

HEALTH EFFECTS INSTITUTE (HEI)

Request for Proposals (RFP): To create an air pollutant database

Summary:

Findings from epidemiological and controlled exposure studies about the health effects of particulate matter (PM) air pollution have led the U.S. Environmental Protection Agency (EPA) and other regulatory agencies to establish new ambient air quality standards for PM. PM is a complex mixture and there is strong and growing interest in understanding whether some components of that mixture and the sources of those components are of greater public health concern. The Health Effects Institute is initiating a systematic, multi-city research program to address these questions. A key prerequisite for this program will be an accessible air quality database for major cities in the US that can be understood readily and applied in epidemiologic and other studies.

The objective of this RFP is to fund the creation and maintenance of a database that contains information about how levels of air pollutants at multiple locations in the US vary spatially and temporally. The initial focus of the database will be data derived from the EPA Speciation Trends Network (STN), which monitors levels of components and characteristics of fine PM at selected sites across the US. Similar information about pollutant gases such as ozone and nitrogen oxides will need to be included in the database. The database is intended to be a resource that will be made available starting in 2005 to HEI-funded projects and to other investigators who want to conduct epidemiologic and controlled exposure studies to determine whether specific characteristics of ambient PM are associated with specific health outcomes.

Background:

The US EPA sets National Ambient Air Quality Standards for six ambient air pollutants - carbon monoxide, lead, ozone, nitrogen oxides, sulfur dioxide, and particulate matter (PM) – that studies have shown induce or exacerbate adverse health effects. For the gaseous “criteria” pollutants, such as ozone and carbon monoxide, the health effects they cause and their pathophysiological mechanisms of action are quite well understood. For PM – solid and liquid particles suspended in air – there is consistent epidemiologic evidence that associates PM with health effects. Despite the emergence of a large number of studies that provide mechanistic underpinnings for the epidemiological data, the characteristics of the specific components of PM responsible for the observed health effects remain poorly understood (Health Effects Institute 2002).

One of the major reasons for the continuing need for enhanced information about PM is its complexity. Unlike the gaseous criteria air pollutants, PM is a mixture of components that vary in size (ranging from approximately 0.005 to 100 μm in aerodynamic diameter) and chemical composition. The EPA currently tracks two sizes of particles: PM_{10} ("coarse") and $PM_{2.5}$ ("fine") particles; that is, ≤ 10 and ≤ 2.5 μm diameter, respectively, that have been found to be associated with health effects.

PM levels and composition vary depending on geography (e.g. rural versus city and at different locations within a city), meteorological conditions, and the time of day or season. This variability in PM characteristics derives from differences in PM sources and aging of the aerosol as it moves away from its emission sources. PM sources may be natural in origin - the result of geographical conditions, weather, or seasonal patterns - or generated by human activities such as driving vehicles and operating manufacturing or power plants. The sources of coarse and fine particles are somewhat different, with coarse particles derived more heavily from crustal materials and fine particles more heavily from anthropogenic sources.

The same sets of major chemical components of PM are found across multiple locations. These are: metals; organic compounds; material of biological origin; ions such as sulfate and nitrate; adsorbed reactive gases; and carbon. Although all these PM components are present in almost all locations, relative amounts of the components differ in different places; for example, levels of sulfate are high in the North Eastern US but levels of nitrates are higher on the West Coast. However, differences among locations in levels of lower level PM components such as specific transition metals or organic compounds are poorly understood.

Despite this variability in PM characteristics, single-city epidemiologic studies in multiple locations have generally reported consistent associations between the concentration of PM_{10} or $PM_{2.5}$ with health endpoints such as increased mortality or morbidity (reviewed in US Environmental Protection Agency 1996 and Health Effects Institute 2001). In studies that reported associations between short-term increases in PM levels and short-term increases in morbidity and mortality, the strongest of these associations were found with older persons and individuals with compromised cardiac or airway function.

One comprehensive multi-city epidemiologic study – the National Mortality, Morbidity, and Air Pollution Study (Samet et al 2000) - suggested that the risk of adverse health effects from exposure to PM_{10} differed across regions of the US; in particular, higher in the North East and Southern California than other parts of the US. One possible explanation for this result is a difference in exposure at different locations to a specific PM component or components. To date, however, the PM components responsible for the observed health effects have not been

established: it is believed though that toxicity depends on multiple PM characteristics. Because controlled exposure and epidemiologic studies suggest that PM may affect multiple physiological pathways, it is also possible that different PM components affect different health endpoints, and may affect different susceptible individuals differently.

References for this section:

Health Effects Institute, 2001. Airborne Particles and Health: HEI Epidemiologic Evidence. *HEI Perspectives*. Health Effects Institute, Cambridge, MA.

Health Effects Institute, 2002. Understanding the Health Effects of Components of the Particulate Matter Mix: Progress and Next Steps. *HEI Perspectives*. Health Effects Institute, Boston, MA.

Samet JM, Zeger SL, Dominici F, Curriero F, Coursac I, Dockery DW, Schwartz J, Zanobetti A 2000. The National Morbidity and Mortality from Air Pollution Study, Part II: Morbidity and Mortality from Air Pollution in the United States. Research Report 94, Health Effects Institute, Cambridge, MA.

US Environmental Protection Agency 1996. Air Quality Criteria for PM. EPA/600/P-95/001. Office of Research and Development, Washington DC).

