State-based Biomonitoring Programs and NHANES Exposure Data

Kristin Dortch, MS
Project Officer, State Biomonitoring Cooperative Agreement
Division of Laboratory Sciences

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Disclosures

The following personal financial relationships with commercial interests relevant to this presentation existed during the past 12 months:

I have no relationships to disclose
THE NATIONAL BIOMONITORING PROGRAM
National Biomonitoring Program

Provide laboratory science that improves the detection, diagnosis, treatment, and prevention of disease resulting from exposure to environmental chemicals

- New and improved, high-quality biomonitoring methods for priority environmental chemicals.
- Assessment of U.S. population’s exposure to priority environmental chemicals using ongoing biomonitoring of NHANES participants.
- High-quality biomonitoring measurements in more than 65 studies per year to determine safe and harmful human exposure levels.
- Effective laboratory support for CDC emergency responses that involve known or potential exposure to environmental chemicals.
- Analytical support, training, and technology transfer to state and local laboratories to support investigations of known and potentially harmful exposures.
NHANES: How we assess exposure of the U.S. population to priority environmental chemicals

- **National Health and Nutrition Examination Survey (NHANES)**
  - Began in 1971
  - Continuous survey since 1999 (survey cycle = 2 years)
  - Stratified, multistate national probability samples
  - About 10,000 participants in 30 locations every 2 years

- **Methods**
  - Face-to-face and computer-assisted interviews:
    - Demographics
    - Socioeconomic
    - Dietary
    - Health-related topics
  - Physical examination
  - Biological specimen collection

More at: [http://www.cdc.gov/nchs/nhanes/about_nhanes.htm](http://www.cdc.gov/nchs/nhanes/about_nhanes.htm)
National Report on Human Exposure to Environmental Chemicals and Updated Tables

- The most comprehensive assessment of Americans’ exposure to environmental chemicals
- Biomonitoring data for 300+ chemicals including pesticides, metals, and chemicals in everyday products
- Establishes national exposure levels and trends over time
- Used by scientists and public health officials to identify harmful exposures
- Updated with new biomonitoring results every year
Updated Tables, January 2017

- Updated Tables reported in 2 volumes
  - Volume 1 – U.S. general population
  - Volume 2 – Pooled samples, adult cigarette smokers and nonsmokers
    - POPs and pesticides in individual and pooled samples
    - Data for special sample of adult smokers and nonsmokers

- Presents data for 304 chemicals
  - 20 reported for the first time
  - 96 with updated data since Updated Tables, February 2015
Recent Changes

- Urine collected from ages 3 years and older starting in 2015
- Identifies Non-Hispanic Asian and All Hispanic racial/ethnic groups (NH 2011-12)
- Special sample of Adult Smokers and Non-smokers
- Pooled Samples (NH 2005-06)
  - PCBs, dioxins, furans, organochlorine pesticides, PBDEs

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Blood (mL)</th>
<th>Urine</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>9</td>
<td>No</td>
</tr>
<tr>
<td>3-5</td>
<td>22</td>
<td>Yes</td>
</tr>
<tr>
<td>6-11</td>
<td>38</td>
<td>Yes</td>
</tr>
<tr>
<td>12+</td>
<td>89-92</td>
<td>Yes</td>
</tr>
</tbody>
</table>

metals: Pb, Cd, Hg, Mn, Se (1+); cotinine (3+); POPs, VOCs, PFCs (12+)

As of 2015
Metals & NPs Nutrition markers
NATIONAL EXPOSURE TRENDS OVER TIME
Exposure to PFOS

- PFOS precursors phased out (2000-02)
- PFOS human levels reduced by 83% since 1999-2000
Exposure to Phthalates & Organophosphate Insecticides

- DiNP increasing (↑265%)
- DEHP decreasing (↓-67%)
  - Legislative actions & public scrutiny

- 1996 FQPA
- Phase-out residential use of chlorpyrifos (2000-1)

