Risk Assessment of Disease in Swine Production – Potential Application to PCVAD

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Iowa State University

Outline of Presentation

• Past, present and future of the PRRS Risk Assessment Tool for the Breeding Herd
• Purpose of the tool and database
• Overview of the tool and database
• Things we have learned from mining the database of assessments
• Application of Risk Assessment to PCVAD – Risk Factors

Acknowledgements

• Dale Polson (BIV)
• Tom Burkgren (AASV)
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• Dale Spiess (BIV)
• Pam Zaabel (NPB)
• Paul Sundberg (NPB)

History of Development

• Fall-2002: Design and development of the PRRS Risk Assessment for the Breeding Herd was done at Boehringer Ingelheim Vetmedica (BIV) – work began in fall of 2002
• March 2005: BIV offered to gift the tool to the American Association of Swine Veterinarians (AASV)
• March 2006: AASV, with support from National Pork Board (NPB) accepted the gift
• September 2006: Iowa State University College of Veterinary Medicine, Food Supply Veterinary Medicine entered into an agreement with AASV to establish a Disease Risk Assessment Program to develop, manage and promote disease risk assessment tools and databases of completed disease risk assessments held by AASV
Present

- Collaborative effort
  - AASV
  - NPB providing financial support
  - USDA, APHIS providing financial support
  - ISU providing program coordination
  - Boehringer Ingelheim Vetmedica providing in-kind support
- Current version of the tool was developed using Microsoft Excel® and Visual Basic for Applications® (VBA)
- Risk Benchmarking Reports on submitted assessments are provided to veterinarians upon request
- Face-to-face meetings with veterinarians to present and discuss the Risk Benchmarking Reports are also being conducted

By the Numbers

- 71: Number of veterinarians that have been trained to use version 2 of the PRRS Risk Assessment Tool for the Breeding Herd
  - 55 in AASV sponsored training session
  - Remainder were trained prior to transfer to AASV
- 403: Number of assessments that have been completed and submitted to the database of version 2 assessments
  - Another 320 assessments were completed using version 1 of the Risk Assessment Tool and submitted to a separate database

Future

- Web version of the tool is currently being developed
  - Introduction of the web version is expected in mid-2007
- Research projects using the Risk Assessment Tool - Ongoing
- Continued development
  - Improvement and refinement of PRRS Risk Assessment for the Breeding Herd
  - Expansion to other diseases, other stages of production and perhaps other species

Access to the Risk Assessment Tool

- To insure the validity and quality of the data collected with the assessments use of the tool is restricted to trained veterinarians
- Veterinarians may attend an AASV hosted training session
  - Contact the Executive Director of AASV, Dr. Tom Burkgren to let him know your interest
    - (515) 465-5255
    - aasv@aasv.org
  - Most training sessions will be held in conjunction with conferences or other events
- Producers with interest in PRRS risk assessment are being directed to their veterinarian(s)
Purpose of The Risk Assessment Tool

• Educate and increase awareness of risks related to PRRSv
• Support prior biosecurity recommendations
• Help identify and prioritize interventions to reduce / manage risk
• Track biosecurity improvement progress
• Justify expenditures for biosecurity

Aggregate external vs. internal risk index score
Company sites vs. all sites in database (2005)

<table>
<thead>
<tr>
<th>Risk Quadrant</th>
<th>Internal and External Risk Index Scores - Individual Benchmarked Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Internal Risk Index Score</td>
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<tr>
<td></td>
<td>External Risk Index Score</td>
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<tr>
<td>Benchmarked</td>
<td>Internal Risk Index Score</td>
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<tr>
<td>Sites</td>
<td>External Risk Index Score</td>
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<tr>
<td></td>
<td>Benchmarked Against</td>
</tr>
</tbody>
</table>

Quadrant divisions are median internal and external risk scores for all sites in the database

Aggregate external vs. internal risk index score
Company sites vs. all sites in database (2006)

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<td>External Risk Index Score</td>
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Uses Continued

• Role in regional or national PRRSv eradication program
• Basis for epidemiological research to answer questions like
  – Why do some PRRS negative or naïve sites become positive while others do not?
PRRS Risk Assessment Tool for the Breeding Herd - Overview

- Consists of several sheets
- First sheet is the Main Menu
- The links to other sheets in the Main Menu are essentially the table of contents for the tool

Risks are Subdivided into Two Categories

- “External risks”: the risk of new introduction of a non-resident PRRSv into a pig population
- “Internal risks”: the risk of an existing or resident PRRSv circulating within its host pig population.

