CDC/ATSDR Environmental Public Health Perfluorinated compounds

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"The findings and conclusions in this presentation have not been formally disseminated by the Centers for Disease Control and Prevention and should not be construed to represent any agency determination or policy."

CDC ATSDR

The National Center for Environmental Health

- **Programs that prevent asthma and Pb poisoning**
- **Measurements of people's exposures to chemicals**
- **Investigate disease outbreaks and exposures**
- **Improve local/state environmental health services**
- **Provide laboratory quality assurance programs**
- **Link environmental data and health data**
- **Protect Refugees and Displaced populations**

CDC ATSDR

Agency for Toxic Substances and Disease Registry

- **Evaluate human health risks from toxic sites and releases and conduct timely, responsive public health actions.**
- **Determine the relationship between exposure to toxic substances and disease.**
- **Develop and provide reliable, understandable information for affected communities and stakeholders.**

CDC ATSDR

NCEH/ATSDR funding to Minnesota

ATSDR-MN Site-Specific Activities	**MN Dept. of Health**	**$**	**442,764.00**
HSEES	**MN Dept. of Health**	**$**	**94,732.00**
Applied Research – Libby asbestos	**U. MN**	**$**	**350,000.00**
Addressing Asthma	**MN Dept. of Health**	**$**	**600,000.00**
Controlling Asthma in Cities	**ALA of MN**	**$**	**921,985.00**
Lead Poisoning Prevention	**MN Dept. of Health**	**$**	**603,851.00**
Environmental Health Specialist	**MN Dept. of Health**	**$**	**134,868.00**

Minnesota State Total FY2006 $ 3,168,180.00

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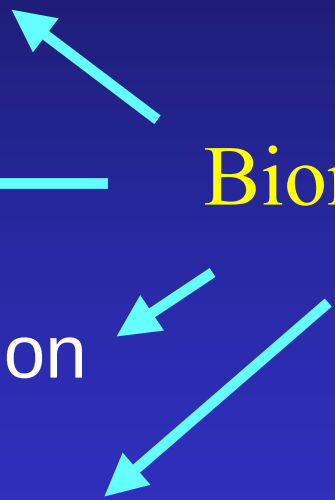
Prevention of disease from toxic exposures

- Detect exposure or disease
- Assess health risk
- Develop and apply intervention
- Assure intervention effectiveness



Biomonitoring

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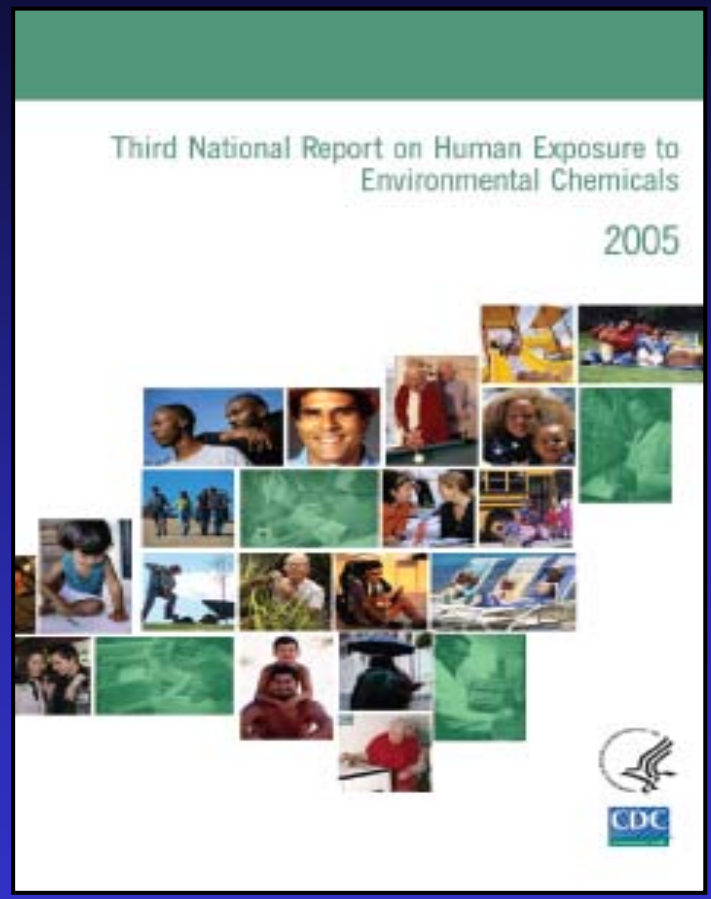
CDC's Biomonitoring Program

1. Assessment of the chemical exposures of the U.S. population
2. Human exposure and health effects studies
3. Laboratory response to chemical and radiologic emergencies

Third National Report on Human Exposure to Environmental Chemicals

- 148 chemicals in blood and urine
- Approximately 2400 people
- Nationally representative sample
- More then 350,000 measurements
- Years: 2001-2002 and includes previous data from 1999-2000



www.cdc.gov/exposurereport

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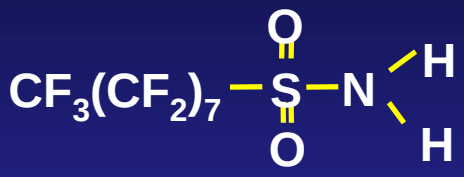
PFCs in NHANES 1999-2000

- **NHANES 1999-2000 was conducted in 26 locations throughout the United States**
- **PFCs were measured in 1562 people 12 years of age and older**
  - **Representative of the general US population**
  - **Demographics: sex, age & race/ethnicity (Mexican-American, non-Hispanic white, non-Hispanic black)**
- **PFCs were measured in 0.1 mL of serum using online-SPE coupled to reversed phase HPLC-MS/MS**

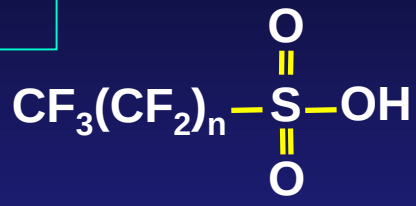
Calafat et al. ES&T 2007, 41:2237-2242.

