USDA
United States Department of Agriculture

SECD
Root Cause Investigation in US

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Animal and Plant Health Inspection Service
Veterinary Services
Science, Technology, and Analysis Services
Sept. 25, 2014

SECD International Meeting
Chicago IL, USA

Acknowledgements:

- National Pork Board
- American Association of Swine Veterinarians
- Swine veterinary consultants
- Food and Drug Administration
- Colleagues in Canada and EU
- Universities (MN, ISU, UC Davis, SDSU, OSU, KSU)
- NAHLN laboratories
- APHIS-Wildlife Services
- DHS-National Bioforensic Analysis Center
- Swine producers of the USA
- Units and staff of APHIS-VS

PEDV identified in US; spring 2013

- US Stakeholders respond
- Multiple investigations: private veterinarians, industry organizations, laboratories, Universities, State and Federal officials
- Research studies funded and initiated
- Web sites and information distribution
- Voluntarily submitted testing results

2014: much information …

- But no conclusive answer to source
- USDA issues Federal Order for reporting as well as funding for response activity
- Also initiates “Root Cause” investigation to revisit information accumulated
- Continued highest priority to find pathway

Root Cause investigation plan

1. Integrate information across all sources
2. Interview consultants, experts
3. Evaluate basic epidemiology: host, agent, environment, timelines, epi curves
4. Formulate criteria and scenarios
5. Collaborate FDA, DHS, industry, universities
6. Revisit farms and attending veterinarians
7. Further investigate scenarios

Basic Epidemiology information

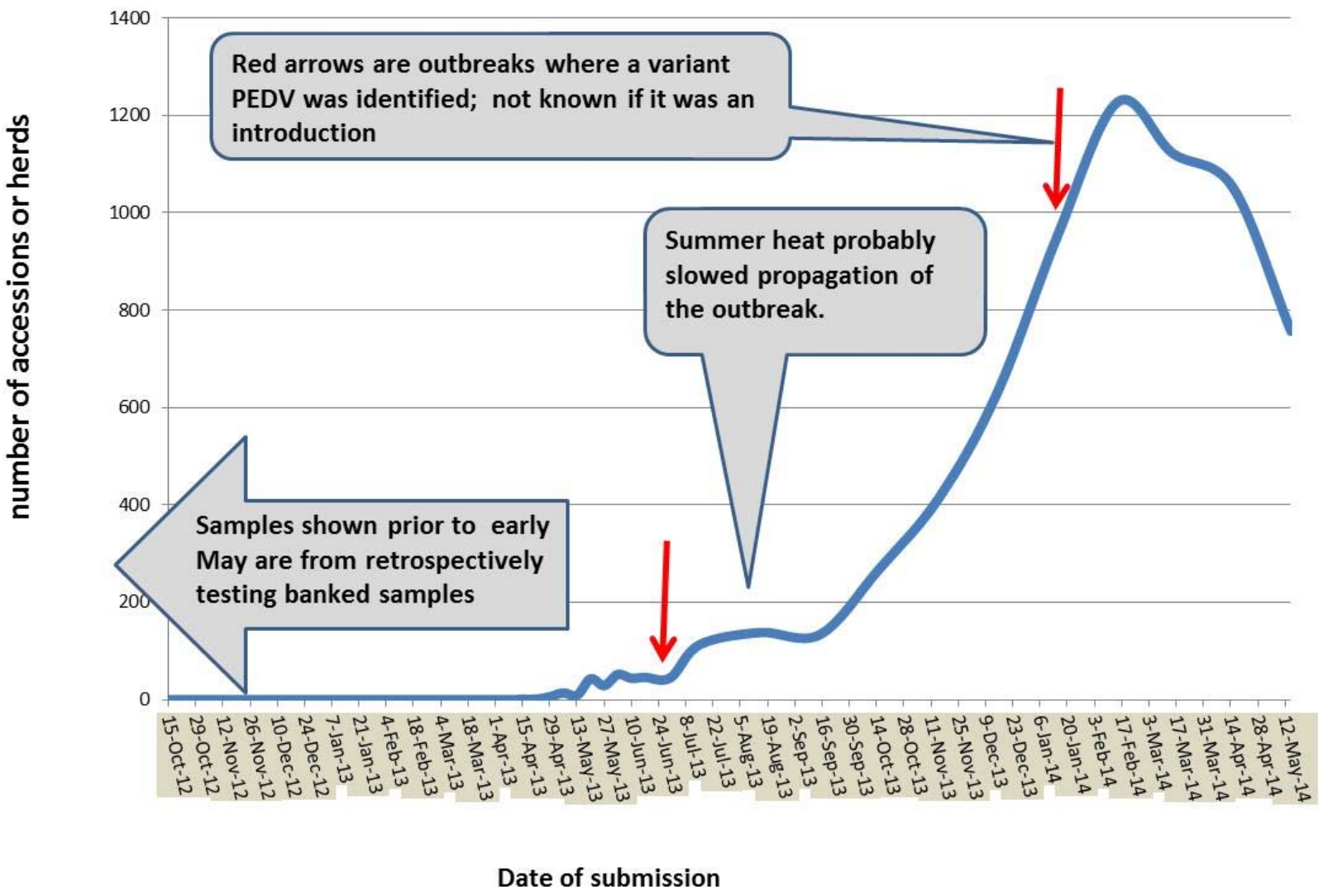
- Four viruses novel to US swine
- Nearly homologous to viruses that plagued China in 2010-2012 outbreak
- Likely more than one outbreak; April to Dec 2013
- Earliest cases ID'ed in commercial farms
- First cases in growing pigs; sow farms not infected

