PEDV in the U.S. Swine Industry

SIPAS

October 8, 2015

Parma, Italy

Dr. Harry Snelson
American Association of Swine Veterinarians

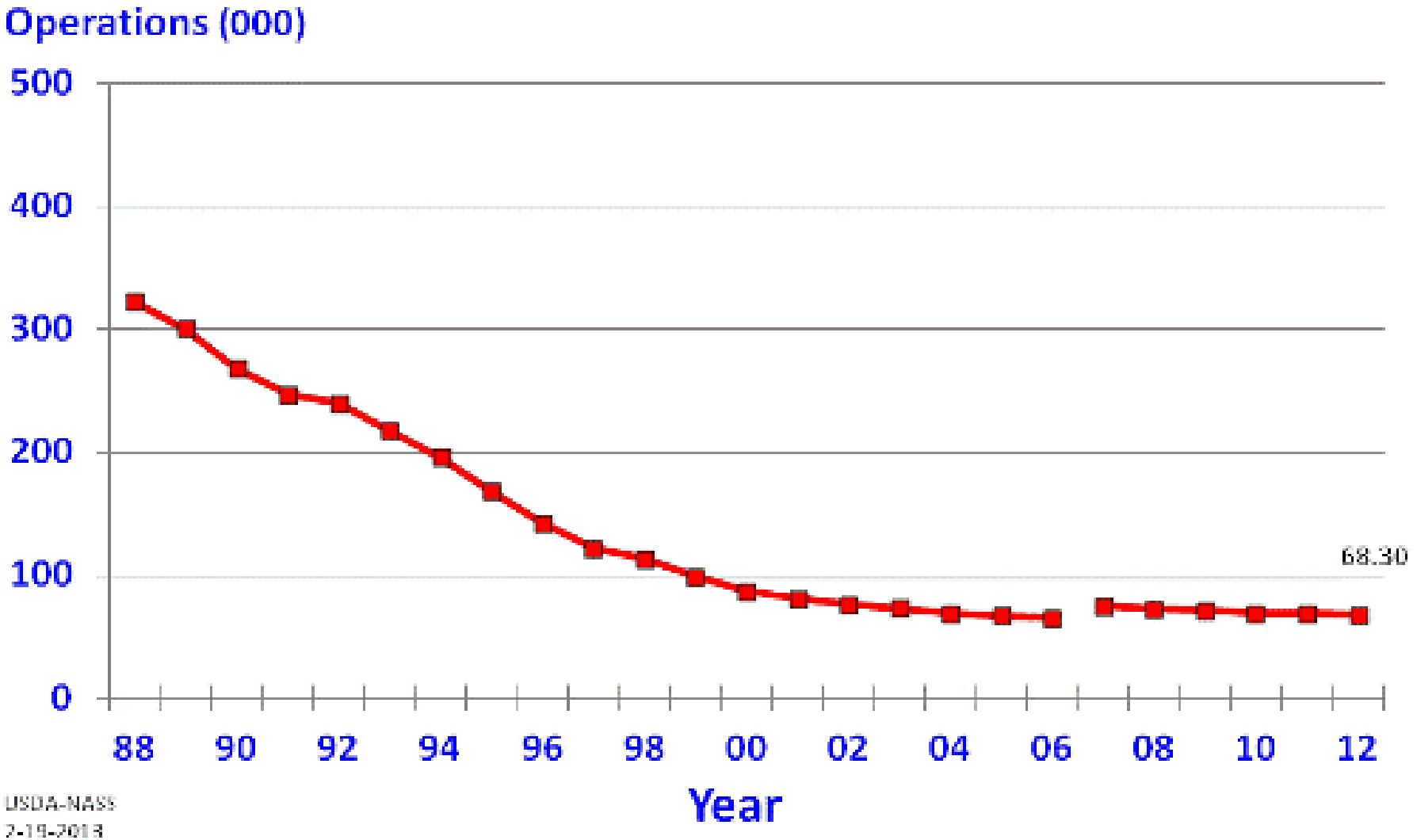
Discussion Topics

- Makeup of the U.S. swine industry
- What is PEDV?
- PEDV introduction into the U.S.
- Response
- Economic Impact
- Lessons Learned

