Canadian human biomonitoring data and its uses in chemicals management

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Conflict of Interest Disclosure

- No conflicts of interest to disclose

Outline

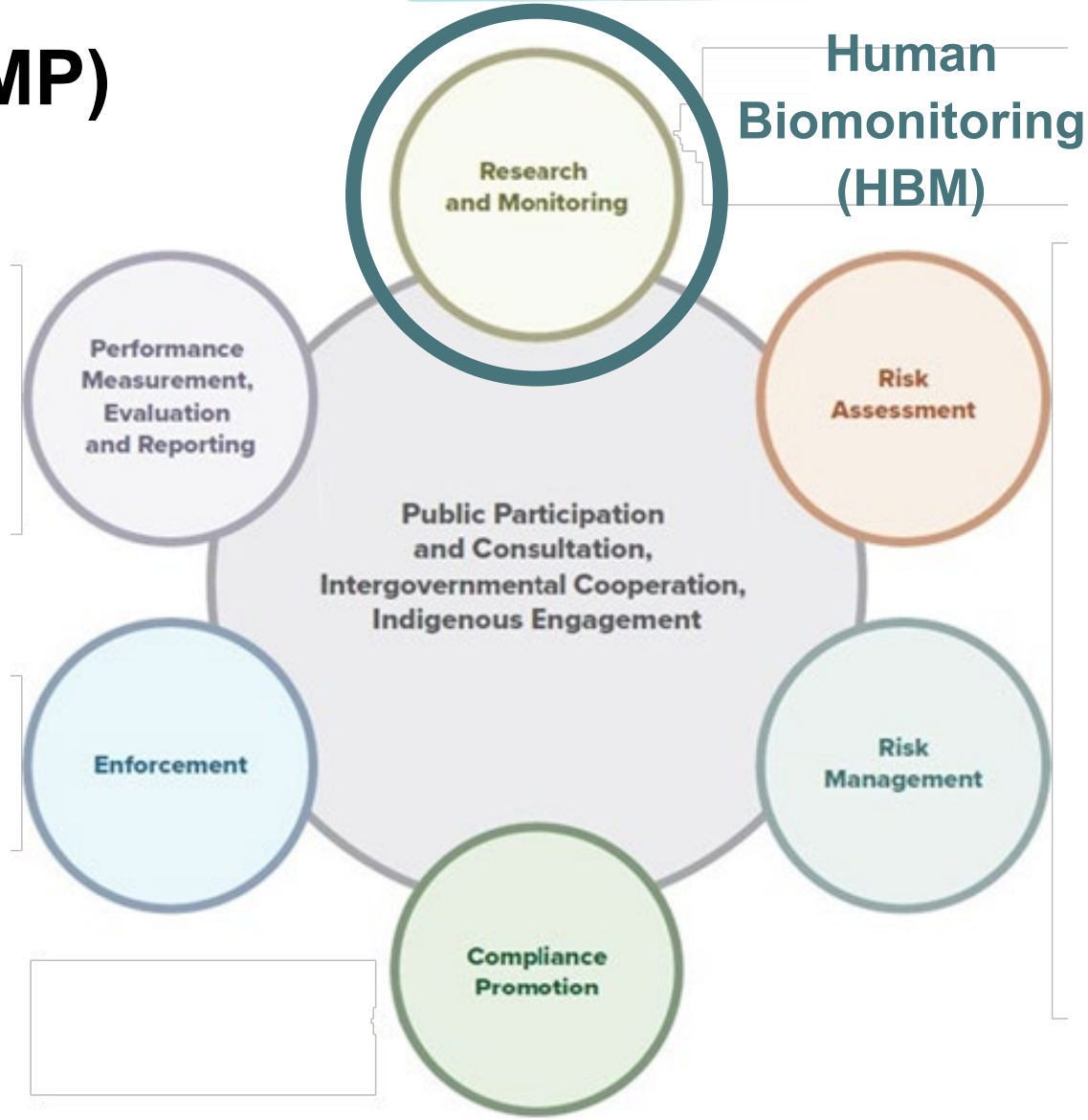
- Overview of chemicals management legislation in Canada
- Canada's national human biomonitoring (HBM) program through the Canadian Health Measures Survey (CHMS)
- HBM data use in risk assessment (RA) and risk management (RM)
- Current and future directions

Chemicals Management Plan (CMP)

- Federal initiative launched in 2006 to reduce risks posed by chemicals to people living in Canada and the environment

- Jointly managed by Health Canada (HC) and Environment and Climate Change Canada (ECCC)

- Uses the *Canadian Environmental Protection Act, 1999* (CEPA) as its core legislative framework to monitor, assess, and regulate both existing and new substances



The Right to a Healthy Environment (R2HE)

CEPA was amended in **June 2023**, and changes included recognition that every individual in Canada has a right to a healthy environment

CEPA now specifies that the Ministers of ECCC and HC shall conduct research, studies or monitoring activities to support the Government of Canada in protecting the right to a healthy environment

An implementation framework was published in July 2025 and outlines how the right to a healthy environment is to be considered in the administration of CEPA, including for HBM activities and data

Canadian Health Measures Survey (CHMS)

- Conducted by Statistics Canada in partnership with Health Canada and the Public Health Agency of Canada
- Cross-sectional survey conducted in two-year collection periods
- Each collection period samples around 6,000 people living in the 10 provinces to produce national estimates
- Representative of 96 to 97% of the population

