Vaccination for beef cattle in northern Australia

Vaccines are an important part of a herd health plan. When used correctly as part of a property health plan, vaccines can help prevent common endemic livestock diseases, leading to improved animal health, welfare and productivity. Northern beef producers should be aware of the endemic diseases in their region that can be prevented by vaccination.

Immunity

This is the ability of an animal to withstand a specific disease, infection or toxin (e.g., tetanus and botulism are caused by bacterial toxins). Immunity is acquired through the animal's exposure to the disease agent. The major component of an animal's immune response to an infection or toxin is the antibodies that are created against the particular disease, infection or toxin (Note: not all toxins elicit an immune reaction).

Immunity can be acquired actively or passively.

Active Immunity results when exposure to an infectious agent stimulates the immune system to produce antibodies to that disease. Active immunity can be acquired through natural infection or vaccination. Either way, the antibodies produced by the animal's immune system will recognize any subsequent introduction of the infectious agent and neutralise it. Active immunity is long-lasting, and sometimes life-long.

Passive Immunity occurs when an animal acquires antibodies to a disease rather than producing them from their own immune system. A newborn calf acquires passive immunity from the dam's colostrum.

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 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 immune response takes 7-21 days 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 neutralise 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. Therefore, most animals are considered 'immune' to a disease after they have had it. Bovine Ephemeral Fever is a classic example of a lifelong immunity acquired from natural infection. However, the animal's age when first infected influences the severity of the clinical signs experienced.

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 (weakened) live vaccines.

Killed vaccines cannot 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 neutralise the infection or toxin, hence preventing disease.

For vaccines that require two doses, the timing between doses is important. Most of the information on the vaccine pack 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.

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 become ill.

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. However, for some diseases, antibody levels stay high for much longer periods, and immunity is considered lifelong. Repeat vaccination later in life is not required. The protective immunity to some diseases is mainly through a cellular immune response, rather than antibodies. Examples of where this occurs include *Leptospira hardjo* and bovine Johne's disease.

Adjuvants are chemicals often used to modify or enhance the effects of a vaccine to stimulate a greater and often prolonged antibody response. Some adjuvants are irritants and can cause a visible lump under the skin, so it is important to ensure the recommended vaccination sites are always adopted. The presence of a lump however, provides some reassurance that the animal has actually been vaccinated successfully. For example, it is always reassuring to see the lump on the side of the neck of a bull that has supposedly been vaccinated against vibriosis.

Live, or modified attenuated live vaccines are developed from a weakened virus, protozoon or bacterium, 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 e.g., tick fever vaccine. 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.

Handling & storage of vaccines

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

- Unless otherwise stated, keep vaccines refrigerated or when ready to use, keep cool in an esky with an ice brick.
- Use insulated bags/cooler with ice packs during transport or alternatively a car fridge if available.
- Do not remove vaccines from packaging until ready to use and then avoid placing open packs of vaccines directly against ice bricks.
- Place vaccines in a cooler when not in use whilst in the yards.

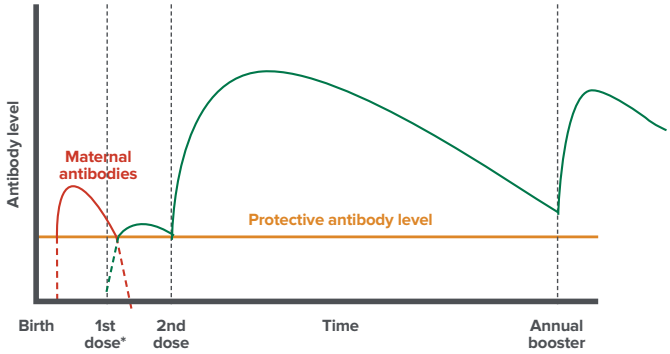
Given the different vaccination schedules, it is important to read the label and information sheet provided with the vaccine before using it. Check the appropriate timing between shots (if multiple shots are required), the dose and method of administration.

Most vaccines are given as a subcutaneous injection (under the skin), but this does vary. Ultravac® Scourshield®, a scours vaccine in cattle, is given intramuscularly.

Manufacturer's recommendations should always be followed when storing vaccines. Record batch numbers and expiry dates for quality assurance and future reference. Some vaccine such as tick fever vaccine have a very short shelf life and vaccination procedures need to be carefully planned to use the vaccine as soon as possible after purchase.

