Impact of environmental policy on children's exposure: Examining trends in biomonitoring of five environmental chemicals

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Disclosure

Alyson Lorenz

The following personal financial relationships with commercial interests relevant to this presentation existed during the past 12 months:

No relationships to disclose

Support and Disclaimer

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- The findings and conclusions of this presentation do not necessarily represent the official views of EPA or ASPH.

Objectives

- Describe trends in children's exposure
- List factors that may influence these trends
- Describe the potential impact of (selected) policy actions on trends in children's exposure to:
  - Lead
  - Mercury
  - Perfluorochemicals
  - Bisphenol A
  - Perchlorate
- Discuss opportunities for decreasing children's exposure through policy

Children's environmental health

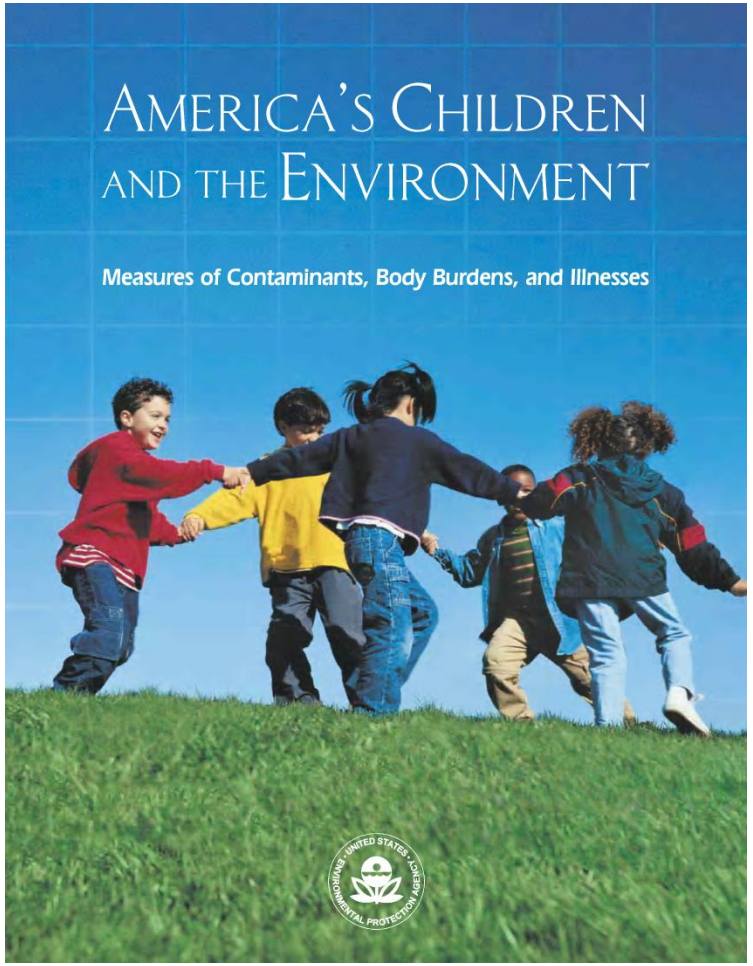
- Different environmental exposures
  - e.g. breastfeeding, prenatal exposure
- Physiological differences
  - e.g. immature immune systems, slower excretion from the kidneys
- Behavioral differences
  - e.g. hand-to-mouth behavior, crawling

Children are often more susceptible to environmental threats and thus may experience the most benefit from environmental policy

America's Children and the Environment

- Periodic report from EPA that compiles data from various government sources
- Forthcoming 3rd edition: source of analyses in this presentation

For more information visit: www.epa.gov/ace



Biomonitoring data

- Data used in the ACE report were obtained from the National Health and Nutrition Examination Survey conducted by NCHS at CDC
- Data are representative of the U.S. civilian noninstitutionalized population
- Environmental chemicals are measured in blood and urine samples
  - Children of all ages participate, age groups differ by chemical
  - Women of child-bearing age (16-49 years) are another lifestage of concern for children's health due to prenatal exposure

nhanes
National Health and Nutrition Examination Survey

Lead | Health Effects

- Most sensitive health effect for children:
  - Neurological: IQ loss, impaired cognitive function, behavioral problems (occurs at blood lead levels <10 µg/dL)
  - No safe level of lead exposure!

