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Tackling the Research Challenges of Health and Climate Change

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Ebi et al. (2009) presented a timely and important analysis of the federal investment in research focused on understanding, avoiding, preparing for, and adapting to the health impacts of climate variability and change. The authors argued that the public health community is inadequately prepared to address the health risks associated with climate variability and change, and that funding necessary to address this challenge is inadequate. Ebi et al. (2009) were particularly critical of the National Institutes of Health (NIH) for overstating its investments in research on the health impacts of climate change, citing a 2007 NIH spending report of $164 million for Health Effects of Climate Change. We would like to respond by highlighting two current activities of the NIH that address these issues: the Trans-NIH Working Group on Climate Change and Health (led by the FIC) and an interagency working group on climate change and health (led by the National Institute of Environmental Health Sciences). Both activities are in midstream, but we plan to have initial products and recommendations available by the fall 2009.

In 2008, a planning group was convened at the NIH to assess the research questions in health and medicine that climate change presents. Sixteen NIH institutes and centers are actively participating in the Trans-NIH Working Group on Climate Change and Health, with coordination from the Fogarty International Center (FIC). The working group is *a*) analyzing the relevance of the NIH portfolio in this area; *b*) engaging the biomedical research community in a discussion of the health effects of climate change; and *c*) identifying research needs and priorities for an NIH research agenda for climate change and health, including the development and evaluation of clinical and public health strategies for adaptation to a changing world.

In January 2009, an interagency working group was formed to identify areas in which strategic research on the linkage between climate change, the environment, and human health could greatly enhance our understanding. Led by the NIEHS, this group was formed to expand the activities of the NIH-focused activity and aid in the coordination of a broader research effort focused on human health for the entire U.S. government research community. The working group is *a*) examining the research portfolio on the health impacts of climate change across the U.S. government; *b*) expanding the dialogue among federal agencies to help coordinate the diverse missions of the U.S. government agencies; and *c*) developing a general conceptual model for research needs to aid in research coordination. The results of this interagency working group, when combined with the Trans-NIH Working Group, will guide the NIH in developing a research portfolio that is science driven and directly relevant to the needs for prevention and intervention to protect human health from climate change.

Assessing the relationship of basic research projects to policy-defined problems is often challenging. For climate change and biomedical research, the challenge is compounded by the complexity of the interaction pathways between climate variables, environmental change, and human health outcomes. Furthermore, concerns over the nature and magnitude of the health threats have changed considerably in the past few years. The figures cited by the NIH for Health Effects of Climate Change in recent years reflected studies that are principally basic human biology related to conditions that are sensitive to climate and atmospheric phenomena, including ultraviolet radiation, To provide an analysis of the NIH portfolio that is more relevant to the current policy concerns with effects of global warming, we are utilizing the new NIH grant fingerprinting technology [Research, Condition, and Disease Categorization (RCDC)] to capture all the potentially relevant projects, followed by a manual process in which experts from the institutes and centers that administer the grants categorize this diverse pool of projects into three general bins: *a*) those with a climate change focus, *b*) those that address climate parameters, and *c*) those that address human conditions that are climate sensitive. Details on the methods and results are forthcoming, but preliminary results indicate that only a handful of research projects in the 2008 portfolio (< 10) had a direct focus on the health effects of interannual or long-term climate change, a somewhat larger group (90–100) studied health effects in relation to climate parameters, and the largest group (> 700) were indirectly climate-relevant in that they focused on the basic human biology of climate-sensitive conditions without actually examining climate parameters. This detailed project analysis essentially agrees with the view of Ebi et al. (2009) that there are relatively few research projects directly focused on the interface of health and climate change, and thus the investment by the agency, using this narrower definition, is significantly less than the $164 million reported by NIH in 2007 for "Health Effects of Climate Change" (NIH 2009a).

In parallel with this portfolio analysis, we have begun to assess—through both the Trans-NIH Working Group and the interagency working group—what the NIH research agenda for climate and health should look like. These efforts will unfold over the next months, but in general terms, we expect the recommendations to include the need to *a*) understand the etiology and epidemiology of current and future health threats from global climate change; *b*) identify the most vulnerable populations/subpopulations and their specific health and medical concerns; *c*) develop predictive models with enough resolution to inform surveillance and medical and public health planning; *d*) develop clinical, translational, and implementation science tools, including cost-effectiveness estimates, to prevent and/or intervene on principal health concerns; and *e*) enhance the human research capacity necessary to advance these goals.

Importantly, the NIH has already taken steps to address two key needs identified in our preliminary analysis—predictive modeling of potential health effects of climate change, and capacity building in environmental public health—through soliciting grants in this area as part of the Challenge Grants initiative enabled by the American Recovery and Reinvestment Act (ARRA 2009; NIH 2009b). To facilitate public health planning and inform adaptation strategies, we need to develop quantitative and predictive models of effects of climate change and of the burden related to a diversity of communicable and noncommunicable diseases, as well as enhanced research capacity through skills and partnerships with communities.

