

RESPONSIBLE USE OF MEDICINES IN AGRICULTURE ALLIANCE

**ruma**

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**GUIDELINES**

# **Responsible use of vaccines and vaccination in sheep production**

A farm health planning initiative in partnership with DEFRA

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# Responsible use of vaccines and vaccination in sheep production

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## **Introduction**

Sheep are prone to a variety of diseases, many of which are rapidly fatal. Such diseases often strike a flock without warning, resulting in considerable losses.

Indeed the losses suffered by the sheep farmers of Scotland in the early part of the last century led directly to the establishment of the Moredun Research Institute in 1921. The then directors, in their wisdom, appointed two outstanding bacteriologists Dalling (later to be knighted) and Gaiger, whose initial brief was to investigate the horrendous losses, now recognised as braxy and lamb dysentery.

Only two years after their initial investigation, a crude vaccine against *Clostridium septicum* (the cause of braxy) had been developed. It consisted of a sterile filtrate of the growth of *C. septicum* in a liquid medium. When administered pure, it was found to be toxic but when diluted with carbol saline it afforded a good degree of protection without toxic effects. By the early 1930s the introduction of a formalinised whole culture vaccine was shown to provide superior protection and to have far greater safety margins.

During the late 1920s the scourge of lamb dysentery was tackled by Dalling, Mason and Gordon who described both passive immunisation of the lamb by use of antitoxin or by colostral protection after vaccinating ewes with formalinised whole cultures. These workers were the first to recognise one of the ewe's greatest attributes, the ability to transfer antibodies, and hence protection, to the lamb. They clearly demonstrated that the source of protection was from ingested colostrum and not from placental transfer. To this day, this ability to transfer immunity from ewe to lamb is still exploited.

In 1931 the first vaccine against a viral condition, louping-ill, was produced by Gordon and his fellow workers.

Veterinary Investigation Disease Analysis (VIDA) statistics have revealed that, over the past ten years or so, the most commonly diagnosed infectious causes of death or disease in sheep, in descending order, have been enzootic abortion of ewes (EAE), toxoplasmosis, pneumonia and septicaemia due to the *Mannheimia* spp./*Pasteurella* spp. complex, and the clostridial diseases predominantly pulpy kidney and lamb dysentery. All of these diseases can be controlled or prevented by vaccination. (Parasitic gastro-enteritis falls between *Mannheimia* spp./*Pasteurella* spp. and the clostridial diseases in importance)

## **How do Vaccines Work? Antibody /Antigen Response**

When an animal is infected with a disease-provoking agent which may be a bacterium, virus or protozoan, it is either overwhelmed and death occurs or a response to the infection is stimulated which eventually overwhelms the invading organism. This is termed the antibody/antigen response: the antigen being the invading pathogen and the antibody being the body's response and defence.

Antibodies may also be referred to as immunoglobulins or gammaglobulins. They are Y shaped and each responds to a specific antigen which may be a bacterium, virus, toxin or protozoan. The tips of the Y bind to the antigen thus disabling it. If the antigen is present in large amounts then the antibody can signal for complement to help neutralise the antigen.

There are five classes of antibody:-

A =IgA, D=IgD, E=IgE, G=IgG and M =IgM. Of these the two most important are IgG and IgM. IgG can be found in blood and body fluids. It is a small molecule and can therefore penetrate tissues with ease. IgM on the other hand is a large molecule and appears early in the disease process. IgA is produced in large quantities on mucosal surfaces protecting them from invading pathogens. Complement is a series of soluble proteins produced in the liver, few in number but important in their function of lysing invading cells and molecules. Having disabled the invading antigen then the phagocytes (white blood cells) move in to remove the dead cells or debris.

Other proteins involved in the immune response include lymphokines which stimulate the lymphocyte production. Equally important are the B and T cells produced in the thymus. B cells mature into plasma cells which actually produce the antibody in response to a given antigen. Large quantities are produced but at the same time other B cells or memory cells prime themselves against the antigen, clone themselves but do not actively produce antibody. These remain in the body for a period of time from days to years. Once the antigen re-appears in the body they rapidly multiply and produce large quantities of antibody which overwhelms the antigen whether it be bacteria, virus, toxin or protozoan. These dormant B cells are sometimes referred to as memory cells. The T cells actively kill invading infectious agents. They also have the ability to identify virus infected cells and eliminate them.

The immune system is clearly highly complex. The ability to function to its potential can be compromised in several ways. Certain viruses can influence its response as can deficiencies in essential nutrients. Animals in poor bodily condition, lacking in essential micro-nutrients, stressed or suffering from concurrent disease rarely respond fully to invading pathogens.

Vaccines work by stimulating the immune system without provoking disease. This is achieved by either inactivating the organism, by growing it in the laboratory in a succession of culture media so that it undergoes subtle changes and when introduced into the body it provokes an immune response without causing disease. In the case of protozoa, certain individual strains have been identified which naturally fail to complete their expected life cycle. Thus if introduced into the body, an immune response is provoked but disease does not occur because the life cycle is incomplete. In other cases invading bacteria produce powerful toxins, these are treated chemically to inactivate them. In some experimental vaccines, part of the organism (epitope) is removed and inserted into a harmless bacterium. As the harmless bacterium multiplies in the body the inserted epitope is recognised by the B cells and an immune response is stimulated. As yet there are none of these latter type of vaccines available for sheep in Great Britain.

Usually the full response to a vaccine does not occur for about 14 days after administration. Generally live modified vaccines, viral and protozoan vaccines provoke a satisfactory immune response with a single dose. Bacterial vaccines frequently require two doses to elicit

a satisfactory response. This is referred to as a **primary course**. Timing between doses is fairly critical and a full response only occurs about 14 days after the second dose.

Adjuvants are added to some inactivated vaccines, these may be simple aluminium hydroxide, Quil A or in some cases an oil. These act by helping to present the antibody more directly to the immune system slowing the dispersion from the injection site and to act directly by stimulating the immune response. Vaccines stimulate the immune system by mimicking a pathogen, but failing to induce actual disease due to inactivation or attenuation. Fit, well fed sheep respond well to vaccines, poor debilitated, parasitised and those suffering concurrent disease do not.

## **Maternally Derived Antibody**

A correctly vaccinated ewe will have circulating antibody against the organism to which she has been immunised. The ewe has the ability to concentrate certain antibodies in her colostrum. The amount of antibody depends on several factors including the nutritional state of the ewe and the amount of circulating antibody. Frequently the concentration in the colostrum exceeds that in the circulation. In the case of lambs, antibody is absorbed for up to 18 hours but absorption starts to decrease after six hours. Thus the lamb is protected against neonatal disease, in particular those which strike in the first 21 days or so of life. Maternal antibody slowly fades, some persisting longer than others. A common misconception is that it can be “boosted” by a dose of an appropriate vaccine to the lamb. This is not the case as the gammaglobulins have been donated by the ewe to the lamb, since the lamb has not been stimulated to produce these gammaglobulins they cannot be boosted.

In many species circulating maternal antibody seriously interferes with response to vaccines. In sheep there appears to be much less interference, certainly with the vaccines likely to be administered early in life. Generally administration of vaccine can safely be delayed until the level of maternal antibody has waned.

## **Types of Vaccines**

Live attenuated vaccines are prepared by growing the target organism in artificial media in the laboratory. The organism is serially passaged many times through the chosen media until it has lost its virulence, but retains its ability to provoke an immune response.

Protozoal vaccines are derived from a strain of the organism which naturally fails to complete its life cycle. This renders it non pathogenic to the target species yet provokes a very strong immune response.

