

RESPONSIBLE USE OF MEDICINES IN AGRICULTURE ALLIANCE

ruma

GUIDELINES

Responsible use of vaccines and vaccination in pig production

A farm health planning initiative in partnership with DEFRA

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CONTENTS

	Page no.
1. Principles of vaccination	3
2. Maternally derived antibodies (MDA)	3
3. Targets of vaccination	4
4. Types of vaccines	5
5. Methods of administration	6
6. Vaccine handling and administration	6
7. Vaccine failure	9
8. Supply of vaccines	9
9. Specific disease vaccination regimes	10
9.1 Porcine parvovirus	10
9.2 Porcine reproductive and respiratory syndrome	10
9.3. <i>E.coli</i>	11
9.4. Clostridia	12
9.5 Erysipelas	13
9.6 <i>Mycoplasma hyopneumoniae</i>	14
9.7 <i>Lawsonia intracellularis</i>	15
9.8 Atrophic rhinitis	15
9.9 Glasser's Disease	16
9.10 Aujeszky's Disease	16
9.11 <i>Salmonella typhimurium</i>	17
10. Non disease vaccines	17
11. Importation of vaccines	18
12. Suggested vaccination regime for young growing pigs	20
13. Suggested vaccination regime for breeding pigs	21
14. Pet pigs	23

Principles of Vaccination

The aim of any vaccination policy in any species is to challenge the individual with a “controlled” dose of a potentially pathogenic organism (bacterium, virus, mycoplasma etc) in order to stimulate an immune reaction in the vaccinee that will prime the animal’s immune system to respond quickly and effectively to any future field challenge. Thus, vaccination is designed to prevent future disease – **it will not prevent future infection.**

The RUMA *Responsible use of vaccines and vaccination in farm animals* guideline contains detailed information on the functioning of the immune system. For practical purposes within these species specific guidelines the immune reaction of the pig following challenge with a foreign organism can be divided into three forms:-

- 1) Humoral response. Here, challenge stimulates circulatory lymphocytes (white blood cells) to produce antibodies (principally IgG and IgM) that can be measured in the blood stream. These antibodies may impart protection against the relevant organism should it penetrate the physical barriers of the body (skin, mucosal surfaces etc.). It is the humoral response that is measured by serological tests but in itself may not be protective. A humoral response will take two to three weeks to occur. The levels of circulatory IgG and IgM are typically mirrored in colostrum in the immediate post-partum period, colostral antibodies being derived directly from the blood stream (*cf* milk antibodies which are produced locally within the mammary tissue).
- 2) Mucosal response. The mucosal surfaces (ie the lining of the intestine, reproductive tract and mammary tissue) form a physical barrier to infection. In addition lymphocytes present just below the surface excrete antibodies (IgA), which work locally against foreign organisms that may attach to the surface. This bathing of the surface with antibodies is the primary method of protection against organisms which attach via the mucosal surface (e.g. *E. coli*, *Lawsonia intracellularis*). The levels of mucosal immunity are not directly measurable by a serological test. Production of IgA in response to mucosal challenge is often, but not necessarily, very rapid (a few days).
- 3) Cell mediated immunity. This is probably the most effectively destructive component of the immune response to infection challenge/vaccination and is particularly important in certain infections eg *Mycoplasma hyopneumoniae*. It generally takes weeks rather than days to reach a peak following challenge/vaccination and is not specifically or practically measurable by serological tests.

The aim of each specific vaccination programme is to stimulate the particular responses most appropriate to the disease-causing organism concerned. It is also necessary to be aware of the response expected, as this may influence the speed of protection following vaccination.

Maternally Derived Antibodies (MDA)

It is pertinent at this point to briefly mention the role of maternally derived protection (colostral immunity) and its effects on vaccination regimes. In the pig (unlike the

human) there is no direct transfer of circulating antibodies (IgM and IgG) across the placenta. Therefore the newborn piglet is totally vulnerable to challenge from any organisms.

To overcome this risk, the sow produces antibody-rich colostrum (the antibodies derived directly from her bloodstream), which can be absorbed intact by the piglet in the first 12-24 hours of life. Vaccination of the sow prior to farrowing will increase the colostrum antibody levels against the vaccinated organism(s) and boost piglet protection. In such situations the aim of vaccination is purely to directly induce antibody production by the sow; it is not used as a priming system that will allow the sow to respond to field challenge although this is likely to be an incidental result. Antibodies acquired by the piglet in this way will slowly degenerate with time but also will be “mopped up” by any challenge. The duration of protection gained will depend upon:-

- 1) The quantity of colostrum consumed
- 2) The age of the piglet when colostrum is consumed.
- 3) The concentration of antibodies in the colostrum
- 4) Any challenges met
- 5) The specific organisms against which the antibodies are active.

Whilst active challenge will use up maternally derived antibodies (MDA), this passively derived protection may also prevent the piglet from actively responding to challenge whether from field infection or from a vaccine. For example, porcine parvovirus (PPV) maternally derived antibodies are very persistent and can block a response to any vaccination given before six months of age. However, where the primary protective response required of vaccination is cell mediated, maternal antibodies have very limited blocking effect on vaccinal response (eg *Mycoplasma hypopneumoniae* vaccines). These considerations will thus influence the timing of vaccination.