The length of time vaccines can be stored after opening the vial 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, the vaccine may become contaminated, and it will need to be discarded within a short period after opening. Manufacturers provide recommendations for how long opened vaccines can be stored after the initial opening of the pack.

Figure 1 Schematic diagram of antibody response following vaccination



*The first dose of vaccine may not confer protective immunity. Source: zoetis.com.au/livestock-solutions/sheep/optimise-ewe-health/best-practice-vaccination-for-ewes.aspx

Should I vaccinate?

There are numerous vaccines available to beef producers in northern Australia. Where there is any risk of disease, and a vaccine is available, vaccination to prevent or minimise disease will be a worthwhile investment. Key questions to consider are listed below and veterinary advice is recommended to help formulate a vaccination plan.

Key things to consider when deciding to vaccinate include:

- Is the disease present (in my area) or likely to occur on my property?
- What is the cost and impact of disease, including welfare and workplace health and safety implications?
- Is a vaccine available and what is the efficacy of the vaccine?
- What is the cost of the vaccine including mustering and processing of stock?
- Are alternate control options available?
- What are the cost benefits of adopting a vaccination program including flow on effects for subsequent owners of the stock?

Vaccines:

- are not always 100% protective, and even with vaccination some animals may succumb to disease
- may not be responded to as well by cattle in poor body condition or under severe stress than by healthy cattle
- 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 are not reasons not to use a vaccine, but they must be understood to get the best value from a vaccine.

Vaccines available for northern cattle

Table 1 includes the main diseases in northern Australian beef herds 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. The recommended instruction is for two vaccinations at a minimum of four weeks apart prior to animal husbandry procedures. This provides immunity against five clostridial diseases – tetanus, black leg, black disease, pulpy kidney and malignant oedema. Black disease is associated with liver fluke so is rarely seen in the north. The practicality and economics of being able to ensure calves in northern Australia receive two shots of vaccine prior to animal husbandry procedures can be challenging, however to ensure strong immunity against the five clostridial diseases two doses are necessary. Tetanus especially takes about 10 days to exhibit clinical signs, by which time the vaccine has started producing an initial immune response. The natural challenge from the toxin will further stimulate immunity and should provide protection. The risk of tetanus increases with the use of elastrator rings and the Burdizzo. Black leg is most likely to occur in summer months in flooded areas and after heavy rain when the pastures are highly digestible. Pulpy kidney is associated with high concentrate feeding and is most likely seen when lot feeding, so even if the benefits are not recognised 'on farm', they are realised in a feedlot.

Leptospirosis not only causes abortion in cattle, it can also infect people working with animals (Weil's Disease). Vaccinating cattle against 'lepto' will help protect those working around cattle, as well as the cattle themselves – although other species such as rats and feral pigs are also a high risk factor. While the organism has been detected all over Australia, outbreaks are more common in dairy cattle, coastal regions and in wet swampy areas. In general, a lepto vaccine is given in conjunction with a clostridial vaccine (as 7-in-1) especially in replacement heifers and breeders. The antibody response tends to wane over twelve months and an annual booster is required. Maximum antibody levels and protection against abortion is achieved if the vaccine is given at mid pregnancy. In practice, this usually occurs at the time of pregnancy diagnosis.

Pinkeye vaccination is one of the control measures that might be considered for beef enterprises where pinkeye occurs, especially given the challenges with treating affected animals. Some Bos taurus breeds are more susceptible. Only a single vaccine dose is required 3–6 weeks prior to the infection. Where prolonged infection occurs, a booster vaccination after five months may provide pinkeye control. (Note: Inflammation of the eye [keratoconjunctivitis] can be caused by many factors other than the bacterium in the vaccine. If this is the case, vaccination will not be effective).

Pestivirus vaccination is one way to control bovine viral diarrhoea virus (BVDV). The high prevalence of Pestivirus in northern Australian herds was established as far back as 1967. The biggest risk occurs when a carrier animal (often a pregnant cow) is introduced to a naïve breeding herd. An effective vaccination program (an initial two doses with annual boosters) will minimise the impact of BVDV but once commenced, it is likely to be an ongoing commitment in the herd as the herd will become naïve if vaccination is ceased. Therefore, discuss your herd status and the use of Pestigard® in your herd with your veterinarian. It is highly recommended that studs and seedstock producers implement a sound vaccination program as they need to guarantee that sires sold are not actually carrier animals.

