



# Human Biomonitoring of Environmental Chemicals

Workshop on Understanding Human Biomonitoring  
University of Ottawa  
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# Objectives

- Define biomonitoring
- Provide context
- Describe applications
- Challenges
- Current and future activities

# Biomonitoring definition

The direct measurement of environmental chemicals, their metabolites or reaction products in people, usually in blood, hair, urine, and milk



# Biomonitoring in the news

## << public concerns -- opposing views >>

*“The search for safe: Our bodies contain a 'chemical cocktail. 'All bodies must to survive. But the mere presence of chemicals should not set off alarms”* Financial Post, June 13, 2006

*“Kids' bodies contained cocktail of toxic chemicals; Environment Minister Ambrose accepts group's challenge to be tested.... Health Minister Tony Clement and NDP Leader Jack Layton have also volunteered to be tested”* The Hamilton Spectator, June 2, 2006

*“A toxic life; We're polluted from head to toe...”* Toronto Star, April 21, 2006

*“I had my blood tested; the results show I'm full of carcinogens”*  
Wendy Mesley, CBC Marketplace, March 5, 2006

# Policy Context for Health Canada

## Regulatory

- Canadian Environmental Protection Act
- Food and Drugs Act
- Pest Control Products Act

## Public Health

- Health Protection and Disease Prevention
- Surveillance / Indicators
- Federal Accelerated Contaminated Sites Program
- Children's Environmental Health Strategy
- Tobacco Control Strategy

## International

- Stockholm Convention on POPs
- North American Agreement for Environmental Cooperation
- Canada-USA Great Lakes Water Quality Agreement
- Northern Contaminants/Circumpolar Issues



# Health Drivers for Biomonitoring

- Cancer
- Birth defects
- Developmental Disorders
- Cardiorespiratory disease
- Neurological disease
- Immune system disease
- Renal and hepatic disease
- Endocrine disorders

# **Biomonitoring is not new and has been an important tool to inform policy**

- DDT/POPs in human milk 1967 - 1992
- Aboriginal mercury monitoring 1970 - 1992
- Great Lakes Fish Eaters – POPs & metals 1992 & 1996
- POPs in umbilical cord blood - St. Lawrence 1993 - 2000
- PBDE in human milk 2004
- Maternal blood monitoring - Arctic 1994 - present



