The Association between Particulate Matter (PM) Components and Human Health with Focus on Organic Components

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2013 EMEP Conference
Albany, NY
November 6, 2013
Motivation and Objectives

• Role of PM$_{2.5}$ in health studies
• PM$_{2.5}$ a complex mixture
• Need for assessing role of components
  – NAS report
  – Value
• Objective: define role of components from published literature; what can we say about organics?
Approach

• Reviewed literature through February 2012
• Epidemiology, toxicological, human clinical studies
• Acute studies only (exposures ≤ 1 week)
• No judgments about study methods, analyses
• Studies had to consider at least 2 components and PM$_{2.5}$
• Quantitative results were presented
• Considered most significant positive result
Results

• Identified 49 independent epidemiological studies
  – Mortality
  – Morbidity
  – Cardiovascular
  – Respiratory including asthma
  – Considered most often: sulfates, carbon-containing species
Results – Epidemiological Studies Overall

• 39 studies considered PM$_{2.5}$ and at least 2 components
  
- 21/39 significant association and at least with PM or component
- 2/39 significant association with PM, but not component
- 17/39 significant association with components, but not PM
  
Carbon-containing components gave more significant associations than PM$_{2.5}$

• CVD response
  
- 24/28 studies considering carbon-containing particles found significant associations
- 9/35 studies considering sulfates found significant associations
Results Epidemiological Studies II

• Respiratory responses
  15/26 studies for carbon-containing particles
  12/27 studies for sulfates

• Asthma
  7/20 studies for carbon

• Not much consideration of metals in epi studies
  – Ni, V, Cu, Si, K found greatest effects
Toxicological Studies

Overall

20 studies considered

- 14 in vivo CAPS studies
- 6 in vitro studies using collected PM
- V, Ni most frequently indicted
  - All 20 studies showed some significant effect
    - 5/20 for PM and component
    - 15/20 for components only
    - 10/20 indict some carbon
      - 7/15 with EC/OC
      - 5/15 with OC
- 7/18 indict sulfur
Overall Conclusion

• No major component is exonerated

• More evidence for carbon-containing particles
  – Definition needs to be clarified

• Some concern for metals, especially Ni, V with cardiovascular and respiratory; Al, Si with respiratory endpoints
Limitations/Caveats

• Considered any significant positive results

• Methodologies not evaluated

• No consideration of measurement error

• Multiple comparison issue

• Surrogacy issue
Health Analyses of Thermal Desorption Data (Organic PM Species)


Health Data:
- Medicare enrollees (>64 yr)
- Total emergency CVD and respiratory related hospital admissions

Air Pollution Data:
- PM$_{2.5}$ condensed-phase primary OC species (TD-GCMS) grouped by their chemical structure
  - At least 75% non-missing observations
  - At least 50% above the LOD
  - IQR/median > 0.3
  - All criteria satisfied in all 3 cities
Thermal Desorption Data: Atlanta, Birmingham, Dallas Combined Total CVD
Comparable Results for Atlanta, Birmingham
Total CVD

Preliminary results
Results: All 3 Cities

Total Respiratory:
Thermal Desorption Data

Iso-/anteiso-alkane and alkane exposures associated with increased odds of respiratory admissions
- strongest association for pneumonia

Exposures to cyclohexanes are consistently associated with increased rate of CVD admissions
- Cyclohexane effects have not been examined before
- Mobile source emissions linked to cyclohexanes
Implication of Organic Particle Analyses

• All organics are not equally toxic

• Danger of using EC/OC as generic indicators

• Need to replicate

• New York State implications
Caveat

- One study does not a conclusion make
Questions?