Reference: ACE3

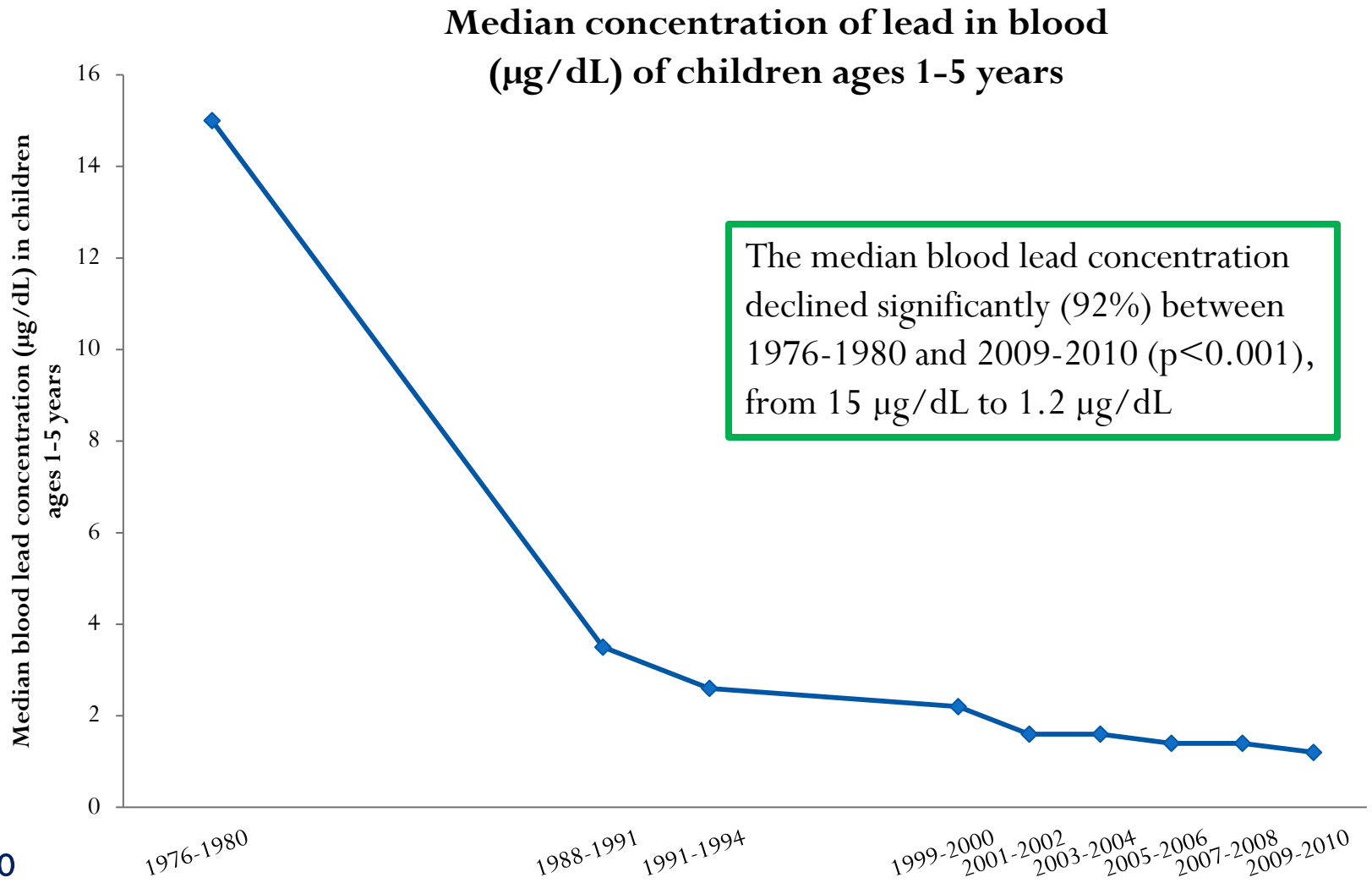
Photo: http://walkingtoschool.blogspot.com/2011/04/beware-forty-percent-rule.html

Lead | Exposure

- In the 1970s and 1980s, the three major sources of lead exposure were:
  - Gasoline
  - Soldered food cans
  - Paint
- Today, the main sources of lead exposure for U.S. children are:
  - Deteriorating lead-based paint
  - Lead contaminated dust

