants can leave a residue that destroys modified live vaccines.
- Keep detailed records. Keep track of what vaccines you use including serial and lot numbers.

Vaccines and immunology are an extremely complex subject and we've only barely scratched the surface here. Your veterinarian is the best source of advice on which vaccines are most suitable for your operation and on how and when to administer them. Having a well designed vaccine protocol and ensuring your newborn calves receive adequate colostrum will help to maximize your herd's immunity and are two important cornerstones of any herd health program.

John Campbell is a professor in the department of large animal clinical sciences at the Western College of Veterinary Medicine.