PEDV Update and Lessons Learned

Lisa Becton, DVM, MS, DACVPM
Dir. Swine Health Information & Research
National Pork Board
Porcine Epidemic Diarrhea virus

• On May 17th, 2015 the US reached the 2-year mark post-diagnosis of the first case of PEDV.

• Since that time, nearly all major (and many not so major) swine states have had positive cases reported for PEDV.
  – 32 different states involved

• Swine Enteric Coronaviral Diseases (SECD) have “upped the ante” for biosecurity on-farm

• Highlighted gaps in protection for incoming diseases
Early Knowledge About PEDV in the US

- PEDV is in the same virus family as TGE & PRCV
- Different strains of PEDV exist with varying severity of clinical signs
- Genomic evaluation showed:
  - U.S. PEDV strain was 99.4% similar to a Chinese isolate from 2012 (strain info from Genbank)
  - Subsequent strains from Canada are similar to US strain
- Viruses considered part of SECD:
  - PEDV
  - Porcine Deltacoronavirus
  - TGE
PED Worldwide Status

- PEDV currently is active and considered endemic in different parts of the world
  - China, South Korea, Thailand, Vietnam, Japan and South America
  - Different from UK strain seen in the 1970’s
  - More virulent strains appeared in 2010 + and continues to be problematic
PEDV Messaging

• PEDV = fecal/oral method of infection and transmission
  – Transmits through contaminated manure
  – Keep from spreading through use of biosecurity plans

• PEDV does NOT affect pork and cannot infect humans...
  – PEDV is not a public health or food safety issue
  – Pork Is Safe!!!
Clinical Signs in Sows

• Sows were febrile, lethargic and scouring during late gestation or 2-3 days before farrowing

Courtesy of Dr. Joe Connor
PED in baby piglets – most severe

Day 1

Day 2

Day 3

Day 4

Courtesy of Dr. Joe Connor
Current Status of PEDV
National Status of PEDV

• Two main sources of information:
Federal Order on June 5, 2014 = PEDV/PDCoV now reportable diseases

Information is site-specific for PEDV + locations

Tracking of premises/cases is from June 5th, 2014 to current
Status to Date

Week Received

Number of Premises

DUAL INFECTION
PDCoV
PEDV
States with PEDV Cases

PEDV Confirmed Positive and Presumptive Positive Premises since June 5, 2014 (confirmed/presumptive)
Created: 09/22/2015
U.S. Swine Health Monitoring Project

752 breeding sites
(20 systems)

2.1M sows

http://www.cvm.umn.edu/sdec/SwineDiseases/pedv/index.htm
EWMA PEDV Graph

Chart 4 - PED EWMA Analysis for years 2013 - 2016

Weekly % cases at risk vs. Weekly # of new cases

EWMA weekly % cases at risk

- EWMA
- Epidemic Threshold
- Actual

5/4/13
Research for PEDV & PDCoV

2013
- ~$1 million for research
- Funded 14 projects
  - Basics of disease
  - Sow immunity (initial work)
  - Foundation for biosecurity

2014
- ~$2 million for research
- Funded 30 projects
  - Feed focus
  - Animal focus
  - Biosecurity validation
  - Disease monitoring

2015
- ~$150,000 for research
- Funded 2 projects
  - Vaccine platform
  - Chemical mitigants for feed

www.pork.org/PEDV
PEDV Research Priorities

Research Priorities – 2013:

• Basic Research of PEDV: (project duration = 6m)
  – Who - What - Where - When - Why - How...
  – Diagnostic test development
  – Basics of disease transmission and survivability

• Sow immunity: (project duration ~ 12 months)
  – Duration of immunity
  – Optimizing feedback protocols
  – Diagnostic tests to assess sow and piglet immunity to PEDV
PEDV/PDCoV Research For 2014

Research priorities – 2014:

- **Feed Focus:**
  - Risk assessment for feed as transmission source
  - Intervention methods for feed (pelleting/additives)
  - Post-processing time on virus
  - Novel bioassay models

- **Biosecurity Validation**
  - Manure management
  - Impact of lime?

- **Animal Focus:**
  - PEDV immunity development
  - PDCoV = pathogenicity & diagnostic test development
PEDV/PDCoV Research For 2015

• Hone in on more specifics of development, duration and optimization of sow immunity (based on 2013/2014 work)

• Feed interventions (based on info from 2014)
  ✓ RFP yet this fall (2015)

• Novel vaccine administration technologies
Virus survival - What have we learned?

Survivability of the virus

- PEDV can survive in many different conditions:
  - Pits; feed slurry; manure; water – fresh and recycle; feed ingredients
  - Survive in cold conditions
  - Survivability in pits can be time dependent
    - PEDV + PCR found at 4 & 6 months
    - PEDV bioassay only + for 4 month
Immunity - What have we learned?

