

# THE ALBERTA BIOMONITORING PROGRAM



# Alberta Public Health Surveillance System

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## Environmental Epidemiological Studies

Cluster Investigation Protocol

## Community Exposure and Health Effects Studies

Enhanced Human Health Risk Assessment based on  
Cytotoxicity Profiling

## Public Health Laboratory Network

Provincial Laboratory for Public Health - Microbiology,  
Alberta Centre for Toxicology, Universities

## Alberta Biomonitoring Program

# Alberta Biomonitoring Committee

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**Alberta Health**

Stephan Gabos

**University of Alberta**

Po-Yin Cheung, Bonita Lee, Don Schopflocher

**University of Calgary**

John Jarrell, Andrew Lyon

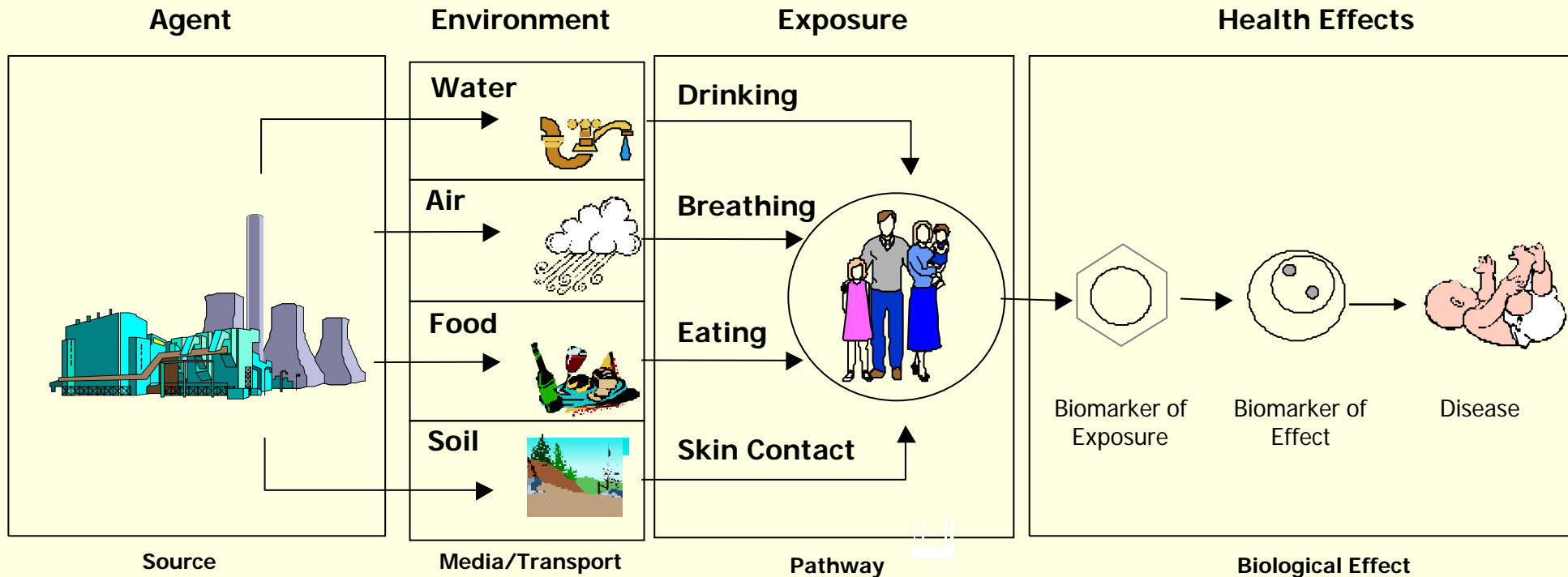
**Alberta Health Services**

Gerhard Benade

**Alberta Centre for Toxicology**

David Kinniburgh, Amy MacDonald

# Environmental Exposure Monitoring



**Hazard Identification**

**Exposure Assessment**

**Biomonitoring**

# Biomonitoring

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- Measuring environmental contaminants or their metabolites in the body (blood, urine, saliva, semen, breast milk, tissue).
- Used for decades to measure exposure to chemicals in an occupational setting
- Now used to assess chemical exposures in the general population and to assess the associated health risks

# Biomonitoring

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- What chemicals are present in the body?
- What is the amount of chemicals that have been internalized (dose)?
- What age, sex, and population groups are most impacted (e.g., children, pregnant women, newborn, First Nations)?
- What are the associated health risks?
- What is the effectiveness of health protection, disease prevention and health promotion strategies and what new strategies are needed?

# Large Scale Biomonitoring Studies

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- National Report on Human Exposure to Environmental Chemicals - Centre for Disease Control and Prevention (CDC)
  - 2009
- Canadian Health Measures Survey
  - 2007
- Consortium to Perform Human Biomonitoring on a European Scale (COPHES)
  - 2009

# Biomonitoring Initiatives in Alberta

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- Dioxins, furans, PCBs – Swan Hills SWC (1996)
- PCBs, pesticides in lactating mother's milk – Capital Health region (2001)
- Chlorination disinfection by-products (DBPs) – Edmonton (2005)
- Organic compounds, tobacco smoke – Component of the community exposure assessment studies in selected communities
- The Alberta Biomonitoring Program, 2005



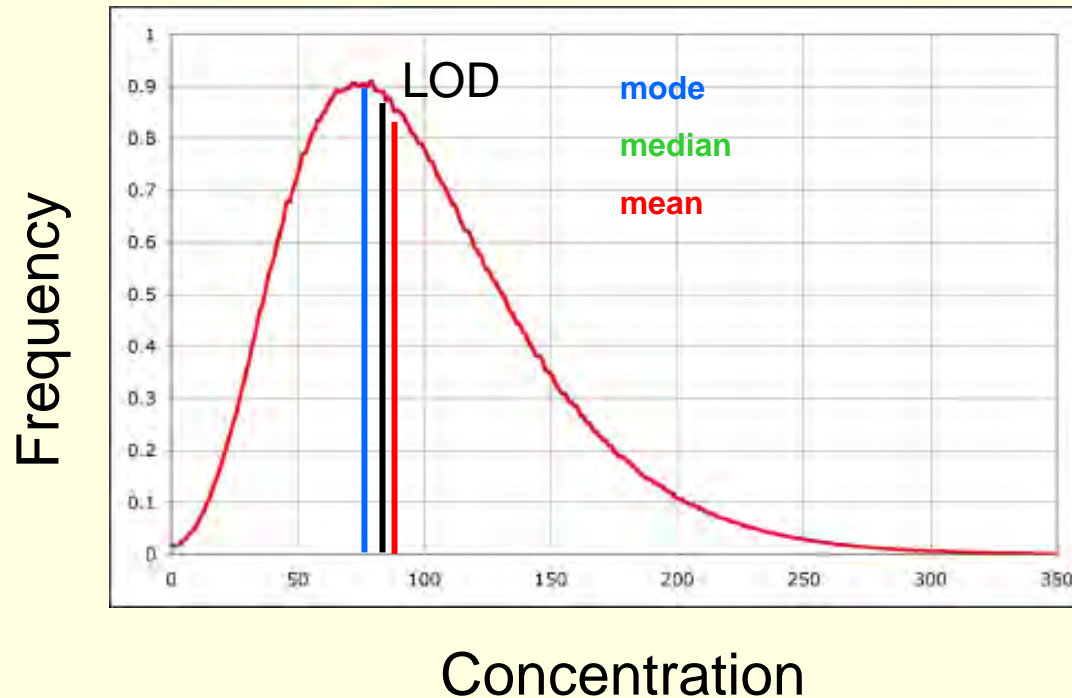
# Alberta Biomonitoring Program Objectives

