PRRS, PEDV, Senecavirus A (SVA): A Review of Recent Developments

Chris Rademacher, DVM

Iowa State University
Swine Extension Veterinarian
Agenda

• Update on PRRS
• Update on PEDV
• Update on Senecavirus A
PRRS Update - 2016

- Estimated to cost the US Swine Industry > $1 Billion USD per year (Holtkamp et al 2015).
- Emergence of new strains that are more virulent (1-7-4 and 1-3-4) on the tail of PEDV infection kept the US swine supply of pigs depressed in 2014.
- Eradication methods are successful on individual farms, but difficult in systems or pig dense regions.
  - Can get them negative, hard to keep negative farms from re-breaking.
Swine Health Monitoring Project – U of MN

2.2 M Sows = Approximately 1/3 of US Swine Industry

Courtesy of U of MN - SHMP
Swine Health Monitoring Project – U of MN

Chart 2 - PRRS aggregate prevalence of sow herd status (n=446) Beginning July 1, 2009

More MLV Vaccine Usage and Less LVI Usage

Classification Scheme
1. Positive Unstable
2. Positive Stable, Ongoing field virus exposure
3. Positive Stable, Live virus vaccinated
4. Provisionally Negative
5. ELISA Negative

Courtesy of U of MN - SHMP
PRRS Eradication vs PRRS Control – What’s Your Goal???

• Lots of farms have spent lots of time and money on eradication programs, only to have the farms break back!
• Herd closure has been successful in eliminating the virus, the problem has been keeping them negative.
• Keys to successful eradication and maintenance of PRRS negative status:
  – Density of pigs in the surrounding area
  – Outstanding Biosecurity and Biosecurity Audits
  – Filtration of Sow Farm → Particularly in swine dense areas

Derald J. Holtkamp, Paul E. Yeske, Dale D. Polson, Jamie L. Melody, Reid C. Philips

A prospective study evaluating duration of swine breeding herd PRRS virus-free status and its relationship with measured risk
Preventive Veterinary Medicine, Volume 96, Issues 3–4, 2010, 186–193
Fundamentals of Herd Closure

• Closing the Herd
  – Bringing into the farm all the replacements for the next 7 months (~210 days)
    • No more entries until the herd is re-opened to new replacements
  – Expose the herd to a PRRS virus – Different Methods
    • Wild strain of the farm – Live virus inoculation
    • MLV Vaccine only
    • Wild strain first, then MLV vaccine
    • Sometimes nothing
  – Designed to get the whole farm acclimated to PRRS
    • Virus will “burn itself out” and disappear as herd gains immunity
      – No susceptible animals left to “keep virus alive”
  – After wild type virus is gone, then use PRRS MLV vaccine to stimulate herd immunity and keep bad PRRS virus out.
Study design & methods

Breeding herds acutely infected with PRRSv

Herd closure + LVI (n=41)

Herd closure + MLV (n=20)

Time to negative pig (TTNP)

TTNP definition based on PRRSv monitoring:
- Herds were monitored for PRRSv by serum RT-PCR
- Monthly testing 30 piglets, starting at 12 weeks post intervention
- Herds achieved TTNP when 4 consecutive negative tests were obtained
  - Based on Am. Assoc. Swine Vet.’s PRRS herd classification 2b (Holtkamp et al., 2011)

Propective study:
Linhares, et al Preventative Veterinary Medicine 2014
Treatment: LVI vs MLV

Median TTNP and 95% CI:
LVI: 26.3 (22.57, 29.57)
MLV: 33.0 (32.00, 41.00)

