

EMERGING SCIENCE FOR ENVIRONMENTAL HEALTH DECISIONS

AGENDA

Emerging Technologies for Measuring Individual Exposomes

DECEMBER 8–9, 2011 ■ THURSDAY, 8:30–5:00, FRIDAY, 8:30–NOON*
HOUSE OF SWEDEN EVENT CENTER, 2900 K STREET, NW, WASHINGTON, DC

THIS EVENT WILL BE WEBCAST.

ENVIRONMENTAL EXPOSURES—broadly defined as originating from external sources (air, water, diet, infection, radiation, stress, etc.) and internal sources (inflammation, lipid peroxidation, the microbiome, preexisting disease, among others)¹—are important determinants of human health. Although chronic diseases are thought to result from the combination of environmental exposures and human genetics, the environmental determinants are poorly understood in comparison to the genetic factors. For example, epidemiologists are now able to conduct genome wide association studies (GWAS) with relative ease, but they still rely upon self-reported questionnaires to characterize environmental exposures. This disparity in data quality between genetic and environmental risk factors spawned the concept of the *exposome* representing all environmental (i.e. non-genetic) contributors to disease—from both external and internal sources—received by an individual during life.² By measuring individual exposomes, environment wide association studies (EWAS) can be conducted which simultaneously test disease associations with thousands of environmental exposures.

WHAT TYPES OF MEASUREMENTS are best suited for characterizing individual exposomes? On one hand, a top-down approach would combine biospecimens, like blood or urine, with new -omics technologies to profile subjects' *internal* levels of metabolites, metals,

macromolecular adducts, serum proteins, and persistent organic compounds.² On the other hand, a bottom-up approach would exploit advances in sensor and cell-phone technologies to measure multiple personal exposures to *external* pollutant levels, as well as host of factors as physical activity, diet, and hormone levels among others. The integration of these two approaches promises to enable us to zero in on important environmental factors and to interleaf EWAS with GWAS.

THIS MEETING WILL TAKE A CLOSE LOOK at emerging technologies that can be used to gather individual exposure information based upon external and internal measurements. Presentations and discussions will explore which of the technologies are “ready now” and which are still “emerging” for use in environmental health research. Particular attention will be paid to the relative advantages and disadvantages of external and internal measurements for characterizing individual exposomes and for performing EWAS. Recent proof-of-concept studies will be highlighted and bioinformatic tools will be discussed. This synthesis should inform researchers and policy makers about the critical roles that the exposome concept and new technologies can play in understanding the origins of human diseases.

¹ Rappaport, S.M. and M.T. Smith, Environment and disease risks. *Science*, 2010. 330(6003): p. 460-1.

² Wild, C.P., Complementing the genome with an “exposome”: the outstanding challenge of environmental exposure measurement in molecular epidemiology. *Cancer Epidemiol Biomarkers Prev*, 2005. 14(8): p. 1847-50.

* On Tuesday, December 9, the committee and liaisons will meet following the forum.

THURSDAY, DECEMBER 8 (8:30AM–5PM)

- 8:30 Opening Remarks—National Institute of Environmental Health Sciences
- 8:35 Welcome and Meeting Objectives—Stephen Rappaport[†], *University of California, Berkeley*

SESSION 1 BACKGROUND AND CONTEXT

Session 1 will provide an overview of the importance of exposure measurements at the level of individuals and the relevance of the exposome concept for integrating scientific disciplines and emerging technologies to better understand the environmental contributors to disease.

Session Chair: William Farland[†], *Colorado State University*

- 8:45 Why We Need to Measure Individual Exposomes—Paul Elliot, *Imperial College, London*
- 9:30 Using –Omics Methods to Characterize Individual Exposomes—Stephen Rappaport[†], *University of California, Berkeley*
- 10:00 Using Personal Monitors and Sensors to Characterize Individual Exposures—Michael Jerrett, *University of California, Berkeley*
- 10:30 Break

SESSION 2 BUILDING THE INDIVIDUAL EXPOSOME

Session 2 will take a deeper look at specific emerging technologies to characterize the individual exposome. The first half of the session will explore 'omic tools to characterize exposures at the molecular level.

The second half of Session 2 will take a look at recent advances in external technologies to monitor personal exposures and responses. Preliminary findings from the

application of these tools in human studies will be discussed as well as their relevance to developing individual exposomes.

