

A Systematic Evaluation of the Evidence for Porcine Reproductive and Respiratory Syndrome Vaccine Efficacy on Reproductive Performance in Sows

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Summary and Implications

Porcine Reproductive and Respiratory Syndrome (PRRS) virus was estimated in 2005 to cost U.S. pork producers \$560 million annually, of which \$67 million was attributed to reproductive disorders in breeding herds. The objective of this report was to provide a comprehensive, systematic review and quality assessment of all available research reports evaluating the use of commercial PRRS vaccines in breeding stock. To achieve the study objective, the systematic review methodology was adopted. The objective of this review therefore was to answer the question, "What is the effect of vaccination with a commercially available PRRS vaccine on the reproductive performance of breeding age female swine?" Four components of the question for a systematic review for an intervention consist of the population of interest, intervention, comparator, and outcome of interest (PICO). All potentially relevant primary research studies were identified, screened for relevance, assessed for standard design features, and if passing both the relevance and quality criterion, were extracted. The evaluation allows us the conclusion that there is a large volume of evidence discussing the effects of PRRS vaccination on reproductive parameters, but the studies are variable in the consistency of reporting and the approach used to measure these values. Based on the evidence gathered from this systematic review a positive benefit on reproductive parameters is reported with the use of vaccination. Practitioners bear the responsibility of assessing the validity of the experimental design and analysis as part of determining the evidentiary value of the conclusions relative to the vaccination decision they are making.

Introduction

Neumann and Kliebenstein (2005) estimated that Porcine Reproductive and Respiratory Syndrome (PRRS) virus cost the U.S. pork producers \$560 million annually, of which \$67 million was attributed to reproductive disorders

in breeding herds. The PRRS virus presents clinically in two ways, reproductive manifestations in breeding stock and respiratory manifestations in nursery and grow-finish pigs. The virus reduces farrowing rates on average by 13.8 %, pigs weaned per sow farrowed by 1.5 pigs, and pigs weaned per sow per year by 4.7 pigs. Several strategies have been utilized to limit the effects of PRRS on a sow herd including all-in/all-out pig flow, planned exposure to wild type virus, herd roll-over, depopulation, and vaccination. The volume of reports about PRRS interventions makes it difficult for practitioners in the field to efficiently access, assess and apply scientific research to make an informed decision about the implementation of a PRRS vaccination in their individual situations. The objective of this report was to provide a comprehensive, systematic review and quality assessment of all available research reports evaluating the use of commercial PRRS vaccines in breeding stock.

Materials and Methods

A systematic review methodology was adopted rather than a traditional narrative review. Systematic reviews address a focused question, using repeatable, transparent methods to identify, evaluate, and summarize scientific evidence related to disease diagnosis, intervention or prevention (Sargeant et al., 2006). The goal of the systematic review methodology is to reduce bias during selection of research studies through use of a systematic process. The transparency of the process allows the reader to judge the conclusion and the strength of evidence used to reach the conclusion. These characteristics set systematic reviews apart from narrative reviews. The question posed be answered by this review process was;

"What is the effect of vaccination with a commercially available PRRS vaccine on the reproductive performance of breeding age female swine?"

PICO: the four components of the question for a systematic review for an intervention consist of the Population of interest, Intervention, Comparator, and Outcome of interest (PICO).

Population of interest: defined as breeding age females managed in conventional facilities. Conventional facilities were defined as animals housed in confinement buildings consistent with modern swine production methods including but not limited to gestation and farrowing stalls, mechanical ventilation, mechanical manure handling systems and typical industry space recommendations. Breeding age

females were defined as gilts eligible for breeding or sows currently used for breeding purposes.

Intervention: defined as the use of a commercially available PRRS vaccine. Commercially available was defined as a vaccine meeting the requirements of the United States Food and Drug Administration or European Union vaccine approval process and available for use in the swine industry.

Comparator: defined as no vaccination against PRRS virus.

Outcome of interest: defined as any quantitative measure of reproductive performance including but not limited to:

farrowing rate, pigs born alive, stillborn piglets, mummified fetuses, pre-wean mortality, pigs weaned, rate or timing of returns to estrus and abortions. **Review process:** after identification of the review question, the review process consisted of four steps: 1) **identification** of a comprehensive list of all potentially relevant primary research studies; 2) **screening** of the identified studies for relevance using a team of reviewers and standardized criterion; 3) **assessment** of relative articles for quality using a team of reviewers and standardized criterion; and 4) **extraction** of data that passed both relevance and quality criterion.

Identification of a comprehensive list of all potentially relevant primary research studies: Based on these definitions a search string consisting of components: “population of interest” AND “disease” AND “intervention” was constructed using the search terms listed in Table 1 and the seven electronic databases used are listed in Table 2.

