Health Canada’s Biomonitoring Approach

Environmental Health Surveillance Workshop

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Presentation Objectives

- To provide an overview of Health Canada’s biomonitoring approach
- Main focus on the biomonitoring component of the Canadian Health Measures Survey
- Framework and infrastructure for biomonitoring
In 2006, the Government of Canada launched the Chemicals Management Plan (CMP) to advance and improve the management of chemical substances and safeguard the health of Canadians.
Human Biomonitoring Context

Exposure

Identification Priorities:
- Chemicals
- Population
- Geographic area

Biomonitoring:
- Collection
- Integration
- Interpretation
- Analysis

Dissemination

Supporting Science:
- Study design
- Laboratory methods/validation
- Biomarker development
- Pilot studies
- Statistical methods
- Tools to interpret biomonitoring data

Users

Assessment
- Policy
- Management

Knowledge synthesis & decision making

Action
- Regulatory
- Public health
Canadian Health Measures Survey
- General population (n=5,000-6,000)
- Nationally representative
  - Cycle 2 – 18 sites (2009-2011)
  - Cycle 3 – 16 sites (2012-2013)

Maternal-Infant Research on Environmental Chemicals
- Pregnant women-infant cohort (n=2,000)
- 10 study centres
- Targeted recruitment

First Nations Biomonitoring Initiative
- 13 communities (n=500)
- Nationally representative (on reserve)

Northern Contaminants Program
- 7 regions, since 1991
- Targeted studies and surveys

Health Canada’s Multi-Pronged Biomonitoring Approach
Canadian Health Measures Survey (CHMS)

- National health survey that collects data on the general health and lifestyles of Canadians to provide information on chronic and infectious disease, physical fitness, nutrition, and other factors that influence health

- Human biomonitoring component

Partners
Statistics Canada
Health Canada
Public Health Agency of Canada
• Establish nationally-representative blood and urine concentrations for environmental chemicals

• Provide baseline data to track temporal trends and to allow for comparisons with sub-populations in Canada and with other countries

• Provide data to explore relationships between environmental chemicals, other physical measures, and self-reported information
CHMS Survey Design

- Cross-sectional survey carried out in 2 year cycles
- Nationally-representative sample covering 96% of population
- Sample size: 5,500 – 6,000
- Age groups (yrs): 3-5, 6-11, 12-19, 20-39, 40-59, 60-79

- Home interview - health questionnaire
- Mobile Examination Centre - direct measures
- Household - indoor air (start in cycle 2) tap water (start in cycle 3)

- Informed consent for all components
CHMS Cycles – Biomonitoring

Timeline


Cycle 1
Mar 2007 – Feb 2009
15 sites
6-79 years (n = 5,600)
92 chemicals

Cycle 2
Aug 2009 – Nov 2011
18 sites
3-79 years (n = 6,400)
91 chemicals

Cycle 3
Jan 2012 – Dec 2013
16 sites
3-79 years (n = 5,700)
105 chemicals

Cycle 4
Jan 2014 – Dec 2015
TBD sites
3-79 years (n = 5,700)
same chemicals as Cycle 3

Cycle 1 biomonitoring report published
Overview published

Cycle 2 biomonitoring report
Revised Overview
Direct Measures (Mobile Examination Centre, MEC)

- Field staff: accredited and qualified health specialists and technicians
- 12 dedicated Statistics Canada interview staff
- Medical advisor working from central office

Measures
- Anthropometry
- Cardiorespiratory and musculoskeletal fitness
- Physical activity
- Oral health exam (cycle 1)
- Blood measures
  - Environmental chemicals, nutritional status, diabetes, cardiovascular disease, infectious disease, blood chemistry, DNA and biobank samples (stored)
- Urine measures
  - Environmental chemicals, iodine, microalbumin, creatinine
- Audiometry (cycle 3)
- FENO (fractional exhaled nitric oxide) (cycle 3)
Selection of Environmental Chemicals for CHMS

Based on:
- Health Canada program priorities

Criteria
- Public health considerations (known or suspected health risk or effects, need for public health action, public concern)
- Regulatory needs (risk assessment and management)
- Evidence of population exposures or sources of exposure
- Feasibility of field collection of biospecimens / respondent burden
- Availability and efficiency of laboratory analytical methods
- Consistency with other surveys
- International commitments (e.g., Stockholm Convention on POPs)
- Cost
<table>
<thead>
<tr>
<th>CHMS Biomonitoring Chemicals</th>
<th>Cycle 1</th>
<th>Cycle 2 (55% new)</th>
<th>Cycle 3 (40% new)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metals &amp; Trace Elements</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td>PCBs</td>
<td>●</td>
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<td>●</td>
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<tr>
<td>Organochlorines &amp; POPs</td>
<td>●</td>
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<tr>
<td>Dioxins/Furans</td>
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<tr>
<td>Flame retardants</td>
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<tr>
<td>Perfluorinated Compounds</td>
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<tr>
<td>Phthalates</td>
<td>●</td>
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<tr>
<td>Environmental Phenols</td>
<td>●</td>
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<tr>
<td>Current Use Pesticides</td>
<td>●</td>
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<tr>
<td>PAHs</td>
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<tr>
<td>Benzene Metabolites</td>
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<tr>
<td>Parabens</td>
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<td>VOCs</td>
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<td>●</td>
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<tr>
<td>Acrylamide</td>
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<td>●</td>
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<tr>
<td>Smoking Status</td>
<td>●</td>
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</tbody>
</table>
Regulatory Case: Effectiveness of Control Actions

