

New Studies Aim to Improve Knowledge of Exposure to Traffic

HEI has funded five studies in a new research program aimed at improving assessment of exposure to air pollution from traffic. The scientists were selected after a request for applications (RFA 13-1) was issued in December 2012. Broadly, the program’s objective is to improve the quantification of the relationship among traffic emissions, near-road pollutant concentrations, and human exposure.

HEI’s Special Report 17, *Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects*, published in 2010, concluded that the zone within 300 to 500 meters of a highway or a major road is the area most highly affected by traffic emissions. The report estimated that 30% to 45% of people in large North American cities reside within these zones. However, the methods and models available to characterize exposures within such high-exposure zones have limitations, and the HEI Health Research Committee identified an important need to investigate how to improve the assessment of exposure to traffic pollution. RFA 13-1 had three specific and complementary objectives:

1. Demonstrate novel surrogates of near-road traffic-related pollution, taking advantage of new sensors and/or existing monitoring data.
2. Determine the most important variables that explain spatial and temporal variance of near-road traffic-related pollutant concentrations.

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NEW HEI RESEARCH REPORTS

HEI NPACT Studies Examine Effects of PM Sources and Components

In October, HEI published two new comprehensive studies on the health effects of particulate matter (PM) and its components. Despite previous claims that certain sources of fine particulate air pollution (PM that is 2.5 μm or smaller in aerodynamic diameter, or $\text{PM}_{2.5}$) may be less toxic than others, the results of the two studies lead to the overall conclusion that no source can yet be excluded as having no health effects. These nationwide studies — funded as part of HEI’s National Particle Component Toxicity (NPACT) initiative — are the most systematic effort ever to combine epidemiologic and toxicologic research to investigate whether “all particles are created equal” and therefore deserve the same level of public health and regulatory attention.

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The NPACT Initiative: Rationale

- Current PM standards based on broad size ranges: PM_{10} , $\text{PM}_{2.5}$
 - US EPA $\text{PM}_{2.5}$ National Ambient Air Quality Standards
 - EU reconsidering PM and other limit values
- Regional and seasonal patterns in $\text{PM}_{2.5}$ composition, associated health effects
- Broad interest in more specific standards
- The NPACT initiative provides the first truly systematic comparison of effects for a range of particle components

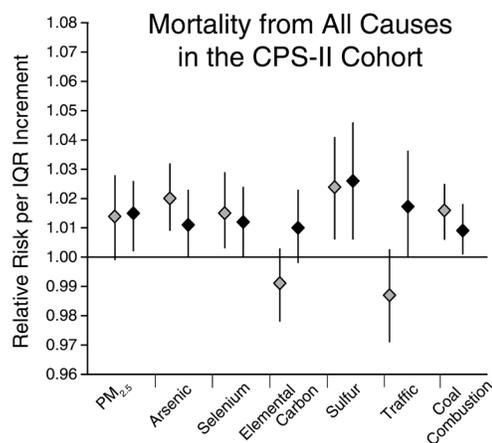
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The studies found links between adverse health effects — particularly on the cardiovascular system — and sulfate particles (primarily from coal combustion) and, to a somewhat lesser extent, traffic sources. But the HEI NPACT Review Panel, 14 experts who, as explained by HEI President Dan Greenbaum, “went over the studies with a fine-toothed comb,” cautioned that the results “do not provide compelling evidence that any specific source, component, or size class of PM may be excluded as a possible contributor to PM toxicity.” The panel went on to note that a “better understanding of exposure and health effects is needed before it can be concluded that regulations targeting specific sources or components of PM_{2.5} will protect public health more effectively than continuing to follow the current practice of targeting PM_{2.5} mass as a whole.”

HEI launched the NPACT initiative in response to calls from its sponsors, at both the U.S. Environmental Protection Agency (EPA) and industry, for answers to these important questions about PM and health. Following extensive planning and intense scientific competition, two teams, led by Morton Lippmann from New York University and Sverre Vedal from the University of Washington–Seattle, were selected to conduct detailed toxicologic and epidemiologic investigations across the United States of air pollution and its effects on cardiovascular and other health outcomes.

Lippmann and colleagues conducted studies in mice and in human cell lines exposed to ambient PM and epidemiologic studies of short- and long-term cardiovascular effects in the Cancer Prevention Study II cohort. Their study has provided new insights into the toxicity of PM components and source categories and identified the Coal Combustion, Residual Oil Combustion, Traffic, and Metals source categories as most consistently associated with adverse health effects. However, other components and source categories could not be definitively determined to have no adverse effects.



