Understanding Vaccination Programs
(Timing is Everything)

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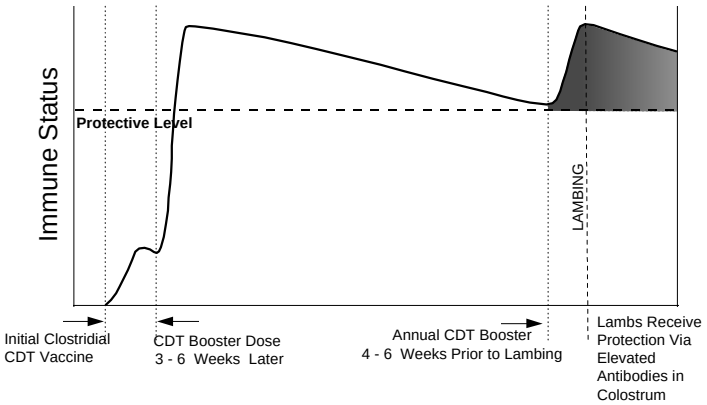
Vaccination of your lambs and ewes is one of the more common, yet least understood health management practices performed by Michigan sheep producers each year. In talking with producers it is obvious that some producers vaccinate their flock for "everything", while others choose a more conservative approach to immunology. However, regardless of your conservative or radical approach to vaccination practices, producers should understand how your basic vaccination program affects the immune status of your flock. Understanding some very basic vaccine terminology and science will also prevent wasted dollars and inadequate protection of your flock.

Live vs killed vaccines: Basically there are two different types of vaccines. These are usually referred to as live or killed vaccine products. Live vaccines usually contain non-infective, live forms of an organism that have been biologically altered to challenge the host - without causing disease. Thus, the live vaccine simulates a natural infection without (usually) the risk of actual exposure to virulent organisms. This simulated challenge produces an immune response in the body that leads to long-term immunity. However, the majority of sheep vaccines in this country are killed vaccines. Regionally, soremouth vaccine is the only approved live vaccine used by some Michigan producers. However, soremouth vaccine (unlike most other modern live vaccines) actually infects your sheep with live soremouth virus that has not been altered to the point of non-virulence.

Active Immunity Produced
by Clostridial CDT Vaccines (Killed Product)



(Adapted from G. Hooper)

Most sheep vaccines, however, fall into the category of killed vaccine products. Killed vaccines provide a similar organism challenge to the animal, but in a totally innocuous manner. Thus, killed vaccines can not become active and produce disease. Commonly used killed vaccine products include the clostridial (overeating disease, tetanus, blackleg, etc.) and footrot vaccines. Achieving adequate immunity with killed vaccines requires two doses of vaccine administered about 3 to 6 weeks apart. The initial vaccine dose stimulates the immune system to respond to the challenge, but it is the second dose of vaccine (booster dose) that raises immunity to a protective level.

The above figure depicts the sequence of immunological events that occurs in a prelambing vaccination program utilizing two initial doses of vaccine followed by a single annual prelambing booster.

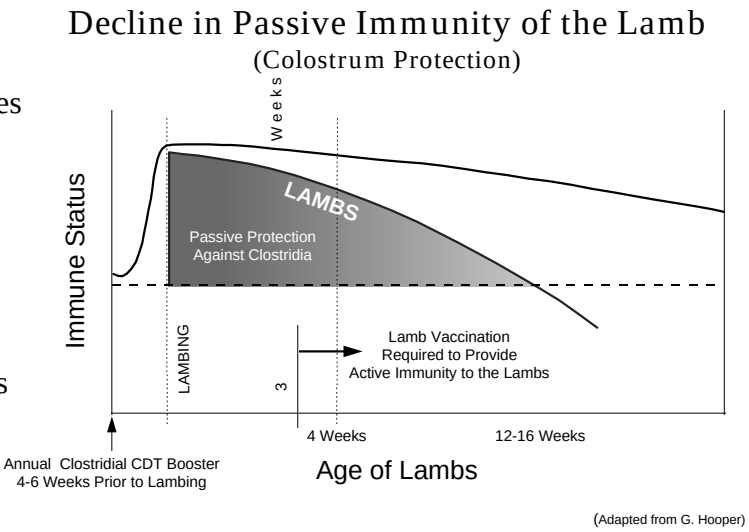
Additionally, the duration of adequate protection depends upon individual animal response to the initial and booster vaccine doses and the level of challenge (low vs high) when natural disease confronts the vaccinated individual. This protective level of immunity declines with time, and usually requires an annual booster dose of killed vaccine to maintain immunity at a protective level. Annual prelambing vaccination of the ewe flock is the usual mechanism for maintaining flock immunity. While this annual booster could be administered at any time during the year, prelambing vaccination also contributes to protecting the lamb. Protection of the lamb will be discussed in the next section.

