Is it safe? New ethics for reporting personal exposures

Ruthann Rudel and Julia G. Brody
Biomonitoring California Workshop on Understanding and Interpreting Biomonitoring Results
March 17, 2011
Oakland, CA
Outline

**Communicating uncertain science**

- Our exposure and report back experience
- Ethics – moving beyond possible harms
- Six questions
- Matching messages to evidence
- Opportunities - who is high and why?
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Household Exposure Study

• 170 homes
Household Exposure Study

- 150 compounds
- 89+ endocrine disruptors
- Air
- Dust
- Urine

Rudel et al., ES&T, 2003
Brody et al., AJPH, 2009
Rudel et al., ES&T, 2010
How to read your results

- Each o represents one other home in the study.
- Is the sample from your home.
- X is the EPA Guideline.

DEHP common uses: Plastics, inks, insect repellant, cosmetics, rubbing alcohol, liquid soap, detergents, lacquers, munitions, industrial lubricant.

Chemical abbreviation (di(2-ethylhexyl) phthalate)

Brody et al. AJPH, 2007
Pollution Comes Home and Gets Personal: Women’s Experience of Household Chemical Exposure*

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With science uncertain...

- What (if anything) should researchers tell study participants about their own results?
  - Could reporting individual results to study participants do more harm than good?
CDC’s Second National Report on Human Exposure to Environmental Chemicals: Background

The National Report on Human Exposure to Environmental Chemicals is an ongoing assessment of the exposure of the U.S. population to environmental chemicals using biomonitoring. The first Report on 27 chemicals was issued in March 2001. This Second Report, released in January 2003, presents blood and urine levels of 116 environmental chemicals from a sample of people that represent the noninstitutionalized, civilian U.S. population during the two-year period 1999-2000.

Scientists from CDC’s Environmental Health Laboratory measured chemicals or their metabolites (breakdown products) in blood and urine samples from selected participants in the National Health and Nutrition Examination Survey (NHANES). Conducted by CDC’s National Center for Health Statistics, NHANES is a series of surveys designed to collect data on the health and nutritional status of the U.S. population.

For this Report, an environmental chemical means a chemical compound or chemical element that is present in air, water, food, soil, dust, or other environmental media. Biomonitoring is the assessment of human exposure to chemicals by measuring the chemicals or their metabolites (breakdown products) in human specimens such as blood or urine. Blood and urine levels reflect the amount of the chemical in the environment that actually gets into the body.

Public Health Uses of the Report

The overall purpose of the Report is to provide unique exposure information to physicians, scientists, and health officials to help prevent disease that results from exposure to environmental chemicals. The following are specific public health uses of the exposure information in the Second Report:

- To determine which chemicals get into Americans and at what concentrations.
- For each chemical with a known toxicity level, to determine the prevalence of people with levels above that toxicity level, e.g., a blood lead level greater than or equal to 10 micrograms per deciliter (µg/dL).
- To establish reference ranges that can be used by physicians and scientists to determine whether or not a person or group of people has an unusually high exposure.
- To assess the effectiveness of public health efforts to reduce exposure of Americans to specific chemicals.
- To determine whether exposure levels are higher among minorities, children, women of childbearing age, or other potentially vulnerable groups.
- To track, over time, trends in levels of exposure in the population.
- To set priorities for research on human health effects.

Interpreting Data in the Report

Just because people have an environmental chemical in their blood or urine does not mean that the chemical causes disease. The toxicity of a chemical is related to its dose or concentration. Small amounts may be of no health consequence, whereas larger amounts may cause disease. Research studies, separate from the Report, are required to determine which levels of a chemical may cause disease and which levels are of negligible health concern. For some chemicals, such as lead, research studies provide a good understanding of health risks associated with various blood levels. For most of the environmental chemicals in the Second Report, more research is needed to determine whether exposure to the chemical at levels reported here is a cause for health concern. CDC conducts such research and provides biomonitoring measurements for this type of research in collaboration with other agencies and institutions.

The Second Report presents data collected to provide estimates of exposure for the civilian, noninstitutionalized U.S. population. The current survey design does not permit us to estimate exposure on a state-by-state or city-by-city basis. For example, it is not possible to extract a subset of data and examine levels of blood lead that represent a state population.
Why talk about science-in-progress?

Responsible communication is a human research ethical responsibility

To minimize harm, maximize benefit, support autonomy and justice
Human research ethics criteria

- **Possible harm**
  - Emotional distress
  - Individual privacy, community stigma
  - Expense, legal effect, ineffective action

- **Possible benefit**
  - Informed action
  - Environmental health literacy
  - Validate health concerns

- **Autonomy**
  - Ability to act consistent with own values

- **Justice**
  - Information disparity / power disparity
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Is It Safe?

- What did you find?
- How much?
- Is that high?
- Is it safe?
- Where did it come from?
- What should I do?
How to read your results

Each ● represents one other home in the study

- is the sample from your home

X is the EPA Guideline

DEHP common uses: Plastics, inks, insect repellant, cosmetics, rubbing alcohol, liquid soap, detergents, lacquers, munitions, industrial lubricant.

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Narrative example

- “We detected many chemicals in every home in the study”

- “One of the chemicals we found in your urine is a weed killer.... If you are using a weed killer in your yard, you could reduce your exposure by controlling weeds without these chemicals.”