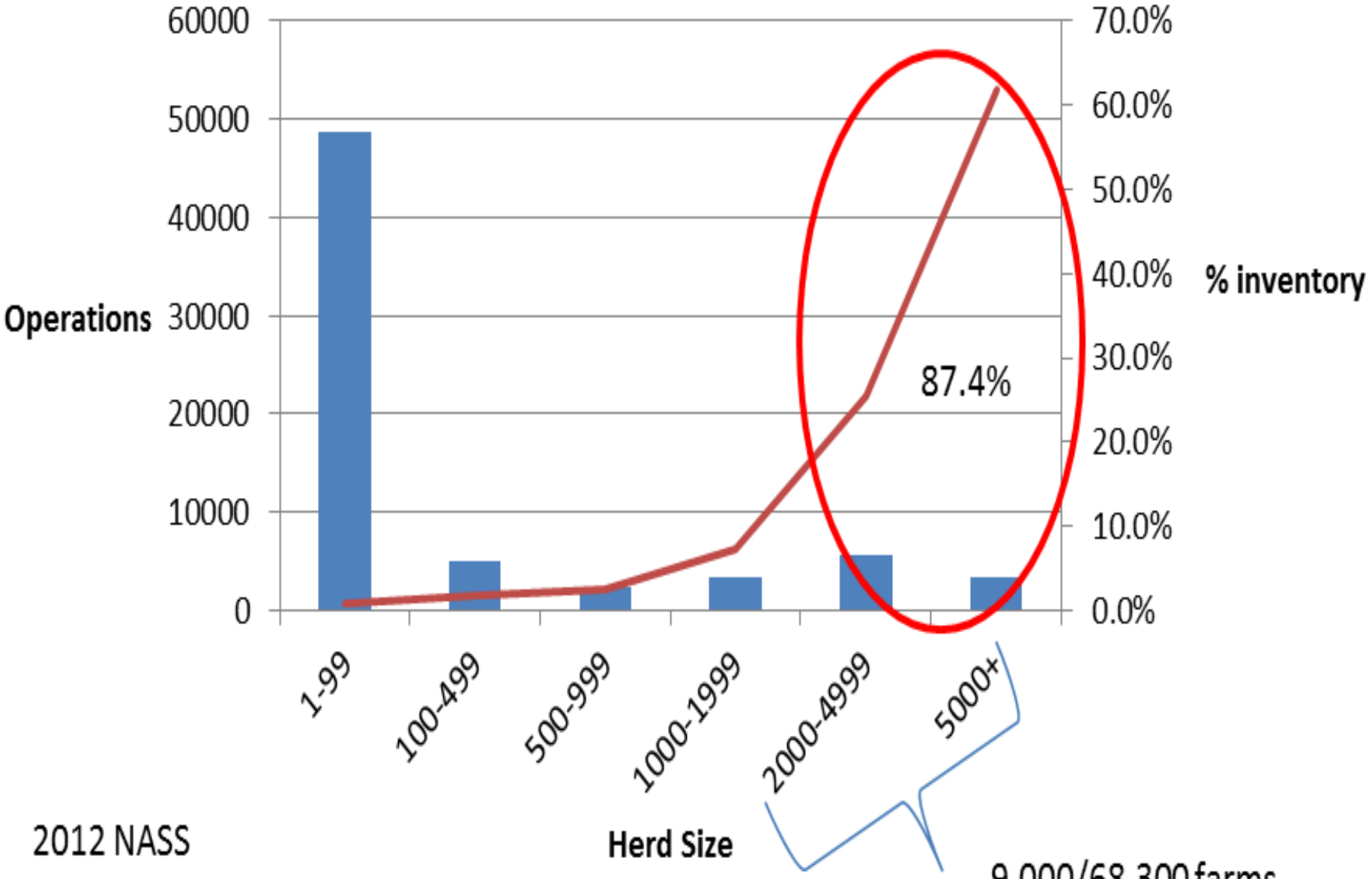
The U.S. Swine Industry

Number of Hog Operations

United States

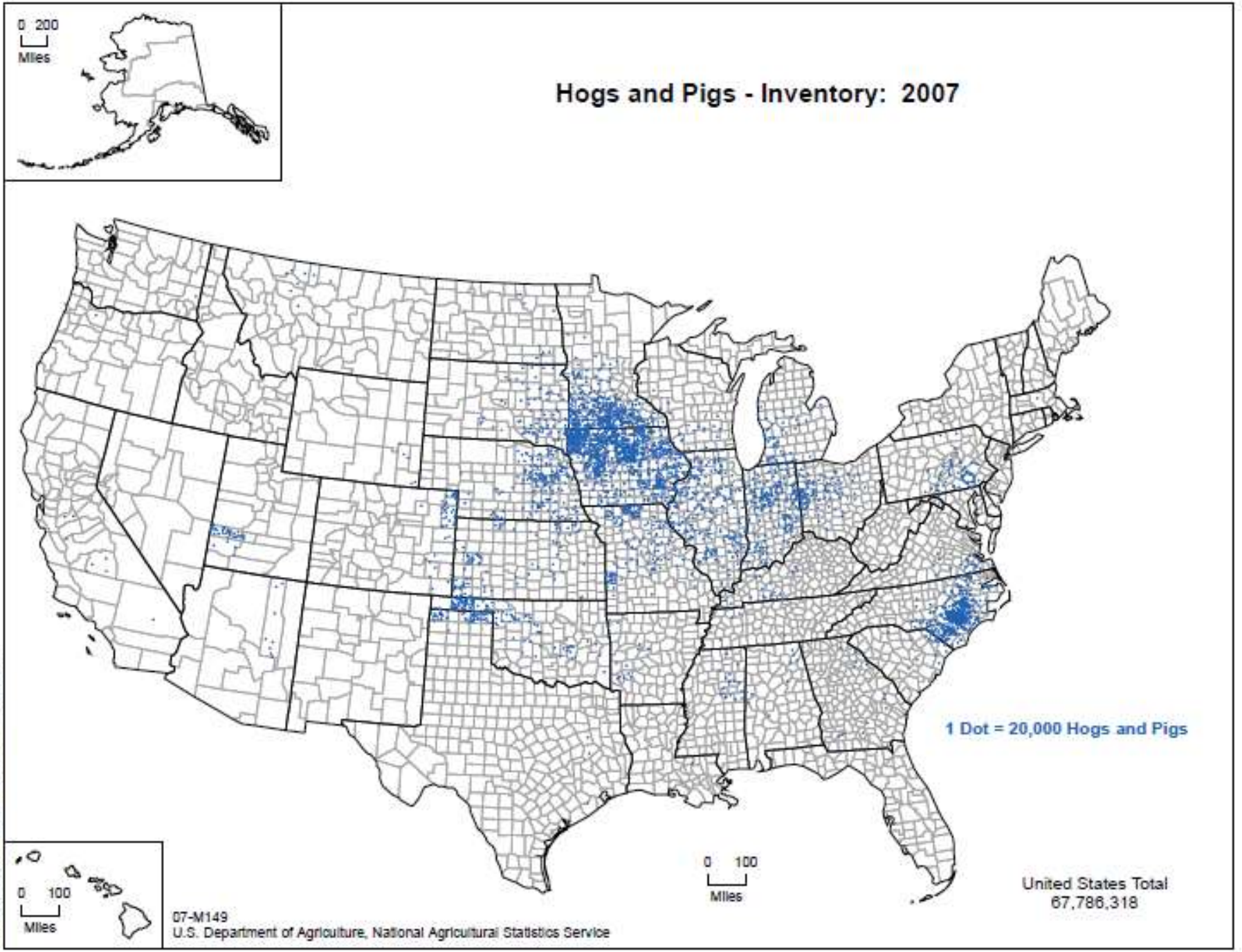


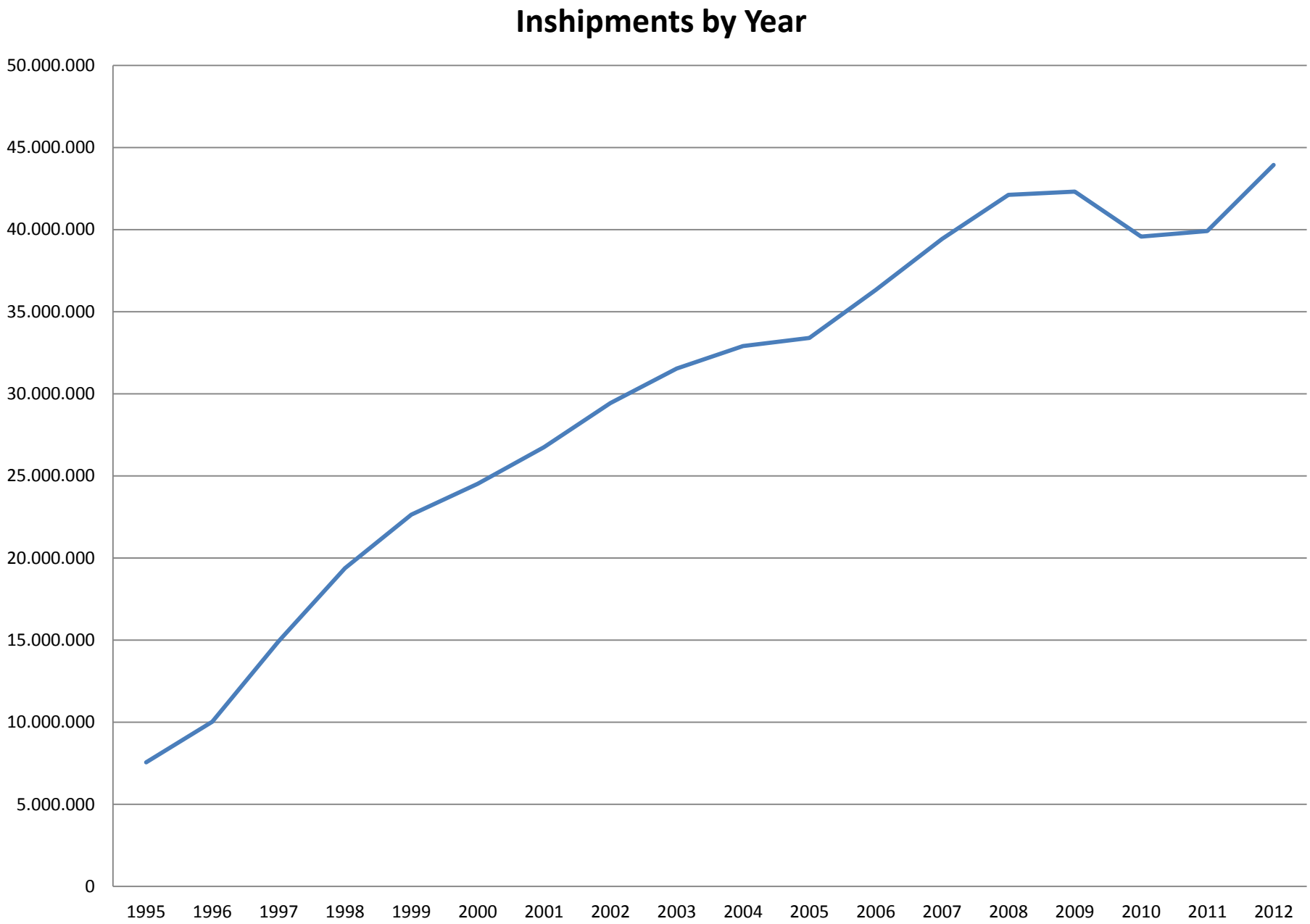
Operations, % Inventory by Herd Size



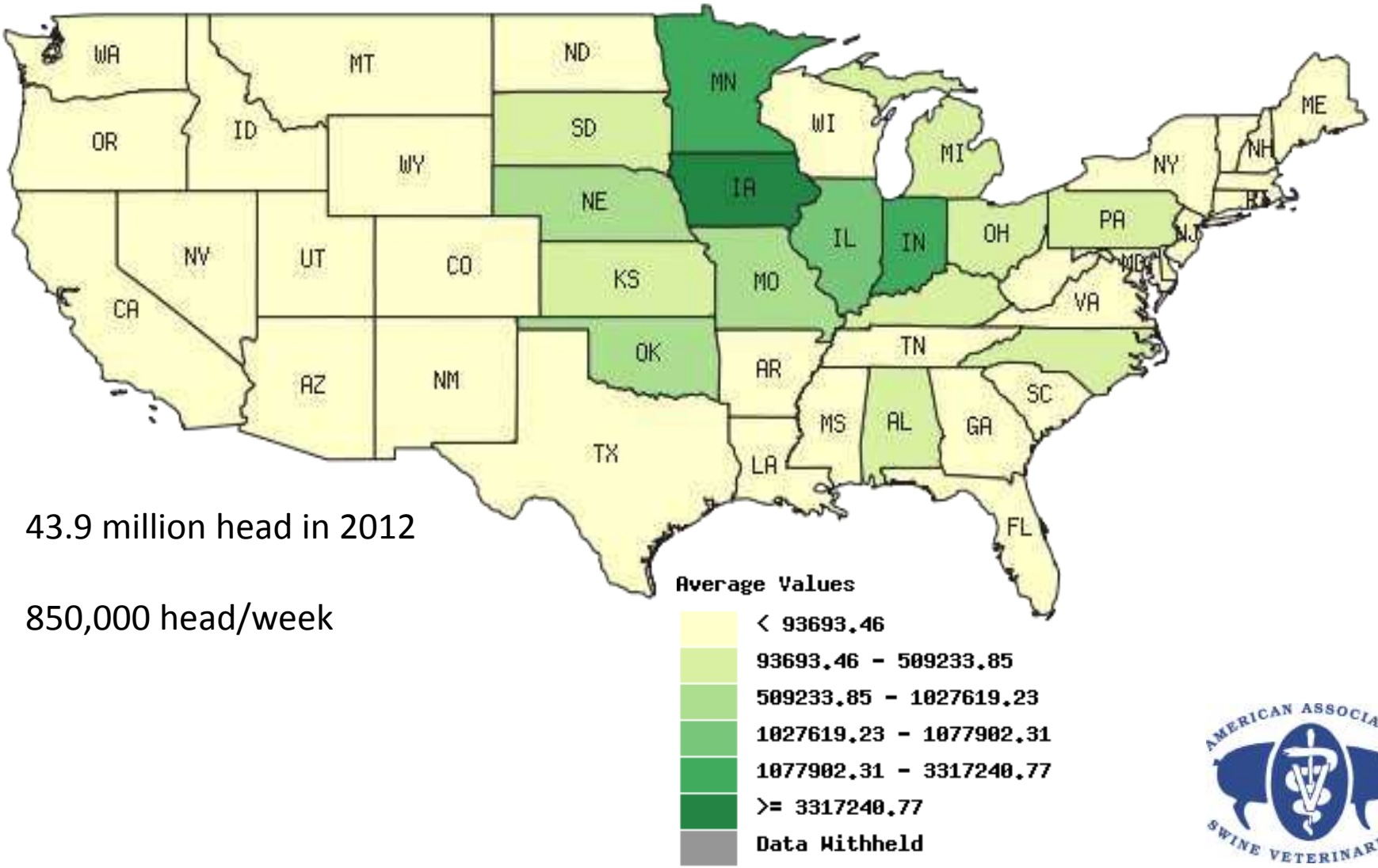
2012 NASS

9.000/68.300 farms


0 200
Miles
Hogs and Pigs - Inventory: 2007
1 Dot = 20,000 Hogs and Pigs
0 100
Miles
United States Total
67,786,318
0 100
Miles
07-M149
U.S. Department of Agriculture, National Agricultural Statistics Service
2007 Census of Agriculture


Inshipments by Year
50.000.000
45.000.000
40.000.000
35.000.000
30.000.000
25.000.000
20.000.000
15.000.000
10.000.000
5.000.000
0
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

