

# Possible vaccination programs. Pros and cons of each of them



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### Highlights

**There is not a single vaccination program. The program implemented on a farm must match the epidemiological conditions and the particularities of each farm.**

**For the control of an outbreak of the disease in breeders, the best option is an emergency vaccination of all the sows, regardless of the pregnancy stage of each animal. On farms with growing pigs we must evaluate the convenience of vaccinating them depending on the seriousness of the outbreak.**

**The immunisation of the replacement gilts during the adaptation period is the keystone of the control programs. This immunisation can be carried out with the administering of two doses of vaccines, through the exposure to the field virus followed by the administering of a dose of vaccine before the animals enter the production stage or through the mere exposure to the field virus.**

**The vaccination of the replacement gilts is a safer practice than their exposure to the field virus, and it should be the system of choice if the gilts do not enter the farm soon enough before their service or when having entered ahead of time there are no premises that allow their complete isolation during the recovery stage.**

**The vaccination of the breeders will depend on the particular conditions on each farm, although it is recommended when the biosecurity measures are not enough to avoid the entrance of the virus from the outside, when there are growing animals on the farm in which the virus circulates, and when the adjustment programs for the gilts are not enough for eliminating the virus circulation in the breeders.**

**The most frequent vaccination program in the sows in the production stage is the herd vaccination of all the animals every three or four months. The main advantages of this system are a better control of the administration of the vaccine and the obtaining of a more homogeneous immune level among the breeders.**

**The vaccination of the piglets is taken into account in two situations: 1. as a complement of the programme for the control of an outbreak on farms where breeders and growing animals live together, and 2. to reduce the losses associated to the circulation of the virus in growing animals on stable farms that wean negative piglets.**

**The main reason of the vaccination of the piglets is the decrease in transmission of the field virus in the vaccinated population so, when accompanied with the appropriate management measures it can lead to the negativization of the flow of growing animals.**

**In the vaccination programs it is essential that the first vaccination is carried out with live attenuated vaccines. In the revaccinations we can alternate the use of live attenuated vaccines and of inactivated vaccines.**

In the first place, we must underline that there is not a single vaccination program or plan, and that the final design must adapt itself to the epidemiological conditions and the peculiarities on each farm. Nevertheless, as a general rule, we can say that the vaccines can be administered to a population in two different epidemiologic situations: in an outbreak situation, in which the virus is circulating actively on the farm, causing clinical signs in the affected animals, and in an endemic situation, in which we know that the population is positive and we administer the vaccination as a measure for limiting or eliminating the circulation of the virus, even when, on occasions, it may not cause an evident disease. There is a third possible situation in which the farms are negative and where what is recommended is not the vaccination of the animals, but extreming the biosecurity measures to guarantee the maintenance of that status.

When we are facing an outbreak, the goal pursued is to improve the average immunity of the population as soon as possible as a way of limiting the spreading of the virus among the susceptible population and to avoid the clinical consequences of the infection, that will be much more marked among the sows in the last third of their pregnancy when they become infected. To achieve this objective, the best option is the herd vaccination of all the animals, regardless their pregnancy stage; this helps controlling the circulation of the virus providing herd immunity. If such infection appears in a population with infection immunity, it will last less, involving a shorter shedding and a lower probability of transmission, which will ultimately lead to the cessation of the virus circulation. Actually, this same effect could be achieved with the exposure of all the animals to the field virus, and sometimes this has been the chosen option. Nevertheless, this practice is falling into disuse because, although it is a very effective system for

controlling the virus circulation among the breeders, and it even reduces the time needed to reach the stability regarding the use of the vaccination, the economic consequences of the outbreak are much more serious. This is due to the fact that the vaccination during an outbreak would result in losses caused by the field virus in the animals infected, whilst the exposure to the field virus increases significantly the number of affected animals; assuming that all the animals that are in the last third of their pregnancy will suffer the consequences of the disease.

When the decision of carrying out a herd vaccination of the sows to stop an outbreak is made, the presence of animals of other age groups must be taken into account so as to take other control measures; if this is not done, they will keep being an important source of the virus. These measures may go from changes in the farm management that try to isolate the breeder population, which is the most conservative but also the less effective one, to the vaccination of all the animals, including the growing pigs, depending on the seriousness of the outbreak and the level of internal biosecurity on the farm. This measure; that entails an important economic cost, must be evaluated carefully and it must be accompanied with all the changes needed to avoid the spreading of the virus. The main purpose of the vaccination of the growing animals is to achieve an adequate immunity in this population, because these animals can act as a source of transmission of the virus for the sows, and if the virus circulation is sufficiently high in these age groups, the infection pressure may be enough to exceed the sows' immunity and to achieve the appearance of the symptoms related to reproduction. Likewise, the farm's entrance of new animals potentially susceptible to the infection should be restrained, and when the entrance of replacement gilts is resumed, immunization must be appropriately administered.