[www.cdc.gov/exposurerreport](http://www.cdc.gov/exposurerreport)
Secondhand Smoke Exposure in US Population

NHANES Serum Cotinine Trend: 1988-2012

Geometric Mean ± 95% CI

84% decline 1988-2012
STATE BIOMONITORING PROGRAMS
State Biomonitoring program is to increase the capability and capacity of state public health laboratories to conduct high-quality biomonitoring science and assess human exposure to environmental chemicals within their jurisdictions.
# 2001-2002 Planning Grant

![Map of the United States highlighting states and consortia](image)

## States

- **Non-participating states**
- **Individually-funded states**

## Consortia

- **Rocky Mountain Consortium**
- **Minnesota, North Dakota, and South Dakota Consortium**
- **Georgia and South Carolina Consortium**

**Consortium Lead**

Washington, DC
2009-2014
State Biomonitoring Cooperative Agreement
2014-2019
State Biomonitoring Cooperative Agreement
2014-2019
State Biomonitoring Cooperative Agreement

Key Outcome
• High-quality, substantial, and previously unavailable state-specific exposure information using biomonitoring

Collaborations
• Strategic partnerships encouraged to maximize use of resources and improve sustainability of state biomonitoring programs

Existing infrastructure
• Pre-existing equipment and ability to conduct biomonitoring science

Funding awarded to six states or consortia
• Purchase laboratory equipment, hire and train staff, conduct fieldwork and data analysis, communicate results to study participants

Non-Financial CDC Support
• Technical Support, Grantee Meetings, Quality Assurance Programs
Developing Biomonitoring Capabilities

**Epidemiology**
- Participant recruitment and enrollment process
- IRB approval
- Data collection and management system
- Reporting results back to participants
- Advisory panel

**Laboratory**
- Develop, standardize and validate methods
- Sample processing
- Laboratory analysis
### Your Urinary Arsenic and Uranium Test Results
Compared with Participants in this Study and with National Averages

<table>
<thead>
<tr>
<th>Analyte Tested</th>
<th>Your Results (µg/g creatinine*)</th>
<th>Test Completion Date</th>
<th>Levels of Others in this Study (µg/g creatinine)</th>
<th>Levels in the U.S. Population (µg/g creatinine)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>50&lt;sup&gt;th&lt;/sup&gt; Percentile</td>
<td>95&lt;sup&gt;th&lt;/sup&gt; Percentile</td>
</tr>
<tr>
<td>Total Arsenic</td>
<td></td>
<td></td>
<td>6.39</td>
<td>50.4</td>
</tr>
<tr>
<td>Uranium</td>
<td></td>
<td></td>
<td>0.007</td>
<td>0.029</td>
</tr>
</tbody>
</table>

* (µg/g creatinine) = micrograms per gram creatinine

**Note:** "Below Reporting Limit" indicates that your arsenic level was less than the level the laboratory can accurately measure. "<LOD" indicates the results were less than the limit of detection (LOD). This means the results were less than the lowest level that can be detected by the laboratory.

*Creatinine is a protein that is excreted in your urine. By measuring the amount of creatinine in your urine, we can account for how diluted your urine is (i.e., how well hydrated you are).

* U.S. population numbers are from the *Fourth National Report on Human Exposure to Environmental Chemicals*, Updated Tables (February, 2015).

*<sup>50</sup> Percentile: The level that 50% of the participants tested at or below. 95<sup>th</sup> Percentile: The level that 95% of the participants tested at or below.