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- Determine concentrations of environmental contaminants in relevant samples from various populations in Alberta
- Compare to guideline levels and to other regions of Canada and other countries
- Use data to inform future public health interventions and evaluate existing interventions
- Generate new hypotheses on exposure sources

# Log-Normal Distribution

- Within a population most environmental chemicals are distributed log-normally



- 50% of samples will be non-detectable if individual samples are analyzed

# Pooling Samples

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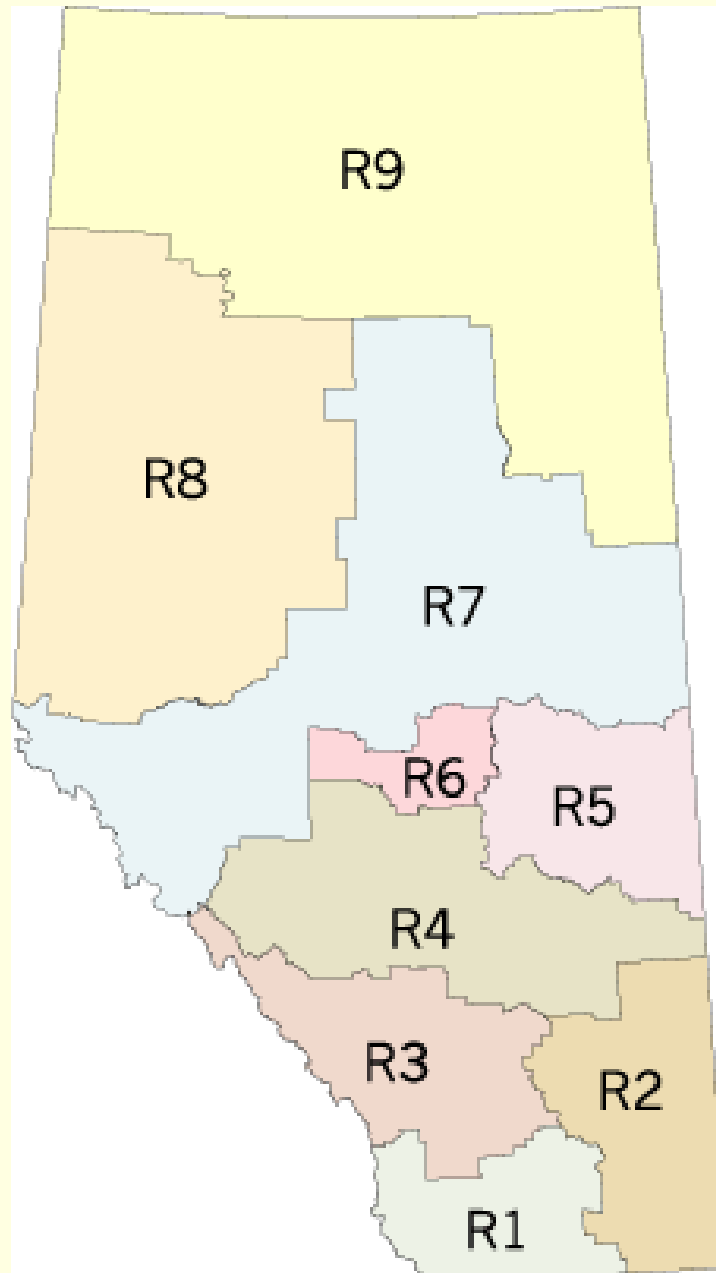
- Cost
  - \$3000-\$5000 per sample
- Fewer ethical concerns
- Population level monitoring
  - Proper pooling design allows estimation of population means without measuring individual samples
- Eliminates information on variance of individual concentrations within the pool
  - Obtain measurements from more than one pool within a stratification
- Available samples – routinely collected from other programs

# Phase 1: Pregnant Women - Sampling Methods

- Existing samples were used: n=28,484
- Each pool consisted of 1 mL of serum from 150-200 women

Age (years) \ Region	Northern AB	Central AB	Southern AB
18-25	15	15	24
26-30	11	15	24
31+	8	15	24

# Alberta Health Regions



# Exclusion Criteria

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- Samples from outside Alberta (n=1,999)
- Samples that tested positive for antibodies to HIV and/or syphilis and/or Hepatitis B surface antigen (n=266)
- Duplicate samples from the same individual (n=3,176)
- Misclassified samples (n=534)
- Samples with unknown maternal age (n=40)

# Sampling Protocol

## Creating specimen line list:

1. Line list of significant positive (HIV, HBsAg and Syphilis) that need to be pulled and excluded
2. Create Line list of individual-based specimens:
  - a. Only select the first specimen from an individual
  - b. Only select specimens from Alberta
  - c. Divide the specimens by region
  - d. Exclude specimens from Calgary site ProvLab from the Northern and Central Alberta list
  - e. Exclude specimens from Edmonton site ProvLab from Southern Alberta list
  - f. For Southern Alberta specimens: sort by age group and month-interval
  - g. For Northern Alberta and Central Alberta specimens: sort by age group only

## Retrieval of specimens:

Using the region\_age-group linelist, identify specimens that have at least 1.0 ml and select eligible specimens and sort them into appropriate sets

For Southern Alberta younger to incl. 25 years monthly specimens available for pooling

No. patients per month

Fewer than 400

More than 400

Randomly divide the monthly samples into two groups of equal number of samples (i.e., exclude one sample if the total number of patients is an odd number)

Aliquot 1 ml from each sample per pool into methanol-rinsed polystyrene bottles and create TWO pools of equal volume and mark the final volume on the bottle

Label each pool as South\_'Age gp'\_'month\_'boxnumbers' and store at -20

For each month, randomly select 200 samples per pool & aliquot 1 ml from each sample per pool into methanol-rinsed polystyrene bottles

create TWO pools of 200 ml each

Label each pool as South\_'Age gp'\_'month\_'boxnumbers' and store at -20

For Southern Alberta 26 to incl. 30 years monthly specimens available for pooling

No. patients per month

Fewer than 400

More than 400

Randomly divide the monthly samples into two groups of equal number of samples (i.e., exclude one sample if the total number of patients is an odd number)

Aliquot 1 ml from each sample per pool into methanol-rinsed polystyrene bottles and create TWO pools of equal volume and mark the final volume on the bottle

Label each pool as South\_'Age gp'\_'month\_'boxnumbers' and store at -20

For each month, randomly select 200 samples per pool & aliquot 1 ml from each sample per pool into methanol-rinsed polystyrene bottles

create TWO pools of 200 ml each

Label each pool as South\_'Age gp'\_'month\_'boxnumbers' and store at -20

For Southern Alberta 31 years and up monthly specimens available for pooling

No. patients per month

Fewer than 400

More than 400

Randomly divide the monthly samples into two groups of equal number of samples (i.e., exclude one sample if the total number of patients is an odd number)

