



Immunizations for Oklahoma Cow-Calf Herds

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This is a suggested vaccination schedule that is based on the science of immunology and the art of inducing immunization through administering vaccines or bacterins. This fact sheet will not cite data or give references. However, for recent thorough discussions on immunization, readers should refer to articles by Drs. Roth, Ellis, Cullor, Schultz, Hutcheson, and West in the 26th Annual Proceedings of the AABP Meeting September 16-19, 1993, pages 3-39.

First, some definitions or descriptions of types of immunity need to be discussed.

1. **Native defense mechanisms.** These mechanisms are functional immediately when an infectious agent enters the body even if the animal has not been immunized. They include many things such as enzymes, tears, saliva, white blood cells, stomach acids, and many other factors that may kill bacteria or viruses. They are most effective when an animal has been properly immunized, and some animals genetically have better native defense mechanisms.
2. **Passive immunity.** This is a temporary immunity and comes from some source other than being made by the animal. The most common and most important kind of passive immunity is the antibodies that newborn animals receive through the mother's colostrum. These immunities have finite lives that vary among diseases. In cattle, blackleg colostrum antibodies are gone by about two months of age, while BVD colostrum antibodies may last six months or longer. Other examples of passive immunity are tetanus antitoxin, which animals or people are given when exposed, and gamma globulin, which people are given when exposed to hepatitis "A." An animal cannot develop permanent or acquired immunity through vaccination if passive antibodies are present.
3. **Acquired immunity.** This is permanent or semi-permanent immunity that is developed by the animal's immune system when the animal is exposed to a disease or properly vaccinated. It takes at least one week and usually two weeks following infection or vaccination for the immune system to produce the antibodies that are necessary for protection. The antibodies produced are specific against that particular organism or disease, unlike the native defense

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mechanisms, which may destroy many different organisms. There are three types of acquired immunity.

- a. **Humoral immunity.** This is immunity from antibodies that are produced by lymphocytes (white blood cells). These antibodies are circulating in the bloodstream and can attach to the specific infectious agent to inactivate or neutralize the organism so it can be destroyed or removed by some of the native defense mechanisms. These antibodies are most commonly present in colostrum antibodies. Some organisms are resistant to humoral antibodies and must be controlled by cell mediated immunity or secretory immunity.
- b. **Cell mediated immunity.** Cell mediated immunity is produced by other types of lymphocytes when an animal is exposed or properly vaccinated. These lymphocytes specially recognize the disease organism, and when later exposed, they attack and inactivate the infectious organism. Cell mediated immunity is important in control of respiratory diseases. Cell mediated immunity is not as easily produced as humoral immunity and is rarely produced by a killed vaccine because the infectious agent usually has to replicate in animal cells to stimulate this system. This is why *modified live vaccines (MLVs)* are produced.
- c. **Mucosal or secretory immunity.** The antibodies responsible for humoral and cell mediated immunity are circulating in the blood stream. It is difficult for these to get to the linings of the intestinal tract, mammary gland, respiratory tract, and reproductive tract; therefore, they are not as effective against infections of those organs. Secretory immunity is best produced by the cells lining the organ following natural infection. MLVs are effective if they attack the lining cells of the organ that produces the secretory antibodies. If the MLV can be introduced into the organ, the organ will develop secretory antibodies. This is what occurs, for example, following vaccination of calves with the intranasal IBR-PI3 vaccine (Infectious Bovine Rhinotracheitis and Parainfluenza-3 viruses).
4. **Vaccination.** The process of inoculating a vaccine into an animal. Does not imply an immune response has occurred.

5. Immunization. The process of vaccinating an animal, which responds with a detectable immune response. (Does not imply that the animal is protected from the disease.)

6. Endemic. A disease that is always present in an area or herd. (i.e., blackleg, anaplasmosis, and others in certain areas).

Vaccination failures may occur for a number of reasons, including animal factors, vaccine factors, and human error. Examples are (1) colostral antibodies in young animals preventing development of acquired immunity; (2) improper storage, handling, or injection of vaccines; (3) animals incubating or highly stressed at time of vaccination; (4) overwhelming infection too great for vaccine immunity to provide protection; and (5) too much time between initial injection and booster injection of killed vaccines. There are many other factors that, along with the above factors, are actually related to proper planning and design of the vaccination program.