Case study
Victoria River District (NT) Vibriosis trial

A trial was conducted in 2004/5 and 2005/6 to determine whether there was any economic benefit from giving maiden heifers one injection of a vibriosis vaccine (Vibrovax™) just prior to joining. The vaccine instructions stated that heifers older than 18 months of age only require one injection of the vaccine to gain immunity from vibriosis for two years. Since most heifers are joined for the first time at two years of age in the Northern Territory, giving one injection of a vaccine is a practical treatment, whereas a vaccine that requires two injections several weeks apart is not practical, due to the high mustering costs associated with large paddocks. The vaccinated group (VIB) and the control group (CON) all grazed together in the same paddock and bulls (mixed ages) were introduced to the heifers in late December and remained with them continuously from that point onwards. Several fences were washed down over the wet season and as a result, other bulls gained access to the paddocks – in addition, not all heifers were re-mustered. In both years of the trial, at the round one muster, pregnancy rates in the vaccinated group (VIB) were 11% higher than in the control group (CON).

NB: the presence and severity of diseases vary markedly between years depending on seasonal conditions, feed supply and vector spread (disease spread by insects), so never rely on the results from just one year. Understand all the factors that determine disease outbreaks.

Calf scours is a complex disease with several different organisms including rota virus, corona virus and Escherichia coli bacteria potentially being responsible. However, vaccination is usually effective at decreasing scours, even though the vaccines do not cover all the potential pathogens. Cows need to be vaccinated pre-calving to ensure adequate colostrum antibody levels to protect young calves. The risk factors appear to be poor seasons (low quality colostrum), maiden heifers and small calves (breeds like Wagyu are more susceptible).

Vibriosis can result in poor reproductive rates. It can be controlled by making sure bulls are properly vaccinated. Bulls should receive two doses of vaccine prior to their first use, followed by annual booster vaccinations. Vibriosis is very prevalent and the immunity acquired through natural infection can suppress the disease sufficiently for it to go unnoticed. It is a venereal disease and consequently maiden heifers are always naïve and most vulnerable. Vaccination of heifers and cows may be required where bull control is problematic or where herds are found to be infected.

Bovine ephemeral fever (BEF or three-day sickness) is a viral disease in cattle, transmitted by biting insects (primarily by mosquitos and midges). It is endemic in the far north and in coastal regions. Natural infection provides lifetime immunity. The severity of symptoms increases with age and death can eventuate in older, heavier animals. The disease causes mild temporary symptoms in young stock. The risk increases after a series of dry seasons with low insect activity. The distribution and spread of the disease depends on seasonal conditions and vaccination is the only means of preventing the disease in regions outside the endemic area with two initial doses required.

Botulism is a major problem in northern beef herds, especially in regions acutely deficient in phosphorus. It is probably the biggest factor contributing to breeder mortality in northern Australia. There is no treatment for the disease, vaccination is the only way to protect the breeder herd. Bone chewing and ingestion of carcase material is a high risk factor. Phosphorus supplementation can reduce the prevalence of botulism. Steers do not usually require vaccination as they are sold at a much younger age and are less prone to acquire phosphorus through bone chewing.

Tick fever is a group of three separate diseases transmitted by cattle ticks. It is localised to the cattle tick endemic area of northern Australia and seldom presents as a problem in these regions as passive immunity followed by natural challenge ensures most animals are protected at an early age. *Bos indicus* cattle are more resistant to ticks and the risk of infection. The major risk factors are stock located in the marginal tick areas where the prevalence of ticks may be eliminated during dry seasons. Producers who wish to move cattle, especially bulls, north of the 'tick line' should consider vaccination against tick fever. Cattle should be vaccinated at least four weeks prior to movement into the tick endemic parts of northern Australia to allow time for protective immunity.

Case study
Pilbara Botulism trial

A trial was established to assess the effectiveness of vaccinating for the toxin Botulism. In September 2006, two thirds of the trial heifers were vaccinated with Pfizer Longrange™, with the other third remaining unvaccinated as a control. Trial animals were identified with RFID (radio-frequency identification) tags and were flagged on the computer system linked to a tag reader. The vaccinated group of animals were re-vaccinated at the second round of mustering in September or October over the next three years.

