

# Protecting Children's Health for a Lifetime: Environmental Health Research Meets Clinical Practice and Public Policy



GRAND HYATT WASHINGTON, WASHINGTON, DC

## Summary

OCTOBER 19 - 20, 2010

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## AGENDA

**Tuesday, October 19, 2010**

**Constitution CDE/C Corridor**

**8:00 – 8:30 a.m.**

**Registration**

**Constitution E Foyer**

Continental Breakfast generously provided by the Association of Occupational & Environmental Clinics

**8:30 – 8:50 a.m.**

Welcome and Introductions

***Christopher Zarba**, Deputy Director, National Center for Environmental Research, EPA*

***Peter Grevatt**, Ph.D., Director, EPA Office of Children's Health Protection and Special Advisor to EPA Administrator on Children's Health*

**8:50 – 9:45 a.m.**

Session 1 – The Children's Environmental Health Community: Who, What, Where, and How

**Moderator: Marie Lynn Miranda**, Ph.D., Director, Southern Center on Environmentally Driven Disparities on Birth Outcomes, Duke University

**Session Description:** A panel representing leadership from various federal agencies and institutions, and national programs will present an overview of their key roles in children's environmental health research, clinical practice, and public health policy, including the NIEHS/EPA Children's Environmental Health and Disease Prevention Research Centers (Children's Centers), Pediatric Environmental Health Specialty Units (PEHSUs), the National Children's Study (NCS), EPA, NIEHS and Congressional leadership. This session will set the tone for fostering collaboration and will explore how the players can address children's environmental health issues together.

**Panel Speakers:**

***Gwen W. Collman**, Ph.D., Interim Director, Division of Extramural Research and Training, National Institute of Environmental Health Sciences*

***Jerome A. Paulson**, M.D., Co-Director, Mid-Atlantic Center for Children's Health & the Environment at Children's National Medical Center*

***Steven Hirschfeld**, M.D., Ph.D., Acting Director, National Children's Study, Eunice Kennedy Shriver National Institute of Child Health and Human Development*

***Sally Darney**, Ph.D., EPA/ORD National Program Director for Human Health*

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***Robin Appleberry***, Counsel to Representative Henry A. Waxman,  
Chairman of the House Committee on Energy and Commerce

9:45 – 11:00 a.m.

Session 2 – Prenatal Exposures

**Moderator:** **Brenda Eskenazi**, Ph.D., Director, Children's Center for Environment Health, UC Berkeley

**Session Description:** The prenatal period can be uniquely susceptible to effects from exposure to toxic substances. Some effects may manifest early (e.g., birth defects), others later in childhood (e.g., childhood cancer), and some not until adulthood or even the next generation. Identifying sources and exposures to chemicals during pregnancy is an important step in developing preventive intervention programs that improve health. This session will present the science and policy approaches in two different areas: one where the science is well-established on the impacts on development (lead) and one where the science is evolving rapidly (phthalates and other endocrine-disrupting chemicals). In addition, speakers representing PEHSUs will present a clinical case study followed by relevant scientific findings, with an emphasis on findings to inform appropriate clinical advice. In addition, speakers will address challenges for communicating with individual patients/parents in the clinical setting, and patients/parents and the public at large about preventing exposures.

**Speakers:**

***Susan Buchanan***, M.D., M.P.H., Associate Director, Great Lakes Center for Children's Environmental Health

***Kevin Chatham-Stephens***, M.D., Pediatric Environmental Health Fellow, Mount Sinai Pediatric Environmental Health Specialty Unit

***James Quackenboss***, M.S., Research Physical Scientist, National Exposure Research Laboratory, EPA

***Robin Whyatt***, Dr.P.H., Deputy Director, Columbia Center for Children's Environmental Health

***Sheela Sathyanarayana***, M.D., M.P.H., Pediatric Environmental Medicine Specialist, Northwest Pediatric Environmental Health Specialty Unit at the University of Washington

11:00 – 11:15 a.m.

**Break**

Refreshments generously provided by the Association of Occupational & Environmental Clinics

11:15 a.m. – 12:45 p.m.

Session 3 – Environmental Exposures and Neurodevelopmental Effects

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**Moderator: Kimberly Gray, Ph.D.,** Division of Extramural Research and Training, National Institute of Environmental Health Sciences

**Session Description:** There is evidence to suggest that there are environmental effects on mental disorders, most notably an increased rise in many types of mental disorders in young people in the last 50 years. The cause for the rapid rise in rates remains unknown. However, few genetic links have been identified and replicated, and thus lend support to a substantial role of the environment in these complex diseases. In the past ten years, the NIEHS and U.S. EPA Children's Centers have reported a link between early exposure to environmental chemicals and neurobehavioral and cognitive impairment in infants and children. In addition, the Pediatric Environmental Health Specialty Units (PEHSU) report great interest in these health effects on the part of parents and clinicians, with more and more questioning the effects of environmental exposures and neurodevelopmentally related outcomes.

Exposure can occur early during fetal development via transplacental delivery, postnatally via breast milk, or directly through the child's environment. We will explore the scientific data to support long-term changes in neurodevelopment associated with early exposures as well as new animal data to support potential mechanistic pathways of importance as well as new measures of sub-clinical phenotypes and potential confounding effects of current therapies. The PEHSUs will present information on chelation practices that have not been approved by FDA and on environmental exposures and autism spectrum disorders. This session will provide an integrated summary of studies exploring the relationship between the environment and development delays in children conducted by investigators from the Children's Environmental Health Centers and cases being confronted by PEHSUs currently.

**Speakers:**

***Susan Schantz, Ph.D.,*** Director, Children's Environmental Health Center at University of Illinois

***Leslie Rubin, M.D.,*** Co-Director, The Southeast Pediatric Environmental Health Specialty Unit at Morehouse School of Medicine

***Alan Woolf, M.D., M.P.H.,*** New England Pediatric Environmental Health Specialty Unit at The Children's Hospital, Boston

***Irva Hertz-Picciotto, M.D., M.P.H.,*** Deputy Director, UC Davis Center for Children's Environmental Health

**12:45 – 2:00 p.m.**

2:00 – 3:00 p.m.

**Lunch on your own**

Session 4 – Role of Children's Environmental Health Science to Inform Chemicals Management

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**Moderator: John M. Balbus, M.D., M.P.H.,** Senior Advisor for Public Health, National Institute of Environmental Health Sciences

**Session Description:** Chemical production has dramatically increased since World War II, with more than 80,000 chemical substances registered for use in the United States, and about 2,800 of these are used or imported in more than 1 million pounds. Only a fraction of these substances have been adequately tested for potential human health effects due to inadequacies in the current regulatory structure in the United States. This has been recognized by the U.S. EPA, nongovernmental organizations, and industry.

Children can be more vulnerable to chemical exposure, both because of inherent developmental susceptibilities and behaviorally related increased exposures. Recognition of the need to formulate regulatory policy to adequately address potential child vulnerabilities has been increasingly recognized over the past 20 years and incorporated into more recent legislation, such as the Food Quality Protection Act. The research generated by the Children's Environmental Health Centers has been critical to the growing recognition of the importance of children's special vulnerabilities, which in turn has been integrated into current legislative and regulatory activities.

**Speakers:**

**Ken Cook, President and Co-Founder, Environmental Working Group**

**Tracey J. Woodruff, Ph.D., M.P.H., Director, UCSF Children's Center**

**3:00 – 3:15 p.m.**

**Break**

Refreshments generously provided by the Association of Occupational & Environmental Clinics

**3:15 – 4:30 p.m.**

Session 5 – Children's Environmental Health in a Global Context

**Moderator: Leslie Rubin, M.D.,** PEHSU Co-Director, The Southeast Pediatric Environmental Health Specialty Unit at Morehouse School of Medicine

**Session Description:** Ninety-one percent of the world's 1.8 billion children ages 0-14 years live in developing countries. Urbanization, unregulated industrialization, population growth and displacement, and increased pressure on limited natural resources underlie the environmental hazards in poorer nations. The World Health Organization (WHO) estimates that approximately one third of the disease burden in developing countries is attributable to environmental factors, two to three times higher than the attributable portion in the most developed countries. This unequal disease burden on the poorer nations may be further aggravated by differences in access to health



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care. The disparate burden of disease for children in developing countries due to air, water, soil, and food contamination is less well characterized compared with children in the more developed nations. Mitigation measures are often unaddressed in the quest for economic development. Obstacles to protecting children’s environmental health in developing countries include inadequate medical and public health infrastructure and financial resources, shortage of laboratory equipment and trained technical personnel, and distrust between the public and governmental agencies.

This session will explore the existing and potential infrastructure for establishing and maintaining global partnerships to improve children’s environmental health in a global context. Specifically, lessons learned and future directions for research collaboratives, training initiatives, and establishment of a network of global children’s environmental health centers will be discussed.

**Speakers:**

***Catherine Karr, M.D., Ph.D., M.S., Director, Northwest Pediatric Environmental Health Specialty Unit at the University of Washington***

***Tom Robins, University of Michigan Fogarty Center***

***Frederica P. Perera, Dr.P.H., Director, Columbia Center for Children’s Environmental Health***

***Ruth Etzel, M.D., Ph.D., Senior Officer for Environmental Health Research, World Health Organization***

4:30 – 5:45 p.m.

Session 6 – Social and Community Context for Understanding Children’s Environmental Health Outcomes

**Moderator: Marie Lynn Miranda, Ph.D., Director, Southern Center on Environmentally Driven Disparities on Birth Outcomes, Duke University**

**Session Description:** Although it is widely agreed that maternal and fetal health and well-being are determined by multiple forces, surprisingly little is known about the interactions of those forces. For example, elevated environmental exposures often occur in communities facing multiple social stressors like deteriorating housing, inadequate access to health care, poor schools, high unemployment, high crime, and high poverty — all of which may compound the effects of environmental exposures. This phenomenon is especially severe for low income and minority pregnant mothers, with significant health implications for the fetuses they carry. This session will focus on the social context within which environmental exposures occur as well as the differential response to environmental exposures that may be induced by underlying social stress.

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**Speakers:**

**Rosalind J. Wright**, M.D., Channing Laboratory, School of Medicine,  
Harvard University

**Richard Auten**, M.D., Department of Pediatrics, School of Medicine,  
Duke University

**Scott Crain**, Medical-Legal Partnership of Seattle

**Gregory Diette**, M.D., Co-Director, Johns Hopkins Center for Childhood  
Asthma in the Urban Environment

5:45p.m.

Adjourn for the day

**Wednesday, October 20, 2010**

**Constitution CDE/C Corridor**

8:15 – 8:45 a.m.

**Registration**

**Constitution E Foyer**

Continental Breakfast generously provided by the Association of  
Occupational & Environmental Clinics

8:45 – 9:15 a.m.

Session 7 – Federal Partnerships to Protect Children's Environmental  
Health

**Speakers:**

**Kevin Teichman**, Ph.D., Deputy Administrator for Science, Office of  
Research and Development, EPA

**Lisa P. Jackson**, M.S., EPA Administrator

**Gwen W. Collman**, Ph.D., National Institute for Environmental Health  
Sciences

**Howard K. Koh**, M.D., M.P.H., Assistant Secretary for Health, U.S.  
Department of Health and Human Services

9:15 – 9:30 a.m.

Session 8 – Recap of the Previous Day

**Moderator: Peter Grevatt**, Ph.D., Director, EPA Office of Children's  
Health Protection and Special Advisor to EPA Administrator on  
Children's Health

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- 9:30 – 10:30 a.m.                      Session 9 – Concurrent Breakout Sessions – Opportunities for Collaboration  
(Please refer to the Session 9 – Concurrent Breakout Sessions – Opportunities for Collaboration attachment in the meeting folder.)
- A. Community Outreach and Translation                      **Conference Theatre**
  - B. Training the Pipeline    **Latrobe/Bulfinch**
  - C. Policies for Children’s Environmental Health Protection: Role of the Children’s Research Centers and PEHSUs                      **Farragut/Lafayette**
  - D. Environmental Health Protection Health Disparities                      **Constitution CDE/C**
- 10:30 – 10:45 a.m.                      Break**  
Refreshments generously provided by the Association of Occupational & Environmental Clinics
- 10:45 – 11:30 a.m.                      Session 10 – Opportunities for Collaboration – Reporting Out From Breakouts  
**Moderator: Peter Grevatt, Ph.D.,** Director, EPA Office of Children’s Health Protection and Special Advisor to EPA Administrator on Children’s Health
- 11:30 a.m. – 12:30 p.m.                      Session 11 – The Big Talk – Next Steps for Children’s Environmental Health  
  
**Speaker:**  
**Annie Murphy Paul,** journalist and author of “Origins: How the Nine Months Before Birth Shape the Rest of our Lives”
- 12:30 p.m.                                      Adjourn**

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Environmental Health Research Meets Clinical Practice and Public Policy**

**The Grand Hyatt, 1000 H Street, NW, Washington, DC**

**October 19 – 20, 2010**

**FINAL Summary**

**OVERVIEW**

In celebration of Children's Health Month and new grant awards for the next phase of the U.S. Environmental Protection Agency's (EPA)/National Institute of Environmental Health Sciences' (NIEHS) Children's Environmental Health and Disease Prevention Research Centers ("Children's Centers"), EPA hosted a national public meeting, *Protecting Children's Health for a Lifetime*, October 19 – 20, 2010, in Washington, DC. This report provides a summary of the presentations and discussions from the meeting.

*Protecting Children's Health for a Lifetime* brought together the expertise of the Children's Centers and the Pediatric Environmental Health Specialty Units (PEHSUs) of North America, EPA scientists, policy-makers and children's health advocates to explore the latest research findings on children's environmental health and their practical application in clinical, community and policy settings. Research from the Children's Centers has provided the scientific foundation for new ways to think about children and the environment; translate scientific findings into relevant information for clinicians, workers and parents; and conduct research in close collaboration with local communities. The PEHSUs provide a vital resource for parents, the public and other clinicians who need current information about risks from chemicals in the environment. The Children's Centers and PEHSUs represent a powerful and growing community of children's environmental health experts who are essential to preventing and managing environmentally related illness in children.

The meeting was sponsored by EPA's Office of Research and Development (ORD) and Office of Children's Health Protection (OCHP), the U.S. Department of Health and Human Services' (HHS) NIEHS and Agency for Toxic Substances and Disease Registry (ATSDR) of the Centers for Disease Control and Prevention (CDC), and the Association of Occupational and Environmental Clinics (AOEC). The goal of the meeting was to foster closer collaboration between leading experts on children's environmental health research, clinical practice and policy across different federal agencies, academic institutions and children's health advocacy nongovernmental organizations.

The 1.5-day meeting featured interdisciplinary presentations and discussions to explore connections between research findings, clinical and community practice, and child-protective policies. Discussion topics included effective approaches for communicating research findings and technical information to parents and the general public. Annie Murphy Paul, journalist and author of *Origins: How the Nine Months Before Birth Shape the Rest of Our Lives*, closed the meeting with an exciting keynote address on communicating with the public about complex scientific topics such as environmental impacts on children's growth and development. The meeting also included four breakout sessions focused on: (1) enhancing pediatric environmental health training for medical, nursing and public health students; (2) the role of science in children's environmental health protection; (3) improving community outreach and translation; and (4) connecting children's environmental health research to national efforts to eliminate racial/ethnic and economic health disparities.

**Tuesday, October 19, 2010**

**WELCOME AND INTRODUCTIONS**

*Christopher Zarba, National Center for Environmental Research (NCER), ORD, EPA*

Mr. Zarba, of EPA's NCER, welcomed meeting attendees on behalf of Paul Anastas, the Assistant Administrator for EPA's ORD and Science Advisor to the Agency. Mr. Zarba emphasized the importance of the participants' work and expressed the goal of fostering closer collaboration among the participants as the leading experts on children's environmental health research, clinical practice and policy across federal agencies, academic institutions and children's health advocacy organizations.