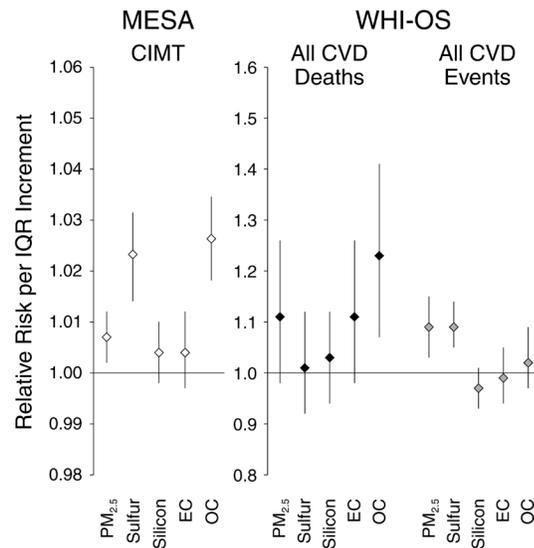
Relative risks of mortality from all causes in the Cancer Prevention Study II (CPS-II) cohort associated with PM_{2.5} and selected components and factors. Gray and black diamonds depict results from the random effects Cox models without and with contextual ecologic covariates, respectively. IQR denotes interquartile range. (From HEI Research Report 177, Lippmann et al.)

and identified the Coal Combustion, Residual Oil Combustion, Traffic, and Metals source categories as most consistently associated with adverse health effects. However, other components and source categories could not be definitively determined to have no adverse effects.

Vedal and colleagues studied the cardiovascular effects of PM components, with a focus on traffic sources. They analyzed data from the Multi-Ethnic Study of Atherosclerosis and the Women’s Health Initiative Observational Study cohorts, and they also exposed mice to combinations of mixed vehicular engine emissions and non-vehicular PM. They found strong evidence for associations of PM_{2.5}, organic carbon, and sulfur with subclinical and clinical outcomes in the cohorts, with weaker evidence for elemental carbon. Their toxicologic study provided strong evidence for effects of mixed vehicular engine emissions and, to a lesser extent, exhaust gases on vascular markers in mice; non-vehicular PM induced few effects.

The HEI Research Committee will discuss the major findings of these reports and identify priorities for research on unresolved issues as it goes forward to develop HEI’s 2015–2020 Strategic Plan for the Health Effects of Air Pollution. [HEI](#)

An Executive Summary of the NPACT studies, along with the complete studies and online appendices of additional data, can be found at www.healtheffects.org. For more information contact Kate Adams (kadams@healtheffects.org) or Annemoon van Erp (avanerp@healtheffects.org).



Associations between selected pollutants and carotid intima-media thickness (CIMT) in the Multi-Ethnic Study of Atherosclerosis (MESA) cohort (left) and total cardiovascular disease (CVD) mortality or events in the Women’s Health Initiative Observational Study (WHI-OS) cohort (right). IQR denotes interquartile range. (From HEI Research Report 178, Vedal et al.)

NPACT Oversight and Review Process

Given the complexity and importance of the research funded under the NPACT initiative, the work of the two study teams was overseen by a special NPACT Oversight Committee, an offshoot of the HEI Research Committee. The Oversight Committee, chaired by Mark Utell of the University of Rochester, New York, consisted of independent scientists appointed by HEI to oversee every aspect of the research and statistical analyses. It met approximately annually with the investigator teams during the research phase and provided advice and feedback on the study design, plans for analysis, and progress. HEI also conducted independent audits of the data for quality assurance and control throughout the studies.

In addition, HEI formed an NPACT Advisory Group, which included representatives from the EPA and industry sponsors of the NPACT

studies, as well as other interested stakeholders. The advisory group met with the NPACT investigators to discuss study designs, progress, and other key issues.

After completion of the research phase, the investigators submitted comprehensive reports of their findings, which were intensively examined by a special NPACT Review Panel convened by the HEI Review Committee. The panel, chaired by Bert Brunekreef of the University of Utrecht, the Netherlands, and Ted Russell of the Georgia Institute of Technology, Atlanta, consisted of 14 experts who had no involvement with the design, implementation, or oversight of the studies. After the investigators responded to the panel’s initial review, the panel also produced HEI Commentaries for both reports and a Synthesis of the NPACT initiative to summarize what the studies have shown, the implications for decision making, and what still needs to be learned.

3. Improve inputs for exposure models for traffic-related health studies; evaluate and compare the performance of alternative models.