Dr. Schultz, in the 1993 AABP proceedings, lists the *objectives of immunization*:

1. Immunization should produce a good humoral, cellular, and local immune response similar to natural infection.
2. Immunization should produce protection against clinical disease and reinfection.
3. Immunization should give protection over several years, preferably a lifetime.
4. Immunization should result in minimal immediate side reactions (e.g., reduced milk production, weight loss, infection of the fetus with abortion, congenital anomalies, or persistent infections).
5. The vaccine should be simple to administer in a form acceptable to the producer and practitioner.

6. Cost and benefits of administration of vaccine should clearly outweigh the cost and risk of natural disease.

Obviously, not all vaccines will meet all the above objectives all of the time. Some cannot be given to pregnant animals, some require booster vaccinations, many do not impart longtime immunity, and some are not cost-effective. Therefore, when selecting a vaccination program, one must do a risk assessment to determine the desired vaccines and the time to administer the vaccines. What is the probability of the animals in question becoming clinically or subclinically ill? If they are susceptible to infection, will the morbidity, mortality, cost of treatment, and loss of production be sufficiently reduced to warrant the cost of vaccines and labor involved? Remember, vaccines do not induce a 100 percent immune response and not all immune responses are protective against disease. The selection of a vaccine is also part science and part art. Science enters into the equation when veterinarians keep up with the data on immune responses and side effects from newer vaccines. Also important is management and/or nutritional information that enhances an immunization program. Art is the application of the known science to a particular situation, herd, or environment.

Recent scientific and lay literature has been laden with information on respiratory disease and vaccination programs for prevention and control of respiratory diseases. The plethora of lay information (and some veterinary articles) have fed the controversy of what kind of vaccine to use and how often to administer the vaccine. Much misinformation and fear has resulted from relying too much on the art of vaccination rather than the science of immunology. For the cow-calf producer, it certainly has detracted from the concept of herd immunity.

Good cow-calf herd immunity has classically been thought of as preventing clostridial diseases, abortion diseases, calf scours, and respiratory diseases in replacements, or, if the

Table 1. Facts to Remember about MLV and NI Vaccines.

<i>Modified Live Vaccines (MLVs)</i>	<i>Killed-Inactivated Non-Infectious Vaccines</i>
1. Provide longer duration and more complete immunity than non-infectious vaccines.	1. Provide short-lived, systemic immunity.
2. Should produce cellular and secretory immunity.	2. Provide poor cellular and secretory immunity.
3. Do not require multiple vaccinations for immunologic memory.	3. Often require re-vaccination to ensure immunologic memory.
4. Often do not require re-vaccinating or require fewer re-vaccinations during life of an animal.	4. Require multiple vaccinations for active immunity.
5. Rarely cause hypersensitivities, but may be virulent for certain individual animals or may cause animals to revert to virulence.	5. Often cause hypersensitivity reactions.
6. When used on pregnant animals, some abortions will occur	6. Cannot cause disease even in immunologically compromised animal.

producer retained ownership, respiratory diseases in stocker and feeder cattle. Little attention has been given to the effect of cow-calf vaccination programs on the next link of the beef food chain. In line with the Beef Quality Assurance and Food Safety programs, cow-calf veterinarians and cow-calf producers should also start addressing herd immunity as to how it affects food safety (injection site lesions) and feedlot health (morbidity and antibiotic residues).

One of the most important considerations in designing a vaccination program, after the specific vaccines have been selected, is timing. When should the vaccine be administered? Incorrect timing of vaccination is the greatest cause for vaccines failing to immunize. Timing includes such considerations as: 1) the effects of maternal (colostral) antibody on active immunization; 2) the period of time between injection of vaccines that require multiple doses; 3) the age the disease most often occurs; and 4) the competence of the immune system, especially as it may be affected by age and stress.

With the above thoughts in mind, the following programs for different herd scenarios are suggested:

- A. The first and most simple is for a cow herd that is known to have immunity (through exposure or vaccination) to the common viral and bacterial disease seen in Oklahoma. In such a herd, outbreaks ordinarily would not be expected, and the goal would be to maintain herd immunity (active in yearlings and cows and maternal passive immunity in nursing calves).