Eleven PFCs measured

Sulfonamides

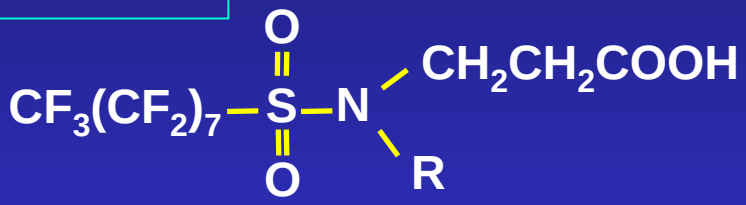


Sulfonic acids



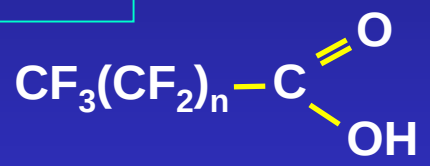
n = 5 (PFHxS)
7 (PFOS)

PFOSA



R = Et (Et-PFOSA-AcOH)
Me (Me-PFOSA-AcOH)

Carboxylic acids



n = 6 (PFOA), 7 (PFNA)
8 (PFDeA)
5 (PFHpA), 9 (PFUA),
10 (PFDoA)

LODs ranged from 0.1 to 0.2 ng/mL

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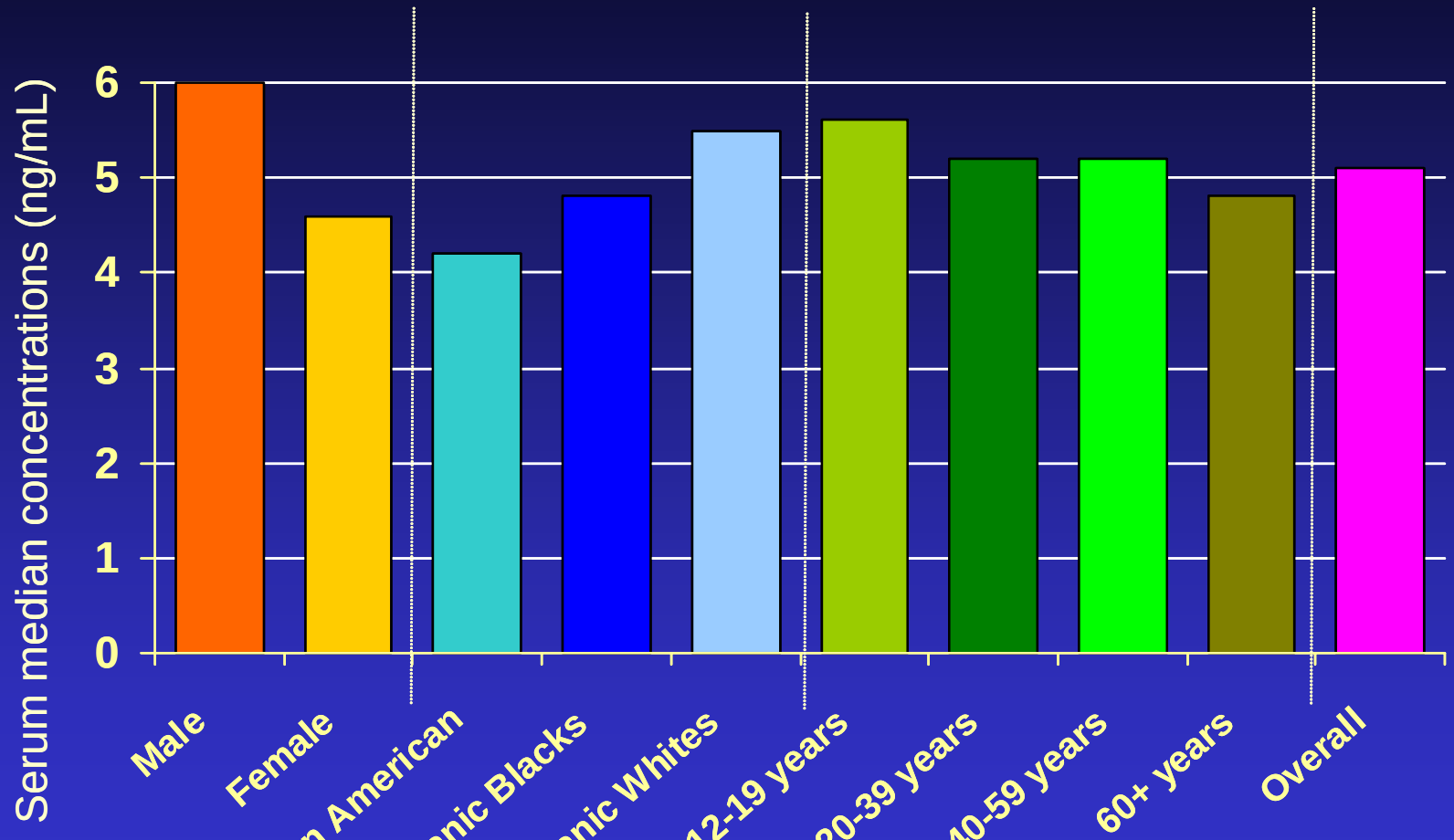
PFOA – NHANES 1999-2000



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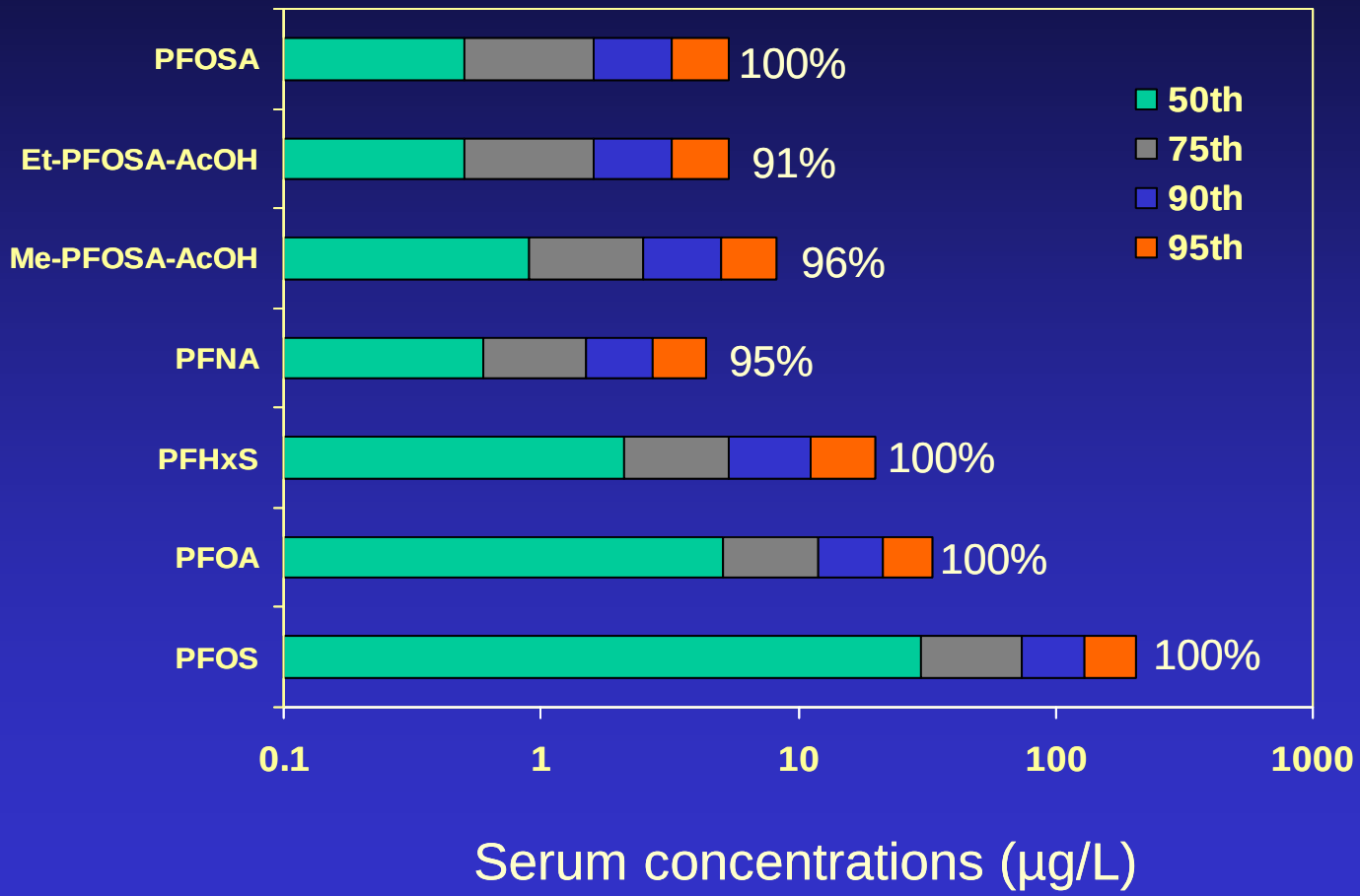
Comparing exposure to PFCs NHANES 99-00 (N = 1562)