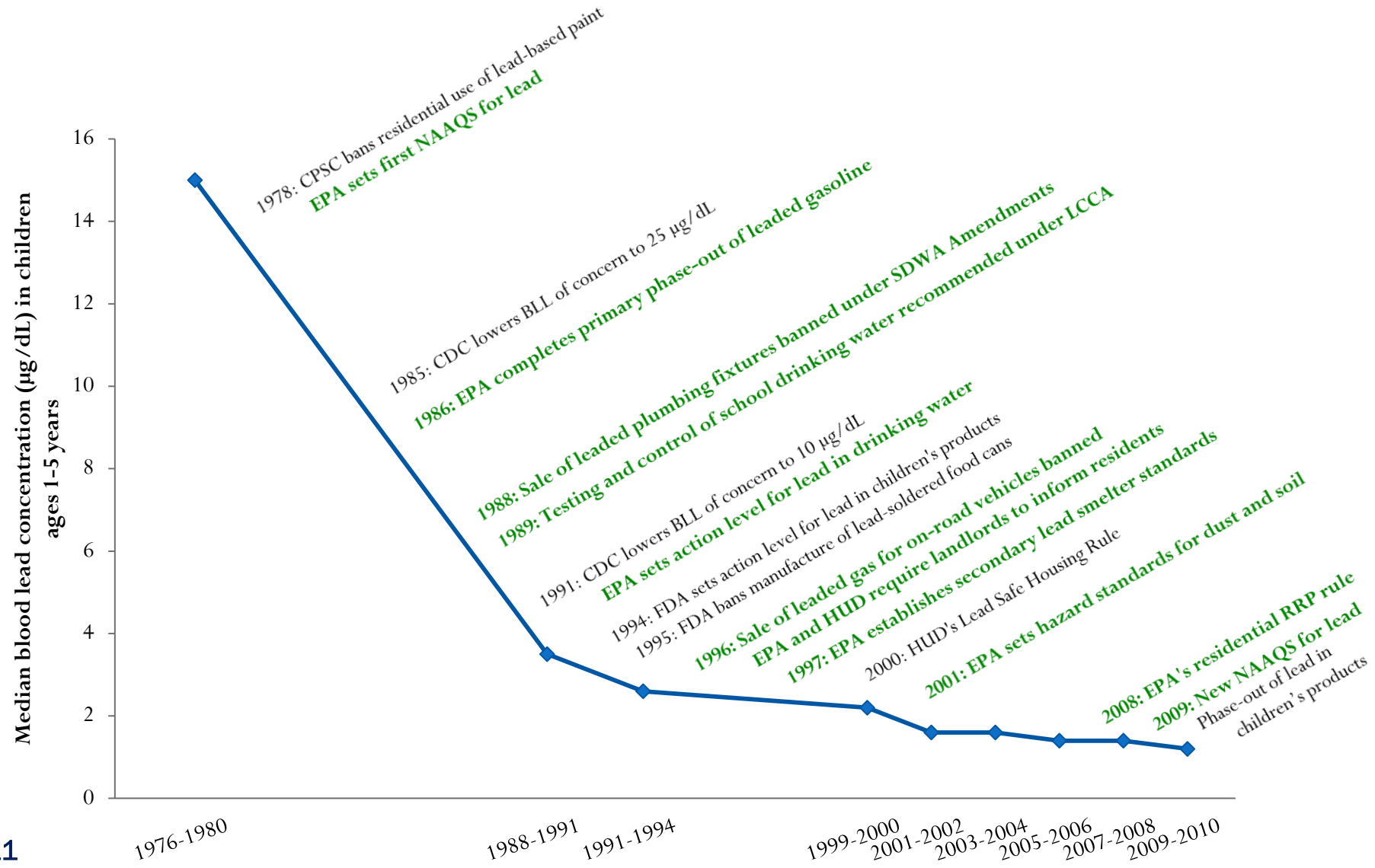
References: Pirkle et al. (1994). The decline in blood lead levels in the United States. *JAMA*.
CDC. Lead: Prevention Tips. Online at: http://www.cdc.gov/nceh/lead/tips/htm
Photos: http://www.case.edu/think/images/lead.png; http://phil.cdc.gov/phil/home.asp

Lead | Biomonitoring



The median blood lead concentration declined significantly (92%) between 1976-1980 and 2009-2010 ($p<0.001$), from 15 µg/dL to 1.2 µg/dL

