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Production Assistants
Steven Claas
Lynn Leary

Layout
David Brown

Logo Design
Ruth Cronje, and Jan Swanson;
based on the original design by Dr. Robert Dunlop

A quantitative approach to sampling studs

Albert Rovira, DVM, MS, Claudia Muñoz-Zanzi, MV, MPVM, PhD
University of Minnesota

During the last decade, most boar studs have achieved a PRRSV negative status. However, some of them became reinfected. In many cases, reinfection of negative boar studs remained undetected until sow farms became infected through semen. Therefore, traditional protocols to monitor PRRSV in boar studs proved inefficient. During the last few years, veterinarians have implemented different changes in monitoring protocols, in an attempt to improve their early detection capability. As a result of these changes there is a large variety of different protocols in use that have not been evaluated.

This report summarizes the preliminary results of a NPB funded project that aims to investigate the effectiveness of different PRRSV monitoring protocols for boar studs using a Monte Carlo simulation modeling approach. The Monte Carlo model developed simulates the introduction and transmission of PRRSV into a negative herd, including the changes in infection, shedding, and serology status in each boar over time. Specific assumptions were made for duration of PCR positive serum, PCR positive semen, and ELISA positive serology after infection from published data. Based on this model, protocols with different sample size, sampling frequency and sampling specimen/diagnostic test have been evaluated and compared in terms of performance and cost. Performance is expressed in terms of probability of early detection (PED) during the first 2 weeks after introduction (early detection). These preliminary results examined the use of PCR and ELISA on individually tested samples.

Effects

Sample size

Increase in sample size effectively increases early detection. This effect is more evident with frequent sampling (daily as opposed to monthly) and with sample sizes between 5 and 30 boars.

Sampling specimen

Serum PCR is more effective in the early detection of PRRSV outbreaks, followed by semen PCR and serum Elisa. There is no evident benefit in testing sera for both Elisa and PCR instead of only PCR.

Sampling frequency

Increase in sampling frequency effectively increases early detection. For example, if our budget allows us to test 40 boars a month by serum PCR, we are more likely to detect an outbreak by testing 10 samples a week (PED=0.43), than by testing 20 samples biweekly (PED=0.37) or 40 samples once a month (PED=0.27) (**Figures 1-4**).

Figure 1: Effect of sample size and specimen on the performance of daily protocols

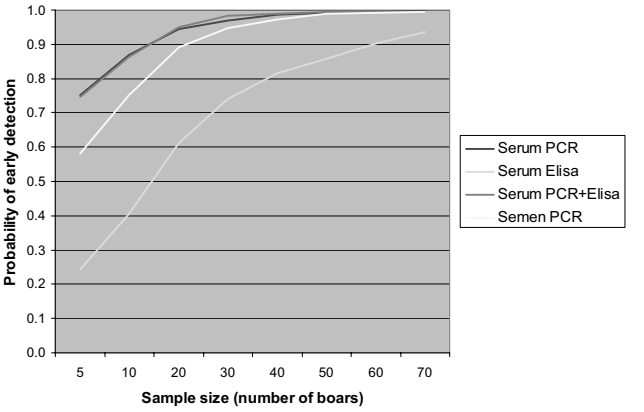


Figure 2: Effect of sample size and specimen on the performance of weekly protocols

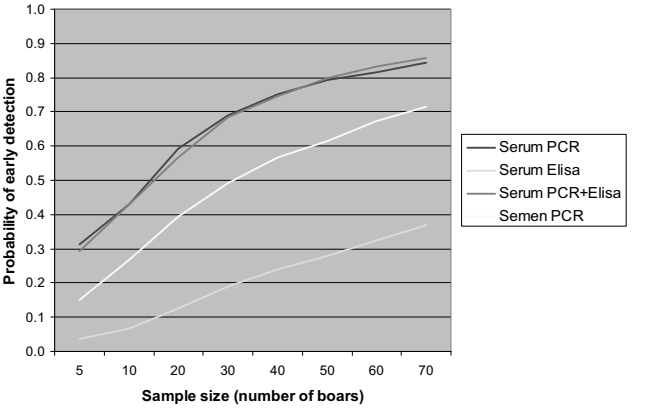


Figure 3: Effect of sample size and specimen on the performance of biweekly protocols

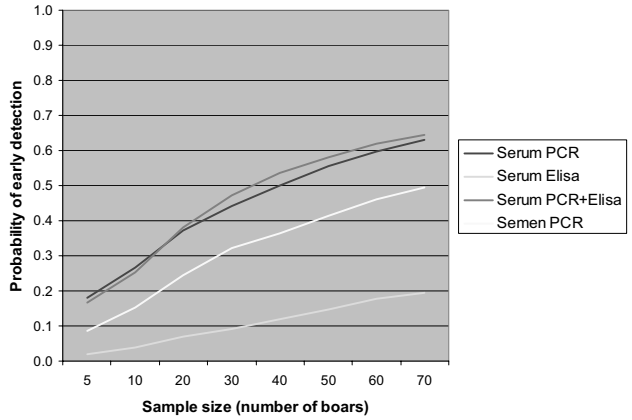
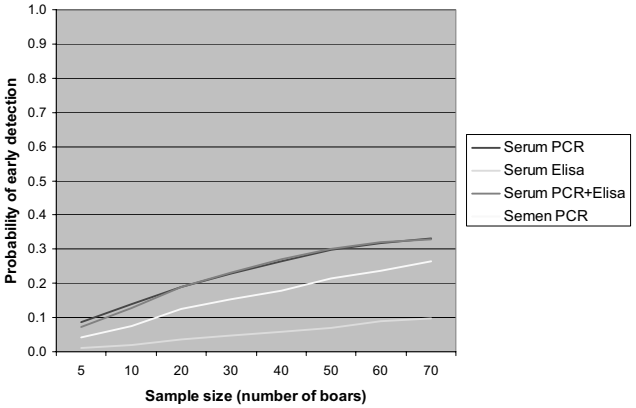


Figure 4: Effect of sample size and specimen on the performance of monthly protocols



Determination of optimum protocols for different cost levels

Cost for PCR and Elisa tests were assumed to be $21.5 and $4.50, respectively (cost does not include sampling costs). As expected, protocols using larger sample size, more frequent sampling and PCR instead of ELISA were the most effective. However, these are also the most expensive. Therefore, protocols that maximize early detection were identified for different budgets. Optimum protocols as well as their related costs and probability of early detection are reported in **Figure 5**:

Whether the optimum protocol is used, the higher the budget available for monitoring, the higher the capability of early detection. However, the most likely real-life scenario is the availability of a fixed, limited budget for monitoring. Therefore, it is important to identify the optimal protocol for the available budget in order to make the most of the expense, time and labor. For example, testing 30 boars by semen PCR weekly would cost $2,580 with a PED of 0.5, whereas testing 20 boars by serum PCR weekly would be less expensive ($1,720), and would provide a PED of 0.6.

In general, the use of serum PCR samples and the increase in the sampling frequency are more cost-effective strategies than the use of large sample sizes. PCR testing of pooled serum samples would potentially decrease testing costs, assuming that PED can be maintained.

Future modifications of the model will allow us to evaluate the blood swab as a sampling specimen and to evaluate the effect of pooling samples.

Figure 5: Early detection capability of optimum protocols for different cost levels