U.S. Hog Inshipments, 2012

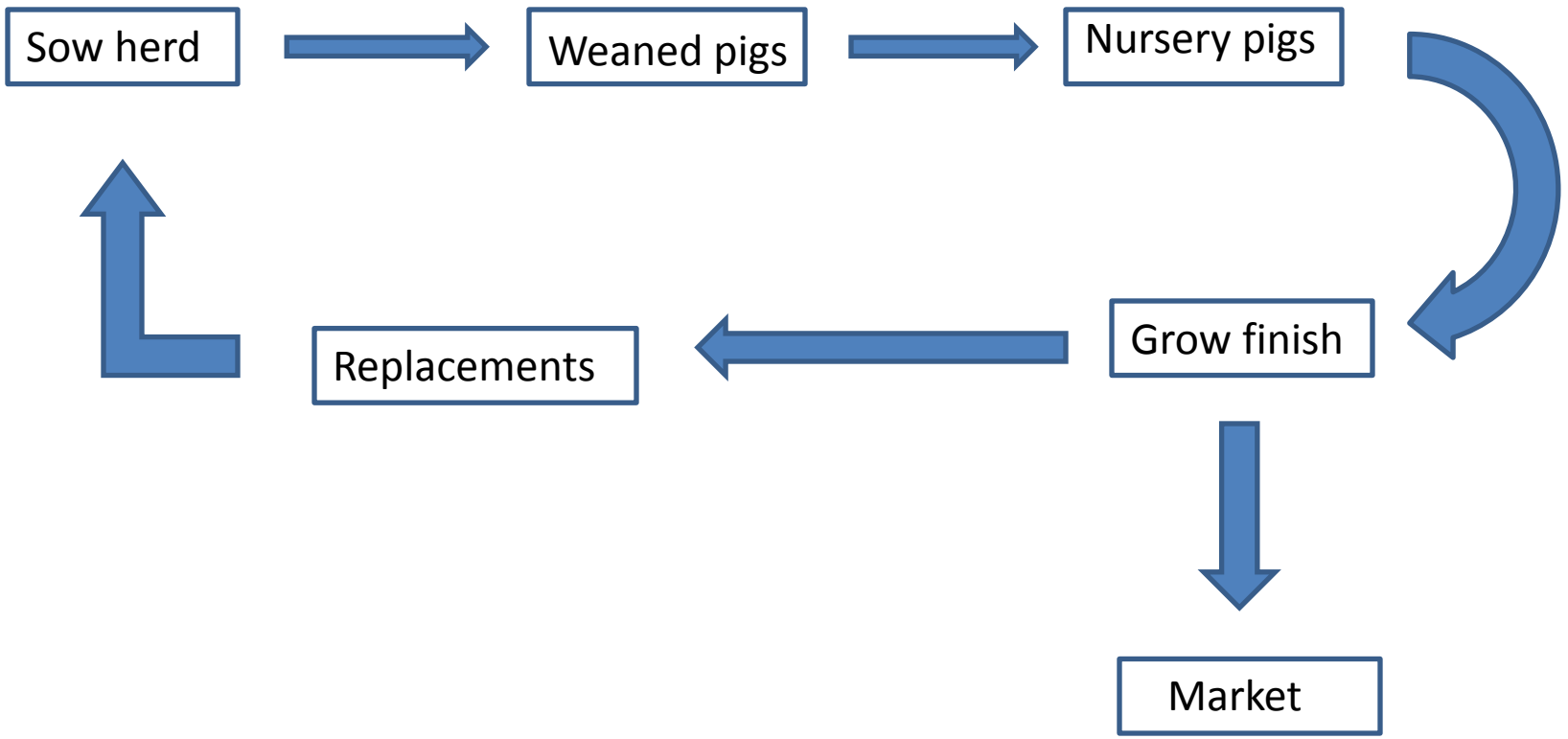


43.9 million head in 2012

850,000 head/week

AMERICAN ASSOCIATION SWINE VETERINARIANS

Swine to Pork Chain



Pork Food-Chain

Green lines/font = feed segment
Red lines/font = live animal segment
Purple lines/font = processing/marketing segment
Black lines/font = immediate consumption segment

Major Flows
Minor Flows


Feed Producer


Industrial use
(rendering, oils, fertilizer)

Non-food, non-feed
Products & uses


Feed Brokers


Feed Milling and
Distribution


High processed meats/protein
(sausages, protein supps,
powdered, pet foods)


Imports

Exports


Distributor


Nucleus Unit
(Genetics)

Boar Stud
(Genetics)


'State' Sow Market
(culls; incl gilts, boars)


Pork Packer & Processor
(includes value-added
processing)


Retailer, Restaurant,
Institutional

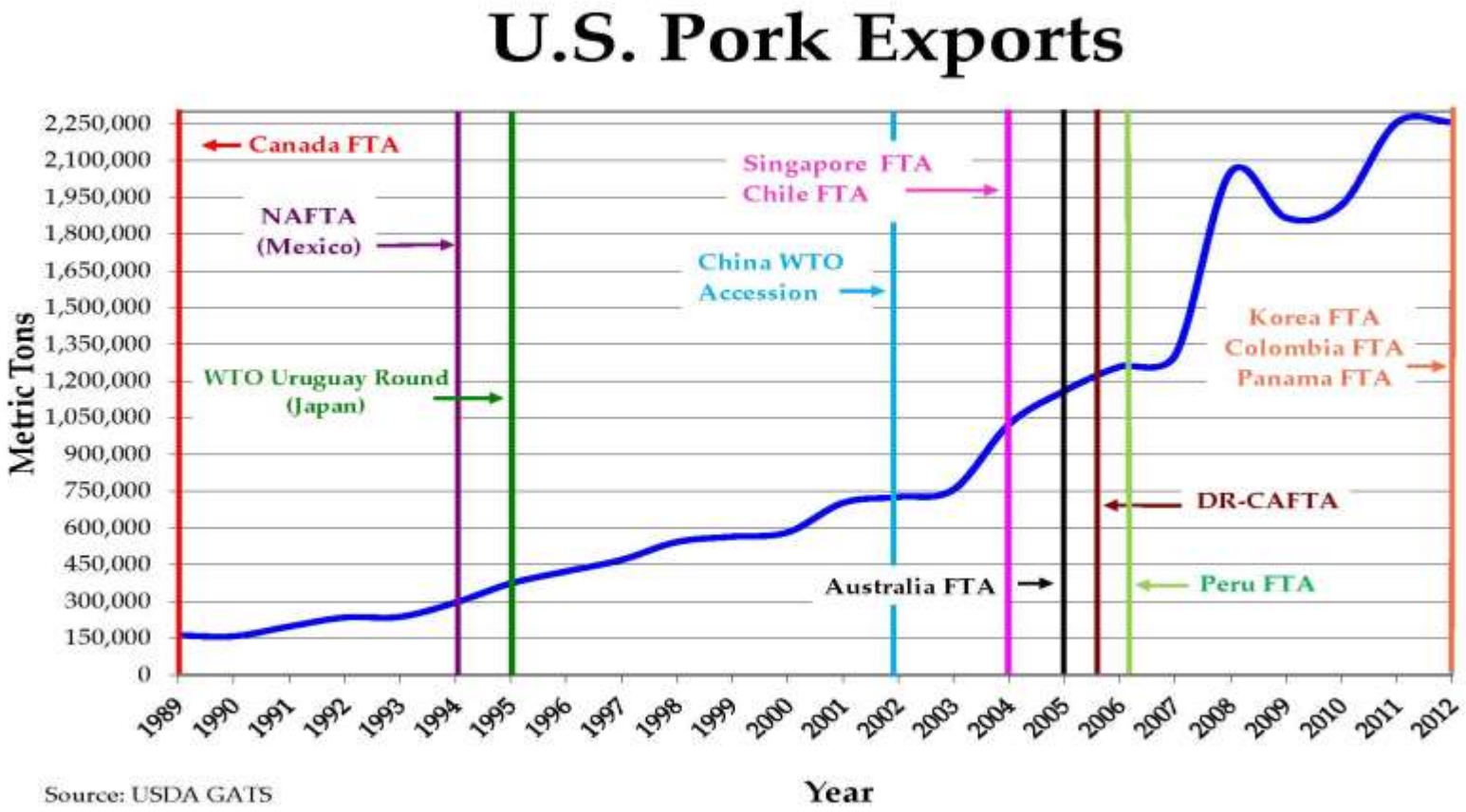

Multiplier Units & Sow Farms
(Production Sows)


Finishing Unit
(Commercial Pigs)


Nursery Unit
(Commercial Pigs)


Out-of-State Growing
And Finishing


Consumer



2012:

2.3 million metric tons

Value: $6.3 billion (record)

Exports add $56/head for U.S. producers

Industry Summary

- Lots of small farms
- Most of the inventory is consolidated on herds >2000 head
- Frequent movements
- Minimal excess production capacity
- Complex pork chain
- Lots of imported inputs
- Exports are important

Porcine Epidemic Diarrhea Virus Outbreak

What is PED Virus

- Coronavirus
- Fecal-oral pathogen
- Clinically indistinguishable from TGE
  - High morbidity
  - High mortality in suckling pigs (100%)
  - Diarrhea, vomiting, anorexia
- Piglets begin signs and shedding within ~8 hours
- Not a human health or food safety concern
- 98.4% homologous with 2012 Chinese strain

