

PRRS Eradication by Herd Closure

Montserrat Torremorell and William T. Christianson

PIC, 3033 Nashville Rd., Franklin, KY, USA 42134; *Email*: mtorremorell@pic.com

■ Introduction

PRRS eradication strategies have recently received attention from the US swine industry. PRRS virus infection can be costly and difficult to control and is a major limitation, often preventing efficient production in intensive swine units.

A variety of strategies have been described for PRRS eradication. Total depopulation/ repopulation, partial depopulation (Dee et al., 1993), isowean (Gramer et al., 1999) or segregated early weaning (Rajic et al., 2001), test and removal (Dee 1998), mass vaccination with unidirectional pig flow (Dee & Philips, 1998) and herd closure are among the strategies that have been promoted.

We will describe the procedure of PRRS eradication without depopulation based on herd closure. This procedure has also been described as PRRS elimination by roll over, flow-through or normal attrition.

■ PRRS Eradication - Biosecurity

The first and most important thing is to evaluate whether we can keep the system negative during and after the eradication program. A reasonable understanding on how the virus entered the unit is the starting point. Although this may sound basic, we tend to forget about it. We have documented various PRRS breakdowns in negative systems. In these systems, after pigs and semen are excluded, transport, people, equipment movement and local pig density were identified as the most likely factors responsible for the infection.

Therefore, lateral infections can be common. In positive systems, they may go unnoticed since the systems are already infected positive. A similar situation occurred with TGE: when 90% of the swine farms in a system were affected, it was difficult to keep farms negative, reinfections being common. As regions,

areas and production systems became negative, then, it became possible to maintain the negative farms.

Therefore, strict biosecurity procedures have to be followed at all times and it is imperative to have isolation areas for all replacement animals (this is also very important during stockings).

■ PRRS Eradication by Herd Closure

Herd closure vs. closed herd:

Herd closure or closing a farm, refers to a period of time during which replacement animals are not introduced. This applies to both, internal replacements as well as replacements purchased from a breeding stock company. Some such interruption is an essential part of the PRRSV eradication program described in this section.

Closed-herd system: Replacements are produced internally and are introduced into the sow herd directly from the grower or finisher independently of the PRRS status. Generally speaking “closed-herd systems” do not achieve PRRSV elimination, although they do bring a measure of disease control.

Objective

Naïve, sero-negative replacement animals are introduced into sero-positive breeding herds when virus transmission has ceased. These negative animals replace the sero-positive herd through normal attrition or by scheduled culling of the previously infected animals. This strategy results in a negative population of breeding animals over time.

To begin, a general evaluation of the farm or system determines whether PRRS eradication is needed for the farm, whether it can be done and if so, if it is economically practical.

- **Location:** the farm should be located with enough isolation to limit risk of reinfection after the program is complete.
- **On-farm biosecurity:** strict on-farm biosecurity measures are needed to prevent the introduction of new viruses and to prevent movement of the virus within the farm or system.
- **Source of semen:** semen must be only from a routinely monitored PRRS negative boar stud.

- **Replacement animals:** only naïve, sero-negative replacements are used. An isolation area to hold and test the replacements is mandatory.
- **Transport:** it is important to have a good understanding of how pigs are moved within the system and how trucks are cleaned and disinfected. Special attention should be paid to cull and slaughter trucks.
- **Type of production system:** Farrow-to-finish farms are at a disadvantage when it comes to using this procedure since virus infection from the grower animals cannot be kept away from the breeding herd.

Principles

Evidence to support this strategy is from field observations showing that, in closed populations, the viral infection dies out overtime (Harris et al., 1987; Freese & Joo, 1994). The principles supporting PRRSV eradication by this method were recently summarized (Torremorell et al., 2000). These principles are summarized as follows:

Immunity:

Pigs previously infected with, and recovered from, PRRSV are immune to experimental, homologous challenge for extended periods of time suggesting that homologous immunity is protective (Lager et al., 1997). In addition preliminary data suggests animals with a strong cellular immune response no longer harbor infectious virus.¹⁰ Importantly, this immunity may take up to six months to fully develop, thus the need to close the herds for an extended period of time (Meier et al, 2000). The purpose of the closure is to allow adequate time for such immunity to develop in all the adult animals.

Biosecurity/transmission:

At the beginning of a PRRSV elimination project, populations of pigs with differing immune status (immune vs. susceptible) will coexist in the farm. During this time, it is essential to identify all possible sources of virus within the farm and to establish optimal biosecurity measures between the different populations to accommodate pig flow and prevent transmission. Biosecurity measures to prevent the possible introduction of new viral strains need to be recognized and strengthened.