The only vaccines considered imperative in this program are the Clostridial bacterin/toxoids and the IBR-BVD MLVs. These diseases are endemic, and all Oklahoma herds will be exposed at one time or another. With transportation of infected and incubating cattle being what it is, an unvaccinated closed herd that is protected by quarantine is a myth. These vaccines are highly effective and inexpensive when used as recommended.

1. At approximately two months of age, all calves should be vaccinated for clostridial diseases with an effective bacterin/toxoid, making sure products and methods will be used that provide immunity and minimize injection site reactions. Calves this age (and sometimes younger) have lost passive protection for clostridial diseases and are therefore susceptible to infection. Calves this age in herds with good maternal immunity will not likely be susceptible to other common diseases. The passive immunity to BVD will still be at high enough levels to interfere with injectable vaccines and may still be protective. Colostral passive immunity to IBR, PI3, and Leptospirosis are intermediate in duration and may or may not be protective. If these diseases are a threat in young nursing calves, nasal IBR-PI3 vaccine and *Leptospira* bacterin may be used. However, the clostridium antigens are the only ones routinely recommended.

2. At two to four weeks before weaning, the following are recommended:

- a. *The Clostridium bacterin/toxoid of choice*. In most herds, no further clostridial vaccinations will be necessary; however, some herds may require annual boosters.
- b. *IBR, PI3, and BVD MLVs*. Five-way *Leptospira* bacterin may be incorporated if it is considered necessary in your area. Remember, this herd is known to have immunity to these viruses, and administering a MLV to calves is not threatening to pregnant dams the calves are nursing. This vaccine is known to provide the quickest and highest humoral response, plus it produces cellular and secretory antibodies. **(CAUTION: At weaning, some calves may still have passive BVD immunity which could block active immunity.)**
- c. *A Pasteurella leukotoxoid vaccine*, which should be boosted in two to four weeks (weaning). Data show that such a program significantly reduces respiratory disease and treatment time of respiratory disease after weaning in exposed calves.
- d. *Calfhood vaccination of replacement heifers with strain 19 Brucella abortus vaccine*. Vaccination has protected our clean herds and I do not recommend discontinuing this vaccine until we have maintained a Free State status.

3. At weaning, a booster for the *Pasteurella leukotoxoid* vaccination is recommended. Some veterinarians recommend boosters of IBR, BVD, and PI3 MLVs, but most revaccinations with a MLV product do not stimulate a secondary response. The advantage of this booster would be if a previously inhibitive passive immunity had waned, thereby permitting the MLV antigens to stimulate a primary response.

4. At one year of age, the following vaccines are recommended for replacements:

- a. *IBR-BVD MLVs with a 5-way Leptospira bacterin as a diluent*. This vaccination should provide lifelong immunity against IBR-BVD infections. There will likely be no secondary response if the weaning vaccination provided immunization, but this administration is important to permanently protect those that still had BVD passive immunity at weaning. This is important for protecting the embryo and fetus plus providing colostral antibodies. The *Leptospira* immunity is short-lived and must be boosted at least annually.
- b. *Campylobacter (vibriosis) bacterin*. If *Campylobacter* infertility is a possibility, the first injection of the bacterin should be administered and reinjected in two to four weeks. This bacterin must be boosted annually. Remember, campylobacteriosis is

primarily an infertility disease, so breeding animals must be protected during the early part of the breeding season. These bacterins provide short-lived immunity and do not have maximum protective titers at breeding when given in combination with *Leptospira* bacterin at pregnancy palpation or when the calf is weaned. To be most effective, *Campylobacter* bacterins should be given prebreeding.

5. At weaning or pregnancy testing time, cows should receive annual boosters of the following:

a. *Five-way Leptospira bacterin*. Cowherd *Leptospira* infections primarily involve late term abortions, and best protection is provided when the bacterin is administered at pregnancy testing time. Herds with a high degree of exposure to *Leptospira* abortion may require twice-a-year vaccination.