Aliquot 1 ml from each sample per pool into methanol-rinsed polystyrene bottles and create TWO pools of equal volume and mark the final volume on the bottle

Label each pool as South\_'Age gp'\_'month\_'boxnumbers' and store at -20

For each month, randomly select 200 samples per pool & aliquot 1 ml from each sample per pool into methanol-rinsed polystyrene bottles

create TWO pools of 200 ml each

Label each pool as South\_'Age gp'\_'month\_'boxnumbers' and store at -20

## Phase 2: Children's Study – Sampling Methods

- Existing samples were used: n=1373
- Each pool consisted of 400  $\mu$ L of serum from 196-240 children

Age (years) \ Region	Southern AB
$\leq 5$	3
6-13	3

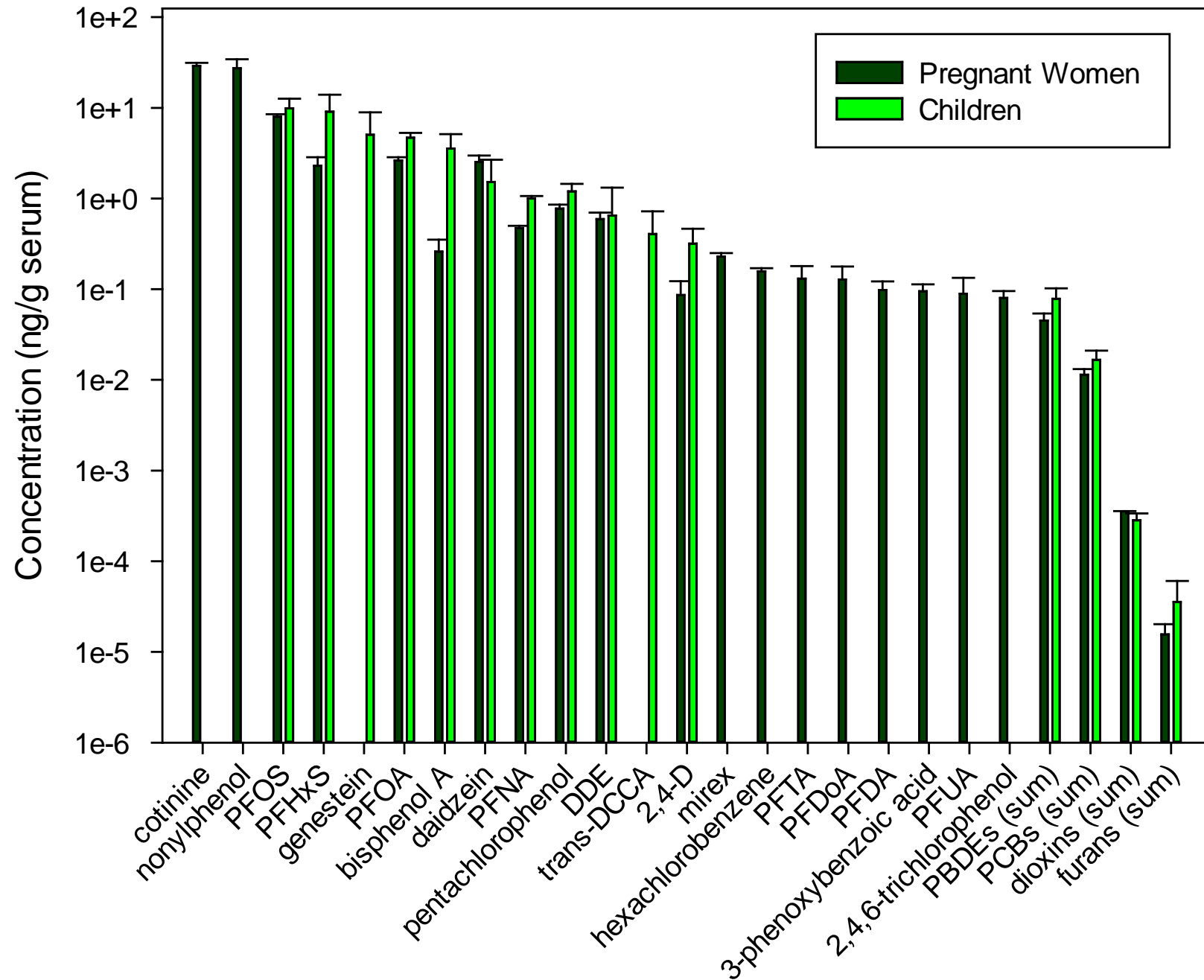


# List of Chemicals

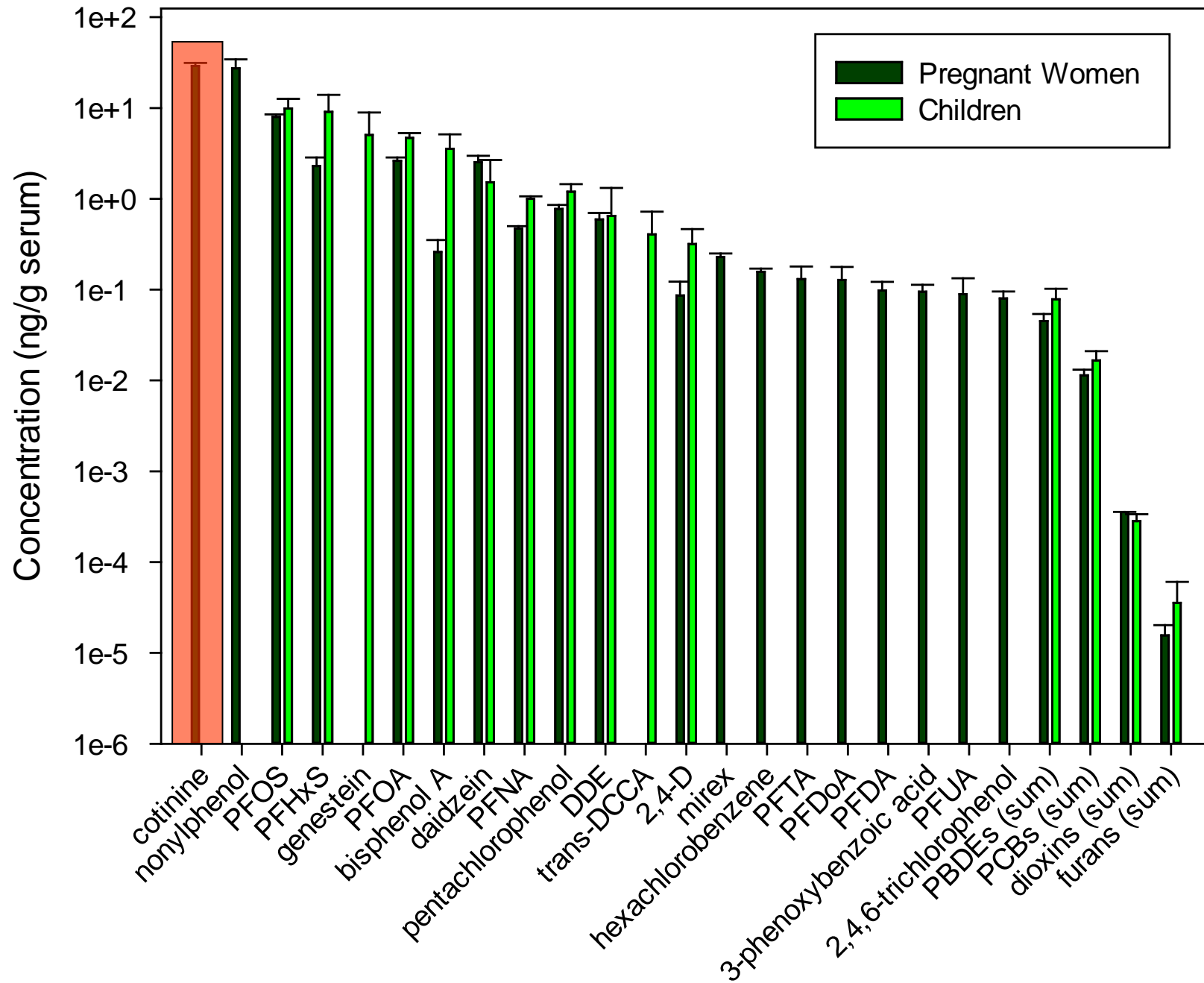
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- Dioxins and Furans
- PCBs
- Organochlorine Pesticides
- Polybrominated Compounds
- Perfluorinated Compounds
- Phenols (Bisphenol A)
- Methyl Mercury
- Metals and Micronutrients
- Polycyclic Aromatic Hydrocarbons
- Organophosphate Pesticides
- Pyrethrin / Pyrethroids Pesticides
- Herbicides
- Carbamate Insecticides
- Nicotine and Cotinine (tobacco smoke)
- Phytoestrogens