Inactivated vaccines are those in which either the organism itself is inactivated as are any toxins produced by the organism. In fact many bacterial vaccines produce an imperfect response unless the toxin, known as a toxoid on inactivation, is also present. In certain vaccines the toxoid alone is utilized to stimulate the immune system, particularly when the

bacteria are always present in small numbers in the sheep. Inactivation is still in many cases achieved by the use of formalin.

Both live attenuated and inactivated vaccines have advantages and disadvantages. Generally live attenuated require only a single dose and the response tends to be greater in that the memory B cells are produced in greater numbers. The vaccines are more fragile and require very careful handling and reconstitution. There is the theoretical possibility that they could return to virulence, although this has not been recorded in any sheep vaccines.

Inactivated vaccines generally provoke a less intense response, hence a primary course of two doses are usually required but not always. The first dose acts as a sensitising dose and the second as the confirming dose. Disadvantages are that full immunity is not achieved until fourteen days after the second dose has been administered. Again in theory incomplete inactivation could lead to frank disease in vaccinated sheep. This has not been recorded in sheep vaccinated with licensed products in the UK.

Under modern licensing arrangements for vaccines in the UK and the European Union safety data is very carefully scrutinised to ensure that no harm can befall sheep which have received a vaccine.

Safety of the consumer is paramount and several vaccines have a specified withdrawal time which must be observed.

## **Limitations and Expectations**

Every sheep is an individual and as such each responds in a slightly different way to any vaccine. Some are good responders and others are poor. Studies have shown that within an identically fed and aged flock the response to vaccines varies greatly. This is a reflection of the innate individual variability to respond to invasion by pathogenic organisms. Left to nature, the poor responders would suffer greater disease losses and hence over a period of time natural selection would favour those with the better response to invading pathogens.

Overwhelming infection can break through the strongest immunity, whether natural or vaccine induced. In some cases concurrent disease can influence the ability of the antibodies to successfully neutralise an incoming pathogen.

Protection of the young lamb by maternally derived antibody (MDA) is dependent upon the quality and quantity of the colostrum. Clearly lambs from live multiple births will receive less colostrum than singletons. The third small triplet may in fact be denied adequate intake by two strong siblings. Quantity and quality is dependent upon adequate nutrition, and hence trace elements may play a significant part. It is well documented that sheep on diets inadequate in selenium and iodine respond poorly to vaccination. Some breeds are better at mothering lambs than others.

However the greatest failures are caused by incorrect vaccine programmes being used and the incorrect administration of vaccine. Vaccination into the wool instead of under the skin or into the muscle obviously provokes no immune response!!

## **Methods of Administration**

Vaccines used in sheep in the UK are administered individually by injection either subcutaneously (sc) or intramuscularly (im), with one being administered by the intra-dermal (id) route. The main sites for injection are either on the side of the neck about 10cm (four inches) below the ear for sc administration or immediately in front of the shoulder for im administration.

- 1) For sc injection the skin at the point of injection should be raised and the vaccine applied using a short needle (0.9mm x 15mm). Care must be taken to deposit the vaccine under the skin and not into the wool. Vaccination into wool provokes no immune response!
- 2) For im injection the triangle in front of the shoulder is the ideal site. The point of injection should be the centre of the triangle. The preferred size of needle for im injection is 0.9mm x 25mm.
- 3) For intra-dermal see under the orf heading.
- 4) In most cases automatic multiple “guns” will be used. It is essential that these are carefully set to the correct dose before vaccinating starts.
- 5) When instructed, always shake the vaccine well to evenly distribute the contents. This is particularly important with inactivated bacterial vaccines.
- 6) Never vaccinate wet sheep.

## **Handling and Administration**

Storage and administration data for all licensed vaccines is contained in the Marketing Authorisation (MA) or the Summary of Product Characteristics (SPCs). This should be re-read when new batches are purchased as recommendations may change. The most important information on the SPC formerly known as the data sheet may be summarised:-

### **a) Storage**

All vaccines should be kept in a locked store away from the reach and sight of children, and refrigerated at +2°C to +8°C. Freezing of sheep vaccines renders them unfit for use. If accidentally frozen the re-suspended contents take on a floccular appearance.

They should not be left exposed to sunlight or variable temperatures. Some products are particularly viscous when cold and can or should be gently warmed (eg in a pocket) prior to administration to ease passage through the syringe and needle.

### **b) Syringes**



Where automatic syringes are used these must be washed and dried after use. On no account should water, alcohol or disinfectant be left in the syringe as this may have the effect of deactivating the vaccine. This is particularly important when live vaccines are to be used.

c) **Needles**

Always use a needle appropriate to the route of injection and size of the animal whether it be lambs or adults. Needles must be sterile and sharp. Needles should be changed regularly usually after 15 to 20 doses have been administered. If using a single dose syringe it should on no account be re-inserted into the bottle. Instead a sterile needle should be inserted and left in the bottle and each dose withdrawn through it, re-attaching the needle used to inject the sheep each time.

d) **Hygiene & Health**

Only vaccinate healthy animals – vaccination of a sick sheep not only risks a failure of the vaccine but increases the risk of adverse effects (especially with live vaccines). In general avoid vaccinating ewes in the 14 days before lambing when their ability to respond to vaccination may be compromised by the hormonal and other changes occurring at that time as well as the excess stress perhaps initiating abortion or a metabolic disorder.

As a general rule concurrent prophylactic treatments do not interfere with vaccination. The exception is in pregnant ewes. These should never be subjected to multiple pharmacy in the last six weeks of pregnancy. In specific situations, the concurrent use of antimicrobials at the time of vaccination and for several days either side must be avoided. Other treatments such as with anthelmintics usually do not interfere with vaccination but always seek advice from a veterinary surgeon first before using any concurrent treatments.

e) **Multiple Vaccinations**

Most vaccine licences state that a vaccine should not be administered simultaneously with another. This is principally the result of a lack of detailed information rather than a known adverse interaction. There are certain circumstances when two different vaccines may be administered concurrently. When this is permitted two different vaccination sites must be chosen preferably on the opposite sides of the neck. However different vaccines must never be mixed in the same syringe and the two vaccination sites must be distant from each other.

f) **Dose Rates**

The dose rates stated on SPCs are carefully calculated and fully evaluated in trials before a licence is issued. It is vital to adhere to the recommended dose rate. Using more than the recommended dose will not improve the immune reaction, but may risk

adverse reactions and be economically wasteful. A failure to give an adequate dose will undermine the immune reaction and lead to vaccine failure. Likewise, where the recommendations requires a primary course of two doses of vaccine, a failure to respect the necessary interval (typically between two and six weeks between doses but specific to each vaccine) or a failure to give the second dose at all will lead to vaccine failure.

g) **Part Used Bottles**

All sheep vaccines are supplied in multiple dose bottles with the instructions that any unused vaccine should be discarded once the bottle is broached. This is for a number of reasons:

- a. Risk of the bottle having become contaminated with bacteria or other micro-organisms.
- b. Increased air in the bottle increasing the risk of oxidation damage to the antigen or carrier.
- c. Temperature fluctuation between storage and use increasing product decay.
- d. With live vaccines, there is relatively rapid death of the organism once reconstituted

Partial or completely empty bottles constitute pharmaceutical waste and must be disposed of along with needles and syringes (which constitute clinical waste) in an approved manner. Return of bottles to the supplier in a dedicated “sharps” container is often the best method of disposal. On no account should bottles, needles and syringes be disposed of with ordinary domestic or trade waste or on farm bonfires.

h) **Timing of Vaccination**

Vaccination should be carried out well before field challenge is expected. In the case of disease challenge to very young lambs, adequate colostral antibodies will only be available if the ewe has been correctly vaccinated and boosted at the optimum time. Be sure to observe SPC recommendations regarding the use of vaccine at certain times in the animal’s life (for example ‘do not use in pregnant ewes’).

i) **Safety**

Accidental self-injection can have serious implications for the operator, particularly in the case of oil-based vaccines. Where such accidents occur, urgent medical attention should be sought (preferably A&E attention) and the SPC for the relevant product should accompany the patient.

j) **Adverse Reactions**

In general, licensed products are safe to use in the target animals but occasionally transitory depression and pyrexia can occur especially with live injectable and multicomponent vaccines.

