The Financial Impact of PRRS Virus
JT Holck and DD Polson

- PRRS virus infection can result in financial losses due to increased death loss, poor reproductive performance, an increased significance of other diseases, increased use of vaccines and medications, and increased diagnostic costs.
- Acute outbreaks in breeding herds have been estimated to be around $250 per sow with some estimates as high as $302 per sow.
- Costs associated with persistent infections in breeding herds or growing pig herds are much more difficult to quantify. Some authors have estimated the costs to range from $6.25 to $15.25 per pig.
- An increase in the significance of other swine pathogens on a farm after a PRRS outbreak can represent an enormous cost to the producer.
- It is typical for producers to spend more money on diagnostic testing and herd monitoring after their herd becomes infected with PRRS virus. This diagnostic work is often necessary in order to develop comprehensive control or eradication strategies.
- Partial budget analysis can provide a simple method for estimating the cost of the disease on a farm and help to justify the amount of money that can be spent to develop control and eradication strategies.
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Introduction

Since it was first described in the U.S. in 1987 as "mystery swine disease" (Dial and Parsons, 1989), the virus now recognized as causing PRRS has had a huge impact on the global pig industry. Much of our combined efforts in swine health over the last decade have focused on understanding, preventing, or controlling PRRS. As its name implies, PRRS virus affects both reproductive performance in the breeding herd and, in its respiratory form, growth performance in their offspring. Anyone who has experienced PRRS first hand is well aware of its often-devastating impact on breeding herd performance (Polson et al., 1990) and its chronic effect on health and growth rates in post-weaning pigs (Kefferbar et al., 1992). These visible effects on pig health and performance have financial consequences, as well (Polson et al., 1992a, 1992b; Polson et al., 1994). However, although the impact of an acute outbreak of PRRS on herd performance is easily measured, the financial impact is not. For that reason, while the impact of PRRS on reproduction, morbidity, and mortality has been extensively documented, there is little information in the literature describing the financial ramifications of PRRS. In this section we will attempt to provide a brief overview of the potential financial impact of PRRS on the breeding and growing pig herd, some "rules of thumb" formulas to estimate the impact on a herd, and a partial budget approach for estimating the cost of current intervention strategies. Examples and illustrations give values in U.S. dollars ($).

The Financial Impact of PRRS in the Breeding Herd

When a herd is first infected with PRRS, the initial clinical presentation can be dramatic and costly. Hoefling (1992) estimated the "cost" of an initial breeding herd outbreak in four Illinois herds to be $100, $170, $428, and $510 per breeding female, respectively. In this case, the term "breeding females" included all females in the breeding herd, i.e., unmated gilts, primiparous gilts, and sows mated one or more times in their lifetime. These estimates were based upon the decreased production of weaned pigs and increased costs associated with animal health. Polson et al. (1992a) described a four-month outbreak in a 250-sow herd in Minnesota, estimating the cost at $236 per breeding female for the year of outbreak. This loss was composed primarily of lost opportunity for revenues on 966 pigs that would have otherwise been produced had the herd performed at its baseline productivity levels (derived from the same period for the previous three years). This opportunity loss represented a reduction of 3.8 pigs weaned per female per year and translated into a decrease in profits of $59,781 for the year of the outbreak, or a decrease in profit per hundredweight of $9.42. Dee et al. (1997) documented losses averaging $228 per sow over a 12-month period due to elevated mortality rates, reduced growth rates, and increased medication and vaccination costs.

Using these documentaries of initial outbreaks of PRRS in the breeding herd, the estimated average cost of an acute outbreak would be $255/sow: Hoefling, 1992 $302/sow Polson et al., 1992a $236/sow Dee et al., 1997 $228/sow Average cost $255/sow

Unfortunately, the economic impact of PRRS in the breeding herd is not confined to the initial or acute phase of an outbreak. Relative to pre-infection performance, diminished reproductive performance can continue into the post-acute or chronic phase. While the literature documenting the financial impact of chronic PRRS infection in the breeding herd is scarce, formulas are available to estimate the impact in specific herds. The financial impact of changes in farrowing rate (FR), liveborn (LB), and prewean mortality (PWM) can be estimated using the margin-over-variable-cost (MOVC) method. Baseline assumptions for these estimates include 80 percent FR, 10 pigs per litter LB, 12 percent PWM, 5 percent postwean mortality, 7-day weaning-to-service interval, 115-day gestation length, 21-day lactation length, and 65-day service-to-nonfarrowing interval. A range of $20 to $50 per pig MOVC, with a mean of $35 per pig MOVC, is used to provide a range in outcome representing potential market conditions.