(Log rank p-value 0.0171)
MLV herds had less total losses

Wilcoxon p-value 0.0171

Difference of 1,443 pigs / 1,000 sows
# PRRS Stabilization Project

## Performance Summary

<table>
<thead>
<tr>
<th></th>
<th>System A</th>
<th>System A Feeder Pig vs No-Vacc</th>
<th>System B</th>
<th>System C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursery ADG</td>
<td>23% increase</td>
<td>-</td>
<td>7% increase</td>
<td>10% decrease</td>
</tr>
<tr>
<td>Nursery Mortality</td>
<td>63% decrease</td>
<td>-</td>
<td>23% decrease</td>
<td>38% decrease</td>
</tr>
<tr>
<td>Finishing ADG</td>
<td>6% increase</td>
<td>5% increase</td>
<td>7% increase</td>
<td>2% increase</td>
</tr>
<tr>
<td>Finishing Mortality</td>
<td>33% decrease</td>
<td>32% decrease</td>
<td>35% decrease</td>
<td>30% decrease</td>
</tr>
<tr>
<td>W-F ADG</td>
<td></td>
<td></td>
<td></td>
<td>6% increase</td>
</tr>
</tbody>
</table>

Comparing 15-18 months before to 15-18 months after the project was initiated.

**Goal:** Produce PRRS negative pigs and then vaccinate them to minimize growing pig losses
Summary

• PRRS continues to be a very big and costly problem for the US swine industry.
• Herd closure is still the best tool to get rid of PRRSv from breeding herds (sow farms)
• Herd closure and PRRS vaccine provides a repeatable system to control PRRS and minimize the cost.
PEDV Overview

- Porcine Epidemic Diarrhea Virus (PEDv) is a coronavirus
  - Very similar to TGE (Transmissible Gastroenteritis)
- Primary clinical signs:
  - Severe diarrhea in pigs of all ages
  - Pigs <14 days of age are most susceptible
  - Off feed and some vomiting
  - Death is related to dehydration
- Spread via the fecal-oral route
- Incubation period is very short (12-24 hours) before clinical signs
  - Can shed the virus before clinical signs are seen.
- Very infectious – takes very little to infect pigs.
  - Thimble full – Infect every pig in the US
Current PEDV Monitoring – 2.1 Million Sows Reporting

Chart 4 - PED EWMA Analysis for years 2013 - 2017

Classification Scheme
1. Positive Unstable
2. Positive Stable, Ongoing field virus exposure
3. Provisionally Negative
4. Negative

Number of sows: #REF!
Number of farms: 1026

Recent PED EWMA

2/3/2017
PEDV Breaks – New Breaks or Re-breaks?

Chart 3 - PED quarterly incidence of infection by history of previous infection
Beginning May 2013

% of herds reporting infections

Chart Legend:
- No previous infection
- Previously infected
- EWMA
- Epidemic Threshold

Courtesy of U of MN - SHMP
PEDV Sow Farm Response

1. Confirm PEDV
2. Wean all pigs older than 10-12 days of age
3. Feedback entire breeding herd – fecal material neonates
4. Euthanize or abort the next 3 weeks of pigs being born
5. Clean farrowing houses, hallways extensively
6. Start trying to save newborn pigs 21 days after feedback.
7. Wash sows going into farrowing
8. Restrict movement of personnel in farrowing
PEDV Vaccine

• 2 commercially available vaccines
  – Harris (Label = 1 dose pre-farrow)
  – Zoetis (Label = 2 doses pre-farrow)

• Industry reports have been very positive, especially in chronically infected herds.
  – Help to clean farms up.

• Doesn’t appear there will be much value in naïve pigs.
  – Preliminary reports have demonstrated no value in challenge studies
% PWM in PEDV chronic herds

PEDV Vaccine helpful to clean up infected sow farms
Impact of sIgA and Lactogenic Immunity in Vaccinating Naïve and Previously Exposed Sows

Piglet mortality

sIgA levels in colostrum/milk

No Value in Vaccinating Naïve Sows/Gilts with Current PEDV Vaccines

Secretory IgA appears to be correlated with piglet survivability. Vaccine does not induce secretory IgA to protect piglets in naïve sows.

