

PM10 Concentrations and Health Effects:  
What we've known for a while and What's new

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# Outline

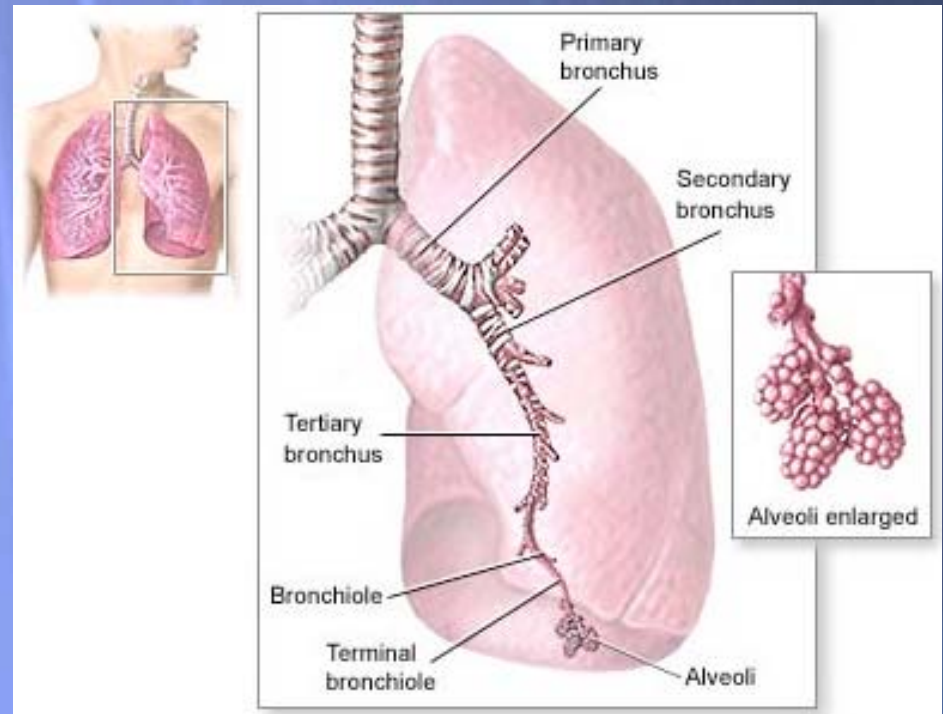
- ✦ The Respiratory System
- ✦ Diseases of concern
- ✦ Environmental agents
- ✦ Prior studies of PM10 impacts
- ✦ Continuing PM10 research
  - ✦ Impact of endotoxins
- ✦ Conclusion; Implications for Pinal County