Using these baseline assumptions and ranges in MOVC, a one (1) percent decrease in FR equates to a potential loss of $3.20 to $8.00 per mated female per year, with a mean (using $35 MOVC) of $5.60 per mated female per year. A 1.0 pig per litter decrease in LB equates to a potential loss of $37.00 to $92.00 per mated female per year, with a mean of $64.00 per
A one percent increase in percent PWM equates to a potential loss of $4.20 to $10.40 per mated female per year, with a mean of $7.30 per mated female per year. These rules-of-thumb can be used to estimate losses where sufficient production information is available and a reduction in performance can be proven to be the result of PRRS virus infection. You can insert your own herd size (i.e., mated female inventory) and estimates in Table 1 to estimate the annual financial impact of PRRS in your breeding herd.

In addition to lost production, the impact of a PRRS outbreak on animal health costs can be dramatic. Expenses associated with prevention and treatment of secondary infections increased 60 percent during the 12 months following an outbreak of PRRS in a 2700 sow operation in Poland (Pejsak et al., 1997). During the peak of the outbreak, the animal health costs were four times higher than prior to the PRRS infection and a year after the outbreak this parameter had not returned to pre-PRRS levels.

### The Financial Impact of PRRS in the Growing Pig Herd

While PRRS virus by itself can have devastating affect in the breeding herd, in the growing pig it is usually most harmful in combination with other pathogens, such as Mycoplasma hyopneumoniae, swine influenza virus, Salmonella choleraesuis, or Streptococcus suis. Therefore, it is difficult to separate the impact of PRRS virus on growth performance and the subsequent financial implications from those imposed by concurrent infections.

Based upon productivity levels in herds that had successfully eliminated PRRS virus by nursery depopulation, Dee and Joo (1993) estimated an increase...
of 14 to 30 days in the finishing stage attributable to PRRS virus in combination with secondary bacterial agents. They estimated an additional cost to finish such pigs at $7.50 to $15.00 per pig marketed due to reduction in growth rates, increased mortality, and increased numbers of non-marketable pigs associated with PRRS virus infection. Kerkaert et al. (1994) reported a 70 percent loss in profits in a feeder pig operation due to endemic PRRS virus infection in the nursery. A reduction in over $5.00 per pig was attributed in the nursery stage alone due to decreased growth rates, increased feed conversion, and increased mortality. Dee and Joo (1994) estimated the cost of an endemic PRRS nursery problem in a 600-sow herd at $225 per sow per year ($10.50 to 12.50 per pig marketed). This cost estimate was based on a 10 percent nursery mortality, a 50 percent reduction in average daily gain, and a 33 percent rate of non-marketable pigs.

Using a financial model, Polson et al. (1994) estimated that the difference between affected and non-affected nursery pigs ranged from $0.73 per head placed on feed to $18.21 per head placed. This model utilized baseline assumptions (below) while varying the impact on ADG and mortality:

1. Average daily gain (ADG) = 0.8 pounds per head per day
2. Feed-to-gain (F/G) = 1.75 pounds
3. Weigh of pigs entering the nursery = 12 pounds
4. Days on feed = 42 days
5. Non-feed variable costs per pig = $1.00 per pig
6. Feed costs = $200 per ton
7. Feeder pig price = $0.95 per pound

As shown in Table 2, as either ADG worsened or mortality increased, the observed difference in financial impact between affected and non-affected pigs increased. These estimates also provided for the length of an acute outbreak or episode as it affected ADG. As expected, the longer the episode, the greater the increase in financial impact.

Based on the information in the published literature, the average cost of PRRS in the growing pig would be between estimated at between $6.25 and $15.25 per pig.