Assessment and definition of the population:

Defining the dynamics of the viral infection, as it occurs within the farm, is prerequisite to accomplishing biosecurity. It is important to identify where the virus recirculates, at what age the pigs become infected, and the serologic and infection status of current replacements. From this it is determined whether animal flow can be adequately managed to allow the needed segregation.

Replacement animal introduction:

A consistent and assured source of negative replacements and semen is required.

Sentinels as biologic indicators of infection:

Virus-naïve, sero-negative sentinel animals can be used as biologic indicators to ascertain that there is no virus recirculation in the farm. Confidence on the timing to safely begin introduction of negative replacements would depend on the testing evidence of these sentinels, demonstrating their continued freedom from PRRSv infection. In some systems, the first groups of negative gilts are used as the sentinels.

Attrition effects on sow population:

Previously exposed infected animals will need to be removed as the elimination process progresses. Whether removal of previously infected pigs is done by test and removal, accelerated culling based on age, or herd closure, the fact is that previously exposed animals are a potential risk factor for transmitting infection to susceptible animals. At this time, even though elimination by herd closure is attractive, data is lacking to recommend this method over others. However, clinical experiences to date indicate that this method may be a safe, effective, cost efficient method to achieve successful PRRS elimination.

■ Procedure***Step 1***

The first step is to create an **infected, recovered and immune population** of animals in all reproductive animals. This is achieved by **managing the gilt pool**. This step is very important since it will create a population of immune animals.

The candidate farm **must stand alone**, not housing any growing animals other than nursing pigs. Three site farms are good candidates. Farrow to finish farms will be continuously challenged by the close presence of virus in the growing pigs making it very difficult to restrain the virus in such production systems.

Step 2

The second step is to **close the farm** to the introduction of replacement animals for a prolonged period of time. As a rule of thumb the farm should be closed for a minimum of 6 months, although this will depend on the production flexibility of the farm and clinical situation. Methods to decrease this time period are discussed below (item c). In most cases this time period will be longer. By

closing the farm, naturally developing immunity eliminates virus infection from the herd. To accomplish a period without animal introductions and, at the same time, minimize the costs associated with the program, an off-site breeding project with negative replacements should be considered. If replacements are not available, breeding targets, parity structure and overall production will be affected. In order to minimize the cost associated to the interruption of gilt introduction, three strategies can be implemented:

a) Off-site breeding project

This strategy will allow the farm to hit breeding targets in an off-site location. The pregnant gilts will be introduced into the sow farm at farrowing or late in gestation. The extra costs are the lease of an off-site facility, added labour and the extra animal movements. The breeding project requires negative gilts, thus at the end of the closure period, production is resumed with negative replacement animals.

The economic and operational differences between this and total repopulation are several. Fewer gilts are needed, essentially the same number of gilts that would be used in normal flow are required overall. Younger parity animals are not being slaughtered (wasted) and normal replacement flow remains the same. The down-time costs associated with depopulation are avoided. Also, a detailed clean-up procedure on the sow farm is not conducted. An external site will have to be rented and while breeding labor can be done by personnel already present on site one, there will be increased labour costs for the project.

b) Introduce sufficient replacements inside the sow farm previous to closure

This is recommended in systems where virus is actively recirculating in the sow farm (for instance, immediately following an outbreak). These replacements can be exposed to, and recover with immunity, from the virus while the sow farm is closed for the prolonged period of time. This strategy may not work in situations where the sow farm is considered very stable and virus recirculation is minimal as replacement infection cannot be assured. This strategy mimics TGE elimination procedures and requires active, on-going infection at initiation of the process.

c) Farms in which replacements were infected at a nursery age offer additional opportunity.

A consistent nursery infection and recovery pattern, accompanied by freedom from clinical signs and affirmed with serologic monitoring may reduce the closure time to 2-4 months. This could be achieved by changing the gilt introduction schedule to quarterly introductions. The decision to implement a shorter closure period depends on the number of viral strains present, sow farm stability, the acclimatization program, and the farm's biosecurity.

Step 3

Allocate a source of **negative replacements**. After initiation of an elimination project, all future replacements must be negative when introduced into the sow farm. The semen source must also be negative.

Step 4

Introduction of negative replacements into the sow farm. The initial introduction of naïve, sero-negative animals is the riskiest step in this process. Risk is limited only with the assurance that virus recirculation has ceased in the sow farm. Unfortunately this is difficult to assess, since laboratory techniques applied to large swine populations are not sensitive enough. One way to limit this risk is by using naïve, sero-negative sentinel animals prior to negative replacement introductions. These sentinel animals are commingled with sero-positive sows and gilts in a separated facility to determine whether virus is still being shed.