# Respiratory System Facts

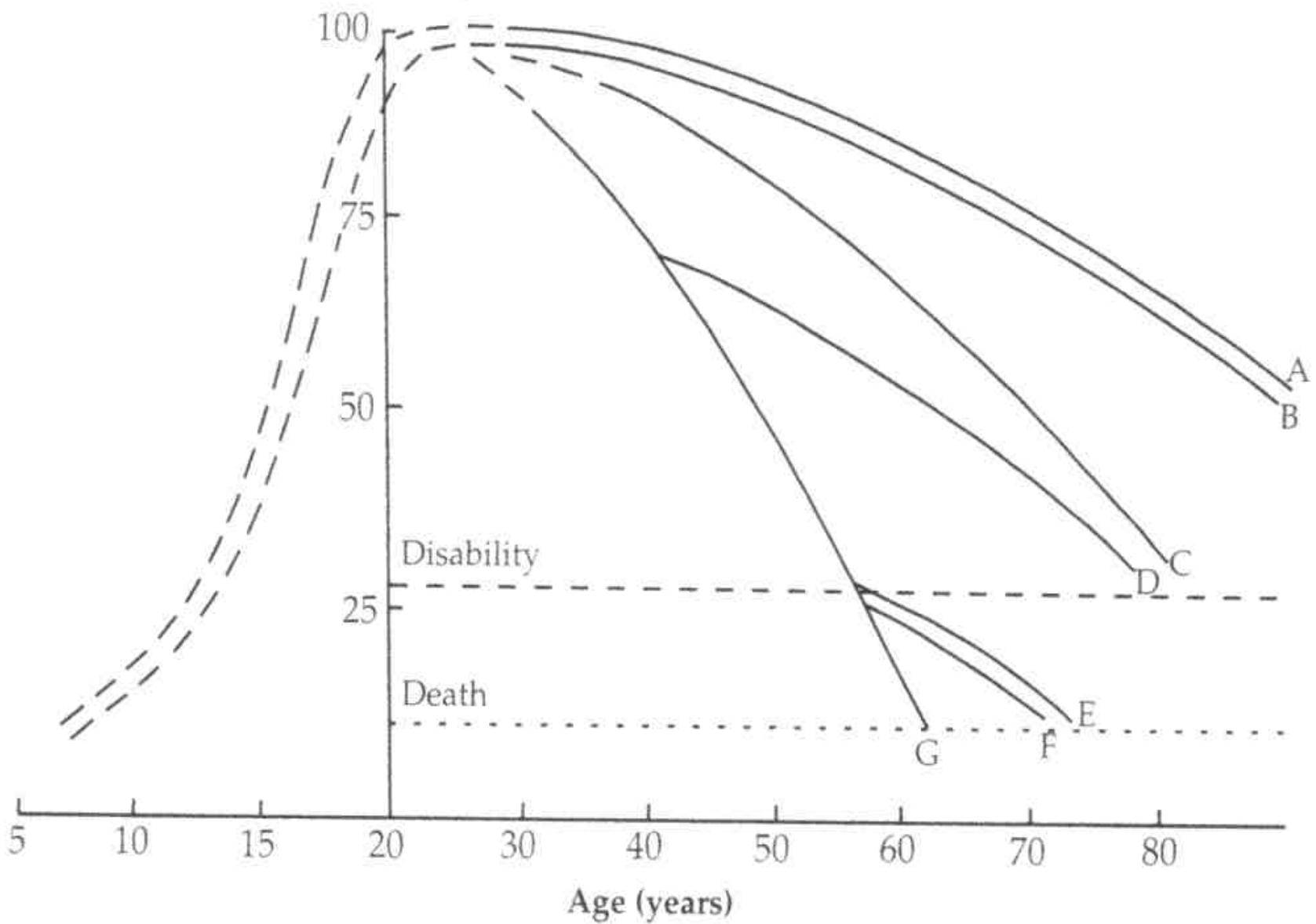
- ✦ Large gas exchange surface area: 100 square meters in adults
  - ✦ Vast majority at alveolar interface
  - ✦ Turbulent flow in large airways and at airway branch points
- ✦ Muco-ciliary clearance at airway branch points
  - ✦ May be antigens
- ✦ Average adult breaths ~ 12,000 liters per day
  - ✦ Approximately  $10^{12}$  fine or ultrafine particles per day
  - ✦ About 25% of this reaches the alveolar surface
  - ✦ There are about  $5 \times 10^8$  alveoli
  - ✦ 500 - 1,000 particles per alveolus

## The challenge:

- clearance of particles without inflammatory amplification
  - immune specific
  - immune non-specific
- resolving infections