Clinical Picture

Courtesy Dr. Ackerman

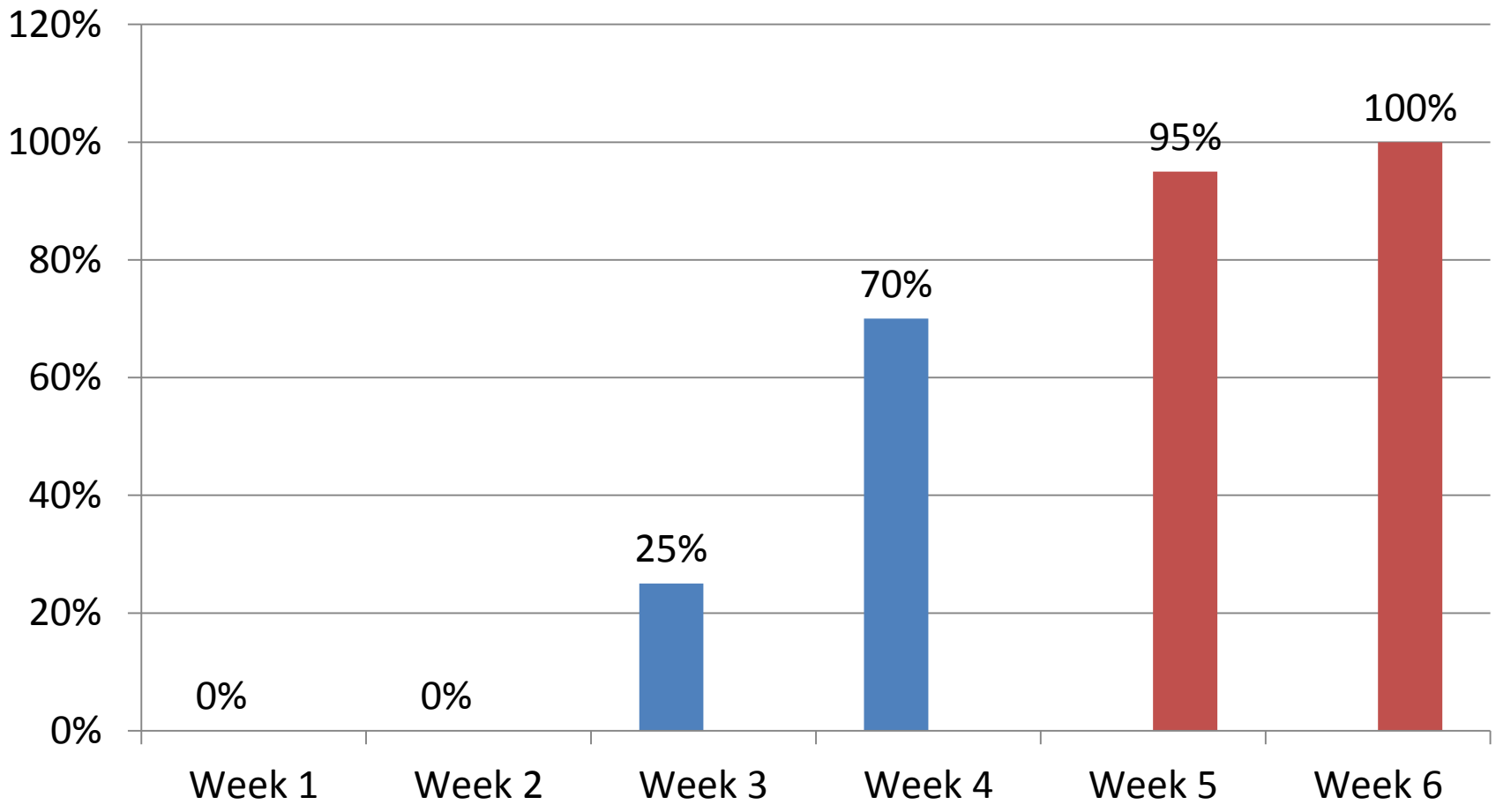
Clinical Picture

Courtesy Dr. Ackerman

Clinical Picture

Courtesy Dr. Ackerman

Percent Survivability to Day 7



Courtesy of Dr Ackerman

PEDV Outbreak Timeline

Part 1 – PEDV Timeline – May 2013

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
28	29	30	1	2	3	4
5 1st Phone Call	6 1st Indiana – Sow Farm	7 2nd Indiana – Sow	8 TGE PCR results came back neg	9 IHC & PCR neg Called lab	10 EM POS NVSL	11
12	13	14	15	16 NVSL Announces PEDV	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	1

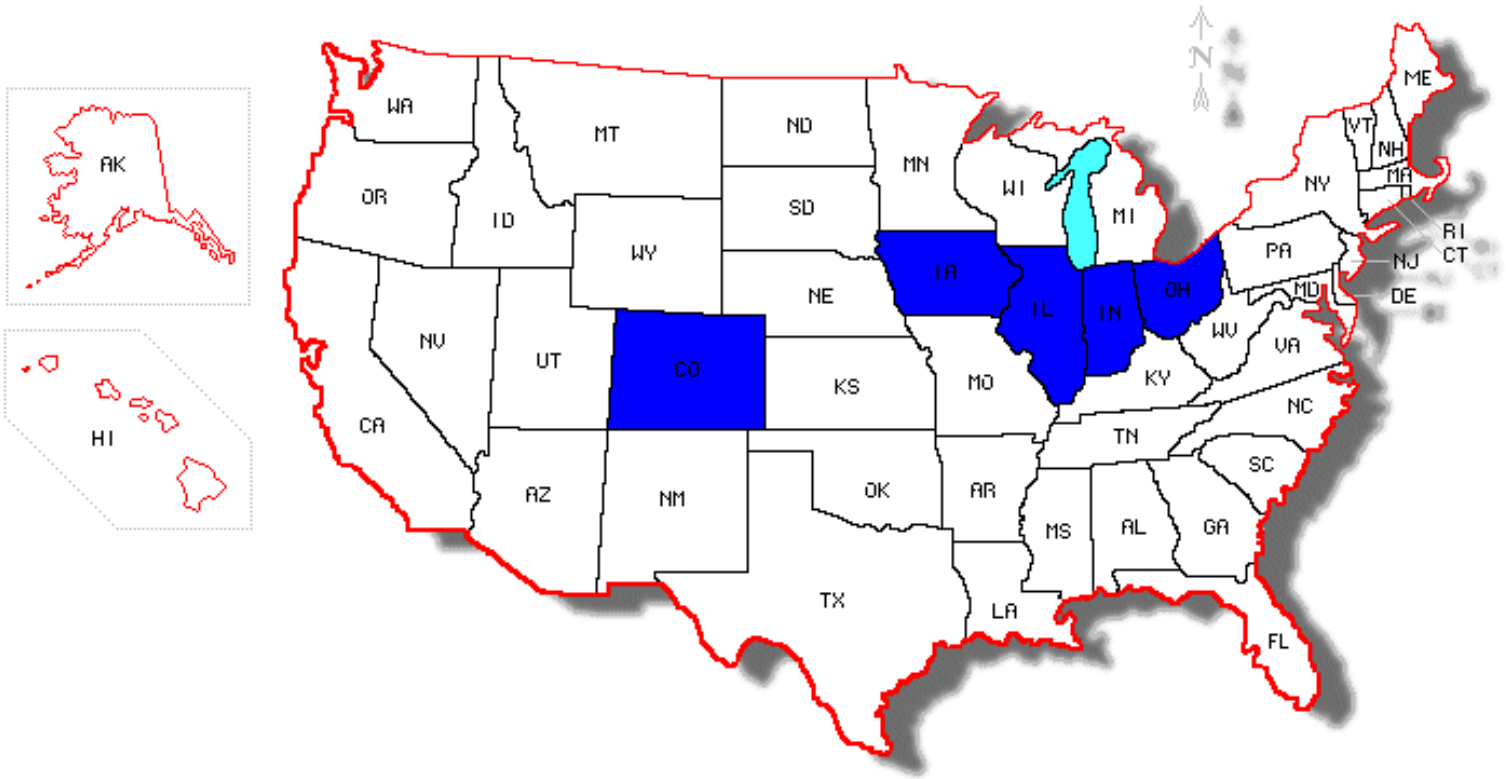
Courtesy of Dr Ackerman

Sun	Mon	Tues	Weds	Thurs	Fri	Sat
28	29	30	1 May	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17 4 cases known (3 in IA, 1 in IN)	18
19	20	21	22	23	24	25
26	27	28	29	30	31	1

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY (TOTALS)
	15 **APRIL**	16 OH – GF	17	18	19	20 1 GF
21	22	23	24	25	26 IN – GF	27 1 GF
28	29 IA (W. Central) – SOW	30 IA (NE) – SOW OH – GF IA – GF	1 **MAY** IA – GF	2 IA – GF	3 IA – GF	4 4 GF 2 SOW
5	6 IA (NW) – SOW	7 IA – GF IA – GF	8 IN – SOW MN – SOW IA – GF	9 IA – GF IA – GF IA – GF	10 CO (Eastern) – SOW IA – GF IN – ?? IN – ?? PA – ??	11 7 GF 4 SOW 3 UNKNOWN
12	13 MN – GF	14 CO – SOW MN – GF	15 MN – SOW MN – GF	16 IA – SOW	17 IA – SOW IA – SOW IA – GF	18 4 GF 5 SOW (31 actual cases)
19	20 IA – SOW IN – SOW IN – SOW IA – GF MN – GF MN – GF	21 CO – GF IA – GF IA – GF IA – GF IA – GF IA – GF IA – GF IA – GF IA – GF MN – GF OH – GF	22 CO – SOW CO – SOW IA – GF IA – GF IA – GF IA – GF IA – GF IA – GF IA – GF OK – GF	23 IA – SOW IA – SOW GF OH MN – ??	24 IA – GF IA – GF IA – GF IA – GF IA – GF CO – GF CO – GF MN – GF MN – GF MO – GF MN – ??	25 34 GF 7 SOW 2 UNKNOWN

