



# Environmental Public Health Tracking and Biomonitoring

## What is environmental public health tracking?

- Environmental public health tracking (EPHT) is the ongoing collection, integration, analysis, interpretation, and dissemination of data on environmental hazards, exposures to those hazards, and health effects that may be related to the exposures.
- The goal of EPHT is to provide information that can be used to plan, apply, and evaluate actions to prevent and control environmentally related diseases.
- For more information, see <http://www.cdc.gov/nceh/tracking/>.

## What is biomonitoring?

- Biomonitoring is the direct measurement of people's exposure to environmental contaminants by measuring substances or their metabolites in blood, urine, or other specimens.
- The Environmental Health Laboratory of the National Center for Environmental Health at the Centers for Disease Control and Prevention (CDC) has been performing biomonitoring measurements for more than 30 years.
- Biomonitoring has become the standard for assessing people's exposure to toxic substances and for responding to serious environmental public health problems.
- For more information, see [http://www.cdc.gov/nceh/dls/national\\_biomonitoring\\_program.htm](http://www.cdc.gov/nceh/dls/national_biomonitoring_program.htm).

## **Biomonitoring is an essential component of the National Environmental Public Health Tracking Network.**

- EPHT must include data on environmental hazards, human exposure, and health effects. The most health-relevant method of determining human exposure to environmental hazards is biomonitoring.
- Laboratory personnel bring new ideas and concepts to the EPHT Network (e.g., laboratory personnel can identify a different way of sampling the study population or provide new ways or techniques for analyzing the samples that would result in more reliable results).

## **The CDC Biomonitoring Program and the CDC National Environmental Public Health Tracking Program work closely together.**

- CDC's Environmental Health Laboratory and the National EPHT Program rely on each other for scientific/technical expertise.
- Biomonitoring program scientists provide advice on strategies for building the National EPHT Network and Program.

## Examples of EPHT/State Laboratory Collaborative Activities

- **California:** The California EPHT Program is a member of the Western Tracking and Biomonitoring Collaboration (WBTC). This collaborative includes representatives from Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, and Washington, and Wyoming. The focus of this collaborative effort is (1) to develop a funding proposal for regional planning to enhance capacity (e.g., for laboratory information management systems) and (2) to conduct joint projects (e.g., biomonitoring for arsenic exposure from drinking water or for mercury exposure from fish consumption).
- **Connecticut:** The Connecticut EPHT Program is collaborating with the state's Public Health Laboratory, Maine's Public Health and Environmental Testing Laboratory, and Vermont's Public Health Laboratory in a regional effort to examine umbilical cord blood from recent deliveries for levels of mercury, lead, cadmium, and related biomarkers. The Connecticut EPHT will provide funding to the state laboratory for supplies, proficiency-testing validation, sample preparation, and transport.
- **Florida:** Through a partnership with the University of Miami, the Florida EPHT section has been working with state regional laboratories in Tampa, Jacksonville, and Miami-Dade counties (1) to link electronically data on childhood blood lead levels (BLLs) with data from childhood developmental disability records and (2) to analyze the aggregate data for potential associations. The Florida EPHT has also provided supplemental funding to the laboratory to enable it to identify and screen uninsured children for elevated BLLs. Otherwise, these children may not receive such screening. These activities help make the database more complete and will help to assess the effectiveness of interventions to reduce these children's exposure to lead. EPHT staff members recognize that blood lead and other biomonitoring data are critical to identifying associations between environmental hazards and health effects. The Florida Department of Health continues to collaborate with Florida laboratories by involving them in EPHT workgroup committees and coordinating efforts to gather BLL data.
- **Illinois:** Childhood lead poisoning prevention is one of the priorities of the Illinois EPHT program. Illinois EPHT staff members receive test results of childhood blood lead screening reported by the Illinois Department of Public Health laboratories through the Child Lead Poisoning Prevention Program. The EPHT program is creating a risk-prediction map to allow local health departments to focus their limited resources for screening and remediation activities on high-risk areas. The map is being developed using a geographic information system (GIS) model produced at Duke University in North Carolina. The map will link the results of blood lead level tests with tax assessor and U.S. census data. The model also maps the locations of local resources, such as hospitals, physician offices, laboratories, neighborhood meeting rooms, and local health departments.
- **Maine:** The Maine Bureau of Health (MEBOH) EPHT program is collaborating with MEBOH's Office of Public Health Emergency Preparedness (OPHEP) and the Public Health and Environmental Testing Laboratory (HETL) to establish a statewide biomonitoring program in Maine. The efforts to establish the statewide program will be coordinated with chemical-terrorism preparedness efforts for a Level-2 laboratory (Level-2 laboratories can analyze for selected metals in blood and urine, for nerve agents in urine, and for cyanide in blood). The partners are preparing a pilot study to assess the ability of new instrumentation purchased for chemical-terrorism preparedness to analyze children's blood samples for lead that currently are submitted to the state laboratory. The partners will measure blood lead, mercury, and cadmium levels for children aged 1-6 years and assess the feasibility of measuring arsenic and uranium 238. MEBOH EPHT staff

