Measuring antibiotic use in the swine industry

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Antibiotic use (ABU) in food animals

What really matters?

- Are food animal industries doing harm, and how much?
- Are antibiotics used efficiently in food animals?
  - What is effective and necessary for animal health and wellbeing, and food safety?
  - What is philosophically defensible?
- How good is the evidence?
  - Harm to public health
  - Benefits to animal health and/or food safety
  - How best to use antibiotics in food animals
- How to do better, regardless of impact on public health?
US Swine industry overview

- > 60,000 farms
- ~ 70 million inventory
- > 110 million animals marketed annually

<table>
<thead>
<tr>
<th>Hog and Pig Farms by Type of Owner</th>
<th>% of Operations</th>
<th>% of Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family/Individual</td>
<td>83</td>
<td>41</td>
</tr>
<tr>
<td>Corporation</td>
<td>8</td>
<td>34</td>
</tr>
<tr>
<td>Partnership</td>
<td>7</td>
<td>23</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>All</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Increasingly concentrated industry

2014: Operations >5000 head
~ 5% of operations
~ 68% of inventory
DOGMA:
"If you can't measure it you can't manage it"

TRUTH:
"The important stuff can't be measured"
Towards meaningful measurement

Purpose
Stakeholders’ Goals

Context
Inference
Communication
Action

Scope
Target population
Time/Space

Metrics
Measurement Rates

Scale
Granularity
Accuracy
Cost
What is the primary goal?

- Reduce the impact of ABU in animals on clinical resistance in human medicine
- Reduce ABU in veterinary medicine
  - Independent of AMR and stewardship outcomes
  - Arbitrary targets?
- Optimize ABU (use more effectively)
  - Inform and motivate antibiotic stewardship
  - Reduce ‘inappropriate’ antibiotic use
  - Preserve efficacy of antibiotics in veterinary medicine
NPB Sabattical project NPB 2015-2016

- Review AMU systems used in EU
  - Visits to DK, NL, BE, DE (2013, 2016)
- White paper to NPB (April 2016) on options for measurement in US industry
  - Assessment of existing data sources
  - Comparison of metrics
  - Form industry task force
- Design pilot project for AMU measurement
- May 2016 - FDA RFP (funded Sep 2016)
Develop and implement an antibiotic use data collection program in U.S. swine production

- FDA cooperative agreement
  - 5 year time frame
- Evaluate existing data on antibiotic use in the swine industry
  - 2016 data forward
- Develop a platform for data collection that minimizes producer disruption
- Guidance of NPB task force
Leverage existing data

- ‘Pork powerhouses’
  - 30 producers >50% of production
  - Record/analyze AMU for cost accounting reasons
  - Some benchmarking on costs of AMU
    - Agristats, Metafarms
  - Variability in granularity of data recorded
  - Some publishing AMU (mg/lb)

- Private benchmarking initiatives (PART)
General approach

- Initial focus on large systems and existing data collection systems
  - Scope and granularity of data
  - Approaches to achieve confidentiality
  - Benchmarking and understanding practices
  - Development of metrics

- Phased development
  - Initial pilot project for feasibility
  - Grow-finish
Voluntary participation

- Need for AMU data and analysis
- Potential for sharing data already collected
- Must give value to participants
  - Benchmarking
  - Broader industry benefit
- Confidentiality
- Benefits of USG involvement
  - Credibility and analytical resources
- Metric(s)
Leverage existing data

- Accounting based – no standard method
  - Invoicing not administration
- Level at which use is attributed and analyzed
  - System
  - Flow
  - Site
  - Barn
  - Lot (group)
  - Pigs (injection only)
What is a year?

