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CLEAN **AIR** RESEARCH PROGRAM

AIR POLLUTION RESEARCH ADDRESSES RELATIVE TOXICITY OF DIFFERENT PARTICLE SIZES

Issue:

Outdoor air pollution particles are currently divided into three classes based on their size:

- Coarse particulate matter (PM) consists of particles with a diameter between 2.5 and 10 micrometers (µm) and deposit efficiently along the airways. Particles larger than 10 µm are generally not inhalable into the lungs.
- Fine PM consists of particles with a diameter less than 2.5 µm and can be inhaled deeply into the lungs.
- Ultrafine particles, the smallest, consist of particles with a diameter smaller than 0.1 µm and have widespread deposition within the respiratory tract.

It is not well understood whether particles with different size ranges have different abilities to cause adverse health effects.

The U.S. Environmental Protection Agency currently regulates PM on the basis of mass in both the fine and coarse size ranges. More than 150 epidemiology studies have demonstrated an association between fine PM and acute mortality and morbidity.

A smaller number of studies have linked exposure to coarse PM with increased mortality and morbidity. However, uncertainty about the effects of coarse PM derived from different sources has led EPA to ask for science to address the question of differential toxicity from coarse PM of urban areas versus PM of rural areas. There is also concern that because of the high concentration of biological compounds present in coarse PM, compared with smaller size fractions, asthmatics may be a particularly susceptible subpopulation to coarse particles.

In addition, there is concern that there may be adverse health effects associated with exposure to ultrafine particles, which, if established, could potentially lead EPA to propose a a PM standard for these smaller particles.

Because of these uncertainties, regulators and scientists both believe there is more to learn about the adverse health effects of different sized PM, especially as the composition of these particles varies.

Scientific Objective:

The Clean Air Research Program in EPA's Office of Research and Development is conducting a comprehensive and integrated research program to compare the cardiovascular and pulmonary responses of humans or appropriate animal models to different sizes of PM. Both EPA

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scientists as well as academic researchers funded by the Agency are engaged in these studies.

The research program includes studies which:

- Compare the cardiovascular and pulmonary response of healthy human volunteers or animal models exposed to coarse, fine, and ultrafine particles.
- Determine if people with pre-existing cardiovascular or pulmonary disease such as asthma are especially susceptible to one or all of the particle sizes.
- Compare the cardiovascular and pulmonary response to coarse PM originating from urban and rural areas.
- Identify the underlying cellular and molecular mechanisms by which each size fraction causes adverse health effects.
- Characterize the relative toxicities of coarse, fine, and ultrafine PM from several different geographical areas that have different sources of PM pollution. The chemical composition of these size ranges can simultaneously be associated with the health outcomes.
- Characterize the relative toxicity of different particle sizes from real world sources, notably near highly trafficked roadways.
- Conduct epidemiological field studies to assess size related health impacts on selected populations of high risk. especially near roadways.

Application and Impact:

Research to expand our knowledge about the health effects associated with exposure to different size particles will provide important information that will allow EPA to set PM standards which are optimally protective of human health.

The research will help EPA regulators:

- Determine if it is appropriate to regulate particles based on the number of particles rather than size.
- Assess whether ultrafine particles should be regulated.
- Assist with making decisions on where to position air quality monitors to obtain the data that best represents human health risks.

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