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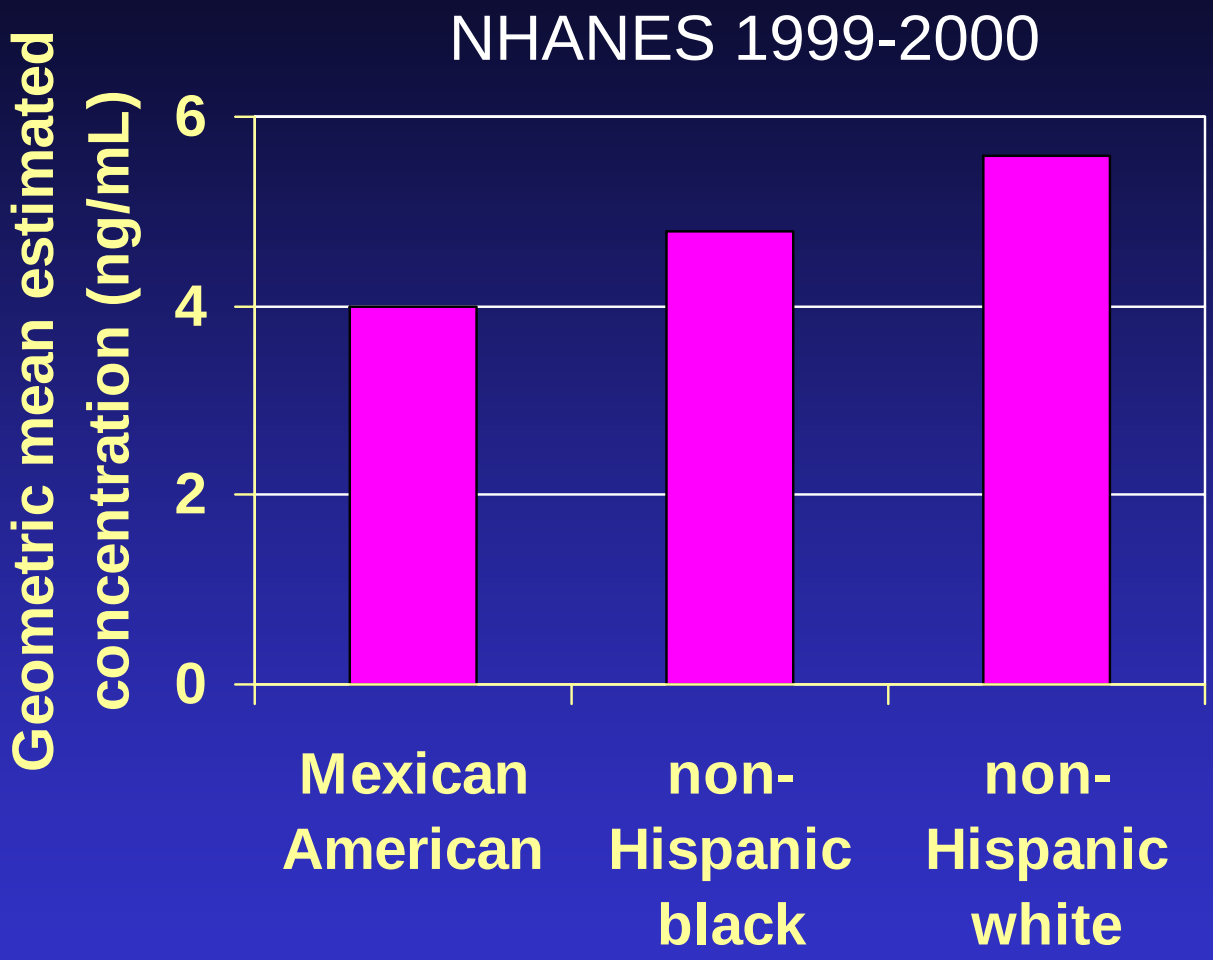
Findings – NHANES 99-00

- Seven PFCs were detected in more than 90% of samples
  - PFOS > PFOA > PFHxS
- Variability in exposure to PFCs
  - no clear “age” trends
  - Mexican Americans have the lowest concentrations
  - PFOA and PFOS higher in males than in females.
    - Most pronounced at younger ages
  - Higher education associated with greater concentrations of PFOS and PFOA