Mr. Zarba acknowledged the successful collaboration between EPA and NIEHS in funding the Children's Centers program and as key partners in advancing children's environmental health research. In addition, he commented on the important work of the PEHSUs and acknowledged the meeting's co-sponsors, the AOEC, the administrative organization for the PEHSUs. Mr. Zarba described the variety of children's health topics to be addressed during the meeting, including the latest science on how prenatal exposures may affect children's development, neurodevelopmental effects of environmental factors, children's environmental health in a global context, the contribution of social environmental factors to children's health, and how these concerns could be seen in the clinical setting. He noted also that participants would have the opportunity to explore policy applications of children's environmental health research.

*Peter Grevatt, OCHP, EPA*

Dr. Grevatt welcomed the meeting participants and noted that children's health is woven throughout all seven of the priorities that EPA Administrator Lisa Jackson has established for the Agency. Researchers and clinicians have played crucial roles in making progress in the children's environmental health field, such as reductions in blood lead levels, and Dr. Grevatt anticipated that they would continue to make major contributions in the future. He stated that much of the discussions during the meeting would focus on priorities-including what types of research to emphasize and what can be learned from communities.

**SESSION 1: THE CHILDREN'S ENVIRONMENTAL HEALTH COMMUNITY: WHO, WHAT, WHERE, AND HOW**

*Moderator: Marie Lynn Miranda, Duke University*

Dr. Miranda introduced the session by discussing the many components of the children's environmental health community, including the Children's Centers, PEHSUs, the National Children's Study (NCS), NIEHS, and others. She added that, for those not completely embedded in the community, it can be difficult to understand how the components fit together. Dr. Miranda stated that the goal of Session 1 was to introduce the key components, explain how they fit together and visualize how they could work together in the future. She displayed maps indicating where various components of the children's environmental health community are located and related them to the demography of different parts of the country. She suggested the possibility of building a relational database that would identify all of the entities working on a particular topic or having specific types of resources.

*Gwen W. Collman, Division of Extramural Research and Training, NIEHS, National Institutes of Health (NIH)*

Dr. Collman noted that the U.S. maps shown by Dr. Miranda represent only a portion of the research in children's environmental health. The NIEHS global environmental health map shows many supported projects in other countries, including those where populations have very high exposures to detrimental

factors. She said that these international projects are essential to a full understanding of children's environmental health.

Dr. Collman said that she has been part of the Children's Centers program since its inception and always felt a strong bond with the investigating teams. She noted that the partnerships that have been created with community organizations and health care providers have strengthened the translation of work in children's environmental health. She added that discoveries from this program have made key contributions to the field of child health and have enhanced scientific understanding. When the Children's Centers program began in 1998, not enough was known about the sources of environmental contaminants that affect children or their relationship to health effects. Since then, many advances have been made. It now is understood that exposure to endocrine-disrupting chemicals (EDCs) during pregnancy, infancy or puberty can be associated with adverse health effects, and research has begun to demonstrate links between environmental exposures at critical periods and neurodevelopmental outcomes. For example, a link between secondhand smoke and asthma has been established. Much has been learned about environmental justice and health issues, hundreds of scientific papers have been published, and a rich children's environmental health literature has been created.

Dr. Collman said that completed work points to exposure-outcome associations that need biological explanations, and some of those explanations probably fall within the field of epigenetics. NIEHS has been leading the NIH effort to understand DNA methylation, histone acetylation and other epigenetic mechanisms that may be critical to the causation of disease.

Dr. Collman characterized the next phase of the Children's Centers program as involving new directions and new scientific opportunities. The program's focus has been expanded to include additional exposures such as arsenic and additional diseases such as childhood leukemia. Some continuing Centers are building on previous grants to move into new areas such as obesity and the metabolic syndrome. Producing discoveries alone is not enough, however—collaboration among scientists, communities and health professionals also is essential. Dr. Collman said that the Children's Centers program is a critical piece of the future work of NIEHS, and federal partnerships are part of the commitment to taking the science produced by this program and making it accessible to regulatory agencies.

She continued that when the Children's Centers program began, the concept that early-life exposures to environmental stressors might lead to long-term health impacts was novel. Today, the paradigm has shifted, and the word "might" is no longer used. Evidence that exposures during key windows of susceptibility can have important adverse health effects is increasing, and public interest in this subject is growing as well. The public has called for a precautionary approach to chemicals, and many citizens are advocating for regulations to protect children. In addition, the public is unwilling to wait for scientific certainty, and scientists are being asked to communicate about their discoveries and any uncertainty earlier than in the past. Dr. Collman concluded that, through the continued success of the Children's Centers program, all of the researchers and clinicians at the meeting can contribute to the health of today's children and to the health of future generations.

*Jerome A. Paulson, Mid-Atlantic Center for Children's Health and the Environment at Children's National Medical Center*

Dr. Paulson introduced the PEHSU program by explaining that the PEHSUs are a resource for pediatricians, public health officials, school personnel, parents and others who need answers to questions about children's health and the environment. One PEHSU is located in each EPA region and is staffed on a part-time basis by a coordinator and various clinicians. The role of the PEHSUs is to address all issues that come to them and provide science-based answers to the questions posed, even if the answer is that scientists do not yet understand a topic. Dr. Paulson listed the topics that the PEHSUs are asked to

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address most often: lead, mold, mercury, pesticides, phthalates and bisphenol A (BPA). Inquiries are received on many other topics as well. About one-half of all inquiries are from parents, but an increasing number are from health professionals. In addition to responding to inquiries, the PEHSUs teach health professionals and parents about occupational health; communicate with the media, schools and others; participate in environmental evaluations; and help to formulate public health policy as advisors to government agencies. At the National level, the PEHSUs have developed advisories for health providers and patients on a variety of topics, ranging from melamine, phthalates and BPA to the aftermath of floods, hurricanes and wildfires. A list of all of the PEHSUs and their contact information can be found at <http://www.pehsu.net>.

*Sally Darney, ORD, EPA*

Dr. Darney summarized the work that ORD is performing to provide the scientific foundation to protect children's health. She explained that ORD has a large children's health program that involves integrated transdisciplinary research. EPA's major exposure and risk management laboratories are located in Cincinnati, Ohio, and Research Triangle Park, North Carolina; the National Center for Environmental Assessment (NCEA) and extramural Science To Achieve Results (STAR) grants program (part of NCER) are based in Washington, DC.

Dr. Darney characterized EPA's Computational Toxicology Research Program as a major current effort in the area of understanding chemical contaminants. The ToxCast™ component of this program is in the process of screening thousands of chemicals with *in silico* and high-throughput cell-based assays.

Dr. Darney said that ToxCast™ is relevant to children's environmental health because of its focus on the developmental pathways of toxicity, including endocrine disruption and cancer pathways, and their integration with exposure databases. Another ToxCast™ component, the Virtual Embryo, uses a systems approach to predict developmental toxicity. EPA has integrated information on methods by which children are exposed to chemicals into the *Child-Specific Exposure Factors Handbook*. The Agency's community-based risk assessment program is taking an integrated approach to defining community in the context of children's health disparities by evaluating community-level vulnerability in addition to risks from exposure to chemicals. Information on social and economic context is being integrated with exposure information.

*Steven Hirschfeld, Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD), NIH*

Dr. Hirschfeld summarized the NCS and emphasized its international component. The NCS will examine the effects of the environment—broadly defined to include such factors as air, water, diet, sound, family dynamics, community and cultural influences, and genetics—on the growth, development and health of children across the United States. The study will follow the cohort of children from before birth until 21 years of age with the goal of improving children's health and well-being and increasing understanding of the role that various factors play in health and disease. Findings will be made available to the public as soon as possible so that they can be put into practice. The major agencies involved are the NIH, NICHD, NIEHS, EPA, and CDC.

The main study will involve about 100,000 children, including an estimated 17,000 with obesity, 5,000 with asthma, 5,000 with learning disorders, 1,000 with autism spectrum disorders, and smaller numbers with other chronic health issues. The study is being implemented in stages. The "Vanguard" study already is under way and focuses primarily on logistics. The main study will focus primarily on exposure and response, with many integrated substudies. The main study will begin in early 2012, when enough data from the Vanguard study are available to inform its design. The recruitment strategy is based on geographic segments. Of the approximately 3,000 counties nationwide, a subset of about 100

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representative counties has been selected. Study participants will need to reside in the selected counties to be recruited for the study. Women between the ages of 18-49 (or pregnant) will be enrolled in the study. The study participants and their offspring will be followed in a longitudinal study. The details of the assessments have not yet been established. All methodology used in the main study will be field tested before use.

Data from the NCS are intended to be shared broadly with other researchers and are not reserved for use by participating NCS investigators. As appropriate, data from adjunct studies also will be shared. It is anticipated that the NCS will form the basis of child health guidance, interventions and policy for future generations.

*Robin Appleberry, Committee on Energy and Commerce, U.S. House of Representatives*

Ms. Appleberry explained that she was speaking in a personal capacity, not as a representative of the House Committee on Energy and Commerce. As a parent, she finds that the roles of Congress and of parents often are not that different; both struggle to understand scientific data and make appropriate decisions based on science.

A major focus for Congress at the time of this meeting was the reform of the Toxic Substances Control Act (TSCA) and how to move forward in modernizing chemical management. Ms. Appleberry said that Congress has sometimes found itself in the position of making scientific decisions, but that this position represents a failure of the system. She characterized the appropriate role of Congress as being to establish a framework for scientific decision-making by regulatory entities, not making scientific decisions itself. Accountability and flexibility are important elements of this process; statutes and policies should not be created in such a manner as to require the use of scientific approaches that have become outdated.

She noted that, to ensure that Congress establishes policies that enable agencies to make decisions based on the best and emerging science, researchers and clinical practitioners need to help inform policy-making. Scientific findings should be communicated earlier. Congress wants to know about new discoveries just as the public does and can accept the reality of scientific uncertainty. Ms. Appleberry urged the researchers in the audience to communicate their findings in clear, comprehensible lay terms. Members of Congress and their staffs are not toxicologists or pediatricians; for presentations to be useful to them, they must be relevant and timely. For example, for TSCA reform, she said that Congress needs to hear from the scientific community about such topics as why children are more vulnerable to environmental chemicals and how EDCs work. The science is critical here and can make a significant difference in policy-making. She added that Congress wants to set policies appropriately but is at high risk of not doing so if input is not received from scientific experts.

*Discussion*

A participant commented that she was struck by the high proportion of children in the NCS who will have various chronic conditions. Although some of the conditions may overlap, it appears that as many as 40 percent of the study participants will have one or more of the diseases or risk factors listed. She asked whether current population data exist on the proportion of children with these diseases or risk factors. Dr. Hirschfeld responded that he was not aware of such data but that the "normal" child is more of a statistical notion than a reality. The calculations of the numbers of children with particular conditions were made for the benefit of researchers who focus on these areas.

A participant asked Ms. Appleberry whether providing information to Congress could be construed as lobbying, which is forbidden by many of the organizations that fund scientific research. Ms. Appleberry said that she is not an expert on lobbying and legal issues, but one method of providing scientific



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information is to work with registered lobbying organizations, partnering with and informing them, rather than approaching legislators directly. Also, scientists could be involved in education. Congressional staff members often develop relationships with scientists in various fields and approach them for information when an issue arises that relates to their specialty. A participant noted that none of the clauses in scientists' funding remove their rights as citizens. Researchers may provide education and information without taking a position on a specific bill or candidate. Dr. Collman added that the partnerships that researchers have with community groups can be helpful because these groups are influential with Congress.

**SESSION 2: PRENATAL EXPOSURES**

*Moderator: Brenda Eskenazi, University of California (UC), Berkeley*

Dr. Eskenazi thanked the organizers for arranging this session and briefly discussed experiences from her own research. She noted that, in 1998 when the UC Berkeley Children's Center was just beginning, the researchers expected to focus on pesticide exposure. They had no knowledge of the emerging chemicals that they would study in the future or of the types of biospecimens and environmental samples that would need to be collected in their future research.

Dr. Eskenazi said that the session would focus on well-known toxicants such as lead and emerging contaminants such as phthalates. She urged participants to think preemptively about emerging contaminants of concern and future research needs in children's health. She noted that the session would start with case studies from the clinic, move to the field and then return to the clinic. Presentations would start with two case studies involving lead and continue with a presentation on exposure assessments to old and new toxicants, including an example involving phthalates; the session would conclude with a talk on communicating risk to families.

**Unusual Case of Lead Toxicity in Pregnancy**

*Susan Buchanan, Great Lakes Center for Children's Environmental Health*

Dr. Buchanan described a case of lead toxicity in pregnancy involving a 17-year-old expectant mother who had retained bullet fragments from a gunshot wound to the head. Until shortly before she became pregnant, she had lived in an older home with flaking paint on the windowsills, but she had since moved to newer, rehabilitated housing. She had no history of pica, eating home-grown vegetables or use of clay bowls. An X-ray showed that the retained bullet fragments were in the skin, not the brain tissues. Surgery to remove the fragments was planned, but the patient decided not to undergo the operation. Issues raised by the case include the question of whether lead can leach from the skin to the bloodstream, the breastfeeding advice to be given to the mother, interventions for the infant, and the need to clarify home versus intrinsic exposure.

**Prenatal Lead Exposure**

*Kevin Chatham-Stephens, Mount Sinai PEHSU*

Dr. Chatham-Stephens presented the second lead toxicity case, in which a neonatologist contacted the Mount Sinai PEHSU regarding a 24-year-old woman of Mexican origin, in the 39th week of pregnancy, whose blood lead levels had increased from 13 to 48 micrograms per deciliter ( $\mu\text{g}/\text{dL}$ ) during her pregnancy. Her husband and 18-month-old child did not have comparably high lead levels. Delivery was induced prior to the 41st week of pregnancy, and the lead level in the cord blood was 51  $\mu\text{g}/\text{dL}$ . The mother and infant were treated by chelation.

Follow-up examinations during the 10 weeks following delivery showed that the infant's blood lead level remained at the postchelation level but that the mother's lead level rose again, to 47  $\mu\text{g}/\text{dL}$  at 10 weeks.

Potential sources of her exposure to lead may have included lead-based paint, pica behaviors, occupational or hobby exposures, or the use of traditional remedies. Other sources of lead exposure could have included imported eye cosmetics, candy, spices or dinnerware. Dr. Chatham-Stephens noted that patients may not report the use of folk or complementary remedies because they think of them as ordinary consumer products rather than “remedies.” He also noted that, in New York City, 94 percent of pregnant women with elevated blood lead levels are born outside of the United States.

### **Prenatal Chemical Exposures**

*James Quackenboss, National Exposure Research Laboratory, ORD, EPA*

Mr. Quackenboss noted that combining the perspectives of clinical practice, experimental research and observational research provides the strongest approach to the assessment of prenatal chemical exposures. Some of the more familiar examples of prenatal exposure include maternal smoking, alcohol consumption and glucose intolerance, about which much is known; and environmental tobacco smoke (ETS), low-level lead exposure, ambient air pollutants, polycyclic aromatic hydrocarbons (PAHs), pesticides and drinking water disinfection by-products, which are not as well understood. Emerging examples of potential risks include polybrominated diphenyl ethers (PBDEs) from flame retardants, perfluorochemicals, phthalates and other EDCs, as well as psychosocial factors such as stress.

He noted that pesticide exposures in the general population result from residential indoor pesticide use and foods. People also may be exposed through pesticide use in the care of pets, residential outdoor use, occupational exposure, proximity to agriculture, other building uses or public health treatments. The primary sources of exposure to EDCs are through indoor sources and consumer products, many of which may not be recognized by consumers. Recent research has linked prenatal exposures to pesticides and EDCs, with effects suggestive of adverse outcomes.