# Applications of Biomonitoring

## Assessing Risks (reduces uncertainty in exposure)

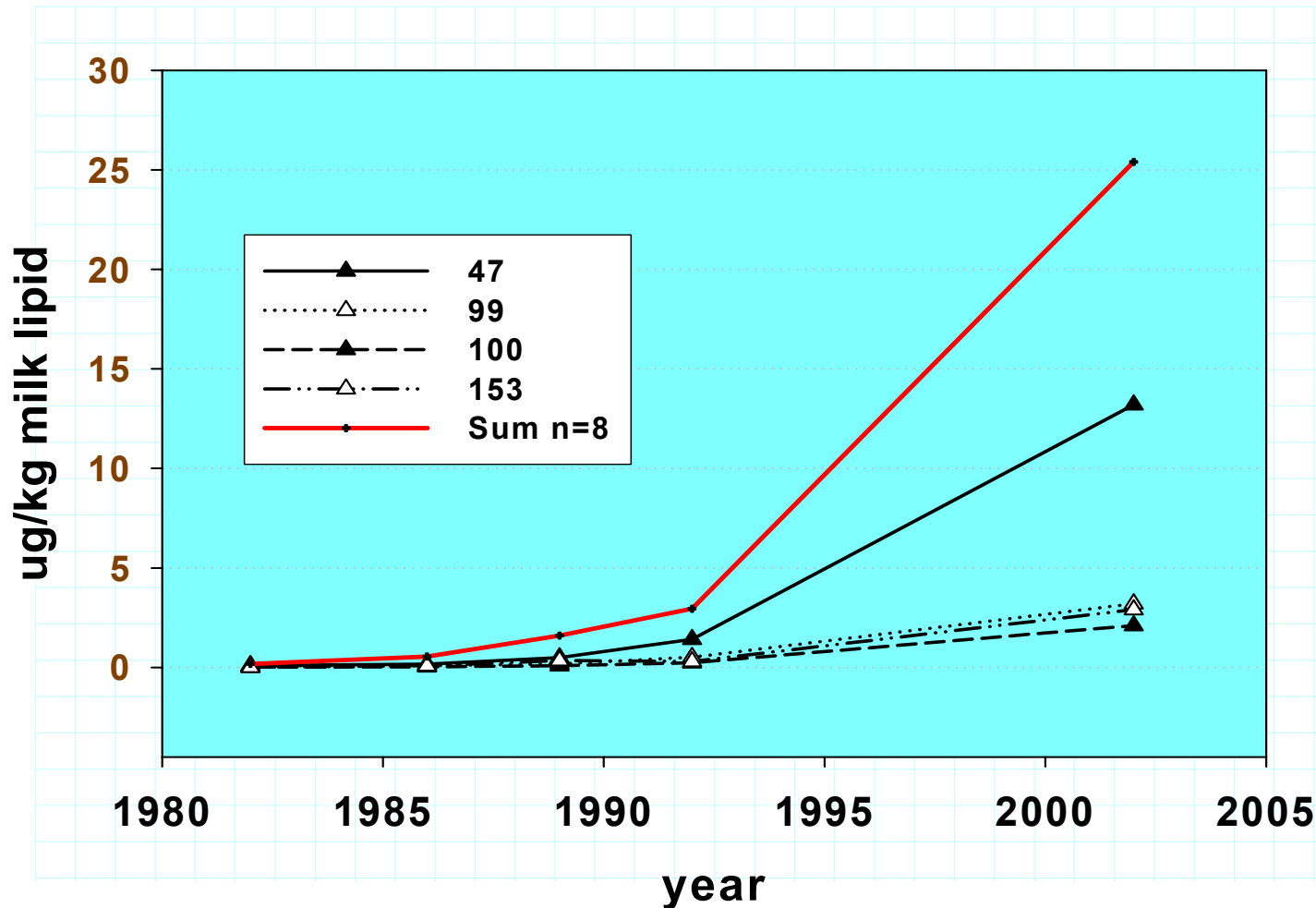
- Detect exposure (how much – objective measure)
- Assess health risk (reference ranges, populations at risk, epidemiology and health investigations)

## Managing Risks (increased use in health protection)

- Develop and apply interventions (inform and focus on priorities)
- Assure interventions are effective (tracking time, geographic trends, tracking and surveillance)