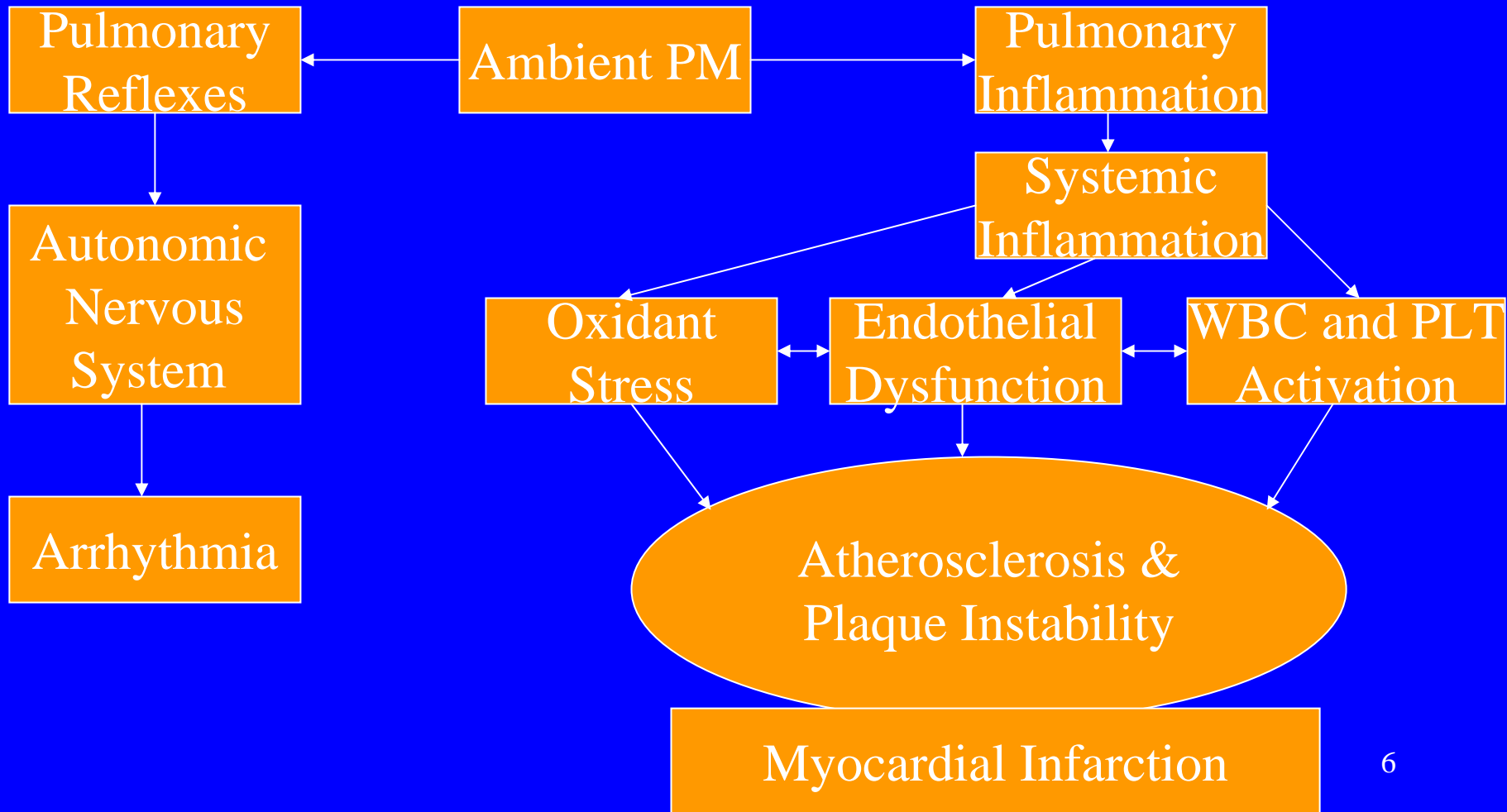
FEV<sub>1</sub> as % of  
value at ages  
20-25 years



# Major Lung Diseases

- Asthma -- “reversible” airway obstruction (17 million people)
  - Who develops asthma?
  - What are risk-factors for onset?
    - Age related factors (childhood vs. adult onset)
  - What are the environmental interactions?
    - Dust, plant allergens, pollens
- Chronic Obstructive Pulmonary Disease (21 million people)
  - Most often attributed to smoking
  - Fully 20% of patients with COPD have never been smokers
- Idiopathic pulmonary fibrosis