Targets of vaccination

From the previous comments it can be appreciated that in pig there are several targets of vaccination:-

- 1) Protection of the actual individual to which the vaccine is administered (e.g. *Mycoplasma hypopneumoniae* and *Lawsonia intracellularis* vaccines).
- 2) Protection of the unborn litter by vaccination of the dam (e.g. PPV)
- 3) Protection of the newborn piglet by vaccination of the dam and acquisition of MDA (e.g. *E. coli*, *Clostridium perfringens*)
- 4) Combination of protection (e.g. vaccination of the sow to protect her and her future litter – via MDA – against erysipelas).

In modern pig production, vaccination regimes form part of a population disease control programme, whereby vaccination of the group – whilst not necessarily imparting total protection on the individual – has the effect of lowering the disease challenge to the whole thus minimising clinical signs of enzootic disease.

Types of Vaccines

Vaccines available in the UK for use in pigs can be categorised by both their clinical nature and/or their form. To give controlled doses of specific infectious agents, vaccines can be either live or dead.

Live vaccines contain living organisms originally derived from non pathogenic infections or from clinical disease outbreaks; the organisms will then be attenuated to render them harmless. They have the advantage of being more immunogenic than killed vaccines and are particularly well suited to mucosal stimulation– mimicking natural infection more closely. However they potentially have the ability to lead to excretion and spread to non vaccinates and to revert to virulence causing disease.

Dead vaccines contain specific concentrations of whole or part of the relevant organism or organisms, and/or toxins produced by them. Where intact organisms are used as the antigen they are killed – usually chemically. They therefore do not have the ability to create disease, although the presence of toxins can potentially be harmful; they may not induce as strong a reaction as a live vaccine. Dead vaccines are weakly effective at stimulating mucosal immunity and therefore vaccines targeted in this area are of necessity live.

In addition to the actual antigen, most vaccines will contain chemicals that act as non-specific stimulants of the immune system (adjuvants). These vary from aluminium hydroxide, to Vitamin E (tocopherol) and various inorganic oils. Each have implications for the degree of immunogenic stimulation, injection site reactions and potential harm to operators, with oil-based vaccines being particularly harmful if inadvertently self injected.

Four physical forms of liquid vaccine are available: -

- a) Water based
- b) Oil based
- c) Oil-in-water (where oil droplets containing the antigen are suspended in water).
- d) Water-in-oil (water droplets containing the antigen are suspended in oil).

The choice of such carriers will depend upon the nature of the primary antigen and the level of non-specific immune stimulation required. Different micro-organisms have highly variable antigenicity. For example, PPV is a very strong antigen and vaccines prepared from it give strong long lasting immunity whereas *Erysipelothrix rhusiopathiae*– the cause of erysipelas - is a weak antigen giving only short duration of protection.

As a general rule, live vaccines are supplied as freeze-dried plugs that require reconstituting with a carrier (either water or a specific adjuvant) for immediate application. Dead vaccines usually are supplied as ready-to-use suspensions.

Methods of Administration

The majority of vaccines used in pigs in the UK are administered individually by injection either subcutaneously(sc) or intramuscularly(im). The main sites for injection are either the neck or the ham although, in view of the high meat value of the ham, the former site is always preferred. Avoidance of injecting into fat is critical; the following points are relevant:-

- 1) For sc vaccination the thin skin at the point where the ear attaches to the head (distally) should be “tented” and the vaccine applied using a short needle (15-20mm).
- 2) For im injection aim for the neck muscle behind the ear at the level of the top of the ear. The size of needle used will depend on the size of the pig to be injected eg. baby piglets 15mm, sows 40mm).

Oral vaccination is also relevant in pigs – but when used on a group basis, care is needed to ensure the vaccine remains potent . Where live bacterial vaccines are used (e.g. *Lawsonia intracellularis*) additives present in mains water (e.g. chlorine) can inactivate the vaccine rendering it useless.

Vaccine Handling and Administration

Storage and administration data for all licensed vaccines is contained in the Marketing Authorisation(MA) or Summary of Product Characteristics(SPC) formally the data sheet. However some general principles of product handling can be outlined. Any stockman responsible for vaccination must be fully trained in the safe and effective use of vaccines.

- a) Storage – All vaccines should be kept in a locked store – away from children, and refrigerated. 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 (e.g. in a pocket) prior to administration to ease passage through the syringe and needle and avoid temperature shock in young piglets.
- b) Syringes – For small usage products, disposable syringes are to be preferred. Some oil-based vaccines react with the silicon coat on the rubber plunger and make repeated injection difficult; such vaccines should be used with syringes lacking a rubber end to the plunger.

Where automatic syringes are used these must be washed and dried in between batches of use but 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 with live vaccine use.

- c) Needles – Always use a needle appropriate to the size of the pig being vaccinated, suited to the type of injection given (sc or im) with as small a bore as possible. Needles must be sterile and sharp. Where litters are being vaccinated a new sterile needle should be used for each litter and, where groups of pigs are vaccinated, a new needle will be needed every five to 20

pigs depending on the age of pig (older pigs with thicker skin necessitate more frequent needle renewal).