Immunity to the virus

• We now have many different diagnostic tools to detect PEDV:
  – Can detect the virus (PCR)
  – Can detect exposure to the virus (ELISA or IFA)
  – Can evaluate the level of immunity to the virus (FFN, IFA)

• Basics of immunity:
  – Gut immunity is needed for protection
  – Piglets need to consume milk to be protected against PEDV
  – The response to PEDV can vary by sow and so can protection passed to piglets
Immunity - What have we learned?

**Immunity to the virus**
- Sows do respond to feedback and develop antibodies
  - Oral exposure is best but exposure also causes clinical illness
  - Vaccines can help, but killed products may not have enough foreign protein to stimulate immunity

- Sow immunity:
  - Immunity has been seen for at least 6-7 months
  - Work being done on cross-protection and some degree of protection may be happening
  - Will use results of these studies for continuation of work for 2015*
Transportation management is critical!!!

- Packing plants present a high risk for spread of PEDV

- Certain procedures for trucks can kill the virus:
  - 160°F for 10 minutes kills PEDV
  - Clean, disinfect and heat (see above) can kill PEDV and other pathogens!
Feed management

- Takes a very small amount of virus to infect pigs (7 infectious units of cell culture)

- Some potential products can help to eliminate virus in feed

- Assessment of pelleting and heat treatment may be effective for point-in-time virus control

- Sequencing batches of feed can aid in mitigation of risk
Feed management

– Feed mills can become extensively contaminated including dust!

– Key is to reduce mechanisms by which products and ingredients can become contaminated

– Decontamination of mills is very labor intense and +/- do-able
Applied Biosecurity
Transportation Research

• Modeling of potential infection spread at packing plants
  – Plants still provide high risk for downstream contamination of GF floors but for sow farms as well
  – How to mitigate risk?
    • REMOVE manure!!!
      • Removal of manure from flooring and trailers CAN help to minimize the risk of spread by reducing survivability of the virus on surfaces.

• What else can be done?
  – Follow basic biosecurity for washing/disinfecting trailers to get rid of manure
  – Heating to 160º F for 10 minutes can kill PEDV
  – Use disinfectants according to label to kill PEDV
Removal of Organic Material Is KEY!
Examples of the Line of Separation
Feed and Feed Systems Biosecurity

- Mills can be easily contaminated and be a point source for contamination for feed, ingredients and equipment.

- Limit external contamination:
  - Cover receiving grain pits
  - Avoid sweeping in spills or dust from mill back into processed feeds
  - Sequencing batches of feed can reduce level of PEDV and reduce potential risk
Feed and Feed Systems Biosecurity

• Point-in-time interventions can work to control the virus:
  – Organic acids, essential oils, other additives and formaldehyde have shown ability to kill PEDV
  – Pelleting temps can kill PEDV, but feed can easily be contaminated post-processing

• Need to maintain appropriate temps consistently—avoid pellet plugs or start up to assume you have virus kill
Feed and Feed Systems Biosecurity

- Sanitation interventions for live-haul can work for feed trucks to reduce contamination.
- Keep cabs of tractors clean to minimize contamination.
- Further research underway to look at other in-feed interventions post-processing.
- Other areas of risk:
  - Tote bags (USDA)
  - Other container sanitation
USDA Study on Totes - PEDV

- PED survival ~ 5wks at room temp (not at 6wks)
  - Stable for 10 wks at 4°C and -80°C
- No federal regulations yet; +/- FSMA
- USDA Root-cause Investigation complete
Manure Handling

• Since PEDV can survive in colder weather, need to make sure steps are in place to prevent spread of the virus through contaminated equipment!
  – Hoses, drag lines, manure, boots etc.
  – Clean, dry and downtime
  – Track where equipment/teams have been
  – Maintain a Line of Separation
PEDV Materials and Research

- All research and updates available at www.pork.org

- Created a PEDV-specific site for all information

- Compiled factsheet booklet available for procedures/protocols
Disease Preparedness
Emerging Disease Issues

• PED has highlighted a gap in protection of animal health (domestically and internationally)

• PED has shown the need to focus on identifying key needs and resources to support US agriculture/animal health

• Identified a need for an Emerging Disease Response plan
Development of an Emerging Disease Plan

- **USDA** - *ongoing*
  - Working on Emerging Disease Response plan
  - National List of Reportable Animal Diseases (NLRAD)

- **NPPC** - *ongoing*
  - Reinstate concept of Swine Health Board
  - Working on Emerging Disease Plan – all stakeholders (USDA included)

- **Swine Health Information Center (SHIC)**
  - NPB one-time funded at $15 million for 5 years
  - Utilize the AASV disease “Matrix” identifying future diseases/risks for research roadmap
  - Primary focus is on new and emerging diseases of swine
  - i.e. Seneca Valley Virus focus
Summary

• PED has proven to be a major swine health challenge AND highlighted a gap in disease protection (domestic and international).

