Economic Impact of Disease

Dr. Derald Holtkamp

Cartagena, July 16, 2014
Outline

• Financial impact of disease on the global pork industry

• Examples in the U.S.
  – PRRS virus - Summary of cost of PRRS study sponsored by the National Pork Board
  – PEDV
Source of financial losses

- Productivity losses
- Increased inputs/costs
  - Animal health costs
    - Vaccines
    - Antimicrobials
    - Diagnostics
    - Veterinary services
  - Labor
  - Biosecurity
Source of financial losses

• Outbreak related costs
  – Disruption of pig flow
    • Increased facility costs or inability to sell pigs at optimal market weights
  – Penalties in production contracts
  – Cost of control or elimination (e.g. depopulation-repopulation, herd closure, etc.)
Source of financial losses

• Costs associated with outbreaks in genetic breeding herds (ie. herds producing genetic replacement stock) and boar studs
  – Vast majority of the US industry will no longer accept PRRS virus positive semen or genetic replacement females
  – **Disruption of sales or supply of gilts and semen**
  – Cost of elimination
    • Depopulation/repopulation to get it done fast
      – $300 to $400 per sow for depop/repop vs. $10 to $40 for herd closure and rollover
Source of financial losses - Others that can be devastating when they occur

- Trade barriers
- Reduction of demand
  - Enzootic diseases / food safety
- Restrictions on pig movements
- Lawsuits
- Employee morale
- Strained business and neighbor relationships
- Damage to business reputation
- Bankruptcy
Major impact on the relative competitiveness of countries

Countries that manage to eliminate, or at least effectively control, the major swine diseases will gain a competitive advantage
Outline

• Financial impact of disease on the global pork industry

• Examples in the U.S.
  – PRRS virus - Summary of cost of PRRS study sponsored by the National Pork Board
  – PEDV
In the US: estimated annual cost of productivity losses caused by PRRSV is $664 million
Data for the economic analysis was compiled from several sources

1. Survey of swine veterinary experts on the incidence and impact of clinical PRRS on pig production efficiency

2. Survey of production records recorded during the period 2005 to 2010
   - Commercial farms with known PRRS virus status
Breeding herds were categorized according to their current PRRS virus status, history of recent outbreaks and PRRS virus status prior to recent outbreaks.

* AASV/PRRS-CAP categories
  I (PRRS virus-positive, unstable) &
  II (PRRS virus-positive, stable)

† AASV/PRRS-CAP categories
  III (provisionally PRRS virus-negative) &
  IV (PRRS virus-negative)
Groups of growing pigs were categorized according to their PRRS status at placement and at the time of marketing

*Negative by ELISA and PCR

**Positive by ELISA or PCR

***Positive by ELISA or PCR due to exposure to vaccine or wild-type virus

Methods
Process for estimating the cost of productivity losses in the U.S.

Two step process

1. Disease
2. Lost productivity
   \[ \text{Change in revenue and costs} \]
3. Change in profit $$
Estimating the productivity losses

- Estimates of productivity from survey of production records (2005 to 2010)
  - Estimated for BH-A, B, C and D herds
  - And for GP-A, B and C groups of pigs
Estimating the benefit of an animal health intervention

Methods

1. Disease
2. Lost productivity
3. Change in revenue and costs
4. Change in profit $$
Converting productivity losses into $$$

Enterprise budgeting models

• Set of equations that go from:
  – Productivity metrics
  – Market pig prices
  – Input prices

• To:
  – Costs
  – Revenue
Estimating the value of productivity losses for the entire country