On no account should a needle be inserted into a pig and then reinserted into a bottle (this risks contaminating the bottle). Where repeated doses are to be extracted from the bottle a single needle should be used in the bottle and different needles used to inject the pigs. (This issue is not relevant with automatic syringes).

- d) Hygiene and Health – Never inject in a site heavily and visibly contaminated e.g. with faeces. Only vaccinate healthy animals – vaccination of an unwell animal not only risks a failure of the vaccine but increases the risk of adverse effects (especially with live vaccines).

In general, avoid vaccinating sows seven days either side of farrowing where the ability to respond to vaccination may be compromised by the hormonal changes occurring at that time.

As a general rule, concurrent prophylactic treatments do not interfere with vaccination. However, in specific situations, the concurrent use of antimicrobials at the time of vaccination and for three days either side of application must be avoided. This is relevant to live vaccines administered orally (eg *Lawsonia intracellularis* and *Salmonella* spp vaccines). If the animal is unwell requiring therapy, then vaccination should be delayed until full recovery.

- e) Multiple Vaccinations – A number of vaccines are available which provide protection for more than one disease at the same time (eg PPV and erysipelas, *E. coli* and *Clostridium perfringens*). There are also a number of instances where it is appropriate to vaccinate for more than one disease around the same time. 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. This general rule should be followed but in particular **on no account:-**

- 1) Should vaccines be mixed in the same syringes.
- 2) Should two vaccines be injected into the same site, even if several days apart.

- f) Dose Rates – The dose rates stated on SPC's (data sheets) are carefully worked out and fully evaluated in trials that lead to full licensing. Therefore the stated dose should always be applied. Using more than the stated dose may not improve the immune reaction, will risk adverse reactions and be economically wasteful. A failure to give an adequate dose may undermine the immune reaction and lead to vaccine failure. Likewise, where the stated regime 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 may lead to vaccine failure.

g) Part Used Bottles – All pig 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:

- 1) Risk of the bottle becoming contaminated with bacteria, or other organisms.
- 2) Increased air in the bottle increasing the risk of oxidation damage to the antigen or carrier.
- 3) Temperature fluctuation between storage and use increasing product decay.
- 4) With live vaccines, rapid death of the organism once reconstituted (eg after three hours following reconstitution for live PRRS vaccines).

Partial or completely empty bottles constitute pharmaceutical waste and must be disposed of along with needles and syringes (which constitute clinical waste) by incineration in approved equipment. Return of bottles to the supplier in a dedicated “sharps” container may be 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 – It is always necessary to vaccinate pigs prior to field challenge, allowing time for the protective immunity to develop. Take notice of SPC (data sheet) recommendations relating to proscribed timing (eg do not vaccinate pregnant animals etc).

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 (data sheet) 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 vaccines.

Other adverse effects sometimes seen include injection site reactions (especially with oil based vaccines but more often the result of contamination at the site of infection), abortion in pregnant sows, temporary collapse (probably the result of accidental intravenous (iv) injection or temperature shock) and anaphylactic (allergic) reactions.

Adverse effects in excess of those warned on the data sheets should be reported to the Veterinary Medicines Directorate under the adverse reaction-reporting scheme and to the licence holder. (details and documents available at <http://www.vmd.gov.uk/>).

k) Withdrawal periods

The current range of vaccines authorised for use in the pig in the UK have zero meat withdrawal periods following application. There is clearly little

point in vaccinating a pig close to slaughter and injection site reactions may lead to carcass trimming and downgrading.

l) 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 (e.g. “all maiden gilts vaccinated against PPV with (*dose and product*) two weeks prior to service”). 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 or failure to protect.

Vaccine Failure

The majority of failures of vaccination regimes in pigs are the result of:-

- a) Misdiagnosis of disease leading to incorrect vaccine choice.
- b) The disease problem being multifactorial with other factors predominating and precipitating disease.
- c) Misuse of vaccines including problems with storage, application and dosage.
- d) Excessive challenge by field infection in situations of poor hygiene, ventilation etc.
- e) Strain variants not covered by the vaccine used (e.g. *E. coli*, erysipelas, *Haemophilus parasuis*).

Where a genuine vaccination failure occurs and no error in use can be identified, the failure should be reported to VMD under the adverse reactions scheme as well as reporting to the Manufacturer/Supplier.

Supply of Vaccines

Currently 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 (e.g. PPV, PRRS vaccines)
- 2) POM-VPS – obtainable from the veterinary surgeon, pharmacist, or suitably qualified person (ie the former pharmaceutical merchant list (PML) category)

Any vaccine used outwith its stated licensed conditions (eg vaccines licensed in other food producing species but used in the pig e.g. *Salmonella typhimurium* vaccine) can **only** be supplied and used under the direction of the veterinary surgeon attending the farm and the standard meat withdrawal period of 28 days may apply following administration.

SPECIFIC DISEASE VACCINATION REGIMES

1. Porcine Parvovirus (PPV)

Porcine parvovirus is a disease affecting only the unborn litter leading to death of the embryo or foetus. It is the most common cause of the stillbirth, mummification, embryonic death and infertility (SMEDI) syndrome but is not usually a cause of abortion. The virus is ubiquitous within pig populations and can be spread in semen. It is therefore essential that all gilts are immune prior to breeding. This may be achievable by challenge with field virus and can be confirmed by serological testing. Where an animal is naturally challenged and has developed immunity it is likely that this will be lifelong.

