

Fact sheet

Vaccination in sheep flocks

What are vaccines?

Vaccines are proteins (antigens) that initiate a protective immune response within an animal. In most cases the immune response involves antibodies that can then block either the disease agent (bacteria or virus) or its product (toxin) so disease does not occur.

The first time an animal is exposed to an antigen, the response is slow and may not be strong. This is why in natural infection, animals still develop disease, and why many recover from disease over time. The disease triggers an immune response that includes the production of antibodies, which then reduce or nullify the disease.

However, if the disease is severe, death or production losses will already have happened as the immune response is occurring. If an animal does survive, invariably the next time they are faced with the same challenge, their immune system is primed and ready, and the antibody response is much quicker and stronger – resulting in the disease having little or no effect. This is why most animals are considered ‘immune’ to a disease after they have had it.

Vaccination aims to generate this immune response and make animals immune without (in general) giving them the disease or experiencing the effects of the disease.

Types of vaccines

There are two main types of vaccines:

1. Killed vaccines
2. Live, or modified attenuated live vaccines.

Killed vaccines have no ability to cause disease and contain the right protein (antigen) to get a protective immune response. In most cases, two doses (usually at least 3–4 weeks apart) are needed for these vaccines to be effective.

The first dose is referred to as the primary or sensitising dose, and produces a low antibody response over 7–21 days. The second or booster dose produces a more rapid, stronger and longer lasting antibody response so the animal has lots of antibodies in their blood stream ready to nullify the antigens from either the organism or its toxin, hence preventing disease.

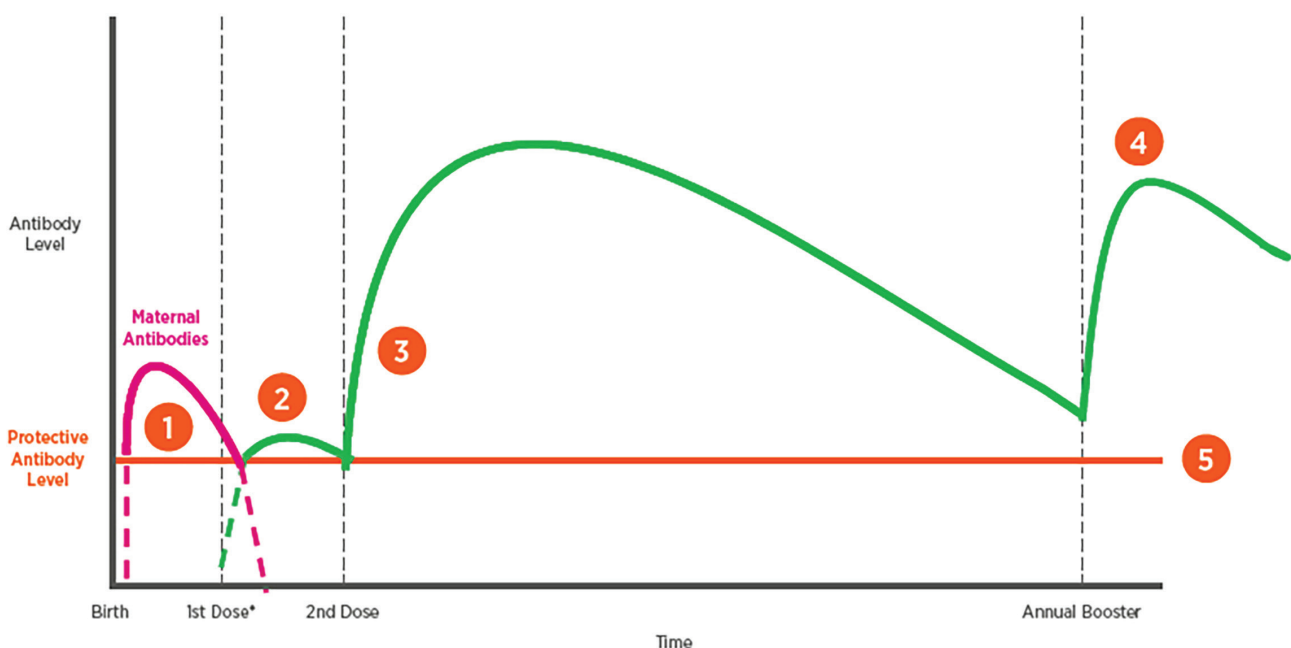
For vaccines that require two doses, the timing between doses is important. Most of the information on vaccines comes from the companies that develop them, and their goal is to identify the best protocol to get protection as soon as possible. Recommendations on vaccine packs usually refer to the minimum time between doses.

