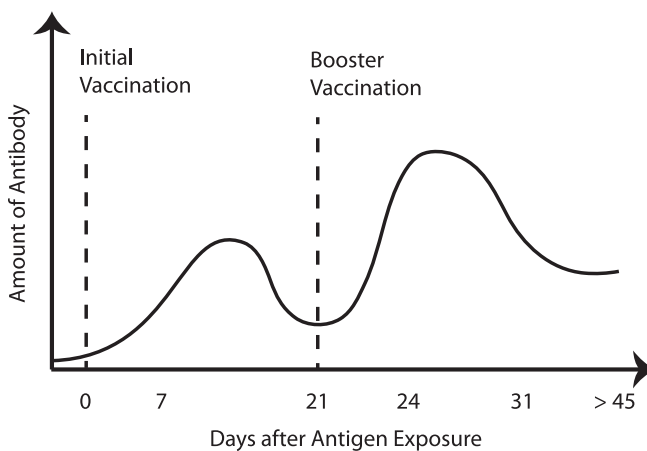


Developing immunity in cattle requires an effective herd health program. Vaccinations are not a silver bullet cure all for disease in a cowherd, but are a primary component of a complete herd health program. Vaccines contain antigens of disease-causing agents, and are used to stimulate cattle's immune systems and create an immune response before significant natural exposure to disease-causing agents. It is important to understand that vaccination does not equal immunization. Many factors influence the immune response to vaccinations, including stress, vitamin and mineral balance, nutrition, and overall health of the animal being vaccinated. A basic understanding of how the immune system responds to a vaccine is important to understanding how vaccines function.

The first time a cow's immune system encounters a pathogen (disease-causing agent), it often cannot respond quickly enough to prevent disease. However, the immune system usually succeeds in neutralizing the infection over time. After an animal recovers from an infection, memory cells that have been produced by the immune system remain for months to years. Memory cells are programmed to recognize specific pathogens if they are encountered again, and facilitate a response before the pathogen can cause disease. Memory cells recognize parts of a pathogen's body called antigens. Antigens are molecules unique to each pathogen, and memory cells use antigens to recognize specific pathogens.

Vaccines work by exposing the immune system to antigens from a specific pathogen, tricking the body into thinking it has encountered the actual pathogen. Exposure to an antigen stimulates an immune response, which creates memory cells for that pathogen without causing the negative effects of an actual first infection. Most vaccines are either modified-live vaccines (MLV) or killed vaccines (killed). The MLV contain live microbes that have been modified so that they have the antigenic components of the disease-causing agent but do not cause disease; killed vaccines contain antigen components or pieces of the disease-



**Figure 1. Change in serum antibody concentration over time after a primary and secondary (booster) exposure to vaccine antigen.**

causing agent. Presenting the antigens to the immune system for processing greatly depends on the type of vaccine used and on the route of administration. For example, an MLV vaccine labeled for intramuscular injection (injection directly into muscle tissue) may not yield the desired immune response if it is administered subcutaneously (injected into the fatty layer of tissue directly beneath the skin).

Secondary exposure to a pathogen or its vaccine makes the immune system stronger and better prepared for future exposure. This is because some memory cells have a longer lifespan than others; this is also what makes the timing of vaccinations so important. A second (booster) vaccination creates a stronger immune response of longer duration because the concentration of memory cells and their effectiveness increase with repeated exposure to an antigen (Figure 1). This is why one vaccination usually does not provide sufficient protection. Most vaccines require a booster two to four weeks after the initial vaccination and annually thereafter. The goal is to stimulate the immune system by repeated ex-

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posure to an antigen so antibodies are present in the body at a level that is highly protective if exposure to the actual pathogen occurs. However, disease may still occur in cases where pathogen exposure exceeds the animal's protective level for that disease.

### **WHY VACCINATED ANIMALS STILL SOMETIMES GET SICK**

The most common reason vaccinated animals get sick is because they fail to fully respond to vaccination, or fail to become immunized. Procedures to maximize immune response include following label directions for timing, route of administration, and proper vaccine handling, and minimizing stress that can suppress immune function. Some vaccines, especially MLVs, must be handled very carefully. Exposure to heat, sunlight, or being mixed too long prior to use can reduce a vaccine's effectiveness. All vaccines must be kept cool, even while the vaccine is in the syringe. Nevertheless, even when everything is done correctly some animals fail to mount an immune response sufficient to create immunity to the disease. Factors contributing to this failure are poor nutrition (including micro and macro mineral imbalance or deficiency), vitamin deficiency, congenital immunodeficiency, and poor overall health.

While it does not provide perfect protection, vaccination is the most effective tool available to prepare an animal's immune system to respond to disease challenges. Preparing the immune response before exposure to stress and disease will result in cattle being better able to mount an adequate immune response when challenged. A sound vaccination program developed with your veterinarian and carried out using proper timing and technique is critically important for maintaining the health and profitability of your herd.

### **GLOSSARY**

**Pathogen:** disease-causing agent

**Antigens:** molecules unique to each pathogen by which the immune system recognizes the pathogen

**Modified-live vaccines (MLV):** vaccines containing live microbes that have been modified so that they have the antigen components of the disease-causing agent but do not cause disease

**Killed vaccines:** vaccines containing antigen components or pieces of the disease-causing agent

**Intramuscular injection:** injection directly into muscle tissue

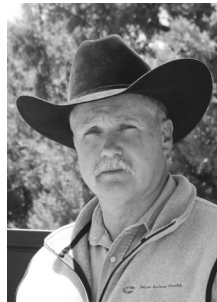
**Subcutaneous injection:** injection into the fatty layer of tissue immediately beneath the skin

**Primary vaccination:** the initial exposure to an antigen via vaccination

**Booster vaccination:** second vaccination to stimulate the immune system via repeated exposure to an antigen

**Congenital immunodeficiency:** weakness of the immune system present at birth

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