Mr. Quackenboss characterized fetal exposure as of special concern because many critical periods of human development occur *in utero*. Much happens during the first 2 months of gestation; if exposures during this period are not captured, important effects may be missed. Exposure misclassification may occur if mothers do not remember exposures during this period correctly. In the NCS Vanguard study, efforts are being made to capture data about exposures during pregnancy through environmental monitoring, biomonitoring and indirect measures such as community exposure, rather than by relying exclusively on recalled information. One of the challenges in assessing some types of exposures is the difficulty of obtaining blood samples from infants during the first year of life.

Mr. Quackenboss listed biological samples of value in assessing prenatal exposures, including blood samples taken during pregnancy, especially during the first and third trimesters; blood samples taken from the child as early in life as possible; urine samples from both the mother and child; breast milk; hair; and saliva. House dust has been considered a high-priority environmental sample that is relevant to multiple exposures and outcomes. Logistical concerns include the timing of specimen collection; the cost of sample collection, storage and analysis; the burden on study participants; and questions about the stability of environmental samples and biological specimens for future analyses.

### **Associations Between Maternal Prenatal Phthalate Urinary Metabolite Concentrations and Child Mental, Motor and Behavioral Development at Age 3 Years**

*Robin Whyatt, Columbia Center for Children's Environmental Health*

Dr. Whyatt explained that phthalates are high-production-volume chemicals used widely in consumer products, including plastics, household materials, personal care products, medical supplies, toys and food packaging. Virtually everyone is exposed to them. Phthalates are chemicals of concern because some are

endocrine disruptors that cause anti-androgenic effects or interfere with thyroid function; recent studies have associated exposure to phthalates with developmental and behavior problems in children.

She explained that the Columbia University Center for Children's Environmental Health had measured phthalates in third trimester urine samples from 327 African American or Dominican women in New York City and related these measurements to measures of infant development and findings from a child behavior checklist that serves as an early indicator of behavioral problems. Phthalates and their metabolites were detected in almost all of the urine samples, and the women were exposed to multiple phthalates simultaneously. No significant association was seen between maternal exposure to phthalates and mental development, sleep problems or behavioral problems in the externalizing domains (attention problems or aggressive behavior) in their children. Associations were found, however, between two compounds and decreased child motor development at age 3 and between three compounds and increased behavioral problems in the internalizing domain (such as anxious/depressed or withdrawn behavior).

### **Communication and Prevention in the Clinical Setting**

*Sheela Sathyanarayana, Northwest PEHSU at the University of Washington*

Using phthalates and vaccines as examples, Dr. Sathyanarayana discussed issues involved in counseling parents. She explained that parents often see media coverage of scientific studies and ask their health care providers what to do. Health care providers usually are not well-informed about the issues of concern, and scientific data and publications typically are not intended for use in clinical settings. Thus, both clinicians and parents face challenges.

Dr. Sathyanarayana noted that, with regard to phthalates, parents want to know how to find out whether specific products contain phthalates, what the current regulations are, what health effects to look for, and what alternative products are available. Physicians find these questions difficult to answer because of limited knowledge and limited time to communicate health information. When counseling families about phthalates, it is best not to dismiss their concerns but instead to recognize that data on the health impacts of these and other modern chemicals are limited. Families can be told that it is not useful to conduct body burden testing and that the health impacts of exposure are not known at this time. Appropriate resources can be used to educate families on how to reduce exposure. For example, families can be told that diet is the largest source of phthalates for most of the population, and exposure can be reduced by choosing fresh rather than processed foods and by using glass food storage containers when possible. Not placing hot liquids in plastic containers and not putting plastic containers in the microwave oven or dishwasher also may be helpful. Families can be directed to PEHSU resources.

With regard to vaccines, Dr. Sathyanarayana indicated that parents are concerned about mercury, adjuvants and the possibility of overloading the immune system. They also may believe that their child is not at risk for the disease that the vaccine prevents or that the disease is not dangerous. Some also have ethical, moral or religious objections to vaccination. As with phthalates, dismissing parents' concerns is not an effective approach to communication. Instead, health care providers need to help families through the decision-making process and understand that experts and the public speak different languages and have different levels of knowledge. She concluded that an effective approach to counseling includes listening to parents' concerns, asking about their information sources, asking if they have thought about a plan for immunizations for their child, and reassuring and educating at each visit.

### *Discussion*

A participant commented that relative risks may be misleading, and it is time to move away from a statistical methodology that was not designed for the types of risk assessment for which it currently is used. Dr. Whyatt stated that in her study the purpose was not to conduct a risk estimate but rather to

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examine potential associations between compounds and outcomes. When evidence is found that links compounds to a disease, it is appropriate to examine the relative risks in the population. Dr. Whyatt agreed that extreme care should be taken when relative risks or odds ratios are used in describing findings to the media. Dr. Sathyanarayana noted that many clinicians do not understand the meanings of relative risks and odds ratios because they do not have epidemiologic or public health training. Like the media, clinicians need straightforward messages, and such messages rarely involve numbers.

Another participant commented that California's Proposition 65, which has been criticized for creating the need for an excessive number of warnings, also has had the beneficial effect of prompting many product reformulations to avoid warnings. Thus, it has taken unnecessary toxic exposures out of the marketplace. The participant also asked about Health 2.0 as a source of information for pregnant women. Members of the panel were not sufficiently familiar with Health 2.0 to comment on its value. (*Additional information on Health 2.0 can be found at <http://www.health2news.com>.)*

Another participant commented on the need to integrate the activities of professional societies, including those of pediatricians, obstetricians, environmental health researchers and others. Dr. Sathyanarayana responded that conveying practical education on common pediatric environmental health topics was discussed at a special workshop held the previous evening. She noted that there is greater interaction between the pediatrics community and the environmental health community, but there is little communication between obstetricians and the other groups. Dr. Eskenazi added that another challenge is conveying and translating information from researchers to clinicians.

Dr. Darney noted that interesting gender differences have been seen for neurological outcomes and asked Dr. Whyatt if she had stratified for gender in her study. Dr. Whyatt responded that gender differences were not evident in her data.

EPA's Dr. Devon Payne-Sturges said that a conundrum exists in that a message to reduce one kind of exposure might lead to increases in another. For example, promoting consumption of fresh fruits and vegetables to reduce phthalate exposure might increase exposure to pesticides. Dr. Sathyanarayana replied that she had focused specifically on phthalates in her talk. In actual clinical practice, multiple issues must be taken into account when counseling families. Exposures should not be considered in isolation. Dr. Whyatt noted that merely washing fruits and vegetables can be useful in reducing pesticide exposures. She added that it would be best to have guidelines on healthy eating and a healthy environment that do not require people to learn extensive details about specific exposures.

Maureen Phipps, chair of the American College of Obstetricians and Gynecologists' Committee on Health Care for Underserved Women, said that she would disseminate the message to her colleagues about the need for obstetricians to become more engaged with the children's environmental health community.

Dr. Eskenazi concluded the discussion session by informing the group that the International Society for Children's Health and the Environment had been formed recently and that attendees would receive an e-mail notice about the society and a request to participate.

**SESSION 3: ENVIRONMENTAL EXPOSURES AND NEURODEVELOPMENTAL EFFECTS**

*Moderator: Kimberly Gray, Division of Extramural Research and Training, NIEHS, NIH*

Dr. Gray introduced the session, which was intended to explore evidence of links between early exposure to environmental chemicals and neurobehavioral and cognitive impairment in infants and children, including attention deficit hyperactivity disorder (ADHD) and autism.

**Exposure to Lead or Polychlorinated Biphenyls (PCBs) as Risk Factors for ADHD**

*Susan Schantz, Children's Environmental Health Center at the University of Illinois at Urbana-Champaign*

Dr. Schantz explained that parallels can be drawn between the behavioral problems of children with ADHD and those exposed to lead or PCBs. ADHD is the most commonly diagnosed neuropsychiatric disorder of childhood, affecting about 9 percent of boys and 4 percent of girls. Environmental exposures appear to play a role. Key behavioral features include attention problems and impairment of executive functions such as response inhibition, working memory and cognitive flexibility. Indirect evidence indicates that ADHD is associated with hypofunction of dopamine in the prefrontal cortex. The environmental exposure most strongly associated with ADHD is maternal smoking; other exposures that may be relevant include maternal alcohol consumption, pesticides, lead and PCBs.

Dr. Schantz noted that exposure to lead or PCBs in animal models has resulted in deficits on tests of the executive functions that are similar to impairments seen in humans who have been diagnosed with ADHD, with stronger effects in males. For example, response inhibition in rats can be assessed through a test in which the animals must learn to wait 15 seconds between lever presses to obtain a reward. PCB-exposed animals are less successful at this test than unexposed control animals, but their performance is improved by amphetamine, a drug that is of therapeutic value in ADHD. Similarly, in a test of cognitive flexibility in which rats are required to adjust their behavior to obtain a reward, PCB-exposed animals do not perform as well as unexposed animals. Tests of the same types of functions in children with ADHD and those exposed to PCBs or lead have shown patterns similar to those observed in the experimental animals.

In summary, Dr. Schantz stated that environmental exposures, especially exposures to chemicals that reduce brain dopamine, may contribute to ADHD. Research in animals can play a valuable role in helping to identify factors that contribute to ADHD in humans.

*Discussion*

An attendee asked whether the use of selective serotonin release inhibitors has been examined in pregnancy and whether their use increases ADHD risk. Dr. Schantz said that she was not aware of any such research.

Another participant asked whether the studies described by Dr. Schantz involved animals with current or past exposures. Dr. Schantz replied that the animals were exposed early in life and studied in adulthood, so the experiments examined past exposure. In the case of humans, studies typically measure levels of PCBs in cord blood and examine behavior in later childhood. Studies of lead, however, have been of varied design, sometimes involving current exposures.

### **Questions Parents Have About Autism**

*Leslie Rubin, The Southeast PEHSU at Morehouse School of Medicine*

Dr. Rubin explained that neurodevelopmental disorders constitute a large group of conditions; impacts on the brain can result in many different consequences. He thanked Dr. Sathyanarayana for articulating the challenges that clinicians face in answering parents' questions. Many parents obtain health information from the Internet, which is not policed in any way. This presents difficulties for clinicians.

Dr. Rubin noted that answering parents' questions is especially challenging with regard to conditions on the autism spectrum. The spectrum is widening; the term "autism" implies the most severe disorders. It is expected that the official definition of the autism spectrum soon will include Asperger's syndrome, which will substantially increase the number of individuals who are counted as affected. Dr. Rubin asked attendees to indicate whether they had a family member or were close to someone who had a family member on the autism spectrum; about one-third of the people in the room indicated that they did.

He identified the two main questions that parents have about autism: What caused it? What can we do to make it better or cure it? The causes of conditions on the autism spectrum are not well understood, and treatment is not as simple as administering a medication. The condition has lifelong implications, and it can be difficult to answer parents' questions about their children's future. Dr. Rubin added that the reasons for the steep rise in the prevalence of autism are not well understood. Environmental factors may play a role, but changes in diagnosis also are important.

### **Autism and Environmental Influences: Interpreting Tests and Laboratory Findings**

*Alan Woolf, New England PEHSU at The Children's Hospital, Boston*

Dr. Woolf noted that autism is a clinical issue that arises at PEHSUs across the country on a daily basis. Autism is a very complex condition, and addressing it requires time and thoughtful consideration for the families involved. The prevalence of autism ranges from 1 in 150 to 1 in 500 in different populations. Autism is four times more common in males than females. Autism was first described in 1943 by Leo Kanner, who observed difficulties in social relationships in individuals with this condition but unfortunately concluded that poor parenting was involved in its causation. When parents are asked what they believe causes autism, about one-half mention immunizations and one-half genetics; some also cite the environment, pregnancy complications and the overuse of antibiotics.

Dr. Woolf said that the use of chelation challenge tests in autism had been in the news at the time of the meeting. The theory of chelation challenge is that if a chelant mobilizes a metal for excretion, that proves that toxic amounts are present. In practice, however, nonautistic people excrete minerals, and there is no link between metals excretion and health except with high body burdens. The chelation challenge is not recommended because the chelants are toxic and the procedure is expensive and can remove essential minerals. No diagnostic or therapeutic value has been scientifically established for the chelation challenge in autism.

Dr. Woolf identified hair analyses for minerals and metals as another issue that arises frequently when counseling parents of children with autism. The results of these analyses have been found to be unreliable, with laboratories often generating very different results from the same sample. When multiple laboratories assessed the same sample for 19 elements, widely divergent results were obtained; some laboratories recommended dietary changes or supplements, suggesting a possible conflicts of interest. There is no Clinical Laboratory Improvement Amendments (CLIA) certification for hair testing.

Dr. Woolf said that, when the New England PEHSU evaluates a child who may have autism, the evaluation begins with a review of previous medical records and laboratory testing, along with a careful

gathering of the child's history and a physical examination. A thorough assessment is made to rule out other conditions that may have similar symptoms. In communicating with families, the PEHSU emphasizes the "3 Es" (encourage disclosure, empathize and empower) and "3 As" (acknowledge, assess and advocate). He noted the importance of encouraging parents to inform the clinician about what they are doing for the child therapeutically and for the clinician to acknowledge that much remains unknown about autism.

### *Discussion*

Dr. Paulson pointed out that although there is no CLIA oversight for hair testing, laboratories that perform these tests often state that they are CLIA certified without explaining that the certification does not apply to this particular test.

### **Environmental Causal Factors for Autism**

*Irva Hertz-Picciato, UC Davis Center for Children's Environmental Health*

Dr. Hertz-Picciato highlighted the major known cognitive developmental toxins. She expressed hope that it might be possible some years from now to have such a list for autism, thus enabling preventive interventions. Autism is a developmental disorder characterized by deficits in social reciprocity and communication and by repetitive behaviors or restricted interests. Symptoms are present by age 36 months, and diagnosis is made primarily through two instruments: the Autism Diagnostic Observation Scale, which involves observation of the child, and the Autism Diagnostic Inventory-Revised, which involves a standardized interview with the primary caregiver.

Dr. Hertz-Picciato said that a sevenfold increase in the incidence of autism, as determined from a database of children who received services, was observed between 1990 and 2001. It has been estimated that about one-third of the increase was a result of a change in diagnostic criteria, a trend toward a younger age at diagnosis and a broadening of the definition to include milder cases. Diagnostic substitution might explain an additional one-third of the increase. The remainder of the increase cannot be fully accounted for, however, so the possibility of a true increase should be considered. Asthma, obesity, ADHD, diabetes and mental health disorders (obsessive-compulsive disorder and bipolar disorder) increased during the same time period, suggesting the possibility of a common set of environmental exposures that provides a unifying explanation for the increased incidences of autism and these other conditions.

Dr. Hertz-Picciato noted that the "bad parenting" hypothesis of autism set research back for decades; some stigma remains today, even though autism is now known to be caused by aberrant brain development. The causes of autism are multifactorial, likely involving both genetic and environmental factors. The environmental factors that contribute to autism have not been identified conclusively but might include environmental chemicals, nutritional deficiencies, microbiological agents, gestational and perinatal conditions, fertility treatments and other medical interventions. It is likely that science will identify multiple relevant factors rather than a single "smoking gun."