The response to the RFA was unprecedented: HEI received 80 letters of intent to apply. Given this large number, the Research Committee made an initial review and invited full applications from about 30 respondents, of whom 27 submitted applications. As is customary, the applications first were reviewed and ranked by a panel of experts. The top-ranked applications were then reviewed by the Research Committee. Important criteria in deciding which studies to recommend for funding were the novelty of the approach, responsiveness to the RFA, and likelihood that the study would improve the assessment of exposure to traffic pollution. In addition, the committee aimed to ensure that the projects selected would together address all three of the RFA's objectives.

The studies approved by the Board of Directors for funding are described below. The research is expected to start in early 2014 and be completed within two and a half years.

Benjamin Barratt, lecturer in air quality science, King's College London, and colleagues from the University of Hong Kong and University of British Columbia–Vancouver will perform an extensive campaign to measure exposure to traffic-related air pollution at more than 100 sites in Hong Kong. A unique feature of this study is that it will include indoor and outdoor measurements at different heights along streets with high-rise, adjoining buildings on both sides (“street canyons”). A three-dimensional land-use regression model will be developed to model exposure to traffic-related air pollution for Hong Kong residents. The research team's overall objective is to develop a three-dimensional modeling methodology that can be translated to other street canyons and megacities in Asia and beyond.

Stuart Batterman, professor of environmental health sciences, University of Michigan–Ann Arbor, will use existing air pollution dispersion models to predict both short- and long-term exposure in Detroit, Michigan. He and colleagues from the University of North Carolina–Chapel Hill and Cornell University in Ithaca, New York, will add new features to the models, such as



The new studies will investigate ways to improve assessment of people's exposure to traffic pollution, a research priority identified in HEI's Special Report 17, *Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects*, published in 2010.

estimates of secondary particulate matter from traffic-related emissions, and develop procedures to speed up the intensive calculation process. In addition, they will explore novel data fusion techniques called Bayesian melding, which will combine measured and modeled concentrations of traffic pollutants. The study will build on existing data sources in Detroit, including monitoring data from NEXUS (the Near-Road Exposures and Effects of Urban Air Pollutants Study), a cohort study investigating the effects of traffic on children in Detroit.

H. Christopher Frey, Distinguished University Professor, North Carolina State University, Raleigh, and a multidisciplinary and multi-institutional team will collect an extensive set of data on land use, traffic activity, and air pollutant concentrations near a freeway and in a residential neighborhood in Raleigh and Durham, North Carolina, respectively. The field campaigns will include detailed measurements of multiple pollutants at different distances from the freeway and mobile monitoring on predefined routes in the neighborhood. Ultimately, Frey and colleagues from the University of North Carolina–Chapel Hill, North Carolina Central University in Durham, and the Research Triangle Institute will evaluate these different types of data and measurements and integrate them into a spatial-temporal statistical framework to estimate exposure to traffic pollution. This will be

compared with less detailed models, including a model based on land-use regression.

Jeremy Sarnat, associate professor, Department of Environmental Health, Emory University, Atlanta, Georgia, and colleagues from Georgia Institute of Technology will evaluate novel surrogate measures of multiple traffic-related pollutants, or “multipollutant traffic surrogates,” by collecting different types of measurements (outdoor, indoor, and personal) and explore the use of metabolomics (the study of the metabolic profile of an individual) to identify possible exposure-related metabolites. An example of a multipollutant traffic surrogate would be a combination of measurements and emission estimates of elemental carbon, carbon dioxide, and oxides of nitrogen. The sampling sites will be in and around two student dormitories in Atlanta — one located close to a major urban highway and one located farther away from major roads or any other sources of pollution. Personal-exposure and blood samples will be repeatedly collected from 60 dormitory residents.

Edmund Seto, associate professor, Department of Environmental and Occupational Health Sciences, University of Washington–Seattle, will develop traffic-related air pollution exposure models in the San Francisco Bay area. Seto and colleagues from the University of California–Berkeley will establish a dense monitoring network using real-time sensors at 64 sites that will collect year-round air pollution data. In addition, they will estimate personal exposure through scripted exposure experiments designed to mimic common near-road exposure scenarios (e.g., different commuting modes, traffic intensity, and atmospheric conditions) in urban and residential areas. They will compare exposure estimates obtained from monitors carried by individuals during the exposure experiments with estimates obtained through land-use regression models using data from the monitoring network. Ultimately, the research will inform scientists conducting future epidemiologic studies in the use of new low-cost sensors for assessment of personal exposure to near-road air pollution. [HEI]

For more information about the studies contact Maria Costantini (+1-617-488-2302; mcostantini@healtheffects.org) or Hanna Boogaard (+1-617-488-2306; jboogaard@healtheffects.org).