PFOA - Race/ethnicity differences



All differences are statistically significant

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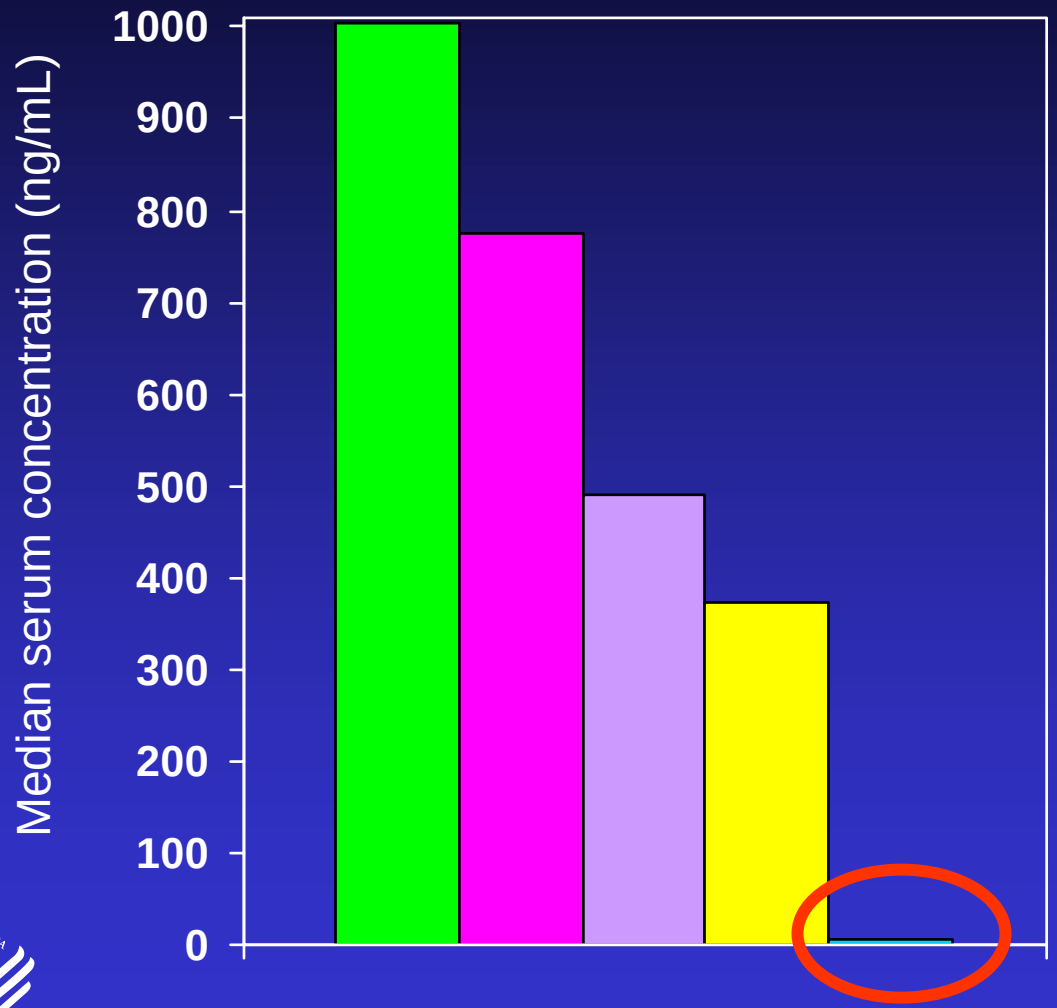
Comparing PFOA Levels



- Occupational (N = 6; SD = 2642 ng/mL; Ehresman et al. Environ. Res. 2007)
- Occupational (N = 18; IQR= 422-999 ng/mL; Emmett et al. JOEM 2006)
- Occupational (N = 259; US EPA Public Docket AR-226-1922 2005)
- Little Hocking water system (N = 291; IQR = 221-576 ng/mL; Emmett et al. JOEM 2006)
- NHANES 1999-2000 (N = 1562; 95% CI = 4.7-5.7 ng/mL; Calafat et al. ES&T 2007)

100X difference between background and exposed groups

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ATSDR Assessment of PFOA Exposures in West Virginia

Clement Welsh, Ph D, MPH

Deputy Director
Division of Regional Operations
ATSDR

Request from WV Bureau of Public Health

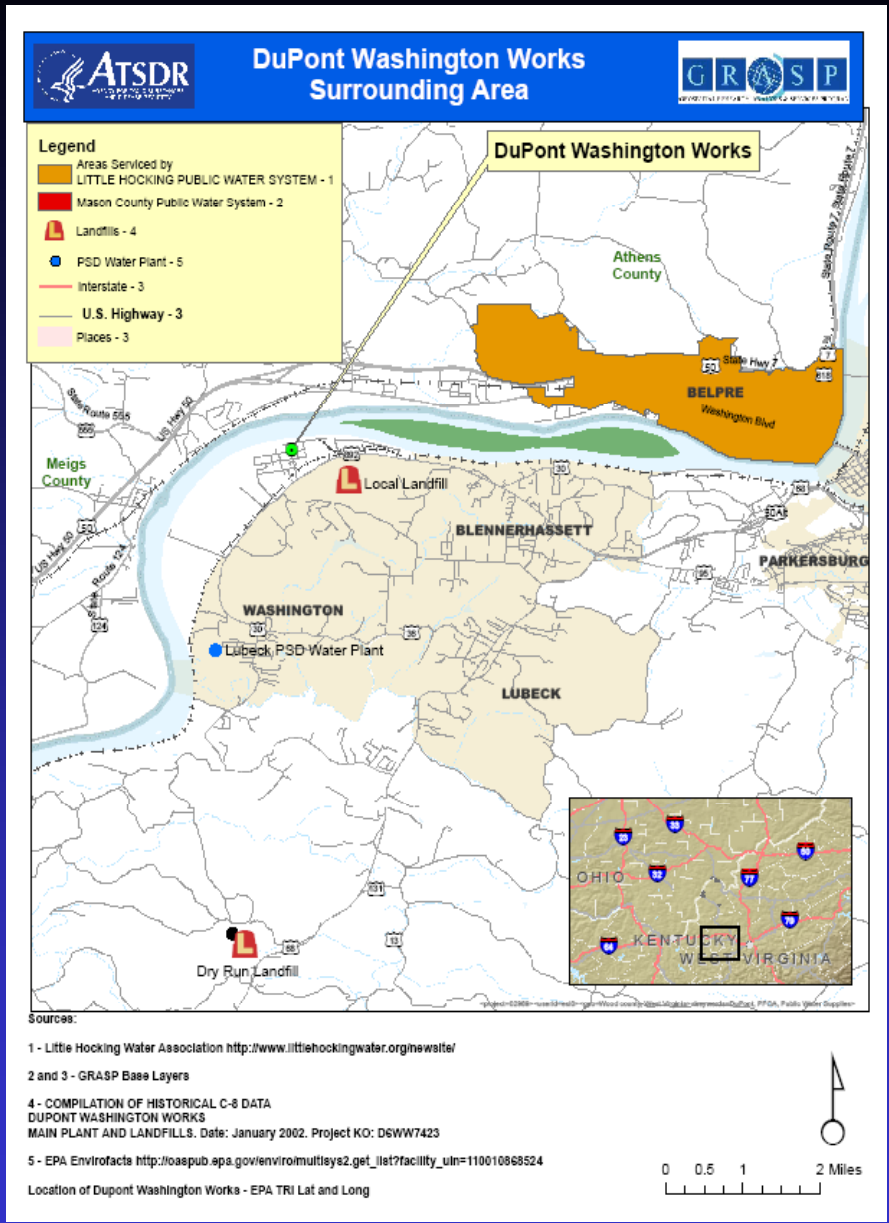
Questions Posed:

1) **Is their a public health threat posed by continued consumption of water supplies contaminated by PFOA?**

2) **What are recommendations for follow up health activities for this population?**

DuPont Washington Works Facility

- **PFOA used by facility since early 50's**
- **Emissions released in air, discharged to Ohio River, or shipped off-site for disposal**



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Study by Researchers at the University of Pennsylvania

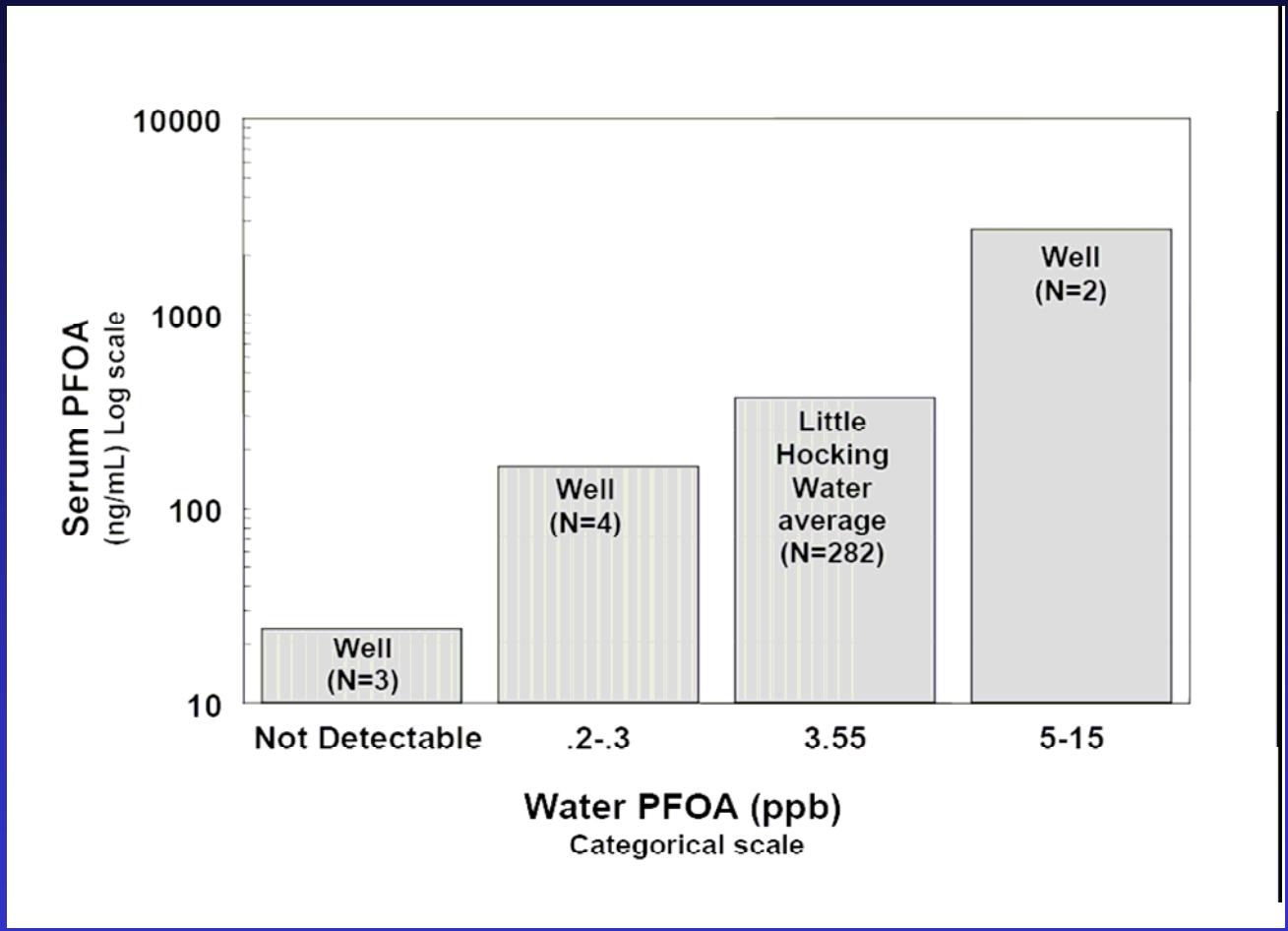
Emmett et. al., JOEM, 2006

282 serum levels of PFOA measured on users of a contaminated water supply

Little Hocking Water System; PFOA = 3.55 ppb (mean for years 2002-2005)

Median serum PFOA concentrations of 374 ng/ml.