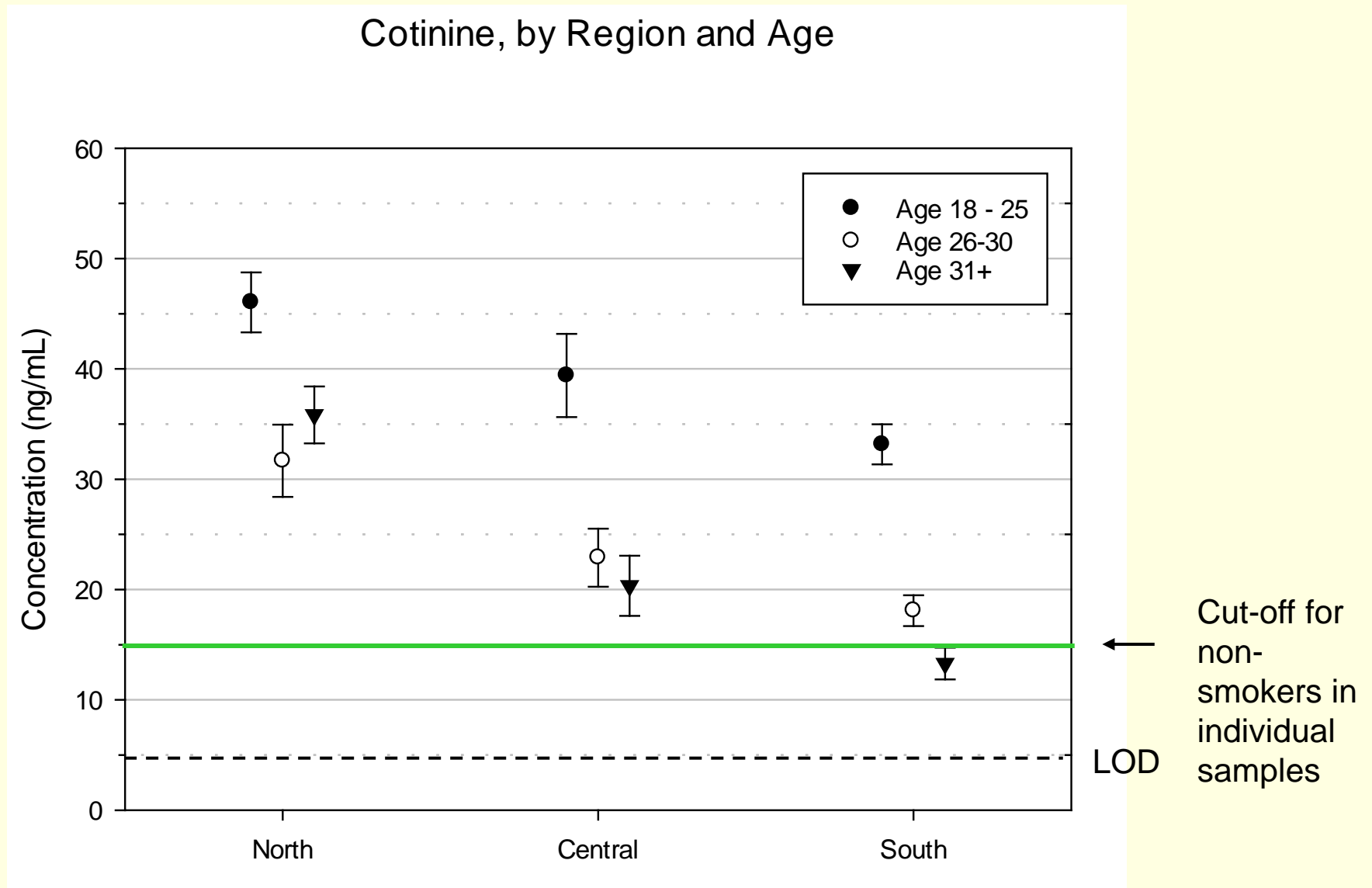
# Detectable Organic Contaminants



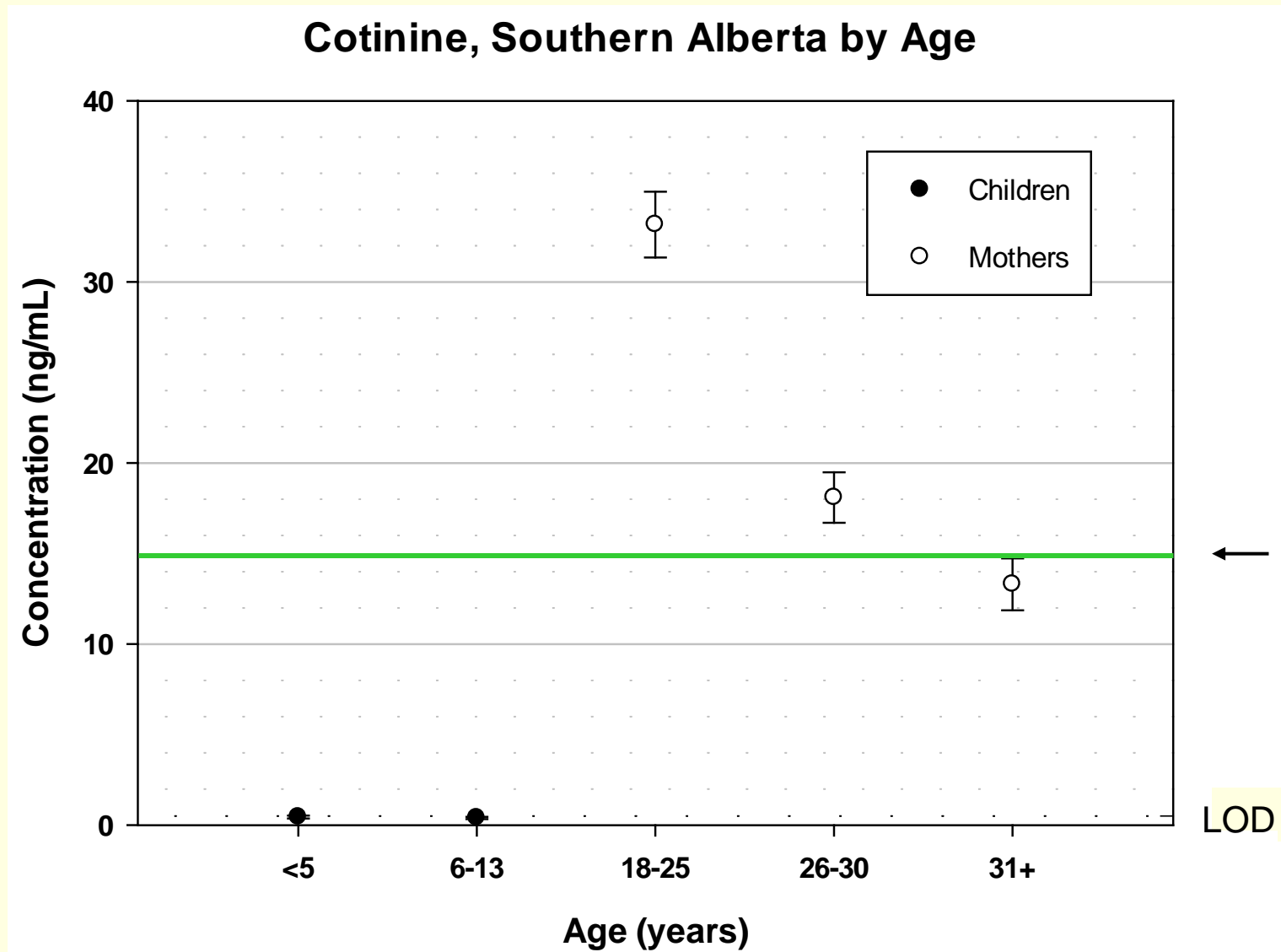
# Cotinine



# Smoking Biomarkers – Pregnant Women

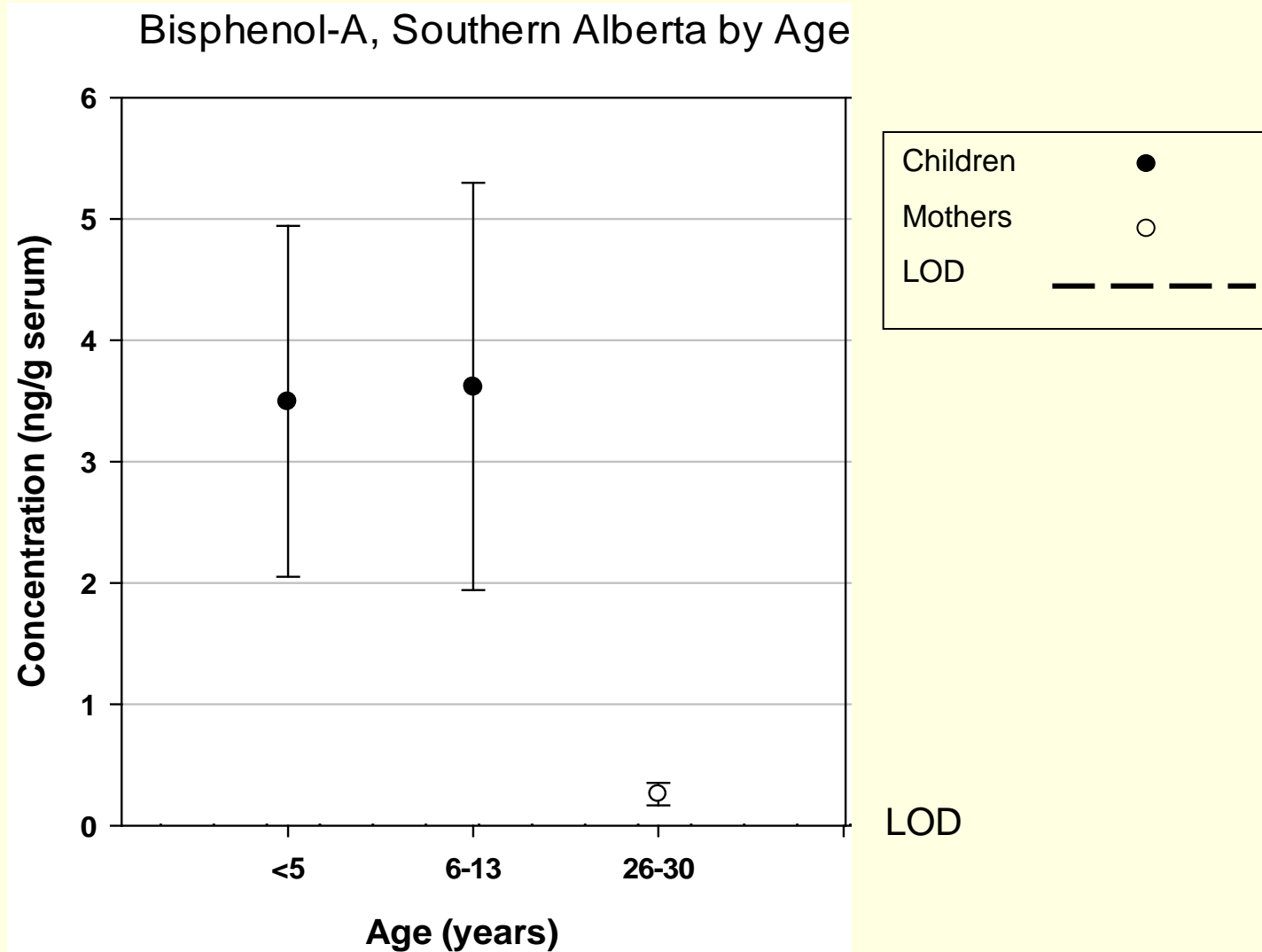


# Smoking Biomarkers – Pregnant Women vs. Children

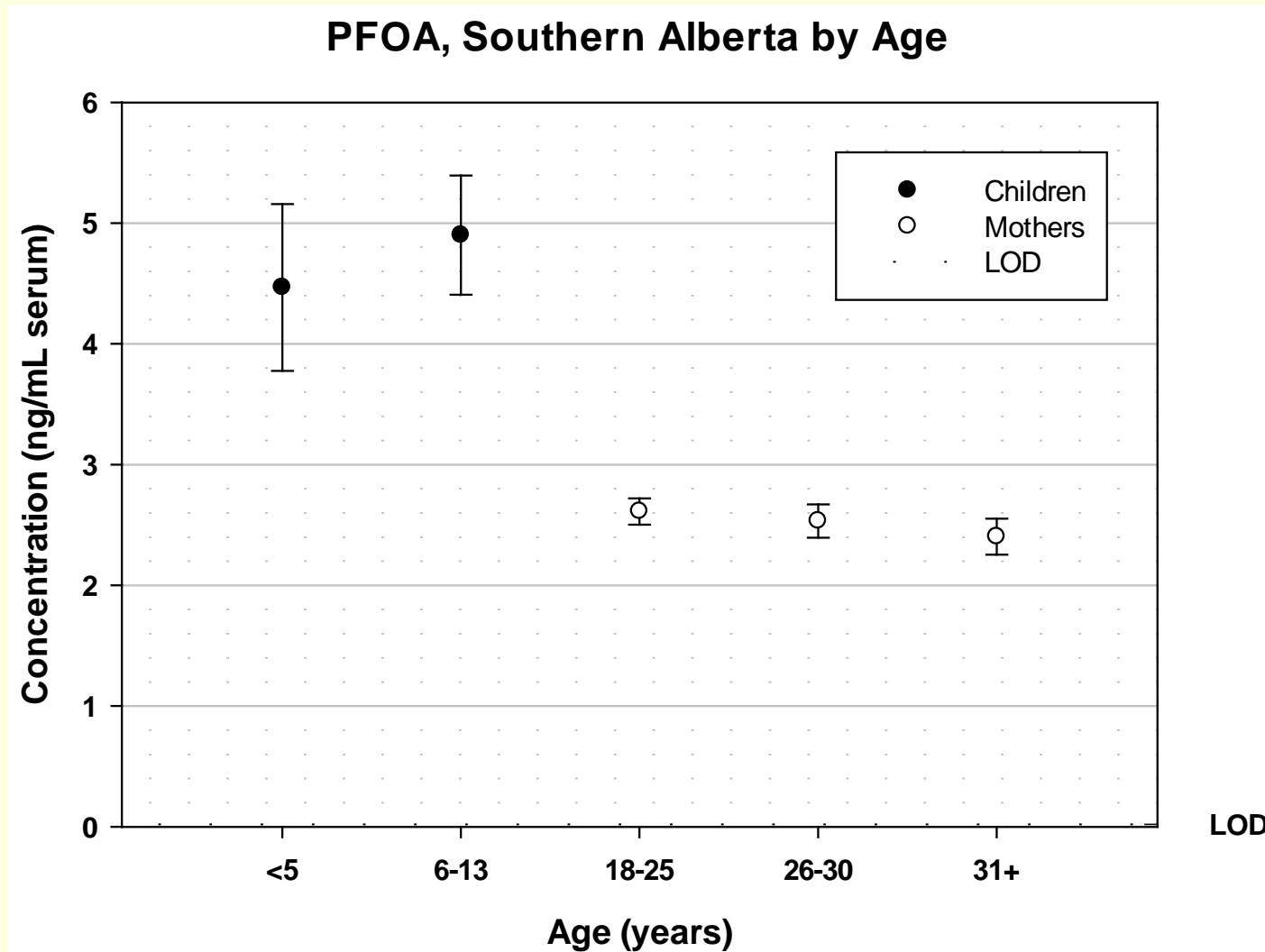


Cut-off for non-smokers in individual samples