Due to the extensive nature of the station and the large number of cattle, it was impossible to confirm the death of many of the trial animals. Instead, the measure of the effectiveness of the vaccine was the presence or absence of animals for more than three consecutive musters, with animals missing three or more musters considered to have died. After the first two years, some heifers were dispersed throughout the breeding herd and the computer system allowed these animals to be tracked. The computer recorded the last date that an animal's tag was scanned, and therefore it could be determined how many mustering rounds an animal had missed. It is conceivable that animals may have been 'missing' for several years then reappear. Both vaccinated and control animals had the same opportunities to disappear and then reappear. However, there is also a high probability that the majority died. Animals were not confirmed dead unless the carcass was sighted, and the RFID tag recovered. Results indicated that 7% fewer animals from the botulism vaccinated group were missing for three or more musters compared with the unvaccinated control group.

When to vaccinate

If you have decided to vaccinate, the question then arises as to when to vaccinate. The cost of vaccine is usually only a small part of the overall cost. The expense of mustering and handling stock usually dictates that many vaccination programs have to coincide with routine husbandry procedures.

There are several opportune times in a normal calendar when this occurs, such as at branding, weaning, or (more usually) to coincide with pregnancy testing. While weaning is an ideal time to start vaccination programs, the other times when vaccination opportunities arise are at selection of heifer replacements and at bull testing. It does not make a lot of sense to do a full Bull Breeding Soundness Examination but fail to protect the investment with a vaccine against three-day sickness, Vibriosis and other preventable diseases.

Rules of vaccination

1. Always follow manufacturer's instructions where possible with regards to timing of vaccination, care of the vaccine and site of injection.
2. If handling and mustering are major factors preventing the adoption of the manufacturer's instructions, then multiple vaccines can be given on the same day. However, never mix vaccines in the same syringe. The manufacturers do this already wherever possible to solve this issue e.g., '5 in 1' or '7 in 1' vaccine. If it can be done, they would have done it already.
3. Use separate syringes for each vaccine and administer at different sites – approximately 4 inches (10cms) apart. Use different sides of the neck. Don't vaccinate in the rump or other parts of the carcase.
4. Vaccinate at weaning if possible, for most diseases.
5. If tick fever vaccine is being administered, plan to administer it two weeks after all the other vaccines have been given if in a low risk situation. This is because a tick fever vaccine may affect the immune response to the other vaccines. However, if the animals are from a clean area, then give the tick fever vaccine first as this is where the biggest losses could occur. Finally, if there is only one chance to vaccinate the animals before they are released and there are no alternatives, give all vaccines at once following the rules outlined above. This is far better than giving no vaccine at all.
6. Keep needles clean but do not use disinfectants with modified live vaccines. Change needles frequently (every 50 jabs recommended) as they don't cost much in comparison to severe trim at the abattoir.
7. Thoroughly wash the vaccinating gun with clean water and flush with a mild disinfectant solution after use. Store in a clean, dry place and flush thoroughly with warm clean water prior to use.
8. Always have a cooler box or some other such facility to keep the vaccine cool if the procedure is to be carried out over several hours or more. Use insulated vaccine pouches during use to slow the heating of vaccine and protect it from light.

Vaccination technique

Most vaccines are administered subcutaneously i.e., under the skin (not into the muscle), see Figure 2. Severe reactions can occur if you inject oily vaccines into muscle. The preferred site is in the neck area forward of the shoulder. Injecting here minimises the potential for carcase damage and financial loss, should trimming be necessary.

If administering injections subcutaneously, use a short needle (1/2 inch or 12.7 mm). Set the needle on the syringe so that the open end of the bevelled point of the needle is facing the skin and not visible to the eye, see Figure 2.

If the head is able to be restrained, then a two hand technique is the most accurate way to ensure correct delivery of the vaccine. Lift a fold of loose skin with your free hand and inject at the base of the 'tented' skin, ensuring that the needle does not pass straight through the fold of skin.

If animals are injected in the race, then a one-handed technique is the safest and easiest method. Change needles regularly to improve the accuracy and confidence in correct injections and use a 45-degree angle of entry.

For intramuscular injections, use a longer needle (20 mms) and inject at a perpendicular approach to the neck muscles.

Operator safety

Extreme care must be taken when injecting cattle to avoid accidental needle-stick injury to the operator (e.g. when the animal is inadequately restrained and twitches/jumps when it feels the needle). The second hand, lifting the skin to form the "tent" for a subcutaneous injection, is particularly vulnerable and the reason why shrouded, self-tenting vaccinators are a good option to consider.