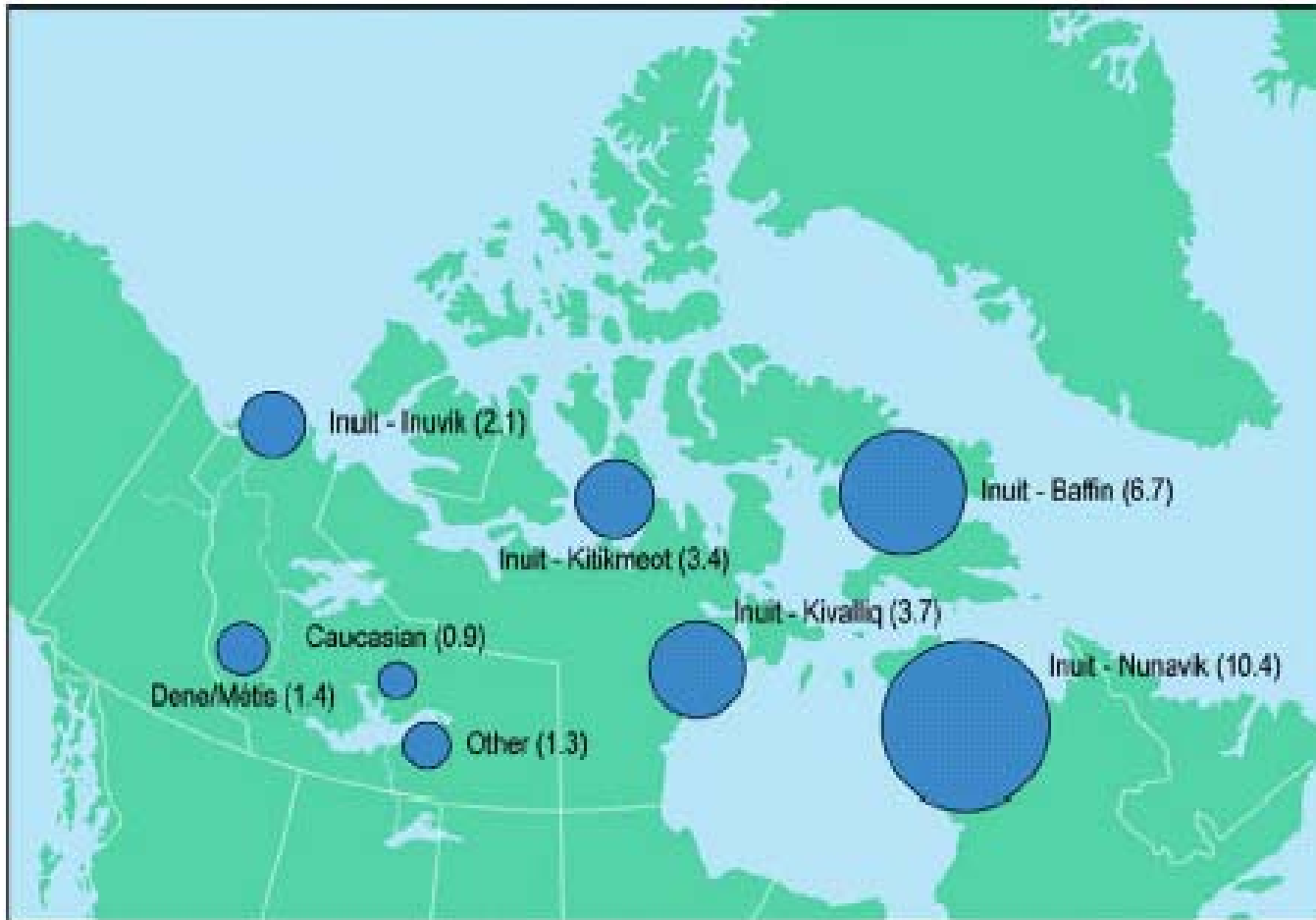
# Detect Exposure - emerging trends

## Trends of PBDEs in Canadian human milks 1982-2002 (bio-bank and recent milk samples)



# Assess Health Risks - identifying at-risk populations

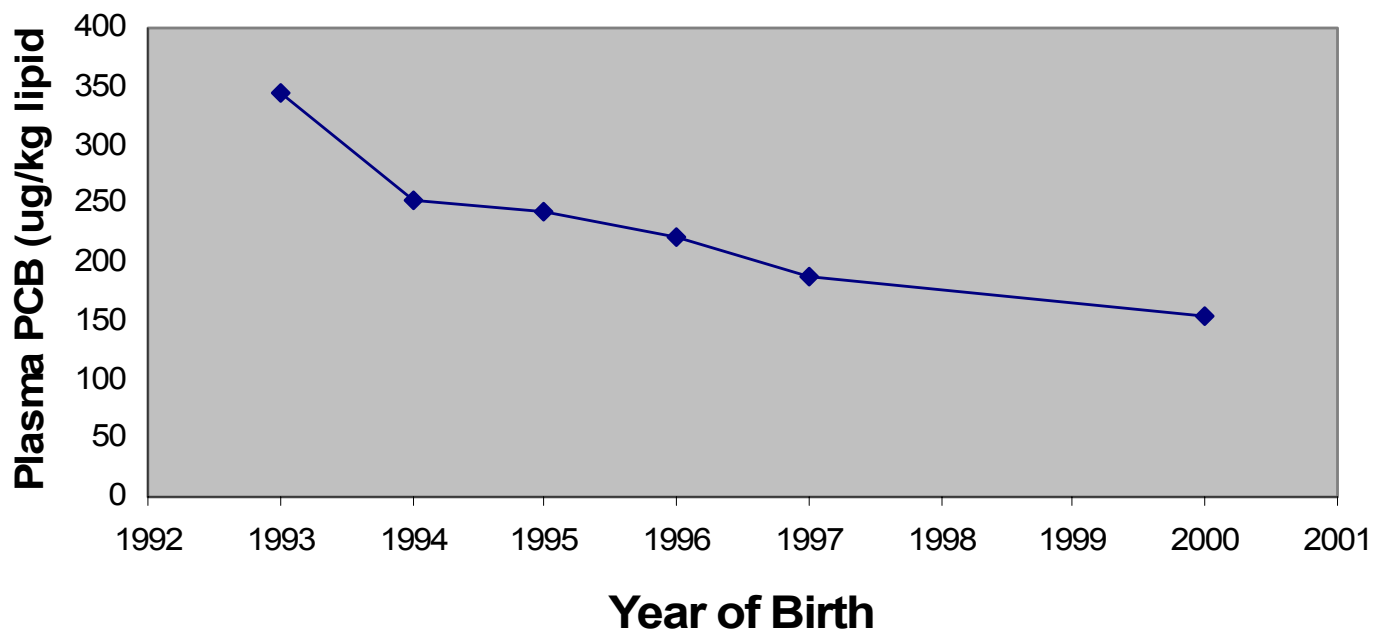