Outcome of retrospective testing & on-boarding PEDV PCR

Initial PEDV herds



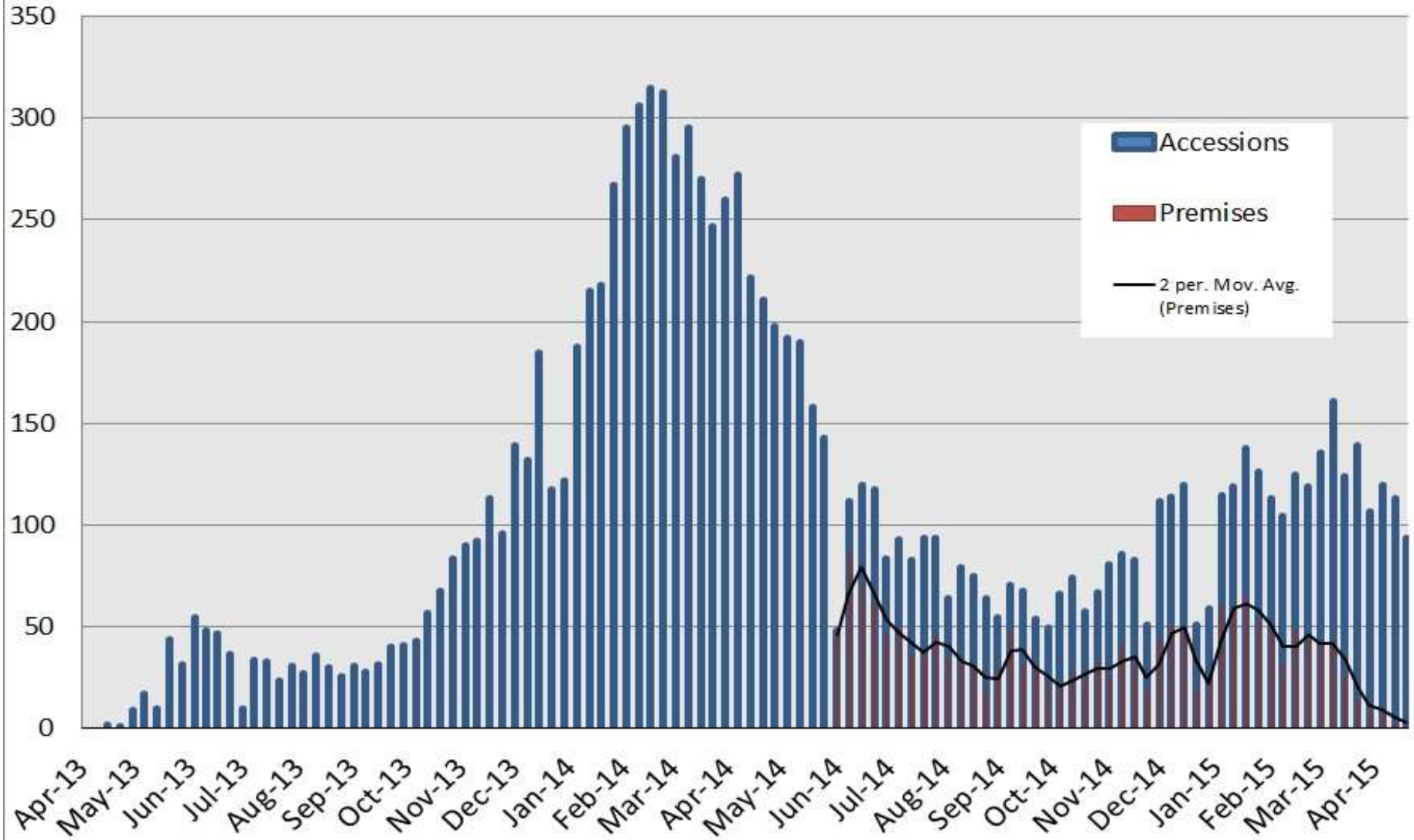
Source: diymaps.net (c)

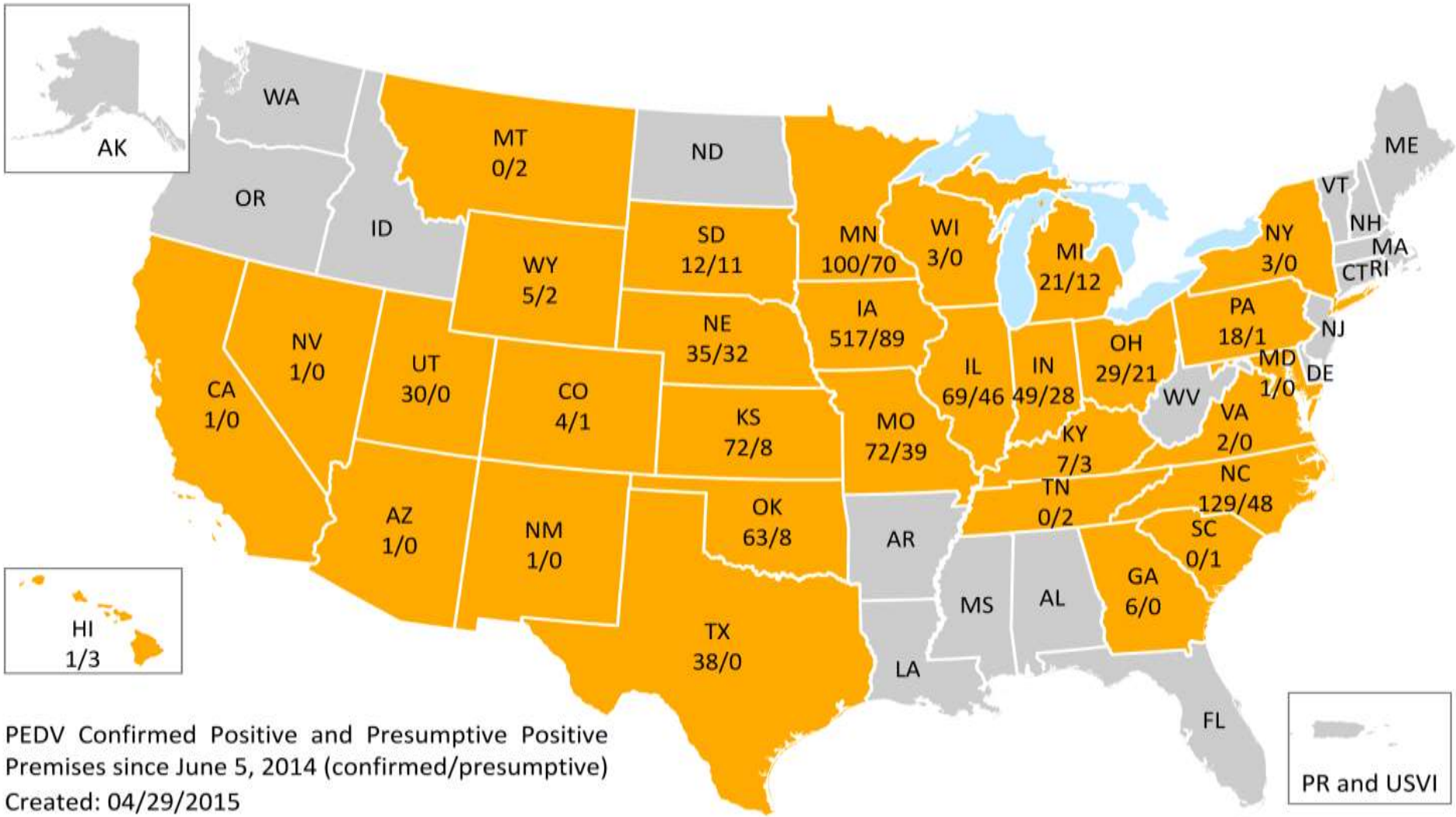
Current Status as of 09/20/15

Test Results	Cumulative
PEDv Positive Accessions	12,655
Total Accessions Tested	68,800
Percent PED Positive Accessions	18.4%
Number of States Reporting Positive Accessions	34

Courtesy of NAHLN

New PEDv Case Reports by Week





Courtesy of NAHLN

PEDv Diagnostic Tools

1. Real-Time PCR
2. Immunohistochemistry (IHC)
3. Indirect Fluorescent Antibody (Serology)
4. Electron microscopy (EM)
5. Virus Isolation (VI)
6. Sequencing

Courtesy Dr Rodger Main, ISU-VDL

Route of Introduction

Scenarios

- *Intentional introduction
- Clothing/shoes while traveling
- Human nasal passages (study underway)
- Escape from laboratory or diagnostic sample
- *Circulating in Feral swine
- Contaminated biological
- Plant material- Antibiotic filler; e.g., rice hulls
- Semen or live animals
- Birds or bats
- Illegal product entry
- *Imported organic soybeans or corn
- Vitamin and mineral premixes
- Amino acid supplements
- *Pet food/treats
- *Complete feed swine base mixes/premixes

Key information: farm epidemiology

1. No common: company, production type or age group, veterinarian, ration, supplement, biological product or vaccine, semen source, service company, or renderer…
2. Geographically separated: no physical link
3. ~6 farms in 2-weeks … no known connection
4. No small farms…commercial, good-excellent biosecurity
5. No visitors from other countries and few from home

Survey Results

- Only seven variables were considered significantly likely to have some association with the introduction of PEDv
- These seven risk factors were associated with the process of feeding the animals.
- Did not implicate any specific finished feed, feed ingredient, feed manufacturer or ingredient supplier.

Veterinary Survey

- Objective: Identify any risk factors potentially associated with the introduction of the PEDv into the U.S. swine herd
- Survey designed by AASV, NPB, NPPC & USDA-CEAH
- Administered by practitioners, data transferred to CEAH via link designed by FAZD at Texas A&M
- Data analyzed by CEAH
- Questionnaire examined > 100 variables
- 25 case herds, 18 matched control herds

Key information: “Feed conundrum”

1. ***Early Case-Control study pointed at feed*** ($p<0.05$)
2. Several consultants suspected feed initially.
3. Several herd investigations suggested feed, but not proven.
4. BUT no common feeds, feed mills, product brands, feed components, supplements, lot numbers…
5. Stable at cool temps. Not stable in dry feed at room temp.

Feral swine scenario

- If PEDv were in U.S. prior to April, 2013, would be in isolated population. E.g.; feral swine or small farms
- Serum samples from WS archived prior to April, 2013
- 368 from Midwest and Hawaii; all negative
- Combined with other data, unlikely that a feral swine reservoir existed prior to April 2013

Introduction by people

- Compelling possibilities, but doesn't fit the data

Complete feed and base-mixes

- No common product between farms

Pet treat scenario

– Plausible scenario for post-cooking contamination, failure of irradiation procedures, and transit to U.S.

– If carrying virus, would need to contaminate fomite to move to farms. i.e., tote

Organic soybeans scenario

- Organic farms prohibited from using manure fertilizer near harvest time
- Farms small, likely have pigs, may use same equipment to transport grain as animals.
- None of first U.S. farms had organically grown pigs
- Some used soybean hulls but don't know source

**If soybeans were source of introduction, virus still had to transit the U.S. Would have to be fomite to move to feed mills and farms.

Cross-country rapid transit scenario

- PEDv moved to farms in multiple states in first weeks
- Only one link between farms: almost all feed mills, use some type of salvage product in rations. e.g., DDGs, soybean hulls, bakery waste, pet food, dairy products, etc.
- Recycle companies provide warehousing and transport; service areas cover many states.
- Rapid and efficient. Trucks may carry recycled dairy products one day and DDG the next.
- Transport companies were only connection capable of moving product quickly to mills across States.

CRITICAL POINT: There is no suggestion of wrong doing or bad practices by any company.

The tote scenario

- Totes (aka: FIBC) 1,000 to 3,000 pound volume, made of woven polypropylene material
- Commonly transport bulk feed to mills and farms (small farms not as likely to buy in bulk)
- Used to import products (e.g., organic soybean) and other purposes: flood control, saw dust, and ???
- Designed for reuse and commonly reused in U.S.
- Unknown if imports come in new totes, but no regs prohibiting
- ***Association of PEDv and feed in study is confounder**
- Virus to many locations by reuse or contaminating equipment or feed at mill.