# Possible Mechanisms Linking PM and CV Disease

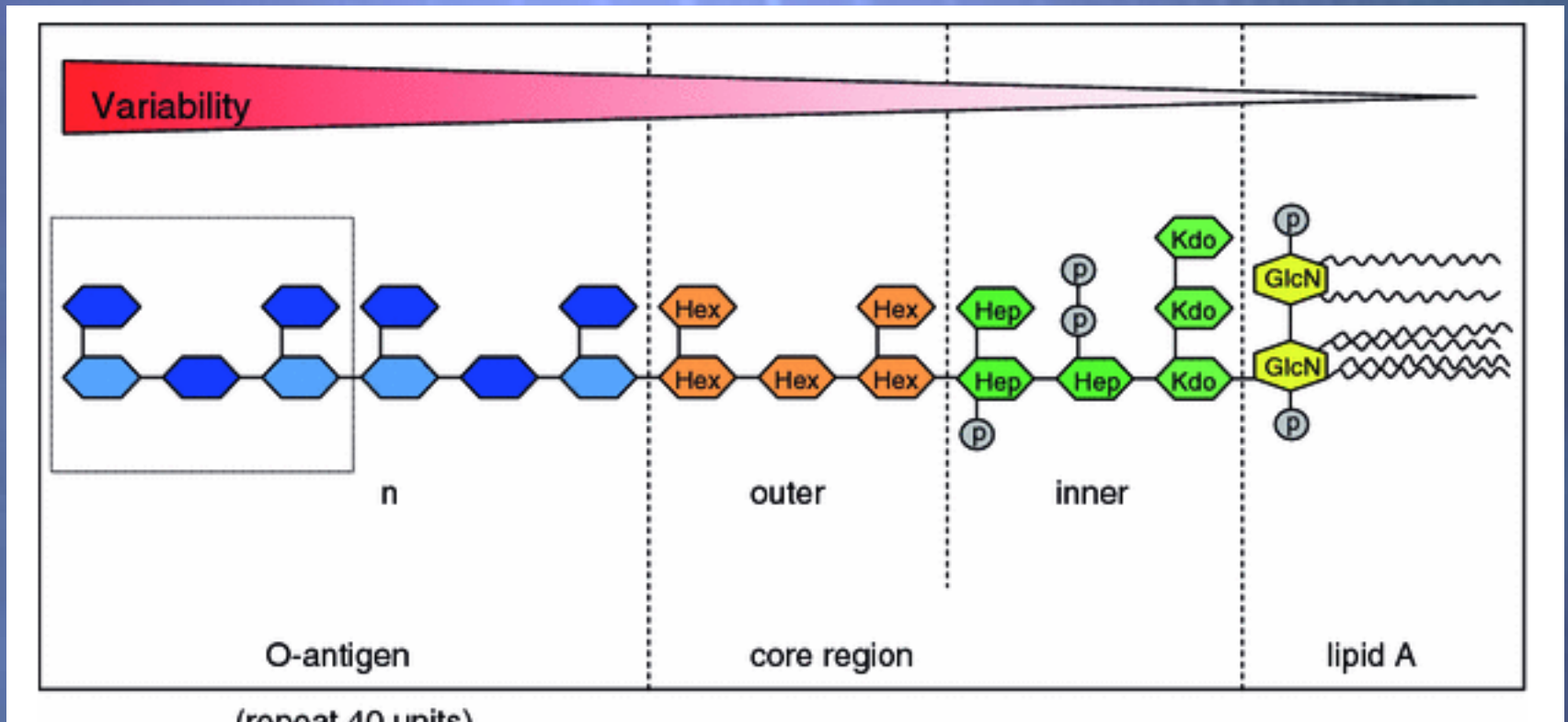


# Environmental agents

- ✦ Gases
  - ✦ Chemically reactive
  - ✦ Physiologically reactive
- ✦ Inorganic Dusts
  - ✦ May be antigens or “haptens”
  - ✦ Dust-loading of immune system cells
- ✦ Pollens (antigens)
- ✦ Adsorbed materials onto respirable particles
- ✦ Occupation-specific
  - ✦ Diacetyl (popcorn “butter”)
  - ✦ Mining and milling
  - ✦ Agricultural

# Environmental Agents

## Endotoxin Structure



Immunogenicity

Direct toxicity

# PM10 and Endotoxins

- ✦ “PM10” is a generic physical descriptor
- ✦ Endotoxin can adsorb on PM10 particles
- ✦ Research indicates that endotoxins adversely affect the health of animals
  - ✦ Respiratory endotoxin disease severity is exacerbated by fine dust inhalation.