Maternal Contaminant Levels in Arctic Canada: total Mercury ( $\mu\text{g/L}$  plasma)



Source: Van Oostdam et al., Sci. Total Environ. 2005

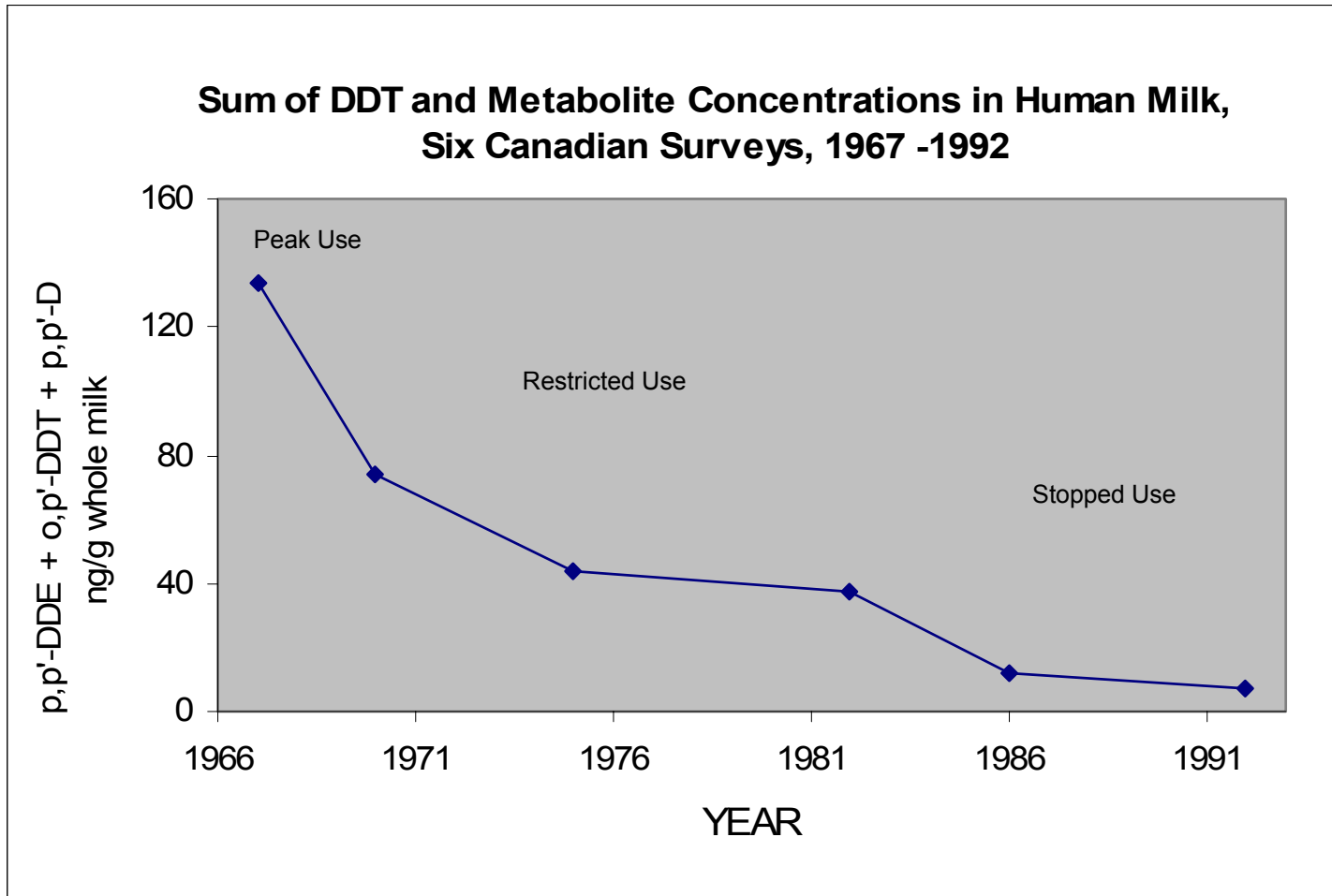
## Develop/Apply Interventions (community outreach)