Other adverse effects sometimes seen include injection site reactions. These are usually transitory. A particular adverse reaction in sheep is the use of a footrot vaccine and moxidectin injectable. The mechanism is not clear, but well documented reports have included a 10% abortion rate in pregnant ewes. Adverse effects in excess of those warned on the SPC should be reported to the Veterinary Medicines Directorate under the adverse reaction-reporting scheme using the “Yellow form” ML252A and to the licence holder. (Details and documents are available at <http://www.vmd.gov.uk/>).

## **Withdrawal Periods**

The current range of vaccines authorised for use in sheep in the UK do have varying meat and milk withdrawal times. It is important that the SPC is studied to determine which vaccines have withdrawal periods.

## **Recording**

In common with all pharmaceutical products used in meat producing animals, there is a statutory requirement to record all vaccines coming onto the farm – including batch numbers – and to record all usage. Where the vaccines are applied on a routine predetermined programme, a record of that programme may suffice rather than individually recording the use in each animal is acceptable (eg “all ewes injected with a clostridial vaccine (*dose and product*) five weeks before due lambing date). However it is necessary to record the dates of use for each batch of vaccine including the batch number to enable tracing in the event of adverse reactions including failure to protect.

## Vaccine Failure

There are many reasons why vaccines may appear to fail in protecting sheep against some diseases.

The commonest are in descending order:-

- 1) Incorrect primary dose
- 2) Failure to boost at the correct interval.
- 3) Incorrect route of administration
- 4) The placing of the vaccine into the fleece rather than sc or im.
- 5) Failure to complete a vaccination programme before field challenge occurs.
- 6) Inappropriate timing of vaccine and vaccinating at the wrong age.
- 7) Contamination of syringes and multidose “guns” with disinfectants particularly when using live attenuated vaccines.
- 8) Improper storage or freezing of vaccine.
- 9) Use of the wrong vaccine, for example *Mannheimia* spp. pneumonia vaccines do not protect against pneumonic infections caused by *Pasteurella multocida*.
- 10) Unfit, heavily stressed and sheep suffering severe selenium deficiency respond poorly to vaccines.
- 11) Multipharmacy can cause vaccine failure if its effect is to induce a metabolic disturbance.
- 12) Breed differences may be significant as is individual variation with a small number of poor responders

## Supply of Vaccines

All licensed vaccines in the UK fall into one of two legal categories:-

- 1) POM-V – only obtainable under veterinary prescription including directly from the attending veterinary surgeon (eg all abortion vaccines)
- 2) POM-VPS – obtainable from the veterinary surgeon, pharmacist, or Suitably Qualified Person (ie the former pharmacy and merchant list (PML) category). This list for example contains all the combined *Mannheimia* spp./*Pasteurella* spp. and all but one of the clostridial vaccines.

## Major Sheep Diseases Controlled by Vaccination

- 1) Clostridial Diseases.
- 2) *Mannheimia* spp. and *Pasteurella* spp. pneumonia and septicaemia.
- 3) Sheep Abortion both Enzootic and Toxoplasma.
- 4) Footrot.
- 5) Orf (Contagious pustular dermatitis).

## 1) Clostridial Diseases

There are ten recognized clostridial diseases affecting sheep in the UK. These can be conveniently divided into three groups of disease. The *enterotoxaemias*, the *myonecrosis* and *toxaemias* and the *neurotropic* disorders.

Clostridia are ubiquitous wherever sheep are kept. Some conditions are more local than others, some are associated with distinct age groups and some require specific trigger factors. All but one of the diseases is caused by the sudden multiplication of the bacterium producing highly lethal toxins. The exception is *C. chauvoei* which is both a toxin producer but also has an invasive element. The production of the toxins usually means that death intervenes rapidly once illness is detected. In effect, sheep suffering from clostridial disease invariably die. Losses can be catastrophic with, in the case of lamb dysentery, up to a third of the lamb crop dying.

The *enterotoxaemias* are produced by four members of the *C. perfringens* group types- A,B,C and D, *C. novyi* type B, *C. haemolyticum* (formerly *C. novyi* type D), *C. sordelli* and *C. septicum*.

The *C. perfringens* group multiply rapidly in the intestine to produce a variety of toxins resulting in several distinct conditions. *C. perfringens* type A is not common but occurs in both young lambs and older lambs. *C. perfringens* type B causes lamb dysentery killing lambs in the first three weeks of life. *C. perfringens* type C causes straggling in older sheep particularly on the Romney Marsh and in Yorkshire but is not common. *C. perfringens* type D causes pulpy kidney and is the most common of all the enterotoxaemias and probably of all the clostridial diseases. It affects all ages of sheep from one week old lambs to aged adults.

*C. novyi* type B causes black disease which is associated with the presence of liver fluke. It too can cause catastrophic losses in bad fluke years.

*C. haemolyticum* causes sporadic losses in adult sheep and is commoner in the wetter areas of Britain.

*C. sordelli* has only recently been recognised as a major cause of loss in sheep of all ages. In young lambs it is associated with heavy creep feeding, in grazing lambs sudden dietary changes precipitate an abomasitis. It is also seen in ewes before or after lambing as sudden death and is regularly mistaken as either a calcium or magnesium deficiency.

*C. septicum* causes braxy in either lambs or shearlings in the autumn when they ingest frozen forage.

The *myonecrosis and toxaemia* group include some of the clostridia which are responsible for the enterotoxaemias, but with a different portal of entry, disease expression is very different.

Malignant oedema occurs when the skin and underlying tissues have been invaded by *C. septicum*, *C. sordellii* and *C. novyi* type B. *C. chauvoei* falls into this group, but unlike the other clostridia it is both invasive and a potent toxin producer. It causes blackleg, post-parturient gangrene and an invasive cardiac myonecrosis. It also responsible for cases of malignant oedema.

The *neurotropic disorders* arise from the effect of toxins from *C. tetani* producing the classic tetanus syndrome. In addition certain strains of *C. perfringens* type D produce a focal symmetrical encephalomalacia.

### **The Clostridial Vaccines**

There are six clostridial vaccines available, essentially similar except for the number of components and thus the degree of immune cover they provide. Two are essentially cattle vaccines which only protect against blackleg and are very unlikely to be used in sheep.

The remaining four protect against 4, 7, 8 or 10 clostridial components.

The 4 component vaccine protects against *C. perfringens* types B, C & D as well as *C. tetani*.

The 7 component vaccine protects against *C. perfringens* types B, C and D. *C. tetani*, *C. septicum*, *C. chauvoei* and *C. novyi* type B.

The 8 component vaccine contains all those found in the seven with the addition of *C. haemolyticum*

The 10 component vaccine contains all those found in the eight with the addition of *C. perfringens* type A and *C. sordellii*.

In addition both a 4 and a 7 component vaccine are available which are combined with *Mannheimia* spp. and *Pasteurella* spp. components. This vaccine will be discussed later.