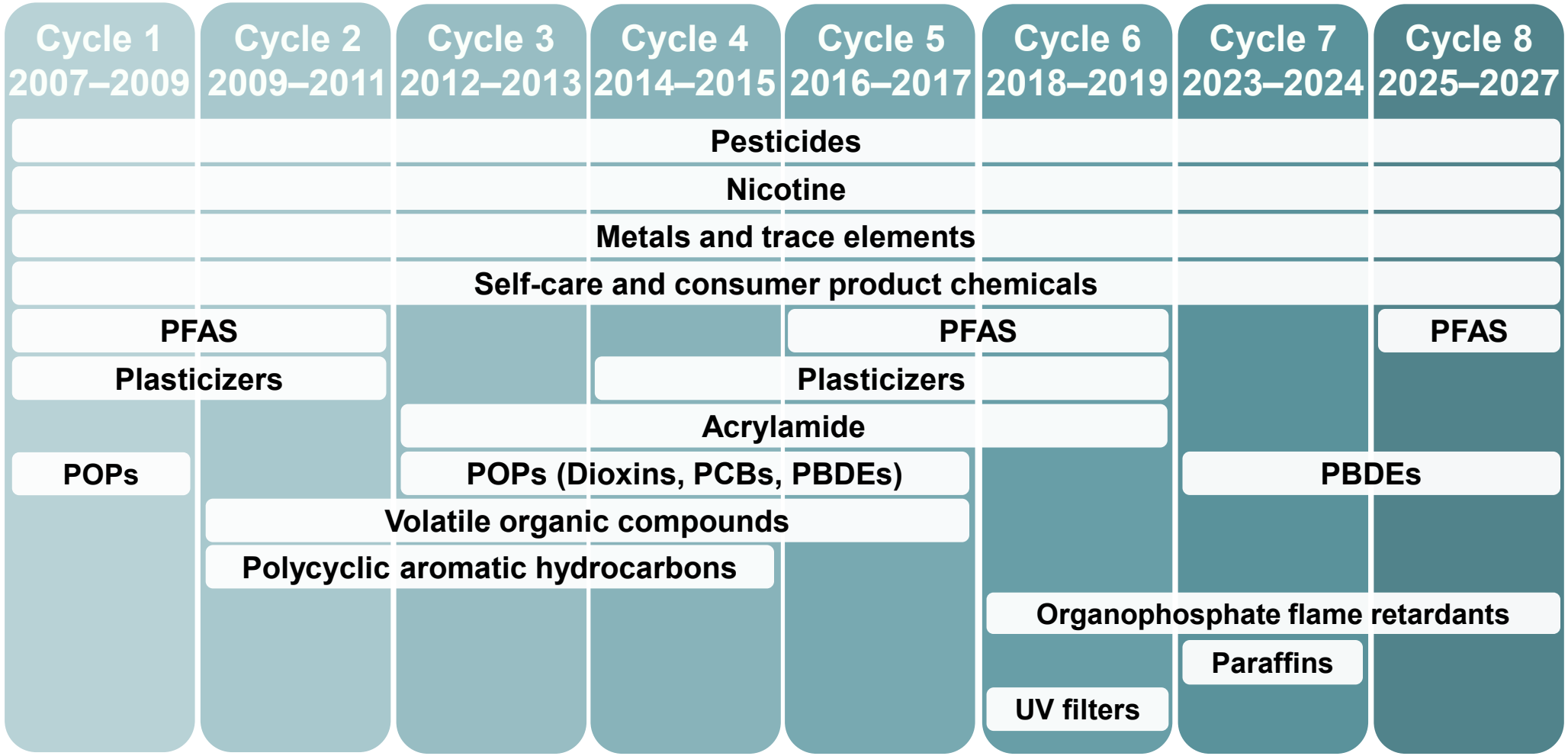
Canadian Health Measures Survey (CHMS)

7 cycles over 17 years
(2007–2019, 2023–2024)