**Trends in PCB Concentrations in Umbilical Cord Blood  
of Newborns from the Lower North Shore of the St.  
Lawrence River**



Source: Dallaire et al., 2002

# Track the Effectiveness of Actions - controls



Source: Craan and Haines, 1998

# Interpretation depends on Design

- Objective / Hypothesis (surveillance or research)
- Population selection and sample size
- Biomarker (selection and validation)
  - Sensitivity
  - Specificity
  - Biologic relevance
  - Toxicokinetics
  - Practicality

# Challenges

## Scientific/Technical

- Survey and laboratory methods
- Biomarkers (specificity and validity)
- Linking sources, exposures, body levels, internal dose, health effects (exposure assessment, toxicology, epidemiology)
- Establishing reference doses and tissue guideline values

## Ethical/Social/Legal

- Informed consent, privacy and confidentiality
- Targeted populations (e.g. children, aboriginal)
- Bio-banking
- Reporting

# Challenges

## **Interpretation and Communication**

- Exposure detection vs health effects
- Proof vs precaution
- Stakeholder and public engagement

## **Determining Priorities**

- Very large number of existing and new substances
- Rapidly emerging areas (e.g. nano materials)
- Dealing with mixtures

# Biomonitoring at Health Canada

- National surveys
  - Canadian Health Measures Survey
  
- Sub-populations
  - Pregnant women / fetus
  - Children
  - First-Nations – community specific
  - Northern populations
  
- Sentinal studies (pilots)
  
- Corresponding research
  - Toxicology
  - Pharmacokinetics
  - New analytical methods / biomarkers

# Canadian Health Measures Survey

## Biomonitoring Component

- In the field 2007 - 2009
- 5000 Canadians, ages 6 - 79 years
- Collection of blood and urine
- Corresponding questionnaire
- Indicators of chronic and infectious diseases, fitness, nutrition, environmental exposures
- Environmental chemicals
  - metals, phthalates, PCB, PBDE, OC pesticides, organophosphate pesticides, phenoxy herbicides, cotinine, perfluorinated compounds, Bisphenol A
- National level / population representative – creating reference values



# Looking Ahead

- National surveillance
- Community investigations
- Increased use of biomonitoring in epidemiology
- Greater role in health protection and prevention

# In Closing

- Biomonitoring is an important tool – but not the only tool
- Regulatory, public health and policy contexts exist
- Ongoing challenges to collect specimens, measure and interpret biomonitoring data
- The ultimate goal is to protect health and prevent disease