The principles behind clostridial vaccines are similar. Protection is afforded to young lambs from ingested colostrum high in antibodies. Protection is afforded to adult and older lambs by direct vaccination.

The choice of which vaccine to use in any particular situation depends upon the risk factors identified as well as past history of disease losses.

The 4 component vaccine is used to confer protection on lambs either by way of the ewe's colostrum or to protect lambs born to unvaccinated ewes which are likely to reach market weight by five months. If used in ewes, the ewe herself is still only protected against struck, one of the rarest causes of death, but not against any of the other clostridial diseases which affect adults.

The 7, 8 and 10 component vaccines are used to protect lambs by way of the colostrum as well as affording protection to the ewe herself. The choice of which vaccine to use again depends upon disease history and to a certain extent on management practices. If for

example lambs are heavily creep fed than they are potentially susceptible to *C. sordellii* abomasitis. Thus it would be prudent to use the 10 component vaccine.

All clostridial vaccines apart from the 10 component require a 2ml dose, the 10 component one only requires a 1ml dose. There are no meat or milk withdrawal times with clostridial vaccines. Always remember to shake the bottles well to evenly suspend the contents.

The clostridial vaccines are inactivated and as such require two doses spaced four to six weeks apart to provide an adequate response. Maximum immunity is achieved 14 days after the second dose. This primary course requires an annual booster to maintain the immune status.

In the case of ewes this annual booster should be given as detailed on the SPC because the recommendations vary from vaccine to vaccine. Generally the timing suggested is eight to two weeks before the onset of lambing. In cases of a prolonged lambing period it may be advisable to boost the earlier lambing ewes and then boost the later lambing ewes nearer their expected lambing date. Boosting the ewe at this time results in a high level of antibodies in her colostrum, as long as she is in good bodily condition and well fed.

The greatest failure in the sheep industry is to omit to vaccinate sheep between their initial primary course and their first pre-lambing dose, if they are bred as shearlings or thieves (first mated at 18 months of age). Therefore it is vital that shearlings or thieves intended for breeding receive a booster dose in the summer before they go to the ram.

Clostridial vaccines are essentially toxoids and protect against the lethal toxins produced during the rapid multiplication of the offending bacteria. Four clostridial diseases can affect lambs in the first months of their lives. It would be impossible to vaccinate against these diseases as antibodies do not develop quickly enough. The ewe has the remarkable ability to concentrate antibodies in her colostrum. Thus lambs, which successfully ingest sufficient colostrum in the first 18 hours of life, are protected against these fatal conditions. The best known of which is lamb dysentery, others include tetanus, pulpy kidney and abomasitis. This passive immunity slowly wanes at different rates for different components but for the four listed above there is evidence that this passive immunity lasts for at least twelve weeks.

The clostridial vaccines are highly effective. If used correctly, losses to clostridial disease can easily be eliminated.

## **2) *Mannheimia* spp. and *Pasteurella* spp. Diseases**

The *Pasteurella* spp. group of disease were until recently classified as being caused by either *Pasteurella haemolytica* or *P. trehalosi*. The *P. haemolytica* serotypes have been reclassified as *Mannheimia haemolytica* whilst all the *P. trehalosi* have retained their classification. Further reclassification is imminent for some of the individual *M. haemolytica* serotypes. Originally there were 12 *P. haemolytica* A types and four *P. haemolytica* T types. Despite the re-classification the current vaccine contains 8 of the most economically important serotypes taken from these 16 including both A types and T types.

*Mannheimia haemolytica* is found in 97% of all sheep tonsils. A suitable stressing factor or concurrent infection with either ovine PI3 virus or with *Mycoplasma ovipneumoniae* results in rapid multiplication with bacteria spilling down both oesophagus and trachea to initiate a pneumonia and septicaemia. Sheep of all ages can be infected from a few days of age to adult. *Pasteurella trehalosi* is also found in the pharyngeal area, particularly in weaned lambs, similarly stress or other factors induce a sudden multiplication resulting in a septicaemia and pneumonia with a marked pleurisy. Unlike *M. haemolytica*, *P. trehalosi* is also a toxin producer. This makes treatment of cases far less rewarding.

Unlike the clostridial diseases certain farms are far more likely to have encountered outbreaks of disease than others. In fact many farms have never experienced an outbreak. The vaccines provide a good degree of protection, where risk-analysis dictates vaccination, against disease but not as absolute as with the clostridial vaccines. In particular concurrent infection with *M. ovipneumoniae* can seriously compromise the immune response.

### ***Mannheimia* spp. and *Pasteurella* spp Vaccines**

The *Pasteurella* spp. vaccines have been improved by the addition of iron-regulated proteins (IRPs). It was demonstrated that certain antigens were present in sera of recovered animals which were absent from laboratory grown cultures. *Mannheimia* spp. and *Pasteurella* spp. have an absolute requirement for iron to survive, this is not freely available *in vivo* in the animal. Thus the use of IRPs removes any available free iron by binding with it and so the bacteria are unable to maintain their metabolism and perish. This produces enhanced cross protection against the individual serotypes not included in the vaccine. There is a limit to the number of different serotypes that can be successfully incorporated into a vaccine as well as the ability of the immune system to raise a successful response to a whole host of slightly differing serotypes.

The inactivated *Pasteurella* spp. vaccine contains eight of the most epidemiologically important serotypes, these include several of those of *Mannheimia* as well as some of those of *P. trehalosi* serotypes.

The vaccine can be used in sheep of all ages from three weeks to adult. A primary course of two doses of 2ml given sc four to six weeks apart is required with full immunity only developing 14 days after the second dose.

Annual boosters of 2ml are required. Under some circumstances when the challenge is very heavy or previous experience indicates a particular risk periods a booster dose may be given two to three weeks before that period is expected.

Maternal transfer to the young lamb is less efficient than with the clostridial diseases and the period of passive protection lasts for about three weeks.

As with the clostridial vaccines there is no meat or milk withdrawal period.



### **Combined Clostridial and *Mannheimia* spp. and *Pasteurella* spp. Vaccines**

There are two combined clostridial /*Mannheimia* spp./*Pasteurella* spp. vaccines available. These are a combination of the 7 component clostridial vaccine and the *Mannheimia* spp./*Pasteurella* spp. vaccine described above. This vaccine is designed for use in breeding animals.

The second is a 4 component clostridial vaccine containing *C. perfringens* type D, *C. septicum*, *C. tetani* and *C. chauvoei* combined with the *Mannheimia* spp./*Pasteurella* spp. vaccine described above. This vaccine is designed for use in finishing and store lambs.

### **Choosing the right vaccine combination**

In the vast majority of cases the already combined 7 component clostridial and *Mannheimia* spp./*Pasteurella* spp. vaccine fulfils the risk assessment for the flock. In other cases protection may be required against, bacillary redwater due to

*C. haemolyticum*, enterotoxaemia due to *C. perfringens* type A or against diseases caused by *C. sordellii*. Under these circumstances your veterinary surgeon must be consulted as to whether it is possible to use the appropriate 8 or 10 component clostridial vaccine with the *Mannheimia* spp./*Pasteurella* spp. vaccine. That consultation must include the question as to whether the two products can be used concurrently. In practice, if this is approved by the veterinary surgeon, it means vaccinating with one of the products on one side of the neck and the other on the opposite side. On no account should the products be mixed together.

Attention must always be paid to SPC recommendations. In the case of the clostridial and *Mannheimia* spp./*Pasteurella* spp. vaccines there is no meat or milk withdrawal period.

### **3) Sheep Abortion**

There are a variety of reasons why sheep abort. The two commonest are enzootic abortion caused by *Chlamydomphila abortus* and that due to *Toxoplasma gondii*.

