



## Biomonitoring

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### OVERVIEW

Biomonitoring, the process of measuring environmental chemicals in people, plays an important role in protecting public health by helping researchers determine what environmental factors influence conditions or diseases such as birth defects, developmental disabilities and cancer. Biomonitoring also is an essential part of the public health response to chemical emergencies, whether accidental or terrorist. Although federal government laboratories can conduct biomonitoring, most state laboratories do not have biomonitoring capacity and lack the resources to develop this capability. A federal effort is currently under way to help states develop this capacity so they can better respond to local environmental health concerns.

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### WHAT QUESTIONS CAN BIOMONITORING HELP ANSWER?

- In the event of a terrorist or suspected terrorist attack: Did the attackers deliver chemical weapons? Who needs medical treatment for exposure?
- Do increased levels of mercury, dioxin or polychlorinated biphenyls (PCBs) in game fish threaten our community's health?
- Have no-smoking policies been effective in reducing tobacco smoke exposure in non-smokers in our state?
- Do pesticides pose a risk to our residents who farm, live near farms, or eat certain types of food?

By indicating exactly what chemicals people have in their bodies and at what levels, biomonitoring provides a scientific foundation upon which sound policy decisions can be built. When combined with disease tracking data and environmental hazard information, biomonitoring provides researchers with the tools that may soon help uncover the environment's role in disease. This knowledge can eventually help medical and public health practitioners prevent disease.

Actions taken in 1976 demonstrate the importance of biomonitoring in the decision-making process. Around this time, the Centers for Disease Control and Prevention (CDC) was measuring lead levels in children's blood and found that a very high proportion of children—nearly nine out of 10—had high levels of lead in their bloodstreams (exposure to lead can cause behavioral problems I.Q. loss, and other problems in children, even at very low



## **SERIOUS DISEASES, UNCERTAIN CAUSES**

Biomonitoring may provide some of the crucial information that is needed to discover the cause of many chronic diseases.

Environmental factors have been linked to diseases such as asthma, leukemia, learning disabilities, cancer and developmental disabilities. Seventeen percent of U.S. children under age 18 have developmental disabilities—such as mental retardation, autism, cerebral palsy and attention deficit hyperactivity disorder (ADHD).<sup>1</sup> Between 5 percent and 10 percent of children who attend public schools have learning disabilities, and ADHD affects another 3 percent to 6 percent. Although the causes of most developmental disabilities are unknown, research suggests that chemicals in the environment—including mercury, lead, PCBs—can cause developmental disabilities in children.<sup>2</sup>

Despite the research advances in environmental health during the last few decades, researchers have not yet found definitive answers to many questions about the health effects caused by environmental factors.

levels). By monitoring the amount of lead in children, researchers found that leaded gas was the primary cause of high lead levels. This information helped the U.S. Environmental Protection Agency (EPA) follow through with eliminating lead from gasoline. Lead levels in children dropped dramatically as a result.

Biomonitoring also provides health departments with the tools to investigate clusters of illnesses or conditions, such as cancer or birth defects, to determine if chemical exposure plays a role in these clusters.

## **FEDERAL ACTIVITY**

CDC currently collects data on human exposure to more than 140 environmental chemicals, including pesticides, PCBs, mercury and environmental tobacco smoke (also called second-hand smoke). CDC releases reports on exposure to environmental chemicals in order to provide unique information to physicians, scientists, and health officials. The data can be used to:

1. Determine which chemicals get inside people and at what levels;
2. Determine the prevalence of people with levels of a chemical that are above known toxicity levels;
3. Establish a baseline that can be used by physicians and scientists to determine whether a person or

group has an unusually high exposure;

4. Assess the effectiveness of public health efforts to reduce exposure to specific chemicals; and
5. Set priorities for research on human health effects.

When biomonitoring data is combined with hazard and health tracking information, it will eventually help physicians, researchers and public health officials prevent diseases that are influenced by environmental factors.

## **STATE ACTIVITY**

To determine the hazard exposure levels at the state, city or community level, or to respond quickly to suspected chemical terrorism, states will need to implement their own biomonitoring programs. CDC is working to improve state laboratory biomonitoring capability. Between 2001 and 2003 CDC awarded \$10 million in planning grants to states. Only a few received CDC grants to carry their plans forward, however.

