ANIMAL FEEDING OPERATIONS, AIR QUALITY AND PUBLIC HEALTH

WHAT IS HAPPENING AT UNMC

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TOPICS FOR TODAY

• Concerns by the public about AFOs
• What is public health, why is it important?
• How is human respiratory health assessed?
• Air quality exposure assessment on farms
• How does air quality affect the health of livestock farm neighbors? Farmers?
NEIGHBOR HEALTH CONCERNS

• Odors, specific health effects, flies, noise
• Vulnerable persons included (children, the elderly, chronically ill)
  • Inclusion of vulnerable persons is how the public differs from the workers
  • Healthy worker effect is a large factor
PUBLIC HEALTH CONCERNS

- Respiratory diseases
  - Aggravation of asthma, other lung disorders
  - Possible causation of new lung disorders
- Non-respiratory issues
  - Psychological complaints
  - Other (a variety of symptoms reported)
EXAMPLE #1 OF AFO NEIGHBOR HEALTH CONCERNS

• Question: Parents of a child with recurrent pneumonia want to know if they should move because of a hog confinement facility being constructed 10 miles away.

• The child’s physician advised them to move to a community without this type of exposure because of risk to their child of having more lung infections
EXAMPLE #2 OF AFO NEIGHBOR CONCERNS

• A farm family living 1 mile from 2 hog farms says that one of the children has breathing difficulties when playing outdoors and that 2 of the children often vomit repeatedly at night.
• They also object to the hog odor.

  • Their family physician advised them to move away.
  • They were also told by their doctor to stay in their basement when the hog odor is severe.
AFOS, AIR QUALITY & PUBLIC HEALTH: THE HEALTH OF FARM NEIGHBORS

• High level of concern expressed by farm neighbors and others
• Published scientific information about exposures, respiratory and other health effects
  • Limited to a small number of studies describing exposures and symptoms
Historically, ~30% of hog farmers had lung symptoms
- Cough, wheezing, shortness of breath with exertion

Lung inflammation is associated with this work
- Review: Von Essen SG & Auvermann BW. J of Agromed 2005

But workers compensation claims now uncommon
- Why? Is air quality improved in modern hog barns?
- Not known because gaining funding for this work and access to barns/workers has not always been possible
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WHAT IS PUBLIC HEALTH?

- The WHO defines health as: “A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.”
- A population can be as small as a few people or as large as all the inhabitants of several continents.

See Ten Essential Public Health Services at http://www.asph.org/
WHY IS PUBLIC HEALTH IMPORTANT?

“Health care matters to all of us some of the time, public health matters to all of us all of the time.”

C. Everett Koop
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This drawing shows the major airways of the human lung.
AIRWAY AND ALVEOLAR TISSUE

• Photomicrograph of an airway and adjacent alveolar tissue, where gas exchange occurs
  • 40X magnification
ASSESSMENT OF LUNG HEALTH

- Questionnaires
  - Symptoms
  - Exposure assessment
    - Non-invasive, easily administered
    - Designing questionnaires that give informative data is a challenge
ASSESSMENT OF LUNG HEALTH: FIELD RESEARCH, SCREENING AND EDUCATION

- Lung function testing at farm trade shows
  - Non-invasive/simple but won’t detect subtle disease
  - Suitable for field studies
  - Can use for screening (see photo from Husker Harvest Days 2006)
ASSESSMENT OF LUNG HEALTH: CLINICAL STUDIES

• Bronchoscopy with bronchalveolar lavage
  • Information about cells, proteins in the lung
    • Pro: gives a lot of information
    • Con: invasive, expensive, must be done in a hospital
    • Used to study swine confinement farm workers in small numbers, not practical for studying neighbors

• Induced sputum, using hypertonic saline
  • Also yields information on cells, inflammation
  • Can be done as a field study on livestock farms
ASSESSMENT OF LUNG HEALTH: EPIDEMIOLOGY

• Epidemiology
  • Study of how often diseases occur in different groups of people and why
• A finding from epidemiologic studies:
  • Being a livestock farmer protects against lung cancer, according to US death certificate data
ASSESSMENT OF LUNG HEALTH: LABORATORY-BASED PROJECTS

• These projects can be done using animal models or cells in culture
  • Are an indirect means of studying mechanisms by which AFO exposures cause effects on the lung
    • Example: Poole JA et al. Repeat organic dust exposure-induced monocyte inflammation is associated with protein kinase C activity. J Allergy Clin Immunol 2007

• Can test ideas generated by clinical studies

• Gives evidence about which of the hundreds of substances in agricultural dusts are bioactive
Figure 3

(A-B). Muramic acid analysis of the various agricultural and domestic house dust extracts. (A) Muramic acid concentration normalized to the total amount of dust extracted in Tween (ng/mg). (B) Muramic acid concentration normalized to total volume in the 1% HBSS dust extract (ng/mL). Mean results ± SEM are presented (N=3). *Statistically different from all other dust extracts (p<0.001). #Statistically different from all other dust extracts (p<0.05).