Dr. Hertz-Picciato described the *CH*ildhood Autism Risks from Genetics and the *E*nvironment (CHARGE) Study, which is designed to identify factors contributing to autism, including genetic factors, environmental factors and their interactions. The study has employed a case-control design with population-based recruitment, standardized clinical confirmation of diagnosis and linkage to state-of-the-art laboratories. Environmental exposures are assessed in a variety of ways, using biospecimens, interviews, linkage to exposure databases and medical records. Three groups of children are included: those with autism, those with developmental delay and controls drawn from the general population. Results as of this meeting indicated that blood mercury levels are slightly higher in the control children than in the other groups, reflecting higher fish intake in the controls. The findings do not address the

question of whether mercury is a causal factor for autism because only recent exposure was measured. Much evidence of dysregulated immune systems has been observed in the autistic children, but it is unclear whether the abnormalities are a cause or a result of the autism. No difference in PBDE levels was observed between children with autism and controls, but current PBDE concentrations may be a poor surrogate for exposure during critical developmental periods. Analyses of pesticides and air pollutants from traffic currently are being reviewed.

Although the CHARGE Study has provided important clues, its greatest limitation is its retrospective design. Dr. Hertz-Picciato and colleagues therefore have initiated a second study with a prospective design that focuses on pregnant women who already have an autistic child and as a result are at increased risk of having another. Prospective studies complement retrospective studies, but it is important to remember that there may be differences between families with one autistic child and those with more than one. The NCS, because of its large sample size and prospective design, also may make important contributions to understanding the cause of autism.

#### *Discussion*

Dr. Paulson noted that when researchers examine neurodevelopmental outcomes, they are looking at final pathways. Dr. Rubin responded that researchers are looking at distinctive conditions, which may or may not be syndromes. If there is a final common pathway in the brain, it has multiple sites. Different neurodevelopmental conditions may overlap because of the complexity of the brain.

#### **SESSION 4: ROLE OF CHILDREN'S ENVIRONMENTAL HEALTH SCIENCE TO INFORM CHEMICALS MANAGEMENT**

*Moderator: John M. Balbus, NIEHS, NIH*

Dr. Balbus explained that NIEHS is unique in the NIH "family" because it focuses primarily on prevention and primary public health issues. NIEHS's priorities are similar to those of this session—to develop public health practices and technologies and inform public health protection. To have an effective chemical management system, it is essential to know: (1) what chemicals are causing what health effects and at what doses; (2) who is vulnerable and when they are vulnerable; (3) the settings, co-exposures and life stages at which exposures cause the most harm; and (4) how to protect people during vulnerable times. Much of the work necessary to develop an effective chemical management system is outside the scope of NIEHS, but NIEHS supports research that can inform all four of these facets.

Traditionally, chemicals management focused on single chemicals and adults. Today, however, scientists recognize that it is not possible to test every chemical for every possible health effect and that children do not respond to chemicals in the same manner as adults. Science is moving toward changing the paradigm by examining common pathways of toxicity and focusing on critical windows of exposure, epigenetics, persistence and inheritance across generations. Scientists and regulators no longer are dealing primarily with cancer, which traditionally has driven chemicals management, but rather with other conditions that currently are epidemic. The new approach facilitates examining cumulative risk—that is, multiple exposures in the context of co-stressors that may be nutritional, environmental or social.

Dr. Balbus said that NIEHS is very committed to providing new insights on chemical regulation. One important component is the National Toxicology Program, which is collaborating with EPA on assays to inform regulation. A key lesson from recent scientific advancements is that whatever system may be put into place must ensure the safety and sanctity of the womb. The system also must be flexible to accommodate transformative new ways of assessing chemical exposure.



### **10 Americans: Toxic Chemicals and Human Health**

*Ken Cook, Environmental Working Group*

Mr. Cook discussed a study that his organization performed a few years earlier that had a profound impact on the debate about toxic chemicals and health. The study, called 10 Americans, took samples from 10 individuals on 1 day and tested them for toxic chemicals. A total of 287 different chemicals were found in the 10 samples. What made the study special is that the 10 people were newborn infants; the samples were taken from cord blood. The results demonstrated exposure to a wide variety of chemicals before birth. The message of the study, Mr. Cook said, is that industrial pollution begins in the womb. The popular conception that the fetus is somehow protected from environmental exposures is incorrect.

The levels of chemicals found in the cord blood samples in this study were low, usually in the parts per billion (ppb) range, but it is possible for exposures in this range to have effects. Some medications exert their therapeutic effects at blood levels in the ppb range, and undesirable side effects also may be observed at these levels. Therefore, the possibility of significant effects should not be dismissed just because exposure levels are low.

Mr. Cook added that increases in health problems such as leukemia, hypospadias, childhood brain cancer and autism currently are being observed, and these changes cannot be explained by genetics alone. It has not been established that chemical exposures are causing these effects, but given the presence of exposures and the knowledge that some health problems are on the rise, research to determine whether the exposures are safe seems prudent.

Mr. Cook indicated that individuals can be advised of ways to reduce their exposure to chemicals with poorly understood effects—such as by buying organic produce, choosing low-mercury fish, filtering tap water and using stainless steel rather than nonstick cookware—but it is not reasonable to expect the public to solve the problem by shopping its way out of it. Toxic chemicals reform is needed. Chemicals should be demonstrated to be safe for children and others who are sensitive to them before they are allowed on the market. It should be assumed that chemicals are harming people until proven otherwise, and health and safety studies of chemicals should be disclosed. Currently, such requirements do not apply to industrial chemicals as they do for pesticides.

Mr. Cook noted that changes can be made in the regulation of industrial chemicals just as other changes have been made before—including changes in perceptions about public health issues such as smoking, and changes in regulations such as removing lead from gasoline and PCBs from electrical equipment. He summarized that the goal of reform should be to ensure that when infants come into the world, everything possible has been done to avoid exposures that might compromise their health as they go forward in life.

### **Moving Into the Future: New Science and Children's Environmental Health**

*Tracey J. Woodruff, UC San Francisco Children's Center*

Dr. Woodruff explained that, prior to 1996, EPA assessed each pesticide and exposure route individually and did not have a general policy for childhood susceptibility. Newer science indicated, however, that children are more sensitive than adults, exposure for an individual pesticide should account for all sources, and multiple pesticides with a common mode of action should be considered together. These conclusions were reflected in the National Research Council (NRC) report *Pesticides in the Diets of Infants and Children*, the Food Quality Protection Act of 1996, and the 1997 Federal Executive Order *Protection of Children From Environmental Health Risks and Safety Risks*.

Dr. Woodruff noted that what was thought of as novel in 1996 currently is routine at EPA. Scientists are finding increasing evidence that exposure to some environmental factors jeopardizes children's health and

may relate to large increases in certain health problems. The evidence also is strong that environmental health risks disproportionately affect children. The prevalence of chronic conditions among children and youth, including obesity, asthma, other physical conditions, and behavioral and learning problems, increased from 1988 to 2006. In one study of 8- through 14-year-olds, one-half suffered from a chronic condition at some point during the 6-year study period.

Dr. Woodruff added that research on children is leading the way in elucidating the importance of variability, biological susceptibility, multiple chemical exposures and low doses. For example, studies of PBDEs have shown that the low levels measured in people can make a difference; children with higher concentrations within a low-dose range scored lower on tests of mental and physical development. Variability among individuals is illustrated by paraoxonase 1 (PON1), an enzyme that detoxifies pesticides. Levels of this enzyme in children are lower than in adults, and PON1 levels vary 26-fold in newborns. The importance of multiple chemical exposures was demonstrated by a study showing that exposure to both paraquat and maneb had a greater effect on brain development than exposure to either substance alone, even though the substances act by different mechanisms.

In two important reports released in 2008, *Science and Decisions: Advancing Risk Assessment* and *Phthalates and Cumulative Risk Assessment*, Dr. Woodruff noted that the NRC recommended upgrading the assessment of chemicals based on new science. The NRC concluded that cumulative exposures matter, and chemicals that act on the same common adverse outcome—not just those with the same mode of action—should be considered together. The NRC also concluded that: (1) low doses matter, (2) thresholds should not be assumed for noncancer effects, and (3) variability in human susceptibility has not received sufficient or consistent attention by EPA. The NRC recommended that EPA move toward quantifying population variability more explicitly in exposure assessment and dose-response relationships.

Dr. Woodruff concluded that, fortunately, interventions to reduce exposure can be effective. For example, switching to organic produce can reduce exposure to pesticides, and actions taken at the societal level to reduce exposure to lead have resulted in decreases in children's blood lead levels. Everyone—including government, industry and advocacy organizations—now agrees that TSCA should be modernized and that protecting children is critically important.

### *Discussion*

Dr. Eskenazi commented that it is important to think about working at the global level as well as at the individual and societal levels. The failure of the United States to ratify the Stockholm Convention on Persistent Organic Pollutants is an embarrassment. Dr. Eskenazi urged meeting participants to think globally. Mr. Cook responded that exposures result from products that come from all over the world. Whether at the state, federal or international level, the first response to concerns about potentially harmful ingredients usually is not policy—because policy takes time—but rather a response in the marketplace. Consumer choices can send messages.

Dr. Woolf commented that he had been asked to write a blog for parents on whether they should buy organic foods for their children. The question is not a simple one because the official U.S. definition of organic is relative, and organic foods cost more. Moreover, exposure does not equal health effects. Therefore, the situation is complex, especially for disadvantaged families. Dr. Woodruff agreed that purchasing organic foods is expensive. In addition, parents should not have to be chemists. Protection should occur at the societal level. Mr. Cook likened buying organic to “private school for food”—not everyone can find or afford it. There is a need to focus the industry more in the direction of using less harmful and fewer pesticides.

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A participant asked the panelists to comment on future issues, such as nanotechnology. Dr. Woodruff agreed that future issues are important and said that there is a need for a standardized way to organize the testing of all chemicals. Mr. Cook agreed that nanotechnology is a concern. As with other substances, government agencies are saying that there is no evidence of a problem, but such evidence may be found at some future time. In most instances, the public’s experience with government information on the safety of a chemical involves sudden switches: one day a chemical is safe; the next day it is not. This has a profound impact on the ability of the government to be believed. Earlier communication about uncertainties is needed, and government agencies need to acknowledge that a substance is under investigation and that definitive answers are not yet available. Dr. Balbus added that it is important to become aware of when exposure becomes large scale. In the case of lead, concerns were raised decades before action was taken. Regulatory agencies need to be proactive in such situations.

A participant asked the panel to think about the role of the scientific community in education, including in educating legislators. Dr. Woodruff replied that one of the challenges is that people are intimidated by federal agencies. Her institution has a program to teach fellows, clinicians and community groups about environmental health policy and how to approach EPA to talk about science. The goal is to increase the pipeline of communication to enhance understanding of the science and create more partnerships.

**SESSION 5: CHILDREN’S ENVIRONMENTAL HEALTH IN A GLOBAL CONTEXT**

*Moderator: Leslie Rubin, Southeast PEHSU at Morehouse School of Medicine*

Dr. Rubin began the session by showing maps highlighting the locations of PEHSUs across the country and related centers around the world. He noted that he recently attended a meeting in Africa and was struck by how different the world of environmental health is there, with more severe exposures and major toxic events. His vision of the PEHSUs is one of a network of networks protecting children worldwide.

**Beyond the Backyard: Building Children’s Environmental Health Capacity in Southeast Asia**

*Catherine Karr, Northwest PEHSU at the University of Washington*

Dr. Karr explained that the PEHSU program’s global outreach is important because children’s hazardous exposures are magnified in developing and transitional countries. Colleagues in those countries have a limited capacity to address these issues. The PEHSUs can help by leveraging partnerships across the North American PEHSU network and within their institutions. A natural partner in this work is the Fogarty International Center, which conducts international training and research programs. Some institutions, such as the University of Washington, have a Fogarty Center and a PEHSU, but even those that do not can think about potential connections with other countries.

Dr. Karr noted that when the Northwest PEHSU wanted to get involved in children’s environmental health in Southeast Asia, PEHSU personnel made contact with the Fogarty program that already was working in the region. The PEHSU representatives were able to present the PEHSU model at a meeting in Hanoi, Vietnam, and got a sense of the leadership there. They quickly learned that there were no children’s environmental health champions in Vietnam. Although there was a school health program, expertise in children’s environmental health was lacking. A children’s environmental health training team was formed in cooperation with Project Vietnam. The team delivered training sessions and gathered information about environmental health concerns from health professionals at hospitals and major pediatric departments in Vietnam. They found that important environmental health problems—including microbiological food poisoning, tobacco smoke exposure, inadequate sanitation, air pollution and water contamination—were present, and pediatric care providers realized their importance and believed that the problems were increasing. Most of the clinicians, however, had no training and no idea of how to access local or regional resources to help address these issues.

Dr. Karr characterized the next step in the program as involving building champions for children's environmental health in Southeast Asia. With sponsorship from the Fogarty Center, five junior academics or early career professionals in government were selected to participate in a 2-year program of in-person and distance-learning workshops and mentoring and to conduct children's environmental health studies in their region. The topics of these projects include secondhand tobacco smoke exposure, ambient silica-containing particulate exposure, childhood lead exposure in a community in which lead battery recycling takes place, environmental triggers of asthma, and hazardous exposures among children working in the salt industry.

**Addressing the Challenges of Underdevelopment for Children's Environmental Health in Southern Africa: The University of Michigan Fogarty International Center Program**

*Tom Robins, University of Michigan Fogarty Center*

Dr. Robins began by listing some of the critical global issues in children's environmental health, including lack of access to safe drinking water, malnutrition and infections, ambient and indoor air pollution, child labor in unhealthy and unsafe conditions, and environmental exposures from occupations in agriculture and the informal sector. He focused his presentation on Southern Africa, where perinatal and childhood mortality rates are high and more than 60 percent of the workforce is in the informal sector of the economy, including the agricultural sector.

He noted that Southern Africa lacks skilled professionals and academic programs in environmental and occupational health. When the University of Michigan's Fogarty Center initially became involved in work in this region, the only postgraduate training available was three diploma programs, all in South Africa. In response, an effort was made to build regional capacity, starting in South Africa and expanding to other countries. Dr. Robins reported that, at the time of this meeting, in the third cycle of funding, the focus was on four countries with the greatest structure in place. National resource centers and review committees are being established, and funding is being provided for graduate students from these countries at South African universities. Another grant has been funded for research training on chronic lung diseases. Specific aims of the grant include supporting research training of 10 doctoral students, bringing 10 mid-career scientists to the University of Michigan for 4 months of training, and developing distance-learning modules to enhance the regional repository of training materials.

The program review committee for this project functions as a steering committee, and Dr. Robins is the only North American on that committee. The committee has served as a means to bring people from leading area universities and government agencies together; it has supported research and influenced policy. One successful effort has involved air pollution-related health effects among children in Durban, South Africa, where a school is located between two oil refineries in a valley with heavy haze in the air. Cooperation was obtained from government agencies, and it was found that children in the area had very high rates of airway hyperreactivity, which were strongly related to exposure to air pollutants. That study led to a much larger government-funded study across multiple schools, with one of Dr. Robins's South African colleagues as the principal investigator, and to decreases in emissions from the refineries. Dr. Robins added that great potential exists for programs of this type to successfully address the enormous needs for training and research in children's environmental health in developing countries.

**International Studies of Exposure to Air Pollutants on Neurodevelopment**

*Frederica P. Perera, Columbia Center for Children's Environmental Health*

Dr. Perera reported on studies of exposure to air pollutants and neurodevelopment conducted in New York City; Krakow, Poland; and Tongliang, China. The goal was to carry out parallel molecular epidemiologic studies over a gradient of exposure in different ethnic groups and investigate health

disparities. The study populations were young, healthy, nonsmoking pregnant women and their children, and the study was designed with repeat measures of exposures, biomarkers and outcomes.

