DIRECT FROM CDC ENVIRONMENTAL PUBLIC HEALTH TRACKING NETWORK

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Biomonitoring and Environmental Public Health Tracking

Editor's Note: As part of our continuing effort to highlight innovative approaches and tools to improve the health and environment of communities, the *Journal* is pleased to publish a bimonthly column from the Centers for Disease Control and Prevention's (CDC's) Environmental Public Health Tracking Network (Tracking Network). The Tracking Network is a system of integrated health, exposure, and hazard information and data from a variety of national, state, and city sources. The Tracking Network brings together data concerning health and environmental problems with the goal of providing information to help improve where we live, work, and play.

Environmental causes of chronic diseases are hard to identify. Measuring amounts of hazardous substances in our environment in a standard way, tracing the spread of these over time and area, seeing how they show up in human tissues, and understanding how they may cause illness is critical. The Tracking Network is a tool that can help connect these efforts. Through these columns, readers will learn about the program and the resources, tools, and information available from CDC's Tracking Network.

The conclusions of this article are those of the author(s) and do not necessarily represent the views of CDC.

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People can be exposed to chemicals in air, water, food, soil, or other environmental media such as consumer products (Centers for Disease Control and Prevention [CDC], 2009). Biomonitoring can help determine which environmental chemicals people have been exposed to by measuring how much of these chemicals actually get into people's bodies (CDC, 2009). These measurements in blood or urine can then be associated with a hazard present in the environment or, along with health-related information, with a health effect that would follow exposure (Needham, Calafat, & Barr, 2007). This makes the connection between environmental hazards, exposures, and health effects.

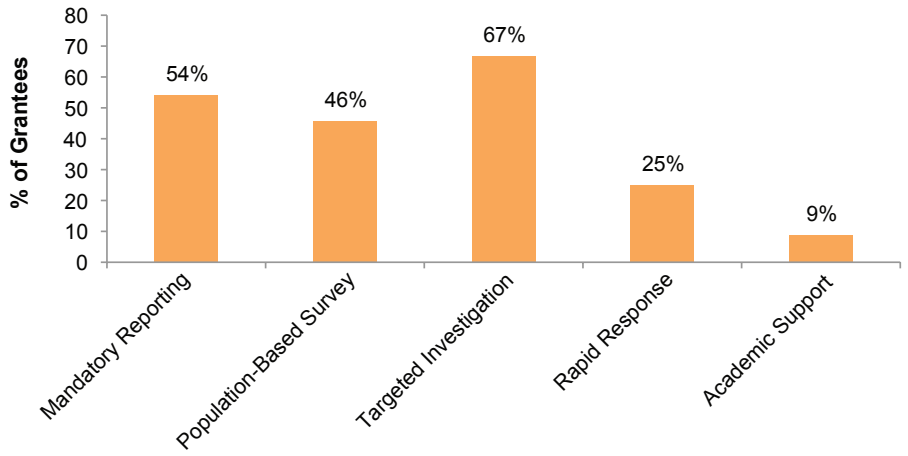
Biomonitoring data can also be used to monitor trends of body burdens of chemicals, identify at-risk populations, and determine effectiveness of regulations (Needham et al., 2007). This column describes the role of biomonitoring data in the Environmental Public Health Tracking Program (Tracking Program) and the work that has been undertaken so far to integrate biomonitoring data into the Environmental Public Health Tracking Network (Tracking Network).

Environmental public health tracking or surveillance is defined as 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 (McGeehin, Qualters, & Niskar, 2004). Therefore, environmental public health tracking typically integrates data from the following three types of surveillance: environmental hazard, exposure, and health effect (Thacker, Stroup, Parrish, & Anderson, 1996). Hazard surveillance documents hazards in the environment (e.g., ozone in air), while exposure surveillance determines the extent of human contact with environmental hazards (e.g., childhood blood lead testing) (Thacker et al., 1996). Health effects surveillance documents the disease burden in populations (e.g., prevalence of birth defects) (Thacker et al., 1996). This is the "three-legged stool" that characterizes environmental public health tracking data (The PEW Environmental Health Commission, 2000). These three data types complement each other.

The Tracking Network is a national web-based system that presents environmental haz-

FIGURE **1**

Number of Tracking Program Grantees With Biomonitoring Projects by Category (*N* = 24)



ard, exposure, and health effects data in one place. The Tracking Program funds 24 states and one city health department (grantees) to develop and maintain state tracking networks. Currently, the national Tracking Network presents data on the following topics from the three categories of surveillance data:

Environment
- Climate change
- Outdoor air
- Community water
- Homes
- Community design

Exposure
- Pesticide exposures
- Childhood blood lead testing
- Biomonitoring population exposures

Health Effects
- Asthma
- Birth defects
- Cancer
- Carbon monoxide poisoning
- Heart attacks
- Heat stress
- Reproductive and birth outcomes
- Developmental disabilities

Integrating Biomonitoring in the Tracking Network

In 2011, the Tracking Program's biomonitoring taskforce was formed. One of the taskforce's objectives was to develop a module to integrate biomonitoring data into the Tracking Network.

National Data

For the first phase, biomonitoring data on these 11 analytes (e.g., the chemical or a metabolite) from the Centers for Disease and Control and Prevention's *National Report on Human Exposure to Environmental Chemicals* were selected to be presented on the Tracking Network.