Categories of Risk

Hierarchy of External Risk Factors

<table>
<thead>
<tr>
<th>Organization Level</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>External Risks</strong></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Pig Related</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Live Animals</td>
<td></td>
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<tr>
<td>Replacement of live animals into the breeding herd</td>
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<tr>
<td>Animal Components</td>
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<tr>
<td>Entry of semen into the breeding herd</td>
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<tr>
<td>Non-pig Related</td>
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</tr>
<tr>
<td>Operations</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Transportation of live animals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation of feed</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Employees and service vehicles</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Disposal of dead animals and waste management</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Employees and visitors</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Entry of supplies</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Facilities</td>
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<td></td>
</tr>
<tr>
<td>Biocides</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Location</td>
<td></td>
<td></td>
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<tr>
<td>Density of pig farms in the area</td>
<td></td>
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<tr>
<td>Neighboring pig farms</td>
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<td></td>
</tr>
<tr>
<td>Distance to pork industry infrastructure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Topography and vegetation of surrounding area</td>
<td></td>
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</tbody>
</table>
Internal Risks Questionnaire

External Risks Questionnaire

PRRS Risk Assessment Tool for the breeding herd

Database & Benchmarking Tool

ISU College of Veterinary Medicine, Food Supply Veterinary Services
**Individual Risk Factors**

**Herd and Site Characteristics**
- **Size of Breeding Herd**
  - Above 3000
  - 2000 to 2999
  - 300 to 799
  - 299 or Less

**Parity Segregation**
- Mixed Parity
- All Gilt Farm
- All Parity 1+ Farm

**Average Parity of Breeding Herd**
- 1 to 2
- 2 to 3
- 3 or More

**Type of Breeding Herd**
- Commercial
- Genetic Multiplier
- Genetic Nucleus

**Characteristics of the Site**
- Stages of Production
  - Farrow to Wean
  - Wean to Finish
  - Farrow to Feeder

**Gestation Housing**
- Combination Pen and Individually Housed Gestation During Less Than 2 Weeks
  - Combination Pen and Individually Housed Gestation During More Than 2 Weeks
  - All Individually Housed Gestation

**Construction of Pens**
- Pen Dividers Are Open as With Gates
- Pen Dividers Are Solid

**Type of Watering System**
- Multiple Animal Waterers (Such as Troughs) Only
- Combination of Individual Animal Waterers (Such as Nipples or Cups) and Multiple Animal Waterers (Such as Troughs)
- Individual Animal Waterers (Such as Nipples or Cups) Only

**Type of Feeding System**
- Drop Feeders
- Hand Feeding

**Type of Waste Handling System**
- Shallow Pit Recharge / Pull Plug System
- Deep Pit
- Flushed System

**Use of Recycled Lagoon Water for Flush or Recharge**
- No
- Yes
Pareto Chart

Summary of What is in Assessment Database

<table>
<thead>
<tr>
<th>PRRS Status</th>
<th>Production Type</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative or Naïve</td>
<td>Commercial</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>Genetic</td>
<td>114</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>196</td>
</tr>
<tr>
<td>Positive</td>
<td>Commercial</td>
<td>185</td>
</tr>
<tr>
<td></td>
<td>Genetic</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>207</td>
</tr>
<tr>
<td>Total</td>
<td>Commercial</td>
<td>267</td>
</tr>
<tr>
<td></td>
<td>Genetic</td>
<td>136</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>403</td>
</tr>
</tbody>
</table>

Starting to Learn from the Data
- Benchmarking of Individual Risk Factors for “Best Biosecurity Practices”

- PRRS\(v\) positive vs. negative or naïve sites

Washing frequency of vehicles used to transport genetic animals

% of Sites in Database w/ Same Infection Status

- Never, rarely or unknown
- At least once per 10 loads
- Between every load

Negative or naïve sites: [Bar Graph]
Positive sites: [Bar Graph]
Drying time following wash of vehicles used to transport genetic animals

- No requirements
- Vehicles allowed to dry completely before next load
- Assisted drying technology is used to dry washed vehicles

Disinfectant use on vehicles used to transport genetic animals

- No disinfectant used or unknown
- Phenol-based compound (BioPhene, Environ, Tek-Trol, Laro, Lysol) or aldehydes (DC&R, Cidex, Formaldegen) used
- Hypochlorite (Clorox, Halazone, Chloramine-T) or peroxygen (Virkon) used
- Iodine (Wescodyne, Premise, Iofec, Iosdyn, Losan), or quaternary ammonium combinations (Synergize, Aseptol) used