- Estimates for the entire U.S. were made using information on:
  - Breeding herd inventories and pigs marketed from United State Department of Agriculture (USDA)
  - The relative percentage of herds in each PRRS classification from the survey of veterinarians
<table>
<thead>
<tr>
<th>Herd Inventory</th>
<th>BH-A</th>
<th>BH-B</th>
<th>BH-C</th>
<th>BH-D</th>
<th>WOF PRRS</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Breeding female inventory</td>
<td>6,780,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average breeding female inventory (breeding females / herd)</td>
<td>1,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of breeding herds</td>
<td>5,788</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage of breeding herds in category, U.S.</td>
<td>26.0%</td>
<td>6.0%</td>
<td>30.6%</td>
<td>36.0%</td>
<td>6,780,000</td>
<td>6,780,000</td>
</tr>
<tr>
<td>Breeding female inventory for single herd simulations</td>
<td>0</td>
<td>0</td>
<td>1,000</td>
<td>0</td>
<td>6,780,000</td>
<td>6,780,000</td>
</tr>
<tr>
<td>Unmated gilt as a percentage of breeding female inventory (%)</td>
<td>7.5%</td>
<td>7.5%</td>
<td>7.5%</td>
<td>7.5%</td>
<td>7.5%</td>
<td>7.5%</td>
</tr>
<tr>
<td>U.S. Mated female inventory</td>
<td>0</td>
<td>0</td>
<td>528</td>
<td>0</td>
<td>5,353,900</td>
<td>5,353,900</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Herd Turnover</th>
<th>BH-A</th>
<th>BH-B</th>
<th>BH-C</th>
<th>BH-D</th>
<th>WOF PRRS</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average female cull rate</td>
<td>60.73%</td>
<td>47.49%</td>
<td>60.45%</td>
<td>49.30%</td>
<td>56.17%</td>
<td>56.12%</td>
</tr>
<tr>
<td>Average female death rate</td>
<td>8.41%</td>
<td>5.93%</td>
<td>9.11%</td>
<td>9.58%</td>
<td>8.42%</td>
<td>9.11%</td>
</tr>
<tr>
<td>Annual female replacement rate (% of average breeding female inventory)</td>
<td>5.9%</td>
<td>5.7%</td>
<td>66%</td>
<td>69%</td>
<td>5.9%</td>
<td>5.9%</td>
</tr>
<tr>
<td>Number of female replacements entered (gilt/year)</td>
<td>0</td>
<td>0</td>
<td>556</td>
<td>0</td>
<td>3,423,313</td>
<td>3,428,300</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Breeding Performance / Productive and Nonproductive Days</th>
<th>BH-A</th>
<th>BH-B</th>
<th>BH-C</th>
<th>BH-D</th>
<th>WOF PRRS</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Litters farrowed/mated female/year</td>
<td>2.45</td>
<td>2.33</td>
<td>2.75</td>
<td>2.38</td>
<td>2.45</td>
<td>2.40</td>
</tr>
<tr>
<td>National productivity adjustment factor for litter farrowed/mated female/year</td>
<td>56%</td>
<td>56%</td>
<td>56%</td>
<td>56%</td>
<td>57%</td>
<td>57%</td>
</tr>
<tr>
<td>Litters farrowed / year - Adjusted to national productivity average</td>
<td>2.36</td>
<td>2.25</td>
<td>2.58</td>
<td>2.35</td>
<td>2.34</td>
<td>2.34</td>
</tr>
<tr>
<td>Productive female day</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average lactation length (days)</td>
<td>22.0</td>
<td>23.0</td>
<td>23.0</td>
<td>23.0</td>
<td>22.0</td>
<td>22.0</td>
</tr>
<tr>
<td>Average gestation length (days)</td>
<td>115.0</td>
<td>115.0</td>
<td>115.0</td>
<td>115.0</td>
<td>115.0</td>
<td>115.0</td>
</tr>
</tbody>
</table>
Total cost of productivity losses attributed to PRRS virus in the U.S. breeding and growing pig herd was $664 million annually

- $1.8 million per day
- $114.71 per sow annually
- Increase of approximately $104 million from the $560 million annual cost estimated in 2005
  - Inflation alone explains 40 percent of the increase
Total additional costs attributed to PRRS virus for animal health, biosecurity and other outbreak related costs were $477 million annually

- Animal health ($140M)
- Biosecurity and other outbreak related costs ($337M)
The cost of productivity losses is shifting from the growing pig to the breeding herd

- Loss in U.S. breeding herds was $302.06 million in 2011, with 45% of the total compared to 12% in 2005.
- Loss in the growing pig herd was $361.8 million in 2011, with 55% of the total compared to 88% in 2005.
Results

Distribution of breeding herds by PRRS category on October 1, 2010

- 28 percent of the breeding females in the U.S. were in PRRS virus-free herds (BH-A) on October 1, 2010
- 42 percent of all breeding females were in herds that had a PRRS outbreak in the last 12 months (BH-B + BH-D)
- 30 percent of the breeding females in the U.S. were in PRRS virus-infected herds that did not have an outbreak in the last 12 months (BH-C)

Source: Survey of veterinarians; 26 veterinarians representing 2,339,800 females
For the year ending October 1, 2010, 60 percent of pigs in the U.S. were negative at weaning (GP-A + GP-B). BUT of those that were negative at weaning, 58 percent were positive before marketing. GP-A: Negative at weaning and remained negative through marketing. GP-B: Negative at weaning but became infected before they were marketed. GP-C: positive at weaning.