Follow-up study results

1. As of 8/10/15, no detection of 5 viruses in samples of 25 imported soybean shipments.
2. No virus detected from 40 samples of imported jerky pet treats archived prior to April, 2013.
3. As of 8/10/15, no virus detected from 60 FIBCs provided by participating feed mills. (Note: samples submitted were new FIBCs from U.S. products recently used.)

Follow-up study results

4. Virus stability in totes:
   - Woven FIBC fabric treated with cultured PED virus.
   - Virus stable for 10-week at 4^0C and -80^0C
     Viable virus detected at 5-wks but not 6-wks at room temperature.

5. Serologic tests on 368 feral swine archived prior to April 2013 were negative.

Conclusions

1. There is no smoking gun or proven answer.
2. Tote scenario (FIBC) explains the data, key findings, and investigations.
3. Recommendations out of scope for RCG, but interventions to consider might be:
   - Voluntary industry management of tote sanitation (disinfect, not reuse, heat treatment).
   - Industry/university further research on sanitation.
   - Regs requiring new totes for imported products.
   - Other regs or voluntary actions ????

Response to the Outbreak

Response to the Outbreak

- USDA declares PEDv to be “transboundary”
  - Not reportable
  - Non-regulatory
  - No trade restrictions – except Mexico
- NPB, NPPC and AASV take the lead
  - Survey to determine route of introduction compiled and analyzed by CEAH
  - CEAH continuing to work on epidemiology with UMN

Response

- AASV survey of initial cases
  - No smoking gun but feed related issues were identified as having an increased association with introduction
    - All feed and ingredient samples have thus far tested negative
    - No specific company or ingredient has been implicated
    - Continue to work with FDA and feed manufacturers
- PEDv websites at www.aasv.org and www.pork.org

Response

- Development of 3 working groups
  - Biocontainment
    - How to limit spread off an infected premises
  - Biosecurity Transport
    - Review, modify, recommend biosecurity plans for transport, shows/exhibitions, producers
  - Packing Plant
    - Recommend biosecurity principles for packing plants, buying stations, etc
- These working groups have developed a number of guides targeting biosecurity published on NPB website

Research

Research

- NPB, NPPC and AASV funded a study by Dr. Jim Lowe to look at transmission in harvest plant lairage.

Lairage Study

- Trailers do become contaminated at packing plants due in part to movement of drivers
- The more contact that occurs, the higher the rate of contamination

One positive trailer in means 1.7 positive trailers at exit

Plant	Contaminated at entry	Contaminated at Plant	Contamination Ratio
A	2.25%	8.05%	3.58
B	7.00%	4.30%	0.61
C	10.84%	10.81%	1.00
D	2.00%	0.00%	0.00
E	14.56%	3.08%	0.62
G	3.00%	1.03%	0.34
All	**5.98%**	**4.31%**	**0.72**

Courtesy Dr. Jim Lowe

Research

- Dr. Matthew Turner surveyed cull sow buying stations in NC
  - Minimal biosecurity in place
  - Virus present, likely transmission occurring
  - Willingness on the part of the managers to make changes

Research

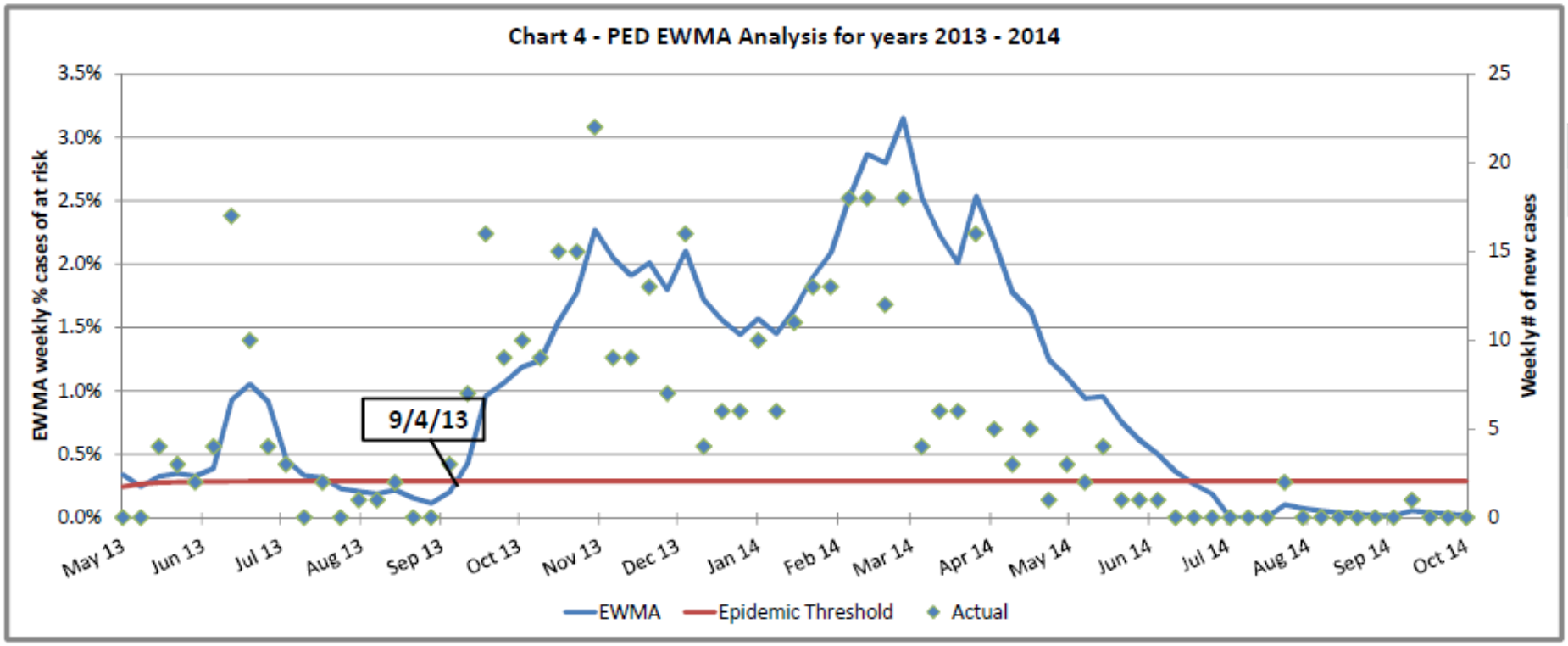
- Pork Board -- > $1 million for PEDv research
  - Rapid response to research call
  - Research objectives
    - Diagnosis
    - Pathogenesis
    - Environmental stability
    - Epidemiology
    - surveillance
  - Shortened timeline
    - 13 days to identify and initiate research projects
    - Progress updates every two weeks
    - Six month deadline

Economic Impact

Background

- Pig losses significant September 2013 – August 2014
- Majority of the impacts occurred in 2014
  - Farmers: increased net returns
  - Processors, retailers: Reduced net returns
  - Consumers: Price increases

Weekly New PED Cases



Number of sows	2,082,942
Number of farms	738

UMN Swine Health Monitoring Project, 2014

U.S. Swine Inventory Disposition

	September 2012 - August 2013	September 2013 - August 2014	Change	% Change
U.S. sows farrowing, head [a]	11,372,000	11,344,000	-28,000	-0.25%
U.S. pigs saved per litter [a]	10.22	9.91	-0.31	-3.03%
U.S. pig crop, head [a]	116,201,000	112,476,000	-3,725,000	-3.21%
	January 2013 - December 2013	**January 2014 - December 2014**	**Change**	**% Change**
U.S. Commercial hog slaughter, head [b]	112,076,700	106,875,700	-5,201,000	-4.64%
U.S. average carcass weight, pounds [c]	206.89	213.74	6.85	3.31%
U.S. Commercial pork production, pounds [b]	23,187,100,000	22,843,300,000	-343,800,000	-1.48%

Source: USDA, NASS; Schulz - 2015

The increased piglet mortality (0.31 pigs/litter) is the primary cause of the decreased pig crop.

Average carcass wt/head increased by 6.85 pounds, but decreased number of head resulted in an overall decrease in pork pounds by 344 million pounds.

MetaFarms Production Index for the Q1-2013 vs. Q1-2014

First-quarter closeout performance

Nursery	2013	2014	% change
Average start weight, lb.	12.8	12.9	—
Mortality, %	3.70	3.75	1.4
Average weight out, lb.	55.2	57.4	4.0
Feed per head, lb.	68.4	72.3	5.7
ADG, lb./day	0.85	0.89	4.7
FCR	1.63	1.64	—
ADFI, lb./day	1.40	1.46	4.3
Average days on feed	48.9	49.5	1.2
Finishing			
Average start weight, lb.	54.2	54.5	—
Mortality, %	4.32	4.31	—
Average weight out, lb.	271.5	280.1	3.2
Feed per head, lb.	616.0	647.0	5.0
ADG, lb./day	1.84	1.87	1.6
FCR	2.87	2.90	1.0
ADFI, lb./day	5.28	5.44	3.0
Average days on feed	116.4	118.7	2.0
Days to first (top out) sale	100.8	102.3	1.5
Wean-to-finish			
Average start weight, lb.	13.5	13.3	-1.5
Mortality, %	5.53	5.19	-6.1
Average weight out, lb.	271.1	278.7	2.8
Feed per head, lb.	675.0	699.0	3.6
ADG, lb./day	1.61	1.62	—
FCR	2.63	2.64	—
ADFI, lb./day	4.23	4.28	1.2
Average days on feed	159.5	163.3	2.4
Days to first (top out) sale	146.0	148.5	1.7

- Mortality post-farrowing was not impacted
- Performance in N & G-F unaffected

Stein, Feedstuffs, May 2014

>500 production companies

Forecasted and Estimated 2014 Costs and Returns

		Scenario						
	2014 Forecast made September 2013	2014 Estimate with forecasted finished pigs sold/female/year	Difference	2014 Estimate Finished pigs sold per mated female per year -43%	-33%	-23%	-13%	-3%
Productivity impact								
Finished pigs sold/female/year	20.48	20.48	0.00	11.67	13.72	15.77	17.82	19.87
Economic impact								
Average total revenue, $/head	$160.95	$204.52	$43.56	$204.52	$204.52	$204.52	$204.52	$204.52
Average total costs, $/head	$146.73	$150.16	$3.43	$186.61	$173.96	$164.59	$157.38	$151.65
Net return, $/head	$14.22	$54.36	$40.14	$17.91	$30.56	$39.93	$47.14	$52.87
Return on investment, %/head	9.66%	35.90%	26.24%	9.40%	17.34%	24.00%	29.68%	34.57%