The endemic situations can be very variable, and this leads to very different vaccination plans. When a vaccination program is designed, the level of stability and management of the farm must be taken into account, including the internal and external biosecurity measures and also if the farm has an all-in-all-out system or is a multistage farm. The only common guideline is that in every situation the control programs must include the adjustment of the replacement sows. Although it is possible to immunise these sows with the field virus, as already mentioned in a previous question, in many cases vaccines are used in the adaptation programs. An essential requirement is that the first vaccinations are carried out with live attenuated vaccines, because the stimulation attained by the inactivated vaccines in negative animals is not enough to confer an effective immunity. Apart from this requirement, there are many other possibilities that involve the administering of one, two or even three doses of the vaccine, more or less distant in time that could include a last dose of inactivated vaccine and the combination of the exposure to the field virus with a later vaccination, before the entrance into the production stage. Choosing one system or the other will depend on the particular conditions on each farm.

Although the immunisation of the replacement gilts with the virus that is circulating on the farm and the later vaccination before entering the production stage could cause a specific immunisation against the virus and provide a more solid protection to the animals which could be considered the ideal system on unstable farms, it must not be applied if the premises do not allow the introduction of young replacement gilts as well as a total isolation of each batch to stop the virus circulation during the recovery period, that must be long enough so as to guarantee that the gilts are not carriers when they enter the production stage. If both requirements are not met, the best option is to administer two doses of the vaccine, which is also the favourite practice on the stable farms in which the virus does not circulate among the sows. In this case, the maintenance of the field virus in the replacement animals increases the risk for the sows in the production stage, whilst the immunity conferred by the vaccination is appropriate for protecting the replacement gilts in this kind of populations.

Carefully choosing the best adjustment programme for the replacement gilts in each case is a key element when the circulation of the virus in a farm is present, as well as evaluating the farm's epidemiologic situation and the possibilities of carrying it out correctly in each batch of sows. The failure in the adjustment of the replacement gilts equates to the failure in the stabilisation of the farm. It has been already shown, many times, that the introduction of replacement animals is one of the main destabilising factors of the breeder farms.

Regarding the sows in the production stage, the implementation of vaccination programmes is optional

and it depends on the particular conditions on each farm. When the farm has a stable situation and systematically weans negative piglets, possesses good biosecurity conditions and is a multistage farm, it may be enough with the implementation of an efficient adjustment programme of the replacement gilts and it may not be necessary to vaccinate the sows in the production stage. Nevertheless, this situation is not very frequent since it's more common that farms are not entirely stabilised or that their biosecurity measures allow periodical reinfections with new strains that may cause more or less serious outbreaks of the disease. Also, on farrow-to-finish farms and on those farms with both, stages 1 and 2, the presence of growing animals on the farm introduces a destabilising factor that is not always easy to control. Under these conditions, the adjustment of the replacement animals alone is not enough to keep a high immunity level in the population, so it is necessary to implement, also, vaccination programmes in the sows in the production stage.

Throughout time, different vaccination systems have been developed. One of the first ones used is known with the name 6/60 that supports the vaccination of the sows on the 6<sup>th</sup> day of the lactation and on the 60<sup>th</sup> day of the gestation, followed by vaccination in each lactation period. This system was developed aiming to achieve a suitable immunisation of the sows without compromising the safety by avoiding the vaccination of the sows in the last third of their pregnancy, which is higher moment risk of transplacental infection. This system prioritises safety when administering the vaccines. One of the disadvantages is that not all the sows are vaccinated at the same time which contributes to a heterogeneous immunity level in the population, favouring the existence of subpopulations, complicating the control of the administration of the vaccine, since the interval between doses will depend on the reproductive efficiency on each farm and of each animal. It has also been demonstrated that with time, the transplacental infection risk, when revaccinations of the sows are carried out by the end of the gestation, is relatively low and that no significant alterations are caused in the reproduction, provided that the sows have been immunised previously during the adjustment stage, as it currently happens on all the farms.