# Bisphenol A (BPA)

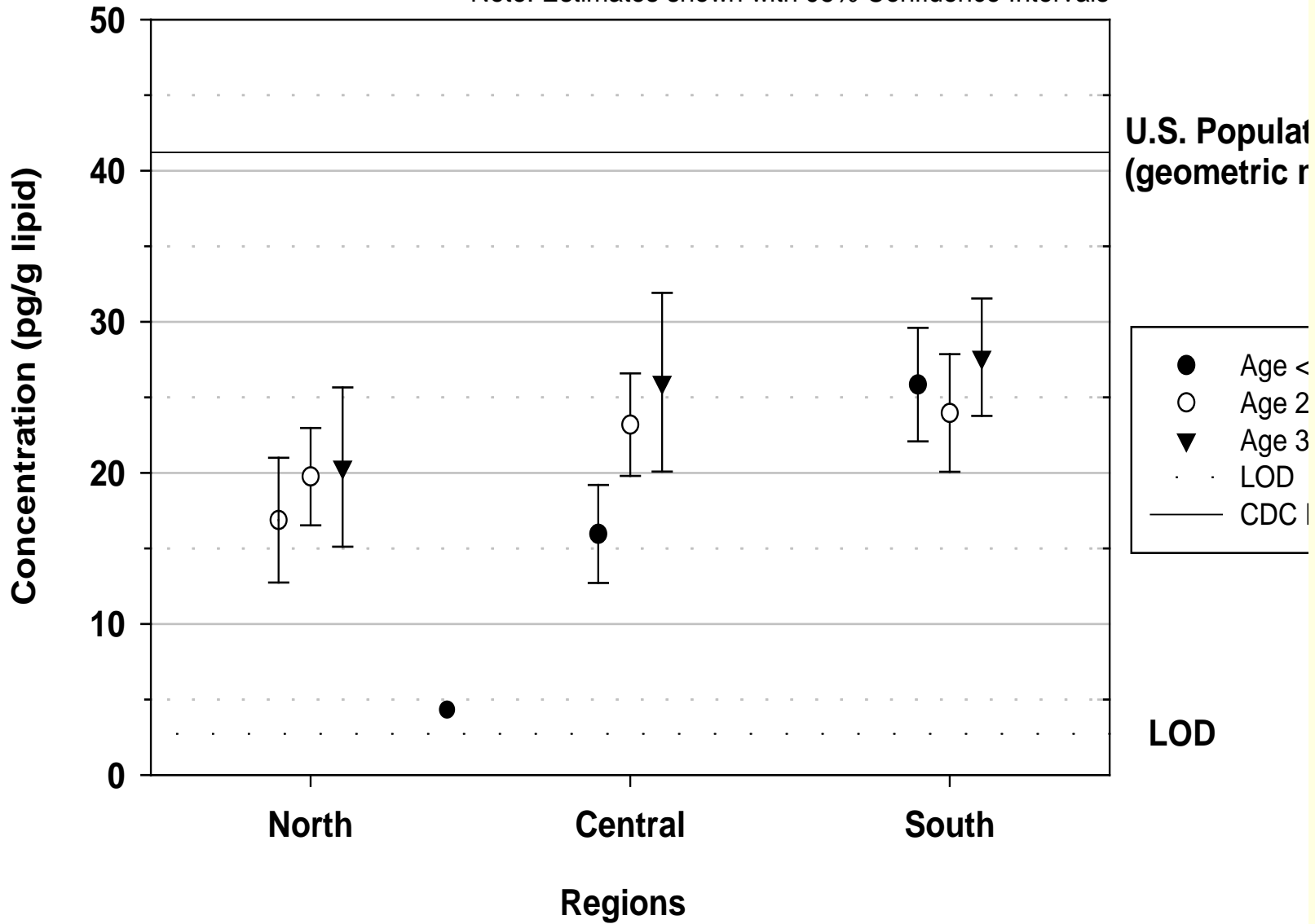


# Perfluorooctanoate (PFOA)



# 1,2,3,4,6,7,8 HpCDD (Lipid), by Region and Age

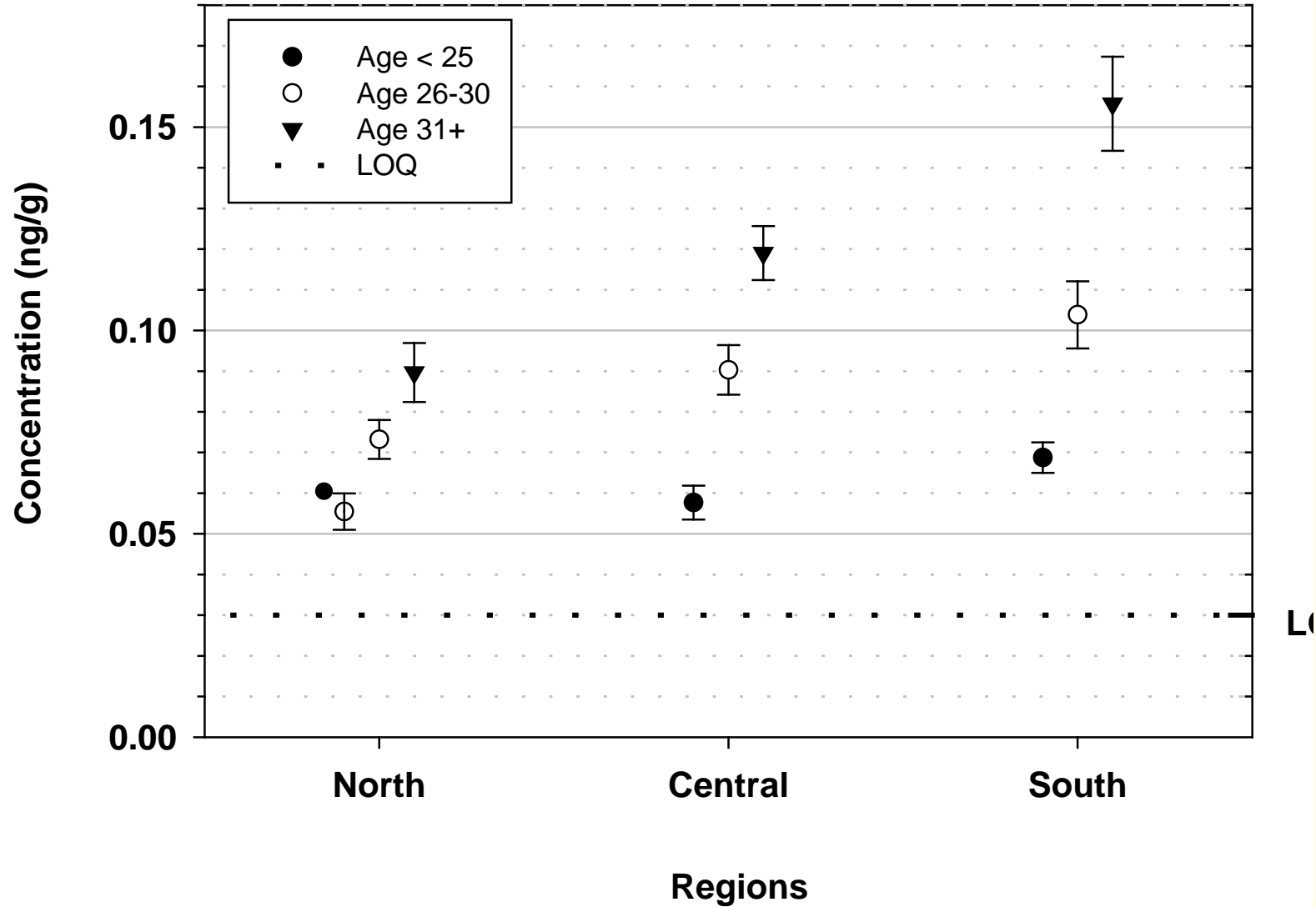
Note: Estimates shown with 95% Confidence Intervals





# Methylmercury (whole serum), by Region and Age

Note: Estimates shown with 95% Confidence Intervals