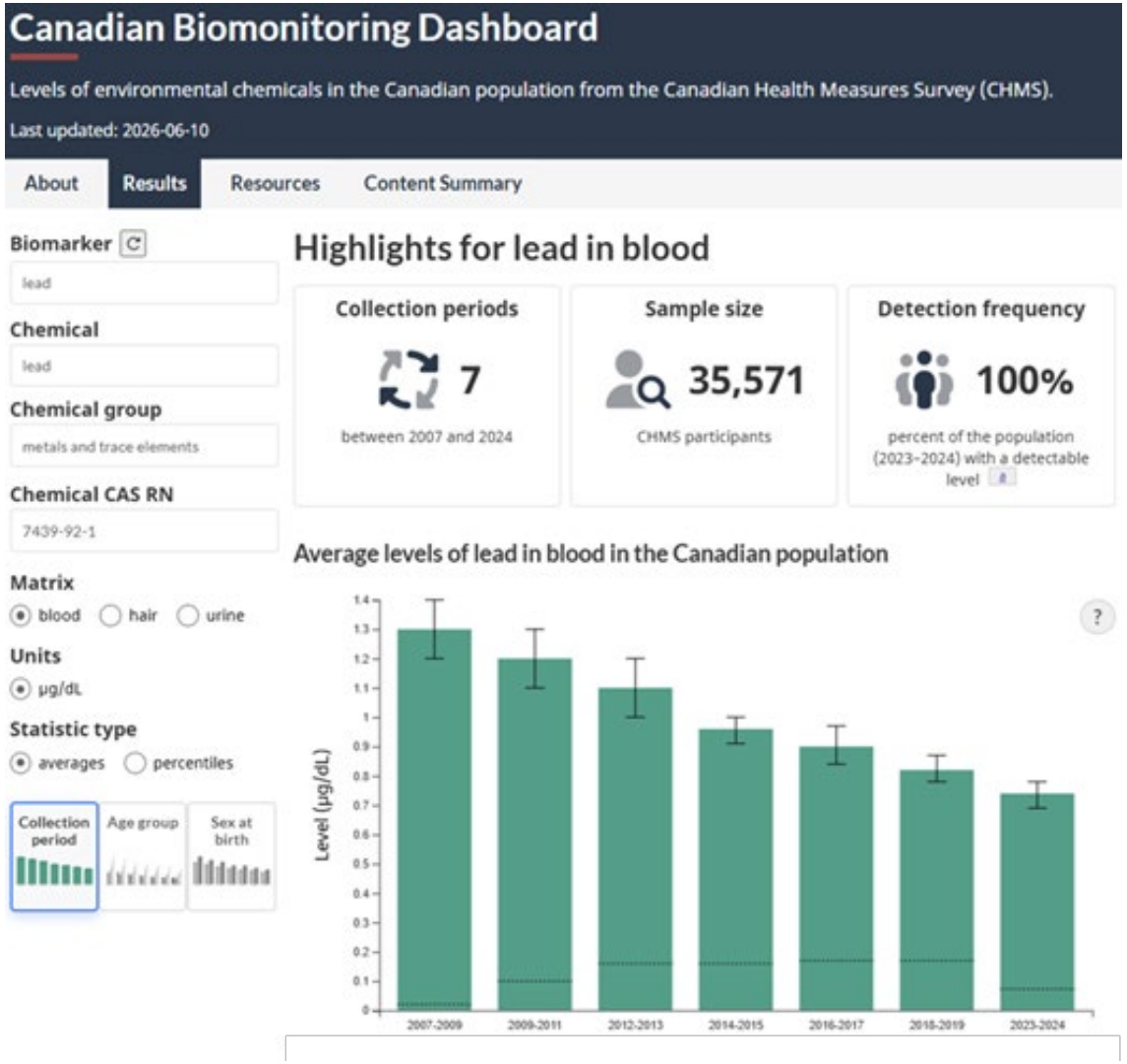
Around 40,000 people
sampled since 2007

Over 350 chemicals
measured in blood or
urine since 2007

Canadian Health Measures Survey (CHMS)

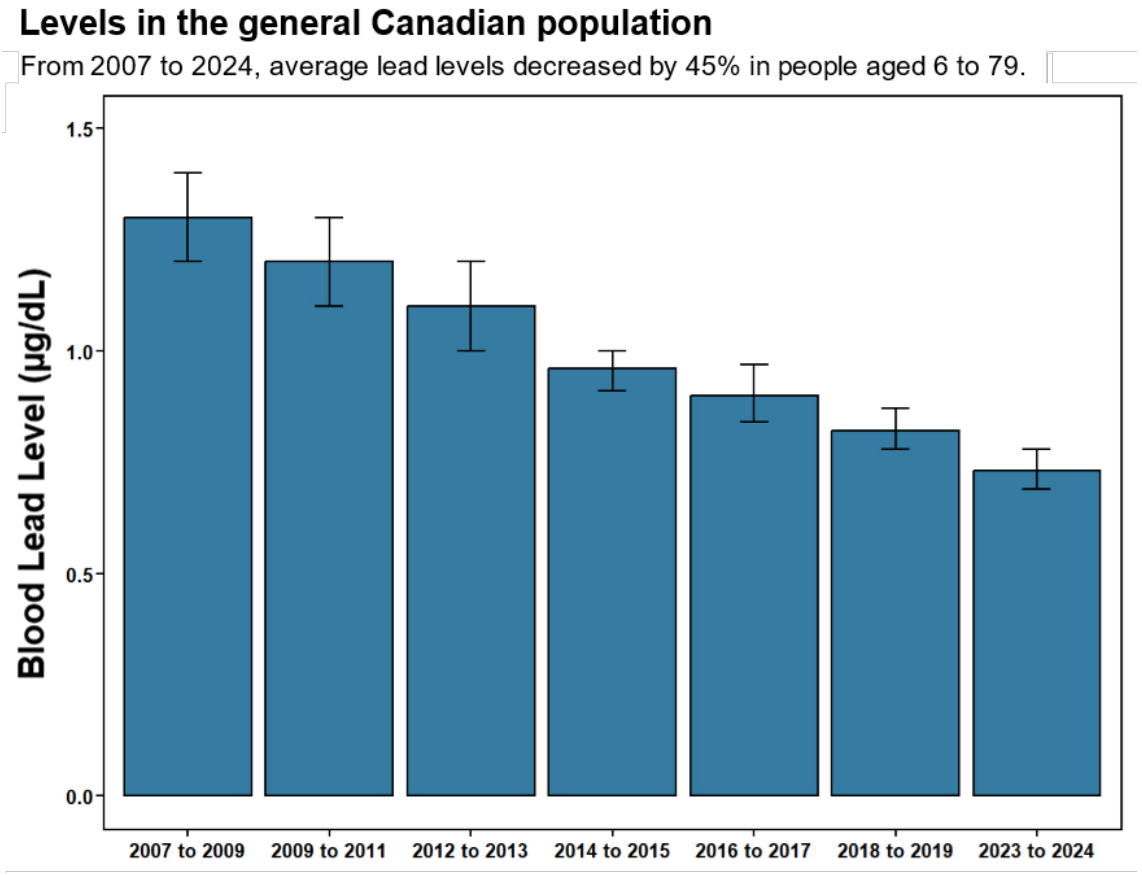


Canadian Biomonitoring Dashboard



- The [Canadian Biomonitoring Dashboard] features key information highlights and interactive results visualizations of environmental chemical levels in the Canadian population and for various sub-populations measured through the CHMS

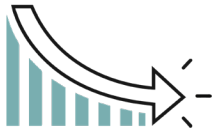
Biomonitoring Fact Sheets



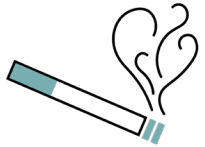
- The Biomonitoring Fact Sheets feature information about environmental chemicals and levels of these chemicals in people living in Canada, as measured through the CHMS and other biomonitoring initiatives

- Fact sheets are available for 19 chemicals or chemical groups

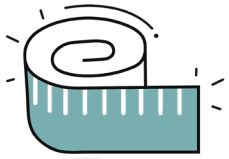
HBM Data Uses



1. Establish baseline concentrations of chemicals in the Canadian population and track trends in concentrations over time.



2. Compare levels of chemicals among different populations (including sub-populations within Canada or populations of other countries).