In reality, if animals have received the first dose some time in their life, and almost certainly in the last six months, a second dose will still act as a booster and result in a strong, prolonged antibody response. However, the animal is not fully immune in the period between the first and second doses, and so animals are at risk of succumbing to a disease if only one dose is given.

Once the booster dose has been given, antibodies will reach their maximum levels within several days, and animals will be immune to the disease (in general).

Over time, the antibody levels in the blood fall, and at some point for most diseases these vaccine-induced antibodies fall below the protective level (see Figure 1). Therefore, while some antibodies are still present, there are not enough to immediately stop disease, and some animals may then get the disease.

Figure 1: Schematic diagram of antibody response following vaccination



Source: zoetis.com.au/livestock-solutions/sheep/optimize-ewe-health/best-practice-vaccination-for-ewes.aspx

For this reason most vaccines require additional, usually, annual boosters. Clostridial vaccines are good examples of vaccines that require two initial doses, and then a follow-up annual booster vaccination to maintain the highest level of immunity.

In contrast, Gudair®, the sheep vaccine to protect against ovine Johne's disease, requires only one dose, despite being a killed vaccine. This is because the immune response works through the cellular rather than the antibody system.

Live, or modified attenuated live vaccines are developed from a weakened virus or bacteria, allowing it to replicate in the body and generate an immune response. Due to this process of pathogen replication promoting a protective response, many live or attenuated live vaccines do not require booster shots. While attenuated live vaccines do not usually cause disease, if disease is caused it is usually significantly milder than a strain caught through animal-to-animal transmission.

Scabigard® protects sheep against scabby mouth and is a live vaccine that ensures strong immunity with a single (scratch) vaccine. The animals develop the disease (without affecting them) approximately two weeks later and then develop immunity. While immunity is not lifelong, the likely continued exposure to scabby mouth virus over time results in 'boosting' and therefore (in general) annual boosters are not considered necessary.

Handling vaccines

Handling vaccines correctly is important because vaccines are sensitive to temperature and light. Freezing, overheating or prolonged exposure to sunlight will kill vaccines.

If you are distributing vaccines between September and March, make sure the vaccines are kept on ice and use an esky when marking or weaning.

Given the different vaccination schedules, it's important to read the label and information sheet provided with the vaccine before using it. Check the appropriate timing between shots (if multiple shots are required), the dose and method of administration. Most vaccines are given as a subcutaneous injection (under the skin), but this does vary.

Tips for storing vaccines

The length of time vaccines can be stored depends on sterility to reduce the subsequent growth of organisms in the vaccine.

Open the sealed tube and fix it carefully to the pack and gun to reduce the opportunity for contamination. If the vaccine is then stored as this closed unit, there is likely to be little chance of growth of organisms.

However, if you are not careful when setting up the equipment then the vaccine may become contaminated, and it will need to be discarded within a short period of opening.

Manufacturers provide recommendations for how long opened vaccines can be stored.

Should I vaccinate?

To make the decision whether to vaccinate or not, you need to consider the:

- cost and impact of disease, including welfare implications
- likelihood of the disease occurring
- cost of vaccine
- efficacy of the vaccine.

Vaccines:

- Are not usually 100% protective, and even with vaccination some animals may succumb to disease.
- May not necessarily stop an animal being infected or transmitting the disease. In most cases they stop the outcome of the disease, and they may or may not stop infection.
- May mask a disease being present.

These aren't reasons to not use a vaccine, but they must be understood to get the best value from a vaccine.



Let's look at two examples

1. Pulpy kidney in lambs

Challenge

A producer is concerned about losses just prior to or after lamb marking. The producer vaccinates lambs at marking with 6-in-1 and is wondering if this is sufficient. The first cross ewes have been joined to terminal sires and the producer is expecting to get \$150 average for lambs straight off their mothers at 14–15 weeks of age. Replacement ewes are purchased with two 6-in-1 vaccinations administered prior to purchase.

