A Public Health Perspective on Industrial Animal Operations

D’Ann Williams DrPH, MS
Research Associate
Environmental Health Sciences
Johns Hopkins Bloomberg School of Public Health
Agriculture and the Environment

- Emissions associated with agricultural operations
  - $\text{PM}_{10}$ and $\text{PM}_{2.5}$
  - $\text{O}_3$ precursors, $\text{NO}_x$ and VOCs
  - Greenhouse gases ($\text{CO}_2$, $\text{N}_2$, and $\text{CH}_4$)
  - $\text{NH}_3$
  - $\text{H}_2\text{S}$
  - Biologically active agents,
    - bacteria, mold spores, allergens, endotoxin
  - Odors - related to the over 200 volatile organic compounds
  - Chemical drift – pesticides, herbicides, pharmaceuticals
Agriculture and Occupational Exposures

• What we know from industrial animal workers
  – pulmonary changes – reduced lung function
  – mucous membrane irritation,
  – asthma
  – chronic bronchitis
  – asthma-like syndrome
  – bronchial hyper-responsiveness
  – chronic obstructive pulmonary disease
  – sensitization
  – acute toxicity from high-dose gas exposures (nitrogen oxides, hydrogen sulfide, ammonia)
  – hypersensitivity pneumonitis,
  – eczema and skin disorders

Source: Mitloehner and Schekner, 2007, Omland, 2002
Public Health Implications

- Respiratory health
- GI health
- Odors
- Psychological
- Quality of life

- Nuisance
- Environmental Impact
- Economics
“Sound Science”

• These exposure situations are not clear-cut

• Clear-cut findings would include
  • an objective finding (e.g., a measurable effect, such as an altered blood chemistry or abnormal radiograph)
  • an adverse health effect, measured toxic substances at known toxic concentration, and an obvious dose-response relationship.

• These community exposures are much more complex because they are a mix of physical, mental, emotional, and social stressors.

Source - Donham. 2010
The public health perspective

• Rural vs Urban

• Traditional farming and the industrial farming process

• Susceptible populations
  – Children
  – Asthma
  – Elderly

• There is no “safe level of PM
• Threshold limits for allergens are being questioned
• Gases are irritants and contributors of chronic respiratory disease
Environmental Health paradigm

Diagram:

1. "Susceptibility" Genes & Effect Modifiers
2. Agents, Sources, Distribution
3. Exposure
4. Effects on Health
5. Assess Risk
6. Reduce Risk
7. Policy & Law
8. Work environment
9. Intervention

Flow:
- From "Susceptibility" Genes & Effect Modifiers to Individuals & Community
- From Agents, Sources, Distribution to Exposure
- From Exposure to Effects on Health
- From Effects on Health to Assess Risk
- From Assess Risk to Reduce Risk
- From Reduce Risk to Policy & Law
- From Policy & Law to Work environment
- From Work environment to Intervention
- From Intervention to "Susceptibility" Genes & Effect Modifiers

Arrow directions indicate the flow of the paradigm.
Study Area
Yakima County

• One in 11 adults have asthma.

• One in 14 adults have had a heart attack, coronary heart disease, angina, or stroke.

Economic costs of asthma as reported in “The Burden of Washington Asthma”
Study

• 20 Proximal (P) within ¼ mile from facility or facility sprayfield
• 7 Intermediate (I) 3 miles from facility, but not > 3 mile from sprayfield
• 13 Distal (D) > 3 miles from facility and sprayfield
  – Simultaneous indoor/outdoor sampling for 5 days
  – Study Sampling Timeframe June 10 – August 19, 2008

Collected Samples and Analysis

• Airborne PM Total Dust
  – BGI 400S pump, 37mm cassette, PTFE filter
    • PM Mass – gravimetric analysis, JHSPH
• Bos d 2 Cow Allergen – ELISA, Indoor Biotechnologies, Inc.
• Ammonia – Grandko Passive Sampler, ICP analysis, JHSPH

Settled Dust

• Bos d 2 Cow Allergen – ELISA, Indoor Biotechnologies, Inc.
• Endotoxin analysis – LAL, Thorne Lab U. Iowa
Housing Characteristics

Home types were similar:

• home age
• # of people in home
• presence of pets
• air conditioning use
Air Results

Outdoor concentrations - 80, 8 and 2 times higher in proximal vs distal homes

Indoor concentrations 10, 2, NSD higher in proximal vs distal homes
Settled Dust Results

**Log Bos d 2 by Home Type**

**Log Endotoxin by Home Type**
Results
Distance to Facility

Airborne concentrations above "background" seen at up to 5 miles
Communities

• These findings illustrate that large scale dairies influence the concentrations of environmental contaminants inside and outside of Yakima County community homes.

• There is little research in the US on communities impacted by animal operations.

• There are currently no studies which are looking specifically at community exposures to airborne agricultural contaminants and health outcomes.

• There are no national reporting programs for rural health or agricultural community illnesses.
Further Research is Needed

• Studies are needed which evaluate the benefits of research demonstration projects

• Need to evaluate the benefits of best management practices and proposed technologies

• Rural ambient air quality monitoring is needed to evaluate these exposures.

• The establishment of a rural health reporting system is recommended which evaluates:
  • Respiratory
  • GI
  • Mental Health (odors, extra stressors)
  • Quality of Life (enjoyment of environment, economic)