Lead | Policies



Lead | Policy Updates

- May 16, 2012: CDC concurs with ACCLPP recommendations and lowers the blood lead 'reference value' to 5 µg/dL
- Regulations currently under development at EPA:
  - Review of NAAQS for Lead (CAA)
  - Regulatory Revisions to National Primary Drinking Water Regulations for Lead and Copper (SDWA)
  - Review of Residential Lead Dust Hazard Standards (TSCA)
  - Lead Renovation, Repair, and Painting Program for Public and Commercial Buildings (TSCA)
  - Lead Wheel Weights (TSCA)
  - Lead Emissions from Piston-Engine Aircrafts (CAA)

Mercury | Health Effects

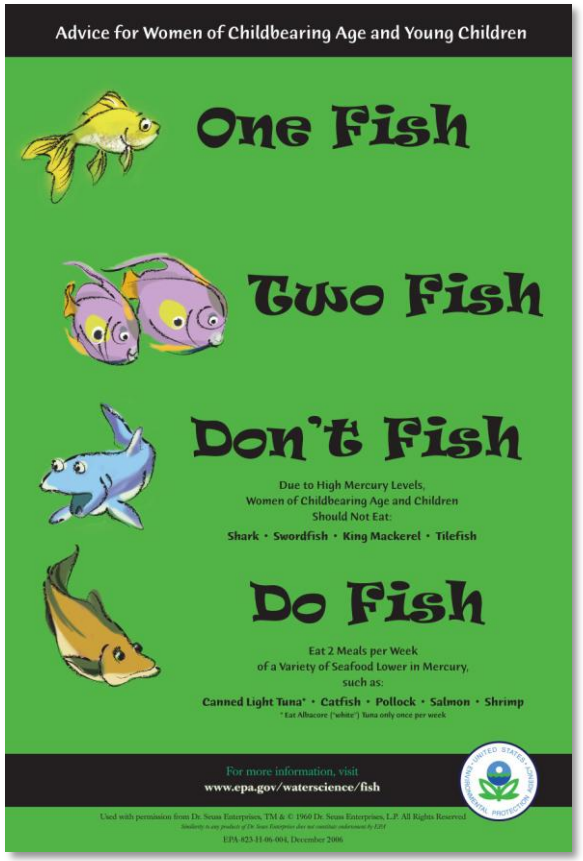
- Most sensitive health effect for children:
  - Neurological: delays in reaching developmental milestones and decreases in intelligence resulting from exposure to methylmercury
- Prenatal exposure period is the most sensitive

References: ACE3; EPA (2007). TEACH Chemical Summary: Mercury..
Photo: http://www.cdc.gov/NCBDDD/video/LTSAE/ThreeMoms/index.html