Courtesy of Trevor Schwartz 2015
PEDV Summary:

• Less PEDV related activity this past winter compared to last year.
  – “National herd immunity” and better biosecurity
• Production impact still significant to breeding herds
• Have a better understanding on risk factors and methods to inactivate virus
• Immunity looks to be fairly protective
  – We have tools to clean up farms and prevent chronic state
Seneca Virus A (Seneca Valley Virus)

- Senecavirus A is a non-enveloped single-stranded RNA virus of the family *Picronaviridae*.
  - Discovered in US in 1988
  - 2-4 cases per year investigated by USDA/APHIS. – Not a new disease
- Foot and Mouth Disease Virus (FMDV) and swine vesicular disease virus (SVDV) is also a member of this same viral family.
- Clinical signs are **INDISTINGUISHABLE** from any of the 4 Foreign Animal Swine Vesicular Diseases.
  - We must treat each case of vesicular disease as a possible Foreign Animal Disease!!
Current Status of Senecavirus A at ISU VDL

Senecavirus A PCR Positive Cases by Farm Type

Date by Week

# SVA PCR Positive Cases

- Sow
- Growing Pig
- Unknown/Other
Serial Shedding Evaluation from Market Pigs

- 1200 head finishing barn with report of acute lameness and vesicular lesions on snout and feet.
  - 20-30% prevalence initially (overnight)
  - Market weight animals
- Purchased 10 head of market animals after the barn recovered and rest were sold (28 days post-outbreak)
- Sampled serum, tonsil and rectal swabs at 36, 43 and 50 days post-outbreak.
Market Pig Shedding Study

Avg CT of Serial Sampling of 10 Market Pigs

Virus Isolation Negative on all samples!!
Seneca Virus Breeding Herd Cases

• Week of August 17th
  – Reports of high neonatal morbidity and mortality in pigs less than 7 days.
    • With or without diarrhea (more common with diarrhea)
    • Not usually finding much for other diarrhea agents
  – Some sows with high fevers early on (104-106°F)
  – Some sows not eating fully (not much for off feed)
  – Mortality is short lived (4-7 days)

Similar to reports from Brazil in 2014-2015
Seneca Virus Breeding Herd Cases

• With descriptions similar to these, pathologists began to run SVV PCR on various samples from submitted cases → started finding positives!!

• Upon further investigation, then finding evidence of vesicular disease in breeding age animals.
  – 10-40% prevalence
    • Vesicles or coronary band lesions
  – NO LESIONS IN PIGLETS, Gross or Histologically.
Senecavirus A in neonatal pigs
SVV PCR on neonatal pigs (less than 7 days)

Seneca Valley Virus PCR testing on neonatal piglets (less than 7 days of age)

Lots of virus, but NO DISTINCT HISTOLOGIC LESIONS
What’s been the impact on production?

- Small increase (2-5%) in % PWM for 1 week in most cases.
- May double % PWM if there are other agents present
  - Clostridium difficile
  - Rota virus
- No significant reports of reproductive impact (Conc. Rate, Farrow Rate, Litter Size)
Sow Serial Sampling Study

• Selected 11 affected litters and 11 unaffected litters randomly from the 4 youngest farrowing rooms.
  – Clinically affected: Extreme pre-weaning mortality with or without clinical evidence of vesicles on snout or coronary bands.
  – Clinically unaffected: Parity matched controls in close proximity to the affected litter selected.
Senecavirus A in neonatal pigs

Clinically Affected

Not clinically affected
Sampling

- Collected serum, oropharyngeal swabs and rectal swabs from:
  - Clinically affected sow and 2 of her piglets
  - Clinically unaffected sow and 1 piglet.
- Collected weekly samples for 6 consecutive weeks.
- First samples collected 8 days after clinical signs first reported.
- SVA PCR run on all samples and CT cutoff used = 40
SVA PCR - Sow PCR Results

PCR Cut Off at Ct =40, but true biological cutoff has not been established yet.
SVA PCR - Piglet PCR Results

PCR Cut Off at Ct =40, but true biological cutoff has not been established yet.
Virus Isolation Results

- All PCR positive samples at 6 weeks post-break were VI negative
- All Sow PCR positive samples for have been VI negative (Weeks 1 and 2)

Most likely only shed viable virus for 2-3 weeks
New isolates appear to be very different than the older ones and similar to Brazilian isolates.
Seroprevalence results