3. **Inform chemical risk assessments (RA) by providing information on measured levels in Canadian populations.**

4. **Assess the effectiveness of risk management (RM) actions intended to reduce exposures and health risks from specific chemicals.**

5. Support research on the potential links between exposure to certain chemicals and specific health effects.

HBM Data Use in RA

1. Support RA by identifying priorities for future assessment based on detection and levels in people living in Canada

HBM Data Use in RA

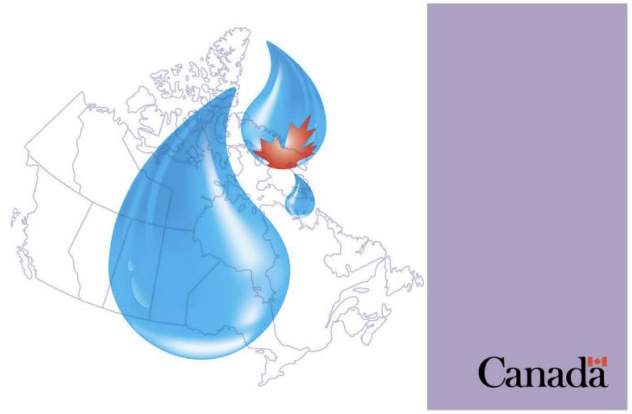
1. Support RA by identifying priorities for future assessment based on detection and levels in people living in Canada

2. Support RA by confirming exposure levels in the Canadian population, and identifying population groups with higher exposure levels

Guidelines for Canadian Drinking Water Quality

Guideline Technical Document

Cadmium



Proposed Re-evaluation Decision PRVD2015-07

Deltamethrin

HBM Data Use in RA

1. Support RA by identifying priorities for future assessment based on detection and levels in people living in Canada

2. Support RA by confirming exposure levels in the Canadian population, and identifying population groups with higher exposure levels

3. HBM-based RA

International Journal of Hygiene and Environmental Health 220 (2017) 167–178

International Journal of Hygiene and Environmental Health

Review

A review of human biomonitoring data used in regulatory risk assessment under Canada's Chemicals Management Program☆

Angelika Zidek*, Kristin Macey, Leona MacKinnon, Mikin Patel, Devika Poddalgoda, Yi Zhang

Existing Substances Risk Assessment Bureau, Safe Environments Directorate, Healthy Environments and Consumer Safety Branch, Health Canada

HBM-based RA Methodology

1. Qualitative approach

- Quantitative approaches
  2. Direct comparison
  3. Dose reconstruction
  4. Comparison with HBM guidance values

- Over 350 substances were assessed using these methodologies

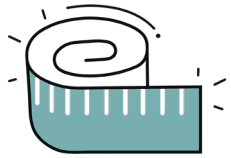
HBM-based RA Methodology

1. Qualitative approach

- Low exposure scenarios as evidenced by low detection rates in the population
- Low concern with respect to human health
- CEPA non-toxic conclusion

- Substances assessed through this approach:
  Beryllium (Be), Vanadium (V) (2020)
  Cerium (Ce), Germanium (Ge), Lanthanum (La), Neodymium (Nd), Praseodymium (Pr), Tellurium (Te), Yttrium (Y) (2024)

HBM-based RA Methodology



2. Quantitative approach – Direct comparison

- HBM data are compared directly with the corresponding blood, urine, or tissue levels measured in people or animals where a biological effect was observed

- Requires extensive data and information to link biomarker levels with a measurable health outcome or adverse effect

- Substances assessed through this approach:
  PFOS (2006), PFOA (2012), Lead (2013)

HBM-based RA Methodology

3. Quantitative approach – Dose reconstruction (reverse dosimetry)

Exposure Guidance Value (µg / kg bw / day)

External Exposure (µg / kg bw / day)

HBM Data (µg / L)

- Estimate external exposures (e.g., daily intakes) based on HBM data, which can then be compared with health-based exposure guidance values (e.g., acceptable or tolerable daily intakes, reference doses, reference exposure levels) or dose associated with a critical health effect (point of departure)

- Requires information about the population (e.g., daily urine output, body weights) and about how the chemical moves through the body (e.g., urinary excretion fraction)

- Substances assessed through this approach:
  Boron (2016), Triclosan (2016), Parabens (2020), Phthalates (2020), Flame Retardants (2020, 2021)

HBM-based RA Methodology

4. Quantitative approach – HBM guidance values (forward dosimetry)

Exposure Guidance Value (µg / kg bw / day)

HBM Health-Based Guidance Value (µg / L)

HBM Data (µg / L)

- Derive HBM health-based guidance values (HB2GVs) from exposure guidance values, which can then be compared with HBM data

- Substances assessed through this approach:
  Cobalt (2017), Selenium (2017), Zinc (2019), Barium (2020), Iodine (2020), Molybdenum (2020), Tin (2020), Silver (2022), Aluminum (2024), Bismuth (2024), Lithium (2024), Thallium (2024), Titanium (2026)

HBM-based RA Methodology

Draft screening assessment - Zinc and its compounds (2019)