Source: Survey of veterinarians; 26 veterinarians representing 41,496,625 pigs marketed.
Cost of productivity losses attributed to PRRS virus in the U.S. in the breeding herd (Farrow-to-wean, $/breeding female)

<table>
<thead>
<tr>
<th>Economic Impact ($ per breeding female)</th>
<th>BH-A</th>
<th>BH-B</th>
<th>BH-C</th>
<th>BH-D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Revenue - Difference (from BH-A)</td>
<td>($172.71)</td>
<td>($61.78)</td>
<td>($90.65)</td>
<td></td>
</tr>
<tr>
<td>Total Costs - Difference (from BH-A)</td>
<td>($1.12)</td>
<td>$0.14</td>
<td>$0.63</td>
<td></td>
</tr>
<tr>
<td>Net - Difference (from BH-A) -&gt; Average annual cost of PRRS in U.S. breeding herds</td>
<td>($171.59)</td>
<td>($61.92)</td>
<td>($91.28)</td>
<td></td>
</tr>
</tbody>
</table>

Outbreaks were more costly in breeding herds that were PRRS virus-free (BH-B) before the outbreak compared to those that were PRRS virus-infected (BH-D).
### Cost of productivity losses attributed to PRRS virus in the U.S. in the growing pig herd

(Wean-to-finish, $/pig placed)

<table>
<thead>
<tr>
<th>Economic Impact ($ per head placed)</th>
<th>GP-A</th>
<th>GP-B</th>
<th>GP-C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Revenue - Difference (from BH-A)</td>
<td>($5.68)</td>
<td>($9.35)</td>
<td></td>
</tr>
<tr>
<td>Total Costs - Difference (from BH-A)</td>
<td>($3.07)</td>
<td>($4.45)</td>
<td></td>
</tr>
<tr>
<td>Net - Difference (from BH-A) -&gt; Average annual cost of PRRS in U.S. growing pig herds</td>
<td>($2.61)</td>
<td>($4.90)</td>
<td></td>
</tr>
</tbody>
</table>

Results

$4.90 - $2.61 = $2.29

What it is worth to keep a pig that is negative at weaning negative all the way to market
Productivity losses by PRRS category in the breeding herd

Reduction in pigs weaned / mated female / year (*calculated*)
(from BH-A)

Source: Survey of veterinarians; 26 veterinarians representing 2,339,800 females
Animal health costs in the breeding herd by PRRS category

Results

| Source: Survey of veterinarians; 26 veterinarians representing 2,339,800 females |

<table>
<thead>
<tr>
<th>Category</th>
<th>BH-A</th>
<th>BH-B</th>
<th>BH-D</th>
<th>BH-C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immunization cost/pig weaned</td>
<td>$2.08</td>
<td>$3.22</td>
<td>$1.91</td>
<td>$2.87</td>
</tr>
<tr>
<td>Pharmaceutical cost/pig weaned</td>
<td>$0.59</td>
<td>$1.15</td>
<td>$1.13</td>
<td>$0.91</td>
</tr>
<tr>
<td>Diagnostic cost/ pig weaned</td>
<td>$0.14</td>
<td>$0.26</td>
<td>$0.23</td>
<td>$0.22</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$3.32</td>
<td>$3.15</td>
<td>$1.79</td>
<td>$1.74</td>
</tr>
</tbody>
</table>
Productivity losses by PRRS category in the growing pig (wean-to-market)

Major source of loss associated with PRRS virus in growing pigs is mortality

Source: Survey of veterinarians; 26 veterinarians representing 41,496,625 pigs marketed

1,2,3,4 Different superscripts indicate statistical significance; Values from production records only
Summary

• Despite years of research, the PRRS virus continues to be costly to the U.S. swine industry
  – It is an incredibly adaptable virus!