#### **Enzootic Abortion**

Enzootic abortion still remains the single most common cause of abortion. The infection occurs at lambing time with naïve ewes and lambs acquiring infection from the products of conception from aborted ewes. In some cases these may be carried a considerable distance by foxes and crows. Under most circumstances abortion will not occur until the following year's lambing. These latently infected sheep are undetectable by serological or other means. It is considered that the ram plays no part in the dissemination of *C. abortus*. However of major concern is *C. abortus* role as a major zoonotic agent causing influenza-like symptoms and in pregnant women it can cause miscarriage and at worst death.

Sheep that have aborted will in future years carry lambs to full term with apparently normal births, although frequently the products of conception from these ewes are infected with *C. abortus* thus acting as a source of infection for any naïve ewes or lambs.

## **Toxoplasma Abortion**

Unlike enzootic abortion, the infectious agent is not passed from sheep to sheep but is acquired from the environment. In fact sheep are the accidental host. Toxoplasma is a coccidian inhabiting the intestine of the cat and is acquired from rats and mice. Young cats excrete about a million oocysts per gram of faeces over a period of about 10 days when first infected. Re-excretion can occur if the cat becomes debilitated or suffers an *Eimeria felis* infection. The oocysts can survive in the environment for periods of up to a year under favourable conditions. The infective dose for a sheep is two thousand oocysts. The effect of infection depends upon the stage of pregnancy at the time of ingestion of the oocysts. If infected in the first 70 days of pregnancy the foetus dies, is reabsorbed and the ewe is barren. If infection occurs between day 70 and 120 the foetus again dies but is presented as a “mummy” at full term. Infection later results in true abortion or the birth of small weakly lambs which usually die at about three days despite intensive care.

## **Enzootic Abortion Vaccines**

There are three vaccines available to control and prevent enzootic abortion. Two are live attenuated whilst the other is an inactivated vaccine. They vary considerably in their usage so much so that each will be dealt with as a different entity.

### **The live attenuated vaccines**

Whilst two manufacturers market a live attenuated vaccine their properties are virtually identical. The vaccines are presented as a freeze dried preparation requiring reconstitution with the supplied diluent. It is important that the reconstituted product is used within two hours, after which potency rapidly decreases. Care is needed in this process and pregnant women should not handle these vaccines. The route of administration is either sc or im, in each case a single 2ml dose should be given. Vaccination must be given at least 4 weeks before mating. Antibiotics, in particular tetracyclines, must not be given within 14 days either side of vaccination. These vaccines must not be used in pregnant ewes or ewe lambs.

Challenge studies have demonstrated that protection against *C. abortus* is undiminished for at least three pregnancies after vaccination. In endemically infected flocks natural boosting with field *C. abortus* should maintain protection for a further year. Concurrent use with the Toxoplasma vaccine is permitted with one of these vaccines but vaccination must be at different sites. No other vaccine should be administered within 14 days of vaccination.

Unlike most vaccines there is a seven day meat and milk withdrawal period.

### **The inactivated vaccine**

This is an emulsion of water-in-oil inactivated vaccine. Care must be taken by the operator not to accidentally self inject. If this should occur immediate medical help must be sought, with the SPC (data sheet) being taken to the hospital or medical surgery with the patient.

The primary dose is a single 1ml given im, the vaccine being administered either four weeks before the introduction of the rams or four weeks after their removal.

The effect of vaccination remains for 771 days (approximately two years) after which a booster dose is required. This consists of a single dose of 1ml. Water-in-oil vaccines are viscous on removal from the refrigerator and it is permissible to gently warm each vial before use. As with the live vaccines, concurrent vaccination with the toxoplasma vaccine is permitted only when vaccination is carried out before the introduction of the rams. (The use of the toxoplasma vaccine in pregnant ewes is contra-indicated). Again the vaccines must not be mixed when used together, and sites on the opposite side of the neck must be selected.

Studies have indicated that the use of this vaccine in ewes challenged before vaccination reduced the number of abortions. Thus it may be used as an aid in the control of an abortion outbreak due to *C. abortus*. Unlike the live attenuated vaccines, this vaccine has no meat or milk withdrawal period.

### **Toxoplasma Vaccine**

This is presented as a concentrated suspension of the S48 strain of *Toxoplasma gondii* which is diluted immediately before use. The reconstitution process must be followed exactly as described on the SPC in order to minimize any risk to the operator as living tachyzoites can cause disease in man. Pregnant women and those of child bearing age should not reconstitute or use this vaccine.

This is a fragile vaccine since living tachyzoites succumb to heat. It is advised that each vial is reconstituted as and when it is required. The whole day's requirement should not be reconstituted at once. There is rapid deterioration in efficacy two hours after dilution. The deterioration is faster in the presence of direct sunlight and high temperatures.

The dose is 2ml given im preferably within four months of mating but no later than three weeks before the introduction of the rams. This single primary dose affords protection for at least two lambing seasons. Since toxoplasmosis is an environmentally acquired condition, under most circumstances sheep will acquire a natural booster challenges. The vaccine may be administered concurrently with one of the live and the inactivated enzootic abortion vaccines as long as the precautions outlined under those vaccines are fulfilled.

As with the live attenuated enzootic vaccine there is a meat and milk withdrawal period, in this case of six weeks.

### **4) Footrot**

This is an infectious disease of sheep caused by the anaerobic bacterium *Dichelobacter nodosus*. The infection starts with excoriation of the skin in the interdigital space, thus allowing *D. nodosus* to colonise the skin-horn junction. *D. nodosus* rapidly destroys the horn tissue causing under running with further secondary bacterial involvement. The bacterium survives no longer than 10 days on pasture but for many weeks in the tiny cracks

and crannies in the horn of chronically infected sheep. Unlike many diseases the sheep does not mount an antibody response to infection with *D. nodosus*. Transmission of disease takes place in moist warm conditions. During dry weather transmission is minimal.

*D. nodosus* can be divided into several serogroups and immunity is solidly serogroup specific. In all, 10 serogroups are recognised A-I and M. In the UK there have been no reports of the presence of serogroups I and M. The B serogroup is complex and the most common with many strains showing minor serological differences. The virulence of disease depends upon the serogroup present, although studies at Moredun have shown that up to three serogroups can be present on a single foot simultaneously.

The available vaccine contains antigens to all eight serogroups present in the UK with, in addition, two further B strains resulting in a 10 strain vaccine. Vaccination programmes must be tailored to individual flocks. It is as well to remember that sheep do not naturally produce antibodies to *D. nodosus*. Thus the vaccine can be used, both as a curative as well as a prophylactic agent. Vaccination will not eliminate footrot from a flock on its own but when used in conjunction with other management tools, footrot incidence can be drastically reduced. During periods of non transmission, a footrot elimination programme can be attempted and footrot vaccine plays a crucial role in the success of such programmes.

The vaccine can be used like a conventional vaccine with a primary course of two doses administered four to six weeks apart, then with an annual booster dose. However strategic use before the onset of a transmission period may be more effective and economical. A single dose of vaccine provides high levels of antibodies for four to five months. This period will frequently cover the danger period.

The dose is 1ml given sc, as this is an oil adjuvanted vaccine, care must be taken during administration. If accidental self-injection occurs immediate medical advice must be sought, with the SPC (data sheet) being taken to the hospital or medical surgery with the patient.

The vaccine is viscous at low temperatures and it is well to gently warm it before use to allow for easier, more accurate administration. The effect of the oil adjuvant may produce severe local post vaccinal reactions. It is recommended that sheep are not vaccinated within six months of show or sale. In addition in some cases local pigmentation of the wool may occur. This must be considered before starting a vaccination programme in show sheep.