Table 1. Search terms used in the literature review.

Population	Disease	Intervention
hog	PRRS	vaccine
hogs	porcine reproductive and respiratory syndrome	vaccines
swine	PRRSv	vaccination
swines	porcine reproductive and respiratory syndrome virus	vaccinations
pig	PRRSV pneumonia	immunization
pigs	PRRS pneumonia	immunizations
finisher	Blue Ear Disease	immunize

Table 2. Search results from each database.

Database	Number
AGRICOLA	512
Agris	131
Biological and Agricultural Index	2
Biosis Previews	465
CAB Abstracts	334
Medline	219
PubMed	248
2006 Swine Information CD	24
Total (with duplicates)	1935

* No other language or year restrictions were imposed.

Screening of the identified studies for relevance using a team of reviewers and standardized criterion: Abstracts from the initial search were downloaded into a reference management database. Duplicate abstracts were removed. The relevance of abstracts identified in the search was assessed by two independent reviewers using the following criteria: (1) does this abstract report primary research? (2) does this abstract report use of a commercially available vaccine (not autogenous)? (3) does this abstract report application of the intervention to sows and/or gilts? (4) does this abstract report quantitative measurement of at least one reproductive parameter including but not limited to farrowing rate, pigs born alive, stillborn piglets, mummified fetuses, pre-wean mortality, pigs weaned, returns to estrus and abortions? The abstract was removed from the study if either reviewer responded “no” for any of the questions. If a sound relevance assessment could not be made from the abstract the full text was evaluated.

Assessment of relevant articles for standard design features using a team of reviewers and standardized criterion: For abstracts passing the relevance screening the full manuscript was obtained. Articles not written in English were excluded. When the full text of the articles could not be found the article was excluded. Full reports of abstracts were read, and if still considered relevant, were assessed for the presence of standard design features by two independent reviewers. The standard design features were: 1) randomization to intervention group, 2) use of a control group and, 3) blinding of observers from the identity of the intervention groups. These study features were evaluated as they represent an important role in reducing study bias. Only articles describing these three criteria were passed for data extraction and evidence summation.

Extraction of data that passed both relevance and quality criterion: Data extraction was completed by one reviewer and when unclear this reviewer consulted with the other authors as needed. For articles remaining in the review after relevance and quality screening, data were summarized and reported. Data extracted including randomization type, intervention protocols, challenge type, description of control

groups, and reproductive parameters was collected. Conclusions were based on the summary of the data.

Results and Discussion

The electronic searches yielded 1935 abstracts, 1911 from the seven electronic databases and 24 from the 2006 swine information CD (Table 2). After de-duplication 841 references remained. Of the 841 references, 164 could not be assessed based on information in the abstract, therefore full text copies were obtained. Full text copies of nine articles were not found and were removed from the review. At the conclusion of the relevance screening process, 20 manuscripts remained for quality assessment. Nine of twenty articles were obtained from conference proceedings, the remaining 11 articles were peer reviewed. Failure to report of blinding of the observer and/or omitting to report the use of a contemporary control group were the most common reasons for removal at the quality assessment stage. Six of the 20 articles used the word “random” when discussing the allocation of intervention groups. However, only 2/20 articles described the method of randomization. Only eight of twenty articles used a contemporary control group. The remaining 12 articles used pre-vaccination herd production records to quantify the effect of the vaccination in place of controls. The only article relevant to the original clinical question and that reported all three quality criteria

were published by Pejsak et al. (2006) by and the results from that publication are summarized in Table 3.

Table 3. Pejsak Z. Markowska-Daniel I. Randomized, placebo-controlled trial of a live vaccine against Porcine Reproductive and Respiratory Syndrome Virus in sows on infected farms. *Veterinary Record*. 2006;158:465-478.

Variable	Group ¹		P-value
	A	B	
Return to estrus %	4.08	7.00	0.005
Live born piglets per sow	10.20	9.87	0.030
Weaned piglets per sow	9.50	9.13	0.004

¹Group A- Received one dose of live vaccine and Group B- received one dose of placebo

Given the prevalence, economic impact, and potential cost of interventions only the strongest evidence should be used to guide intervention decisions for PRRS field cases. Based on the evidence gathered from this systematic review a positive benefit on reproductive parameters is reported with the use of vaccination. This review revealed the need for stronger evidence to assess the impact of vaccination for PRRS. The evaluation allows us to conclude that there is a large volume of evidence discussing the effects of PRRS vaccination on reproductive parameters, but the studies are variable in the consistency of reporting and the approach used to measure these values.