Where natural infection does not occur vaccination is essential. Typically gilts would be vaccinated two to four weeks prior to first service but not before six months of age. Further single doses may be needed annually (depending on the product used) although this may be superseded by field challenge of the vaccinated gilt, imparting lifelong immunity.

Some PPV vaccines are also licensed for use in the boar with the aim of reducing viral excretion in semen. PPV has no adverse effect on the boar *per se*.

Where a new gilt herd is established there is a very high risk of PPV disease and thus vaccination is essential.

As a result of widespread use of PPV vaccines since the mid 1980's, disease is now rarely seen. However, a typical outbreak in a non immune herd can be devastating and cost at least 10 times that of a long-term vaccination programme. (PPV vaccines may be supplied in conjunction with erysipelas vaccines *qv*).

2. Porcine Reproductive and Respiratory Syndrome (PRRS)

This viral disease is widespread in the UK pig herd although some individual herds have been maintained PRRS free. The virus can be responsible for devastating epizootics affecting fertility and piglet survival but is commonly a chronic problem undermining sow productivity and growing pig respiratory health.

Introduction of the virus to the herd may be airborne, by infected stock (eg replacement gilts) and in semen as well as by contaminated vehicles etc. A naïve herd should be considered for vaccination if biosecurity measures are less than thorough. Both live and killed vaccines are available – the former licensed for use in both breeding and growing pigs, the latter solely for use in the breeding herd. Live vaccines are not recommended for use in a PRRS free herd.

The general programmes for vaccination are:-

a) Breeding Herd

Vaccinate prior to mating – live vaccine requires a single dose and give full protection in four weeks; killed vaccine requires two doses with a three to four weeks interval and requires at least another three weeks for protection to occur. Typically, booster vaccine doses are required in mid pregnancy at every subsequent litter. Such use of live vaccine is outside of license specification which states that booster doses should be given prior to weaning and not be given to pregnant animals.

b) Feeding Herd

Vaccination of growing pigs must be delayed until MDA has largely waned (usually five to six weeks old) but early enough to allow protection to develop before field challenge occurs. Growing pigs vaccinated with live PRRS vaccines should not come into direct contact with unvaccinated pigs for five weeks.

Boars may be vaccinated as part of the herd programme but excretion of virus in semen from the live vaccine can potentially occur for two to three weeks after vaccination.

In the breeding herd where PRRS disease is a regular or repeated problem the low cost of vaccination gives a cost benefit ratio of 1:10 to 20 i.e. it is highly cost effective.

In the feeding herd PRRS can act as a facilitator of other respiratory diseases and commonly acts in concert with *Mycoplasma hyopneumoniae*.

The cost of vaccination would be easily outweighed by a reduction in growth rates delaying slaughter by five days taking no account of other specific treatments required and decrease in feed conversion efficiency.

3. *E. coli*

E. coli are ubiquitous and can be associated with a wide range of diseases in different ages of pigs. Most importantly, *E. coli* is the cause of severe enteritis in both newborn and newly weaned pigs. A number of vaccines exist, all of which are given by injection and induce a humoral response yielding IgM and IgG. However, to protect against enteritis it is necessary for the intestine to be bathed in antibodies which act to nullify the adhesions of the bacteria, which enable the bacteria to adhere to the intestinal wall (K88, K99 etc). The failure of systemically applied vaccine to stimulate local IgA in the gut means that vaccination of the individual pig early in life will not protect against post-weaning disease.

Vaccination targeted at the sow prior to farrowing will stimulate colostral antibodies that will bathe the gut for the first three to four days of the newborn piglets' life affording complete protection at this time. Any absorbed antibodies from the colostrum will be of very little value in protecting piglets beyond this age against enteric disease. Therefore *E. coli* vaccination is only appropriate in controlling neonatal enteritis.

Each vaccine has its own specific programme and dosage regime but in general gilts are given two doses prior to farrowing (with the appropriate interval) and sows a single booster prior to each subsequent farrowing. In many herds, vaccination of the gilts alone is sufficient to control disease but such a decision must be made on a case-by-case basis.

New herds particularly indoors are at high risk of neonatal *E. coli* disease and as such should be vaccinated as a matter of course.

Neonatal *E. coli* disease can cause high levels of mortality in affected litters (over 50% in some cases) and the relatively low cost of vaccinating one sow to protect 10 piglets means that *E. coli* vaccines are highly cost effective. All *E. coli* vaccines are dead consisting of a variety of strains covering the most common adhesions. Where known strains are a problem it may be appropriate to choose a specific vaccine. Some vaccines also contain a toxin component.

E. coli vaccines may be marketed as combination products eg. with erysipelas or clostridial vaccines (qv).

4. Clostridial Vaccines

Clostridial disease in the pig can take one of three forms.

- a) Clostridial enteritis associated with *Clostridium perfringens* types A, B & C, D.
- b) Aero chocolate liver in sows and older growing pigs (*Clostridium novyi*).
- c) Tetanus (rare).