*Contra-indication.* Sheep must not be vaccinated with footrot vaccine if they have been treated with a moxidectin 1% injection (a macrocyclic lactone). Equally footrot vaccinated sheep must not be treated with moxidectin injectable 1%.

There is no meat or milk withdrawal period for the footrot vaccine.

## **5) Orf (Contagious Pustular Dermatitis)**

Orf is caused by a parapox virus. Lesions develop after the virus has been introduced through micro-abrasions. The commonest site is around the mouth and in severe cases it can

involve the hard palate and gums. In adult ewes, lesions can occur on the teats frequently leading to a secondary mastitis. In many parts of the country orf is referred to as thistle disease, as close grazing is ideal to produce the micro-abrasions. Frequently secondary infection particularly with staphylococci exacerbates the condition. Generally orf infection is self-limiting with self-cure occurring within 28 days or so. The virus survives for long periods under dry conditions but only for a period of six weeks under wet damp conditions. It therefore frequently survives from year to year in sheep houses with subsequent infection in young lambs.

Due to the nature of parapox infection and the multitude of different field strains, the orf vaccine does not produce complete elimination of disease, but it is stated to be an aid to the prevention and reduction in severity of infection.

The orf vaccine contains living mild field strains of orf virus. Recent advances have markedly improved both vaccine and applicator. The vaccine is applied intra-dermally (id), by a scarifier, to the skin. The SPC must be consulted on preparation of the applicator as well as ensuring the best technique to achieve a good “take.”

The site of vaccination is important. In ewes the preferred site is the axilla, in young lambs, again the axilla is the best site. In older growing lambs the inner aspect of the thigh is the best site. The choice of site in the ewe is to prevent possible vaccine contamination of the teats. In young lambs if vaccinated in the inner thigh they can nibble at the developing vesicles and infect their mouths. In growing lambs neither of these restrictions apply and it is easier to vaccinate in the thigh. Unlike other vaccines there is no colostral transfer of antibodies to lambs from the ewe.

Orf vaccine is used in ewes to reduce teat infection, in young lambs to prevent and reduce neonatal mouth lesions. In older lambs it is used, either in the face of an outbreak to reduce the severity of the outbreak or it is used before challenge to prevent and reduce the effect of infection.

Precautions when using this vaccine are numerous the most important being that it should never be used in flocks free of orf. It should never be used in ewes less than seven weeks before lambing, thus preventing the shedding of contaminating scabs in the lambing pens. Unvaccinated and vaccinated sheep should not be mixed, shorn or dipped for 28 days after vaccination. Whilst it is always recommended that wet sheep are never vaccinated it is even more important that orf vaccine is never applied to wet sheep.

There is no meat or milk withdrawal period with the orf vaccine

Remember orf is a zoonosis and great care must be exercised in handling this vaccine. Should accidental self administration occur seek medical advise immediately, with the SPC (data sheet) being taken to the hospital or medical surgery with the patient.

## **Minor or Localised Conditions Controlled by Vaccination**

- 1) Erysipelas
- 2) Louping-ill

### 1) Erysipelas

Erysipelas is a recognised cause of infectious polyarthritis in sheep. It is most commonly seen as a post-dipping lameness. At other times young lambs develop an acute lameness from about two weeks of age. At this age it is virtually impossible to distinguish erysipelas arthritis from the far commoner problem caused by *Streptococcus dysgalactiae*. It is therefore important to obtain an accurate diagnosis as to the cause of the lameness. Post dipping-lameness occurs for a variety of reasons usually managerial, but on some properties where hygiene is exemplary it may still occur.

As with the clostridial vaccines, the ewe will concentrate antibody in her colostrum which if ingested by the lamb will provide enough protection during the early danger period. Sheep requiring protection against post-dipping lameness should have received either their second primary dose or annual booster at least three weeks before the expected date of challenge.

Erysipelas vaccine is an inactivated whole cell vaccine of *Erysipelothrix rhusiopathiae*. Primary vaccination consists of two doses of 2ml given sc separated by a three-week interval. Ensure that the bottle is well shaken to evenly suspend the contents.

### 2) Louping-ill

Louping-ill is an acute virus disease of the central nervous system. Infection is transmitted by ticks. Thus louping-ill is confined to tick infested areas. Within tick infested areas there are large tracts of land where ticks themselves are not infected with the virus. The disease slowly moves outward from infected areas. Infection with louping-ill virus itself will affect from 5 to 60% of the flock, clinical signs vary from sudden death to transient ataxia. However if infection occurs after infection with another tick-borne pathogen *Ehrlichia phagocytophila* then the reaction is far more severe and mortality will frequently reach a 100%. The disease occurs most frequently in lambs and yearlings in endemically infected flocks. Any naïve sheep introduced to a tick area for the first time is susceptible.

Vaccination of ewes will result in the transfer of antibodies in the colostrum, which provide between 8 and 12 weeks protection. Thus on endemically infected farms all ewe lambs retained for breeding should be vaccinated in the autumn or the following spring but well before the spring "tick rise." This primary dose protects for two years, thus a late autumn booster in their first pregnancy will further protect them as well as inducing high levels of antibody in the colostrum. All purchased sheep should be vaccinated at least 28 days before exposure to tick-infested pasture.

The louping-ill vaccine is an oil emulsion preparation. It is viscous when cold and should be gently warmed before use to facilitate easier administration. The dose is 1ml given sc. In the case of accidental self injection medical advice must be sought immediately, with the SPC (data sheet) being taken to the hospital or medical surgery with the patient.

## **Diseases for which a Special Import Certificate (SIC) or Special Treatment Certificate (STC) may be obtained**

- 1) Ovine Johne's Disease (OJD)
- 2) Caseous lymphadenitis

### **1) Ovine Johne's Disease (OJD)**

The incidence of OJD in the UK is not fully known but does appear to be increasing. In infected flocks losses can be considerable and economically damaging. The disease, caused by *Mycobacterium avium* subspecies *paratuberculosis*, (*Map*), presents as a group of ewes losing weight, with no other reason for this weight loss. Diagnosis is difficult in the living sheep but serology examination can be useful. In the UK the disease appears to affect ewes from four years of age and upwards. If OJD is confirmed in a flock, vaccination is permitted. To initiate supply of vaccine a veterinary surgeon must apply to the Veterinary Medicines Directorate (VMD) for a Special Import Certificate (SIC). Information concerning SIC applications can be found on the VMD website.

[www.vmd.gov.uk](http://www.vmd.gov.uk)

The vaccine is a killed whole cell vaccine produced in Spain. The bacteria are inactivated by heat and adjuvanted with mineral oil in multiple emulsions. The vaccine is administered as a 1ml dose given either im or sc. In flocks with a high incidence of OJD whole flock vaccination is advocated. All replacements should be vaccinated between the first two to three weeks of life and six months. A single dose confers life long protection. As this is an oil adjuvanted vaccine it should be gently warmed before use and well shaken. As with all oil based vaccines if accidental self-injection occurs immediate medical aid must be sought, with the SPC (data sheet) being taken to the hospital or medical surgery with the patient.

The vaccine has no meat or milk withdrawal period.