Since this administration guideline leads to an heterogeneous immune status of the population and it has been proven that the vaccination in the last third of the gestation shows no serious safety problems, the 6/60 system has fallen into disuse, and currently, the most frequent thing is to carry out herd vaccinations every 3 or 4 months, depending on the infection pressure. This system, that implies the vaccination of all the animals synchronously, allows, on one hand, a better control of the vaccinations, and on the other achieving a more homogeneous immunity in the population without negative consequences related to the safety of this practice.

Whichever vaccination program is implemented, it is essential, as it has been already mentioned, that the first vaccination is carried out with live attenuated vaccines. Later on, the revaccinations can be administered with the same kind of vaccine or alternating between attenuated vaccines and inactivated vaccines. Although these latter vaccines do not prompt enough immunity to protect the sows that have not been previously exposed to the virus, it seems that their administration in revaccination schedules causes a secondary response not very different from that obtained with live vaccines. Nevertheless, we must underline that there is little verified information regarding the comparative performance of the programmes with live vaccines and the combined programmes.

Finally, we must mention that it is possible to implement vaccination programmes in the growing animals. Indistinctly which is the goal, the vaccination must be carried out with live attenuated vaccines, because these animals are going to receive their first vaccine dose. The vaccination of piglets may be implemented for two main reasons: 1. to improve the production rates and to reduce the incidence of the disease in the growing stage on stable farms in which the piglets are weaned being negative but become infected during the growing stage, and 2. to control an outbreak of the disease due to the decrease in the infection pressure to which the breeders are subject on farms that house breeders and growing animals. In the first case, the vaccination of piglets is implemented at an early age; this is, around three weeks of age, whilst in the emergency cases it is administered to all the animals. Nevertheless, we must bear in mind that when we seek to improve the production rates of the growing pigs, the vaccination will only be fully effective if it is administered at least 3 or 4 weeks ahead of time with regard to the exposure to the field virus, because the development of the immunity is relatively low and the animals will not show protection until they reach a minimum immunity level.

The vaccination by itself will not eliminate completely the risk of infection in the vaccinated animals, but it will reduce the length of the viraemia and will limit the spreading of the virus throughout the body and the shedding of the virus. This reduction in the shedding of the virus will lead to a decrease in its transmission rate, especially in a vaccinated population, with a lower susceptibility to the infection. In turn, this drop in the transmission rate may lead to the displacement of the field virus until a total elimination of its circulation if all the population has been vaccinated. The vaccination is maintained for a sufficient length of time until the total eradication of the field virus is attained, and it goes together with management measures directed to limit the virus transmission; as the management in all-in-all-out systems, the use of specific equipment for each age group, without the sharing of equipment between batches, and the control of the movements of animals and people on the premises.

Therefore, the vaccination of the piglets can be recommended on farms where the virus does not circulate anymore in the breeders but still circulates in the growing animals because, if it has been correctly designed, it will help to eliminate the field virus completely from the farm.

Nevertheless, we must bear in mind that it is quite difficult to achieve this effect with the vaccination of piglets on unstable farms, where the efficacy of the vaccination will be lower because an unpredictable amount of piglets will already be infected when the vaccination is administered. In infected populations, the main value of the vaccination is the modulation of the virus excretion without the effect being clear regarding the course of the infection. This is, in fact, the effect sought in the emergency vaccinations of all the animals where it is not so important to protect the piglets as to avoid a high infection pressure in the sows.

**Table 1.** Possible vaccination schedules in replacement gilts

Replacement gilts		
Determinants	Possibilities	Pros and cons
<ul style="list-style-type: none"> <li>• The immunisation of the gilts is a necessary condition in any PRRS control programme, and the vaccination is the more common way of carrying it out</li> <li>• In negative animals, the first vaccination must always be carried out with a live attenuated vaccine</li> </ul>	<ul style="list-style-type: none"> <li>• Administration of two doses of vaccine during the adaptation period with a variable separation in time depending on the age at which the sows enter the farm and on the rest of the vaccination program</li> <li>• Exposure to the field virus followed by the vaccination of the animals once the acute stage of the infection has passed and before the animals enter the production stage</li> </ul>	<ul style="list-style-type: none"> <li>• The adaptation with two vaccine doses is the safest approach. It is the only option if the adaptation period is short, if we cannot carry out an isolation period of the gilts after the infection or there is not a real and effective separation with respect to the sows in the production stage. It is also the recommended approach on stable farms in which the virus does not circulate among the breeders</li> <li>• The exposure to the field virus followed by the vaccination is less safe, but it increases the specific immunity against the field virus that circulates on the farm and provides a higher protection in the case of unstable farms</li> </ul>