Dee and Joo (1993) $7.50 to $15.00 per pig
Kerkaert et al. (1994) $5.17 per feeder pig
Dee and Joo (1994) $10.50 to $12.50 per pig
Polson et al. (1994) $0.73 to $18.21 per pig
Average cost $6.25 to 15.25 per pig

While the estimates in the literature are accurate for the herds that were evaluated, the impact of PRRS virus on performance (and subsequently, on profits) will vary for specific herds. In addition, market conditions, such as feed costs and live hog prices, will affect the magnitude of the financial impact. For those reasons, sensitivity analyses are useful to estimate the impact of PRRS in specific herds.

Using the key parameters affected, namely, average daily gain (ADG), feed efficiency (F/G), and percent marketable pigs (excludes culls and mortality), the results of a simple sensitivity analysis is provided in Table 3 for low, moderate, and high impact scenarios. The baseline assumptions for these analyses included an incoming pig weight of 50 pounds, 130 days on feed, 1.6 pounds of gain per day, and a feed efficiency of 3.0. The low impact scenario assumes a 3 percent improvement in marketability (an increase from 85 to 88 percent associated with a reduction in mortality from 5 to 4 percent and a reduction in culls from 10 to 8 percent) and a 0.05 improvement in ADG and F/G. The moderate impact scenario assumes an improvement of 5 percent marketability (an increase from 85 to 90 percent associated with a reduction in mortality from 5 to 3 percent and a
Table 3: Sensitivity analyses for low, moderate, and high impact scenarios of PRRS in finishing stage with varying live hog prices and feed costs

<table>
<thead>
<tr>
<th>Live hog price</th>
<th>Feed cost per pound</th>
<th>$0.42</th>
<th>$0.45</th>
<th>$0.48</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.060</td>
<td>$4.59</td>
<td>$4.99</td>
<td>$5.40</td>
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</tr>
<tr>
<td>$0.075</td>
<td>$4.33</td>
<td>$4.73</td>
<td>$5.13</td>
<td></td>
</tr>
<tr>
<td>$0.090</td>
<td>$4.06</td>
<td>$4.47</td>
<td>$4.87</td>
<td></td>
</tr>
</tbody>
</table>

Moderate impact scenario: 0.1 decreased ADG, 0.1 increased F/G, and a 5 percent decrease in percent marketable pigs

<table>
<thead>
<tr>
<th>Live hog price</th>
<th>Feed cost per pound</th>
<th>$0.42</th>
<th>$0.45</th>
<th>$0.48</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.060</td>
<td>$8.42</td>
<td>$9.16</td>
<td>$9.90</td>
<td></td>
</tr>
<tr>
<td>$0.075</td>
<td>$7.95</td>
<td>$8.69</td>
<td>$9.42</td>
<td></td>
</tr>
<tr>
<td>$0.090</td>
<td>$7.47</td>
<td>$8.21</td>
<td>$8.95</td>
<td></td>
</tr>
</tbody>
</table>

High impact scenario: 0.15 decreased in ADG, 0.15 increased F/G, and a 10 percent decrease in percent marketable pigs

<table>
<thead>
<tr>
<th>Live hog price</th>
<th>Feed cost per pound</th>
<th>$0.42</th>
<th>$0.45</th>
<th>$0.48</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.060</td>
<td>$14.92</td>
<td>$16.22</td>
<td>$17.52</td>
<td></td>
</tr>
<tr>
<td>$0.075</td>
<td>$14.11</td>
<td>$15.41</td>
<td>$16.71</td>
<td></td>
</tr>
<tr>
<td>$0.090</td>
<td>$13.29</td>
<td>$14.59</td>
<td>$15.89</td>
<td></td>
</tr>
</tbody>
</table>

reduction in culls from 10 to 7 percent), 0.1 ADG, and 0.1 F/G. And the high impact scenario and assumes a 10 percent improvement in marketability (an increase from 80 to 90 percent associated with a reduction in mortality from 7 to 4 percent and a reduction in culls from 13 to 6 percent) and a 0.15 improvement in ADG and F/G.

The Financial Impact of PRRS Intervention

The importance and cost of the proper diagnosis

PRRS is often blamed for performance problems that either are not caused by PRRS virus or are not due to PRRS virus alone. In breeding herds, when farrowing rates or litter size fall below expectations, PRRS is frequently held accountable. In the growing pig, PRRS virus is often considered responsible for respiratory disease and poor performance. Sometimes the blame is justified; all too often, it is not. Many times, there are infectious and/or management factors which, in addition to PRRS (or even instead of PRRS), are deserving of as much or more attention. Although a complete and thorough diagnostic workup may cost hundreds of dollars, the question must be asked, “What is the cost of not having the proper diagnosis?”