- CEPA non-toxic conclusion

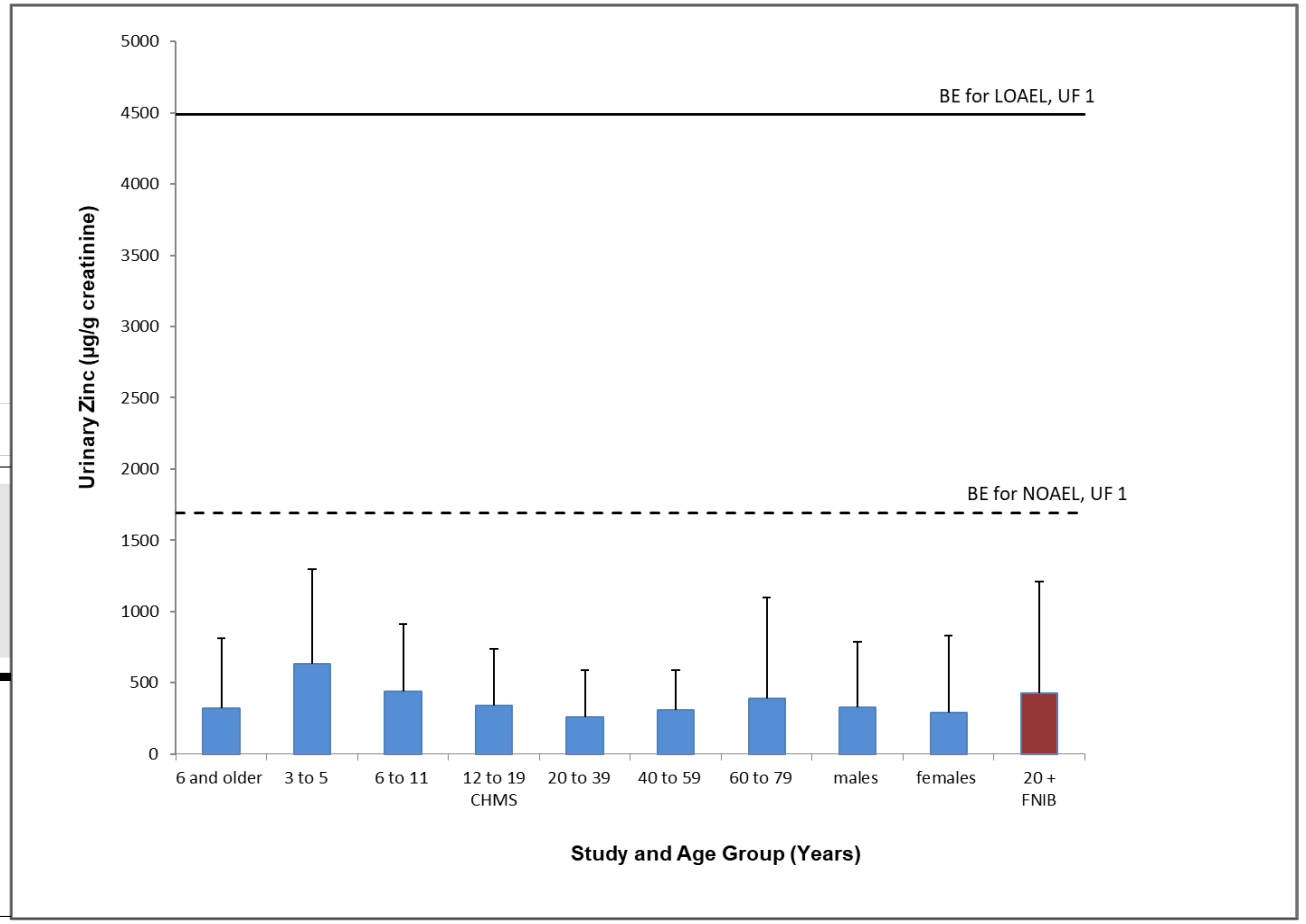
Regulatory Toxicology and Pharmacology 106 (2019) 178–186

Regulatory Toxicology and Pharmacology

Derivation of biomonitoring equivalents (BE values) for zinc

Devika Poddalgoda*, Kristin Macey, Scott Hancock

Healthy Environment and Consumer Safety Branch, Health Canada, Government of Canada, Ottawa, ON, Canada



HBM-based RA Methodology

Screening assessment – Selenium and its compounds (2017)

- CEPA toxic conclusion

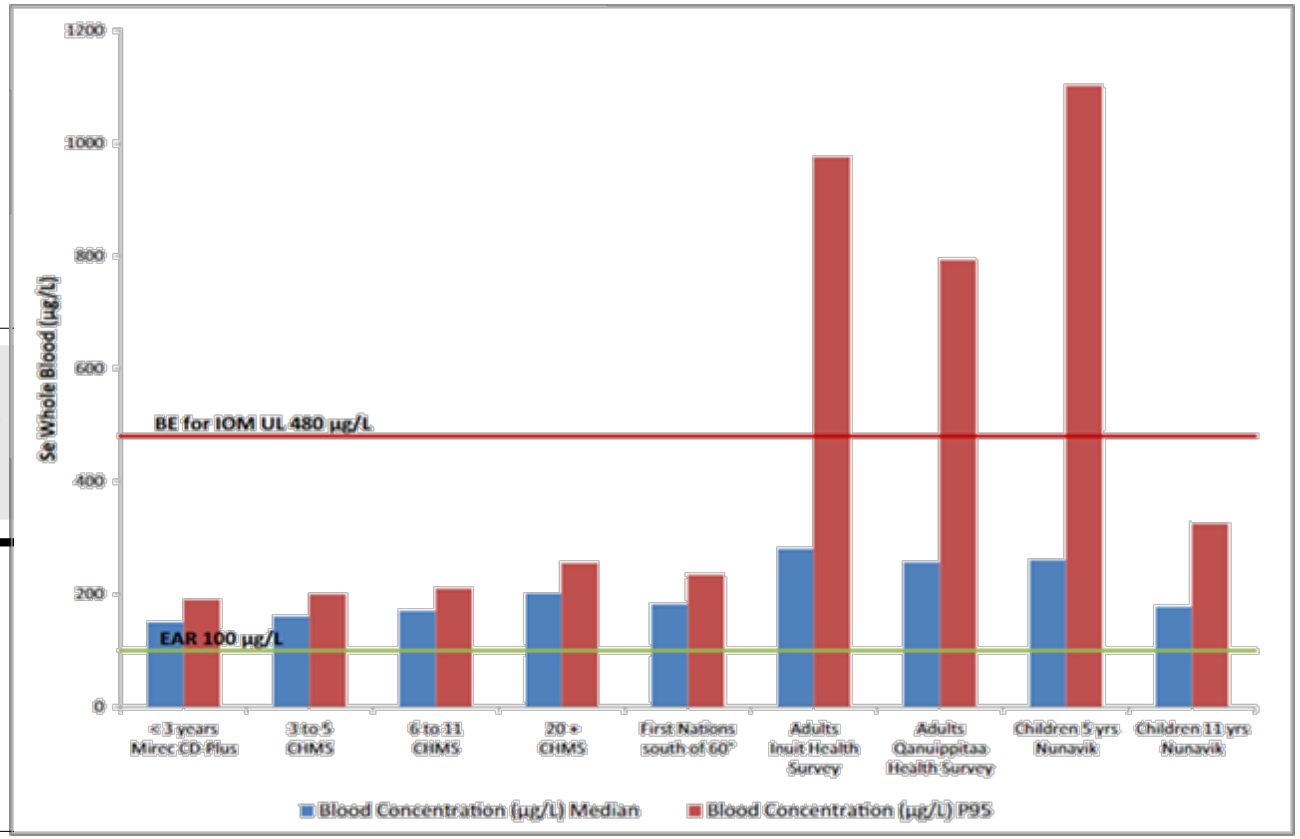
Regulatory Toxicology and Pharmacology 70 (2014) 333–339

