The public health crisis of antibiotic misuse in animal agriculture
Overview

• What is industrial food animal production?

• Changes in farms and animal production practices

• Animal waste

• Antibiotics in animal ag

• Human health concerns related to antibiotic resistance
• EPA definition for Animal Feeding Operation (AFO)
  • Animals stabled/confined and fed/maintained for 45d/yr
  • Crops, vegetation, forage not sustained in normal growing season over any portion of the lot or facility

• Concentrated Animal Feeding Operation (CAFO)
  • > 1,000 animal units = >1,000,000 lbs of live weight

• Industrial Food Animal Production - characterized by:
  • High throughput production methods
  • One site
  • Controlled conditions
  • Uniform consumer product
  • Small profit margins
Food animal production in the US has been transformed over the last 50 years.
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**Change in Broiler Industry Structure, 1959 - 2012**

- **Average number of broilers per operation**
- **Number of broiler operations (1000s of farms)**

Food animal production in the US has been transformed over the last 50 years

Changes in hog industry structure, 1959 - 2012

Localization of production

1949
Poultry processing plants
- Each dot represents a plant processing 50,000 or more chickens each year

2007
Chicken production
- Each dot represents annual sale of 1 million or more chickens
Geography of production - swine

Hogs and Pigs - Inventory: 2012

1 Dot = 20,000 Hogs and Pigs

United States Total
66,026,785
## 2009-10 Slaughter and Inventory Statistics for US Livestock

<table>
<thead>
<tr>
<th>Animal</th>
<th>Slaughtered/year</th>
<th>Inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chickens</td>
<td>8,658,860,000</td>
<td>Not given</td>
</tr>
<tr>
<td>Hogs</td>
<td>113,733,800</td>
<td>64,400,000</td>
</tr>
<tr>
<td>Cattle &amp; calves</td>
<td>33,300,000</td>
<td>93,700,000</td>
</tr>
<tr>
<td>Sheep &amp; lambs</td>
<td>2,611,200</td>
<td>6,900,000</td>
</tr>
<tr>
<td>Turkeys</td>
<td>245,768,000</td>
<td>Not given</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9,054,273,000</strong></td>
<td>---</td>
</tr>
</tbody>
</table>

Source: USDA 2010
Vertical integration/contract production

• Structure extremely common (>90%) in poultry and swine industries (Martinez/USDA 2002)

• Integrators
  • Own animals
  • Control inputs
  • Own processing plants

• Growers
  • Operate under contract
  • Own animal waste

• “Farmers”? 
What are we feeding food animals?

- Antimicrobials/antibiotics and synthetic hormones
- By-products of slaughtered animals and “rendered” animals
- Animal waste
- Waste from industrial processes
### WHAT ABOUT ANIMAL WASTE?

<table>
<thead>
<tr>
<th></th>
<th>(Treated)</th>
<th>(Untreated)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Human Waste</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generated/yr</td>
<td>6.9 million dry tons</td>
<td>287 million dry tons</td>
</tr>
<tr>
<td>Applied to Land/yr</td>
<td>3.9 million dry tons</td>
<td>&gt;270 million dry tons</td>
</tr>
</tbody>
</table>

~ one dry ton of animal waste generated for every US citizen
What’s in animal waste?

• Bacteria
• Protozoa
• Viruses
• Animal dander
• Pharmaceuticals
• Heavy metals
• Hormones
• Nutrients

courtesy SRA Project - www.sraproject.org
What happens to the waste?
Back to antimicrobial use in animals

Multiple Purposes
- Treatment
- Control
- Prevention
- Growth Promotion

80% of Antimicrobials in U.S. Sold for Use in Food Animal Production

Producers have no responsibility to report use

Use is considered proprietary!