Action

To get effective protection around lamb marking, the producer needs to vaccinate the ewes pre-lambing. A single vaccination at lamb marking to the lambs will only provide a small level of protection 2–3 weeks post marking.

If a 5-in-1 or 6-in-1 vaccine is used pre-lambing, then a single pre-lambing booster will cost approximately \$0.30/dose plus labour ie. \$30/100 ewes and just over \$0.23/lamb if there is 130% lambing percent.

Benefit

Assuming a 98% protection from vaccination, and 5% of lambs get pulpy kidney, the gain from vaccination would be \$925/100 ewes, or a return on investment of 30:1 or 3,000%.

The producer needs to save one lamb every six or seven years to pay for the vaccination.

2. Arthritis in sheep

Challenge

There are a number of causes of arthritis but if the main cause is erysipelas, then vaccination may be appropriate. A producer is concerned about arthritis in lambs, which is observed around marking. Last year the producer had at least 20 lambs out of 500 (4%) affected which could not be sold.

Action

Erysipelas vaccine is given to ewes pre-lambing, and can be given at the same time as a pre-lambing 6-in-1.

Benefit

The vaccine costs \$0.70 a dose, and if approximately 20% of ewes require two doses, then allow \$0.85 per ewe. If the loss associated with arthritis is the full value of the lamb (\$150), the vaccine is 95% effective and the lamb marking percent is 130%, then there will be gain of \$3,280 by vaccinating (a return on investment of vaccinating of over 7:1).

In summary

These scenarios emphasise the importance of assessing the likelihood and level of disease in the absence of vaccination, something always easy in hindsight but difficult in reality.

Where there is any risk of disease, and a vaccine is available, vaccination to prevent or minimise disease will be a cheap and almost always worthwhile investment

Vaccines available for sheep

Table 1 includes the main diseases for which vaccines are available, and some of the main products on the market. The following provides a brief discussion on each of these issues, to highlight when vaccination is most useful, and examples of appropriate programs.

Clostridial vaccinations are relatively cheap. They require two vaccinations approximately four weeks apart to provide strong immunity. A single shot at lamb marking provides only short-term protection and it is not until the second dose is given that lambs/sheep can be considered protected. To protect against tetanus at lamb marking, ewes must be vaccinated pre-lambing.

Black disease almost always occurs when liver fluke is present. If your sheep have liver fluke, keeping sheep properly vaccinated is important. While immunity for tetanus and black disease are both long lasting (and probably after three doses lifelong immunity occurs), immunity to pulpy kidney appears to last for a much shorter period, and boosters should be timed to occur prior to a high challenge (grazing high quality feeds in rapidly growing lambs, lucerne or grain feeding). Generally, booster vaccinations 6–12 months apart should be sufficient, but there have been some suggestions that under continuous high challenge, more frequent boosters (every 3–6 months) may be justified.

Tasvax 8-in-1 provides extra protection for several less common clostridials (lamb dystentery) but does not cover cheesy gland.

In general, where there is any risk of clostridial diseases, proper vaccination is extremely cost-effective and worthwhile. Rams should be vaccinated at least annually (after their initial two doses).

Cheesy gland has been identified as an unnecessary cost at processing, and while production losses are not always evident, where clostridial vaccines are being used it makes sense to always include cheesy gland (ie. use 6-in-1), given the low extra cost (around \$0.07/dose).

Scabby mouth vaccine (Scabigard®) is a live vaccine administered via scratching the bare skin. A small line of pustules form along the scratch line, which then encrusts, scabs and falls off. A sample of vaccinated sheep should be checked for 'takes' 10–14 days after vaccination. The scratch allows the virus to take hold, and a relatively harmless infection occurs but provides strong immunity.

Scabby mouth is a zoonotic disease (humans can catch it) so care must be taken when using the live vaccine, as exposure to the vaccine on an existing scratch can lead to a nasty infection for the operator. It is important the vaccine does not come into contact with disinfectant as this can kill the vaccine and make it ineffective.

The difficulty with scabby mouth vaccination is that it is believed the virus can live for many years in the soil, so by using a live vaccine, you are 'introducing' the disease, and then ongoing vaccination will be necessary. But it is probably present already on most sheep properties, and if you are considering vaccinating, it is usually because your sheep have already had an outbreak of scabby mouth, in which case the virus is already present on-farm. There is a specific declaration on scabby mouth vaccination on the National Vendor Declaration form (Q2).