Where disease is encountered in young pigs vaccination of the gilt/sow prior to farrowing with a polyvalent clostridial vaccine is highly effective. As with *E. coli* vaccines, the standard programme would involve two doses in the gilt prior to farrowing (with appropriate intervals) with subsequent single booster doses prior to farrowing each subsequent litter. Alternatively, the primary course of two doses can be given to the maiden gilt soon after arrival in the breeding herd with booster doses given prior to each farrowing. It should be noted that currently these toxoid vaccines do not cover *Clostridium perfringens* type A disease and thus an accurate diagnosis is required prior to embarking on a vaccination programme. As a general rule, indoor pig farms are low risk from clostridial disease and vaccination is usually only undertaken where there is a history of disease.

However, the outdoor herd is at a much higher risk and normally sows would be vaccinated as a routine. It should be noted that clostridia are soil and faecal

borne organisms that sporulate and survive almost forever. Whilst sheep are particularly susceptible to clostridial diseases, it is not necessary for pasture to have been grazed by sheep to create a risk in pigs. All outdoor pigs are at risk.

Where *Clostridium novyi* is recognised as a problem in sows, vaccination with an appropriate polyvalent vaccine is highly efficacious.

With the exception of a combined *E. coli/Clostridium perfringens* vaccine, which has been developed specifically for pigs, the polyvalent clostridial vaccines were all developed for sheep and cross-licensed for pigs. Where supply problems occur with a pig-licensed product, it is possible under veterinary prescription alone, to use a product that is only licensed for sheep. Under the prescribing cascade, however, a licensed vaccine should be the first choice if available.

Acute neonatal clostridial enteritis can wipe out whole litters without clinical signs. In the high risk outdoor situation, vaccination is highly cost effective. In the indoor situation, the cost of vaccination must be carefully balanced against the cost of the disease.

5. Erysipelas

The causative organism of erysipelas in pigs (*Erysipelothrix rhusiopathiae*) is widespread in vermin and wild birds. The pig is particularly susceptible to disease and therefore all pig farms should be regarded as high risk. In particular straw barn-type accommodation for growing pigs, to which wild birds have access, creates a situation in which erysipelas is common. (It is rare in growing pigs in fully enclosed, slatted floor-type buildings).

Erysipelas is capable of producing a range of clinical pictures:-

- 1) Peracute disease – sudden death/septicaemia
- 2) Acute disease – ‘diamonds’
- 3) Reproductive disease – abortion and infertility
- 4) Chronic arthritis (often causing carcass condemnation)
- 5) Sudden death associated with endocarditis

Vaccination – using inactivated vaccines - should be routinely applied to gilts and sows to protect both themselves and their offspring. Typically two doses are required as a primary course (with the appropriate interval between doses) followed by boosters every six months (or each parity). To maximise transfer of colostral protection (which can last up to 12 weeks in the young pig) vaccination should occur prior to farrowing.

Where vaccine is combined with PPV it is necessary in gilts to administer a first dose of erysipelas vaccine alone followed after the appropriate interval by a second dose of the compatible combination product.

Where disease is known to occur in growing pigs a single dose of vaccine from six weeks of age can be given and in very high risk situations where high

levels of disease are seen it may be appropriate to give a full two dose primary course to growing pigs with the appropriate interval.

It should be highlighted that the chronic arthritic form of erysipelas, which is often the most costly form of the disease in growing pigs, results from a type III hypersensitivity reaction and as such will not in itself be controlled by vaccination. However, a vaccination programme over time will reduce the overall bacterial challenge and therefore reduce the risk of pigs coming into contact with the organism thereby reducing the chances of arthritis occurring.

There are a number of strains of the organism and commercial vaccines only protect against one or two of the most common. Disease associated with non-vaccine strains is extremely rare (despite the lack of cross protection) and the very low cost of erysipelas vaccines in breeding animals renders its use obligatory in all pig herds.

6. *Mycoplasma hyopneumoniae*

Enzootic pneumonia (SEP) resulting from infection with *M. hyopneumoniae* is the most common respiratory disease seen in pigs and can often act as a trigger of other infectious disease in the lung.

Killed vaccines for use in the growing herd have been available since the mid 1990's and are now widely used.

They are available in either single or two dose format, the immunity from which lasts up until slaughter in most situations. Programmes vary with vaccine and individual farm situations but in most cases early vaccination (as young as one week of age) is appropriate depending on the vaccine used.

The killed vaccines depend upon cell-mediated immunity and it is believed that maternally derived antibodies have minimal adverse effect on the piglets' reaction to vaccination.

SEP vaccines are valuable tools in controlling population disease. Examination of lungs of vaccinated pigs reveals that some disease is still evident but, as a general rule, vaccination will reduce the average percentage of lung tissue affected in a herd to less than five percent (SEP score two on the 55 scoring system).

Ten percent lung damage due to SEP equates to a loss of growth between 30 and 100kg live weight of about 40gm/day. Vaccination would be expected, on a herd level to reduce this lost growth by more than 50%. As a general rule, herds experiencing damage affecting on average more than seven percent of the lung tissue, will gain a cost benefit from vaccination (i.e. herd average SEP score of more than 4/55).