Dr. Perera explained that in one part of the overall study, the relationship of PAH exposure, as determined by measuring PAH-DNA adduct levels in maternal and cord blood, to various outcomes in the children was assessed. PAH exposure was highest in the Chinese group, intermediate in Poland, and lowest in New York. In the New York cohort, high prenatal PAH exposure was associated with reduced birth weight and infant head circumference and with lower scores on a mental development scale at ages 1 to 3 years and on an IQ test administered at age 5 years. Similarly, high prenatal PAH exposure was associated with reduced fetal growth and lower scores on a child intelligence test at age 5 years in Poland. In China, an unusual opportunity was available because it was possible to study groups of women before and after the closure of a coal-fired power plant that contributed greatly to air pollution in the area. In the group examined while the plant still was in operation, high PAH levels were associated with adverse effects on fetal and child growth and child cognitive development. In the groups studied after the closure of the plant, however, no association was seen between cord PAH-DNA adduct levels, which were much lower than in the previously studied group, and adverse effects on growth or cognitive development. Dr. Perera noted that the findings from this study informed the development of new policies in New York and were presented to both the scientific community and the public in Poland.

### **Children's Environmental Health at the World Health Organization (WHO)**

*Ruth Etzel, WHO*

Dr. Etzel began her presentation by paying tribute to the work of Dr. Jenny Pronczuk de Garbino, who died less than a month before the meeting and had launched many of the children's environmental health initiatives at WHO. WHO activities related to children's environmental health include a training package for health care providers, the development of standardized forms for pediatric environmental health history taking, research on children's environmental health indicators, extensive international collaborative research, and the creation of five WHO Collaborating Centers on Children's Environmental Health, with more to be launched in the future.

Dr. Etzel said that WHO's principal role is as a change agent, helping to move from knowledge to action on a national level. For example, WHO has teamed with partners to convince countries to phase out leaded gasoline. WHO also has worked with research groups to incorporate environmental health measures into longitudinal studies and to try to promote harmonization in the variables measured in these studies.

Dr. Etzel invited the meeting attendees to become involved in WHO activities. She said that WHO does not have enough experts; fewer than 100 people at WHO are working full time on environmental health. WHO needs outside researchers to write and review reports, serve on expert committees, teach and speak. The organization can accommodate short-term, on-site assignments and provide sabbatical opportunities. WHO is especially interested in soliciting the help of outside scientists in developing an inventory of scientific expertise and of the ways in which individual scientists would be willing to work with the organization. She noted that WHO would like to tap the knowledge, expertise and caring of the attendees at this meeting to help children around the world.

### *Discussion*

Dr. Rubin closed the session by expressing appreciation for Dr. Etzel's invitation. He noted that sharing and communicating with other parts of the world enriches everyone. The stories told by each of the researchers and teachers in this session, he continued, have shown not only what their specific projects have accomplished but also indicated how the world has been improved by their efforts.

**SESSION 6: SOCIAL AND COMMUNITY CONTEXT FOR UNDERSTANDING CHILDREN'S ENVIRONMENTAL HEALTH OUTCOMES**

*Moderator: Marie Lynn Miranda, Duke University*

Dr. Miranda explained that this session grew out of the idea that the social context in which environmental exposures occur is important. It is one thing to be exposed to high levels of PM and another to be exposed to these levels while simultaneously experiencing other stressors such as inadequate housing and community violence. In many instances, multiple stressors are present in the same population. Understanding what happens in such situations is important in terms of setting priorities for research, outreach, translation and interventions.

**Contextual Stress and Physical Environmental Toxins Linked to Urban Childhood Asthma: Independent and Synergistic Effects**

*Rosalind J. Wright, Channing Laboratory, Harvard Medical School*

Dr. Wright began by emphasizing that it is time to move toward incorporating social determinants into children's environmental health in a serious manner. Known factors, such as genes and environmental exposures, explain only a portion of the disparities in disease occurrence among populations. Social factors may be important explanatory factors, and they should be examined rigorously.

She noted that neuroendocrine-immune interactions provide a link between the mind and the lung. Stress can be linked to clinical manifestations in the respiratory system. For example, in a study in which caregivers of young children were asked a single question about their stress levels (how unpredictable they thought their lives had been), high caregiver stress levels were significantly associated with repeated wheeze (a marker for future development of asthma) in their young children.

Dr. Wright stated that a global indicator of stress is not sufficient to make interventions possible. It is necessary to determine the sources of stress. In inner-city communities, important stress domains include financial strain, racism/discrimination, interpersonal violence, community violence and other negative life events (many of which are related to housing, such as disputes with landlords and fear of eviction).

Dr. Wright and her colleagues have focused on trauma because it is a high-impact stressor. They have prospectively examined maternal trauma history, including whether the mother experienced post-traumatic stress disorder or depression as a result of the traumatic event, and its effects on the child's regulatory systems. One mechanism by which stress during pregnancy may affect the fetus is through endocrine disruption, particularly involving cortisol. Saliva analyses indicate that patterns of maternal daily cortisol levels differ between highly stressed mothers and others. An atypical cortisol trajectory during pregnancy may program the child for disruptive diseases of the immune system such as asthma. Another possible mechanism involves changes in the way that the mother interacts with the child after birth. Poor caregiving quality could disrupt regulatory systems in the child and increase disease risk. In a pilot project, it was shown that infants born to mothers with a history of traumatic events were slower to recover from a stressful situation (having the mother stop responding to the infant during play) and more likely to hyperventilate when exposed to this stressor.

She reported that, in another investigation, it was found that repeated wheeze by age 2 years (a marker for future asthma risk) was significantly more common in children who were exposed to both higher levels of an air pollutant (black carbon) and higher community violence but not to those who were exposed to only one of these factors. This finding emphasizes the importance of including social and community factors in children's environmental health studies. If these factors are not taken into account, important effects could be missed.

*Discussion*

A participant asked whether Dr. Wright had included chronic stresses such as financial stresses in her studies. Dr. Wright replied that chronic stress is important to measure, and all of the stressor domains she mentioned can be perceived as chronic because they usually affect inner-city families on a long-term basis.

**Air Pollution and Resource Deprivation: Lessons From Mouse Models**

*Richard Auten, Department of Pediatrics, School of Medicine, Duke University*

Dr. Auten described animal research that is aimed at improving understanding of how environmental factors—along with host and social factors—affect child health outcomes. Most past toxicologic studies in animal models have examined a single agent and relatively simple exposures, an approach that provides high precision but low relevance. In contrast, epidemiologic studies have examined multiple exposures, yielding high relevance but low precision. A balance between relevance and precision is needed.

Dr. Auten stated that the use of animal models involves some tradeoffs. In mice, much neurological and lung development occurs postnatally, and there is a Th2 bias in allergic asthma. In humans, most neurological and lung development is prenatal, and human asthma involves mixed Th responses. In addition, the mouse airway and human airway are organized differently, and the reasons for airway hyperreactivity may differ between the two species. The advantages of mouse models are the opportunities that they provide to use defined exposures, study the animals throughout their entire lifespan and conduct multigenerational studies of epigenetic factors.

He noted that a study recently was conducted in which mice from a strain with average ozone susceptibility were exposed to industrial particles during pregnancy, after which the offspring were exposed to ozone at levels similar to those in Mexico City. Outcomes, such as changes in cytokines and lung inflammatory responses, were more detrimental in animals exposed to both the prenatal and postnatal insults than in those exposed to either one alone. When the test was repeated with a more environmentally relevant exposure—inhaleation of diesel particles at levels of exposure similar to those on U.S. roadways—again the double exposure had stronger effects. Persistent effects on lung function but not lung structure were observed, and preliminary findings indicated that the nervous system primarily was responsible for the observed airway hyperresponsiveness.

Dr. Auten added that, in another experiment, a third factor—resource deprivation—was added to the system by limiting the amount of nesting material available to the dams. When nesting material is inadequate, dams spend more time away from the pups, which is a source of stress to the pups. When this stressor was added to the exposures to air pollutants, differences in pup body weight were observed, and mortality rates were high. Further studies with lesser degrees of stress will be needed to identify effects on lung function and neurocognitive effects.

*Discussion*

A participant asked whether enriched environments might modulate the response to environmental exposures. Dr. Auten replied that this topic was being investigated in a pilot study.

**Why Doctors Need Lawyers: Cases From the Seattle Medical-Legal Partnership for Children**

*Scott Crain, Medical-Legal Partnership of Seattle*

Mr. Crain explained that in 2008, a medical-legal partnership (MLP) was initiated in Seattle. The goal of an MLP is to improve health by addressing legal problems or through advocacy. In vulnerable populations that experience health disparities, many people may have problems that affect their health and that can be addressed through the legal system. Examples of such problems include poor housing quality, food insecurity and decreased access to resources because of factors such as language or cultural barriers, geographical barriers, inadequate health insurance or lack of benefits.

Mr. Crain continued that a social history of a patient or family should be more than an inventory of personal health behaviors. It also should include unmet legal needs. In one survey of low-income families, 93 percent had at least one unmet legal need, and the average number of unmet legal needs was 5.6. Many of these needs were related to housing. For example, in one instance, the family of a child with poorly controlled asthma was living in very unstable housing and was unable to be added to a list for better housing because the parent had a 5-year-old history of a criminal conviction; a lawyer was able to help solve this problem and get the family on a housing list. In another instance, an asthmatic child was living in rodent-infested housing and also was allergic to dust mite allergen. Through advocacy, changes were made in the system that had classified the rodent-infested housing as acceptable, and arrangements were made to have the state Medicaid agency pay for hypoallergenic bed covers to reduce dust mite exposure for this child and others.

He noted that pediatricians and other health care providers can help to break the link between poverty and poor health by screening and prioritizing basic unmet needs and by helping families to seek appropriate resources. Consultation with an MLP can help. Social factors influencing child health can be addressed through protection of legal rights. If families are asked about basic needs, they will talk about them. If unmet basic needs are identified, providers can help families by mobilizing legal resources and making referrals. Mr. Crain offered the mnemonic “I HELP” as a guide for screening for legal needs. Each of the letters refers to an area in which families may need legal support, as follows:

- I      Income supports (public benefits, food stamps, health insurance)
- H      Housing and utilities
- E      Education and child care
- L      Legal (immigrant) status
- P      Personal and family stability

*Discussion*

Dr. Wright asked whether Mr. Crain was measuring family stress in the people who seek help through his MLP. Mr. Crain responded that it was difficult to do this because lawyers must maintain confidentiality. Outcomes are assessed primarily by having a social worker interview families after a lawyer has worked with them. Some responses can be demonstrated, but assessing stress is a challenge.

Dr. Paulson expressed support for the MLP concept, saying that having a lawyer available is as important as having medical specialists to whom patients can be referred. In community-oriented research, if it is possible to involve an MLP without compromising research goals, it is valuable to do so.



### **Is Diet Driving the Asthma Epidemic?**

*Gregory Diette, Johns Hopkins Center for Childhood Asthma in the Urban Environment*

Dr. Diette presented a profile of an inner-city boy with asthma, along with data showing that asthma prevalence in the United States started to increase in the mid-1970s. Something must have happened at around that time to affect asthma risk, but the nature of that factor or factors has not been established. There has been no sudden change in infestations with mice or roaches in inner-city housing since the 1970s. Cigarette smoking has decreased. Outdoor air quality has improved since 1976. Therefore, it seems likely that something else is responsible.

Dr. Diette noted that one factor that did start to increase at the same time that the prevalence of asthma increased is the prevalence of obesity. Either or both of these trends might be related to changes in diet that began at the same time, including increased consumption of foods derived from corn and increased consumption of "industrial" food. The food system has changed. Cattle now are raised in concentrated conditions and fed grain instead of grass. Consumption of corn products has increased threefold. Consumption of milk has decreased, and consumption of soft drinks has increased. Americans are eating more beef and chicken, and the diets of the cattle and chickens also have changed.

Dr. Diette said that it can be hypothesized that the consumption of corn is relevant to asthma because corn oil contains the n-6 polyunsaturated fatty acid linoleic acid, which promotes the synthesis of leukotrienes that could affect asthma. Dietary patterns also may be important. A Mediterranean-type diet, which has olive oil as the main fat source and is rich in antioxidants, whole grains, fruits and vegetables, protects against asthma and allergy in preschool children, perhaps by decreasing systemic inflammation.

Dietary patterns in urban African Americans, such as the boy that Dr. Diette profiled above, include substantially less than the recommended amounts of fruits and vegetables, very high meat intakes, and few nuts or legumes. When compared to the diets of white Americans, those of African Americans are skewed away from the "healthy" diet pattern. These dietary trends may be contributing to both asthma and obesity.

Dr. Diette reported that he and his colleagues are planning studies of how diet modifies the response to inhaled allergens and pollutants. Their research will include an observational study of children and two experimental trials, one in an animal model and one in humans, to determine whether dietary modifications can attenuate asthma responses.

#### *Discussion*

A participant asked Dr. Diette to comment on the increase in peanut allergies. Dr. Diette said that he had little information on this subject.

Dr. Whyatt asked Dr. Diette what tool he was using to assess dietary patterns. Dr. Diette explained that he used a validated food frequency questionnaire for the local diet, which was developed by an expert on developing custom dietary questionnaires.

A participant asked whether energy intake or dietary quality was more important. Dr. Diette said that some researchers are investigating the link between obesity and asthma, and energy intake may play a role. He believes, however, that it is likely that poor dietary quality is a risk factor for both obesity and asthma. The questioner then asked whether any data were available on diet and health in the first half of the 20th century. Dr. Diette said that there are questions about the quality of data from that period, but the evidence indicates that asthma was decreasing, at least in terms of mortality.

A participant commented that in primates, structural changes in lung development can be observed in response to prenatal and perinatal exposures to house dust mites. In humans, lung function tracks from infancy to adulthood. Some of the chemicals of interest to the participants in this meeting—such as phthalates, PCBs and dioxin—could impact lung development because they affect branching morphogenesis or alveolization. Dr. Auten replied that one of the problems in studying such relationships is that it is difficult to assess lung growth noninvasively. In animal studies, some changes have been observed, including modifications in the intensity of afferent innervations, but these changes are subtle, and it is not clear whether they are related to wheezing.

An attendee commented that the effects of lead on the hypothalamic pituitary axis (HPA) mirror the stress response in mice. Some of the same effects may occur with other environmental exposures. Dr. Wright responded that evidence suggests that air pollution affects the HPA as well. More will be understood when multiple exposures are examined together over the full life course. It is important to start thinking in terms of the life course to appreciate the full scope and impact of these effects.

Another participant commented that people and the animals that they eat have been consuming more corn and soy since the 1980s, and the corn and soy that they eat have changed. Most corn and soy now are genetically engineered. Dr. Diette replied that although he has not seen any data specifically related to genetic engineering, this topic draws attention to the complexity of the food system. A pound of chicken is not just chicken; what the chicken ate, including genetically engineered feed, and whether it was exposed to pesticides, antibiotics or other substances also may be relevant.

### **Wednesday, October 20, 2010**

#### **SESSION 7/8: RECAP OF THE PREVIOUS DAY**

*Dr. Grevatt, OCHP, EPA*

Dr. Grevatt began by announcing that EPA Administrator Jackson was unable to participate in the meeting because she had been called away to another responsibility. If Administrator Jackson had been present, she would have wanted to emphasize the seven priorities that she has set for the Agency and how important children's health is to each of those priorities. She would have emphasized to the basic scientists and clinicians attending this meeting that the achievements of EPA and its partner agencies are built on the foundation of the work that they have done. There would have been no reason to remove lead from gasoline, for example, if clinicians had not observed health effects and researchers had not established their cause. The same principle applies to ozone, PM, drinking water contaminants and other pollutants. Every significant advance that EPA makes depends on the scientific and health care provider communities. The Administrator would have emphasized environmental justice and the burden that faces underserved populations in the United States and around the world, along with the recognition that children often are the most vulnerable segment of an underserved population.

Dr. Grevatt explained that, in the absence of the Administrator, this session would be devoted to a recap of the previous day, followed by an opportunity for participants to express their views on key issues.