The final introduction of replacement animals entered prior to closure of the herd were obviously PRRS positive. These gilts or boars are considered to be the animals most likely to remain infected and to be the greatest risk as sources of virus. Therefore measures that segregate them from the naïve replacements for the longest time possible should be emphasized.

At farrowing, attempts to farrow sero-positive and sero-negative gilts in the same rooms should be prevented. Additionally, cross-fostering of piglets between these two populations is avoided as long as is practical. This will be achieved by delaying breeding of the negative replacements at least 3 weeks from the time when the last positive gilt was bred.

Step 5

The last sequential step for the herd is the **elimination** of the virus **from the growing pigs**. A depopulation of the nursery will be required. This in turn will create an “empty bubble” which will be moved through out the finisher leaving a population of PRRS negative pigs behind. Vigorous cleaning and disinfection is mandatory. Clean up of the pig flow should not be attempted at the beginning of the eradication program. It should be performed towards the end, if not after, the herd closure when there are indications that the pig flow will remain negative.

Elimination of the previously exposed adult animals occurs through normal attrition. Removal of previously exposed animals is by normal or accelerated culling of all the sero-positive females present at the time the farm was closed. This makes this program very attractive, since it allows the preservation of the breeding herd, its economic value, genetics, optimization of the herd age and

productivity, and minimization of the cost associated in the removal of previously infected animals.

Throughout the program, routine serologic monitoring is required. Monitoring includes sentinels at the beginning of the program, the negative replacements after introduction and in the growing pig population. Monitoring in the production flow is best performed at least on a monthly basis and with adequate statistical power to detect infection if present. The monitoring is continued on an on-going basis. The monitoring confirms that the farm first becomes and then remains sero-negative.

■ Discussion

Although it is recognized that PRRS can be eradicated from farms, most of the PRRS elimination programs have been described and implemented in farms from breeding stock companies. In general, these farms have good biosecurity programs and are located in low pig dense areas. Without any doubt, these circumstances have also contributed to the success of the programs. The question still remains whether we can keep farms negative in large commercial production systems or in high dense pig areas. So far, it has been very difficult to keep farms negative that are part of larger commercial systems. In production systems a system-wide approach versus a single farm approach needs to be explored. Large-scale implementation of PRRS elimination programs will depend on the ability to keep the farms negative.

■ References

- Dee, SA** (1998). Elimination of PRRS virus using a test and removal process in conjunction with serology and PCR diagnostics. *Proc Am Assoc Swine Pract*, Des Moines, IA, pp 117-118.
- Dee, SA, Morrison, RB, and Joo, HS** (1993). Eradicating porcine reproductive and respiratory syndrome (PRRS) virus using two-site production and nursery depopulation. *Swine Health and Prod.* 5:20-23.
- Dee, SA, and Philips, R** (1998). Using vaccination and unidirectional pig flow to control PRRSV transmission. *Swine Health and Prod* 6(1): 21-25.
- Freese, WR, and Joo, HS** (1994). Cessation of porcine reproductive and respiratory syndrome (PRRS) virus spread in a commercial swine herd. *Swine Health and Proc* 2(1): 13-15.
- Gramer, ML, Christianson, WT, and Harris, DL** (1999). Producing PRRS negative pigs from PRRS positive sows. *Proc Am Assoc Swine Pract.* 413-416.

- Harris, DL, Bevie,r GW, and Wiseman, BS** (1987). Eradication of transmissible gastroenteritis virus without depopulation. Proc Am Assoc Swine Pract, Des Moines, Iowa, p 555.
- Lager, KM, Mengeling, WL, and Brockmeier, SL** (1997). Duration of homologous porcine reproductive and respiratory syndrome virus immunity in pregnant swine. Vet Microbiol 58:127-133.
- Meier, WA, Wheeler, J, Husmann, RJ, Osorio, FA, and Zuckermann, FA** (2000). Characteristics of the immune response of pigs to wild-type PRRS virus or to commercially available vaccines: an unconventional response. Proc Am Assoc Swine Pract, Indianapolis, IN, pp 415-418.
- Rajic, A, Dewey, CE, Deckert, AE, Friendship, RM, Martin, SW, and Yoo, D** (2001). Production of PRRSV-negative pigs commingled from multiple, vaccinated, serologically stable, PRRSV-positive breeding herds. J Swine Health Prod. 9(4):179-184.
- Torremorell, M, Henry, S, and Moore C** (2000). Producing PRRSv negative herds and systems from PRRSv positive animals: the Principles, the Process and the Achievement. Proc Am Assoc Swine Pract, Indianapolis, IN, pp 341-347.