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How vaccination works

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Almost all vaccination programs (particularly those using killed vaccines) require two doses for vaccination to be effective. It is, however, still common practice for producers to vaccinate only once or whenever they perceive the risk of disease may be high rather than adopting a set program. However, if a second dose of vaccine is not given to an animal shortly after the first (ideally, within 4–6 weeks) the protection given is short-lived and your money, time and effort has simply been wasted.

Producers need to understand how vaccines work to accept the need for a booster vaccination.

The vaccine itself does not confer immediate protection against disease. Antigens cause the body to produce antibodies in the blood. The vaccine acts as an antigen which stimulates the body to produce protective antibodies. (An antigen is anything that the body recognises as non-self or foreign, and therefore treats as dangerous.) Bacteria, viruses, and certain other complex substances can be recognised by the body as antigens.

When the special blood cells called lymphocytes detect an antigen, they are stimulated to produce antibodies. The antibodies then attach to the antigens and inactivate them. The antigen-antibody complex attracts scavenger cells that then destroy the antigens and so prevent disease.

When the animal encounters an antigen for the first time, it responds with a small primary response. If it encounters the antigen again soon after, the so-called secondary response is much larger, much quicker, and more prolonged.

The Primary Response

It takes time for the body to manufacture antibodies. If the body's lymphocytes have not encountered the antigen before, the body can take 2–3 weeks to generate enough antibodies to protect against the disease.

This is because the lymphocytes must divide and multiply themselves after they have been exposed to the antigen before they can produce large quantities of antibody. This is what happens with the first dose of vaccine.

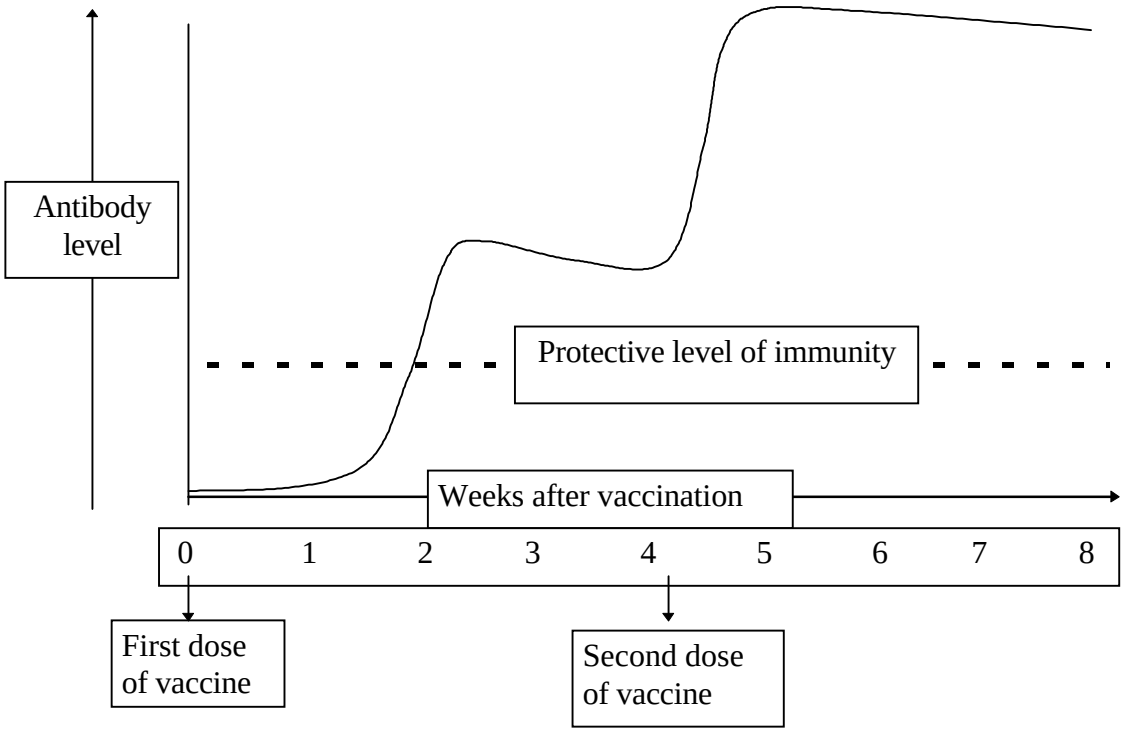
After the first exposure to an antigen, the amount of antibody produced by lymphocytes can be relatively small. The levels of antibodies produced might only offer protection for a few weeks rather than months (see graph below showing primary and secondary antibody responses).

The Secondary Response

If the body is exposed again to an antigen such as a vaccine or bacteria relatively soon after the Primary Response has occurred, the antigen will encounter many lymphocytes that have been previously exposed to the antigen.

These lymphocytes 'remember' how to make antibody to fight that antigen, so the response is more refined and a far greater quantity of antibodies is produced in a much shorter time. This is known as a Secondary Response (see graph below). The Secondary Response can produce protective levels of antibody in hours or days rather than weeks.

Antibody level in response to vaccination



Colostrum is not vaccination!

Some producers believe that young animals receive their first dose of vaccine from the colostrum or first milk of their vaccinated mothers and, therefore, the single shot given at marking acts as the booster. This is not true.

Young animals receive antibodies (not antigens) in the colostrum that were produced by the dam in response to vaccination. Antibodies, however, do not activate the lamb's own immune system. The newborn animal is protected by the dam's antibodies (so-called 'passive immunity') until these die out at 8–12 weeks. Only when the young animal's own lymphocytes have been exposed to the antigen will active immunity develop as the lamb or calf starts to produce antibodies of its own.

Achieving effective vaccination

Lymphocytes have a limited lifespan and are constantly being replaced. All lymphocytes able to recognise an antigen may have disappeared if a second booster vaccination is not given in time. If all lymphocytes capable of recognising an antigen are lost when a second vaccine is given, the body will only produce a small Primary Response. The body will in fact behave as if it had never seen the antigen before. One must therefore stimulate a Secondary Response with a booster vaccination for a vaccination program to provide long-term, effective protection against disease. To achieve this Secondary Response, you must give the second vaccination relatively soon after the first vaccination.

If you delay the second vaccine for 12 months, you will then need to give a third vaccination within weeks of the second to get adequate long-term immunity.

To save an extra muster, it is common practice to vaccinate at marking and weaning. This is probably adequate provided the interval between the two vaccinations is not too long. An interval longer than 3–4 months is probably getting too risky. However, no hard and fast rule can be set as to how long is too long. This depends on how many of the lymphocytes that were exposed to the first dose of vaccine are still alive when the second dose is given. This in turn depends on how old the lymphocytes were when they were first exposed. It will also vary due to genetic differences in the animal and disease status (whether the lymphocytes are fighting more than one battle!)

Whether the level of protection is adequate will also depend on the level of challenge from the disease agent concerned. If the level of challenge is very high (such as very lush pasture causing a high risk of pulpy kidney) protection is more likely to be inadequate if the vaccination program was sub-optimal. It is a matter of numbers of antibodies produced versus the number of infectious organisms present. This ultimately means that a booster shot 4–6 weeks after the initial vaccination gives the best chance of effective control.

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