### **2) Caseous Lymphadenitis**

This disease, caused by *Corynebacterium pseudotuberculosis*, is becoming more common in the UK having now spread from pedigree flocks to commercial ones. A characteristic of infection is the production of multiple abscesses. These may be superficial in the head and neck region or in deeper lymphatic glands such as the retropharyngeal, mediastinal and mesenteric. When internal glands are affected death often supervenes because of pressure on vital organs. Control has been attempted using autogenous vaccines with mixed success. If the autogenous vaccine fails then it is possible to apply to VMD to issue a Special Treatment Certificate (STC) to import a vaccine from New Zealand or Australia. Information concerning STC applications can be found on the VMD website. [www.vmd.gov.uk](http://www.vmd.gov.uk)

The caseous lymphadenitis fraction is combined with either three or six clostridial components. The principle of vaccination against caseous lymphadenitis is identical to that used to prevent clostridial disease.

The vaccine is administered as a 2ml dose with a primary course of two doses spaced four to six weeks apart followed by an annual booster. Attention to this detail has resulted in some Australian flocks reducing the flock incidence from over 15% to under 1% over a three year period.

As the vaccine is imported under a STC a 28 day meat and milk withdrawal period applies.

## Some Clostridial Vaccination Programmes

Unlike most other species the sheep industry is based on a pyramid structure. In general high hill flocks and upland flocks breed their own replacements and sell cross bred lambs to the lowlands. Not all lowland flocks necessarily buy in replacements some opting to maintain closed flocks. No single programme will fit every flock. Indeed any programme, designed for example expressly for hill flocks, will only fit a few, without individual circumstances being considered. Of all the species, vaccination programmes have to be tailored to the individual flock. To that end Flock Health Planning programmes drawn up in conjunction with the attending veterinary surgeon are essential for the best results in both preventing disease and being economically realistic.

Of the diseases against which every flock should be vaccinated are the clostridials. In all other cases vaccination programmes must be based on history of disease incidence and on a realistic risk assessment.

Hill flocks producing home bred replacements and selling crossbred breeding lambs and store wethers require a programme to prevent clostridial disease as follows:-

- 1) Ewe lambs retained for breeding. During the summer at convenient times when the flock is gathered from the hill, usually at marking and weaning each will receive a dose of clostridial vaccine, whether 7, 8 or 10 component depending upon a risk assessment. These will then receive their first booster dose the following summer at a convenient time, such as shearing or as they are joined to the main flock at weaning. They will receive their next dose as a pre-lambing dose. This will be repeated until they are culled. The combined clostridial 7 component *Mannheimia* spp. and *Pasteurella* spp. vaccines will frequently be used in these flocks.
- 2) Crossbred lambs for sale. They will receive exactly the same programme as the ewe lambs retained for breeding, but will of course be sold and the new owner will have to continue with the programme started by the vendor.
- 3) Wether lambs will be vaccinated at the same time as the other lambs but with the 4 component clostridial /*Mannheimia* spp./ *Pasteurella* spp. vaccine. These will be drafted to lowland pastures and sold as finished lambs before further vaccination is required.
- 4) Adult ewes, these will be vaccinated annually with a pre-lambing dose. The choice of vaccine will depend upon history and risk assessment but in many cases will be the combined 7 component clostridial/ *Mannheimia* spp./ *Pasteurella* spp. vaccine.



Lowland flocks producing all lambs for sale as prime lamb but buying in replacements annually require programmes to prevent clostridial diseases as follows:-

- 1) All lambs assuming that the ewe flock is already vaccinated. Those which will reach slaughter weight by 16 weeks, usually singles, require no vaccination
- 2) Those to be finished later require vaccination at 10 weeks and again at 14 to provide active immunity from 16 weeks of age. Choice of vaccination and whether to use a combined clostridial/ *Mannheimia* spp./ *Pasteurella* spp. vaccine must depend on history or risk assessment. Whichever is chosen it is essential that the primary course of two doses is completed before the acquired antibodies have waned.
- 3) Ewes require an annual booster as the pre-lambing dose timed to be given as set out in the SPC for the product of choice.
- 4) Bought in replacements. Despite what a vendor may claim it is wisest to assume that the purchased stock have not been vaccinated (even if they have, they may not have been protected against conditions and disease present on their new premises). On arrival they should begin a primary course of vaccination using the same vaccine as used in the ewe flock. This must comprise of two doses. If bred in the year of arrival they will receive their next dose as a pre-lambing dose and thereafter will need annual boosters at that time. If not bred the first year it is important that they are boosted the following summer as shearlings or thieves.

These are probably the two largest groups of flocks for which it is possible to generalise. All other vaccines available for the sheep industry need to be used on a risk assessment basis or after disease has struck. The one exception could be the toxoplasma vaccine. As this infection is acquired from the environment there is a good argument that all flocks should be routinely protected. Toxoplasma is more prevalent in upland flocks as feral cats are more likely to feed on mice and rats, the natural host for toxoplasma. Yet frequently lowland flocks report cases, in particular of poor weakly lambs which usually die after three days or so despite intensive care, due to a late toxoplasma infection in the ewe.

Whole flock vaccination can be costly. Once infected or infected when not pregnant ewes are solidly immune to toxoplasma infection and will not abort or produce weakly lambs again. Thus it can be seen that it is the younger ewes which are more at risk. It makes sense to spread the cost of establishing a fully vaccinated flock over several years. This is achieved by vaccinating the ewes about to lamb for the first time whether they are ewe lambs or shearlings in addition to those lambing for the second time. In subsequent years only those about to lamb for the first time require vaccination. Thus over a period of three to five years a fully protected flock is established.

## **Specific Vaccination Programmes**

These vaccination programmes are just examples to illustrate how various vaccines are integrated into the sheep year. They are only illustration and each flockmaster/shepherd must develop their own personalised programme based on the disease risks present on their farm. These programmes are best drawn up with their veterinary surgeon when producing the

annual flock health programme. It is essential that they are part of the written health plan in order that no vaccine doses are missed.

### *Example 1*

**Lowland flock, lambing starts March 21<sup>st</sup> and confined to two cycles (lambing over 34 days). Previously experienced abortions due to Enzootic and Toxoplasmosis, before changing policy to only buying in unbred shearlings in early September. Suffers a footrot problem in most Septembers / Octobers. Pasteurellosis an on-going problem with a few losses in ewes at lambing and in lambs finishing in September. All lambs sold finished or as stores by end of October.**

### **Suggested Vaccination programme.**

**August.** In last fortnight of the month the resident ewe flock and ram stud require a single dose of Footrot vaccine.

**September.** Newly arrived shearlings and rams. 1st dose of the 7 component combined Clostridial and Pasteurella vaccine on arrival.

A fortnight later all shearlings to receive a dose of the Toxoplasma vaccine administered concurrently with the Enzootic vaccine licensed for concurrent use with the Toxoplasma vaccine.

**October.** Administer a second dose of the 7 component combined Clostridial and Pasteurella vaccine to the purchased shearlings and rams timed 6 weeks after the 1<sup>st</sup> dose given in early September.

**February.** All pregnant ewes and shearlings to be vaccinated with the combined Clostridial and Pasteurella vaccine on the 7<sup>th</sup> February or as close as possible, certainly no later than 17<sup>th</sup> February (6 weeks pre-lambing)

**June.** Mid June (average age of lambs 10 weeks). Vaccinate all lambs, except large singles or very well grown twins which can confidently be marketed before 15 weeks of age, with the 4 component combined Clostridial and Pasteurella vaccine.

When the flock is shorn. Administer an annual booster dose of the 7 component combined Clostridial and Pasteurella vaccine to all rams including those purchased in the previous August/September

**July.** Last week of July vaccinate all remaining lambs with their second dose of the 4 component combined Clostridial and Pasteurella vaccine

### **Warning.**

The injectable endectocide, moxidectin, must not be used in this flock as there is a contra-indication for its use in Footrot vaccinated sheep.