Serum PFOA Concentrations vs. Water PFOA Concentrations



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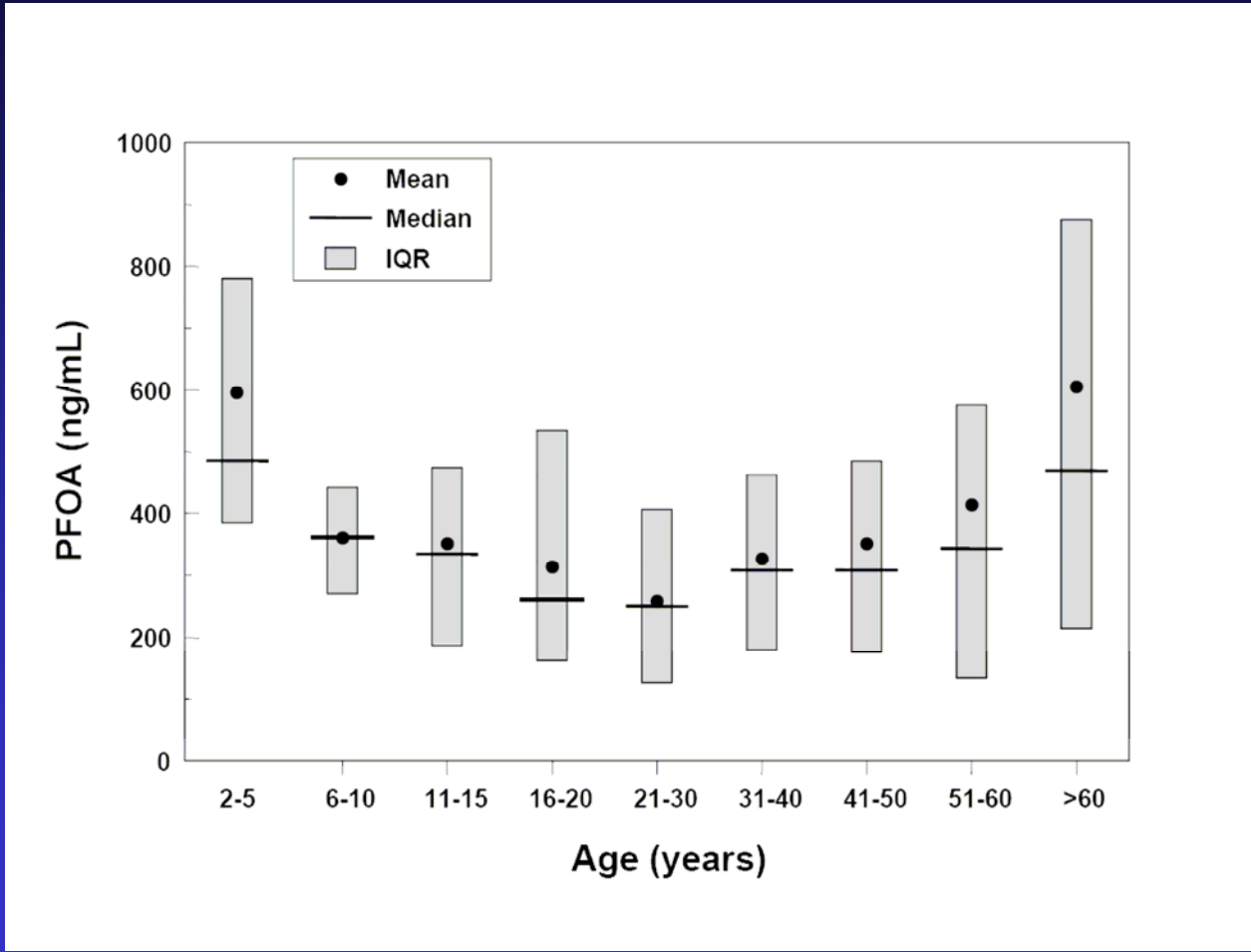
Age vs. Serum PFOA



Primary Findings

- **Drinking water appears to the primary exposure pathway.**
- **Older and younger study participants had higher serum PFOA levels than other age groups.**

Primary Findings

- **The study found "no significant positive relationships between serum PFOA and liver or kidney function tests, cholesterol, thyroid-stimulating hormone, or with red cell indices, white cell, or platelet counts".**

- **"Mean serum PFOA was not increased in those with a history of liver disease or thyroid disease".**

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Primary Findings

- **“No toxicity from PFOA was demonstrated using the measured end points; other endpoints need to be addressed.”**
- **“Based on the findings in experimental animals, other endpoints, particularly cancer, reproductive and childhood endpoints require further study.”**

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Data Gaps / Notes

- **Extent of contamination in area wells is not known.**
- **The individual with the highest serum PFOA level was a well water user.**
- **Well water users (n = 26) showed more variability in serum PFOA levels.**
- **Follow-up work: aimed at producing a better estimate of the PFOA half-life in humans.**

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Ongoing ATSDR Activities

- **Working to complete the Health Consultation for West Virginia.**
- **Contributing to community and physician education.**
- **Working to develop a "chemical specific" health consultation for specific perfluorochemicals.**
- **Working to develop pharmacokinetic models for PFOA exposures.**
- **Continuing to monitor research developments and will update advice as needed**

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C-8 Health Project

Part of a class action lawsuit settlement

>64,000 serum samples with questionnaires

Aims of the project:

- **determine health effects of C-8 exposures**
- **direct additional toxicity studies**
- **identify most impacted groups**

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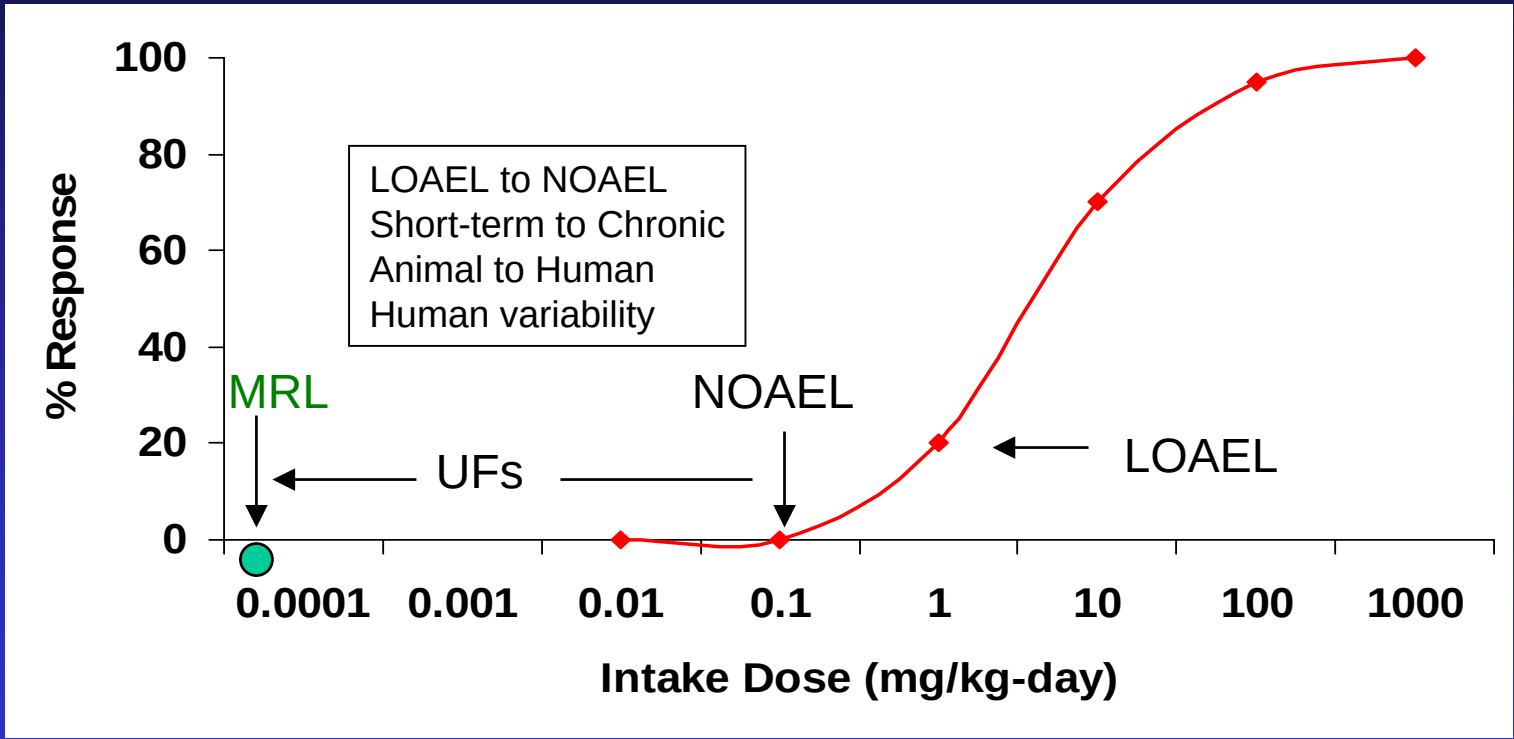
Evaluation of Methodologies for Deriving Health-Based Values for PFCs in Drinking Water