• Spring/summer of 2015 has been quiet but unsure of what fall/winter will bring.

• Plans for dealing with emerging diseases are solidly underway including the development of the SHIC to focus efforts/research on emerging diseases.

• Cooperation and collaboration with all industry and government sectors a must for effective and timely disease control.
Seneca Valley Virus update
Seneca Valley Virus (SVV) Update

• SVV is a Picornavirus that has been identified in the US since 1988
• Clinical signs and lesions = blisters, vesicles, lameness and neonatal mortality in pigs
• The disease mimics Foot and Mouth Disease – cannot visually tell them apart
• SVV does not pose a public health or food safety issue
Seneca Valley Virus

- SVV has been identified in the U.S. since 1988
- SVV has been associated with lesions that are clinically indistinguishable from FMD. Each discovery of blisters on the nose or hyperemia of the coronary band, hoof pad or interdigital lesions should first be investigated to ensure FMD is ruled out. Often the first clinical sign observed is lameness.
- USDA reported 2 cases of FMD investigation that resulted in SVV diagnosis in 2014. In 2015, 12 have been reported with investigations continuing.
- So far this summer, clinical signs have been found in production and exhibition pigs in HI, OH, AL, GA, NC, IL, IA, MN, FL, CO, OK and SD.
- Historically this has been a low production-consequence virus. The biggest issue has been confusion with a possible FMD infection.
- In the fall of 2014, Brazil started to experience SVV-associated pre-weaning mortality. A cause/effect relationship of the losses with SVV has not been proven, but they are clinically associated. Pre-weaning losses have lasted 2 weeks or more and have resulted in 30 – 70% mortality, especially in 1- to 3-day old piglets.
- This summer SVV has been associated with severe lameness lasting longer than expected on finishing floors and farrowing houses in the U.S. There has also been associated neonatal mortality. The incidence is low but the concern is about this possibly being an emerging syndrome, such as Brazil experienced.

In response, SHIC, NPB, NPPC and AASV have been working together to further define the geographical extent of this summer’s U.S. outbreak and to determine the appropriate response.

Research funded by SHIC

1. With SHIC support, Iowa State University has followed shedding in 10 pigs from a severe finishing floor outbreak. Preliminary results show that pigs persistently shed virus for an extended time after infection.
Seneca Valley Virus

Deep nail bed hemorrhages
Seneca Valley Virus
Seneca Valley Virus
Seneca Valley Virus

Senecavirus A in neonatal pigs
SVV Update

Source: USDA

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<tr>
<th>States</th>
<th>No. of Cases</th>
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<td>Iowa</td>
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<tr>
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<tr>
<td>Total</td>
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Source: ISU 9/17/15

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<tr>
<td>Unknown</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
</tr>
</tbody>
</table>

Source: USDA
SVV – clinical cases

Alabama, Colorado, Florida, Georgia, Hawaii, Illinois, Indiana, Iowa, Minnesota, North Carolina, Ohio, Oklahoma, South Dakota
SVV Update

Research
- Identify the duration of shedding of the virus for sows and finishing pigs
- Screen oral fluid samples submitted to ISU and UMN
- Koch’s Postulates
  - Historical US
  - Contemporary US
  - Brazilian
- Sequencing and characterization of the viruses
- Diagnostics
  - ELISA for serology
- Efficacy of disinfectants
SVV Update

Communication and coordination

• Focus on FAD investigations and prevent complacency
• Periodic conference calls started August 7 with variety of SMEs and stakeholders – PED model
• Coordinating research call with VDLs, USDA-NVSL, USDA-FADDL, USDA-RIU, USDA-ARS
• SAHO National Assembly update
• USDA-FSIS
• NPPC’s Packer Processor Industry Council
• SVV Fact Sheet, Update
• AASV’s Swine Health Committee
SVV Summary

- Bottom line communications/actions:
  - If identified, immediately notify state vet and stay on farm; Wait until diagnosis is confirmed – do not assume...that it is SVV and not FMDV.
  - If identified, do not market animals with active lesions/illness.
  - Contact/work with packer to schedule when can eventually sell recovered pigs.
  - SVV is not trade-limiting but have to be aware and take appropriate actions so we do not miss FMDV!!
Questions?

This message funded by America’s Pork Producers