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IAP: Occupational and Community Impacts; Real Communities, Real People

Ellen Silbergeld, PhD
Amy (Chapin) Sapkota, PhD, MPH
Johns Hopkins University
Module 5

IFAP: Economics, Occupational Health, and Rural Communities
Community Health Effects of Swine CAFOs (Real Communities, Real People)

Amy (Chapin) Sapkota, PhD, MPH
Johns Hopkins University
Amy R. (Chapin) Sapkota

- Environmental Epidemiologist and Acting Director, Maryland Department of Health and Mental Hygiene’s Office of Environmental Health
- Earned her PhD in 2005 from the Bloomberg School
- Research Director, Center for a Livable Future
- Assistant Professor, the University of Maryland College Park School of Public Health
- Research interests include pathways of antibiotic resistance and resistance genes from food animal production
Section A

Real Communities, Real People: Community Health Effects Associated with Swine CAFOs
Research at JHSPH

- Research at JHSPH on AMR and food-animal production
  - Epidemiology
    - Exposure, health outcomes
  - Product monitoring
    - Poultry products testing
  - Environmental studies
    - Pathways and routes of exposure
      - Air, water, dusts, soils
      - Biotic transfers—wildlife studies
  - Molecular microbiology
    - Tracking pathogen movement
    - Tracking gene transfer
    - Microbial population genetics/diversity
  - Policy analysis
    - Economic analyses
    - Scientific basis for risk assessment
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Many Nonfood Routes of Exposure and Transfer

Source: Adapted from Dr. Ruth Etzel. USDA.
Case Study: Delmarva Poultry Industry

- 600-800 million broiler chickens produced annually
- 6,000 broiler chicken houses
- 2,500 chicken growers
- 15,000 poultry employees
- Total annual gross income of Delmarva broiler industry: exceeds 1.3 billion dollars
The Other Product of CAFOs

Image Source: USDA
The Delmarva Peninsula’s “Other Product”

- >1,000,000 tons of “manure” produced by ~800 million chickens per year
- Integrators own the birds
- Growers own the waste
- Management—largely land applied

Image Source: USDA
Why Are We Concerned?

- More biosolids applied than land can handle
- Contributes to surface and ground-water contamination
- Increased nutrient runoff into surface waters
- Detectable presence of drugs and resistance determinants in ground-water
Pocomoke River

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CAFOs Are an Environmental Justice Issue

- Location
  - CAFOs and processing plants are located in areas with low socioeconomic status (SES) and high minority populations

- Organization
  - The industry is modeled on share cropping
Organization

- Sharecropping model
  - Vertically integrated, from feed to table
  - A few large producers (e.g., Tyson, Perdue, Smithfield, IBC) control all aspects of production
  - Growers contract with producers
  - Producers contract with chicken workers
  - Compensation based on piece work
Location

- Odds ratio of hog CAFOs by race/income—Mississippi counties

<table>
<thead>
<tr>
<th>Percent Black</th>
<th>0–25% poverty</th>
<th>25–100% poverty</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–29%</td>
<td>1 (ref)</td>
<td>2.68</td>
</tr>
<tr>
<td>30–100%</td>
<td>2.84</td>
<td>1.35</td>
</tr>
</tbody>
</table>

## Odds ratio of hog CAFOs by race/income—North Carolina

<table>
<thead>
<tr>
<th>Poverty %</th>
<th>0–2%</th>
<th>2–10%</th>
<th>10–100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–5%</td>
<td>1 (ref)</td>
<td>1.4</td>
<td>1.1</td>
</tr>
<tr>
<td>5–12%</td>
<td>1.8</td>
<td>3.6</td>
<td>7.0</td>
</tr>
<tr>
<td>12–100%</td>
<td>1.7</td>
<td>3.1</td>
<td>9.6</td>
</tr>
</tbody>
</table>

Who Is at Risk for Exposure?