Figure 2 Injection administration technique

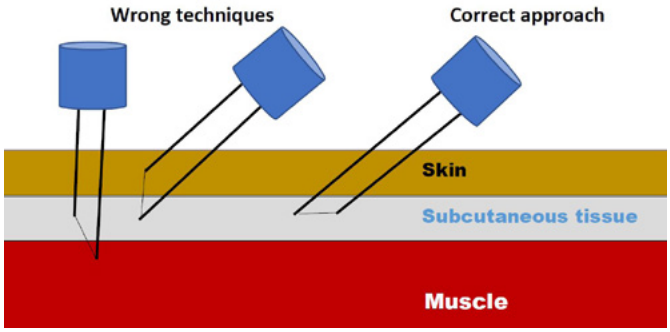


Table 1: Common cattle vaccines for use in northern Australia

Disease	Product	Manufacturer	Vaccine type	Dose rate	Program*	Cost/dose†
Clostridial	Ultravac 5-in-1	Zoetis	Toxoid, killed cellular	2 ml s/c	Two doses at least four weeks apart, annual boosters.	$0.50
	Websters 5-in-1	Virbac	Toxoid, killed cellular	2 ml s/c	Two doses at least four weeks apart, annual boosters.	$0.50
	Tasvax 5-in-1	Coopers	Toxoid, killed cellular	4 ml s/c	Two doses at least four weeks apart, annual boosters.	$0.50
Clostridial plus Lepto	Ultravac 7-in-1	Zoetis	Toxoid, killed cellular	2.5 ml s/c	Two doses at least four weeks apart, annual boosters (at time of pregnancy diagnosis) – replacement heifers and breeding females.	$2.35
	Websters 7-in-1	Virbac	Toxoid, killed cellular	4 ml s/c	Two doses at least four weeks apart, annual boosters (at time of pregnancy diagnosis) – replacement heifers and breeding females.	$2.35
	Cattlevax LC 7-in-1	Coopers	Toxoid, killed cellular	4 ml s/c	Two doses at least four weeks apart, annual boosters (at time of pregnancy diagnosis) – replacement heifers and breeding females.	$2.35
Leptospirosis	Leptoshield	Zoetis	Killed cell	2 ml s/c	Two doses at least four weeks apart, annual boosters at time of pregnancy diagnosis.	$1.70
Pink eye	Bovilis piliguard	Coopers	Killed cell	2 ml s/c or im	Single dose, annual booster 3–6 weeks prior to pinkeye season.	$5
Pestivirus (Bovine Viral diarrhoea virus)	Pestigard	Zoetis	Killed cell	2 ml s/c	Two doses 4–6 weeks apart, annual boosters.	$4.60
Calf scours	Ultravac Scourshield	Zoetis	Killed cell	2 ml im	Two doses 3–9 weeks apart with 2nd dose 2–6 weeks prior to calving. Annual boosters.	$4.50
	Rotovec corona	Coopers	Toxoid, killed cell	2 ml s/c	Initial dose 10–12 weeks prior to calving, 2nd dose 4–6 weeks prior to calving. Annual booster 4–6 weeks prior to calving.	$7
Vibriosis	Vibrovax	Zoetis	Killed cell	5 ml s/c (bulls)	Two doses 4–6 weeks apart, annual boosters.	$9
Bovine Ephemeral Fever (BEF or three-day sickness)	Ultravac BEF	Zoetis	Killed cell	2 ml s/c	Two doses 2 weeks – 6 months apart. Annual booster prior to wet season.	$8–$10
Botulism	Longrange Botulinum	Zoetis	Toxoid	2.5 ml s/c	Two doses 4–6 weeks apart, annual boosters.	$1.50
	Singvac 1 Year botulism	Virbac	Toxoid	2 ml s/c	Single initial dose and annual booster.	$1.30
	Singvac 3 Year botulism	Virbac	Toxoid	2 ml s/c	Single initial dose, booster every 3 years.	$2.45
Tick fever	Trivalent tick fever vaccine	Tick Fever Centre or (order direct online) or phone (07) 3270 9600	Attenuated Live Vaccine. Frozen vaccine exists (contact Tick Fever Centre for details)	2 ml s/c	Single shot – best done at weaning. No booster required.	$5.60

s/c = subcutaneous injection
im = intramuscular injection

* These recommendations align with manufacturer's recommendations where possible given the limited opportunities cattle are able to be mustered and processed on extensive operations in the hot dry tropics.

† These are approximate only at time of publication and will vary. Consult your vet or re-seller for exact pricing.

For more information, visit the Vaccination hub: mla.com.au/vaccination-hub

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