Routine lung scoring in the abattoir is a widely accepted method of monitoring SEP levels and assessing vaccine efficacy.

7. Lawsonia intracellularis

This is the causative organism of the range of clinical enteric diseases that include ileitis, intestinal adenomatosis (PIA) and proliferative haemorrhagic enteropathy (PHE). Virtually all pig farms have been shown to be infected with the causative organism that can be a significant cause of lost growth and even mortality.

The vaccine available is a live whole bacterial culture that is administered orally and stimulates a local, mucosal reaction in the intestine.

The product can be administered in the water system, ensuring that all pigs receive their share of the water over a four hour period but should not be added to mains water - where the chlorination will kill the bacteria - unless the water has skimmed milk powder added (which neutralises the chlorine). It is important to ensure that all instructions about the vaccine are followed. Alternatively it can be given in separate water troughs again avoiding chlorinated water. In smaller herds individual pigs can be drenched directly with the vaccine.

A single dose given to the young pig will provide protection within two to three weeks that will last the growing pig through to slaughter. As it is a live bacterial vaccine, concomitant antimicrobial treatment must be avoided for at least three days either side of vaccination. However, it appears the incorporation of zinc oxide in the diet of pigs receiving vaccine does not interfere with vaccine efficacy.

L. intracellularis is one of a number of potential pathogens that can be involved in the widespread “grower scour” syndrome. Where other organisms are involved, vaccination for *L. intracellularis* alone will not be a reliable control measure and therefore accurate diagnosis based on laboratory sampling is essential prior to use. Serology is a useful adjunct to the diagnostic process in identifying the age at which *L. intracellularis* activity occurs. This can be helpful in determining timing of vaccination.

Where *L. intracellularis* alone is responsible for disease, vaccination would be expected to give a 3 to 5:1 benefit:cost ratio.

8. Atrophic Rhinitis (AR)

Progressive atrophic rhinitis caused by toxin producing *Pasteurella multocida* type D is now an unusual disease in the UK. Vaccination using *P. multocida* toxoid, plus inactivated *Bordetella bronchiseptica* is a highly effective way of controlling the disease that results from infection in the young pigs (usually before 40 days of age). Therefore the protocol employed is to vaccinate gilts and sows prior to farrowing and rely upon transfer of colostral immunity to protect the piglets after birth.

Particular care is needed with AR vaccine as the oily adjuvant is especially harmful if accidentally self injected.

Atrophic rhinitis vaccines should only be used in herds where the disease is known to occur. There is no need or justification for its use in the disease-free herd as the risk of introduction is low. In an affected herd, the cost of AR can be very high with feed conversion efficiency depressed by up to 0.5 across the growing herd. When added to the costs of medication and additional mortality the cost of the disease can exceed the cost of a vaccine programme by 20 – 30 times. Vaccination of the breeding herd is thus highly cost-effective in an affected herd.

9. Glasser's Disease

Disease associated with *Haemophilus parasuis* infection is common in the UK. There are in excess of 20 different strains of the bacterium and currently there is no readily available method of serotyping isolates in the UK. Commercial vaccines rely on one or two specific strains from which there is little or no cross immunity to others.

The available killed vaccine is designed for use in the growing pigs requiring two doses with an appropriate interval targeted for the second dose to be two weeks prior to challenge. This will then cover the growing pigs through to slaughter. Maternal immunity may interfere with vaccine efficiency and as such vaccination should not start before five weeks of age.

Unfortunately much of the clinical disease seen occurs in younger pigs that cannot be vaccinated. Vaccine may be used off licence under the direction of the veterinary surgeon only, with sows vaccinated prior to farrowing (two dose primary course followed by single booster doses in subsequent pregnancies). The success of the vaccination programme will depend upon the vaccine containing the correct strain of *Haemophilus parasuis* for the farm's problem.

10. Aujeszky's disease – (AD) (Pseudorabies)

Aujeszky's Disease is a notifiable disease but has not been seen in Great Britain since it was successfully eradicated by a producer funded slaughter scheme in the 1980's. Therefore vaccination for AD is only appropriate in Northern Ireland where the disease has persisted. Eradication programmes are currently being undertaken in many European countries using a combination of vaccination and test and removal.

Vaccines are live attenuated products, which have undergone gene deletion removing a glycoprotein. The significance of this is that it is possible, with appropriate serological tests, to distinguish between field virus infections and vaccines. This is important as part of herd eradication programmes based upon vaccination, test and slaughter,

The disease can affect both breeding and feeding herds and thus programmes designed to protect both are employed. As a general rule, sows following a primary course of two doses, would be vaccinated three times per year and growing pigs above 10 weeks of age (following decline of MDA) would receive two or even three doses of vaccine through their growing period. Specific vaccination regimes over and above data sheet recommendations may be required as part of eradication policies.

As live injectable products, Aujeszky's vaccines must be used immediately they are reconstituted and **on no account** should they be mixed with killed vaccines. They have the potential to be excreted and spread to non-vaccinated stock.

11. *Salmonella typhimurium*

Clinical disease – usually seen in the form of diarrhoea in weaners – associated with *Salmonella typhimurium* is relatively uncommon in pigs. However, infection is widespread and as part of a national campaign, slaughter pigs are monitored serologically for the presence of previous infection. Heavily infected herds risk financial penalties at slaughter.

