

CDC's National Report on Human Exposure to Environmental Chemicals Update

Christopher J. Borgert

Applied Pharmacology & Toxicology, Inc.

And

Department of Physiological Sciences, Univ. FL
Gainesville, FL

1

What is CDC's National Exposure Report?

- Ongoing assessment of chemical concentrations by biomonitoring in U.S. population
 - Blood and urine from NHANES participants
 - Regionalized and randomized sampling
- Uses definitive reference methods
 - LC/MS/MS, GC/MS/MS, GC/HRMS, ICP/MS
 - Isotope internal standardization (^{13}C , ^2H)
 - Multi-analyte methods

2

NHANES Samples

- National Health and Nutrition Examination Survey
 - A series of surveys conducted by CDC's National Center for Environmental Health Statistics (NCHS)
 - Collects data on a variety of topics, such as infectious diseases, genetically-acquired diseases, cardiovascular health, etc.
 - 1999 data obtained from only 12 locations

3

1st National Exposure Report

- First Report (2001): 27 chemicals
 - OP pesticides (alkyl phosphate metabolites)
 - Heavy metals
 - Phthalate metabolites
 - Cotinine
- Data generally presented as
 - Geometric means
 - 10th, 25th, 50th, 75th, and 90th percentiles

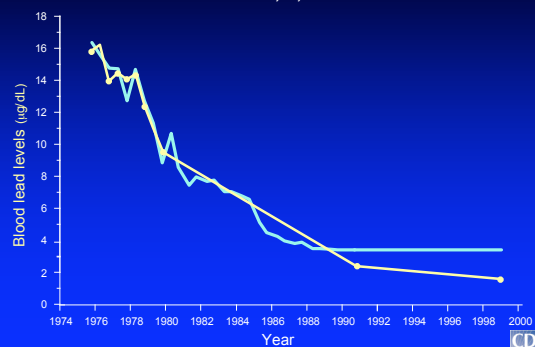
4

Background & Prior Activity

- Numerous prior investigational studies by NCEH/DLS
 - PCBs, dioxins, phthalates, metals, pesticides, volatile organic compounds
 - Subsamples of NHANES
- National efforts
 - 1976-1980 Lead
 - 1982-1984 Lead
 - 1988-1994 Lead, cadmium, cotinine

5

Blood lead levels in the U.S. population 1976 -1999
NHANES II, III, 1999+



2nd National Exposure Report

What is new in *Second Report*?

- Release date: January 2003
- Combined 1999-2000 data
- Total of 116 chemicals: original 27 plus 89 additional chemicals
- Inclusion of categorization by age, sex, race
- <http://www.cdc.gov/exposurereport/>

Future reports in 2-yr. Increments

- e.g. 2001-2002; 2003-2004; 2005-2006
 - provide adequate sampling sizes
 - sufficient time increment to reveal trends.

7

Chemical Groups in 2nd Report

- Current: OP alkyl phosphate metabolites, Heavy metals, phthalate metabolites, cotinine
- Dioxins, furans, coplanar PCBs, non-coplanar PCBs
- Polycyclic aromatic hydrocarbon metabolites
- Organochlorine pesticides and metabolites
- Specific pesticide metabolites
- Phytoestrogens

8

Selection of Chemicals

Criteria

- Independent scientific data suggesting exposure potential *is changing*
- Seriousness of known or suspected health effects
- Proportion of U.S. population at risk
- Need to assess efficacy of public health actions to reduce exposure
- Existence of good analytical method for blood or urine
- Incremental analytical costs

9

Nominations

- Fed. Reg. Vol 67, No. 194. Oct 7, 2002 - solicited nominations, will apply criteria
- Draft list of nominated chemicals released first week of July, 2003
- Many redundant nominations
- All congeners not included in list
- Under review by an expert panel - to finalize in August, 2003
 - No opportunity for public comment
- <http://www.cdc.gov/exposurereport/>

10

National Exposure Report

- *Uses of the Report*
 - Characterize U.S. exposure
 - Serve as reference range for other exposures
 - Identify prevalence of high exposures
 - Identify time trends and effectiveness of public health interventions
 - Identify certain groups with greater exposures, e.g., age groups, sexes, races
 - Set priorities and context for human health research

11



Interpretation: Caveats

- The presence of a chemical does not imply disease
- Better science is needed to characterize relationships of
 - Concentration-exposure
 - Concentration-effect
- High or low levels in a population may result from
 - Sampling times
 - Interindividual differences: kinetics, body size, other
 - Exposure

12



Interpretation: Caveats

- NHANES provides estimates for the civilian, non-institutionalized U.S. population; It cannot support city-to-city or state-to-state comparisons.