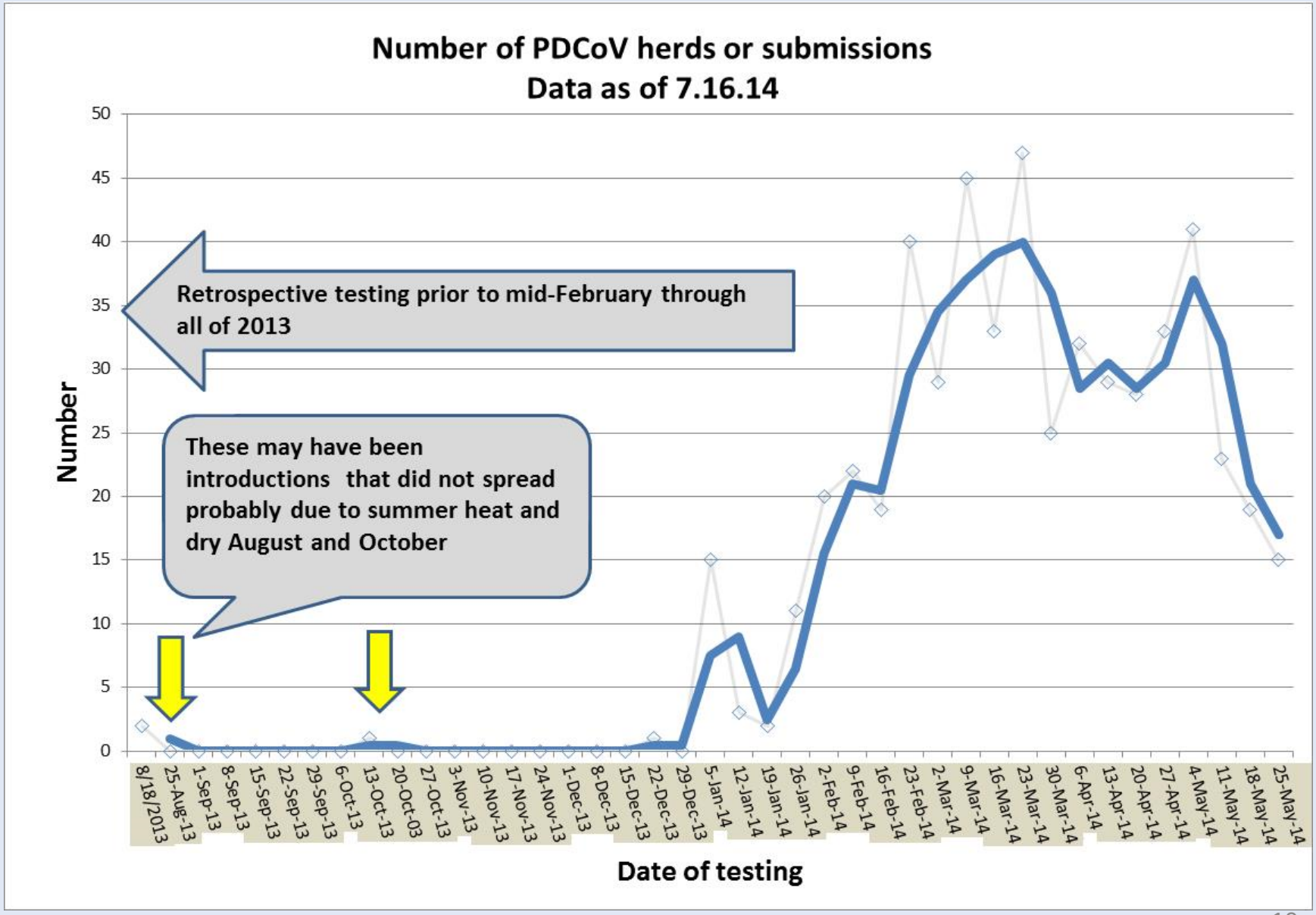
Basic Epidemiology information

- Infectious 100,000,000x dilution (UMN 2013)
- Survival study: <2 week in dry feed, room temp
- Multiple modes of lateral spread in US
- Farms almost same time in different states, different companies, different feed products
- No direct link between farms