Scientists Share Global Perspectives at ISEE Conference

Several HEI staff members participated in the 2013 International Society for Environmental Epidemiology (ISEE) Annual Conference, held in mid-August in Basel, Switzerland. This year's theme was "Environment and Health: Bridging South, North, East and West." Jointly conducted by the International Society for Exposure Science (ISES) and the International Society for Indoor Air Quality and sponsored in part by HEI, the conference offered a wide array of sessions on air pollution and public health and provided ample opportunity to meet with air pollution researchers from around the world.



Above, from left, Marie-Eve Heroux, World Health Organization European Centre for Environment and Health; H. Ross Anderson of St. George's, University of London, and former HEI Review Committee member; and Bert Brunekreef of the University of Utrecht, the Netherlands, and Review Committee. At right, Mike Brauer of the University of British Columbia, Vancouver, and Review Committee. PHOTO BY KATE ADAMS



This year's theme was "Environment and Health: Bridging South, North, East and West."

The five-day conference attracted more than 750 people from Europe, Asia, North and South America, and Oceania. Kate Adams, HEI senior scientist, and Aaron Cohen, principal scientist, led and participated in symposia and oral sessions, and all HEI staff present (including Maria Costantini, principal scientist, and Hanna Boogaard,

staff scientist) attended sessions focused on a broad range of air pollution-related topics. HEI President Dan Greenbaum presented "The USA Outlook on Outdoor Air Pollution — from Science to Regulation" as part of a symposium entitled "Translating Science Into Health Benefits: A Global Perspective on Air Pollution." The session was dedicated to the achievements of scientist Michal Krzyzanowski, formerly of the World Health Organization Regional Office for Europe, who was the winner of this year's ISEE Goldsmith Award.

The next ISEE conference will be held at the University of Washington-Seattle on August 24 through 28, 2014. The next ISES conference will be in Cincinnati, Ohio, on October 12 through 16, 2014. [HEI](#)

HEI Investigator Wins Friedlander Award

Jason Surratt, recipient of HEI's Walter A. Rosenblith New Investigator Award in 2012, recently won the prestigious Sheldon K. Friedlander Award from the American Association for Aerosol Research (AAAR). Surratt is an assistant professor of environmental sciences and engineering at the University of North Carolina Gillings School of Global Public Health. The award, which recognizes an outstanding doctoral dissertation in the field of aerosol science and technology, was established in 1997 to memorialize Friedlander, one of AAAR's founders and a mentor of graduate students at four preeminent U.S. research universities for more than 50 years. Surratt's dissertation, "Analysis of the Chemical Composition of Atmospheric Organic Aerosols by Mass Spectrometry," demonstrates how the



Jason Surratt.

detailed chemical analysis of air, especially through advanced mass spectrometric techniques, has been critical to the discovery of previously unidentified sources of fine particulate matter. Specifically, the

work demonstrates how human-caused pollutants interact with natural emissions from trees to increase levels of fine particulate matter in the air. In addition to the Rosenblith and Friedlander awards, Surratt received the U.S. Environmental Protection Agency's Early Career Award in 2013. [HEI](#)

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Mark Your Calendar!

**HEI Annual Conference
May 4–6, 2014
Alexandria, Virginia**

New Statisticians for the Research and Review Committees

Since the inception of HEI, its Research and Review Committees have relied on leading statisticians to ensure that studies are well designed and intensively reviewed. To fill this need, the HEI Board of Directors recently appointed Francesca Dominici, a professor of biostatistics and



Francesca Dominici. PHOTO COURTESY OF HARVARD SCHOOL OF PUBLIC HEALTH

senior associate dean for research at the Harvard School of Public Health in Boston, Massachusetts, to the HEI Research Committee. Meanwhile, the Review Committee welcomed its own new statistician: Roger D. Peng, an associate professor of biostatistics at the Johns Hopkins Bloomberg School of Public Health in Baltimore, Maryland.

The two committees are multidisciplinary groups of distinguished scientists who play key roles in HEI's work. The Research Committee develops and oversees the institute's research program, and the Review Committee evaluates the scientific quality of each final report written by HEI-funded investigators and prepares a commentary on the research. Dominici and Peng replace two statisticians who have held the committee seats with distinction for the past eight years — Sylvia Richardson of the Medical Research Council Biostatistics Unit, Institute of Public Health, in Cambridge, United Kingdom (Research Committee), and Ben Armstrong of the Public and Environmental Health Research Unit, London School of Hygiene and Tropical Medicine (Review Committee). They recently stepped down in accordance with HEI bylaws, which allow members of scientific committees to serve for a maximum of two four-year terms.