The previous day's session included extensive discussion of chemical exposures and TSCA. Key principles, all of which relate to children's health, included the following:

- Chemicals need to be reviewed against a science-based safety standard.
- Manufacturers should provide EPA with the necessary information to prove that chemicals are safe.

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- Risk management decisions should take into account sensitive subpopulations and available alternatives; EPA needs to have the authority to take action when chemicals do not meet a standard but also needs flexibility.
- Chemicals should be acted on in a timely manner.
- Attention should be paid to the principles of green chemistry.
- EPA should be given a stable source of funding for implementation.

Dr. Grevatt said that he was struck by information presented on the previous day indicating that large numbers of children have chronic health problems. The data on the number of participants in the NCS who are expected to have obesity, asthma or other conditions—and the rising trends in pediatric cancers, asthma and neurodevelopmental disorders—all indicate that much work remains to be done. Most of the diseases discussed during the previous day's presentations are multifactorial, but they have environmental components.

Another topic emphasized on the previous day was the importance of finding effective methods to communicate to populations. Much was heard from clinicians about the challenges they face every day in communicating complex messages to the public about how to protect their children.

Dr. Grevatt described two groups that he thought might be unfamiliar to some attendees:

- The Children's Health Protection Advisory Committee is one of EPA's official advisory committees, and its activities fall under the Federal Advisory Committee Act, which ensures transparency and objectivity. Dr. Grevatt was overseeing this committee at the time of this meeting, and several attendees at this meeting served on it. The committee provides advice to the Administrator about critical children's environmental health issues. For example, the committee has examined the Children's Centers program and the PEHSUs and was providing critical reviews of the opportunities and challenges that they face. In both instances, the reviews were very positive. The committee recently had been involved in providing recommendations to EPA on the development of school-siting guidelines. The committee also has provided guidance on important regulatory actions such as those pertaining to ozone.
- EPA and HHS were co-chairing an interagency task force that touches on everything in the federal government that relates to children's health. This task force was reinvigorated during the year before the meeting and at the time of the meeting was identifying priority issues for agencies to address, including asthma disparities, chemical exposures and settings where children spend time.

Dr. Grevatt asked attendees for their input on the ways in which these groups could be used to greatest advantage and the areas in which they should focus their efforts.

*Discussion*

Dr. Whyatt raised a health disparity issue related to the pesticide chlorpyrifos. At the time of this meeting, EPA's Office of Pesticide Programs (OPP) was in the process of reevaluating this pesticide, which was taken off the residential market some years before but still was being used in agriculture. Because of the way in which the statutes were written, the exposure of pregnant farmworkers to this pesticide is regulated under the occupational part of the Federal Insecticide, Fungicide, and Rodenticide Act, even though these women are just as much at risk when at work as they would be in the home setting.

Dr. Whyatt stated that pregnant farmworkers deserve as much protection as anyone else, but they are not receiving it. She asked whether there was anything that Dr. Grevatt or Administrator Jackson could do about this situation. Dr. Grevatt replied that one of the things the Agency is doing, through OPP, is

examining worker protection standards. There are issues pertaining to children who can work legally in the fields, pregnant women and children who are in the fields because their parents may not be comfortable with other child care options. Migrant farmworkers present an additional challenge. A family may be in one area for 3 months out of the year and then move on to another area. Trying to manage outreach and education in such situations is extremely challenging. Dr. Whyatt commented that the regulatory issue regarding chlorpyrifos was being decided at that time; if the issue was to be addressed, that was the time to do so.

A participant said that on the previous day the Consumer Product Safety Commission (CPSC) had released new limits on cadmium intake from children's products. She expressed concern that this had happened without any outside stakeholder input. She asked: (1) how coordination between agencies and with stakeholders can be ensured; and (2) if, as Dr. Grevatt had remarked in passing, "cadmium is the next lead," what is the next cadmium, and how will it be possible to move beyond the "flavor of the month" approach to toxic substances? Dr. Grevatt said that he could not comment on CPSC outreach to stakeholders. Concern about contamination in imported products is an issue across the federal government. In terms of what could come after cadmium, that question will not be answered until the CPSC becomes aware of additional problems by examining imported goods.

An EPA staff member commented that under the proposed policy that OPP is working to implement, pregnant women will be treated in the same manner whether they are working in the fields, eating an apple or treating their lawns. Public comments on this topic were being addressed at that time, and implementation was to be phased in soon thereafter. Dr. Whyatt agreed that the public comment period was important but stated that strong pushback is likely with this particular issue and that she hoped that Administrator Jackson is aware of it. The EPA staff member said that Administrator Jackson appreciated the "One EPA" concept and understood that this was not just an OPP issue.

Dr. Wright raised the issue of asthma disparities and said that she is increasingly convinced of the need to take a multipronged approach to reducing asthma. Because increasing evidence indicates that stress plays a role in vulnerability, social intervention is needed, in addition to environmental cleanup. A socially enriched environment protects children from the adverse effects of lead, and the same type of relationship may exist for asthma. Although EPA cannot eliminate poverty, there may be ways to intervene at the family or neighborhood level. If a multipronged approach is not taken, she continued, disparities will persist and widen. Dr. Grevatt said that within the context of the task force, everyone identified health disparities in asthma as an area on which to focus. EPA has not been tasked with managing stress, but other departments do address those sorts of issues.

Dr. Miranda commented that the research community has been talking for years about the social context of environmental exposures. The task force provides a timely opportunity for thinking about creating environments in which all children can prosper, without limiting the discussion to chemical exposures. Dr. Grevatt responded that the budget context is an added challenge because the amount of money directed toward the task force is limited. He suggested that, when agencies are working within communities, they should look for opportunities to complement the task force's work.

A participant asked about EPA's interest in tobacco smoke. Dr. Grevatt replied that within the Healthy Homes Program context and when working with other agencies, ETS is a major issue that stands out in terms of its impact on asthma and other health outcomes. EPA has worked on understanding the risks associated with ETS exposure but does not regulate ETS. If EPA addresses the issues over which it has authority and other agencies fail to address tobacco-related issues, the results in terms of health outcomes will be less than ideal. Dr. Grevatt noted that part of the Healthy Homes Program context is how a home is constructed, but another part is the behaviors that people exercise in the home.

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A participant commented that social context is critical in the Healthy Homes initiative. When involved in collaborative efforts, it is important to remember that there are systems in place in communities, such as community clinic programs. It is important to promote collaborations that involve these clinics and other networks, such as the PEHSUs. Dr. Grevatt added that having clinic programs be as robust as possible also is addressed in health care legislation.

Another attendee commented that in the occupational world, Occupational Safety and Health Administration (OSHA) standards provide a clear framework for dealing with industrial point sources. In the environmental world, there is no such clear framework, and it is hard to translate data into health messages. Even if more data were available, reference values are needed. OSHA values do not apply to children or to a 24/7 exposure pattern.

An attendee from EPA Region 8 said that she hoped that TSCA will address some problems encountered in her region, including health problems resulting from “green” products. She cited a case in which green insulation emitted chemicals that made a child sick. The product was banned in Canada and carried labeling indicating that it could cause respiratory issues. The concept of green addresses the carbon footprint, not necessarily health. She expressed the view that the green label should be more closely married to the concept of a healthy home. Dr. Grevatt agreed that labeling is driven by marketing and may not necessarily lead the consumer to the healthiest choice. This issue is being addressed across the federal government. The goal is to enhance the ability of people to choose the safest products. Problems with green products are not limited to insulation; issues also have arisen with other building products.

A participant asked for an update on TSCA reform. Dr. Grevatt said that he did not have the authority to explain where it might go. He noted, however, that the Obama Administration, not just EPA, has developed the principles for TSCA reform.

Dr. Darney said that ORD has considered creating a new program that would integrate science into a sustainable community. This requires examining nonregulatory policies as well as regulation. Science can be brought to bear on such topics as dietary interventions, the use of safe building materials and time to exercise in the school setting. Dr. Darney asked how scientists inside and outside of EPA could bring science to bear on nonregulatory decisions. Dr. Grevatt replied that part of what scientists can do is to provide research and information to others who are making decisions—whether at the local, county or state level. Communication of research findings is important, even when EPA does not have regulatory authority. School-siting guidelines and school environmental health guidelines, for example, will be voluntary. At the local level, New York City banned smoking in bars, based in part on science-based information from EPA. This is an example of how EPA research can lead to healthy choices at the local level.

Dr. Grevatt concluded the session by thanking the attendees for participating in the morning’s discussion.

**SESSION 9: CONCURRENT BREAKOUT SESSIONS: OPPORTUNITIES FOR COLLABORATION**

The meeting continued with attendees participating in four concurrent breakout sessions on the topics of Training the Pipeline; Role of Science in Children’s Environmental Health Protection; Health Disparities; Using the National Plan for Action To Think About Childhood Asthma; and Community Outreach and Translation.

### **Training the Pipeline**

*Discussants: Mark Miller, UC San Francisco PEHSU; and Catherine Karr, Northwest PEHSU at the University of Washington*

This breakout session was held to discuss mechanisms to ensure that training opportunities are available and can be increased for the next generation of children's environmental health and medicine specialists. The participants recognized that it is necessary to ensure that there is future expertise in children's environmental health in industry, academia and government.

Fellowships in pediatric environmental health used to be sponsored by the academic pediatric association, but as this 5-year grant program was discontinued, attendees noted that no sustained pediatric environmental health fellowship was available at the time of the meeting.

Participants pointed out that T32 Institutional National Research Service Award programs at Harvard University and Mount Sinai School of Medicine have engaged clinicians and postdoctoral fellows in environmental health. The George Washington University created a new environmental health track in its medical school, and numerous informal electives or practicums were available at the time of this meeting, as well as guest lectures by PEHSUs, at public health programs.

Nursing has not been a major focus of PEHSUs, and no PEHSUs are located at nursing schools, but doctoral-level nurses have a pipeline as well and have more training in developing studies and evaluations than doctors of medicine. It was suggested that perhaps those who lead research efforts at institutions could reach out to nursing schools to inform doctoral-level nurses of available opportunities.

Other options for training the children's environmental health pipeline and further points raised in discussion included the following:

- Senior faculty at institutions should help this new pipeline develop. Additionally, universities should link to government, and the two should work together.
- Brown University has a graduate program in cancer, immunology and environmental health in which students can focus on one area. This gives the students time to develop an area of special interest, and many go on to postdoctoral fellowships in environmental health.
- Any nursing school offering a doctoral degree could publicize postdoctoral opportunities.
- Opportunities could be created for new graduates, such as postdoctoral programs, new faculty positions or junior researcher positions.
- It would be useful to hold discussions with those who create academic curricula because more exposure to the topic is needed.
- One model is to incorporate environmental health training into every department in medical schools.
- Another option being attempted is teaching environmental medicine in the rotations through occupational medicine and pediatric medicine.
- In nursing school, adding a semester course or even a few lectures on environmental health creates awareness of the subject and the field.

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- CDC's Epidemiology Intelligence Service (EIS) offers hands-on training by assigning public health or medically trained professionals to public health departments or programs providing 2 years of real-life public health practice. Perhaps a PEHSU could be a home for EIS officer experience.
- Through the Intergovernmental Personnel Act, government employees can work at a university for a year and be paid by their agency, similar to a sabbatical from a university.
- The American Association of Medical Colleges annual meeting curriculum would provide an opportunity to educate medical educators about children's environmental health.
- Formalizing, packaging and marketing opportunities for children's environmental health training are essential.
- Finding applicants for funded fellowships is not difficult. It may be possible to work with large funding agencies such as the Doris Duke Charitable Foundation and Howard Hughes Medical Institute because the study of epigenetics lends credibility to the subject matter.
- Scholarly concentration programs, in which students are encouraged to engage in cross-disciplinary research, are being developed in some schools. This is similar to having a major in medical school, and mentoring opportunities are available. Nursing schools do not have time to add concentrations to their programs except at the graduate school level.
- More outreach is needed to family medicine and obstetrics/gynecology about pediatric environmental health. Pediatric environmental health exhibits could be displayed at these groups' conferences.
- A recommendation was made to compile a list of training opportunities to post on the PEHSU website. Also, to keep trainees engaged after a training experience, it was proposed that a listserv be hosted so that members of the profession could network.
- The American Medical Student Association could be an excellent source for funding, as the association has an environmental group.
- The George Washington University has a track system for supplemental education for medical students, and there is an environmental health track. Students in each of the tracks must have a summer experience relevant to their track.
- Case studies that fit within the public health curriculum could be developed.
- Board certification in pediatric environmental health might be necessary to give the discipline credibility.

In summary:

The primary themes discussed included:

1. The need to reach new audiences.
2. At the middle level of training, having scholarly concentration blocks in residencies and extending that to family medicine.

3. Creating postdoctoral opportunities linked to government and industry.
4. The need for board certification of the specialty to provide an incentive for all types of training.
5. The need to formalize and publish a catalog of available training opportunities and establish a listserv for the pipeline.

**Role of Science in Children's Environmental Health Protection**

*Session Leader: Amy Kyle, UC Berkeley School of Public Health*

*Discussant: Cynthia Pellegrini, American Academy of Pediatrics (AAP)*

The breakout session participants discussed several common interests related to the relationship between science and policy in children's environmental health and the role of the Children's Centers and the PEHSUs. Participants recognized that although science has linked agents such as substandard housing and lack of access to medical care to effects on children's health, these problems remain, indicating a disconnect between the work scientists are performing and translation into effective policy. Attendees asserted that it is evident that policy decisions are made by people who have no scientific background. The PEHSUs and Children's Centers need to do a better job of informing each other of what research they are conducting to better inform policy. Session participants recommended staffing PEHSUs with obstetricians, developing a system to track reported health effects related to exposure to chronic hazards such as lead, improving the collection of biomonitoring data to confirm exposures, and having EPA take the lead in addressing green product labeling as a means of improving the health of unregulated indoor environments.

Dr. Pellegrini noted that policy-makers often need scientific information but do not know where to get it. Their job is to synthesize all of the information they receive from their constituents, consumers, corporations, advocacy organizations and other stakeholders and weigh that information against political considerations to take a position on an issue that makes the most sense at a given point in time. In her work as a lobbyist on Capitol Hill, Dr. Pellegrini noted that it is very rare for scientists to engage in this process. She noted that policy-makers often do not have the time to seek out scientific information. They need scientists to meet with them on an individual level and explain the science in terms that they will understand. Scientists also should explain the relevance of the science in terms not only of how constituents will be affected but also the numbers of individuals at risk, their locations and the length of time that negative effects may be noted. She suggested that other ways to reach and form relationships with policy-makers include attending caucuses, joining organizations or consulting hospital administrators, local universities, county health departments and EPA regional offices.

Participants agreed that policy-makers tend to prefer addressing issues that are simple, clear and for which there is consensus. They prefer to avoid dealing with the complex, ambiguous and controversial issues that commonly are raised by scientific research. Advocacy groups tend to pitch science even though they are unqualified to do so. Their information is easy for policy-makers to use as it is declarative and unqualified. Information provided by scientists is disadvantaged by scientists' need to remain objective and their fear of losing their integrity. It was suggested that scientists not tell policy-makers what decision they should make and present the same information to parties on both sides of an issue. Policy-makers should view scientists as resources for pertinent scientific information on which they can depend. Scientists also should inform their associated universities of their plans to interact with elected officials so that university government relations offices can help coordinate the communication process. The participants agreed that a webinar should be developed on how scientists should approach policy-makers.

Participants also suggested that the Children's Centers and PEHSUs could make an effort to collaborate on particular issues of concern when informing policy decisions. It was suggested that they start with



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topics addressed by the PEHSU fact sheets that provide advice on how children's health can be protected in the context of recent developments such as the Gulf of Mexico oil spill. Issues could arise with utilizing the fact sheets for these purposes as they are federally funded, with the exception of those endorsed by AAP.