Criteria for source

- Must fit basic epidemiology information
- Must survive for 3-6 weeks if on ship or few days for plane travel from an international source
- pH~6.5, low temperature, moisture or matrix to protect from desiccation
- Why US outbreak, but not Canada or EU?
- Why during April-Dec 2013?


Number PEDV pos herds or accessions
Data as of 7/16/14
number of accessions or herds
1400
1200
1000
800
600
400
200
0
Red arrows are outbreaks where a variant PEDV was identified; not known if it was an introduction
Summer heat probably slowed propagation of the outbreak.
Samples shown prior to early May are from retrospectively testing banked samples
15-Oct-12
29-Oct-12
12-Nov-12
26-Nov-12
10-Dec-12
24-Dec-12
7-Jan-13
21-Jan-13
4-Feb-13
18-Feb-13
4-Mar-13
18-Mar-13
1-Apr-13
15-Apr-13
29-Apr-13
13-May-13
27-May-13
10-Jun-13
24-Jun-13
8-Jul-13
22-Jul-13
5-Aug-13
19-Aug-13
2-Sep-13
16-Sep-13
30-Sep-13
14-Oct-13
28-Oct-13
11-Nov-13
25-Nov-13
9-Dec-13
23-Dec-13
6-Jan-14
20-Jan-14
3-Feb-14
17-Feb-14
3-Mar-14
17-Mar-14
31-Mar-14
14-Apr-14
28-Apr-14
12-May-14
Date of submission


Number of PDCoV herds or submissions
Data as of 7.16.14
Number
Retrospective testing prior to mid-February through all of 2013
These may have been introductions that did not spread probably due to summer heat and dry August and October
Date of testing

"…when you have eliminated the impossible, whatever remains, however improbable, must be the truth…"

Sir Arthur Conan Doyle

Scenarios

- Intentional introduction
  - No evidence to indicate introduction directly to farms
  - No visitors or unusual events were noted
- Circulating in Feral swine
  - First farms were large commercial-no evidence of feral exposure
  - Farms almost same time in different states different companies
  - No knowledge of infection in pastured or outdoor swine
  - Scenario: feces→ truck or person→ feed mill or farm

Scenarios

- Clothing/shoes contaminated while traveling
  - No history of visitors to infected farms or international travel in time frame
- Human nasal passages (study underway)
  - Should have shown up in previous years
  - No travelers to infected farms in time frame

Scenarios

- Escape from laboratory or diagnostic sample
  - No evidence to suggest association
  - Farms near same time but in different states/companies
- Contaminated biological
  - No evidence to suggest a biological
  - No consistently used product
- Antibiotic filler; e.g., rice hulls
  - Possible contamination in processing
  - Same products used in Canada?
  - Product is very dry (~3-5%)

Scenarios

- Semen or live animals
  - No legal import from possible sources
  - Majority of early cases in growing pigs not sows
- Birds or bats
  - Genetic epi links US viruses to pigs more recently
- Illegal product entry
  - No evidence to suggest
  - Feed products from different feed mills/manufacturers

Scenarios

- Vitamin/mineral premixes
  - Same products used in Canada and EU?
  - Products are dry (~5-7%)
- Amino acid supplements
  - Common to all rations
  - Lysine price competition in early 2013
  - Most manufactured in microbial culture
  - Same product used in Canada/EU?

Scenarios

- Pet food/treats used in swine rations
  - Used in rations, but not directly fed to outbreak
  - Contaminate other rations?
  - Ingredient in base mixes?
  - Contaminate grinders/mixers?
- Complete feed swine base mixes/premixes
  - Associated with outbreaks (& normal herds)
  - No common manufacturer unless purchased wholesale and branded for distribution by different companies

Ongoing collaborations, studies and testing…

- Testing of archived samples:
  - Feral swine samples,
  - Human nasal swabs,
  - Pet treats
- Genetic epidemiology, virus relationships
- Additional field epi data from index farms
- Trace index farm's feed and ingredients
- Monitor US sequences for novel viruses

Thank- you!

Questions?