• Need to continue focusing on preventing outbreaks in sow herds and weaning negative pigs but also have to figure out how to keep them negative all the way to market

• Desperately need a new approach to dealing with the virus
  – Regional control/elimination
  – Take biosecurity to the next level – bio-exclusion, bio-management, and bio-containment
Outline

- Financial impact of disease on the global pork industry
- Examples in the U.S.
  - PRRS virus - Summary of cost of PRRS study sponsored by the National Pork Board
  - PEDV
In the US: estimated annual cost of productivity losses caused by PEDV is $304 million
Economic impact

• Significant morbidity and mortality in neonatal piglets

• Increased costs
  – Vaccination
  – Biosecurity

• PEDV does not generally kill growing pigs – but reduction in ADG may reduce marketing weights
~50% of breeding herds were infected by mid-May, 2014

Incidence from swine health monitoring project at U of MN

Impact on productivity

• 50% of breeding herd in U.S. suffered a PEDV outbreak last year

• On average, 5 weeks worth of weaned pigs were lost in herds that had outbreaks
  – 5 of 52 weeks is **9.6%** of annual production would be lost in herds that had outbreaks
### Revenue lost because of PEDV (in US$)

#### Sows affected

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Breeding female inventory</td>
<td>5,850,000</td>
</tr>
<tr>
<td>Percent of breeding herd inventory with outbreaks</td>
<td>50%</td>
</tr>
<tr>
<td>Breeding inventory with outbreaks</td>
<td>2,925,000</td>
</tr>
</tbody>
</table>

#### Lost weaned pig production

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Weeks of pigs lost following outbreaks</td>
<td>5</td>
</tr>
<tr>
<td>Percentage of annual wean pig production lost</td>
<td>9.6%</td>
</tr>
<tr>
<td>Pigs weaned per sow per year</td>
<td>24</td>
</tr>
<tr>
<td>Weaned pigs lost per sow per year in herds with outbreaks</td>
<td>2.31</td>
</tr>
</tbody>
</table>

#### Lost revenue

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Value of weaned pigs ($/pig)</td>
<td>$45.00</td>
</tr>
<tr>
<td>Total value of weaned pigs lost ($/year)</td>
<td><strong>$303,750,000</strong></td>
</tr>
</tbody>
</table>
Fewer pigs weaned from a given sow inventory results in less revenue with very little reduction in cost.

Nearly all of the costs in the sow herd are either fixed or accumulate on a per sow basis.

Therefore... estimated annual cost of productivity losses caused by PEDV is ~ the lost revenue - $304 million.
Other economic impacts

- PEDV is not a World Organization for Animal Health (OIE) reportable disease and is not considered a foreign animal disease by the United States Department of Agriculture (USDA)
  - Has not affected export markets
  - No quarantines or movement controls
Other economic impacts

Is it a public health concern? NO

• Only infectious to swine
• Is NOT a food safety concern
Impact of PEDV on market hog prices

August 2014 Lean Hog Futures Price, Chicago Mercantile Exchange (CME)
US Department of Agriculture (USDA) instituted a monitoring and control program

- Federal Order requires **mandatory reporting** of all herds diagnosed with PEDV
  - Herds required to identify themselves and provide location information
  - Animal health laboratories required to provide positive tests and location information to USDA
  - Herd Management Plans are required
Restriction on pig movements

- Utah (5/5/14), Arkansas (4/2/14), Texas (2/7/14), Oklahoma (2/10/14), North Dakota (3/4/14), Washington (2/20/14) and Idaho (3/5/14)

- “Certificate of Veterinary Inspection” must be signed by both the owner and the accredited veterinarian
  - “To the best of my knowledge, swine represented on this certificate have not, within the last 30 days, originated from premises known to be affected by PEDV and have not been exposed to PEDV.”
Summary

• Economic impact of PEDV is still about ½ of the impact of PRRSV
  – 664 million USD / year for PRRSV
    • 17.4 billion COP - scaled to the size of the Colombian pig industry
  – 304 million USD / year for PEDV
    • 7.9 billion COP - scaled to the size of the Colombian pig industry

• PEDV has contributed to high market hog prices and very high profits in the U.S.
  – Especially for producers who have avoided PEDV outbreaks
  – This is a short-term situation
  – In the long-run it will increase the cost of production and decrease global competitiveness
Acknowledgements

• National Pork Board for funding the cost of PRRS project (Project # 10-158)

• Associación Colombiana de Porcicultores
  – Organizing committee