# Conclusions from Pregnant Women and Children's Studies

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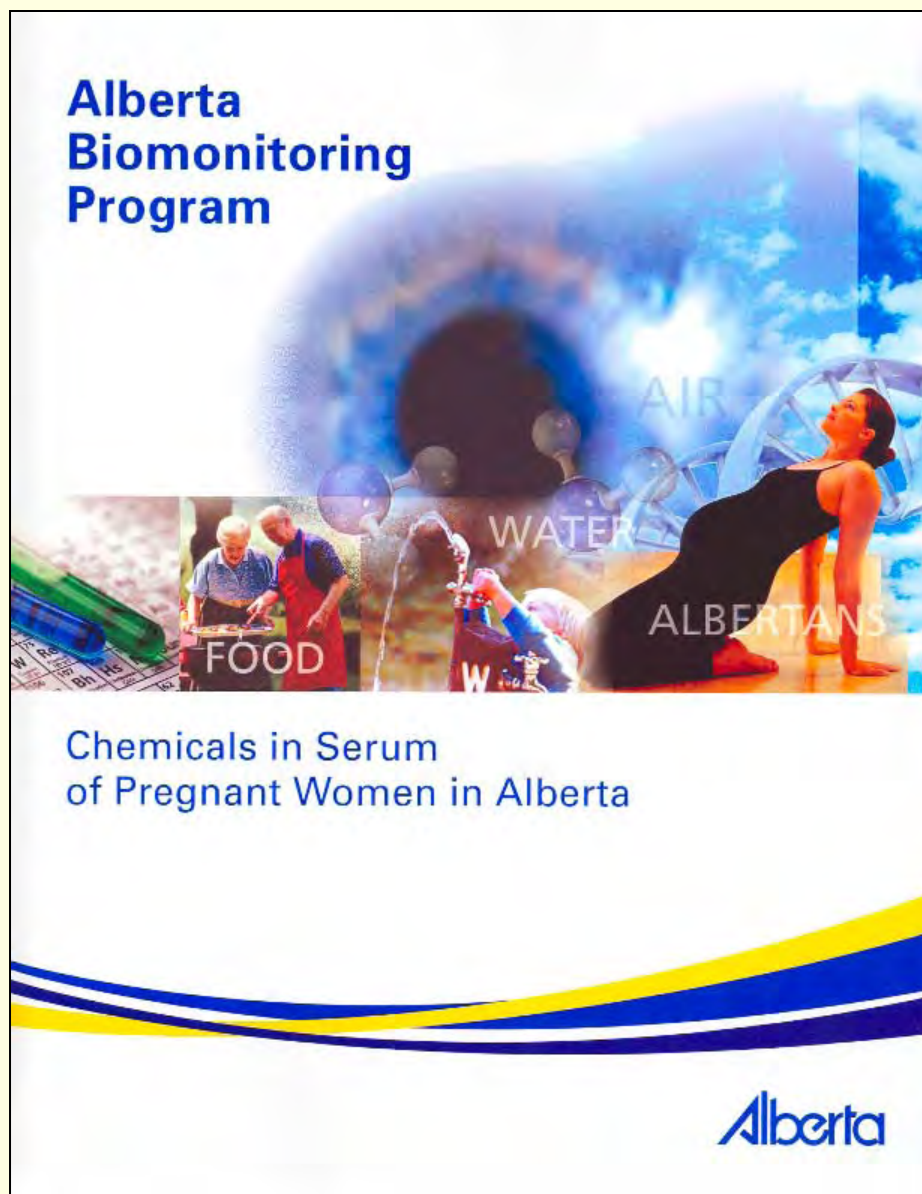
- Pooling of samples enabled a cost-effective, statistically powerful alternative to individual sampling
- First biomonitoring campaign (pregnant women) revealed significant differences based on age and region
- Overall, the age of children ( $\leq 5$  or 6-12 years) was not a determining factor of the observed levels of chemicals
- Significant differences were observed when comparing children's serum concentrations to serum concentrations of pregnant women collected from the same general region (Southern Alberta)