Mark Johnson, PhD, DABT
Assistant Director for Science
Division of Regional Operations
ATSDR

Determination of a Safe Level of Exposure-

Minimum Risk Level (MRL) = Health Based Value



LOAEL- lowest observed adverse effect level
NOAEL- no observed adverse effect level
UFs- uncertainty factors
MRL- no adverse effects for human population

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Interspecies extrapolation of Intake Dose

- Assumes pharmacokinetic similarity between species in:
  - Absorption
  - Tissue distribution
  - Metabolism
  - Clearance

Pharmacokinetic differences for PFCs

- Physiologic half-life for PFOA
  - Rats:
    - 3 - 16 hrs (female)
    - 138 - 202 hrs (male)
  - Monkeys: 21-33 days
  - Humans: 4 yrs

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Options for Pharmacokinetic adjustments

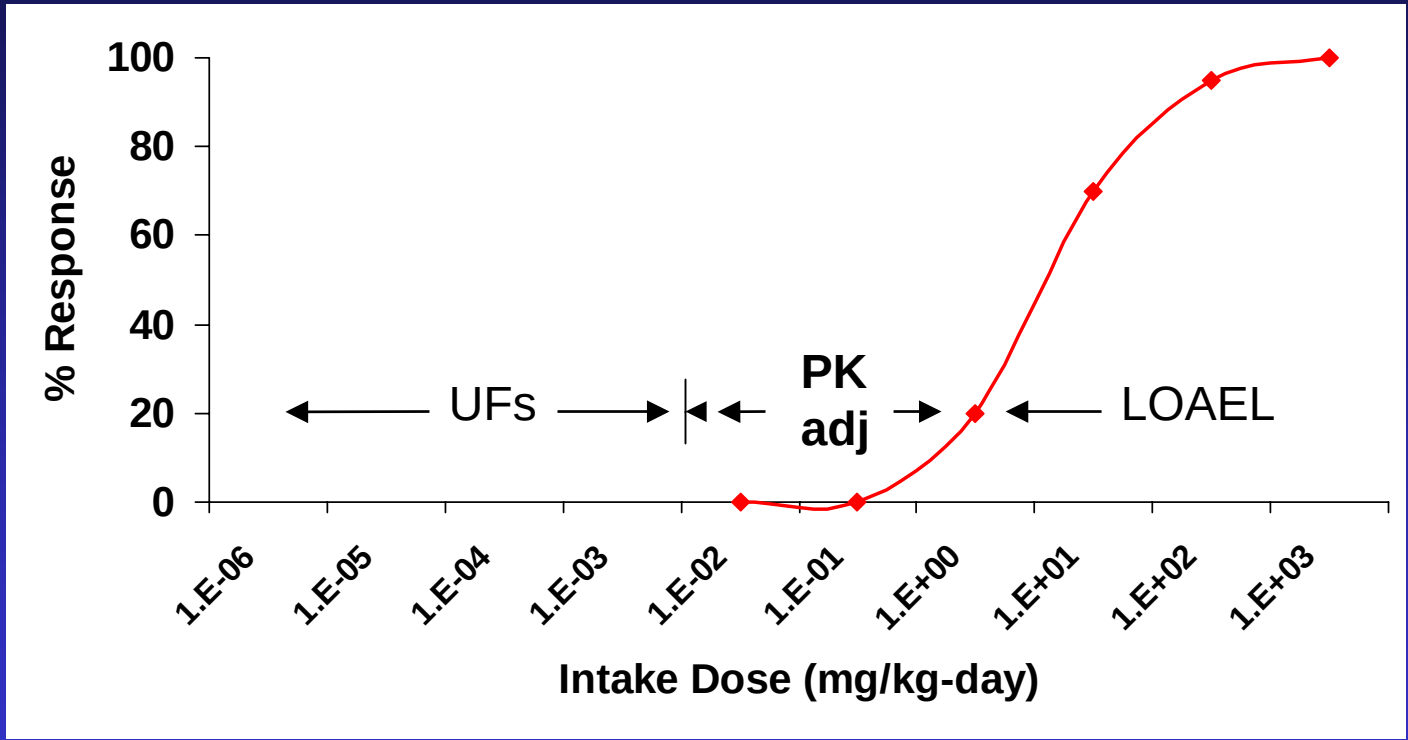
1) Ratio of clearance rates between humans and species for critical effect

$$PK_{adj} \cong \frac{t_{1/2}\ \text{humans}}{t_{1/2}\ \text{species for critical effect}}$$

PFOS: 20

PFOA: 70

Pharmacokinetic adjustment of Intake Dose



Options for Pharmacokinetic adjustments

2) Comparison of serum levels for given intake dose between species
   - Measure or estimate serum [PFC] at the LOAEL / NOAEL / Benchmark dose in animal study
   - Apply UFs for extrapolation to human populations
   - Apply ratio of human serum / intake dose to estimate dose associated with specific effect