Metals measured in urine or blood:
- Arsenic (urine)
- Cadmium (blood and urine)
- Lead (blood)
- Mercury (blood and urine)
- Uranium (urine)

Volatile organic compounds measured in blood:
- Benzene
- Toluene

Disinfection by-products measured in blood:
- Chloroform

Polycyclic aromatic hydrocarbons measured in urine:
- Naphthalene metabolites
- Pyrene metabolite

and
- Cotinine measured in blood serum

The analytes were selected based on one or more of the following criteria: 1) high detection frequency in the U.S. population (i.e., detected at the 50th percentile); 2) have known environmental exposures; 3) can be linked with environmental hazard data from the Tracking Network and U.S. Environmental Protection Agency's air toxics or safe drinking water information system data; 4) good understanding of association with health effects; and 5) good potential for mitigating exposures through policy or other means.

State/Local-Level Data

Another taskforce objective was to document and assess biomonitoring data collected by the then-24 Tracking Program grantees that show exposures on a state or local scale. The goals of this project were to provide an inventory of biomonitoring data in Tracking Program grantee states, identify strengths and limitations of the data for use in environmental public health tracking, and make recommendations about the use of these data on the national and grantee tracking networks. The state-level data and projects conducted in the last 10 years (2001–2011) were grouped into the following five categories.

Mandatory reporting: passive collection of data from the mandatory reporting of chemical exposures to a public health agency.

Population-based survey: active population surveillance to detect spatial or temporal differences in exposure or to evaluate the efficacy of public health actions to reduce exposure.

Targeted public health investigation: conducted in response to community exposure or health concerns.

Rapid response: conducted in response to an exposure event to evaluate clinical measures in individuals and support diagnosis of poisonings and assessment of need for medical treatment.

Support of academic research projects: providing laboratory support to academic research projects.

Results

Project Categories and Analytes

All 24 grantees provided information. The distribution of grantees with projects by category was as follows: 54% mandatory reporting projects apart from childhood blood lead testing (n = 13); 46% population-based surveys (n = 11); 67% targeted investigations (n = 16); 25% rapid response (n = 6); and 9% support of academic research projects (n =

2) (Figure 1). Mercury, arsenic, cadmium and pesticides were the analytes most frequently tested across the five categories of projects (Figure 2). Other analytes included cotinine, polychlorinated biphenyls, phthalate metabolites, polybrominated diphenyl ethers, polychlorinated dibenzodioxins, polychlorinated dibenzofurans, bisphenol A, triclosan, selenium, uranium, perfluorinated compounds, parabens, benzophenone, manganese, and antimony.

Strengths and Limitations

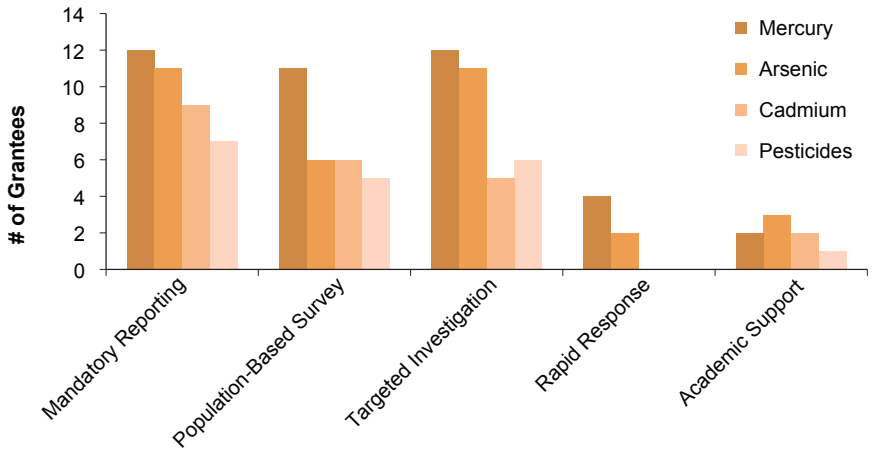
Tracking Program states have conducted a wide variety of biomonitoring activities. A number of grantees have conducted mandatory reporting, population-based surveys, or targeted investigations for the same chemicals. Results from these similar projects could be compared across states or provide a reference for other states with similar projects. Laboratory methods may differ from state to state, different study populations were used in different projects (e.g., adult vs. infant or child populations), and the type of sampling used also differed (e.g., probability vs. nonprobability sampling), however. Most projects used nonprobability or convenience sampling methods. This limits the data that could be compared across states. Only two respondents documented biomonitoring projects in support of academic research. This taskforce project likely did not capture all existing projects in this category, however.

Next Steps

More work remains to be done to further develop the biomonitoring module on the Tracking Network. A next step is to determine how best to present the results of the state biomonitoring data project on the Tracking Network. One example could be presenting information about these projects to facilitate collaboration with researchers. Another next step is expanding the analytes from the *National Report on Human Exposure to Environmental Chemicals* presented on the Tracking Network, for example, to include pesticides analytes, which were some of the most frequently measured analytes in state biomonitoring projects. These pesticide measurements can provide a national reference for data collected at the state level.

FIGURE **2**

Analytes Most Frequently Measured by Project Category



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