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EXPOSURE ASSESSMENT

- Estimating exposure from questionnaires
- Measuring dust levels/content, gases
  - Subjects wear personal air sampling equipment to collect dust then analyze samples in the lab
  - Non-invasive, but sampling & analysis are complex
- Measuring dust, gases in the air in barns or outdoors on or near livestock farms
WHAT CONTRIBUTES TO AIRWAY DISEASE IN SWINE CONFINEMENT WORKERS?

- Number of hours worked per day, years of exposure
- Substances in the air predict lung function change
  - **Total dust concentrations ≥ 1.3 mg/m³** (smokers) or **2.8 mg/m³** (nonsmokers)
  - **Ammonia** levels of ≥ 7.5 ppm
  - Hydrogen sulfide, carbon dioxide, carbon monoxide measured but **not** predictive of chronic lung disease
- Endotoxin also decreases lung function
NEIGHBORHOOD EXPOSURE

- Reynolds et al measured hog dust and endotoxin 60 meters outside a facility
- Ammonia concentrations 0.25 ppm (large farms) to 0.14 ppm (small farms) at 60 M
  - 7.5 ppm of ammonia is the threshold for illness in the swine confinement workers
- Dust and endotoxin barely detectable at 60 M
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• Schiffman et al studied 44 neighbors of hog confinement operations in North Carolina.
  • Found more tension, anger, depression in hog farm neighbors
  • Also more confusion and fatigue, less vigor
• Wing & Wolf conducted interviews on quality of life of persons living near hog farms in North Carolina
  • More respiratory and mucous membrane (nose and eye) complaints in those near hog farms
  • Main finding: quality of life (number of times could open windows, go outside) reduced in hog farm neighbors compared to other groups
    • Wing S et al. Environ Health Perspect 2000
NEIGHBORHOOD HEALTH EFFECTS (3)
LUNG SYMPTOMS IN RURAL CHILDREN

• Survey of 58,169 North Carolina adolescents
  • Respiratory symptoms, allergies, medications, socioeconomic class, household environments
  • More wheeze reported from schools within 3 miles of swine feeding operations (5% higher)
  • Wheeze 24% higher if livestock odors noticeable indoors 2+ times per month
• Mirabelli MC et al. Pediatrics 2006
LONG TERM REACTION OF PUBLIC TO LARGE-SCALE SWINE FACILITIES

• Study done in Illinois:
  • Reisner AT and Taheripour F. J Anim Sci 2007
  • Farmers more positive than non-farmers
  • More likely not to be concerned about odor
  • Those opposed felt little power to remove the facilities once they were built
  • Many not willing to speak out (only activists do so)
  • If there was a lot of conflict initially, some may remain unhappy but the barns usually remained
HOG CONFINEMENT & AIRWAY DISEASE IN WORKERS

- Cough, wheeze, shortness of breath on exertion subacute or chronic in ~30% of workers, historically
  - Risk lower in modern barns? No recent published studies.

- Lung disorders
  - Asthma-like syndrome
    - Inflammation differs from asthma (it is not allergic)
  - Worsening of pre-existing asthma
    - By an irritant, not an allergic effect
  - COPD
    - Hog barn exposure, cigarette smoking additive
ADAPTATION TO HOG BARN DUST

- Persons who **work** in hog barns have **less** inflammation than do previously unexposed volunteers who spend only one day there.
- This is evidence of an **adaptation** to this environment.
  - Interesting question: Does adaptation occur in AFO neighbors as well?
A systematic review was performed, looking at respiratory health of AFO neighbors.

The conclusion:
- The only positive finding: a weak association between self-reported disease in people with allergies or familial history of allergies and respiratory symptoms related to living near AFOs.

NEIGHBORHOOD EFFECT: SUMMARY

- More data is urgently needed on AFO health effects on neighbors (the lawsuits continue)
  - Studies need to be larger and should include vulnerable populations, control groups
  - Must include objective air quality assessment
  - Should include objective measures of health, including lung function
THE END
PHOTO BY DAN BROOKS