"Both Drs. Richardson and Armstrong have provided invaluable service to HEI," said Rashid Shaikh, HEI's director of science. "In addition to helping with the design and

analyses for a number of research studies, Sylvia has also helped HEI explore novel statistical methods. Ben has been unfailing in his very thoughtful reviews and comments on research reports and, most recently, played a very important role in the review of the National Particle Component Toxicity reports. We will miss them both."

Dominici received her Ph.D. in statistics from the University of Padua, Italy. Her areas of expertise include Bayesian methods, longitudinal data analysis, adjustment for confounding factors, and causal inference, and she has extensive experience in the development of statistical methods and their applications in environmental epidemiology, science and health policy, outcomes research and patient safety, and comparative effectiveness research. Dominici has served on many National Academies committees and is a member of numerous professional societies, including the American Statistical Association and the International Society for Environmental Epidemiology. She is associate editor of the *Journal of the Royal Statistical Society*.

Dominici and Peng replace two statisticians who have held the committee seats with distinction for the past eight years — Sylvia Richardson (Research Committee) and Ben Armstrong (Review Committee).

Peng holds a Ph.D. in statistics from the University of California—Los Angeles. His most recent work focuses on environmental biostatistics and the health effects of air pollution and climate change. He is interested in statistical methods for applications to spatial-temporal data as well as point processes, statistical computing, and software engineering. He is a member of many professional organizations, including the American Statistical Association, Free Software Foundation, Electronic Frontier Foundation, and R Foundation for Statistical Computing. He is currently the associate editor of the *Journal of Agricultural, Biological, and Environmental Statistics* and of *Reproducible Research, Biostatistics*. He is also a contributor to the Simply Statistics blog, whose goal is to use "simple statistics to solve real, important problems."

The new committee members have already made substantial contributions to HEI-supported research. Dominici was principal investigator for a statistical review of a time-series mortality study (HEI Research Report 123) and lead author of a volume in HEI's four-part National Morbidity, Mortality, and



Roger D. Peng.

PHOTO BY ROBERT OLLINGER, JOHNS HOPKINS SCHOOL OF PUBLIC HEALTH

Air Pollution Study (NMMAPS; Research Report 94, Part IV). Dominici and Peng were both among the coinvestigators for *Air Pollution and Health: A European and North American Approach* (HEI Research Report 142) and among the coauthors of HEI Communication 12, which describes a project funded by HEI to make data and software from NMMAPS available to the wider research and policy communities. 

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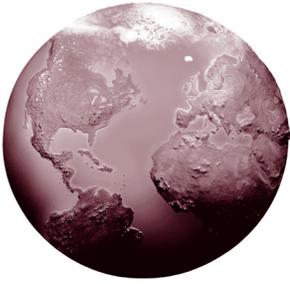
HEI is a nonprofit organization funded jointly by government and industry to research and evaluate the health effects of air pollution. An overview of HEI, information on its current research program, and all published HEI reports are available for downloading, free of charge, from the Web site.

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O'Keefe Delivers Inaugural Address at Major Emissions Control Meeting in Delhi

In September, HEI Vice President Robert O'Keefe delivered an inaugural address, "Air Pollution and Health Impacts, India in a Global Context: Traffic Diesel and a Way Forward," at the 2013 Emission Control Technologies meeting of the Emission Controls Manufacturers Association (ECMA) in Delhi, India. His address highlighted health impacts of ambient air pollution in India that an HEI-led team drew from the Global Burden of Disease 2010 analysis, which was released last December (see *HEI Update*, Winter 2012–2013 and Spring 2013). It also highlighted findings of HEI Special Report 17, *Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects*, published in 2010, and the 2012 report (Research Report 166) from the Advanced Collaborative Emissions Study, which found remarkable reductions in emissions and health effects from new-technology diesel engines (which are equipped with particle filters and advanced nitrogen oxide controls and burn very low-sulfur fuel). The presentation comes at a critical time for India as a major Expert Committee on Auto Fuel Vision and Policy 2025 is currently evaluating air quality and vehicular emission norms, technology, and fuel-quality standards that will affect all types of vehicles for years to come. The draft report of the committee,



HEI Vice President Robert O'Keefe lights the "Lamp of Knowledge" at the opening of the ECMA meeting. With him are (from left) Ranjan Bhushan of ECMA, K.K. Gandhi of the Society of Indian Automobile Manufacturers, and Saumitra Chaudhuri of the Indian government's Planning Commission.

PHOTO COURTESY OF ECMA

which is chaired by Saumitra Chaudhuri, a member of the Indian government's Planning Commission, is expected early in 2014. 