*Additional testing was performed if your Total Arsenic result was greater than or equal to 20µg/g creatinine. This is to determine the types of arsenic in your urine. If your Total Arsenic result was less than 20µg/g creatinine, then no further testing was done. See attached report for additional test results.
Measuring Analytes in Maternal Archived Serum (MAMAS)

- Assess exposure to metals, PFAS, PBDEs, PCBs, and OCPs during pregnancy using archived maternal serum specimens

Foam Replacement Environmental Exposure Study (FREES)

- Compares levels of PBDEs and OPFRs in participants before and after foam furniture replacement

Asian/Pacific Islander Community Exposures (ACE) Project

- Assess exposure to metals and PFAS in 60 Chinese adults living in San Francisco Bay Area

- www.biomonitoring.ca.gov
New Hampshire

Biomonitoring New Hampshire

• Measure total arsenic and uranium in 500 residents of southern New Hampshire who rely on private bedrock wells for drinking

State – Wide Surveillance Study

• Measure chemical contaminants of concern in blood and urine for metals, cotinine, pesticide metabolites and PFAS in a statewide population

New Hampshire PFAS Response

• NH facilitated specimen collection, processing, shipment and results reporting for 1587 individuals tested for PFAS exposure as the result of drinking contaminated water at the Pease Tradeport

http://www.dhhs.nh.gov/dphs/lab/biomonitoring.htm
Virginia

The Exposure of Virginia Residents to Toxic Metals and Perchlorate

- Assess exposure to toxic metals and perchlorate in the general population in Virginia

The Exposure of Firefighters to Toxic Combustion Products

- Coordinate with Virginia Department of Fire programs to assess exposure to cyanide and PAH metabolites in firefighters

http://dgs.virginia.gov/DivisionofConsolidatedLaboratoryServices/VABiomonit
ingProgram/tabid/1550/Default.aspx
Four Corners State Biomonitoring Consortium (Utah, New Mexico, Colorado, Arizona)

Private Well Drinking Water Metal’s Contamination Study
  • Assess exposure of heavy metals in private wells in Utah, New Mexico and Arizona

The Exposure of Four Corner States Resident’s to Metals, Pesticides and Consumer Products
  • Assess exposure of 2,4-dichlorophenoxyacetic acid (2,4-D) containing herbicide
  • P-dichlorobenzene (p-DCB) contaminates found in disinfectants, deodorants and some kinds of pesticides
  • Phthalate contaminates in food and domestic products
  • Pyrethroid-containing insecticides

San Luis Valley Children’s Study
  • Study of chemical exposures in 3 to 13 year old children in the San Luis Valley

http://www.4csbc.org/
Massachusetts

Biomonitoring Massachusetts Study

• Population-based sampling system Behavioral Risk Factor Surveillance System Survey (BRFSS) to recruit participants and assess exposure to metals and polychlorinated biphenyls (PCBs)

Identify Targeted Sample of Massachusetts Population

• Assess exposure to metals in vulnerable populations in the Boston area

Respond to Acute Chemical Exposure Incidents

• Rapid response to accidental mercury exposure for three separate incidents
New Jersey

Environmental Contaminant Levels in Blood and Urine Specimens from New Jersey Clinical Laboratories and Blood Banks

• Developed strategic partnerships to collect samples representative of the state population to assess exposure to PFAS, PCBs and metals

Assessing PFNA Body Burdens Following Drinking Water Intervention

• Monitor an individual’s exposure to PFAS over a three-year period in targeted communities suspected of elevated levels in drinking water

Assessing Environmental Exposure of Expecting Women in New Jersey to Toxic Metals, PCBs, and PFAS

• Intervention in pregnant women exposed to environmental contaminants and assessing outcomes
Previously CDC Funded States

New York

New York PFAS Response

- Assessment exposure to PFOA in Hoosick Falls residents in contaminated water through development of rapid high quality analytical method for 11 PFAS.

  *Journal of Chromatography B, 1049-1050 (2017) 24-29*

- **Washington**

  - Analytical capabilities for metals, phthalates, and creatinine for NIH research studies and public health departments.
Biomonitoring Across the US

Minnesota

Michigan

and many more!...
Future Directions

- Continued state support
- Communicate program successes
- Expanded proficiency program (BQASP)
- National Biomonitoring Network
- New FOA in 2019!

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- APHL
Questions?

Contact Information:
Kristin Dortch
Kdortch@cdc.gov
770-488-0346

For more information, contact NCEH
1-800-CDC-INFO (232-4636)
Follow us on Twitter @CDCEnvironment

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