Regulatory Toxicology and Pharmacology

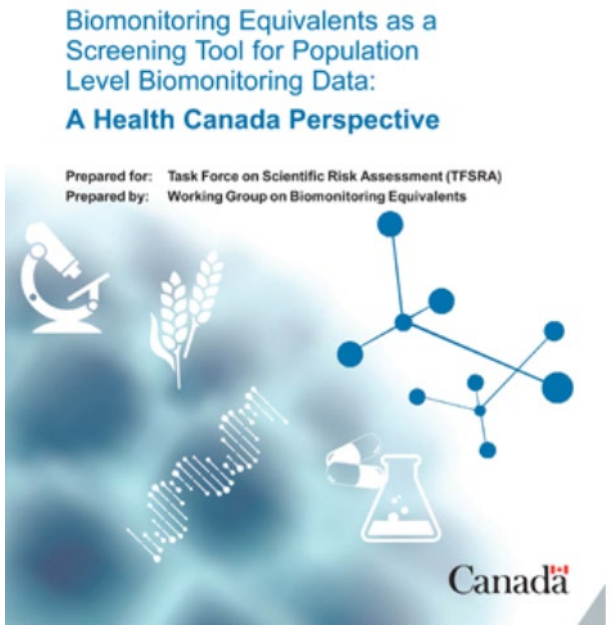
Biomonitoring Equivalents for selenium

Sean M. Hays [a,*], Kristin Macey [b], Andy Nong [b], Lesa L. Aylward [c]

[a] Summit Toxicology, LLP, Allenspark, CO, USA
[b] Health Canada, Ottawa, Ontario, Canada
[c] Summit Toxicology, LLP, Falls Church, VA, USA



Health Canada Task Force on Scientific Risk Assessment



Biomonitoring Equivalents Working Group

- Developed by a multidisciplinary working group under the Task Force on Scientific Risk Assessment
- Established a common Health Canada approach for the use and interpretation of Biomonitoring Equivalents (BEs)
- Published about 10 years ago, its principles and methodologies continue to be widely applied in current risk assessment practice

Recent Derivation of Biomonitoring Equivalents (BEs)

Regulatory Toxicology and Pharmacology 171 (2026) 106161

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Regulatory Toxicology and Pharmacology

Biomonitoring Equivalents for select neonicotinoids

Sean M. Hays [a,*], Theresa K. Lopez [b], Ann Roseberry Lincoln [b]

[a] Summit Toxicology, LLC, Bozeman, MT, USA
[b] Tetra Tech, Inc, Superior, CO, USA

Regulatory Toxicology and Pharmacology 144 (2023) 105481

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Regulatory Toxicology and Pharmacology

Biomonitoring Equivalents for glyphosate

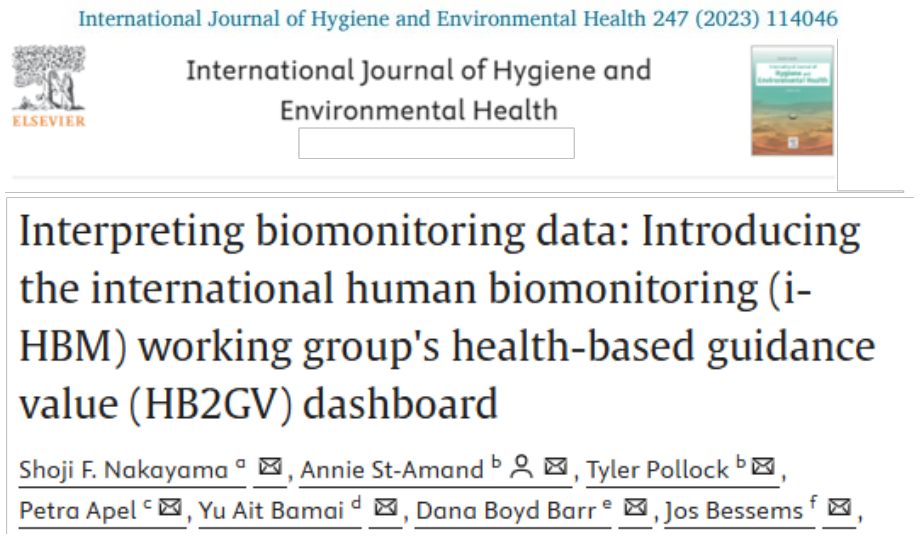
Sean M. Hays [a,*], Christopher R. Kirman [a], Jennifer Flippin [b], Theresa Lopez [b]

[a] Summit Toxicology, LLC, Bozeman, MT, USA
[b] Tetra Tech, Inc, Denver, CO, USA

HB2GV Dashboard

- The Human Biomonitoring Health-Based Guidance Value (HB2GV) Dashboard was developed by the International Society of Exposure Science (ISES) International Human Biomonitoring Guidance Value (i-HBM) Working Group, for which Health Canada is a co-founder and co-chair

- An online repository of over 600 HB2GVs, including biomonitoring equivalents (BEs), human biomonitoring I and II (HBM-I and HBM-II) values, and human biomonitoring guidance values for the general population ($HBM\text{-}GV_{GenPop}$)