No licensed vaccine is available for pigs; however, a live attenuated poultry vaccine for oral use is available but must be used only under veterinary direction, off licence.

As with the *Lawsonia intracellularis* vaccine, the aim is to stimulate local IgA production to prevent adhesion to the villi of the intestine as the precursor to penetration and bacteraemia, which stimulates the humoral response, detected by the serological test.

Double dose vaccination via the water supply has proved effective at controlling clinical outbreaks of disease and may go some way to reducing the levels of *Salmonella* spp in the pig environment and allow a reduction in the serological incidence of infection. As with all vaccination regimes it is important that the vaccine is administered well before field challenge. It would appear that vaccination does not increase the incidence of seropositive animals at slaughter particularly if administered early in life (i.e. before seven weeks of age) suggesting that it does not stimulate a significant humoral response.

As a live oral product, *Salmonella typhimurium* vaccination is vulnerable to being inactivated if used concurrently with antimicrobials and through mains water that is chlorinated. Similar precautions as outlined under 7. *Lawsonia intracellularis* should be followed. The inclusion of zinc oxide in the creep feed may however interfere with the efficacy of this vaccine and should be avoided.

As the vaccine is not licensed for use in the pig a standard withdrawal of 28 days should be applied to all pigs receiving it.

Non-Disease Vaccines

For a number of years immunological castration of pigs has been undertaken in Australia. The vaccine acts against gonadotrophin releasing hormone and temporarily induces vaccinates to destroy GnRH which then limits production of testosterone. The effect is to shrink the testicles, reduce male behavioural characteristics and cut down on boar taint. The vaccine may soon become available in the UK.

Two doses are essential for the vaccine to be effective, with an appropriate interval. The effect lasts for four to six weeks after the second dose in boars and thus needs to be used in the later stages of finishing.

The vaccine may have limited application in the UK as boar taint is generally not regarded as a problem in the carcasses of entire boars. However, the trend to increased slaughter weight may invite application of vaccination particularly as physical castration of boars in the UK is banned under the major quality assurance schemes.

Operator safety is a priority when using this vaccine, as double accidental vaccination will have dramatic effects on sexual hormones in both male and female operators.

Importation of Vaccines

Where significant disease problems occur within the UK and no effective product is available for the prevention and control of disease it is possible to import authorised products under special licence both from within and without the EU. These can only be applied for by a veterinary surgeon and take the form of a Special Import Certificate (SIC) (for an EU authorised product) or a Special Treatment Certificate (STC) (non-EU product) granted by the Veterinary Medicines Directorate (VMD). The fast track on-line system is expected to become available for applications relating to food producing animals although at the time of writing this is not the case. A charge is made for granting such a licence. The licence may impose the standard withdrawal period on the product used.

Full details on the application procedure are available at:-
<http://www.vmd.gov.uk/> and at
<http://www.vmd.gov.uk/publications/consultations/VMR06/VMGNote07.pdf>

A number of vaccines are authorised within the EU, but not in the UK, for significant diseases seen in this country and where appropriate it may be possible to import the product under licence for use on specific premises.

Three particular diseases of pigs maybe relevant:-

1. *Actinobacillus pleuropneumoniae* (APP)

This respiratory disease in growing pigs can be effectively controlled by vaccinating pigs during the early growing stage typically six and 10 weeks of age. There are currently 13 serotypes of APP identified worldwide of which a restricted number have been recognised in the UK. The single vaccine authorised in the Netherlands and elsewhere is a subunit vaccine based on four antigenic components common to all serotypes. In theory the vaccine thus covers all possible serotypes.

Protection is likely to occur two to three weeks following the second injection and would be expected to protect pigs through to slaughter weight.

2. *Streptococcus suis* type II

Typically disease associated with this bacterium occurs in the immediate post-weaning period (four to six weeks of age) causing meningitis, septicaemia and polyarthritis. Protection of the young piglet can be achieved by vaccination of the sow, relying on colostrally derived MDA to provide passive immunity. Vaccination is achieved using a killed oil based vaccine given six and two weeks prior to farrowing at the start of the programme with single booster doses two to three weeks prior to subsequent farrowings.

As a serotype specific vaccine, protection against disease caused by other *Strep. suis* serotypes is unlikely to occur.

3. Porcine Circovirus Type II (PCV2)

PCV2 is an integral component of the post-weaning multisystemic wasting syndrome (PMWS) although it may not be either the sole or primary cause of the disease. Trial work in developing a killed vaccine for use in sows prior to farrowing indicates some protection against PMWS in weaned pigs.

Currently a vaccine has a provisional licence in some EU countries (e.g. France, Germany and Denmark) and it might be possible under the SIC/STC system to import the vaccine where the clinical need can be shown for a specific farm. The standard vaccination programme would involve a two dose primary course of vaccine to sows in late pregnancy followed by a single dose prior to subsequent farrowings.

Guidance should be sought from the VMD over the possibility of importing such a product.