The Need for this RFP

Understanding how PM characteristics differ across the US is critical to the design of any epidemiologic or other study that might disentangle the effects of different PM components. Over the last few years, the EPA's PM_{2.5} Chemical Speciation Trends Network (STN) of approximately 50 monitoring sites across the US has begun to measure and report levels of many components of PM_{2.5}. The STN is one part of the vast network of monitoring stations maintained by the EPA, state, local, and tribal air pollution control agencies that collect ambient air pollution data. These data form part of the Air Quality System (AQS), which also contains meteorological data, descriptive information about each monitoring station (including its geographic location and its operator), and data quality assurance/quality control information. The AQS Web site, <http://www.epa.gov/ttn/airs/airsaqs/>, describes how to download detailed data from the AQS.

Data from the STN are just now becoming available but have not been evaluated and analyzed systematically and are not easily accessible to all investigators. Moreover, some issues related to the QA/QC of these data need to be resolved.

Establishing a longer term research program on the toxicity of different components and sources of PM will require two important products from the respondents to this RFP:

- A compilation and descriptive analysis of the STN PM_{2.5} component data and other relevant pollutant and emissions data available at each STN

- sites (to allow selection of a subset of cities that offer sufficient variation in exposures to conduct systematic health studies); and
- The development of a database at the selected cities that is accessible to epidemiologic investigators and that can support epidemiologic and other health-related studies (e.g., controlled exposure studies using concentrated ambient particles).

Program goals:

The RFP invites multi-disciplinary groups – researchers, consulting groups or others - with experience in database development and air pollution to propose how they would: (a) compile information about pollutant levels at the multiple STN sites; (b) create and maintain a user-friendly pollutant database; and (c) specify what additional information they would add to make site characterization more complete.

The RFP envisions a 2-step process for completing the work:

STAGE 1: Compile information on levels of multiple pollutants at different STN sites, with the collected information made available rapidly to HEI.

This would involve completing a descriptive characterization of the data from all 54 sites in the EPA's STN database by June 30, 2004. This characterization for each STN site should include, but not necessarily be limited to:

- a. Availability of STN and complementary pollutant information – including especially the gases.*
- b. Initial characterization of pollution levels at all sites, including spatial and temporal variation in components and gases, and whether levels of multiple components vary together.*
- c. Availability of data that can lead to the development of source descriptors, and the availability of specific source emissions inventories that have spatial relevance to any given STN site.*
- d. Unique features of specific sites, including proximity to other sites – or pollution sources - in the region.*
- e. An understanding of the quality of the data collected for each pollutant at each site (background levels etc).*

Applicants are also asked to suggest other types of information that might be added to further characterize each site and that might be useful for future epidemiologic studies. Such information might include but not be limited to meteorological, census, or health-related data (such as hospitalizations).

STAGE 2: Create a multi-pollutant database

Using the information collected in Stage 1, the applicant would set up a Web-available database that contains the range of pollutants levels and PM

characteristics and components measured at or near STN sites during the recent years the STN has been in operation (2001 to present) as well as additional information related to emissions that are available for a given area and are likely to be relevant in the future. An initial version of the database would be expected to be completed and ready for use by HEI-funded and other investigators no later than April 30, 2005, with the final validated version up and running by July 1 2005.

Because the EPA's funding for the STN sites is envisioned to continue for the foreseeable future, with continuing input of pollutant information, HEI also would fund the maintenance of the database for at least the next 5 years. This would support future research studies funded by HEI and others.

Funds: Up to \$100,000 available for Stage 1. Although we are not seeking detailed budgets for Stage 2 at this time, we anticipate funding in the range of \$250,000 - \$300,000 for database development, with lower levels for continuing maintenance and update.

Submitting an application: By January 29, 2004, applicants should provide the following:

- a statement of qualifications, outlining the expertise and relevant experience of the team in carrying out both stages of the study;
- a detailed plan and budget for addressing Stage 1 of this program; namely, compiling PM and other pollutant information at all STN and relevant nearby sites monitored by the EPA and state agencies, and suggesting other types of information that would help to further characterize the sites. The detailed plan should be no more than 15 pages in length and should include a timetable for implementation and the roles of individual team members in the effort.

Applicants should also indicate that they are willing to continue to work on Stage 2 of the program and, as noted above, describe the expertise and relevant experience of their team for that effort. They are not asked, however, to submit detailed plans or a budget for Stage 2.

Proposals will be evaluated in February 2004. HEI will work with the successful applicant to further refine plans, if necessary.

Milestones: Assuming an April 1, 2004 start date, the successful applicant will be asked to submit:

- **a Progress Report on site characterization by June 30, 2004. This Progress Report should contain summary information on available air quality and other data at and near all STN sites. It should also contain a template or prototype of compiled pollutant information for at least one of the STN sites.**

- **A completed Stage 1 report by October 31, 2004 that would include information about data quality issues, possible pollutant sources at different sites, and other information relevant to the site, such as meteorological or health-related data. It should also characterize in detail spatial and temporal variability in pollutant levels at one or two STN sites.**
- **Setting up the database is to be completed in an initial form by April 30, 2005, with a final database available for investigator use by July 1, 2005.**

Further information about the RFP can be obtained at www.healtheffects.org/funding.htm

Address any questions to Dr Geoffrey Sunshine at the Health Effects Institute, Boston, MA, via email at gsunshine@healtheffects.org, or phone +1 (617) 886-9330 ext 303.

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