Mercury | Exposure

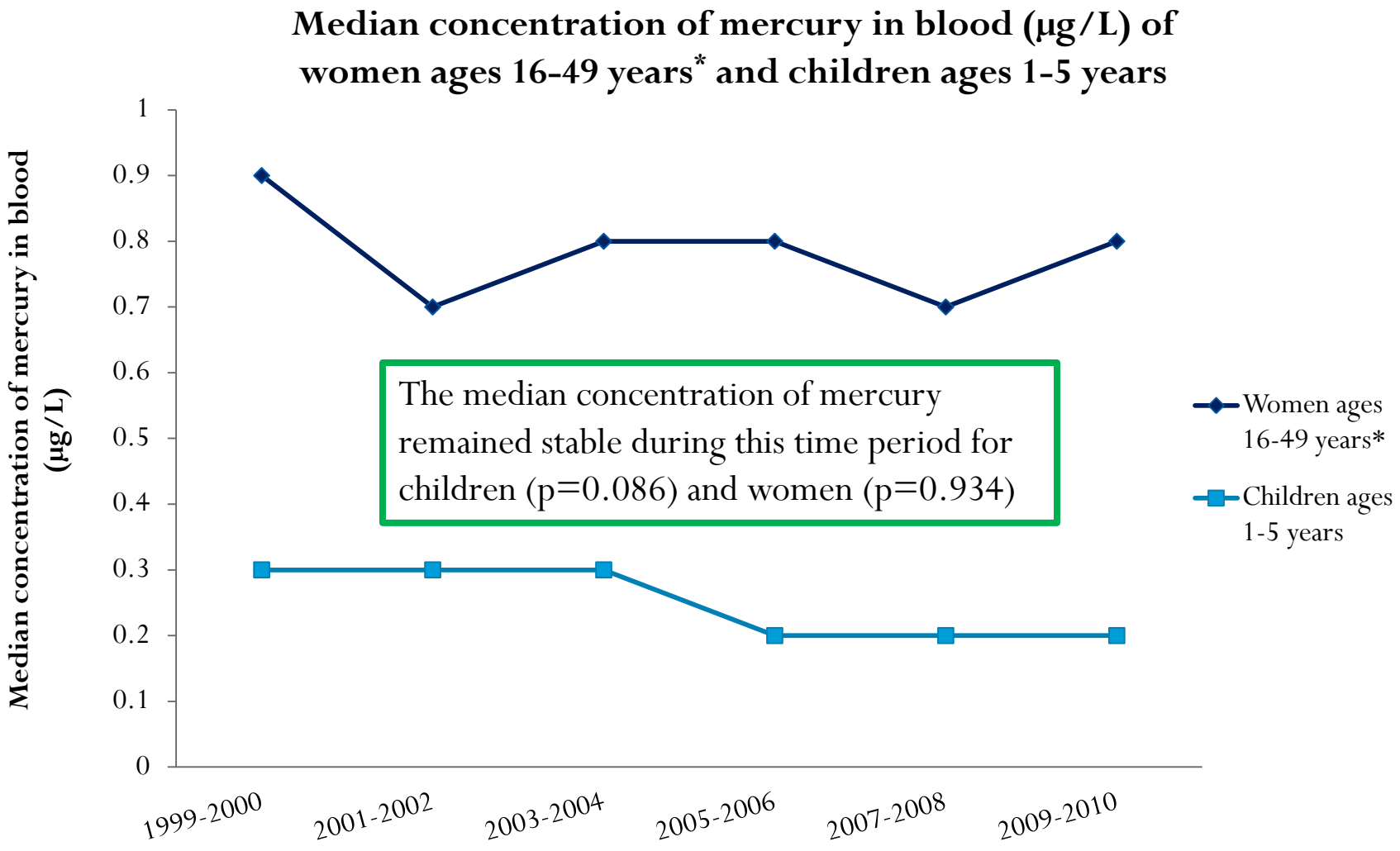
- Primary exposure route for methylmercury:
  - Consumption of contaminated fish and marine mammals
- U.S. emissions have decreased over 50% in the past 20 years, but may account for as little as 3% of global emissions

Note: NHANES measures total blood mercury, which is expected to be representative of methylmercury exposure