- Workers and growers who work in broiler houses
- Workers who handle live chickens at processing plants
- Household members of these persons
- Community residents
The Poultry Environment Health Study

- Hypotheses
  - Persons with direct exposure to the poultry environment are at increased risk of exposure to ABR
  - Exposed persons are at increased risk of bacteria-associated outcomes
  - There is a gradient of exposure, and health risk, among workers, their families, and the community
The Poultry Environment Health Study

- Subjects
  - Poultry house workers
  - “Live hangers”
  - Growers
  - Household members
  - Community residents
Working in the Poultry Industry

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Living Near the Poultry Industry

- Hatcheries
- Feed mills
- Slaughterhouses
- Rendering plants
- Deboning plants

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Shallow Aquifers in Delmarva
The Poultry Environment Health Study

- Exposure risks
  - Pathogens
  - Antibiotic resistance
  - Antibiotics
  - Arsenic

- Pathways
  - Air, water, dusts, wildlife, caught fish, food plants
## Airborne Risks of Exposure: Maryland Hog Farms

<table>
<thead>
<tr>
<th>Bacteria—<em>Enterococcus</em></th>
<th>Antibiotic resistance pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E. dispar</em> (n = 4)</td>
<td>Ery, Clin, Tet</td>
</tr>
<tr>
<td><em>E. durans</em> (n = 2)</td>
<td>Ery, Clin</td>
</tr>
<tr>
<td></td>
<td>Ery, Clin, Virg</td>
</tr>
<tr>
<td><em>E. faecalis</em> (n = 6)</td>
<td>Tet</td>
</tr>
<tr>
<td></td>
<td>Ery, Clin, Tet</td>
</tr>
<tr>
<td></td>
<td>Ery, Clin, Tet, Virg</td>
</tr>
<tr>
<td><em>E. faecium</em> (n = 1)</td>
<td>Ery, Clin, Tet, Virg</td>
</tr>
<tr>
<td><em>E. hirae</em> (n = 14)</td>
<td>Ery, Clin</td>
</tr>
<tr>
<td></td>
<td>Ery, Clin, Tet</td>
</tr>
<tr>
<td></td>
<td>Ery, Clin, Tet, Virg</td>
</tr>
<tr>
<td>Other <em>Enterococcus</em> (n = 11)</td>
<td>Ery, Clin, Tet</td>
</tr>
</tbody>
</table>

Source: Chapin et al. (February 2005). *Environ Health Perspect*, 113, 2, 137-142.
The Poultry Environment Health Study

- **Outcomes**
  - Bacterial carriage
  - Reported diarrheal disease
  - Respiratory function tests
  - Neurological symptoms

- **Methods**
  - Isolation of bacteria from stool; measurement of antibodies in sera
  - Questionnaires
  - Respiratory function testing
Arsenic: The Forgotten Antibiotic

- Extensive use of arsenicals in broiler feeds
- Documented contamination of waste and amended land
- Percolation into groundwater
- *Arsenic is a human carcinogen associated with skin, liver, and cardiovascular disease*
Arsenic and Poultry

- Roxarsone, arsanilic acid used in poultry as coccidiostats and growth promoters—45 g/ton feed
- GP—continuous lifelong exposure in feeds
- Arsenicals excreted (>70%)
- 100-200 mg/bird (900 million/year)
- 50,000-90,000 mt/year arsenic
- Arsenicals → inorganic arsenic
- Leach into groundwater
A Suggestive Trace

Cancer Mortality Rates for Maryland Counties, 1995-1997

Counties with mortality rate significantly higher than U.S. rate

Source: CDC.
To test the geographic correlations between drinking water and
- Land use/agriculture/waste disposal
- Hydrology
- Cancer incidence
- Atherosclerosis ...
Results to Date

- Arsenic levels in some Delmarva tap water exceeds the EPA standard!
- U.S. Geological Survey database does not accurately predict arsenic exposures via drinking water
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