It is not sufficient to determine that a herd is PRRS virus positive or negative; nor is it enough to simply associate clinical problem(s) with PRRS virus isolation or antibody seroconversion. Instead, a thorough diagnostic effort must make the effort to identify other disease-causing agents that may be contributing to PRRS, or perhaps have even been mistaken for it. Due consideration must also be given to the non-infectious factors that often precipitate infectious diseases and even cause the problems that are blamed on infectious agents. To not do so leads to waste as financial and time resources are invested in useless intervention/prevention efforts and lost production opportunity, while problems continue to go unresolved.

Once a definitive PRRS diagnosis has been made, the first consideration for intervention is to determine where the circulation of the PRRS virus is occurring within a herd. The primary transmission of PRRS virus is pig-to-pig, which can be either vertical (sow-to-piglet) or horizontal (pig-to-pig, sow-to-sow). It is critical to understand the cycle of transmission within a herd before beginning intervention, especially
If the sow herd is unstable and there is vertical transmission to the growing pigs, an intervention strategy to eliminate PRRS virus in the growing pigs will fail both biologically and fiscally by not providing a return on investment. On the other hand, if the sow herd is stable (not transmitting PRRS virus to offspring), then an elimination strategy such as nursery depopulation or mass vaccination and unidirectional flow can be beneficial.

The specific PRRS virus transmission pattern within a herd can be determined by serologic monitoring, beginning with a cross-sectional profile of the breeding herd and growing stages (sites). The transmission patterns or classifications are described in Table 4. The cost of transmission profiling will vary depending upon the size of the herd and frequency of testing. Frequency of testing is related to the confidence of findings, especially for elimination or detection strategies. Table 5 describes the annual cost of testing a herd on a per sow and per pig basis (assuming 20 pigs per sow per year) for a variety of herd size and pig flow combinations. Assumptions in estimates presented in Table 5 include:

1. $5.00 per sample cost at the laboratory. This does not include the cost of collection, which may increase costs an additional 20 percent above that described in Table 5.
2. 30 randomly selected animals from the breeding herd are tested monthly.
3. 15 pigs are sampled at exit from each nursery and finisher from each pig flow.
4. The number of pigs tested is the same regardless of group size and, therefore, less on a per pig basis in larger groups.

While this sampling protocol may be adequate for transmission profiling, more samples (and thus higher costs) would be required to provide adequate power for detection in negative herds. Finally, a single point-in-time (cross-sectional) testing could be considered as a first step. This would reduce the initial testing costs, but would need to be interpreted carefully in terms of herd classification and providing the basis for intervention strategies.

A partial budget approach to selecting an intervention strategy

PRRS intervention should be viewed as a step-wise progression of achieving stabilization (moving from unstable to stable) that may or may not be followed by
elimination (stable to negative). Potential intervention options to achieve either stabilization or elimination objectives are listed in Table 6.

The selection of a specific PRRS intervention strategy to achieve either stabilization or elimination should be based upon estimated costs of the intervention and the benefit or return on that investment. Partial budgeting, as described by Boehlje and Eidman (1984), can be a valuable tool in the intervention process. Partial budgets are used to estimate the change in profit or loss associated with some change in the operations procedures (i.e., intervention to stabilize or eliminate PRRS virus). The general format of a partial budget consists of four categories that should be interpreted as changes from the base plan (i.e., no PRRS intervention).

In a partial budget, the first category is any additional income (AI) that the intervention could be expected to provide (i.e., improved performance resulting in more pounds of pork sold). The second category is any reduced expense (RE) that could be associated with the implementation of the intervention strategy (i.e., reduction in individual animal treatment costs). The third category is any reduced income (RI) (i.e., herd closure resulting in decreased throughput and thus less pounds of pork sold) anticipated from the intervention strategy. The fourth category accounts for any additional expenses (AE) from the intervention itself (i.e., costs of vaccine and labor to vaccinate) as well as any other costs that could be associated with the intervention (a net increase in feed consumed as a result of an increase in average daily gain that is not offset by any decrease in feed conversion). The net partial budget equation yields a value for net difference (ND).

$$ND = [(AI + RE) - (RI + AE)]$$

An example of the partial budget format is shown in Table 7.