# Prior Studies

## Health Risks Associated with PM10

- Published studies suggest that extended PM10 exposure contributes to excess mortality
  - Those with cardiovascular disease are at highest risk
    - Heart attack is the dominant threat
  - One study indicates excess cardiopulmonary mortality rises 0.31% for each 24 hour, 10-ug/m<sup>3</sup> increment in PM<sub>10</sub>
  - Lack of rural research does not negate rural risk
- Analysis supports a conclusion that PM10 exacerbates lung diseases
  - For example, asthma
  - The young and old are at highest risk

# Continuing Research; Preliminary Conclusions from American Thoracic Society Report\*

- Assessment of PM10 exposure provides:
  - Strong evidence of correlation with cardiovascular and lung disease exacerbation
  - Strong argument for biological plausibility of underlying mechanism
  - “Adequate” evidence of correlation with impaired lung development in young adulthood
  - More work needed for assessing overall morbidity

# Continuing Research

## Outstanding Needs

- Definitive research regarding health impacts of PM10
  - What is the “morbidity”?
    - Role of preventive interventions
  - Focus on endotoxin impacts
- Syndromic surveillance
  - Earliest possible symptom identification
  - SYRIS – SYndromic Reporting Information System
    - DREAM – NASA Dust and Regional Atmospheric Model

# Dust Model (DREAM) output and syndromic surveillance

SYRIS - Dev

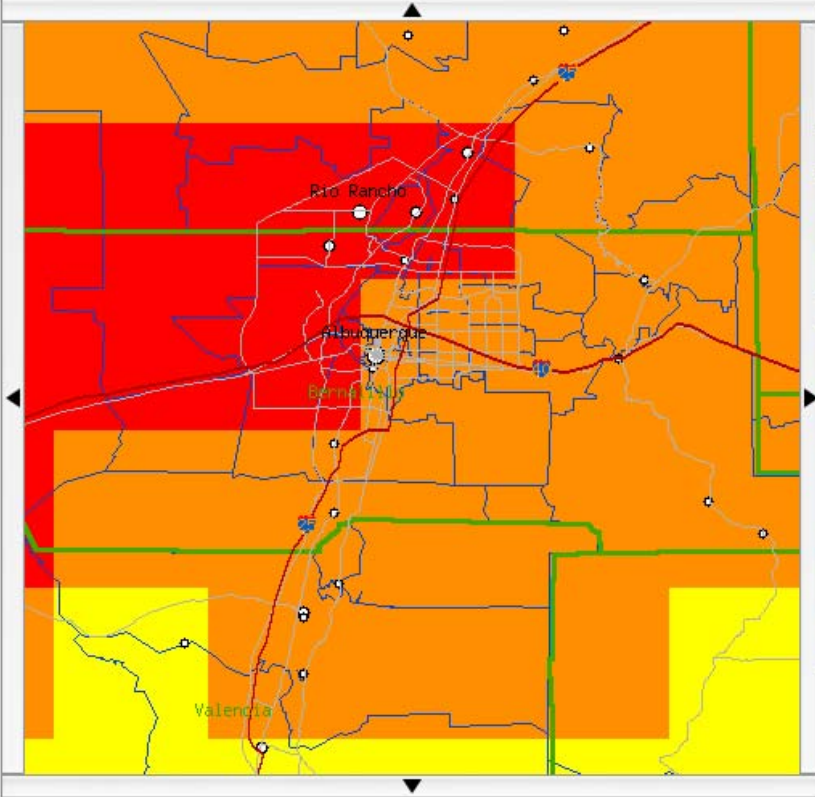
Login Public Health Alerts Public Health GIS Analysis Public Health Alarms Clinician Information