**Table 2.** Possible vaccination schedules in sows in the production stage

Sows in the production stage		
Determinants	Possibilities	Pros and cons
<ul style="list-style-type: none"> <li>The immunisation of the sows in the production stage will depend on the specific conditions on each farm. On unstable farms with a poor biosecurity, a farrow-to-finish system and where the adjustment programmes for the replacement sows do not guarantee the entrance of immune and non-carrier gilts into the production stage, it is necessary to implement vaccination programmes in the sows in the production stage to help to improve the immunity of the animals and to limit the appearance of outbreaks</li> <li>On stable farms, with a good biosecurity and that adapt the gilts correctly, it may be enough with the adjustment of the replacement sows</li> </ul>	<ul style="list-style-type: none"> <li>Programs like the 6/60 program in which a first dose of the vaccine is administered to the animals in their first or second third of the gestation and to lactating sows, revaccinating them a month later and implementing the routine revaccinations for the sows in the lactation stage. This system has fallen into disuse</li> <li>Herd vaccinations of all the animals, regardless of the moment of the production stage in which they are, every 3 or 4 months, depending on the infection pressure and the frequency of outbreaks on the farm</li> <li>Although it is generally accepted that the live attenuated vaccines induce a better immunity than the inactivated vaccines, the latter ones could be used in combined vaccination programmes, because in the case of the revaccinations they can induce a secondary immunity response similar to that of the live attenuated vaccines. There are no data regarding the comparative protection of the animals vaccinated with one programme or the other</li> </ul>	<ul style="list-style-type: none"> <li>The 6/60 programmes are very safe, because they avoid the vaccination of animals in the moment of higher transplacental infection risk. Nevertheless, they do not allow a good control of the implementation of the vaccination and they lead towards a not much homogeneous immunity in the population. In addition, they do not allow to intensify the vaccination programmes. Due to all these reasons, they are not used nowadays</li> <li>Herd vaccinations allow a more effective control of the vaccination programs and lead towards a more homogeneous immune status among the breeders. Besides, they allow to adapt the vaccination frequency to the needs of the farm. Nevertheless, although most of the live attenuated vaccines are authorised for their use in pregnant animals, we must bear in mind that the administration of this kind of vaccines during the gestation period should be restricted to animals with a previous immunity so as to minimise the risk of transplacental infection</li> </ul>

## References

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**Table 3.** Possible vaccination schedules in piglets

Piglets		
Determinants	Possibilities	Pros and cons
<ul style="list-style-type: none"> <li>The vaccination of the piglets must be carried out with live attenuated vaccines because they are negative animals immunised for the first time</li> <li>If our goal is to limit the negative effects of the infection in the growing animals regarding the production parameters, we will have to make sure that we vaccinate non-infected populations and do it as soon as possible before the moment of the infection, because the development of the immune response is relatively slow</li> <li>The use of the vaccination in piglets to achieve a flow of completely negative piglets will only be absolutely effective if the animals come from a stable population of breeders and the infection cycle is maintained in the growing animals</li> <li>The vaccination of positive animals at weaning on an unstable farm will lower the infection pressure and it may be useful for the control of the infection in the sows</li> <li>The decision of vaccinating the piglets should be a decision based on the cost/benefit relationship of the vaccination</li> </ul>	<ul style="list-style-type: none"> <li>Vaccination of the piglets at around 3 weeks of age to protect them against the negative effects of the infection during the growing stage</li> <li>Vaccinations of all the animals with the aim of controlling an outbreak of the disease quickly lowering the infection pressure suffered by the breeders</li> </ul>	<ul style="list-style-type: none"> <li>The vaccination of the piglets does not completely avoid the infection, but it allows to shorten the viraemia period and the virus excretion, so accompanied by the appropriate management practices it can displace the field virus and create a negative flow when the animals are negative at weaning and become infected during the nursery stage</li> <li>When the animals are already infected, the only positive effect shown by the vaccination is the decrease in the shedding of the field virus, and therefore the implementation of the vaccination in these cases should aim at the epidemiologic control of the outbreak and not at the individual response of the vaccinated animals</li> </ul>