Decreasing Blood Lead Concentrations

98% of measures < 5 μg/dL
75% of measures < 2 μg/dL

27% of Canadians ≥ 10 μg/dL
<1% of Canadians ≥ 10 μg/dL

Blood lead intervention level (10 μg/dL)

Canada Health Survey 1978-1979
Canadian Health Measures Survey 2007-2009
Blood Total Mercury Levels in Canadians (CHMS 2007-2009)

Public Health Case: Assessing Exposure/Risk
Public Health Case: Assessing Exposure/Risk

- Blood guidance level for general adult population (M > 18 yrs, F > 49 yrs) is 20 µg/L
- Proposed blood guidance level for children and women of childbearing age (M ≤ 18 yrs, F ≤ 49 yrs) is 8 µg/L

**Estimated population (N) and percentage with blood mercury levels below their respective guidance values for selected Canadian population groups**

<table>
<thead>
<tr>
<th>Population Group</th>
<th>N</th>
<th>% &lt; 8µg/L (95% CI)</th>
<th>% &lt; 20µg/L (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females 16-49 yrs (incl. pregnant women)</td>
<td>7,669,012</td>
<td>97.78 (92.11 – 99.40)</td>
<td>*</td>
</tr>
<tr>
<td>Females 6-49 yrs, pregnant women, males ≤18 yrs</td>
<td>11,541,258</td>
<td>98.39 (93.59 – 99.61)</td>
<td>*</td>
</tr>
<tr>
<td>Females &gt; 49 yrs, males &gt;18 yrs</td>
<td>†</td>
<td>*</td>
<td>†</td>
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</tbody>
</table>

* Guidance value not applicable to selected population
† The estimated N and percentage of females ≥50 yrs and males ≥18 yrs with blood mercury levels <20 µg/L were not calculated in order to meet the confidentiality requirements of the Statistics Act of Canada
Decreasing DDT Concentrations in Human Milk

Sum of DDT and Metabolite Concentrations in Human Milk, Six Canadian Surveys, 1967-1992

Source: Craan and Haines, 1998
Maternal Contaminant Levels in Arctic Canada

PCBs (as Aroclor 1260) (µg/L plasma)

1: 8.0 µg/L Inuit - Baffin
2: 6.0 µg/L Inuit - Nunavik
3: 5.6 µg/L Inuit - Kivalliq
4: 4.5 µg/L Inuit - Kitikmeot
5: 2.4 µg/L Inuit - Inuvik
6: 1.3 µg/L Dene/Métis
7: 1.3 µg/L Caucasian
8: 1.1 µg/L Other

Source: CACHAR 2003

POPks and metal concentrations are 2 to 10 times higher in Inuit who eat traditional foods than in other northern or southern Canadian populations.
## Selected Uses of Biomonitoring Data

<table>
<thead>
<tr>
<th>Substance</th>
<th>Report/Assessment</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
<td>Human Health State of the Science Report on Lead</td>
<td>Regulatory and public health</td>
</tr>
<tr>
<td>Mercury</td>
<td>Canadian Mercury Science Assessment – Health Chapter</td>
<td>National reporting</td>
</tr>
<tr>
<td></td>
<td>Dietary health advice in Arctic communities</td>
<td>Public health</td>
</tr>
<tr>
<td>Cadmium, lead, mercury, PBDE</td>
<td>Canadian Environmental Sustainability Indicators</td>
<td>National reporting</td>
</tr>
<tr>
<td>Perfluorinated substances</td>
<td>Screening Assessment of Perfluorooctanoic Acid, its Salts, and its Precursors</td>
<td>Regulatory</td>
</tr>
<tr>
<td>PBDE</td>
<td>Human Health Risk Assessment for deca-BDE (PBDE 209)</td>
<td>Regulatory</td>
</tr>
<tr>
<td>POPs and metals</td>
<td>Informs and tracks Canada’s progress on international agreements (e.g., Stockholm Convention on POPs)</td>
<td>International commitments</td>
</tr>
</tbody>
</table>

- CHMS dataset accessible by researchers via Statistics Canada’s Research Data Centres
For Additional Information

Human Biomonitoring of Environmental Chemicals
www.healthcanada.gc.ca/biomonitoring

The Canadian Health Measures Survey
www.statcan.gc.ca/daily-quotidien/100816/dq100816a-eng.htm

Report on Human Biomonitoring of Environmental Chemicals in Canada

Maternal-Infant Research on Environmental Chemicals
www.hc-sc.gc.ca/ewh-semt/contaminants/mirec/

Northern Contaminants Program
www.ainc-inac.gc.ca/nth/ct/ncp