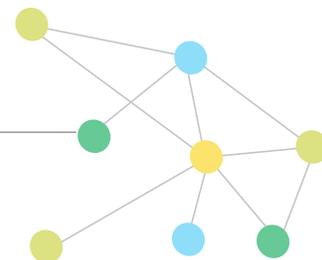
Session Chairs: Susan Fisher[†], *University of California, San Francisco*; David Balshaw, *National Institute of Environmental Health Sciences*

- 10:40 Metabolomics Integrated Epidemiology—Elaine Holmes, *Imperial College, London*
- 11:10 Gene-expression Profiles as Signatures of Environmental Exposures—Avi Spira, *Boston University*
- 11:40 Plasma Proteomics: Lessons from Breast Cancer Research—N. Leigh Anderson, *Plasma Proteome*
- 12:10 Lunch on your own
- 1:30 Sensors to Monitor Individual Exposures to Multiple Air Pollutants—Nongjian Tao, *Arizona State University*
- 2:00 Personal Measurements of Physical Activity—Stephen Intille, *Northeastern/MIT*
- 2:30 Monitoring Personal Hormonal Responses to Environmental Exposures—Rajeshwari Sundaram, *National Institutes of Health*
- 3:00 Break
- 3:10 Session 2 Panel Discussion
- 5:00 **Panelists:** Gayle DeBord, *National Institute for Occupational Safety and Health*; Michael Jerrett, *University of California, Berkeley*; Patricia Mabry, *National Institutes of Health*, Christopher J. Portier, *Centers for Disease Control and Prevention*; Craig Postlewaite, *Department of Defense*; Session 2 speakers

(continued)

About the Committee

At the request of the National Institute of Environmental Health Sciences (NIEHS), the National Research Council formed the Standing Committee on Use of Emerging Science for Environmental Health Decisions to facilitate communication among government, industry, environmental groups, and the academic community about scientific advances that may be used in the identification, quantification, and control of environmental impacts on human health.



FRIDAY, DECEMBER 9 (8:30AM–NOON)

SESSION 3 THE INDIVIDUAL EXPOSOME: PROOF OF CONCEPT STUDIES

The third session will highlight new research that demonstrates the proof-of-concept of developing an individual's exposome. How new bioinformatic approaches can be used to combine and interpret multiple sources of exposome data will be highlighted. The session will also explore approaches to couple individual-level internal and external measures.

Session Chair: Tina Bahadori[†], *American Chemistry Council*

8:30 Proof of Concept of EWAS—Chirag Patel, Stanford University

9:00 Integrating Metabolomics and Animal Model Studies Identifies Gut Flora as a Participant in Cardiovascular Disease—Stanley L. Hazen, Cleveland Clinic

9:30 Panel Discussion

Panelists: Stephen Edwards, *U.S. Environmental Protection Agency*; Nathaniel Rothman, *National Cancer Institute*; Hunter Young, *Johns Hopkins University*; **Session 3 speakers**

10:30 Break

[†] indicates a member of the Standing Committee on Use of Emerging Science for Environmental Health Decisions.

Please note that this meeting will be webcast and recorded. Please visit our website for webcast details.

For more information and to subscribe for updates, please visit
<http://nas-sites.org/emergingscience>
Emerging Science meetings are free and open to the public.

SESSION 4 TRANSFORMATIVE RESEARCH AND ENVIRONMENTAL HEALTH DECISIONS

By promoting discovery of environmental (i.e. non-genetic) causes of disease and rationalizing strategies for confronting disease risks, the exposome concept can transform research and decision making in environmental health. Roundtable members will comment on approaches for measuring individual exposomes and to reflect upon research needs and formulation of policies concerning individual risks. Some key questions included for discussion are:

- How does the individual exposome change environmental health paradigms?
- What implications does the individual exposome hold for epidemiology as well as personalized medicine and prevention?
- What are important near-term opportunities for incorporating individual exposomes into environmental health research and policy decisions?
- How should researchers be encouraged to design projects and report data that will be useful to agencies and communities as they consider environmental risks of disease?

Session Chair: Germaine Buck Louis, *National Institute of Child Health and Human Development*

Panelists: N. Leigh Anderson, *Plasma Proteome*; Linda Birnbaum, *National Institute of Environmental Health Sciences*; Paul Elliot, *Imperial College*; Suzanne Fitzpatrick, *Food and Drug Administration*

11:45 Meeting Summary—Stephen Rappaport[†], University of California, Berkeley

12:00 Meeting Adjourns (post-forum committee and liaison meetings until 3:00pm)

SAVE THE DATE—

- **April 18–19, 2012**
Individual Variability