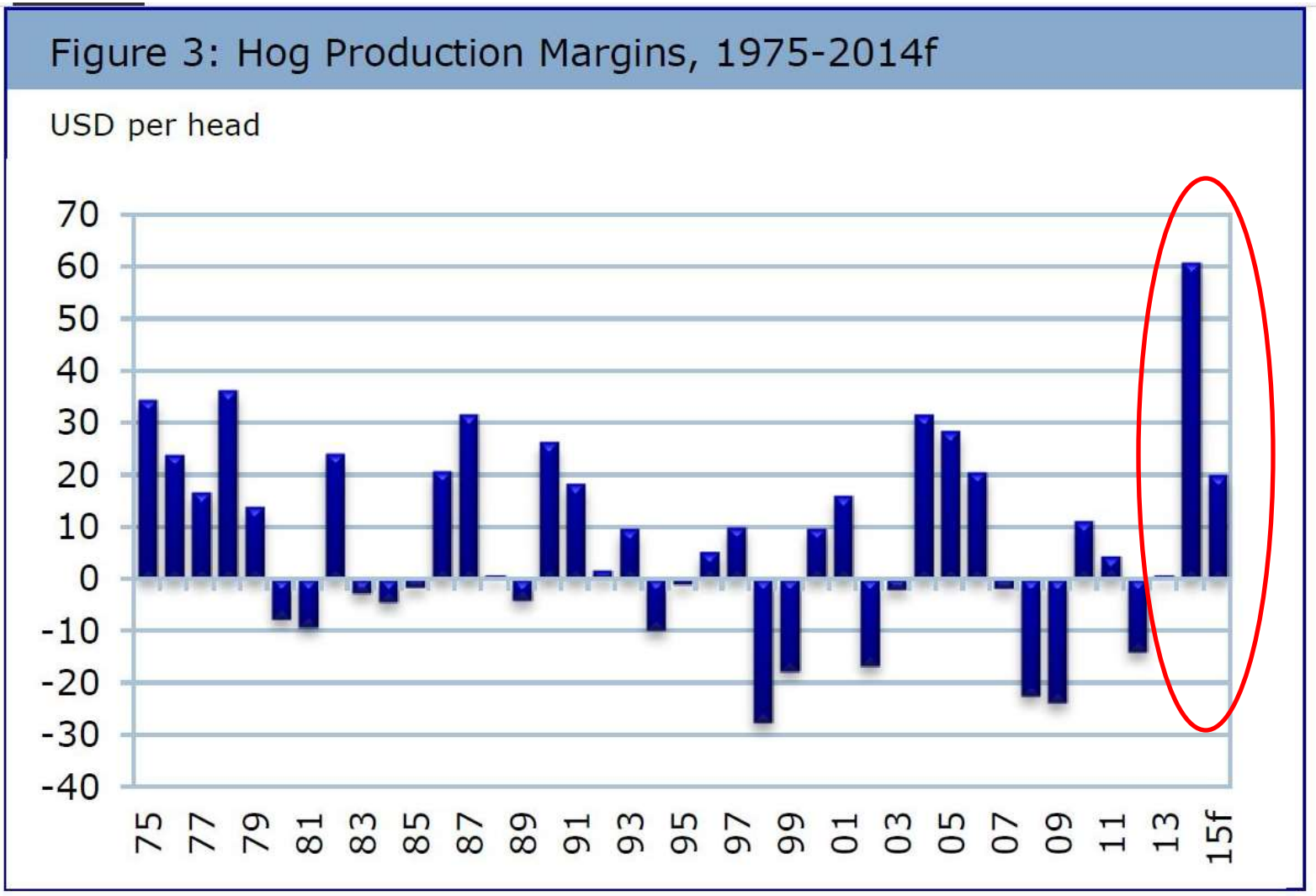
Schulz and Tonsor, 2015

1 2

1 Actual 2014 performance estimates

2 Estimated performance for producers experiencing PED losses

Haves & Have Nots



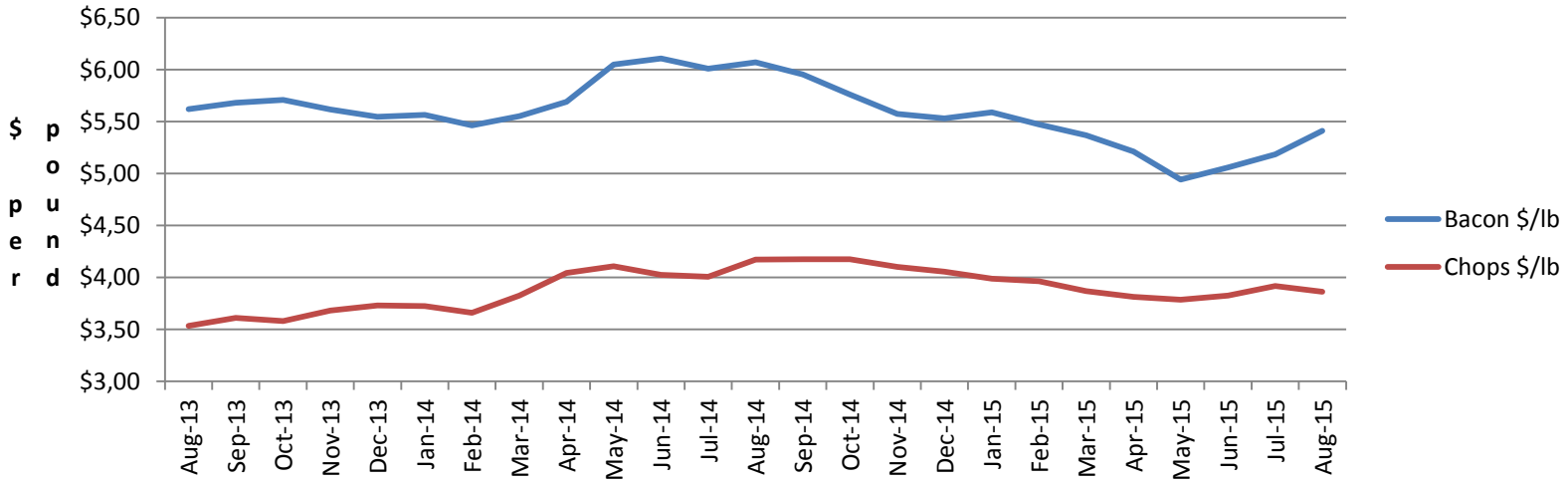
Source: IA State, Rabobank estimates, 2014

Economic Summary
Producer impacts

- Farmers that had pigs found it profitable to feed to heavier wts
  - Used excess finishing space
  - Cheaper feed costs
  - Higher hog prices
- Losses to infected producers are lower than gains to uninfected producers (Paarlberg, 2014)
- Net gain to producers BUT will likely lead to expansion and longer-term erosion of gains

Economic Summary
Packer/Consumer impacts

- Paarlberg (2014) estimates:
  - Packer reductions in annual returns for a 3% loss in pigs = $481 million
  - Consumers see increased pork prices and increases in other proteins



USDA, ERS

Economic Summary

General impacts

- No effect on consumer demand
- No effect on pork exports
- Pork imports increased by 9.48% in 2014

Lessons Learned

What We've Learned

- Although similar to TGE, PEDv is a different bug
  - More active in warmer environments
  - More difficult to control in a sow herd
  - Clinical picture can be more severe
  - Apparently no cross protection with TGE or PRCV
  - Huge amounts of virus are present
- Holes in our defense layers – obviously exist but hard to identify
  - Biosecurity at all levels should be evaluated
  - Particular emphasis on transport, packing plants

What We've Learned

- VDLs responded quickly but challenges with ability to communicate effectively
  - Tools exist today to facilitate this communication
    - FAZD has done an excellent job working with industry to facilitate the transfer of information
  - VDLs and NAHLN have stepped up to try to provide weekly data on new cases but…
    - Without PINs the data is suspect
    - Current mechanism is too labor intensive and archaic

AMERICAN ASSOCIATION SWINE VETERINARIANS

What We've Learned

- The use and ability to capture PINs would significantly improve data sharing
- Challenges exist with defining roles government and industry with transboundary diseases
- We are seeing "rebreaks" in 30 – 40% of herds

PEDv Wasn't a Surprise

- Anecdotal reports from the region
- Published papers from researchers
- Researcher to researcher communications
- Reports to AASV Swine Health Committee
- BUT, what do we do with this information?

Preparing for the next emerging disease

There are known knowns. These are things we know that we know. There are known unknowns. That is to say, there are things that we know we don't know. But there are also unknown unknowns. There are things we don't know we don't know.