members are (1) taking the lead in designing this pilot study and a surveillance plan for tracking metals in Maine's children, and (2) supporting the purchase and use of a new public health laboratory software system and instruments that will facilitate the rapid conversion between public health surveillance and incident-response functions.

- **Maryland:** Maryland's EPHT Program staff work closely with the staff of the state's public health laboratory. The Program has used EPHT funding to purchase equipment and train laboratory staff to perform tests for levels of pesticide metabolites and heavy metals in human urine. These investments have greatly enhanced the state's biomonitoring capacity. The Program will use this enhanced biomonitoring capacity to establish background data on and to assess levels of pesticides and heavy metals in urine. Physicians will be able to tap into this enhanced capability, ordering tests that will help them better diagnose and monitor their patients.
- **Massachusetts:** The Massachusetts EPHT Program is working with the Division of Public Health's Environmental Chemistry Laboratory at the State Laboratory Institute on a project looking at childhood BLLs. EPHT and laboratory staff members meet regularly to review data quality and reporting issues. The EPHT Program also collaborates with staff of the New England Newborn Screening Program in the University of Massachusetts Medical School on a developmental disabilities tracking project. This project includes evaluating newborn screening data for thyroid hormone levels in blood. Lack of thyroid hormone can indicate congenital hypothyroidism, a disorder which can lead to poor growth and mental retardation. If found early and treated with thyroid medication, a child may grow and develop normally.
- **Missouri:** The Missouri Department of Health and Senior Services (DHSS) has a long-term collaboration with the state Public Health Laboratory on biomonitoring of childhood BLLs. The laboratory is submitting blood lead results to DHSS electronically. These results are stored in a data warehouse. The Missouri EPHT program is developing a means to electronically post laboratory and other results in the data warehouse to an individual's client record. Additionally, the DHSS Section on Environmental Public Health and the state Public Health Laboratory are holding ongoing discussions about the need for a biomonitoring program, how the program would function, and what its scope would be. Initial plans, though untested, are in place to deal with a bioterrorist event or public health emergency.
- **Montana:** Montana EPHT staff members are working collaboratively with the state's Public Health Laboratory on several projects, including the CDC-funded biomonitoring project (under the Rocky Mountain Consortium). In summer 2005, the Montana EPHT will begin fieldwork on a pilot project to assess exposure to arsenic in drinking well water. The researchers will compare arsenic concentrations in well water to arsenic levels in urine samples from people drinking water from those wells. An Interagency Heavy Metal Working Group—which includes representatives from the state laboratory, the biomonitoring project, EPHT program, U.S. Geological Survey, Bureau of Mines, and the Montana Department of Environmental Quality—will coordinate this project. The group also will explore the ongoing integration and public availability of water- quality data from all state partners. The EPHT program also is working to improve the collection and reporting of BLLs from the state and other laboratories. Program staff members are designing an electronic blood lead data program that will (1) allow laboratories to report information directly and electronically and (2) allow agencies to better manage the data, track areas of lead exposure, and provide information for client follow-up. As a participant in the Rocky Mountain Biomonitoring Consortium, the Montana EPHT Program also is working closely with the state environmental laboratory to enhance the laboratory's capacity for testing heavy metals. (see also, *Western Tracking and Biomonitoring Collaboration*)

