

# CDC's National Biomonitoring Program

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# Over Thirty Years of Biomonitoring

- State-of-the-art facilities
- Highly trained staff
- Advanced analytical instruments



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# Biomonitoring

Direct assessment of people's exposure to chemicals by measuring the chemicals or their metabolites in blood or urine.

- Indicator of internal dosage
- Inclusive of multiple exposure routes
- Individual measurement, not an average environmental estimate



# Applications of Biomonitoring

- In Risk Assessment
  - Animal dose-level-effect comparisons
  - Human dose estimation
- In Human Research
  - Exposure assignment
  - Benchmarking (e.g., blood Pb)



# Applications of Biomonitoring (cont.)

- In Clinical Settings
  - Clinical poisoning or suspect exposure
  - Occupational exposures (e.g., BEI)
- In Public Health
  - Exposure assignment or case definition in epidemiologic studies
  - Estimate prevalence of unusual exposures
  - Population surveys (e.g., National Exposure Report)



# The National Exposure Report

- National Health and Nutrition Examination Survey (NHANES)
  - Run by CDC's NCHS since 1971
  - Stratified, multistage, national probability sample
  - 8000 people every 2 years (since 1999)
  - 30 localities via mobile examination centers
- Data collected:
  - Extensive questionnaire on demographics, diet, health behaviors, medical conditions
  - Physical examination
  - Medical and nutritional laboratory tests



# The National Exposure Report (cont.)

- Blood or urine sampled from NHANES participants
  - A random 1/3<sup>rd</sup> subsample (most chemicals)
  - Sample size ~2500
  - Third Report (2005) included over 350,000 high-quality analyses
- Descriptive
  - Geometric means, percentiles, and confidence intervals
  - Age, gender, race/ethnicity



## Table 11. Cadmium in urine (creatinine corrected)

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the U.S. population aged 6 years and older, National Health and Nutrition Examination Survey, 1999-2002.