International Journal of Hygiene and Environmental Health 247 (2023) 114046

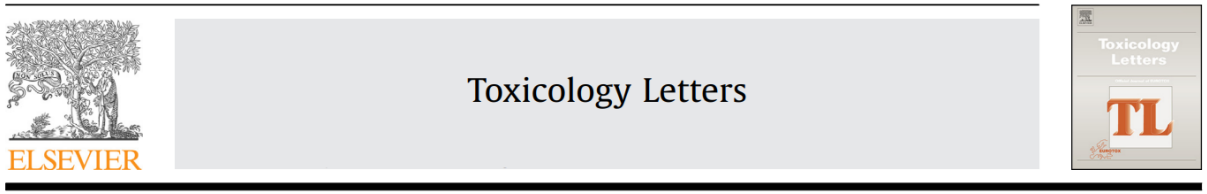
International Journal of Hygiene and Environmental Health

Interpreting biomonitoring data: Introducing the international human biomonitoring (i-HBM) working group's health-based guidance value (HB2GV) dashboard

Shoji F. Nakayama [a], Annie St-Amand [b], Tyler Pollock [b], Petra Apel [c], Yu Ait Bamai [d], Dana Boyd Barr [e], Jos Bessems [f],

Screening of Population Level HBM Data

Toxicology Letters 231 (2014) 126–134



Screening of population level biomonitoring data from the Canadian Health Measures Survey in a risk-based context

Annie St-Amand [a,*], Kate Werry [a], Lesa L. Aylward [b], Sean M. Hays [c], Andy Nong [a]

International Journal of Hygiene and Environmental Health 223 (2020) 267–280

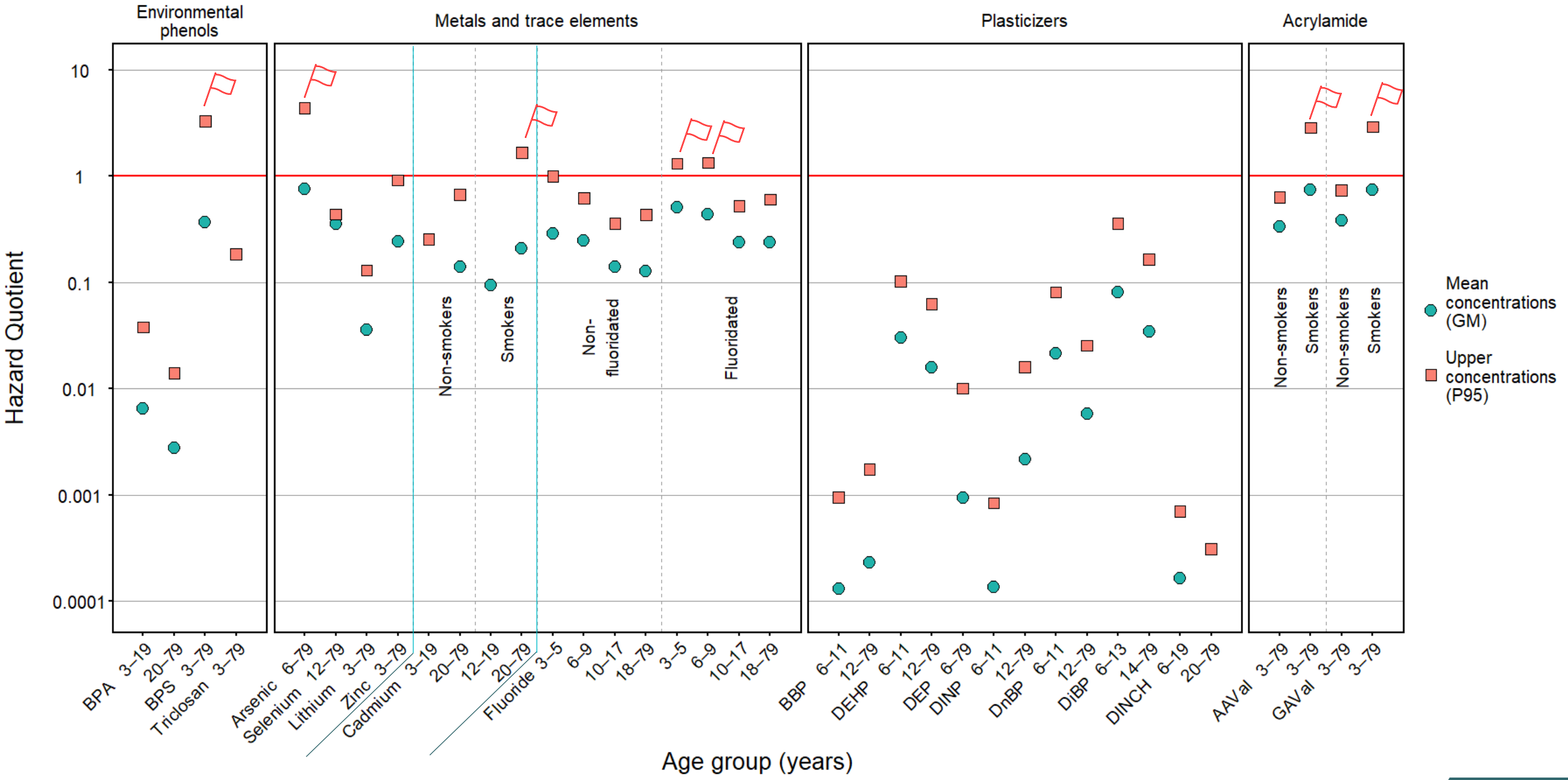
Evaluation of human biomonitoring data in a health risk based context: An updated analysis of population level data from the Canadian Health Measures Survey

Sarah Faure[a,b], Nolwenn Noisel[b], Kate Werry[a], Subramanian Karthikeyan[a], Lesa L. Aylward[c,d], Annie St-Amand[a,*]

Identify exceedances of BEs for follow-up and prioritization

Interpretation:

HQ > 1 → Follow-up recommended

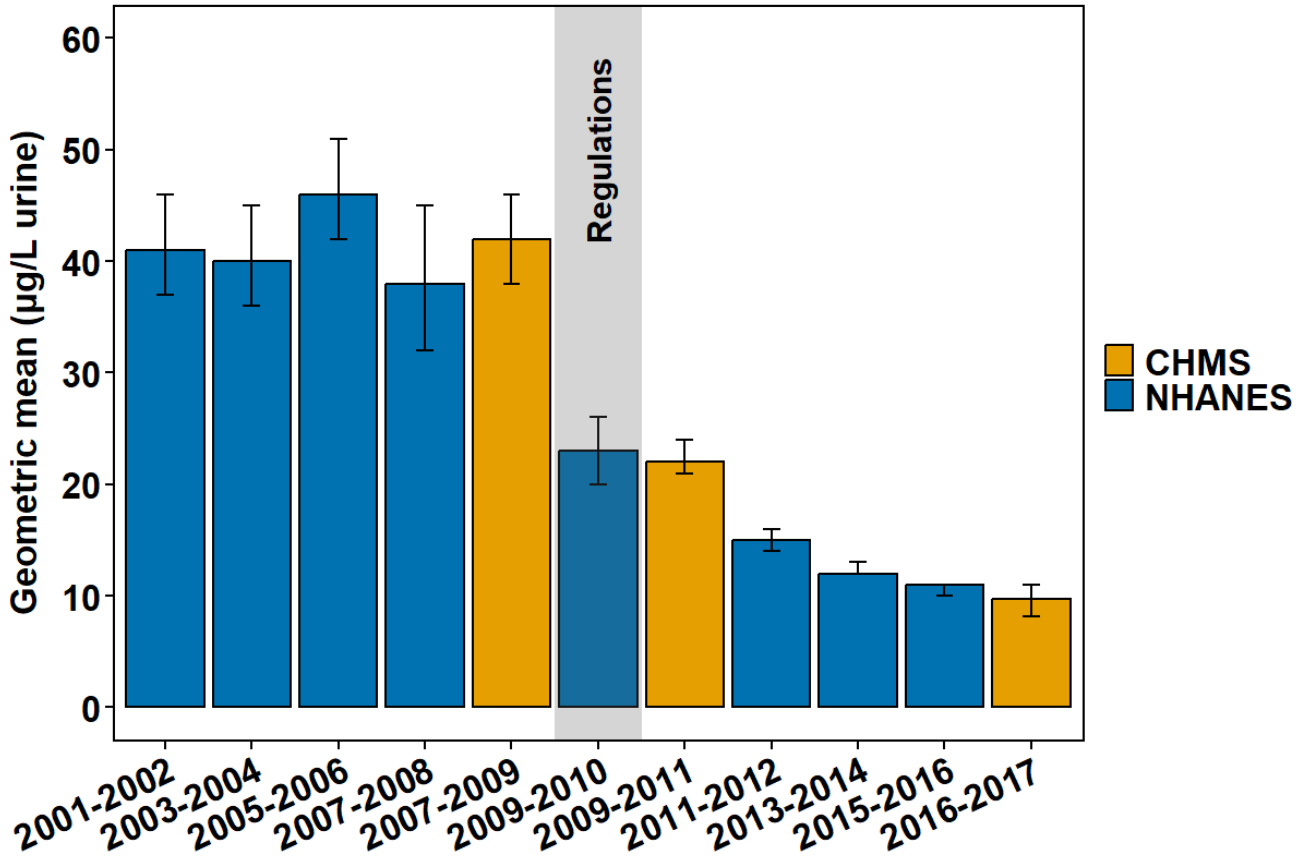

Environmental phenols
Metals and trace elements
Plasticizers
Acrylamide
Hazard Quotient
10
1
0.1
0.01
0.001
0.0001
BPA 3–19
20–79
BPS 3–79
Triclosan 3–79
Arsenic 6–79
Selenium 12–79
Lithium 3–79
Zinc 3–79
Cadmium 3–19
20–79
12–19
20–79
Fluoride 3–5
6–9
10–17
18–79
3–5
6–9
10–17
18–79
Non-smokers
Smokers
Non-fluoridated
Fluoridated
BBP 6–11
12–79
DEHP 6–11
12–79
DEP 6–79
DINP 6–11
12–79
DnBP 6–11
12–79
DiBP 6–13
14–79
DINCH 6–19
20–79
AAVal 3–79
GAVal 3–79
Non-smokers
Smokers
Non-smokers
Smokers
Mean concentrations (GM)
Upper concentrations (P95)
Age group (years)

HBM Data Use in RM

- Support RM performance measurement evaluations as a key performance indicator
- Requires ongoing HBM over time, ideally before and after the implementation of risk management tools and regulations *and* in relevant population groups

HBM Data Use in RM

- Performance Measurement Evaluation for Risk Management of Bis(2-ethylhexyl) phthalate (DEHP)

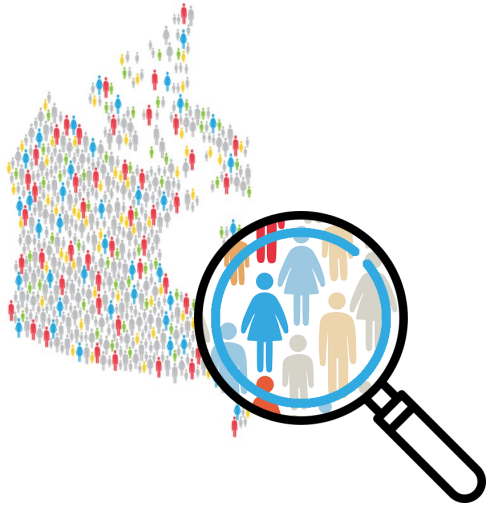


Current and Future Directions

- Greater consideration of **disproportionately impacted populations**, including people who may have higher exposures to substances or may be at greater risk as a result of those exposures

- Measurement of pertinent **biomarkers of effect** alongside **biomarkers of exposure**

- Continued characterisation of **concurrent exposures to chemical mixtures**



International Journal of Hygiene and Environmental Health 234 (2021) 113704

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International Journal of Hygiene and Environmental Health

Exposure Load: Using biomonitoring data to quantify multi-chemical exposure burden in a population

Jeff B. Willey [a], Tyler Pollock [a], Errol M. Thomson [a b], Chun Lei Liang [a], Aubrey Maquiling [a], Mike Walker [a], Annie St-Amand [a]