

## Future Directions:

# Health Effects of PM Combustion Sources and Components

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**Desert Research Institute:** Barbara Zielinska

## Theme and Focus:

# Linking Combustion-derived PM Sources and Components to Health Effects through Biological Mechanisms

- **Health Effects of PM Sources:** Population Studies
- **Health Effects of Diesel:** Animal & Human Mechanisms
- **PM Characterization:** Identify Toxic Sources & Components
- **Statistical Modeling:** Methods Development

**Health Effects of PM Sources:** Receptor-Based Multivariate Source Apportionment applied to Human Studies:

- Studies of Human Chronic Exposure (WHI -OS & MESA Air)
- Acute Exposures (Denver & Seattle Panel Studies)

**Health Effects of Diesel:** Animal & Human Studies of focused on Oxidative Stress Mechanisms in Cardiovascular Disease

**PM Characterization:** Bioassay-Directed ID of Toxic Sources & Components using Chemical, Cellular, & Animal Assays

**Statistical Modeling Methods:** Disease model parameters & estimates, Space-Time Exposure Models, Ambient Attenuation for Chronic Effects Studies



## Population-Based Studies of the Health Effects of PM Sources

Primary Aim:

Identify ambient PM Sources responsible for effects of:

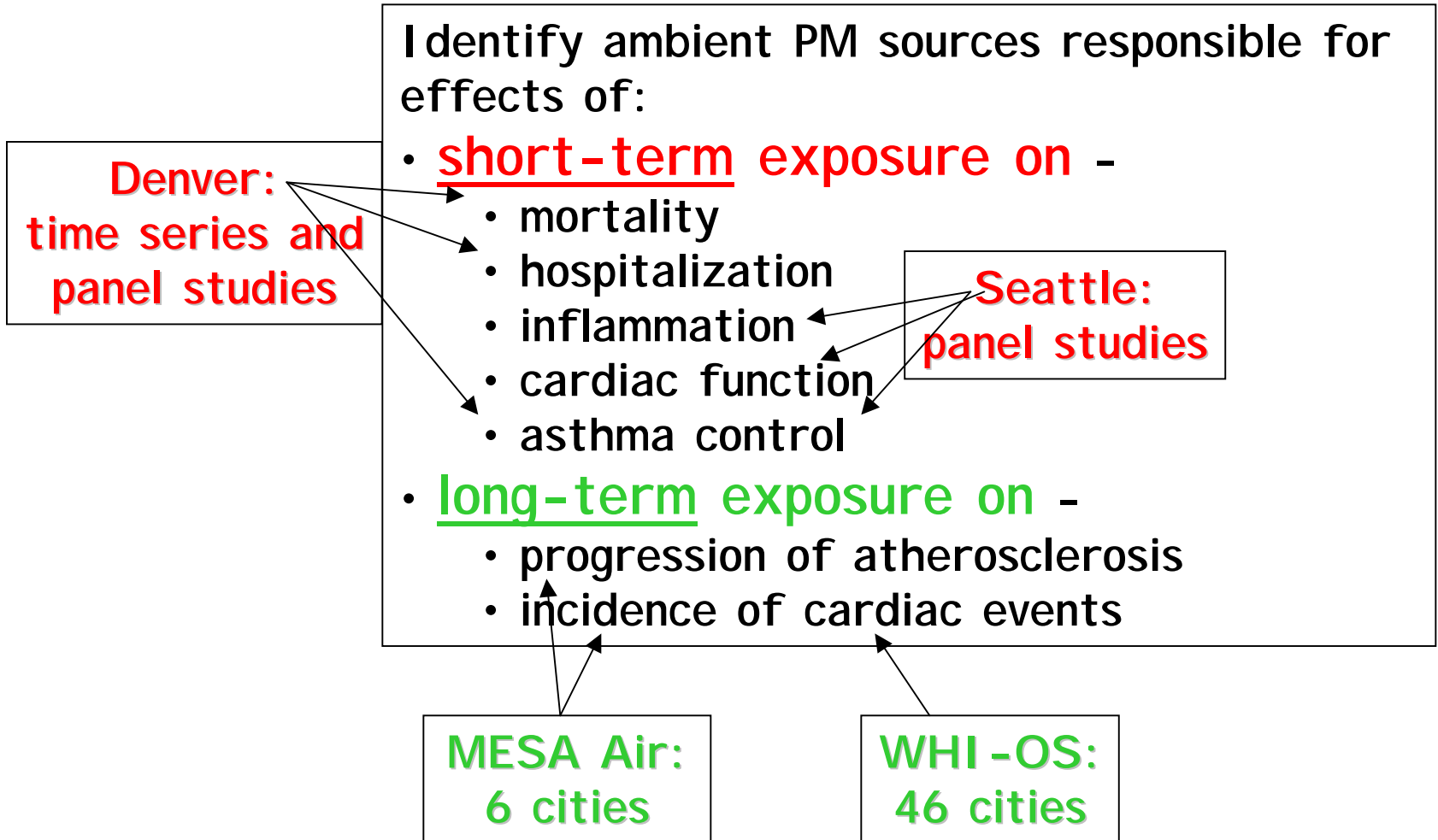
short-term exposure on -

mortality, hospitalization,  
inflammation, cardiac function,  
asthma control

• long-term exposure on -

progression of atherosclerosis &  
incidence of cardiac events

# Utilization of Health Studies:



## Population-Based Studies of the Health Effects of PM Sources

### Supportive Aims:

- **Improve source apportionment methods**
  - Larson: factor analysis over time & space
- **Apply GIS methods for specifying mobile source exposures**
  - Larson & Wang for WHI & MESA cohorts
- **Develop statistical methods for source measures in health analyses**
  - Lumley & Wakefield
- **Validate estimates of source exposures**
  - Liu, Simpson, Zielinska using source tracers