- “We are studying this chemical because....”
Interviews with participants

- 57 participants
- 60-90 minutes, in-person
- Transcribed
- Coded in NVivo

- How do people assign meaning to their results?
- What is their experience?  

Brody, 2007, AJPH
Altman, 2008 JHSB
Morello-Frosch, 2009, EH
Adams, in press, JHSB
Key understandings

- Many chemicals are detected in homes
- Banned substances are found today
- Many sources
- Comparisons to study distributions and EPA guidelines
- Common household chemicals are unregulated, understudied
Key experiences

- Participants wanted their results
- Increased trust in researchers
- Pride in contributing to science and their community
- Frustration at information gaps
- Evolving interpretations, brainstorming
- Motivation to reduce exposure
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Phthalates, BFRs & PCBs in Dust

<table>
<thead>
<tr>
<th>Abbreviated Chemical Name</th>
<th>Concentration (micrograms per gram of dust)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BBP</td>
<td>X</td>
</tr>
<tr>
<td>DBP</td>
<td>X</td>
</tr>
<tr>
<td>DCP</td>
<td>X</td>
</tr>
<tr>
<td>DEHA</td>
<td>X</td>
</tr>
<tr>
<td>DEHP</td>
<td>X</td>
</tr>
<tr>
<td>DEP</td>
<td>X</td>
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<tr>
<td>DHP</td>
<td>X</td>
</tr>
<tr>
<td>DIBP</td>
<td>X</td>
</tr>
<tr>
<td>DOP</td>
<td>X</td>
</tr>
<tr>
<td>DPeP</td>
<td>X</td>
</tr>
<tr>
<td>DPP</td>
<td>X</td>
</tr>
<tr>
<td>PBDE47</td>
<td>X</td>
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<tr>
<td>PBDE99</td>
<td>X</td>
</tr>
<tr>
<td>PBDE100</td>
<td>X</td>
</tr>
<tr>
<td>TrisBP</td>
<td>X</td>
</tr>
<tr>
<td>PCB52</td>
<td>X</td>
</tr>
<tr>
<td>PCB105</td>
<td>X</td>
</tr>
<tr>
<td>PCB153</td>
<td>X</td>
</tr>
</tbody>
</table>

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Risk-based guidelines

• Useful – we want a health-based benchmark . . . but

• Reference values are inconsistent, outdated, incomplete
• Many assumptions to derive equivalent bio-level from rodent intake amount
• Insufficient data on population variability in pharmacokinetics and dynamics
• Don’t consider combined effects
• Fail to communicate high level of uncertainty
Risk assessment-based “bright-line” approaches, while useful, can hide uncertainty and provide false reassurance.

“We shall find a variety of devices which allow ignorance to masquerade as knowledge so that choices may be made . . .”

Choice Complexity and Ignorance
An enquiry into economic theory and the practice of decision making
BRIAN J. LOASBY
What should I do?

**Recommend precaution and more research**

(Avoid ungrounded reassurance)

- Consumer product choices
  - (some) phthalates, BPA

**Clear public health or individual action**

- Lead, mercury
- Diesel, current-use pesticides
- Banned chemicals
  - Chlordane

**Hard for individual to avoid**

- Flame retardants

Brody et al. *AJPH*, 2007
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Your house was selected for retesting because we detected high levels of PCBs.

The levels of PCBs in your blood were . . . among the highest of 4,000 people tested in a national survey by the US Centers for Disease Control.

This suggests that the PCBs in your house are an important source of your overall PCB exposure. . . . We can’t tell from these tests what the sources are in your house.

PCBs were used in electrical equipment, such as transformers, some fluorescent lights, and other products listed on the back of this page.

At high exposures, PCBs affect thyroid hormones and brain development. Scientists have found that eating fatty fish – for example, sea bass, blue fish, and lobster tamale – is usually a significant source of exposure.

Let’s follow up with a phone conversation about this.
Cape Cod homes with high levels of PCBs: 

5 years later

- Air concentrations still high
  - 3-10x higher than EPA guideline (3 ng/m³)
- Dust also
  - 100-1000x higher than EPA guideline (0.22 µg/g)
- Blood levels above 95% level in national survey
- What is the source?
Entry from 1957 edition lists PCBs as ingredients of Fabulon wood floor finish.

<table>
<thead>
<tr>
<th>FABULON Floor finish (Pierce &amp; Stevens)</th>
<th>Maleic alkyd polyester</th>
<th>Modified maleic rosin ester</th>
<th>Cellulose nitrate</th>
<th>Chlorinated bi-phenyl</th>
<th>Hexachlor bi-phenyl</th>
<th>Quadrachlor bi-phenyl</th>
<th>2,4-Bi-phenyl</th>
<th>Diphenyl phosphate</th>
<th>Modified phthalic acid polyester</th>
<th>Cresyl diphenyl phosphate</th>
<th>Secondary butyl alcohol*</th>
<th>Isopropyl alcohol*</th>
<th>Secondary butyl acetate*</th>
<th>Normal propyl alcohol*</th>
<th>Normal propyl acetate*</th>
</tr>
</thead>
</table>

[www.sileentspring.org](http://www.sileentspring.org)
Previously unidentified source of PCBs
Follow up of high exposed individuals

- Responsive to individual expectations
- Consistent with a surveillance program
- Can produce important new information
  - ID high exposed populations
  - discover undocumented sources
  - describe population exposure variability
  - highlight where public health intervention and study could be most fruitful
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All the cited papers are available on our web site
www.silent springs.org