- Tracked by lot
  - Groups closed out in calendar year
  - ABU by weight; pigs/wt by closed lots
  - Variation in ABU among lots within systems

- Not tracked by lot
  - ABU in calendar year across all growing sites
  - Pigs/wt sold across all sites in calendar year
  - Assumes ‘steady state’ production

- Hybrid – feed by system, Water/Inj by lot
Pig Flow complexity

- Wean-to-Finish vs. Nursery and Finishing
- Variability in site capacity and barns
- ‘Double stocking’
- Commingling
- Traceability and allocation of ABU through flow
Attribution issues

- Data mostly based on orders/dispensing
- Amounts allocated to lots or sites (or not)
  - Assume all used for respective lots
  - OK for feed (correct distribution, wastage)
  - Carryover for injectables and water
- Significance of carryover amounts
  - Level of analysis
  - Lot vs. site vs. flow vs. system
Population denominator issues

- Numbers vs. weight vs. both
- Numbers
  - Pigs marketed in 2016 vs. pigs placed
  - Mortality, culls
  - Retained for breeding
  - Primary and secondary markets
- Weight and age of pigs marketed
  - Varies with market conditions
  - Live weight vs. carcass weight
### Scope vs. granularity of data

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Scope</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Descriptive System level</td>
<td>Weight</td>
</tr>
<tr>
<td></td>
<td>Retrospective</td>
<td></td>
</tr>
<tr>
<td>Level 2</td>
<td>Benchmarking Farm level</td>
<td>ADD?</td>
</tr>
<tr>
<td></td>
<td>Retrospective</td>
<td></td>
</tr>
<tr>
<td>Level 3</td>
<td>Stewardship Administration</td>
<td>‘Used’ DD</td>
</tr>
<tr>
<td></td>
<td>Group/animal level Prospective</td>
<td></td>
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</tbody>
</table>
Reduction in antibiotic use is an intervention, not an outcome

Assessing appropriate use?
- Definition?
- Who is qualified to decide?
- What are the criteria?

Outcomes
- Real or projected benefits to human health
- Demonstrable?
Metric pondering?

- Aggregate weight measures meaningless
  - Needs to be explained/articulated in all reports
- Does a magic metric exist?
- Can one exist when we don’t understand the relationships between “use” and “resistance”
- Importance of time of administration in relation to market?
Measurement and Stewardship
Ways forward

**Market Driven**
Niche: RWA, ABF, ..... Differentiated Commercial Customer oriented

**Industry Driven**
Transparency Data driven Stewardship Getting better

**Government driven**
Availability Oversight Enforcement Reduction
Pipestone Antibiotic Resistance Tracker

http://www.pipestonepart.com
The urge to compare?

- Comparison of use among countries
- Comparison of use among species/industries
- Academic interest and curiosity
  - Conversation starter → ‘public shaming’
  - Fodder for misinformation and mischief
- Scientifically meaningless?
  - Ignores geographic and climatic factors
  - Ignores species biology and life span
  - Ignores differences in disease risk profiles
ABU in the Netherlands
Comparison by species

Table 14. Annual defined daily doses animal (DDDA$_{VET}$) for veterinarians active in the broiler, turkey, pig, dairy cattle, veal and non-dairy cattle farming sectors, for 2016. Provided parameters are the mean, 50th percentile (median), 75th percentile (P75) and 90th percentile (P90)

<table>
<thead>
<tr>
<th>Livestock sector</th>
<th>n</th>
<th>Median</th>
<th>P90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broiler farming sector</td>
<td>90</td>
<td>5.12</td>
<td>20.00</td>
</tr>
<tr>
<td>Turkey farming sector</td>
<td>9</td>
<td>8.59</td>
<td>38.79</td>
</tr>
<tr>
<td>Pig farming sector</td>
<td>268</td>
<td>4.94</td>
<td>10.58</td>
</tr>
<tr>
<td>Dairy cattle farming sector</td>
<td>739</td>
<td>2.21</td>
<td>2.84</td>
</tr>
<tr>
<td>Veal farming sector</td>
<td>141</td>
<td>10.48</td>
<td>28.45</td>
</tr>
<tr>
<td>Non-dairy cattle farming sector</td>
<td>682</td>
<td>0.73</td>
<td>1.89</td>
</tr>
</tbody>
</table>

Adapted from 2016 Sda report, p. 37 (Sept. 2017)
Summary

- Measuring antibiotic use in food animals
  - What vs. how vs. why
- Potential for voluntary collection of use data
- Representativeness
- More detailed and granular data needed to inform stewardship in veterinary medicine
- Clarity of purpose for data collection