## Conclusions (cont'd)

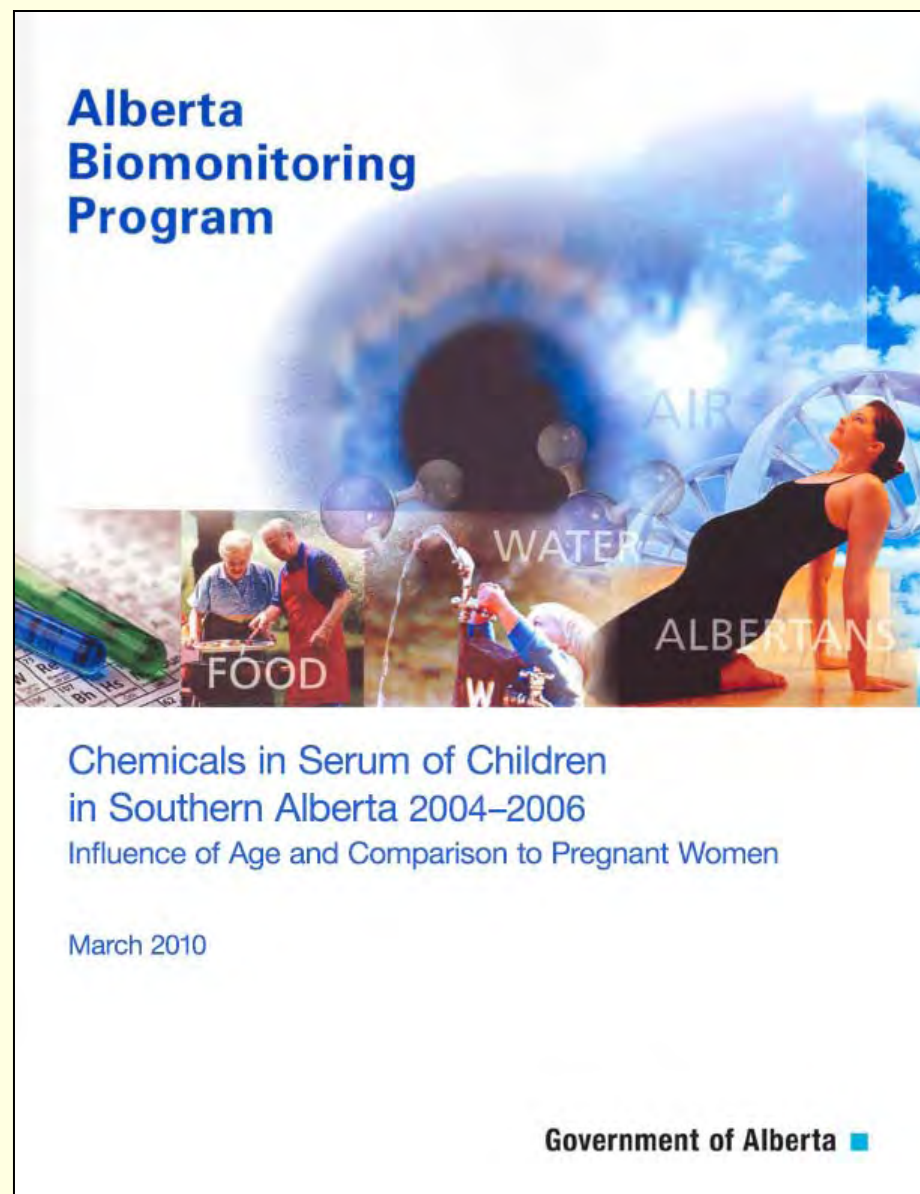
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- Examples of organic contaminants that were higher in children than pregnant women were perfluorinated compounds, bisphenol A, the herbicide 2,4-D, and a metabolite of common pyrethroid insecticide, trans-DCCA.
- Some congeners of dioxins and furans, and certain polybrominated diphenyl ether flame retardants were also higher in some children than certain pregnant women
- Comparison to other populations revealed similar or lower concentrations in the Alberta population.
- These baseline concentrations may serve as a benchmark against which effectiveness of regulations or public health measures may be assessed.

# Published Reports



<http://www.health.alberta.ca/documents/Chemical-Biomonitoring-2008.pdf>



<http://www.health.alberta.ca/documents/Chemical-Biomonitoring-2010.pdf>

# Current Initiative – Phase 3

## Paired Pregnant Women & Cord Blood Pools

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- Collect maternal and cord blood samples and create matched pools
  - samples collected during delivery
  - direct comparison of mothers to babies
- Samples to be obtained in six regions of Alberta: Calgary, Edmonton, Fort McMurray, Grande Prairie, Medicine Hat and Lethbridge
- Previous list of chemicals has been revised

# Revised Compound List

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- Compounds to be removed:
  - Polybromobiphenyls
  - PAHs
  - Organophosphate pesticides
  - Phenoxyacid herbicides
  - Pyrethroid pesticides
  
- Compounds to be added:
  - Phthalates
  - Alkylated Benzenes



# Challenges

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- Ethics approval received from U of A and U of C for each site
- Sample Collection
  - New samples vs. previously collected samples
  - Infrastructure for research studies not available at all sites
  - Contacts at each site
  - Collection tubes, sample processing and transportation

# Future Direction

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- At this time, it is difficult to assess the health implications of the detected contaminants at the low concentrations that were observed.
- Develop a model for interpreting biomonitoring data in public health risk assessment (biomonitoring equivalents)
- Expand collaboration in Western Canada: Saskatchewan
- Extend monitored populations beyond pregnant women and children
- Analyze specimens other than serum based upon studies examining best vehicle for various contaminants
- Continue the Alberta Biomonitoring Program to collect valuable information over time on the effectiveness of current and future chemical regulatory actions and health protection



THANK  
YOU