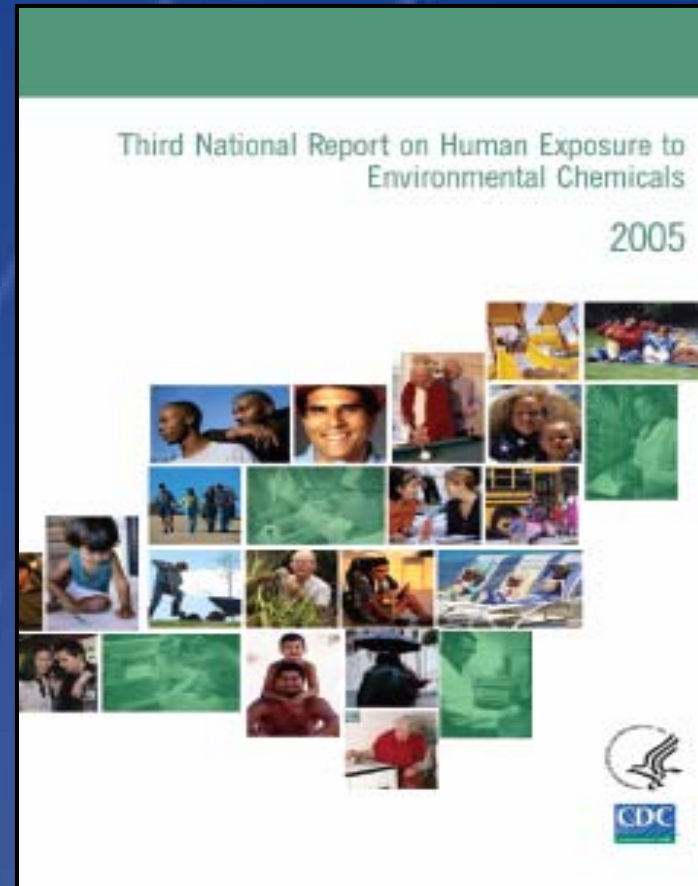
	Survey years	Geometric mean	Selected percentiles				Sample size
		(95% conf. interval)	(95% confidence interval)				
			50th	75th	90th	95th	
<b>Total, age 6 and older</b>	99-00	<b>.181</b> (.157-.209)	<b>.219</b> (.199-.238)	<b>.423</b> (.391-.446)	<b>.712</b> (.645-.757)	<b>.933</b> (.826-1.07)	2257
	01-02	<b>.199</b> (.181-.218)	<b>.212</b> (.194-.232)	<b>.404</b> (.377-.440)	<b>.690</b> (.630-.754)	<b>.917</b> (.813-.998)	2689
<b>Age group</b>							
6-11 years	99-00	*	<b>.085</b> (.063-.107)	<b>.147</b> (.123-.182)	<b>.210</b> (.171-.316)	<b>.300</b> (.184-.607)	310
	01-02	<b>.075</b> (.059-.094)	<b>.100</b> (.083-.112)	<b>.166</b> (.136-.192)	<b>.233</b> (.206-.281)	<b>.291</b> (.221-.440)	368
12-19 years	99-00	<b>.071</b> (.051-.098)	<b>.093</b> (.084-.106)	<b>.147</b> (.130-.163)	<b>.215</b> (.204-.240)	<b>.283</b> (.222-.404)	648
	01-02	<b>.078</b> (.067-.091)	<b>.091</b> (.085-.101)	<b>.136</b> (.123-.143)	<b>.191</b> (.175-.234)	<b>.280</b> (.234-.321)	762
20 years and older	99-00	<b>.267</b> (.247-.289)	<b>.288</b> (.261-.304)	<b>.484</b> (.433-.545)	<b>.769</b> (.727-.818)	<b>1.07</b> (.927-1.17)	1299
	01-02	<b>.261</b> (.236-.289)	<b>.273</b> (.247-.303)	<b>.481</b> (.426-.518)	<b>.776</b> (.691-.850)	<b>.979</b> (.874-1.12)	1559
<b>Gender</b>							
Males	99-00	<b>.154</b> (.131-.182)	<b>.174</b> (.158-.191)	<b>.329</b> (.293-.382)	<b>.617</b> (.537-.700)	<b>.788</b> (.696-.929)	1121
	01-02	<b>.159</b> (.143-.177)	<b>.168</b> (.157-.182)	<b>.334</b> (.304-.364)	<b>.532</b> (.491-.653)	<b>.757</b> (.690-.856)	1334
Females	99-00	<b>.211</b> (.170-.261)	<b>.267</b> (.239-.308)	<b>.473</b> (.423-.551)	<b>.783</b> (.690-.917)	<b>1.09</b> (.813-1.38)	1136
	01-02	<b>.245</b> (.216-.278)	<b>.263</b> (.228-.297)	<b>.479</b> (.414-.541)	<b>.792</b> (.687-.884)	<b>.985</b> (.876-1.16)	1355
<b>Race/ethnicity</b>							
Mexican Americans	99-00	<b>.175</b> (.137-.223)	<b>.181</b> (.144-.225)	<b>.331</b> (.266-.418)	<b>.612</b> (.441-.828)	<b>.843</b> (.674-1.13)	780
	01-02	<b>.156</b> (.136-.178)	<b>.170</b> (.150-.184)	<b>.282</b> (.263-.340)	<b>.501</b> (.388-.614)	<b>.693</b> (.507-.839)	682
Non-Hispanic blacks	99-00	<b>.183</b> (.140-.240)	<b>.201</b> (.168-.241)	<b>.414</b> (.343-.472)	<b>.658</b> (.516-.827)	<b>.873</b> (.722-.962)	546
	01-02	<b>.190</b> (.156-.232)	<b>.195</b> (.174-.225)	<b>.385</b> (.336-.449)	<b>.676</b> (.559-.850)	<b>.917</b> (.725-1.08)	667
Non-Hispanic whites	99-00	<b>.175</b> (.146-.209)	<b>.219</b> (.191-.250)	<b>.432</b> (.387-.470)	<b>.729</b> (.666-.783)	<b>1.00</b> (.826-1.16)	760
	01-02	<b>.205</b> (.184-.229)	<b>.224</b> (.208-.242)	<b>.421</b> (.382-.470)	<b>.719</b> (.668-.784)	<b>.931</b> (.806-1.05)	1132

\* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

# Third National Exposure Report (2005)

148 Chemicals

- 38 new chemicals
- One new class
  - Pyrethroid pesticides
- Additions w/in class
  - PAHs
  - Aldrin, dieldrin, endrin
  - Phthalate metabolites
  - Dioxins, furans and PCBs
  - Pesticides and herbicides



[www.cdc.gov/exposurereport](http://www.cdc.gov/exposurereport)



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# Fourth National Exposure Report

~ 275 Chemicals

## New chemicals:

- Speciated arsenic
- Polybrominated diphenyl ethers
- Fungicides
- Substituted Urea Herbicides
- Some new pesticides and metabolites
- Environmental Phenols
- Perfluorinated chemicals
- Volatile Organic Compounds
- Perchlorate
- Acrylamide

Anticipated release in late 2008



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# Caveats About the National Exposure Report

- The presence of a chemical does not imply disease.
  - More research is needed
  - It is an exposure report
- Only aggregate levels (statistical point estimates) are representative of the U.S population.

*An individual's levels are not representative and limited by:*

  - Collection timing
  - Inter-individual differences: kinetics, body size, other
  - Unique rather than ubiquitous exposure
- Data are not representative of:
  - Locations, unexamined special groups, seasons, products



# Expediting the Release of Biomonitoring Exposure Information

## A One-Stop Source for Program Information

[www.cdc.gov/exposurereport](http://www.cdc.gov/exposurereport)

The screenshot shows a web browser window displaying the CDC website. The address bar shows <http://www.cdc.gov/exposurereport/>. The page title is "CDC - National Report on Human Exposure to Environmental Chemicals | CDC - Wi". The browser interface includes a search bar with "Google" and "Go" buttons, and several tabs are open, including "Employee Communicati..." and "CDC - National Repor...".

The website content is organized into several sections:

- Environmental Health**: A sidebar menu with links to "Division of Laboratory Sciences", "National Report on Human Exposure to Environmental Chemicals", "Report Home", "Third Report", "Additional Process for Reporting Biomonitoring Results", "Biomonitoring Results Since the Third Report", "Chemical Nomination Process", "Publications and Products", "Order the Report", "About CDC's Environmental Health Laboratory", and "Contact Us".
- DIVISION OF LABORATORY SCIENCES**: The main header for the current section.
- National Report on Human Exposure to Environmental Chemicals**: The main title of the report.
- Biomonitoring Results Since the Third Report**: A sub-section with a photo of a woman and text stating: "Since the release of the *Third Report*, the Centers for Disease Control and Prevention (CDC) has published these articles on biomonitoring results for the U.S. population in the peer-reviewed literature...[more](#)".
- Recent Additions**: A list of three articles:
  - Serum Concentrations of Polybrominated Diphenyl Ethers (PBDEs) and Polybrominated Biphenyl (PBB) in the United States Population: 2003-2004** (NEW) by Sjödin A, Wong LY, Jones RS, Park A, Zhang Y, Hodge C, DiPietro E, McClure C, Turner WE, Needham LL, Patterson DG Jr.
  - Urinary Concentrations of Triclosan in the U.S. Population: 2003-2004** by Calafat AM, Ye X, Wong LY, Reidy JA, Needham LL.
  - Exposure of the U.S. Population to Bisphenol A and 4-tertiary-Octylphenol: 2003-2004** by Calafat AM, Ye X, Wong LY, Reidy JA, Needham LL.
- more**: A link to view more recent additions.
- CDC's National Report on Human Exposure to Environmental Chemicals**: A paragraph explaining that the report provides an ongoing assessment of the U.S. population's exposure to environmental chemicals using biomonitoring. Biomonitoring is defined as the assessment of human exposure to chemicals by measuring the chemicals or their metabolites in human specimens such as blood or urine.
- Third Report**: A link to the *Third Report* with the text: "The *Third Report* presents first-time exposure information for the".
- WEB SITE TOOLS**: A section with "External links to free software tools:" and lists of "Adobe Downloads" (Acrobat Reader, Flash Player) and "Microsoft Downloads" (PowerPoint Viewer, Word Viewer).
- Quick Links**: A list of links to "Division of Laboratory Sciences", "National Biomonitoring Program", "National Center for Environmental Health", and "National Health and Nutrition Examination Survey".
- Key Resources**: A list of links to "Executive Summary" (Full Color PDF 3.7MB), "Full Report" (Full Color PDF 3MB), and "Biomonitoring: Making a Difference" (Flash Presentation).
- Utility Links**: "Email this page", "Printer-friendly version", and "Get email updates New!".