# Population-based PM Health Studies with Source Characterization

- Seattle panel studies (acute)
- Denver time series and panel studies (acute)
- WHI -OS (chronic and acute)
- MESA (chronic)

## Enhanced Exposure Measures:

- Ambient monitoring
- GIS-Traffic emission modeling
- Residential/personal monitoring
- Source-specific measures**
- Organic species

Species/Measures  
Source/Component  
Characterization Studies

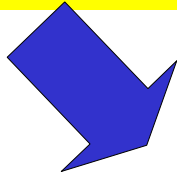
## Specific aims:

- acute effects of sources
- chronic effects of sources
- source-oriented** statistical methods
- exposure model validation



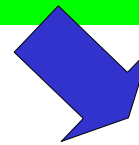
# Statistical Modeling Methods: Linking Health Effects to PM

- Disease Models for Chronic Studies
- Exposure Models for Chronic Studies
  - Space-time models & Ambient attenuation



## Specific aims Population Based Source Characterization Studies:

- acute effects of sources
- chronic effects of sources
- source-oriented statistical methods
- exposure model validation



- Seattle panel studies (acute)
- Denver time series and panel studies (acute)
- WHI -OS (chronic and acute)
- MESA (chronic)





# Population-based PM Health Studies with Source Characterization

## Enhanced Exposure Measures:

- Ambient monitoring
- GIS-Traffic emission modeling
- Residential/personal monitoring
- **Source-specific measures**
- Organic species

## PM Source/Component Characterization

Chemical Source Tracers

Chemical & Biologically Active Components

Mechanism Directed

## Mechanistic Studies of PM Source (Diesel):

- Cardiovascular Mechanisms:
- **Oxidative Stress & Susceptibility: Animals & Humans**
  - Inflammatory Response: Animals
  - Endothelial function: Human Studies

# PM Source/Component Characterization:

## • Source-specific Characterization

- Innovative source apportionment (Population Studies)
- Chemical & Bioassay Directed Characterization
  - Chemical reactivity assays
  - Cellular assays
  - Linked to Animal Toxicology to validate the chemical assays
  - Oxidative stress markers & metabolic products linked to mechanisms
  - Identify factors modifying effect of PM in health studies

## • Component-specific Characterization

- Organic fractions
- Species
  - source tracers
  - toxic/causative agents

## Mechanistic Studies of PM Sources: Controlled Diesel Exposures

- **Animal Studies of Cardiovascular & Pulmonary Mechanisms**
  - Oxidative Stress
  - Inflammatory Response
  - Susceptibility
- **Human Studies of Cardiovascular Mechanisms**
  - Oxidative Stress & Insulin Resistance
  - Endothelial Function (Metabolic Syndrome)
  - Susceptibility

## Core Capabilities:

### Controlled Exposure Facility Core:

Carol Trenga (PI), Joel Kaufman, Tim Larson,  
Tim Gould, Jim Stewart

**Statistics and Data Core:** Lianne Sheppard (PI),  
Thomas Lumley, Paul Sampson

**Administrative Core:** Joellen Lewtas, Sverre  
Vedal, Sally Liu, Collen Marquist

### Collaborator-Consultants:

Univ. of British Columbia: Stephan van Eeden  
(Vasodilation Studies)

Desert Research Institute: Barbara Zielinska  
(Organic Chemical Speciation Studies)

# Future Research Projects:

- **Health Effects of PM Sources: Population Studies**
  - **Sverre Vedal (PI)**, J. Kaufman, T. Larson, S. Liu, T. Lumley, L. Sheppard, J. Wakefield, Y. Wang
- **Health Effects of Diesel: Animal & Human Mechanisms**
  - **Animal Studies (Diesel Chamber)**
    - **Terrance Kavanagh (PI)**, Michael Rosenfeld, Dan Luchtel, Joel Kaufman, Chris Simpson, Stephan van Eeden
  - **Human Studies (Diesel Chamber)**
    - **Jeff Sullivan (PI)**, Joel Kaufman, Jane Koenig, J. Heinecke, C. Trenga, T. Larson, T. Gould, F. Farin, C. Simpson
- **PM Characterization: Identify Toxic Sources & Components**
  - **Dave Kalman (PI)**, Chris Simpson, T. Kavanagh, R. Dills
- **Statistical Modeling: Methods Development**
  - **Lianne Sheppard (PI)**, Jonathon Wakefield, Paul Sampson