The points raised by Ebi et al. (2009) are important and appreciated by the NIH community. Although the overall climate-relevant health research portfolio of the agency has been significant, there has been very little NIH-supported research directly focused on health effects of global climate change. The NIH has the scientific and administrative capability to address the scientific issues and the fundamental responsibility for supporting biomedical and public health research at U.S. academic centers where most of the relevant research will be done. Given the enormity and complexity of this issue and the important role of the NIH in health research, both in the United States and around the world, it is essential that the NIH be more actively focused on

the health implications of climate change and the science that will help us adapt to these challenges.

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Editor's note: In accordance with journal policy, Ebi et al. were asked whether they wanted to respond to this letter, but they chose not to do so.

Lead Exposures from Car Batteries—A Global Problem

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In "Mass Lead Intoxication from Informal Used Lead Acid Battery Recycling in Dakar, Senegal," Haefliger et al. (2009) described a problem throughout the developing world that is both tragic and only now beginning to be understood with respect to its extent and effect.

Eighteen children (and more since) died from acute lead poisoning in late 2008 in Dakar. These poisonings occurred because the individuals recycling car batteries melted slag without appropriate controls and without having any understanding of the toxicity of lead. Most of these recyclers were women who brought their children to their work sites without knowing the risks.

These problems are not restricted to Senegal. Without much effort, investigators from Blacksmith Institute have identified another 22 sites worldwide that are similar to this one. The identified sites are in cities in poor countries, especially in the tropics (e.g., the Dominican Republic, Philippines, Panama, El Salvador, Guatemala, India, Ghana, Jamaica) (Blacksmith Institute 2009).

Epidemiologic studies of exposed populations, such as the one in Senegal reported by Haefliger et al. (2009), are urgently needed to characterize exposures and identify related health effects. An earlier example of such a study was conducted in the Dominican Republic at Haina (also known as Bajos de Haina), which has been called the "Dominican Chernobyl." This community is near an abandoned lead-acid battery recycling smelter, and most of the residents showed signs of lead poisoning.

The Haina site, as well as the surrounding area, was the scene of severe lead poisoning in the 1990s. In March 1997, 116 children were surveyed, and 146 children were surveyed in August 1997. Mean blood lead concentrations were 71 µg/dL (range, 9–234 µg/dL) in March and 32 µg/dL (range, 6–130 µg/dL) in August (Kaul et al. 1999). The study revealed that at least 28% of the children required immediate treatment and 5% had lead levels > 79 µg/dL, putting them at risk for severe neurologic sequelae at the time of the study. In the United States, the action level for blood lead concentration is 10 µg/dL (Centers for Disease Control and Prevention 2007; U.S. Environmental Protection Agency 2000).

The scientific findings from Haina (Kaul et al. 1999) drove a collaborative cleanup of this site, which has recently been completed. The Blacksmith Institute helped locate funding, worked closely with local authorities, and provided technical assistance to assure the cleanup was adequate. We are currently beginning a similar cleanup project in Dakar, at the site studied by Haefliger et al. (2009).

Almost all large urban centers in the developing world have a problem with recycling used lead acid batteries, and hundreds of thousands, if not millions, of children are exposed to lead from battery recycling. In humid conditions, car batteries need to be replaced every 2 or 3 years, and car use is increasing throughout the world, which will result in even more used batteries. Thus, this problem deserves our immediate and serious attention.

Blacksmith Institute, a registered 501(c)3 non-profit organization, is committed to solving pollution problems around the world. R.F. is the founder and president of Blacksmith Institute.

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Editor's note: In accordance with journal policy, Haefliger et al. were asked whether they wanted to respond to this letter, but they chose not to do so.

Periodontal Disease and Environmental Cadmium Exposure

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We were pleased to see the article by Arora et al. (2009), which describes an association between environmental exposure to cadmium and periodontal disease.

In their cross-sectional study among U.S. adults, Arora et al. (2009) found periodontal disease in 15.4% of a nationally representative sample of 11,412 participants. The authors reported that for individuals with periodontal disease, as defined in their study, the geometric mean concentration of urinary Cd (0.50 µg/g creatinine) was significantly higher than for persons with no evidence of periodontitis (0.30 µg/g creatinine).

Arora et al. (2009) correctly stated that the main source of human exposure to environmental Cd is smoking. They proposed that additional sources of Cd in the general population are "emissions from industrial activities, including mining, smelting, and manufacturing of batteries, pigments, stabilizers, and alloys" (Arora et al. 2009).

However, in our view, one Cd source has been overlooked: intraoral dental alloys. Individuals with dental alloy restorations are regularly exposed to a number of trace elements that are continuously released from intraoral alloys (Wataha 2000).

Cadmium may be released from intraoral alloys in dental patients and may be accumulated in both teeth and oral tissues, binding tightly to metallothioneins (Goyer and Clarkson 2001; Munksgaard 1992).