– More on this later

13

Interpretation: Modifying Factors

- What is the application or question?
 - Descriptive population data: CDC's Exposure Report
 - Exposure confirmation and diagnostic use
 - Risk estimates
- What toxic links are missing?

14 

Interpretation Summary

- Who is exposed? To how much?
 - Surveys such as CDC's *National Report on Human Exposure to Environmental Chemicals* can help
 - Need wider application
- Who is at risk?
 - Science is needed to establish concentration-effect relationships

15 

Protocol

- Home interview
- Standardized physical examination @ mobile center
- Blood sample: 1 yr. & older
 - Venupuncture
- Urine sample: 6 yr. & older
- Environmental chemicals sampled in randomly selected sub-samples within specific age groups.
 - Specifics on page 5 of 2nd Report (2003)

16

Demographics

- reference ranges for all 116 chemicals included in the 2nd Report
- separate reference ranges for population subgroups
 - African- & Mexican-Americans,
 - adolescents, (12-19 yrs.) & seniors (60 yrs. +)
 - pregnant women
 - low-income whites

17

Results: Lead, Cotinine

- Decline in number of children with elevated blood lead levels.
- Cotinine levels
 - Decreased 1991-1994 to 1999-2000:
 - 58% for children
 - 55% for adolescents
 - 75% for adults.
 - However, in 1999-2000, cotinine levels in children were more than twice those of adults.
 - Non-Hispanic blacks had levels more than twice those of Mexican Americans and non-Hispanic whites.

18

Results: DDT & Metabolites

- Serum DDE levels three times higher among Mexican Americans than among non-Hispanic whites or non-Hispanic blacks.
- DDE levels are clearly measurable in people aged 12-19 years, even though they were born after DDT was banned in the United States.
- DDT levels presented in the *Report* are clearly lower compared with levels found in several smaller studies of DDT exposure among selected groups in the United States before 1990.

19

Results: PCDDs, PCDFs, PCBs / Phthalates

- Dioxins, dibenzofurans, PCBs, most people had levels below the LOD
 - Most blood samples inadequate (too small)
 - Larger samples planned in future
- Phthalates
 - Levels generally low, many below LOD
 - Similar to results reported from a non-random sampling of NHANES III data (Blount et al. 2000)
 - Several differences for individual phthalates (metabolites) with respect to age, gender, ethnicity
 - Could be due to differences in exposure, body-size relationships, or metabolism.

20

Results: Chlorpyrifos

- Urine levels for the major metabolite of chlorpyrifos (i.e., 3,5,6-trichloro-2-pyridinol) in 1999-2000 sampling to be used as reference range for future *Reports*
 - assess the effectiveness of the recent restriction on chlorpyrifos use in reducing exposure of the U.S. population.
- Children's levels about twice as high as adults.

21

Interpretation: Caveats

- NHANES cannot support city-to-city or state-to-state comparisons.
 - *More on this Next*

22

National Health Tracking Network

- Senate Bill 2054
- -Nationwide Health Tracking Act of 2002
- "develop operate and maintain Nationwide and State Health Tracking Networks"
- "can more effectively monitor, investigate, respond to, research, understand and prevent increases in the incidence and prevalence of certain chronic diseases and relevant environmental, behavioral, socio-economic, demographic, and other risk factors."

23

National Health Tracking Network - Objectives

- Identify populations at risk and respond to outbreaks, clusters and emerging threats;
- **Establish the relationship between environmental hazards and disease;**
- Guide intervention and prevention strategies, including lifestyle improvements;
- Identify, reduce and prevent harmful environmental risks;

24

Network Components

- national baseline tracking network for diseases and exposures;
- nationwide early warning system for critical environmental health threats;
- state pilot tracking programs to test for diseases, exposures and approaches for national tracking;
- federal investigative response capability;
- tracking links to communities and research.

25

State Activity

25 State Planning Grants - 33 States

- South Carolina/Georgia
- New Hampshire
- Florida
- Tennessee
- District of Columbia
- Virginia
- New York
- Connecticut
- New Jersey
- North Carolina
- Massachusetts
- Rhode Island

26

State Activity

25 State Planning Grants - 33 States

- Wisconsin
- Washington
- Rocky Mountain Consortium
- Missouri
- Minnesota
- Louisiana
- Iowa
- Michigan
- Illinois
- California
- Arkansas
- Alaska

27