TABLE 1: Suggested Vaccination Regime for young growing pigs

Age/Stage of Production	Disease	Age of Vaccination + schedule	Comments
Prewaning/At weaning	SEP	Single dose from 7 days of age Or 2 doses 14+ days apart.	Only SEP +ve farms or where high risk of disease breakdown exists.
Post-weaning	Glasser's disease	2 doses 14 days apart from 5 weeks of age.	Where disease is known due to appropriate strains included in vaccine
	PRRS	Single dose of live vaccine from 6 weeks of age.	Only when PRRS clinical disease is present in growing herd or high risk
	<i>Ileitis/Lawsonia intracellularis</i>	Single dose post weaning in water or 2 doses 2 weeks apart.	Avoid in feed/water soluble antibiotics.
	<i>Salmonella typhimurium</i>	Single dose post weaning in water or 2 doses 2 weeks apart.	Avoid antibiotic and zinc oxide treatment. Off licence use 28 day withdrawal period
	Erysipelas	Single dose from 6 weeks of age.	Where disease is known in growing pigs or high risk e.g. future breeding animals.
	Aujeszky's Disease	Single dose from 14 weeks of age.	Only Northern Ireland.

TABLE 2: Suggested Vaccination Regime for breeding herd purchasing replacement gilts

Stage of Production	Disease	Regime	Comments
Predelivery or in isolation	SEP	Single or 2 dose regime – 2 weeks prior to introduction	Only if naïve prior to supply or in specific high risk situation
	PRRS	Single live vaccine dose 3 weeks prior to introduction (or 2 doses of killed vaccine 6 & 3 weeks prior to introduction)	Only if naïve prior to supply or in specific high risk situation
35kg Delivery (3mths old)	Erysipelas	Single dose if not previously vaccinated	
90-100kg Delivery (5 ½ - 6mths old)	Erysipelas	1 st dose of primary course	
	PPV+ 2 nd Erysipelas PRRS	4 weeks later at least 2 weeks prior to service Live vaccine 4 weeks pre-service or killed vaccine 6&3 weeks pre-service (if not vaccinated prior to delivery.)	
	Aujeszky's	Single dose preservice	Northern Ireland Only
During Pregnancy	<i>E. coli</i>	2 doses prior to farrowing 2 –6 week apart	2 nd dose at least 2 weeks prefarrowing; interval depends on vaccine used.
	PRRS	Single booster dose killed vaccine at 70 days gestation.	Where killed vaccine has been given to maiden gilts.
	Clostridia	2 doses 3weeks apart 2 nd dose more then 2 weeks prefarrowing.	Outdoors or where known risk indoors.
	Glasser's Disease	2 doses prior to farrowing. (eg at 5 & 2 weeks prefarrowing)	Off licence use
	Atrophic Rhinitis	2 doses prior to farrowing.	Only where AR known
	Erysipelas	Single booster 2-3 weeks prefarrowing	

Sows			
Preweaning	PPV PRRS	Booster PPV dose Live vaccine booster (unless used off license at 70 days gestation)	
Subsequent gestation	<i>E.coli</i>	Booster 2-4 weeks prefarrowing.	Often not necessary beyond gilts
	Erysipelas	Booster 2-4 weeks prefarrowing.	
	Clostridia	Booster 2-4 weeks prefarrowing.	Where high risk or outdoors.
	AR	Booster 2-4 weeks prefarrowing.	Where disease known in the growing herd.
	Aujeszky's Disease	Boosters every 4 months.	Northern Ireland Only
Glasser's Disease	Booster 2-4 weeks prefarrowing	Off licence use	

NOTES:

1. Specific programmes must be tailored to meet herd requirements. Many farms will not require vaccination for all of the diseases listed. In most farm situations vaccination against erysipelas and porcine parvovirus (PPV) will be essential.
2. Do not administer different products at the same time.
3. Do not use live PRRS vaccine in a PRRS free farm and note different programme requirements for live and dead PRRS vaccines.
4. PPV vaccine requirements in mature sows can be assessed by use of serological profiles.

Pet Pigs

The small but significant number of pigs kept as pets should not be forgotten with respect to vaccination.

Assuming that the pet pig is not kept for breeding, then none of the diseases controlled by vaccinating the breeding sow are relevant (*E. coli*, AR, PPV). Furthermore the main respiratory diseases (PRRS and SEP) are unlikely to be of significance to the individually kept pig and vaccination is usually unnecessary.

However two diseases can be of significance in the pet pig and vaccination should be considered:-

1. Erysipelas – the high susceptibility of the pig, ubiquitous nature of the bacteria and very low cost of vaccination renders this a disease against which all pigs should be vaccinated.
2. Clostridial disease (especially *Clostridium novyi* and *Clostridium tetani*). Where the pet is kept outside in certain high-risk areas or where the ground is known or believed to be contaminated, vaccination of the individual should be considered.

It should be noted that due to the fact that pig vaccines are generally supplied in multiple dose vials or bottles, wastage of vaccine is high when used for pet or individual pigs and unused material should be disposed of appropriately (for example by returning to the supplier for approved incineration.) In some areas, 'Pig Clubs' may be able to coordinate the simultaneous vaccination of several individual separately owned pigs. If this is undertaken at a veterinary practice the individual owners will need to take heed of the legislation relating to restrictions on pig movements details of which should be obtained from the local Animal Health Office of DEFRA

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)
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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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