Active vs Passive Immunity: Both killed and live vaccines produce a type of immunity usually referred to as *active* immunity. Active immunity occurs when the animal's own immune system responds to the challenge of either a vaccine or a natural infection. The idea is to produce a vaccine response before the risk of natural exposure to a disease. Active immunity produces long-term protection against the challenging organism (disease). In contrast, passive immunity refers to short term protection received from another individual. Examples of short term, passive immunity would include the antibodies received by a lamb from its mother's colostrum (first milk) and tetanus antitoxin (produced by hyper immunizing horses to tetanus). In both examples, the target animal did not mount an active immune response, but instead, passively received protection generated in another individual (ex: the lamb's mother or the horse). Passive immunity only protects an animal for several weeks and is used to temporarily protect an individual until they can mount their own immune response. Thus, passive immunity is short-lived, whereby active immunity produces long-term protection. The passive immunity a lamb receives from colostrum must be absorbed by the lamb's intestine during the first 12 to 18 hours after birth. This 18 hour oral "window of opportunity" is the only time the gut is capable of moving immunity (immunoglobulins) from the ewe's colostrum across the gut wall and into the circulatory system of the lamb. Following this 18 hour neonatal period, all passive immunity comes in the form of injectable products such as antitoxins or antiserums.

So when will vaccination of the ewe flock be most effective? The basic vaccination strategy for the ewe flock involves timing vaccine administration to do the best job for both the ewe and her lamb. The ultimate goal is really two fold: 1) we want to provide active immunity to the ewe, prior to when she is most likely to be confronted with the natural disease and 2) encourage high lambing season levels of protective antibodies (against common lamb diseases) in the ewe in the form of elevated immunity in the colostrum. It should be apparent that the timing of vaccination in the ewe flock will vary according to the target diseases. The following examples might help to illustrate this point: 1) footrot vaccine - booster prior to high exposure seasons (fall and spring), 2) abortion vaccines - booster prior to breeding or 3) overeating (*C. perfringens type C&D*) and tetanus vaccines - booster just prior to lambing. Remember that replacement ewe lambs, retained in the breeding flock, should receive both an initial dose of killed vaccine, followed by a second booster dose 3 to 6 weeks later. Once these two doses have occurred, these ewe lambs enter the adult ewe annual booster program. Mature ewes usually just receive an annual booster of vaccine.

Metaphorically speaking, the booster dose of vaccine acts as a "refresher course" for the animal's immune system. This "refresher course" stimulates "memory" of past vaccination, resulting in an elevation in the immune status of the vaccinated ewe. However, this whole "refresher course" process of booster dose and immune response takes about 3 to 4 weeks. Thus, booster vaccination must occur at least 3 to 4 weeks prior to the possible need for maximum protection. This response may be actual exposure to the disease or the production of large quantities of disease specific immunoglobulins in the colostrum.

The diagram on the right illustrates the dwindling nature of passive colostral immunity in the lamb and also illustrates the importance of prelambing vaccination of the ewe. Clostridial protection for *C. perfringens type-C and tetanus,* via colostral immunity, is probably sufficient - without further vaccination of the lamb for these diseases. Disease resulting from tetanus (usually secondary to docking and castration on day 2 or 3 after birth) and *C. Perfringens type-C* (sudden death on day 2 or 3 after birth) exposure occurs very early in life. Therefore, the only effective preventative measures for these diseases is via passive immunity produced by prelambing vaccination of the ewe. However, if you happen to dock and castrate older lambs this might not be the case.



In contrast, losses associated with *C. perfringens type-D* infection (overeating disease) generally occur when lambs are creep fed high grain diets or when lambs enter the feedlot. Due to creep feeding practices, overeating disease is common in winter lambing systems - especially when lambs are 6 to 8 weeks old. As the above figure illustrates, waiting several months to vaccinate lambs for type-D overeating disease is a risky proposition. Lambs should receive the initial dose of type-D vaccine by 3 to 4 weeks of age and a booster dose 3 to 4 weeks later. This practice allows response to the vaccine **before** passive colostral immunity declines to a dangerously low level. While it would be ideal to vaccinate all lambs at exactly 3 to 4 weeks of age, this is not always practical. The hectic, "real world" of the lambing barn often prevents timely administration of the type-D overeating vaccine. Producers get busy and lambs often go unvaccinated until weaning (common handling point). Thus, the initial and booster doses of the vaccine are often postponed until lambs reach 6 to 8 weeks of age. Add another 4 weeks to this scenario (for a response to the booster vaccine) and death losses occur. This is why I have usually promoted initial vaccination in the lambing pen and, hopefully, a booster at about 30 days of age. Producers seem to be able to accomplish the lambing pen vaccination (handling the lambs anyway) but have difficulty with administering the initial dose at 3 to 4 weeks of age. While the above figure illustrates the immunologic usefulness of initially vaccinating 3 to 4 week old lambs - in practice this is difficult. Lambing pen vaccination is a management/health trade off.

In coming feedlot lambs should also be vaccinated with two doses of overeating disease vaccine **before** their rations are jumped to high concentrate levels. Incoming lambs should be vaccinated shortly after arrival (days) and administered a booster about 3 weeks later. Using this scenario, and viewing the first illustration, it should be obvious that a high level of concentrate feeding should be avoided until the lambs have had time to mount an immune response to the booster dose.