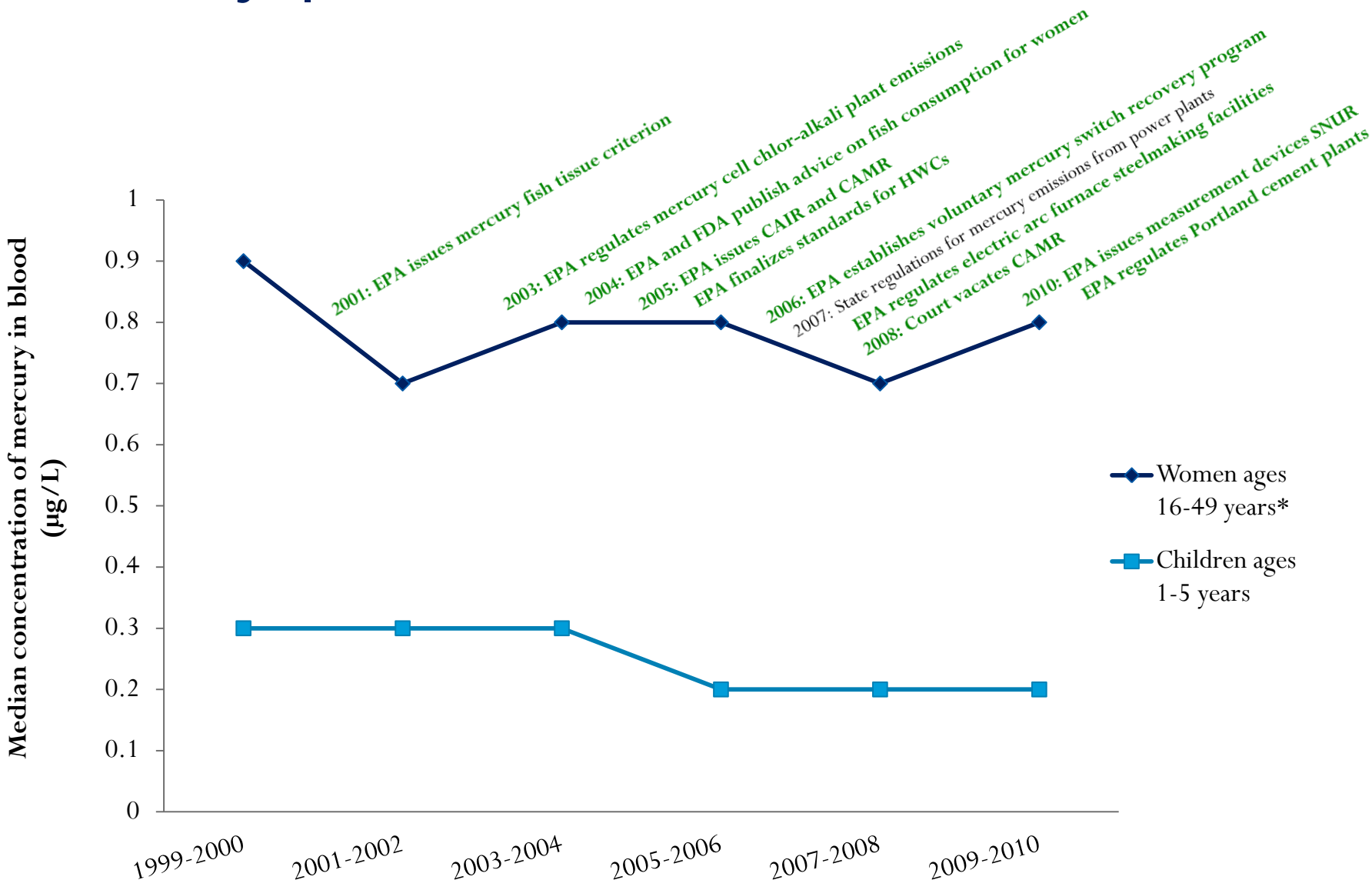
References: EPA. Mercury: Human Exposure. Online at: http://www.epa.gov/hg/exposure.htm.
US EPA Report on the Environment (2009 indicator update)
United Nations Environment Program (2008). The Global Atmospheric Mercury Assessment.
Photo: http://water.epa.gov/scitech/swguidance/fishshellfish/fishadvisories/general.cfm