- **New Hampshire:** The New Hampshire EPHT Program has been working with the CDC-funded biomonitoring program for the past 2 years to better assess exposure to environmental contaminants. The New Hampshire EPHT Program has provided epidemiologic expertise in study method development for assessing exposure to arsenic and mercury. EPHT has funded the purchase of equipment to improve collection, storage, and testing of specimens from people. These specimens will be tested to determine the level of exposure to (1) arsenic in drinking water, and (2) mercury found in recreational fish that people eat. The New Hampshire EPHT provided support to hire student interns to collect water samples to test for arsenic levels in the environment. The data obtained from the arsenic project will be used to support the EPHT project that tracks arsenic exposure and the occurrence of bladder cancer in New Hampshire residents. EPHT staff members are active members of biomonitoring program workgroups focusing on mercury, arsenic, phthalates, and brominated flame retardants. All of these activities have been developed to produce better data for tracking trends in hazards, exposures, and human health.
- **New Jersey:** New Jersey EPHT staff members are conducting a demonstration project to examine links between geographic distributions of lead exposure in children and adults and data on lead hazards in the environment. The project is drawing information from existing biomonitoring databases for human exposure to lead.
- **New Mexico:** The New Mexico EPHT Program is working with the Rocky Mountain Biomonitoring Consortium (RMBC) on an arsenic exposure project. The partners are working to determine whether a difference in urine arsenic levels and arsenic speciation ratios can be detected in individuals exposed to various levels of arsenic in drinking water. This project also will provide baseline levels of arsenic and other metals in urine for the residents of the RMBC states (New Mexico, Wyoming, Colorado, Arizona, Utah, and Montana). The partners will use the results to verify assumptions about drinking water that are used for EPHT. RMBC also is evaluating the possible use of newborn screening dried blood spots to determine the baseline exposure of the population to selected heavy metals. The partners and others can use these baselines to help identify where elevated exposures may be occurring. RMBC also is working to characterize exposure to environmental tobacco smoke in populations that do and do not have smoking statutes. These data can be used to verify assumptions about exposure to tobacco smoke and health outcomes such as cancer, asthma, or other respiratory diseases. RMBC is working on two additional projects focusing on water. The first is an evaluation of the potential for exposure to volatile organic compounds as they evaporate into indoor air from groundwater or subsurface soil. The second is an evaluation of the potential for exposure to radionuclides in drinking water. Both projects will provide information and lessons learned about linking exposure and health outcome data (see also, *Western Tracking and Biomonitoring Collaboration*).
- **New York City:** New York City (NYC) has launched two collaborative biomonitoring and EPHT program efforts:

  - (1) NYC has been collaborating with CDC and the Wadsworth Laboratories of the New York State Department of Health and Mental Hygiene (NYS DOHMH) on a biomonitoring study of mercury exposure in children.
  - (2) NYC conducted its first community health and nutrition examination survey (HANES). The environmental biomonitoring component of NYC HANES, coordinated by the NYC EPHT program, is enabling the NYC DOHMH to characterize and integrate findings about residents' exposures to organophosphates, pyrethroids, heavy and trace metals, and environmental tobacco. Collaborating laboratories include CDC's Environmental Health Laboratory and the

NYS Wadsworth Laboratories. Analyses of NYC HANES data resulted in the discovery of a patient with a high level of mercury poisoning. Such poisoning usually indicates exposure to mercury salt or elemental mercury. Upon further investigation, the patient was found to have used one of several commonly available, but illegal, skin lighteners that list mercury as the active ingredient. The NYC DOHMH launched a wider investigation into the use of this skin lightener in the city, worked with the U.S. Food and Drug Administration laboratory, and confirmed heavy mercury content in six commonly available skin-lightening products. NYC issued alerts and press releases to healthcare practitioners. It ordered 163 stores to stop selling the products and provide it with names of distributors. This biomonitoring effort and the discovery and the response to the mercury exposure were made possible by the EPHT program.

- **New York State:** The New York State (NYS) biomonitoring program advises the New York State EPHT program. The programs plan to work together on a pilot-scale biomonitoring project relating to drinking water contaminants (e.g., trihalomethanes or other disinfection byproducts) and birth outcome data. Additionally, the biomonitoring program staff members are exploring development of other surveillance tools that may be useful to EPHT. The NYS biomonitoring program has also made significant contributions to the NYC Department of Health and Mental Hygiene (NYC DOHMH) EPHT program. Through combined funding from the NYC DOHMH EPHT, biomonitoring funding from CDC, and supplementary NYS support, the state's public health laboratory has been able to contribute quantitative exposure measurements to the NYC DOHMH first-ever community-based Health and Nutrition Examination Survey. For this, the state laboratory is analyzing biological specimens from approximately 1,800 participants for serum cotinine levels (as a measure of environmental tobacco smoke exposure), toxic metals, and levels of mercury and other trace elements in urine. If additional support becomes available, analyses of urinary organophosphate pesticide metabolites will be added to the suite of NYC HANES analytes.
- **Nevada:** The Nevada EPHT Program is collaborating with the Nevada State Health Laboratory and with the Department of Environmental Sciences and Health at the University of Nevada, School of Public Health (the Laboratory is part of the University) to support development of an environmental health laboratory section capable of analyzing lead and mercury in human tissues, as well as in environmental samples. Funding for this project is already available through the University of Nevada, School of Public Health. The Nevada State Health Division, EPHT Program, Clark County Health District, and the University of Nevada are identifying needed resources; developing objectives; and defining requirements, benefits, and deliverables for this laboratory. They are also identifying dates, numbers, types, and the priority of samples they would start to analyze. In addition, project developers are looking into ways to link the results of the lead and mercury analysis to current policies, mandates, laws, or state/national objectives (Healthy People 2010 Guidelines) or other appropriate governing documents. (see also, *Western Tracking and Biomonitoring Collaboration*)
- **Oregon:** The Oregon EPHT Program is proposing to participate in a regional planning and capacity-building process that will allow Oregon to develop biomonitoring capabilities more rapidly than is currently the case. This effort will integrate and support the epidemiologic and state laboratory components necessary for addressing identified environmental public health issues in the state. The Oregon Public Health Laboratory is a partner in this proposal. The capacities of other programs in this proposed partnership can be leveraged to greatly assist Oregon in developing an active biomonitoring program. (see also, *Western Tracking and Biomonitoring Collaboration*)
- **Pennsylvania:** The Pennsylvania EPHT Program works with its state laboratory to identify families with elevated BLLs. As required by law, the state public health laboratory reports elevated BLLs in