Ovine Johne's disease (OJD). The current vaccine (Gudair®) provides good protection against sheep developing OJD, and further assists in control by reducing shedding of OJD organisms for any infected sheep. The vaccine results in a reactive nodule in many sheep vaccinated, and some sheep can get a sterile abscess.

While Gudair® is a killed vaccine, it only requires a single dose for lifetime immunity (booster dose/s are not required). As young lambs are the most susceptible to infection, it is important on endemic properties that lambs being retained on-farm for more than two years are vaccinated as young as practical, which usually means at lamb marking. The general recommendation is to vaccinate lambs between 4–16 weeks of age.

Despite most infection occurring when lambs are young, sheep are usually 2–4 years when they exhibit the clinical signs of weight loss and death. Lambs that are destined for slaughter before 1–2 years will not benefit from Gudair® vaccination. Similarly, vaccinating older ewes is not necessary.

Where OJD is present on a property, vaccinating lambs (at 4–16 weeks of age, and preferably at lamb marking) that are staying on-farm for at least 1–2 years will assist in controlling OJD.

If non-Gudair® vaccinated sheep are brought onto an infected property from a known clean area, vaccination of young sheep (those retained for more than 2–3 years) should also be beneficial.

Gudair® vaccine must be handled with caution. Self-innoculation can lead to very nasty lesions in people, often requiring protracted multiple surgeries over several months. It is recommended that the safety vaccinator is used.

Campylobacter vaccination (Campyvax®) protects against abortion storms caused by campylobacter, and may also increase lambing percentage by decreasing foetal losses.

Campylobacter is believed to be quite widespread, and some reports suggest that vaccination can increase lamb marking percentages by about 10%. Although a trial in southern NSW showed only one in six properties gained any benefit.

Vaccination should be carried out either pre-joining or the booster dose occurring when rams are removed (at the latest). Given the likely widespread nature of campylobacter organisms, young sheep lambing for the first time are at the highest risk to campylobacter, so producers should consider vaccinating ewe lambs/hoggets prior to their first lambing (two doses at least three weeks apart required).

While annual vaccinations pre- or post-joining are recommended, it is likely that ongoing exposure after the initial two doses provides a reasonable level of immunity, so re-vaccination of older ewes may not be worthwhile.

Erysipelas arthritis is mostly a problem in young lambs, and protection is best provided by pre-lambing vaccination of ewes, so that lambs are protected via antibodies in the colostrum following birth and up until marking. Vaccination of lambs at marking and again at weaning will provide long-term protection, but it is important to note that if you are concerned of cases at lamb marking, then a pre-lambing vaccination of ewes will be the most effective approach.

Footrot vaccination may be a consideration in infected flocks, although vaccine use may be regulated in your state, requiring permission for its use. An excellent monovalent or bivalent vaccine has been available, and appears effective where only one or two strains (serogroups) of footrot are present in a flock. There are 10 known serogroups and frequently multiple serogroups are present in infected flocks.

In July, 2020, a '10 strain' (actually 9 strains, with no coverage of serogroup M) vaccine was reintroduced onto the market. Unfortunately, the duration of protection from multistrain vaccines is reasonably short, especially in Merino sheep. Footrot vaccine use should be discussed with your veterinarian. (Currently the monovalent / bivalent vaccine is not available).