Total Prevalence

- **Sows**
  - 28.95% Positive
  - 71.05% Negative
  - Total = 1986

- **Piglets**
  - 14.23% Positive
  - 85.77% Negative
  - Total = 3971

Between Farm Prevalence

- **Sows**
  - 80.00% Positive
  - 20.00% Negative
  - Total = 75

- **Piglets**
  - 61.81% Positive
  - 38.19% Negative
  - Total = 144
Seroprevalence in adult pigs by state. Positive/total (percentage)
Seroprevalence in grower and fattener pigs by state.
Positive/total (percentage)
Disinfection Study – Goyal (U of MN)

- Evaluated 3 disinfectants at 4 deg C and 25 deg C on cement, aluminum, stainless steel, plastic and rubber boots.
  - 5% Household Bleach
    - Diluted at 1:20 (6.5 ounces per gallon)
  - Tek-Trol® (Phenolic Based Compound)
    - Manufacturer recommendation (1:250)
  - Synergize®
    - Manufacturer recommendation (1:256)

http://www.swinehealth.org/results
Disinfection Study – Goyal (U of MN)

• 5% Household Bleach at 1:20 dilution was the most effective at either temperature and on all surfaces.
  – Best results seen with 10-15 minute contact time

• Synergize was about equally effective at the labeled dilution rate, but with 60 minute contact time.
  – % reduction was not quite as high as the 5% Bleach (not significant)

• Tek-Trol (Phenol) did NOT appear to be very effective at all in any of the test conditions.

For more details ➔
http://www.swinehealth.org/results
What are the vectors?

• Summer time distribution of cases?
• Proposed transmission vectors?
  – Rodents
  – Insects
  – Exhibition Swine
What are the vectors?

• 2800 sow farm (MN) and sister farm (0.2 miles away)
  – Mouse and fly samples collected from unaffected herd (0.2 miles away)

• Fomite samples collected from affected farms
  – Feed
  – Flies
  – Rodents
  – Fan dust and ground outside
  – Semen
  – Injectable products
## Vector Testing for SVA

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>PCR Ranges</th>
<th>VI Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground outside farm/dust from exhaust fans</td>
<td>28.34-29.62</td>
<td>Positive</td>
</tr>
<tr>
<td>Internal Hallway Swab</td>
<td>22.92</td>
<td>Positive</td>
</tr>
<tr>
<td>Tractor Bucket (hauling mortality)</td>
<td>31.6</td>
<td>Positive</td>
</tr>
<tr>
<td>Mouse Feces (internal)</td>
<td>28-31</td>
<td>Positive</td>
</tr>
<tr>
<td>Mouse Feces (external bait box)</td>
<td>32-35</td>
<td>Positive</td>
</tr>
<tr>
<td>Mouse Intestines</td>
<td>31</td>
<td>Positive</td>
</tr>
<tr>
<td>Flies from Infected Farm</td>
<td>26-27</td>
<td>Negative</td>
</tr>
<tr>
<td>Flies from Outside of Unaffected Farm</td>
<td>31.67, 35.66</td>
<td>Negative</td>
</tr>
<tr>
<td>Personnel, Injectables, semen, feed,</td>
<td>Negative</td>
<td>Negative</td>
</tr>
</tbody>
</table>

Diel et al, Journal of Clinical Microbiology, June 2016 54:1536–1545
What should you do if you suspect SVA??

- If you see suspect lesions on nose and/or coronary bands?
  - Contact your veterinarian and State/Federal Officials
  - They will determine the next course of actions
- DO NOT attempt to sell pigs with active lesions.
  - Wait until they are completely resolved.
  - Be looking during the load out process
- See an increase in % PWM in neonatal pigs (less than 7 days)
  - Look for vesicular lesions → contact State/Federal Officials
Summary

- Seen a significant increase in cases of Idiopathic Vesicular Disease
  - Senecavirus A in all cases
- Senecavirus A in cases of increases in % PWM in neonatal pigs
  - Short duration (4-7 days)
- Clinical pictures match description of cases in Brazil over the past year.
- The virus may have changed from historical isolates.
  - This may explain the increase in the number of cases
Questions??

Chris J. Rademacher, DVM | Swine Extension Veterinarian
Iowa State University 2225 Lloyd Veterinary Medical Center | Ames, IA  50011
☎: (515) 294-8792  | ✉: cjrdvm@iastate.edu

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