children and adults. The data are collected from hospitals, other public health laboratories, clinics, and physician offices. The EPHT Program analyzes the data through Pennsylvania's National Electronic Disease Surveillance System (PA-NEDSS).

- **Utah:** Utah is a grantee for both the National EPHT Program and the Rocky Mountain Biomonitoring Consortium (RMBC). RMBC's goal is to develop the capacity for and to implement a regional laboratory-based biomonitoring program. The biomonitoring program will assess the extent and nature of human exposures to environmental toxicants; this information will be used to help prevent disease associated with exposure. Participants share technical expertise and resources to advance the common goals of EPHT and RMBC. EPHT and RMBC information technology (IT) staff are collaborating in developing an IT infrastructure that will support activities of both groups. (see also, *Western Tracking and Biomonitoring Collaboration*)
- **Washington:** The Washington EPHT Program and the state's Public Health Laboratories have been collaborating on several biomonitoring initiatives. They are discussing the feasibility of hosting a state health and nutrition examination survey (State-HANES) based on the national HANES. Washington conducts episodic biomonitoring studies. For example, the state is involved in a study of methemoglobin (a biomarker for nitrate exposure) among infants who drink water from private wells. The Washington EPHT staff also is collaborating with the state's Department of Labor & Industries to conduct a cholinesterase monitoring program aimed at early detection of overexposure to toxic pesticides in farm workers. EPHT funds were used to create a cholinesterase monitoring data system (CMDS). The Public Health Laboratory performs the tests. Results are entered into the centralized CMDS database at the Office of Epidemiology, which issues alerts when overexposure thresholds are exceeded. This system was used to track more than 3,600 blood samples from farm workers. Of 611 farm workers with at least one follow-up test, 122 (20%) had depressed cholinesterase levels. Of those 122 farm workers, 23 had significant enough depressions to warrant temporary removal from their work environment to prevent illness from the pesticide exposure. Through its Lead Poisoning Prevention Program, Washington also conducts continuous biomonitoring on the basis of blood lead level test results.
- **Wisconsin:** The Wisconsin EPHT Program has implemented a methylmercury tracking module that involves the submission of hair samples from volunteers to the Wisconsin State Laboratory of Hygiene. The laboratory analyzes the hair samples for levels of methylmercury and sends the results to the Bureau of Environmental and Occupational Health (BEOH). BEOH compares the laboratory results to self-reports of fish consumption and other variables. The information allows a better understanding of methylmercury exposure from fish consumption. These data could help public health officials make decisions about issuing fish- consumption advisories.
- **Western Tracking and Biomonitoring Collaboration (WTBC):** Seven state health departments in the western United States—California, Montana, Nevada, New Mexico, Oregon, Utah, and Washington—have EPHT grants from CDC. In 2003, state public health laboratories in six western states—Arizona, Colorado, Montana, New Mexico, Utah, and Wyoming—formed the Rocky Mountain Biomonitoring Consortium (RMBC), which has also received CDC funding. In February 2005, representatives from these groups met and founded the Western Tracking and Biomonitoring Collaboration (WTBC). One additional state, Idaho, which is not CDC-funded, also has joined WTBC. The focus of this collaborative effort is (1) to develop a funding proposal for regional planning to enhance capacity (e.g., enhance capacity for laboratory information management systems), and (2) to conduct joint projects (e.g., biomonitoring for arsenic exposure from drinking water and for mercury exposure from fish consumption).

**For more information on EPHT and biomonitoring, contact:**

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