Participants were frustrated by their lack of insight regarding upcoming opportunities for policy input such as comment periods. It was suggested that a "policy surveillance system" be put in place to track pending legislation. A committee could be formed and trained on how to identify key regulatory issues that affect children, and this information could be sent to a distribution list of contacts in the PEHSUs/Children's Centers. Members could then volunteer or be assigned to write comments. EPA's Children's Health Protection Advisory Committee already meets regularly to issue statements to the Administrator on issues of developing concern to children's health. Another idea was to collaborate with the Children's Environmental Health Network or other professional organizations that regularly track legislation such as nurses' associations or the AAP.

**Health Disparities: Using the National Plan for Action To Think About Childhood Asthma**

*Moderator: Martha Berger, OCHP, EPA*

*Discussants: Rochelle Rollins, Office of Minority Health (OMH), HHS; Sally Darney, ORD, EPA*

This breakout session focused on a review by Dr. Rollins of the National Plan for Action (NPA) and its relationship to the children's environmental health community, followed by comments from Dr. Darney and discussion by the group.

The NPA, which at the time of this meeting was expected to be launched by the end of 2010 by Secretary of Health and Human Services Kathleen Sibelius, EPA Administrator Jackson, and other top-level federal officials, is a comprehensive federal strategy targeted at eliminating health disparities through increased partnership, coordination, program implementation and leadership. Through this Plan, 12 federal departments will be collaborating to end health disparities.

Dr. Rollins explained that the HHS OMH, with which she is affiliated, is a policy office, with a large portfolio of grants and cooperative agreements. The mission of the OMH is to improve the health of racial and ethnic minority populations through the development of health policies and programs that will help to eliminate health disparities. The main office is located in Rockville, Maryland, but there are regional minority health consultants across the HHS/EPA regions.

Dr. Rollins noted that, for the past 20 years or more, the OMH has been funding projects using an issues-based approach; grants were given to try to end disparities by topic area. Under the NPA, the OMH will focus on a systems approach in grant making and policy activities. Much work has been done in the past 2 years to align the proposed work with the government's primary health tracking tool, Healthy People.

The mission of the NPA is to increase the effectiveness of programs that target the elimination of health disparities through the coordination of partners, leaders and stakeholders committed to action. A 200-page plan was developed and is the document that was to be launched later in 2010. Ten regional blueprints also were being developed, along with a variety of initiatives and campaigns. Two examples of these initiatives are a national business group on health that will bring large employers together to understand and address health disparities. Another initiative involves state legislators working together.

NPA's five objectives are to increase awareness of the significance of health disparities; strengthen and broaden leadership; improve the health system and life experience; improve cultural and linguistic competency; and improve data availability and the coordination, utilization and diffusion of research and evaluation outcomes. NPA will be aligning some critical "stars," including the new HHS minority health

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infrastructure; the hunger for federal collaboration and visioning; action at multiple levels (regional, state and others); the national plan and regional and tribal blueprints; and the focus in Healthy People 2020 on social determinants of health. For Healthy People 2020 and the NPA, it was necessary to create national definitions of “health disparity” and “health equity.” With input from EPA, a mention of a clean environment was added to the health disparity definition, as follows (the language added at EPA’s suggestion is italicized here for emphasis):

A particular type of health difference that is closely linked with social or economic disadvantage. Health disparities adversely affect groups of people who have systemically experienced greater social or economic obstacles to health *and/or a clean environment* based on their racial or ethnic group, religion, socioeconomic status, gender, age, mental health, cognitive, sensory, or physical disability, sexual orientation, geographic location, or other characteristics historically linked to discrimination or exclusion.

The definition of health equity is broader and includes health disparities:

Health equity is attainment of the highest level of health for all people. Achieving health equity requires valuing everyone equally, with focused and ongoing societal efforts to address avoidable inequalities, historical and contemporary injustices, and the elimination of health and healthcare disparities.

Dr. Rollins explained that social determinants of health will be a major part of Healthy People 2020 (<http://www.healthypeople.gov/2020/default.aspx>), which will devote attention to the physical and built environment and to healthy versus unhealthy communities.

At the time of the meeting, the next steps for the NPA were the official launch and implementation of coalitions. Contractors were hired to provide logistic, communication and evaluation support, and funding was in place for coalitions to come together for meetings. It is expected that the NPA will become the flagship activity for disparities, just as Healthy People is the flagship for prevention.

Dr. Darney explained how EPA’s ORD will tie in with the NPA. ORD is realigning all of its programs to integrate them with the Administrator’s seven goals. Children’s health cuts across most of these goals. In the past, the focus at EPA was on ensuring the safety of chemicals; the new focus going forward will be on working for a clean environment and clean communities, which involves going beyond the Agency’s regulatory mandate and taking a holistic view that is not just reactive but proactive. ORD is hoping to launch centers of excellence on health disparities and on the environmental justice theme.

Dr. Darney explained that ORD has launched a website called the Asthma Science Notebook. Public affairs staff members and those from the Office of Air and Radiation, as well as ORD scientists, cooperated in its development. This type of outreach program fits in well with the goals of the NPA.

A participant asked Dr. Berger to clarify the nature of regional health coalitions. Dr. Berger said that the regional coalitions are groups of leaders from the regions who come together to examine policies and programs. Different states and different sectors—such as the business sector, EPA and others—are involved. The purpose is to have multisector leaders working on health equity for a report to Congress. There is room on these regional coalitions for experts on children’s environmental health; their expertise is needed. Dr. Rollins added that later on, there also will be opportunities to work at the state level as well as the regional level.

A participant said that she knew of community members who could have much to contribute to the regional coalitions, but that there would be a linguistic barrier to be addressed. Dr. Rollins replied that

both community representatives and children's environmental health experts are needed on all of the boards and that it was the time to identify suitable people.

A participant suggested the possibility of creating a volunteer group that could be involved with action and education in communities, such as "train the trainer" programs. Dr. Rollins replied that when community-level boards are initiated, this idea could be implemented.

Several participants brought up mold as an equity issue. Industrial hygienists have been giving much attention to mold exposure in the workplace, but the same principles apply in residential settings. There have been lawsuits against landlords regarding mold cleanup. This was suggested as a good area for an MLP. A participant said that the MLP has been a great success in Region 9. There is a law on the books in California about mold that never has been enforced. It could be applied if sufficient funding can be obtained to pay lawyers. Another participant noted that one power of an MLP is its ability to write better letters to help improve housing quality or relocate families. MLPs are considered effective tools for use in addressing housing issues.

A participant noted that many federal groups are working across agencies to address children's health, neighborhood stabilization, the well-being of women and girls, and other cross-cutting issues. She asked whether any attempt is being made to create a collaboration of collaborations. Dr. Rollins said that such efforts are being made. A participant noted that coordination of funding also is important, especially because most actions are local. Dr. Rollins agreed and noted that "breaking down silos" is a major priority.

A participant raised the issue of funding for community clinics. Dr. Rollins explained that this is part of the third NPA goal, and arranging for community health workers to be paid also is part of this goal. Dr. Berger added that the PEHSU community is linking with community health workers to provide clinics with expertise on the environmental precursors of disease. Another participant added that nurses could add value by going out into the community. Public health nursing models include environmental health and other social determinants of health.

A participant asked who will take leadership in the regional coalitions. Dr. Rollins said that the co-chairs for each board would be chosen by that board. Recruitment for the boards was on hold until the formal launch of the NPA.

Just before the session adjourned, Dr. Berger said that efforts would be made to involve a larger number of environmental health experts in the NPA regional coalitions.

### **Community Outreach and Translation**

*Moderators: Jennifer Lowry, Mid-America PEHSU; Patrice Sutton, UC San Francisco*

*Discussant: Kimberly Gray, Division of Extramural Research and Training, NIEHS, NIH*

Dr. Lowry began the breakout session by explaining the role of the PEHSU program. The program was developed in the late 1990s as a collaboration between the ATSDR and EPA. Originally, there were two PEHSUs, in Boston and Seattle. During the Clinton Administration, the importance of children's environmental health was recognized and, at the time of this meeting, each EPA region had a PEHSU.

Each PEHSU includes a pediatrician and a collaborative arrangement with one of the clinics belonging to the Association of Occupational and Environmental Clinics. PEHSUs assist the community, ATSDR, EPA, the public and health care professionals with pediatric environmental exposure issues. For example, the public and/or health care professionals can call a regional PEHSU to discuss a particular individual's environmental exposure case. The PEHSU pediatrician discusses treatment options with the child's

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attending physician and educates the community about the exposure issues for that area. When medical questions arise during community meetings that ATSDR and EPA attend to discuss environmental exposure issues, the local PEHSU may be called on to discuss the medical effects that may result from those exposures.

In considering translation of research into practice and collaborations between groups to ensure that children's health regarding environmental exposures will be addressed effectively, Dr. Lowry suggested that there are disconnects across not just regions but within institutions themselves. For example, within her own institution, she had recently learned that the U.S. Department of Housing and Urban Development funds an individual for its Healthy Homes Program, which sends industrial hygienists to test air quality, lead content and so forth in homes of children with chronic diseases. The PEHSU and Healthy Homes projects can collaborate to ensure that the specialists in each program address all relevant scientific and medical issues related to a case. This cannot occur unless each organization is cognizant of the presence of the other.

Ms. Sutton presented information on clinical translation challenges and successes involving the University of San Francisco, California's (UCSF's) Community Outreach and Translation Core (COTC) and its From Advancing Science to Ensuring Prevention (FASTEP) Alliance. UCSF's COTC works to translate science by addressing the needs of research participants, community members, the clinical community and policy-makers. The COTC at UCSF is affiliated with FASTER. The purpose of the alliance is to increase the capacity to connect, educate and mobilize networks of professional and lay people, organizations and communities that are affected by the lifecycle of reproductive toxicants. FASTER's objectives are to improve clinical practice, advance public health policy and develop a practical application of an ecological model of health. The alliance addresses the environmental influences on reproductive health (i.e., environmental chemicals, *in utero* programming, genetics, nutrition, the social and built environment, and interactions among the factors). These influences need to be addressed together to shape effective prevention-oriented policy. .

A success of FASTER is its diversity and reach. It partners with clinicians and their professional organizations and health care institutions, academic institutions and governmental and non-governmental organizations. A major challenge it faces in translating science into timely prevention is how to bridge the gap between clinical and environmental health sciences. The scientific evidence linking environmental exposures to adverse child health outcomes has yet to be compiled using systematic methods with the capacity to inform effective healthcare decision-making. The relevant evidence is voluminous, of variable quality and largely unfamiliar to health professionals who also often lack the time and training to incorporate the meaning of the science into their practice. Differences between clinical and environmental health science related to the evidence stream and decision-context prohibit the direct application of existing systematic methodologies in use in the clinical arena. There is currently no trusted, ready reference or compendium that provides healthcare decision makers, including clinicians, patients, institutions, and payers, with timely, evidence-based advice about exposure to environmental contaminants. To bridge this gap, UCSF undertook an interdisciplinary collaboration to develop the *Navigation Guide*, a systematic and transparent methodology to evaluate the quality of evidence and strength of recommendations about the relationship between the environment and reproductive health in uniform, simple, and transparent summaries that integrates the best practices of evaluation in environmental and clinical health sciences. More than 20 scientists and clinicians were involved in this project.

There have been other successes. Leaders in the medical community and their professional organizations such as the American Congress of Obstetricians and Gynecologists have become engaged in environmental health; UCSF's COTC has been integrating environmental health science into obstetrics and gynecology textbooks and in articles in peer-reviewed publications favored by clinicians; and

clinicians are being encouraged to partner with environmental scientists to promote prevention-oriented policies related to harmful environmental exposures.

Dr. Gray told the group that NIEHS is creating a clearinghouse for materials through its Partnerships in Environmental Public Health (PEPH) Program. This umbrella program brings together the grantees funded by NIEHS who conduct community participatory research and offers them a repository for their materials, which are required to meet certain evaluation criteria. Non-NIH researchers can partner with EPA STAR or NIEHS grantees to gain access to the PEPH Resource Center. Materials that meet the evaluation criteria will be launched on the public NIEHS website, including sites for children, teachers and physicians. This is an online database at which researchers can manage their materials, view other people's materials and request partners who may have similar materials. The materials can be sorted by pamphlets, brochures, communities or health topics. The coordinator, Liam O'Fallon ([ofallon@niehs.nih.gov](mailto:ofallon@niehs.nih.gov)), can be contacted for further information.

### *General Discussion*

Participants were asked to address two key questions:

1. How can we leverage our common efforts more broadly?
2. What are concrete opportunities for collaboration now that we know what we are all doing a bit better?

The general discussion was broader ranging and led to the following key points of discussion:

- Clinicians need to be involved in community outreach and translation at a broader level. Although the resistance to collaboration seems overwhelming among clinicians, clinicians should be encouraged to see the importance of such collaboration.
  - Clinicians should be encouraged to recognize the importance of involvement at school and other hearings about hazards.
  - EPA is attempting to educate health care professionals about the need for interaction and collaboration with environmental scientists.
- This is a nationwide issue, but many discussions about environmental concerns are occurring at the individual level (e.g., between PEHSUs and physicians).
- PEHSUs could interact more and sooner at the community level. Communities could be encouraged to go beyond referring family members to PEHSUs for discussion about individual cases, and PEHSUs could be invited to meetings when an environmental issue is first being discussed.
  - A participant from EPA Region 2 suggested that PEHSUs might assist with population-based pediatric environmental health issues and other community-wide environmental health issues.
  - It was noted that a deterrent to this participation is that PEHSUs often are contacted for advice well after initial community discussions have taken place; at that point, interactions are becoming more heated.
- Nurses naturally perform outreach interventions within a community. Visiting nurses could be encouraged to recognize that their assessments could include environmental health assessments.

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Within a medical office, one nurse might become the key environmental health person to communicate with the physician and the community about environmental concerns.

- One participant noted that her group from the University of Maryland Environmental Health Education Center is educating nurses at conferences. The group also is investigating how to add informational modules to electronic health records so that the medical community would have information to pass on to the patient.
- A participant from the Region 1 PEHSU noted that nurses in private practices in the Boston area are contacting the PEHSU to obtain environmental health information via e-mail, the Internet or telephone education sessions. The nurses then disseminate the information to physicians and patients.
- PEHSUs and physicians could coordinate their environmental messages to families to ensure that families receive clear and accurate information and that the messages do not conflict with each other.
- PEHSU “house calls” could include household environment assessments that once were conducted by physicians.
- EPA’s new state grant program could include provisions that would encourage state health departments to better address children’s environmental health issues.
  - A participant from the Healthy Schools Network noted that the Energy Independence and Security Act of 2007 included a provision that established the Healthy High-Performance Schools project with authorization for EPA to address school environments and to provide a state grant program that had not yet been funded.
- Creation of a national advisory group in the pediatric network should be considered to move more community and other environmental issues forward. EPA’s OCHP could serve as an advisory unit and networking source to direct people from different organizations and regions that might have similar environmental issues, thereby preventing duplication of effort.
- PEHSUs have unique talents—match those talents to key issues.
- Provide educational and outreach opportunities in all states that provide high-impact results at low funding levels.
  - Leverage existing resources. In EPA Region 4, a networking group concerned with children’s health issues reviewed agricultural, health and environmental programs and developed an inexpensive educational outreach program for all states in the region.
- Educate high-school and college students about hazardous substances in their environment. School nurses could prepare a unique science program that would encourage students to conduct research and prepare presentations to share with classmates.
  - This is being done in the San Francisco area. For example, one program to enhance student awareness about pesticide and toxic substances was beta tested at a university. The students found the project interesting, enlightening and useful. Such a project would be beneficial at the high-school level as well. By developing such projects, young people may be educated about prenatal

exposures prior to the occurrence of such exposures.