Average annual employee turnover

- <25%
- 25% to 49%
- 50% to 74%
- 75% to 99%
- >=100%

Pig density (swine sites) total in a 5 mile radius of this site

- 0
- 1 to 5
- 5 to 9
- 10 to 14
- >=15
Starting to Learn from the Data

• High risk 20% vs. low risk 20% sites
  – Comparing 20% of assessments with highest aggregated external risk index score to those with lowest 20%
Sampling method of serum PCR testing of boars for PRRSv at site(s) from which semen is sourced

- % of sites in database in Top or Bottom 20% External Risk Scores

- Individual samples tested
- Pooled samples tested
- Unknown

Timing of semen use relative to acquisition of serum PCR test results

- % of sites in database in Top or Bottom 20% External Risk Scores

- Always used prior to obtaining PCR test results
- Sometimes used prior to obtaining PCR test results
- Never used prior to obtaining PCR test results

Flow restrictions on vehicles used to transport genetic animals

- % of sites in database in Top or Bottom 20% External Risk Scores

- No restrictions, the same vehicle may haul PRRSV positive and negative or naive animals
- The same vehicle can haul PRRSV positive and negative or naive animals but a minimum downtime is required before visits to negative or naive sites following last visit to positive site
- The same vehicle never hauls both PRRSV positive and negative or naive animals
- Truck(s) are dedicated to this site and do not haul animals from other sites

Route restrictions on vehicles used to transport genetic animals

- % of sites in database in Top or Bottom 20% External Risk Scores

- No special route selection practices
- Transport routes are outlined proactively to avoid roads with swine and swine-related sites along the route
New employees receive formal training on biosecurity procedures

Restrictions on employee access to site

Applying Risk Assessment to PCVAD
- What do we know, or think we know, about the risk factors for Porcine Circovirus Virus (Type 2) Associated Disease (PCVAD)?

Risk Factors - Herd and Site Characteristics
- Genetics
  - Litter effect
  - Breed predisposition
Risk Factors - Other Disease Challenges (Cofactors)

- Porcine parvovirus (PPV)
- Porcine reproductive and respiratory syndrome virus (PRRSV)
  - Timing of exposure, seroconversion in early finisher
- Mycoplasma hyopneumoniae
- SIV
- Others

Risk Factors - Managed Exposure

- PCV2 Vaccines
  - Merial
    - Sows
    - Single dose – gilts two
  - BIVI
    - Piglets
    - Single dose
  - Intervet
    - Piglets
    - Two doses
  - Fort Dodge
    - Piglets
    - Single dose

Risk Factors - Managed Exposure

- Vaccination for other pathogens (immunostimulation)
  - Focus of research has been on interactions with M. hyo vaccination
  - Adjuvant
    - Oil-in-water adjuvants
    - Aluminum hydroxide adjuvant
  - Timing
    - Earlier vaccination to reduce immunostimulation

Risk Factors - Managed Exposure

- Whole tissue homogenate autogenous vaccines
- Serotherapy
  - Acute and convalescent

Risk Factors - Managed Exposure

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Risk Factors - Management Practices

- Breeding herd
  - Fostering
  - Farrowing house animal flow
  - Continuous flow or not strict AIAO
  - Sanitation
  - Castration
  - Type and management of ventilation
  - Type and condition of buildings
  - Colostrum management

Risk Factors - Management Practices

- Grow-finish
  - Type and management of ventilation
  - Type and condition of buildings
  - Large pen size
  - Stocking density
  - Pig flow
    - Continuous flow or not strict AIAO
  - Feeder space

Risk Factors – Current and Historical PCV2 Status

- PCV2 Strain differences

Different forms of the Disease = Different Risk Factors?

- PCV2 Associated Disease (PCVAD)
  - Severe Systemic PCV2 Infection (Postweaning Multisystemic Wasting Syndrome; PMWS)
  - PCV2-associated Pneumonia
  - PCV2-associated Lymphoid Depletion
  - PCV2-associated Abortions and Reproductive Failure
  - PCV2-associated Myocarditis and Vasculitis in Growing Pigs
  - Porcine Dermatitis and Nephropathy Syndrome (PDNS)
  - PCV2-associated Enteritis
  - PCV2-associated Hepatitis
  - PCV2-associated CNS Disease
  - PCV2-associated Exudative Epidermitis
Well Defined Outcome Enhances Value of Risk Assessment

- Case definitions for PCVAD, Severe Systemic PCV2 Infection form of the disease
  - Presence of clinical signs such as wasting, weight loss, and respiratory disease
  - Presence of the hallmark PCV2-associated microscopic lesions (lymphoid depletion and/or histiocytic replacement of follicles in lymphoid tissues or both)
  - PCV-antigen or nucleic acids associated with the microscopic lesions as determined by IHC or ISH (Sorden, 2000).

Questions???