Donald Rumsfeld – U.S. Secretary of Defense

Baltimore classification group	Families affecting homeotherm vertebrates	Genera known to affect swine	Representative virus affecting swine	Exotic or endemic	Enveloped or non-enveloped	Resistance to physicochemical treatments
Group I (dsDNA)[1]	*Herpesviridae*	Varicellovirus	pseudorabies virus	Exotic[2]	Enveloped	Medium
		unassigned	porcine cytomegalovirus	Endemic	Enveloped	Medium
	Adenoviridae	Mastadenovirus	swine adenovirus	Endemic	Enveloped	Medium
	Asfarviridae	Asfivirus	African swine fever virus	Exotic	Enveloped	Medium
	Papillomaviridae	Alphapapillomavirus	swine papillomavirus	Endemic	Non-enveloped	Very High
	Polyomaviridae		none known to be pathogenic	N/A	Non-enveloped	Very High
	Poxviridae	Suipoxvirus	swine pox	Endemic	Enveloped	Medium
Group II (ssDNA)[3]	*Anelloviridae*	Alphatorquevirus	none known to be pathogenic	N/A	Non-enveloped	Very High
	Circoviridae	Circovirus	porcine circovirus	Endemic	Non-enveloped	Very High
	Parvoviridae	Parvovirus	porcine parvovirus	Endemic	Non-enveloped	Very High
		Bocaparvovirus	porcine bocavirus (?)	Endemic	Non-enveloped	Very High
Group III (dsRNA)[4]	*Birnaviridae*		none known to be pathogenic	N/A	Non-enveloped	Medium
	Picobirnaviridae		none known to be pathogenic	N/A	Non-enveloped	Medium
	Reoviridae	Rotavirus	porcine rotavirus	Endemic	Non-enveloped	Medium
Group IV (+ssRNA)[5]	*Arteriviridae*	Arterivirus	porcine reproductive and respiratory syndrome virus	Endemic	Enveloped	Low
	Astroviridae	Mamastrovirus	swine astrovirus	Endemic	Non-enveloped	High
	Caliciviridae	Sapovirus	porcine sapovirus	Endemic	Non-enveloped	High
		Vesivirus	vesicular exanthema of swine virus	Exotic	Non-enveloped	High
	Coronaviridae	Alphacoronavirus	porcine epidemic diarrhea virus	Endemic	Enveloped	Low
		Alphacoronavirus	transmissible gastroenteritis	Endemic	Enveloped	Low
		Deltacoronavirus	porcine deltacoronavirus	Endemic	Enveloped	Low
		Torovirus	porcine torovirus	Endemic	Enveloped	Low
	Hepeviridae	Hepevirus	hepatitis e virus	Endemic	Non-enveloped	High
	Picornaviridae	Apthovirus	foot and mouth disease virus	Exotic	Non-enveloped	High
		Cardiovirus	encephalomyocarditis virus	Endemic	Non-enveloped	High
		Enterovirus	swine vesicular disease virus	Exotic	Non-enveloped	High
		Kobuvirus	porcine kobuvirus	Endemic	Non-enveloped	High
		Sapelovirus	porcine sapelovirus	Endemic	Non-enveloped	High
		Senecavirus	Seneca valley virus	Endemic	Non-enveloped	High
		Teschovirus	porcine teschovirus	Exotic	Non-enveloped	High
	Flaviviridae	Pestivirus	classical swine fever	Exotic	Enveloped	Low
		Flavivirus	Japanese enchephalitis	Exotic	Enveloped	Low
	Togaviridae	Alphavirus	Getah virus	Exotic	Enveloped	Low
Group V (-ssRNA)[6]	*Bornaviridae*		none known to be pathogenic	N/A	Enveloped	Low
	Filoviridae	Ebolavirus	none known to be pathogenic ?	N/A	Enveloped	Low
	Paramyxoviridae	Henipavirus	Nipah virus	Exotic	Enveloped	Low
		Respirovirus	Sendai virus	Endemic	Enveloped	Low
		Rubulavirus	porcine rubulavirus	Exotic	Enveloped	Low
			Menangle virus	Exotic	Enveloped	Low
	Rhabdoviridae	Vesiculovirus	vesicular stomatitis virus	Exotic	Enveloped	Low
		Lyssavirus	rabies	Endemic	Enveloped	Low
	Arenaviridae		none known to be pathogenic	N/A	Enveloped	Low
	Bunyaviridae		none known to be pathogenic	N/A	Enveloped	Low
	Orthomyxoviridae	Influenzavirus A	Influenza A virus	Endemic	Enveloped	Low
		Influenzavirus C	Influenza C virus	Endemic	Enveloped	Low
Group VI (ssRNA-RT)[7]	*Retroviridae*		none known to be pathogenic	N/A	Enveloped	Low
Group VII (DNA-RT)[8]	*Hepadnaviridae*		none known to be pathogenic	N/A	Enveloped	Low

Baltimore classification group	Families affecting homeotherm vertebrates	Genera known to affect swine	Representative virus affecting swine	AASV Average Score	AASV SHC Rank	NPB Rank
Group IV (+ssRNA)[5]	*Picornaviridae*	Apthovirus	foot and mouth disease virus	8.50	1.00	1
Group I (dsDNA)[1]	*Asfarviridae*	Asfivirus	African swine fever virus	8.50	1.00	3
Group V (-ssRNA)[6]	*Orthomyxoviridae*	Influenzavirus A	Influenza A virus	7.33	2.00	5
Group IV (+ssRNA)[5]	*Flaviviridae*	Pestivirus	classical swine fever	7.17	3.00	2
Group I (dsDNA)[1]	*Herpesviridae*	Varicellovirus	pseudorabies virus	6.67	4.00	7
Group IV (+ssRNA)[5]	*Picornaviridae*	Enterovirus	swine vesicular disease virus	6.33	5.00	6
Group V (-ssRNA)[6]	*Rhabdoviridae*	Vesiculovirus	vesicular stomatitis virus	6.17	6.00	8
Group IV (+ssRNA)[5]	*Arteriviridae*	Arterivirus	porcine reproductive and respiratory syndrome virus	6.17	6.00	10
Group IV (+ssRNA)[5]	*Flaviviridae*	Flavivirus	Japanese enchephalitis	6.17	6.00	
Group V (-ssRNA)[6]	*Paramyxoviridae*	Henipavirus	Nipah virus	5.83	7.00	
Group IV (+ssRNA)[5]	*Caliciviridae*	Vesivirus	vesicular exanthema of swine virus	5.83	7.00	
Group IV (+ssRNA)[5]	*Coronaviridae*	Alphacoronavirus	porcine epidemic diarrhea virus	5.83	7.00	
Group IV (+ssRNA)[5]	*Picornaviridae*	Teschovirus	porcine teschovirus	5.00	8.00	4
Group V (-ssRNA)[6]	*Paramyxoviridae*	Rubulavirus	porcine rubulavirus ("blue eye")	4.50	9.00	9
Group V (-ssRNA)[6]	*Orthomyxoviridae*	Influenzavirus C	Influenza C virus	3.83	10.00	

Expert Working Group

- Patrick Webb - NPB
- Joe Connor - Practitioner
- Doug MacDougald – Practitioner (Canada)
- Kent Schwartz – ISU VDL
- Eric Bush – USDA Epidemiologist
- Dick Hesse – KSU Virologist
- Jane Christopher-Henning – SDSU VDL
- Mike McIntosh – USDA FADDL
- Dermott Hayes – Ag Economist
- Kurt Rossow – MN VDL
- John Waddell – AASV SHC Chair
- Harry Snelson – AASV
- Mark Engle – WG Chair (unable to attend)

Representative virus affecting swine	U.S. status	risk	zoonotic risk (none known or yes)	comment	Action items
pseudorabies virus -- hot Chinese strain	exotic	very high	none known	emerging strain, need to evaluate, 1)confirmation of anecdotal info, 2)vx challenge study, 3)develop dx and vx	1) lit search, 2) genbank search, 3) contacts in and working in China
porcine cytomegalovirus	present	low	none known		Lit search
swine adenovirus	present	low	none known		
African swine fever virus	exotic	high risk	none known		need surveillance program; update NAHLN PCR (ongoing currently)
swine papillomavirus	present	low impact does not cause severe disease	unknown		
none known to be pathogenic					
swine pox	present		none known	doesn't spread easily,	
none known to be pathogenic	present	low		possible co-factor, seem to potentiate PCV	
porcine circovirus	present			Chinese variant appears to be emerging, some anecdotal evidence that a new strain may be impacting vaccine.	If active in China it may move up the list

Resource Categories

1. Diagnostics
    a. PCR
    b. Serology
    c. Oral fluids
    d. Virus isolation
    e. Preferred tissues
2. Epidemiology
    a. Global distribution
    b. Strain variability
    c. Species affected
    d. Control methods
3. Routes of transmission
4. Viral viability
    a. Environmental survivability
        i. Seasonality
        ii. Temperatures
        iii. Humidity
    b. Disinfectants
    c. Viral storage
5. Immunity
    a. Post-exposure
    b. Vaccines
    c. Cross-protection
6. Pathogenesis
7. Global distribution

Swine Virus Matrix

	Diagnostics	Epidemiology	Routes of Transmission	viral viability	Immunity		
Pathogen A							
Pathogen B							
Pathogen C							

Next Steps

- Emerging disease surveillance/monitoring is critical on a global scale
- Assign a person or persons to monitor and report
- Literature search on each virus – Result would
  - Identify basic knowledge gaps
  - Focus resource deployment
- Develop a one pager on each
- Ongoing monitoring of news reports and scientific lit
- Establish “trip wires”
- Remove the barriers to discovery
- Work with USDA and SAHOs to determine roles and outcomes – data control, confidentiality, disease control measures

Key Points

- Focus on global production diseases (the “known knowns”)
- Establish a mechanism for evaluating disease implications and prioritizing threats
- Work towards recognizing and filling resource/knowledge gaps (the “known unknowns”)
- Establish a diagnostic/surveillance system that searches for the introduction of emerging diseases

Swine Health Information Center

Mission

To protect and enhance the health of the US swine herd through

- targeted research investments that minimize the impact of future disease threats;
- collection and analysis of swine health data and
- global disease monitoring.

Swine Health Information Center

- Operations
  - Work in synergy with the National Pork Board, the National Pork Producers Council, and the American Association of Swine Veterinarians
  - Add to and not duplicate the capabilities of the associations

- Location
  - Virtual “Center”

Swine Health Information Center

- Board of Directors
- Direction and oversight of programs
  - Research Selection Task Force
  - Endemic Swine Disease Task Force
  - International Swine Disease Task Force
- Lifespan
  - 5 year lifetime unless it is extended by recommendation of the Center's Board of Directors and the approval by the NPB

Swine Health Information Center

- Scope of Work
  - Swine Disease Matrix project
  - Swine health data management, monitoring for trends and analysis of data
  - Priority Order
    1. Swine Health Monitoring Project
    2. Emerging disease monitoring data
    3. Production Animal Disease Risk Assessment Program (PADRAP)
    4. Secure Pork Supply database
    5. Trade support
       a) USDA sanction of data is essential to fulfilling this function

Swine Health Information Center

- Scope of Work, continued
  - Global swine health and issues identification
    - Information network
    - International Swine Disease Task Force
  - Improve the biosecurity and biocontainment ability of the US swine herd
    - Improvement of biosecurity and biocontainment in the industry will be a result of the epidemiological functions of the Center

Swine Health Information Center

- What this isn't . . .
  - A disease response plan
  - A duplication of AASV, NPPC or NPB

- What this is . . .
  - A tool to implement industry preparedness
  - A tool to improve swine health management
  - A tool to enhance non-regulatory disease response
  - A tool to enhance AASV, NPPC and NPB

Resources

- www.aasv.org
- www.pork.org

Special thanks to Dr Lee Schulz, Dept of Economics, ISU

AMERICAN ASSOCIATION SWINE VETERINARIANS