6. Cow herd vaccination is necessary for stimulation of maternal (colostral) antibodies against calf scours. K-99 *E. coli* bacterins administered at least four weeks before calving have been shown to be effective in reducing colibacillosis of newborn calves when adequate colostrum is consumed within six to twelve hours of birth. The first year (pregnant replacement heifers) of vaccination must include two injections two to four weeks apart. The second injection should be given at least four weeks before calving. Annual boosters are given four to eight weeks before calving. Some companies include rota and corona virus vaccines in their products. Studies of antibody levels in colostrum and newborn calves following adequate nursing indicate that currently available rota-corona vaccines do not stimulate adequate maternal antibody production to be protective for the calf. However, the K-99 *E. coli* bacterins are protective and are recommended for herds with colibacillosis infections. Some companies claim their products stimulate high and long-lasting antibody titers so well that the vaccine can be administered to the cow at weaning time, thereby eliminating another handling event. Question your supplier closely regarding this claim.

B. Many cow-calf herds do not have herd vaccination programs, or herd immunity is unknown. Also, some herds calve all year around, and vaccinations cannot be performed uniformly at "working time," "weaning time," "before breeding," etc. In some of these herds, a vaccination program is finally initiated when a severe respiratory disease outbreak or an abortion storm occurs. In these herds, the use of modified live viral vaccines is probably too risky to females in different stages of pregnancy. The administration of MLVs to naive pregnant females runs a high risk of fetal infection and abortion. In these cases, herd immunity must be established through the administration of killed or chemically inactivated MLVs that are safe for pregnant females. Remember, all such products must be administered twice two to four weeks apart. One injection will not provide protection and if the injections are given less than two weeks or greater than four weeks after the

first injection, immunity will be significantly decreased or perhaps non-existent. These protocols must be followed precisely. The chemically altered modified live IBR PI3 and killed BVD products are preferred over killed. All cattle (cows and calves) are given these vaccines to establish herd immunity. However, to maintain herd immunity with the same products, they must be reinjected on an annual basis because the killed or chemically inactivated MLVs do not impart permanent immunity, and cellular immunity is poor.

If such a herd has a defined calving season/seasons, herd immunity can be initiated as prescribed above. Continue herd immunity with MLVs as follows:

1. Two to four weeks before weaning, vaccinate calves with the clostridial bacterin/toxoid and the *Pasteurella leukotoxoid*. Do not use the IBR, BVD, PI3 MLV because the dams may be susceptible due to decreasing immunity from previous killed or inactivated vaccines.
2. At weaning, booster the calves with the *Pasteurella leukotoxoid* and give the IBR, BVD, PI3 MLV. This starts these calves towards herd immunity as in known immune herd in "A" above.
3. After the cows have calved but at least 30 days before breeding, give the IBR, BVD, PI3 MLV to cows and replacement heifers. Within two weeks, this herd will have good permanent herd immunity, and herd vaccination is continued as noted in "A" above.

Some producers cannot or choose not to have a defined calving season and cannot feel secure using the modified viral products with there is risk of accidental injection in pregnant cows. For these producers, the recommended "Keep it Simple" procedure is to use a killed or chemically inactivated modified live virus in all cattle annually. To establish herd immunity, all replacements must be vaccinated with these products twice, two to four weeks apart in the first year.

C. Respiratory disease is becoming more common in nursing beef calves. In the '90s, more cases of *Pasteurella pneumonia* have been diagnosed in nursing beef calves (two to four months of age). Occasionally, IBR virus has also been isolated, but not as frequently as *Pasteurella* species. The suggested approach to these has been to use the following vaccines.

1. *Intranasal IBR, PI3*. Local mucosal immunity is quickly established, and interferon is produced within 24-48 hours, which is somewhat effective against all viruses for a short time.
2. *Pasteurella leukotoxoid*. This should be reinjected in two weeks for good immunity, although two products (One-Shot® and Presponse®) now have labels claiming "one shot" effectiveness.

Maternal antibodies for IBR, PI3, and pasteurella are greatly diminished by six to eight weeks of age, making these calves susceptible when exposed to sufficient numbers or especially virulent organisms. In these cases, the above vaccines should be immunizing and could be administered at six to eight weeks of age on an annual basis in susceptible herds. The preweaning or weaning vaccinations should be used as in "A" above, except the pasteurella needs to be given only once.

D. Other vaccines. In some areas, *Hemophilus somnus* bacterin and Bovine Respiratory Syncytial Virus (BRSV) MLVs are recommended.