2012 medically important ABX sales (61%)

<table>
<thead>
<tr>
<th>Route of Administration</th>
<th>Percentage of Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed</td>
<td>70%</td>
</tr>
<tr>
<td>Water</td>
<td>24%</td>
</tr>
<tr>
<td>Other</td>
<td>6%</td>
</tr>
</tbody>
</table>

Source: FDA
### Key differences in human vs. animal ABX use

<table>
<thead>
<tr>
<th></th>
<th>Human</th>
<th>Veterinary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dose ranges</strong></td>
<td>Therapeutic only</td>
<td>Primarily subtherapeutic</td>
</tr>
<tr>
<td><strong>Duration</strong></td>
<td>Specified, brief</td>
<td>Majority of animal lifespan</td>
</tr>
<tr>
<td><strong>Oversight</strong></td>
<td>Physician-prescribed</td>
<td>OTC and veterinarian-prescribed*</td>
</tr>
<tr>
<td><strong>Drug selection</strong></td>
<td>Often targeted</td>
<td>Preventive uses not targeted</td>
</tr>
</tbody>
</table>

Animal use contributes more “selection pressure” – increasing likelihood of killing weaker bacteria and promoting existing (and new) resistant bugs!
Antibiotics administered at low doses

Susceptible bacteria eliminated

Resistant bacteria survive and multiply
Fig. 3. Spread of antimicrobial-resistant pathogens (X) from agriculture to the community and hospital. Pathogens from CAFOs (pig-farm house) spread through food products, manure lagoons, air, wildlife (birds), animal transport trucks, and deposit of manure on cropland. (Courtesy of Salvador Saenz, El Paso, TX. Copyright ©2008, Salvador Saenz.)
• Animal production facility workers have greatest contact with animals, manure, other environmental vectors

• Recent studies have shown swine production workers are likely to carry bacteria from farms

• Workers at industrial farms are more likely to carry multi-drug resistant bacteria, for as long as days after the last work shift

• Bacteria recovered from workers at farms that did not use antibiotics were far less likely to be multi-drug resistant
Swine production, crop fields, and methicillin-resistant *Staphylococcus aureus*
A New MRSA: Community Associated (CA-)

• Since mid-1990s, large increase in MRSA infections in persons lacking prior contact with the healthcare system

• Shortly after, were recognized to be new MRSA strains

• Were rapidly disseminated among US general population, now affect patients with and without contact with healthcare system

• These new strains cause different clinical syndromes, particularly skin and soft tissue infections (SSTIs)
  • Incidence of SSTIs in US has been increasing

• These new strains now account for the majority of MRSA infections

• Large reservoirs of MRSA isolates now exist outside healthcare facilities
Swine production and MRSA

- Living near a swine production site is a risk factor for CA-MRSA and SST infections

- Living near a crop field where swine waste is sprayed is a risk factor for CA-MRSA and SST infections

- In this study, the population attributable fraction of swine crop fields for CA-MRSA was 10.7%

- Other work
  - Similar study underway in North Carolina
  - Carrel (2014) - Study of VA hospitals in Iowa
AMR infection burden in the US

• 2013 CDC report
  • Estimates 23,000 deaths/yr associated with AMR infections
  • Estimates ~ 2M resistant infections each year
  • Acknowledges use in animals as a factor
  • Prioritized list of infectious agents
Antimicrobial-resistant infections

• Undermines treatment options for bacterial infections
• MRSA: >94,000 invasive infections and >18,000 deaths annually
• Hospital stays are longer and more costly for resistant infections
• Estimated $17-26 billion in additional U.S. health care costs annually
What can you do?

• Hygienic preparation

• USDA Organic-certified vs. conventional meats

• How much meat?

• Get involved
  • Support legislative efforts to curb antibiotic misuse
  • Put pressure on elected officials and regulatory agencies
Take Home Messages

• Farming has become more industrialized over the last half-decade

• Many practices employed in animal production pose risks to people

• Antibiotics are routinely misused in food animals
Take Home Messages

• Workers and communities near industrial farms and crop fields where manure is applied are most exposed to resistant bacteria
• Resistant infections are burdensome and very difficult to treat
• You can be a part of a movement to change the system!