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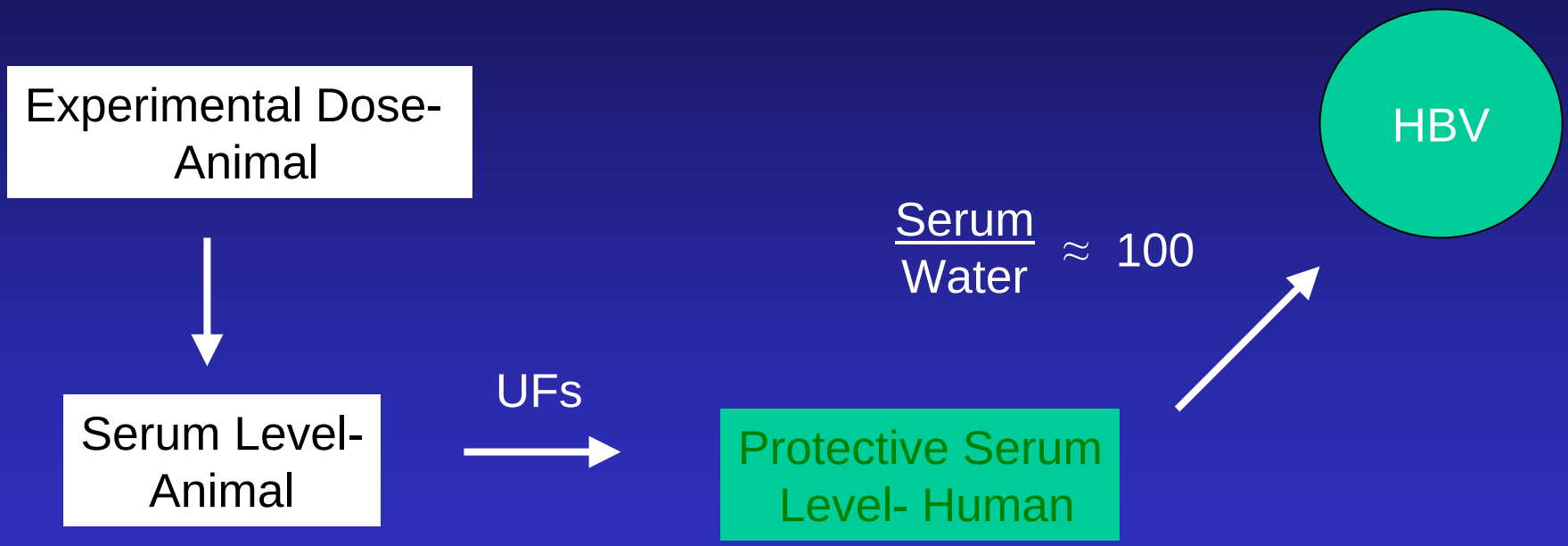
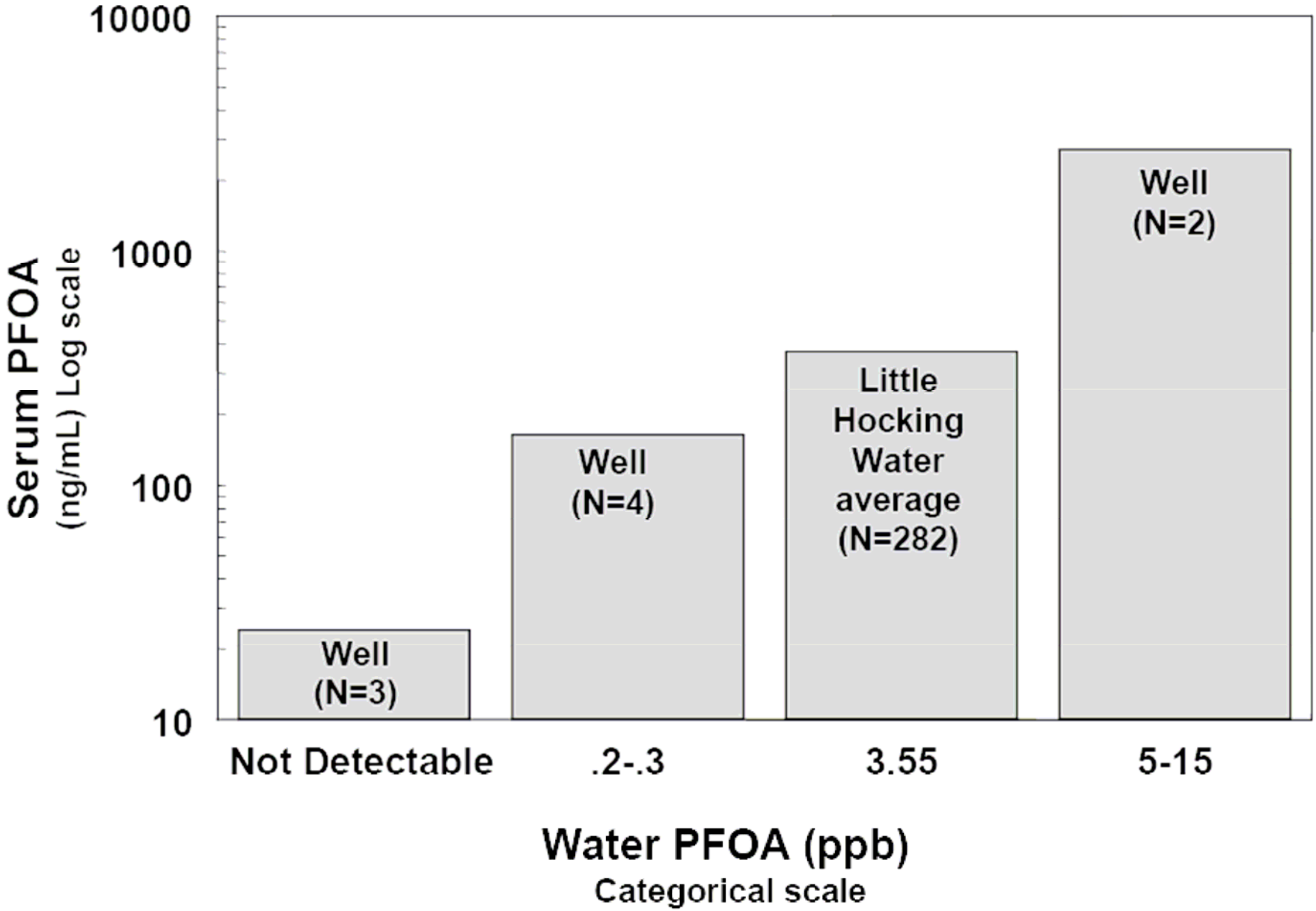
Derivation of Health-Based Values

Derivation of Health-Based Values




10000
1000
100
10
Serum PFOA
(ng/mL) Log scale
Well
(N=3)
Well
(N=4)
Little
Hocking
Water
average
(N=282)
Well
(N=2)
Not Detectable
.2-.3
3.55
5-15
Water PFOA (ppb)
Categorical scale

Final Comments

- The approach used by MDH to develop the Health-Based Values for PFCs in drinking water is consistent with recognized methods and is supported by the current science.
- Other approaches to account for pharmacokinetic differences between species generally result in similar health-based values.