- Educate doctors and nurses while they still are in school by including an environmental health curriculum in their course of study.
  - One EPA staff person teaches a toxicogenomics course to nurses that includes case studies in which the nurses communicate with patients about environmental exposures and their effects.
  - ATSDR Case Studies in Environmental Medicine offer self-instructional, continuing education courses to health care providers about hazardous substances. The program offers complementary Patient Education and Care Instruction Sheets.
- Educate parents using a multifaceted approach—distribute fact sheets on environmental issues at medical offices and clinics. Create PowerPoint presentations, video loops and interactive touch-screen products for waiting rooms of medical offices and clinics. Distribute information via e-mail and include URL links to important websites that contain environmental health information. Adapt the materials to the target audience (e.g., multi-language, culturally sensitive).
  - Engage nurses and physicians in promoting these tools by offering a continuing education module about how to educate patients on environmental risks and exposures.
  - Vida Health Communications has training modules for health care providers and also has a patient education video on prenatal exposures. The pretesting to the public was well received.
  - The McGee Women's Hospital has an environmental health educational video.
- PEHSUs could leverage groups and determine which key partners to approach.
  - Planned Parenthood has started an environmental health outreach program that includes fact sheets on the major environmental exposure issues.
  - Follow the CDC's Healthy Homes strategy that includes multiple agency involvement to develop strategies.
- Pilot test each new program to ensure that it addresses the unique needs of each community.
- Promote NIEHS' new clearinghouse for community outreach.

## **SESSION 10: OPPORTUNITIES FOR COLLABORATION: REPORTING OUT FROM BREAKOUTS**

### **Training the Pipeline**

*Catherine Karr, Northwest PEHSU at the University of Washington*

Dr. Karr reported that the members of the breakout group hear from trainees in many settings and have connected them with opportunities on an individual basis, but no one is completely familiar with the entire wealth of training opportunities available. Therefore, the group planned to reconvene after the meeting to collaborate on the development of a catalog of training opportunities at all levels. There is a need to reach new audiences of trainees, such as those in family practice, obstetrics and gynecology, and nursing. Experts in children's environmental health typically do not interact with these groups.

Early exposure to environmental health can influence a student's interest in the field, so providing exposure to the subject for medical, nursing and public health students can be valuable. Environmental health can become a track in medical schools. Specialty workshops can be presented at meetings attended by educators and students. The presence of children's environmental health specialists at these meetings provides role models for students who may be interested in the field. Presentations to local special interest groups also can be valuable, and year-long or summer research experiences can be successful. Opportunities should be created for medical residents and postdoctoral fellows to spend time at a public health department to see the real-life application of what they have learned.

One major challenge mentioned is that there is no board-certified specialty in children's environmental health, making it difficult to provide incentives for training in this field and to deal with the problem of charlatans. It was suggested that it may be desirable to develop a board-certified specialty similar to the one in clinical toxicology.

### **Community Outreach and Translation**

*Jennifer Lowry, Mid-America PEHSU*

Dr. Lowry explained that this breakout session began with two issues: how outreach can leverage common efforts more broadly and what the concrete opportunities are for collaboration. The discussion, however, quickly expanded beyond those two points to encompass broader issues related to community outreach and translation.

Although community outreach is a nationwide issue, participants noted that many physicians pay little attention to it. Clinicians need to become involved at a broader level. The PEHSUs or other experts can help when a physician calls, but more needs to be done to disseminate information to the public. The breakout group considered how to get the most "bang for the buck" in outreach and translation. Getting the PEHSUs involved early was suggested as one good approach. When possible, PEHSUs should interact more and sooner with the community. Communities could be encouraged to do more than referring individual cases to the PEHSU; it also can be helpful to invite PEHSUs to community meetings at which an environmental issue is discussed. The PEHSUs are valuable resources not only for their knowledge but also because community members may trust physicians more than they trust government agencies.

To inform people about prenatal exposures, the group said that it is necessary to reach them early in their lives, before they have children. One approach would be to include this topic in health education for high-school juniors and seniors and students in the first years of college.

The group also suggested that nurses could play a valuable role in outreach about children's environmental health. The nursing model is more holistic and community-oriented than the medical model. If information about children's environmental health can be provided to nurses, they in turn can provide it to the community in the course of their work. This role need not be limited to public health nurses. Nurses who work in private medical practices also can become involved. A nurse rather than a physician could be the contact point for environmental health education for a particular medical practice.

The group suggested that the grant program regarding school siting could be leveraged to help states do a better job with school health. Health care providers should collaborate with school districts to work on issues such as PCB exposure in schools. The pediatrics network can be a valuable resource for this, and EPA's OCHP can be contacted for advice. Community outreach and translation need not require "reinventing the wheel." Many resources for education already exist.



One of the key themes of the breakout group's discussions was the many ways in which scientists and clinicians can leverage the work that they already are doing for the benefit of the community. Broad networks such as Planned Parenthood can be one means to reach a large number of people. There are many avenues for closer collaboration between children's environmental health experts and communities

### **Health Disparities**

*Suril Mehta, OCHP, EPA*

Dr. Mehta reported that this breakout session focused on the NPA for health disparities. Dr. Rollins described the development of the NPA and its mission. The NPA is in alignment with Healthy People 2020 and was to be launched a few months after this meeting. The NPA's five goals are to increase awareness of the significance of health disparities; strengthen and broaden leadership; improve the health system and life experience; improve cultural and linguistic competency; and improve data availability and the coordination, utilization and diffusion of research and evaluation outcomes.

The second speaker in this session was Dr. Darney, who discussed some of EPA's current efforts to address disparities, especially with regard to asthma. One of the examples she cited was an Asthma Science Notebook website that was a tool for increasing awareness.

The breakout discussion covered some of the objectives of the NPA. Questions were raised about regional health equity coalitions. There also was discussion about grassroots volunteer campaigns to bring people together to tackle environmental health disparities, similar to the community network for asthma. The potential effectiveness of MLPs and the importance of lawyers in efforts such as mold remediation also were discussed. Dr. Mehta concluded by advising attendees to be on the lookout for the upcoming launch of the NPA.

### **Role of Science in Children's Environmental Health Protection**

*Amy Kyle, UC Berkeley School of Public Health*

Dr. Kyle said that this breakout group began its discussion by having each participant describe what he or she wanted to get out of the session. Dr. Kyle had expected that most attendees would focus on single issues, but in fact group members said that there was a need to build a sense of collaboration, community and interaction between the people in the room and to extend this into the places where action is taken. She characterized the unanimity of vision within the group as astonishing.

The group took time to discuss the practicalities of how the members might work together. A decision was made to try to organize a webinar to explain what it means for scientists to engage in policy. Many resources are available, and much thought has gone into this topic. The group wanted to work toward the goal of pulling together information about children's environmental health and propagating it into policy venues. This effort could begin with PEHSU fact sheets and existing information about administrative proceedings at various government agencies.

One approach suggested by the group would be to focus on a specific topic—such as chemicals policy issues or green certification as it relates to purchasing—and develop ideas about how scientists can engage in policy related to that issue. There was much interest in the breakout group in having a group inquiry or examination of what would make policies more effective. Many members of the group were struck by the fact that problems that have been recognized for decades, such as lead contamination, have not been solved completely. The need to be more effective when tackling current and future children's environmental health issues was raised.

**SESSION 11: KEYNOTE PRESENTATION: NEXT STEPS FOR CHILDREN'S ENVIRONMENTAL HEALTH**

*Moderator: Peter Grevatt, OCHP, EPA*

*Presenter: Annie Murphy Paul, journalist and author of Origins: How the Nine Months Before Birth Shape the Rest of Our Lives*

Ms. Paul noted that when it came to the science of childhood health and development, the meeting attendees were the experts. Without their work, she and other science writers would have nothing to write about. Unfortunately, though, interesting and important research often does not reach the public in the way that scientists would like. Speaking from her viewpoint as a science journalist, Ms. Paul gave four reasons for this and explained some steps that scientists and public health experts can take to get past these barriers.

The first barrier Ms. Paul mentioned was that people often simply do not hear about new scientific discoveries. Scientists who are immersed in research on a topic may tend to forget how little the general public knows about it. Therefore, there is a need to find ways to bring the research to the public. Sometimes this can be done through traditional media such as newspapers, radio and television. To make this possible, it helps for scientists to get to know the people who cover science for the media in their area, what kind of stories they are covering and what help they may need. There are additional possibilities in the new media such as the Internet. One way to reach people interested in a subject would be for a researcher to write a blog about what is happening in his or her laboratory. In a blog, it helps to try to give readers a feel for what is going on behind the scenes. Scientists can collect e-mail addresses of interested individuals and send out updates on their research. They can create a Facebook fan page and "friend" people so that those people can keep up with new developments. Facebook can be a very useful bulletin board for sharing information among people who are professionally linked. Another approach is "tweeting"—which may seem silly at first, but it can be very good discipline to get a message down to 140 characters. There may be other ways to communicate as well, such as community newsletters.

A second problem cited by Ms. Paul was that people often find scientific topics too complex or abstract to understand. A researcher's deep familiarity with a subject can be an obstacle to communicating with the public. The best way to fight this problem is to be aware of what people do not know. It can be helpful for a scientist to explain his or her research to a friend, relative or neighbor. After the explanation, the researcher should ask whether anything is unclear and use the feedback to hone the message. The idea of simplifying a message may go against a scientist's instincts, but it is not a matter of "dumbing down" the information. It is more a matter of avoiding the use of specialized vocabulary and of describing only the parts of a study that are most relevant to the listener. It is possible to increase an audience's interest by hypothesizing just a little beyond what the findings show to capture their attention with what the findings may mean. This helps to make research seem vivid and exciting. The excitement that scientists have about their work can be "lost in translation" when communicating with the public. People tend to think of science as dry and boring, but this perception can be changed if they can see that there are real people behind the research and other real people who are affected by it.

Ms. Paul listed the third problem as people thinking that a particular area of research may not have any relevance to them or that they cannot do anything about a problem that science has identified. People can feel very distant and disconnected from science. To get past this obstacle, it helps to offer concrete examples of how research matters to people's health and that of their children and how they can implement research findings in their everyday lives. For example, a scientist could provide a list of things that people can do about toxins in their homes. Past success stories—such as the beneficial effects of removing lead from gasoline and paint—can be described to show that action can make a difference. Scientists also can describe what they do in their personal lives to protect themselves and their families from environmental hazards.

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The fourth issue that Ms. Paul cited as interfering with communication about children's environmental health was that some of the subject matter may be too frightening or upsetting. People may realize that an issue is important but find it too distressing to deal with it. Ms. Paul told the audience that she runs into this situation often with pregnant women and those who have had children. They refuse to read her book because they believe that it will make them more anxious; they do not want to know what they did wrong. It is important to be sensitive to the ways in which research is interpreted by the public. Much depends on how things are phrased (i.e., "doing X may harm your baby" vs. "doing Y may protect your baby"). Ms. Paul explained that she tries to emphasize positive findings whenever possible and avoids writing in a way that might seem antagonistic or patronizing. During her research, she always appreciated it when she heard from scientists that they too had worried about an issue.

Ms. Paul ended her presentation by asking the meeting participants to take note of what seizes their attention in their everyday lives. If a headline or a snippet of news grabs their attention, it would be useful to ask why. The same approaches and techniques can be used when communicating with the public about research findings.

*Discussion*

Dr. Grevatt began the question-and-answer period by asking Ms. Paul what sort of questions she had received while discussing her book that related to the work of the meeting attendees. Ms. Paul replied that the first question usually is something concrete, such as "What can I do?" Tougher questions come from people who feel helpless to change their situations—such as those who live in a city with a great deal of pollution or who share a home with a smoker. These are harder questions to answer, yet the concerns are legitimate. Ms. Paul said she tries to tell women that there is a need to recognize that pregnancy is a critical time. Society needs to ensure that fetuses have a healthy environment in which to grow. Part of the anxiety that Ms. Paul sees in the audiences with whom she discusses her book comes from the idea that pregnant women are considered completely responsible on their own for ensuring a healthy pregnancy—which she feels is more than should be asked of them.

A participant asked whether Ms. Paul's book addresses the larger issue of chemicals policy in the United States. Ms. Paul replied that it does. Her feeling is that part of the guilt she sees comes from the scattershot way in which women obtain information. They are given the impression that if they take one false step, they will harm their fetus. She tried in the book to put all of the research into context so that women could get a sense of the situation as a whole, in addition to offering historical and cultural perspectives.

Another participant asked who Ms. Paul sees as the key audiences for messages about children's environmental health and where she sees gaps. Who is not being reached? Ms. Paul responded that she has given the most thought to reaching pregnant women themselves. Obstetricians are another important target group, and they are less aware of information on environmental health than one would hope. That is a gap. Women in poor communities may be more in need of information than upper middle-class women, who tend to be better informed and have fewer harmful exposures. Ms. Paul said that she also thinks this is not just a women's issue but a concern for everyone. The fetuses at risk are future students, workers and citizens; their well-being is something everyone should consider.

A participant from the OPP said that she was glad that Ms. Paul brought up the new media because they are a very effective way of reaching young adults. Ms. Paul agreed, noting that young people often will accept information and advice from friends rather than doctors or teachers.

Dr. Darney noted that another important audience is women and teenage girls who are not planning to become pregnant. Women who are planning pregnancies are motivated to obtain information, but those

who become pregnant unintentionally are not. This is an underserved group. Ms. Paul noted that in the breakout group that she had attended there had been discussion of incorporating information about children's environmental health into high-school health classes and first-year college workshops. This is important because 50 percent of all pregnancies are unplanned. Therefore, for every woman who is being careful, there is another who is not.

Dr. Sathyanarayana asked about prioritizing risks and said that, when she counsels patients, she tries to do this first. She also mentioned that she has started to post information on her Facebook page and has found this approach to be useful. Ms. Paul replied that using Facebook or Twitter allows for feedback from the audience. Comments and suggestions from readers can help the information provider to sharpen the message. With regard to prioritizing risk, Ms. Paul agreed that it is important and acknowledged that the structure of her book, which has a narrative form, may not have allowed for that. The format did not provide an opportunity to compare risks.

Dr. Woodruff asked whether Ms. Paul had talked with obstetricians while researching her book and whether she had obtained any feedback about their distance from environmental health issues. She also asked how the book interacts with reproductive choice issues. Ms. Paul said that she was very aware of abortion politics when she wrote her book but that the topic never seems to arise when she discusses the book with audiences. She was prepared for controversy, but it has not occurred. In answer to Dr. Woodruff's other question, Ms. Paul said that she primarily talked with researchers, not clinicians, when collecting information for her book, but in her personal experience, she has found that environmental health information is just beginning to filter to obstetricians, primarily because patients are asking about it.

A participant noted that students enrolling in college often have to complete mandatory questionnaires about topics such as alcohol before registering. A similar approach could be used for education about children's environmental health.

Another participant asked Ms. Paul for her opinion as an experienced science journalist on what she needs from the scientific community to make her job easier. How can scientists facilitate communication with journalists? Ms. Paul replied that there are too few forums where journalists can mingle with scientists, yet that is where the best ideas come from. Also, scientists and journalists have different customs. It can be frustrating to talk to a scientist who will not speculate beyond what is in the paper he or she just published. To engage a wider audience, scientists and journalists must meet in the middle. Scientists also have concerns about how accurate and responsible scientific journalism is. If scientists can view journalists as partners and journalists can be worthy of that trust, accurate scientific information will reach the greatest number of people.

#### **ADJOURNMENT**

The meeting organizers thanked the speakers and participants and adjourned the meeting at 12:30 p.m.