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# Biomonitoring Results at [www.cdc.gov/exposurereport](http://www.cdc.gov/exposurereport)

[www.cdc.gov/exposurereport/biomonitoring\\_results.htm](http://www.cdc.gov/exposurereport/biomonitoring_results.htm)

- Brominated Flame Retardants

Serum Concentrations of Polybrominated Diphenyl Ethers (PBDEs) and Polybrominated Biphenyl (PBB) in the United States Population: 2003-2004. *Sjodin et al. Environ Sci Technol 2008;42:1377-84.*

- Environmental Phenols

Urinary Concentrations of Triclosan in the U.S. Population: 2003-2004. *Calafat et al., Environ Health Perspect 2008;116:303-7.*

Exposure of the U.S. Population to Bisphenol A and 4-*tertiary*-Octylphenol: 2003-2004. *Calafat et al. Environ Health Perspect 2008 ; 116:39-44.*



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# Biomonitoring Results at [www.cdc.gov/exposurereport](http://www.cdc.gov/exposurereport)

[www.cdc.gov/exposurereport/biomonitoring\\_results.htm](http://www.cdc.gov/exposurereport/biomonitoring_results.htm)

- Perfluorinated Compounds

Polyfluoroalkyl Chemicals in the U.S. Population: Data from the National Health and Nutrition Examination survey (NHANES) 2003-2004 and Comparisons to NHANES 1999-2000. *Calafat et al., Environ Health Perspect 2007;115:1578-83.*

Serum Concentrations of 11 Polyfluoroalkyl Compounds in the U.S. Population: Data from the National Health and Nutrition Examination Survey (NHANES) 1999-2000. *Calafat et al., Environ Sci Technol 2007;41:2237-42.*



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# Biomonitoring Results at [www.cdc.gov/exposurereport](http://www.cdc.gov/exposurereport)

[www.cdc.gov/exposurereport/biomonitoring\\_results.htm](http://www.cdc.gov/exposurereport/biomonitoring_results.htm)

- Perchlorate

Perchlorate Exposure of the U.S. Population, 2001-2002.

*Blount, et al. Environ Health Perspect 2006;114:1865-71.*

Urinary Perchlorate and Thyroid Hormone Levels in Adolescent and Adult Men and Women Living in the United States. *Blount et al. J Expo Sci Environ Epidemiol 2006;10:1-8.*



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# Summary

- Biomonitoring has useful applications
- The National Exposure Report assesses exposure to environmental chemicals in the U.S. population
- Recent publications are available at [www.cdc.gov/exposurereport](http://www.cdc.gov/exposurereport)



Thank You



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