### *Example 2*

**Lowland flock never experienced a problem with pasteurellosis, but has recently lost ewes at lambing time with confirmed *Clostridium sordellii* infection. The lambing period extends from March 14th to early May, but raddles are used so ewes can be identified as to approximately when they will lamb. Orf is a major problem occurring in lambs in early June. No overt abortion has been seen but there are far too many weakly lambs born which die at 3 days or so. Serology was carried out post lambing and several high titres to Toxoplasma were demonstrated. Replacements are purchased in late August. Footrot is not seen as a problem in this flock.**

#### **Suggested vaccination programme.**

**September.** Newly arrived shearlings and rams. 1st dose of the 10 component Clostridial vaccine on arrival.

A fortnight later all shearlings and two shear ewes to receive a dose of the Toxoplasma vaccine. (Continue thereafter to only vaccinate newly purchased shearlings)

**October.** Administer a second dose of the 10 component Clostridial vaccine to the purchased shearlings and rams timed 6 weeks after the 1<sup>st</sup> dose given in early September.

**February.** All pregnant ewes marked to lamb by 10<sup>th</sup> April vaccinated (annual Booster) with the 10 component Clostridial vaccine between 7<sup>th</sup> and 21<sup>st</sup> of February. All ewes marked to lamb later, to be vaccinated with the same vaccine between 7<sup>th</sup> and 21<sup>st</sup> March.

**May.** All lambs to be vaccinated against Orf, at this age preferred site of vaccination is the inner aspect of the thigh.

**June.** 3<sup>rd</sup> and 4<sup>th</sup> week of June (average age of oldest lambs 11 to 12 weeks). Vaccinate all lambs, except large singles or very well grown twins which can confidently be marketed before 15 weeks of age, with the 10 component Clostridial vaccine (all ages of lambs are susceptible to *C. sordellii* infection)

When the flock is shorn. Administer an annual booster dose of the 10 component Clostridial vaccine to all rams including those purchased in the previous August/September.

**July.** Administer second dose of 10 component clostridial vaccine in last week to all remaining lambs.

**August.** If lambs not given their second dose in late July administer their second dose by mid month.

### *Example 3*

**Upland flock of hill sheep producing cross-bred lambs, and pure bred lambs (females as replacements) Lambing in-by in April, with ewes and pure bred lambs returned to the hill, ewes with crossbred lambs kept on low hill or in-by. Toxoplasma a problem several years ago and flock vaccinated. No louping-ill in the tick population. Pure-bred ewe lambs are wintered away on salt marshes and previously several have been lost with pasteurella pneumonia. Both pure-bred and crossing rams are purchased annually.**

**Suggested vaccination programme.**

**September.** All newly purchased rams to receive 1<sup>st</sup> dose of 7 component combined Clostridial and Pasteurella vaccine.

End of month all replacement shearlings to receive a dose of Toxoplasma vaccine

**October.** If shearling ewes not vaccinated against Toxoplasma in September they must be by end of first week of the month.

Purchased rams to receive their second dose of the 7 component combined Clostridial and Pasteurella vaccine 6 weeks after their first dose.

**February.** In the last week of the month all breeding ewes to receive their pre lambing booster dose of the combined 7 component Clostridial and Pasteurella vaccine.

**March.** All returning away-wintered shearlings receive their booster vaccination of a combined 7 component Clostridial and Pasteurella vaccine before being returned to the high hill for summering.

**June/ July.** When gathered for shearing all breeding lambs to receive a first dose of a combined 7 component Clostridial and Pasteurella vaccine. All wether lambs (both crossbred and pure bred) receive a first dose of a 4 component combined Clostridial and Pasteurella vaccine. All rams including those purchased in the previous autumn receive their annual booster dose of a combined 7 component Clostridial and Pasteurella vaccine.

**August.** At weaning all breeding lambs receive their second dose of a combined 7 component Clostridial and Pasteurella vaccine. All wether lambs receive their second dose of a combined 4 component Clostridial and Pasteurella vaccine.

***Example 4***

**A high hill flock with a lambing percentage of about 70%. All ewes are bred pure with the majority of females retained for breeding. Some rams are either retained or sold as stud rams in the autumn sales. Lambing starts in late April and continues into mid May. A few rams are purchased each year to introduce “new blood” and to try and improve the quality of the flock. There is restricted in-bye land used at lambing time and to provide either silage or hay. Ewe lambs are wintered away on a neighbours lowland farm, with minimal losses. The ticks on the hill are infected with louping-ill. Abortion does not seem to be problem.**

### **Suggested vaccination programme**

**October.** Any purchased rams must be immediately housed and receive a dose of Louping-ill vaccine. All resident rams not vaccinated the previous year require their bi-annual booster. 14 days later they receive a single dose of an 8 component Clostridial vaccine and can be released from the house.

**November.** 4 to 6 weeks after the first dose of the Clostridial vaccine they will require their second dose of the 8 component vaccine.

**February.** All ewes not vaccinated in the past year require a single dose of Louping-ill vaccine. This to be given at a convenient time in mid pregnancy and up to the last month. Timing may be a variable as it must coincide with a winter gather. Away-wintered shearlings can be vaccinated with the Louping-ill vaccine whilst away, so they can be immediately be returned to the hill.

**March.** All lambing ewes to receive their annual pre-lambing booster dose of the 8 component Clostridial vaccine. This is administered as the ewes are returned to the in-bye for lambing.

Away-wintered returning shearlings to receive a dose of Louping-ill vaccine immediately on arrival if not vaccinated in February when away at wintering.

**July.** At shearing all lambs to receive their first dose of the 8 component Clostridial vaccine. Optional to use the combined 7 Clostridial component and Pasteurella vaccine in any ram or ewe lambs for sale.

**August/ September.** At weaning all lambs to receive their second dose of the 8 component Clostridial vaccine. If ram and ewe lambs for sale were vaccinated with the combined 7 component Clostridial and Pasteurella vaccine they should receive their second dose at this time.

### **Further reading:-**

NOAH Compendium of Data Sheets for Animal Medicines, published by NOAH and online at <http://www.noahcompendium.co.uk>

The Responsible Use of Medicines in Agriculture Alliance (RUMA) was established in November 1997 to promote the highest standards of food safety, animal health and animal welfare in British livestock farming.

A unique initiative involving organisations representing every stage of the food chain, RUMA aims to promote a co-ordinated and integrated approach to best practice in the use of animal medicines.

RUMA membership spans the food chain and includes organisations representing interests in agriculture, veterinary practice, the pharmaceutical industry, farm assurance, training, retailers, consumers and animal welfare interests.

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**RUMA is made up of the following organisations:**

*Agricultural Industries Confederation (AIC)*

*Animal Health Distributors Association (AHDA)*

*Animal Medicines Training Regulatory Authority (AMTRA)*

*Assured Food Standards (AFS)*

*British Poultry Council (BPC)*

*British Retail Consortium (BRC)*

*British Veterinary Association (BVA)*

*Linking Environment and Farming (LEAF)*

*Meat and Livestock Commission (MLC)*

*National Beef Association (NBA)*

*National Consumer Council (NCC)*

*National Farmers Union (NFU)*

*National Office of Animal Health (NOAH)*

*National Pig Association (NPA)*

*National Proficiency Test Council (NPTC)*

*National Sheep Association (NSA)*

*The Royal Association of British Dairy Farmers (RABDF)*

*Royal Pharmaceutical Society of Great Britain (RPSGB)*

*Royal Society for the Prevention of Cruelty to Animals (RSPCA)*

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