Table 1: Common sheep vaccines

Disease	Product	Manufacturer	Vaccine type	Dose rate	Program*	Cost/dose†
Clostridial 5-in-1	Ultravac 5-in-1	Zoetis	Killed toxoid / cellular	1 ml s/c	Two doses at least four weeks apart, annual boosters	\$0.25
	Websters 5-in-1	Virbac		1 ml s/c		
	Tasvax 5-in-1	Coopers		2 ml s/c		
Clostridial plus cheesy gland (3-in-1 or 6-in-1)	Glanvac 3-or-6	Zoetis	Killed toxoid / cellular	1 ml s/c	Two doses at least four weeks apart, annual boosters	\$0.32
	Websters 3 or 6 in-1	Virbac				
	Tasvax 6-in-1	Coopers				
Clostridial 8-in-1	Tasvax 8-in-1	Coopers	Killed toxoid / cellular vaccine	2 ml s/c††	Two doses at least four weeks apart, annual boosters	\$0.37
Scabby mouth	Scabigard	Zoetis	Live	0.02 ml scratch	Single dose (for life**)	\$0.42
Ovine Johne's disease	Gudair®	Zoetis	Killed cell	1 ml s/c	Single dose for life	\$2.50
Campylobacter abortion	Ovilis campyvax	Coopers	Killed cell	2 ml s/c	Two doses at least three weeks apart, annual boosters	\$1.40
Erysipelas arthritis	Eryvac	Zoetis	Killed cell	1 ml s/c	Two doses at least 3–4 weeks apart	~ \$0.70
	Eryguard	Coopers	Killed cell	1 ml s/c		
Footrot	Ovilis footvax	Coopers	Killed cell	1 ml s/c	Two doses at least six weeks apart	\$2
Specific footrot vaccine	Monovalent or bivalent	Treidlia Biovet	Recombinant vaccine	As directed	Two doses 3–4 weeks apart	\$1.30-\$2.10

* Recommended by manufacturer

† Approximate cost, Nov 2020

†† Dose varies with age of animal

Vaccination programs for sheep

From the information above, the approach to vaccination for most sheep producers should be relatively straightforward. It is a matter of assessing the likely occurrence of a disease, and in most cases, if a disease is likely to occur, even occasionally, then vaccination will be worthwhile. The higher the rainfall, the more common diseases problems occur (botulism and tetanus may be exceptions).

When to vaccinate?

At **lamb marking**, it will be prudent to vaccinate all lambs with 6-in-1 and where ovine Johne's disease is present, Gudair® as well. Scabby mouth vaccination (scratch) should also be considered, and erysipelas vaccination may be warranted.

At **weaning** (generally six weeks later), any lambs not being immediately sold should receive their booster 6-in-1 vaccination (and booster erysipelas vaccine if needed).

For **ewes** (assuming they have been vaccinated as lambs), a **pre-lambing** 6-in-1 booster vaccination and an erysipelas vaccine should be considered. Remember, the pre-lambing vaccination has to occur at least two weeks prior to lambing to give time for antibody production and incorporation in the colostrum, but it can be given well before that and still give effective colostral levels.

Yarding ewes close to lambing to vaccinate ewes can increase the risk of foot abscesses in wet environments, and subsequent pregnancy toxemia. Vaccinating ewes anytime in the previous six months should act as an annual booster so consider what timing is best. Ewes will initially require two doses of an erysipelas vaccine if protection for arthritis is required, and marking and weaning doses have not been given.

In addition, consider vaccinating maiden lambs/ewe hoggets at their first joining (two doses required) to protect against loss from campylobacter.

Trace elements in vaccines

Some vaccines are available with trace elements added, for example, selenium or vitamin B12. This is useful if lambs at marking need these trace elements, but not for other sheep. A vaccine is given on an animal basis, not a weight basis ie. 1ml dose to a 10kg lamb at marking and a 1ml dose to a 60kg ewe.

Trace elements are given on a per kilogram basis, and so the rate of trace element provided in vaccines is usually only sufficient for lambs at marking.

Purchased sheep

If you purchase sheep directly from another producer, and you can get accurate information on previous vaccinations given to the purchased sheep, this may allow you to determine what future vaccinations are suitable.

However, if you are uncertain about the previous vaccination history, do not assume purchased sheep have received vaccinations. There may be some information provided on an animal health statement or the vendor declaration, but given the usually high returns from adequate vaccination, it is usually best to assume the animals have not been vaccinated, and start a suitable vaccination program for your enterprise.

Gudair® vaccination history may be indicated on the tag (with a V), and knowing the Gudair® vaccination history is important when buying sheep that are going onto likely infected properties.

Further reading

mbfp.mla.com.au/herd-health-and-welfare/tool-62-cattle-disease-vaccines-and-strategies/

ojd.com.au/wp-content/uploads/2013/02/OJD-fact-sheet.pdf

zoetis.com.au/livestock-solutions/sheep/best-practice-videos/gudair.aspx?gclid=CjwKCAiAzNj9BRBDEiwAPsL0d31VzcBWrQn65-c9diADs7sNSZn93PYF9DI0hvUmuFz4LelpZ8XpRoCT6wQAvD_BwE

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