

IDENTIFYING COMPONENTS AND CHARACTERISTICS OF PM ASSOCIATED WITH HEALTH EFFECTS

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HEI Annual Conference
April 18, 2005

Identifying Components and Characteristics of PM Associated with Health Effects

- Why is it important?
- Why is it so challenging?
- How can we find answers?
- HEI's research initiative

Why Is It Important to Understand Which Particles Are Most Toxic?

- Current world PM standards based on current science, broad size ranges: PM₁₀, PM_{2.5}, PM_{10-2.5}
- Over long term, more specific standards could help
 - Target particles most likely to contribute to effects
 - e.g., narrower size range, specific chemical constituents
 - Affect fewer source types, enable industries to control specific PM components
- This will require knowing which particle components are most toxic

What Characteristic of PM Are Associated with Adverse Health Effects? Many Possibilities but None Singled Out Yet

- Size (e.g. UFs)
- Surface area
- Acidity
- Reactive metals
- Organic compounds
- Biological material
- Sulfates
- Peroxides
- Soot (elemental carbon)
- Others

What PM Characteristics Are Associated with Adverse Health Effects?

Why is this question so challenging?

- PM in ambient air is a complex mixture
 - Varies in size, chemical composition
 - Varies spatially and temporally
- Different particles may cause different effects
- Gases may cause same effects or act in concert with PM
- Combinations may be important
- Many variables in addition to PM types
 - Susceptible populations (appropriate species, models of disease)
 - Endpoints ranging from cellular responses to health effects
 - Timing of effects measurements
 - Experimental approaches (e.g., inhalation vs. instillation)

What PM Components Are Associated with Adverse Health Effects?

- **Approaches to sorting out effects of PM components**
 - Studies of ambient mixture: epidemiologic studies, experimental studies with CAPs
 - Can make use of regional and time differences in nature of PM
 - Experimental studies using "model" particles of different sizes, composition to test hypotheses
 - Experimental studies with exposures to PM from specific sources (coal fly ash, diesel PM) or whole emissions mixture
- **Which results are "right"?**
 - Many components can cause changes: Which relevant to health effects?
 - Because of the many experimental variables, results may seem inconsistent in similar studies (difference in species, endpoints, etc.)

How Can We Find the Answers?

HEI, NRC:

Systematic studies across sites and pollutants needed; coordinated epidemiologic and toxicologic approaches



How Can We Find the Answers?

Several major efforts under way or planned:

- EPA's new PM Centers' crosscutting theme: "linking health effects with PM from source categories and components"
- NERC (Lovelace):
 - effects of inhalation of different mixtures on variety of types of toxicity in animals
 - Characterization of mixture components
 - Database to generate hypotheses based on comparison of mixtures with overlapping components
- HEI initiating major program

HEI Research Initiative on PM Components

- Planning started under previous Strategic Plan
- 3-step approach
 - Create Web-accessible database of air pollutant information to facilitate research (nearing completion)
 - Hold workshop to discuss study design issues for multi-site toxicology and epidemiology studies (held August 04)
 - Issue RFA (soon!)

Air Quality Database for Health Effects Studies

- EPA's PM_{2.5} Chemical Speciation Trends Network
 - Ambient measurements of PM and components
- Other sites (gases)
- Local population
- Local sources
- Meteorology

PI Christian Seigneur, Atmospheric and Environmental Research

Air Quality Database

Can be used

- Directly in proposed retrospective epidemiologic studies
- In planning toxicologic and epidemiologic studies based on spatial and temporal variation in air pollution composition
- Along with additional pollutant information

HEI RFA Coming Soon

RFA (mid-2005) looking for

- Multidisciplinary investigator teams
- Hypotheses about components or sources
- Systematic, comparative studies
- Coordinated toxicology/epidemiology (encouraged)
- Consideration of effects of gaseous pollutants

Such studies are difficult to design:

RFA designed to start studies over 2-yr time period

RFA 05-1: Studies to Compare Components and Characteristics of PM Associated with Health Effects

- **RFA 05-1-A Full Studies (mid-2005)**
 - For applicants ready to design a full study
- **RFA 05-1-B: Planning Studies (mid-2005)**
 - For interested scientists who need time and money to gather information and conduct analyses to assess the feasibility of investigating certain hypotheses
- **Another RFA for full studies (late 2006)**
 - For investigators who have conducted HEI planning studies and others

RFA 05-1 A: For Full Studies

Applications for full studies must

- Lay out detailed plans
- Include preliminary data (air quality, epidemiologic, toxicologic) and analyses to show data and study design sufficient to address hypotheses proposed
- Provide evidence as to size of effects of interest; precision to which they can be estimated
- Describe roles of PI and co-investigators
- Make evident in project plan that all team members provided input

RFA 05-1 B: For Planning Studies

Planning studies for investigators who need time and money to:

- Establish multidisciplinary team
- Gather data
- Analyze exposure or other data
- Assess the feasibility of specific hypotheses
- Design a full study

Funding for PM Studies

- Full studies: 3-4 years of funding per study at \$500,000 - \$1,000,000/yr
- Planning studies: up to 9 months at \$50,000 to \$100,000 per study
- HEI expects to fund
 - 1-2 full studies and 2-3 planning studies from RFA 05-1 in 2006
 - 1-2 full studies from second RFA in 2007

Moving Ahead

- Much research has been conducted on particles of different sizes and composition
- Comparison of effects has been difficult because of differences in study designs
- Building on earlier studies, new more systematic approaches—including HEI studies—should provide better comparison of effects across particle characteristics