**SYRIS™**  
SYndrome Reporting Information System

User name: pho@nm.com  
Password: ●●●

Local Map of Syndromes

Information of Immediate Local Importar  
10/1/08: Provisional dust model now available. This is the Dust and Regional Atmospheric Model (DREAM), developed under NASA's Public Health Applications in Remote Sensing (PHAIRS). Model output provided by the University of New Mexico's Earth Data Analysis Center (UNM-EDAC)



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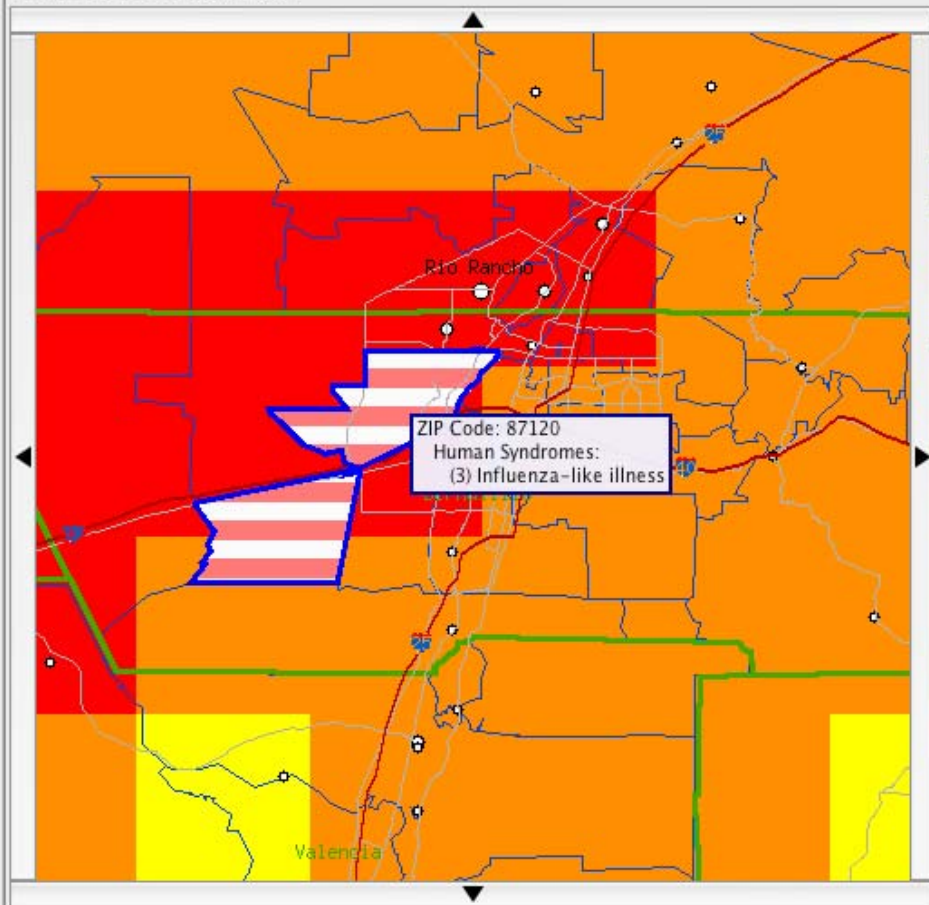
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# Conclusions

- Elevated levels of PM10 associated with adverse health outcomes
  - Total morbidity unknown
- Endotoxins found in rural settings *may* compound PM10 health concerns
  - Veterinary impact likely but unquantified to date (Purdy, USDA)
- PM10 exposure should be treated as a public health issue in Pinal County
  - Syndrome-based surveillance to measure impact of mitigation
  - Dairy and other large animal operations may wish to consider impacts of dust (+/- endotoxin) on productivity.

# Questions or Comments?

“The hardest part about gaining any new idea is sweeping out the false idea occupying that niche. As long as that niche is occupied, evidence and proof and logical demonstration get nowhere. But once the niche is emptied of the wrong idea that has been filling it - once you can honestly say, ‘I don't know’, then it becomes possible to get at the truth.”

--Robert A. Heinlein

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