Most states must rely on CDC to investigate chemical accidents or disease clusters and to assist in pursuing population exposure research. Unfortunately, CDC has neither the staff nor the resources to address each state's differing needs.

With CDC's assistance, three states are beginning projects that use biomonitoring to study exposure to a number of different environmental chemicals. New Hampshire, for example, plans to test private wells and collect clinical samples to determine if residents have high arsenic levels. Residents will also be informed about arsenic and told how to reduce exposure. Approximately 13 percent of New Hampshire's private wells violate the EPA arsenic standard.

Wisconsin, a fishing-oriented state that has issued statewide advisories to protect residents from exposure to mercury and PCBs in fish, would like to investigate the extent of mercury exposure in its population. This would help to determine if advisories are effective and whether mercury poses a health risk to Wisconsin residents. Wisconsin also is interested in using biomonitoring to address the concerns of farm workers, who want to know more about agricultural chemical exposure resulting from aerial pesticide spraying, working in the fields and drinking contaminated water.

California is the only state to introduce legislation that calls for the creation of a biomonitoring program. In May 2004, Senate Bill 689, the "Healthy Californians Biomonitoring Project," passed the Senate—the bill died later in the Assembly, however. The legislation called for creation of a pilot program to monitor breast milk in order to determine if environmental contamination is re-

lated to the increase in the rates of diseases such as autism or breast cancer. The legislation also called for the creation of other pilot projects that use various sampling techniques to test for environmental exposures. Further, the bill recommended that protective public health action be taken in response to the data.

To fund the program, the project initially targeted chemical manufacturers and those who release toxic chemicals. These parties were required to pay fees based on their responsibility for the release of toxics into the environment. In order to increase the bill's likelihood of passing the Assembly, the funding mechanism was changed so the chemical manufacturers would not be charged—funding instead would come from federal and private sources.

### CHALLENGES FOR BIOMONITORING

Industry supports CDC's national effort to monitor human exposure to chemicals because better exposure data can reduce over-regulation and its economic costs to society. However, there are still concerns that monitoring chemicals in humans without knowing what levels may be hazardous will create alarm, leading to unjustified, costly regulations that may not necessarily protect the public. Currently, scientists can test for a large number of chemicals in humans, although for many of these chemicals, the health effects are largely unknown. The scientific rationale for measuring chemicals for which health effects are uncertain but suspected, according to the CDC, is to connect these data with disease tracking data to eventually determine if some exposures are causing health problems, as was the case with lead.

Resources also have been a concern. CDC has not been able to fund all the states that wish to pursue biomonitoring programs, and no state is contributing its own funding, although New York city does fund some of its own biomonitoring program. States that wish to sustain a biomonitoring program may need to combine both state and federal resources—and possibly foundation grants. The cost of maintaining a biomonitoring program may eventually be offset by the reduction of disease and its associated social and economic costs.

Although immediate uses for biomonitoring exist—such as detecting and responding to chemical terrorism and chemical spills, or investigating disease clusters—it

### BIOMONITORING IN PRACTICE

Washington's Department of Health recently began testing farmworker pesticide handlers to determine if they are overexposed to these hazardous chemicals. The results surprised investigators—nearly one in four farmworkers tested had suffered potentially harmful pesticide exposure (testing discovered low levels of a certain enzyme, which indicates pesticide exposure). Twenty of the 345 pesticide handlers tested had enzyme levels so low that immediate removal from their jobs was required. In response to the preliminary data, the Washington Farm Bureau issued a labor advisory, reminding members to provide information and proper training to pesticide workers and to require worker compliance with safety protocols.

also functions as a basic research tool. Determining the exposure levels for many different chemicals today will help focus research to discover which, if any, of these exposures poses a health concern.

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### NOTES

- <sup>1</sup> Centers for Disease Control and Prevention, Developmental Disabilities Web page, [www.cdc.gov/ncbddd/dd/](http://www.cdc.gov/ncbddd/dd/), 2004.
- <sup>2</sup> P. Mendola, S.G. Selevan, S. Gutter and D. Rice, "Environmental factors associated with a spectrum of neurodevelopmental deficits," *Mental Retardation and Developmental Disabilities Research Review* 8, 3 (2002): 188-97.

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This issue of the *Environmental Health Series* was researched and written by Glen Andersen.