To use the partial budget assessment, estimate a value for each of the appropriate categories comparing the

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**Table 6: Intervention options**

<table>
<thead>
<tr>
<th>Intervention objective</th>
<th>Intervention strategy</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stabilization of breeding herd</td>
<td>Herd closure</td>
<td>Torremorell et al., 2000</td>
</tr>
<tr>
<td></td>
<td>Mass vaccination</td>
<td>Sanford, 2000</td>
</tr>
<tr>
<td>Stabilization of the growing pig</td>
<td>Management (McRebel™)</td>
<td>McCaw and Henry, 1995 (also see Chapter 10)</td>
</tr>
<tr>
<td></td>
<td>Vaccination</td>
<td>Gorcyca et al., 1995</td>
</tr>
<tr>
<td>Elimination in the breeding herd</td>
<td>Herd closure</td>
<td>Torremorell and Christianson, 2001 (also see Chapter 10)</td>
</tr>
<tr>
<td></td>
<td>Test and removal</td>
<td>Dee et al., 2001</td>
</tr>
<tr>
<td></td>
<td>Depopulation/Repopulation</td>
<td>Leman, 1991</td>
</tr>
<tr>
<td>Elimination in the growing pig</td>
<td>Vaccination and unidirectional flow</td>
<td>Dee and Philips, 1998 (also see Chapter 10)</td>
</tr>
<tr>
<td></td>
<td>Nursery depopulation</td>
<td>Dee et al., 1998</td>
</tr>
</tbody>
</table>

**Table 7: Partial budget format with potential intervention budget items**

<table>
<thead>
<tr>
<th>Potential intervention budget items</th>
<th>Additional income</th>
<th>Reduced expenses</th>
<th>Reduced income</th>
<th>Additional expenses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential outcomes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased pigs weaned</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased pounds sold</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Improved feed conversion</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Reduced animal treatments</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Potential intervention options</td>
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<tr>
<td>Diagnostic submissions</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Vaccination</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Labor</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Closed herd/depopulation</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Additional facilities</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
impact of the intervention strategy to your baseline (current performance with no intervention). Once all potential changes associated with the intervention are accounted for, a net difference to the operations can be calculated. The subtotal of (additional income + reduced expenses) minus the subtotal of (reduced income + additional expenses) is an estimate of the impact the intervention will have on the operation measured as a “net difference.”

The net difference (or net return) for the intervention can then be used to calculate the benefit:cost ratio. The “net difference” from the partial budget includes the influence of the direct cost of the intervention. In contrast, the “benefit:cost ratio” (BCR) is calculated by dividing the net return, excluding the direct cost of the intervention (DCI) (i.e., “benefit”), by the direct cost of the intervention (i.e., “cost”), resulting in a “benefit:cost ratio.” That is,

$$\text{BCR} = \frac{(AI + RE)(RI + AE - DCI)}{DCI}$$

An example of the use of partial budgeting and the subsequent benefit:cost ratio is described in the literature as a case study in which the impact of vaccination with a modified-live PRRS vaccine at weaning in a system with a PRRS stabilized breeding herd and unstable growing pig herd was evaluated (Polson et al., 2000). Weighing the “benefit” (as measured by a reduction in mortality from 5 to 3 percent and an improvement in ADG from 0.59 to 0.79 pounds per head per day) against the “cost” (additional expense of vaccine and labor to administer) resulted in a benefit:cost ratio range of 2.4:1 to 22:1, depending upon the value of feeder pigs ($0.30 to 0.90 per pound).

A BCR of 2.0 means that there is a $2.00 benefit for every $1.00 of direct intervention cost. In contrast, a BCR of 0.5 means that there is only a $0.50 benefit for every $1.00 of direct intervention cost. Where the BCR is 1.0, there would be a $1.00 benefit for every $1.00 of direct intervention cost.

When doing partial budgets, it is also of value to do a “sensitivity analysis” (Boehlje and Eidman, 1984). As previously demonstrated in Table 3, a sensitivity analysis involves varying some of the input measures (impact on performance, feed cost, market price, intervention cost) to see how they change the output measure (net difference or benefit:cost ratio). In this way, you can assess the potential impact of an intervention if the effect was smaller and/or greater than what you expected.

References