1. The data indicate that *Hemophilus* bacterins do not significantly reduce respiratory disease but may reduce the prevalence of thromboembolic meningoencephalitis (TEME). One should question the cost effectiveness of incorporating *Hemophilus* bacterin in most herds.

2. The inclusion of BRSV vaccine may be helpful in endemic areas, but its use is not recommended unless the virus has been identified as a causative factor of respiratory disease. This vaccine *must* be injected twice two to four weeks apart to stimulate immunity and adds a significant cost to the IBR, BVD, PI3 combination. This organism is not commonly isolated in Oklahoma, and it may not play an important part in respiratory disease here.

3. Until 1995, the only anaplasmosis vaccine available was Ft. Dodge's Anaplaz®, and all veterinarians are aware of Neonatal Isoerytholysis (NI) that is caused by incompatible blood type antigens that may be in the vaccine. NI is caused by certain blood type antibodies that may be present in the cow's colostrum and which cause lysis of the calves' red blood cells and often death after consuming colostrum. Many veterinarians and producers have been reluctant to use the vaccine. Approximately 10 years ago, the company was able to identify the blood type determinant that stimulated the production of the offending antibodies. Therefore, vaccine is not produced from blood with these blood types. The occurrence of NI is now quite rare and has not been reported in Oklahoma in the last 10 years. Anaplaz® is quite safe and effective when used according to directions.

A new vaccine, Plasvax® from Mallinrodt, was introduced in 1995. It has no danger of NI and can be administered at any stage of reproduction. This vaccine has been shown to protect against several strains of anaplasma, and it is hoped that Plasvax® will prove to be as protective as Anaplaz®.

In anaplasmosis endemic areas, vaccination is recommended as the most cost-effective means of control. Vaccines will not prevent cattle from

becoming infected and will not prevent cattle from becoming carriers, but will prevent clinical disease and loss of production. Remember, vaccinated animals will test positive on blood tests and may prevent their interstate movement.

Summary

I. Herds with a good immune program

A. Calves

1. Two months of age
 - a. Clostridial bacterin
2-way or 4-way
 - b. IBR-PI3 nasal vaccine if necessary
 - c. 5-way *Leptospira* bacterin if necessary
 - d. *Pasteurella* leukotoxoid if necessary

2. 2 to 4 weeks before weaning
 - a. Booster clostridial
 - b. Modified live IBR-PI3-BVD vaccine
 - c. *Pasteurella* leukotoxoid
 - d. *Brucella* strain 19—heifers

3. Weaning
 - a. Booster *Pasteurella* leukotoxoid

B. Yearling Replacements

1. Booster MLV-IBR, BVD vaccine
2. Optional
 - a. 5-way *Leptospira* bacterin
 - b. *Campylobacter fetus venerealis* for vibrio

C. Adult Cows—annually

1. Weaning/pregnancy testing
 - a. 5-way Lepto
2. Precalving for calf scours
 - a. *E. coli* K-99
First year—2 doses
Many contain roto-corono virus vaccine also
3. Prebreeding
 - a. *Campylobacter fetus venerealis* for vibrio if necessary

D. Special vaccines

1. *Hemophilus somnus* bacterin
 - a. Not very effective
 - b. Use only if necessary
2. Anaplasmosis vaccine
 - a. Effective control in endemic areas
 - b. Follow label instructions
3. Bovine Respiratory Syncytial Virus (BRSV)
 - a. May be helpful in infected herds, but not reported much in Oklahoma
 - b. Follow label instructions

II. Non-immune herds or herds with unknown vaccine history

A. In face of an outbreak of IBR or BVD **OR** wanting to start herd program:

1. IBR-BVD

- a. Vaccinate all cattle weaning age or older with killed or chemically altered IBR-PI3-BVD vaccine.
- b. Yearling replacements
 - (1) Modified live IBR-BVD vaccine
 - (2) 5-way Leptospira bacterin
- c. Cows after calving but more than 30 days before breeding

- (1) Modified live IBR-BVD
- d. Weaning calves
 - (1) Modified live IBR-PI3-BVD

The above vaccinations can be completed in approximately 12 months after starting program and can not be continued as a program for the immune herd as in (I A-D) above.

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