Mercury | Biomonitoring



*Birth rate adjustment applied

Mercury | Policies



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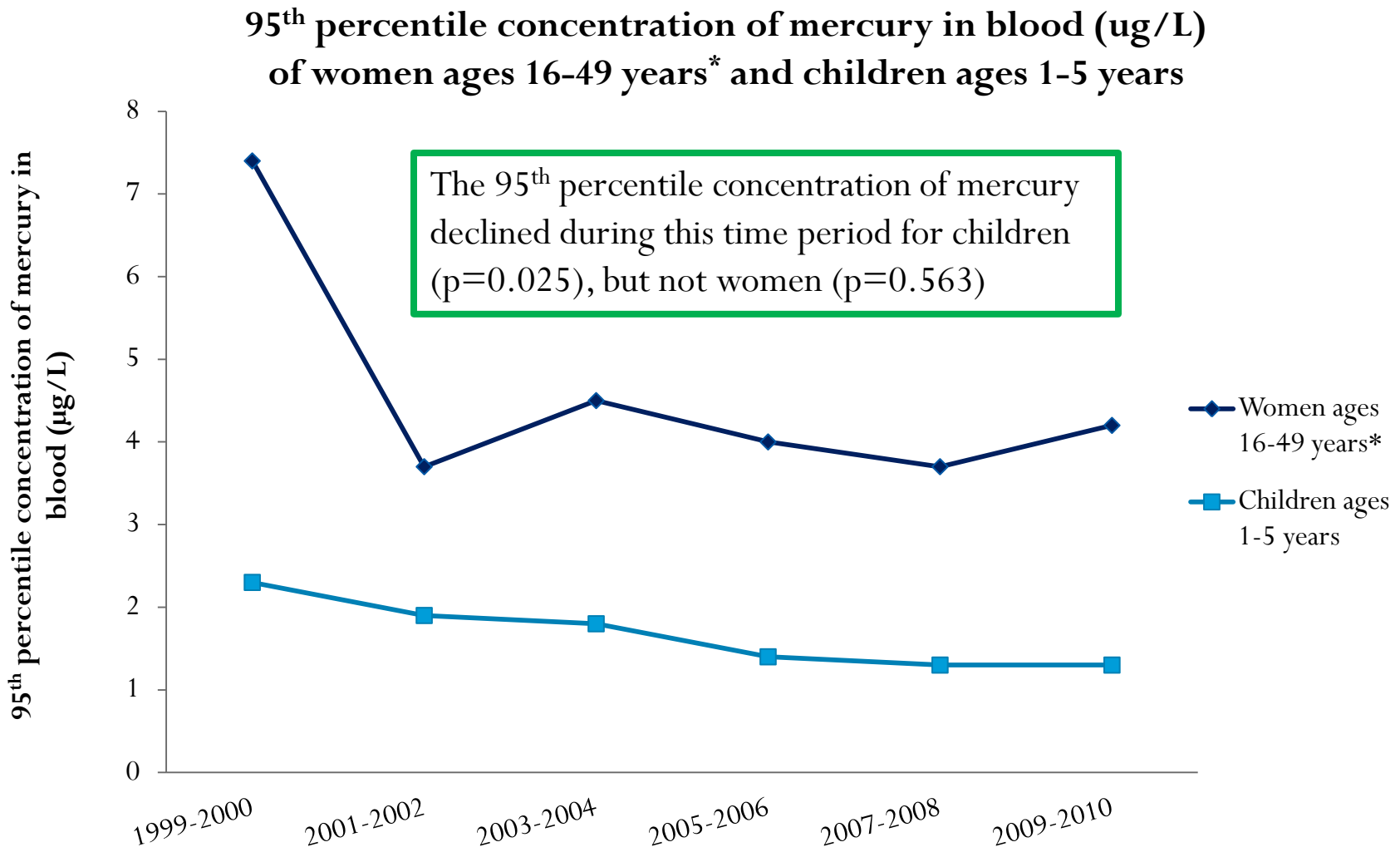
Mercury | Biomonitoring



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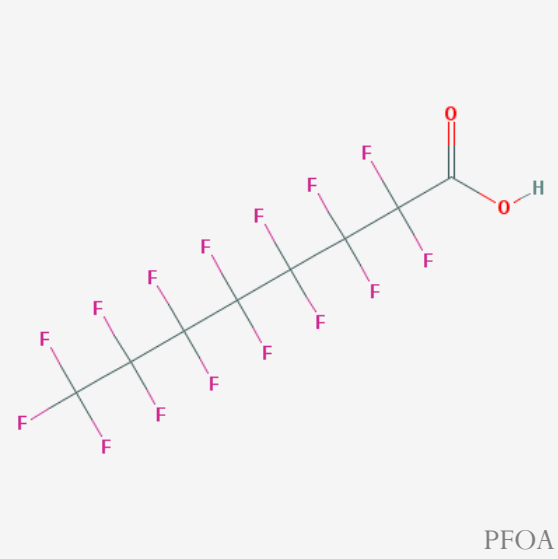
Mercury | Policy Updates

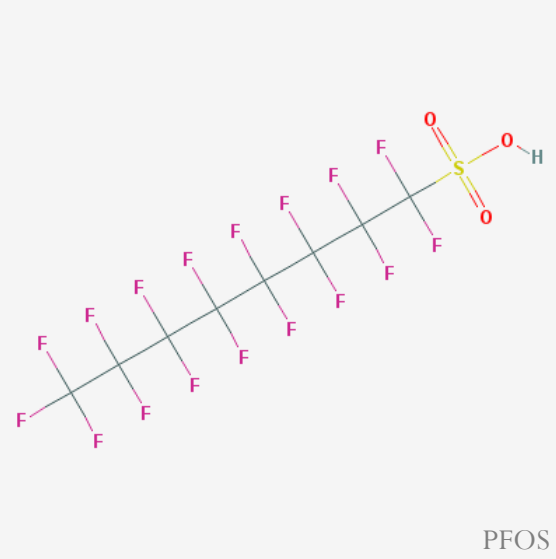
- December 21, 2011: EPA issues Mercury and Air Toxics Standards for Power Plants (standards for new sources under technical review until March 2013)
- January 2013: Final meeting of UNEP's Intergovernmental Negotiating Committee for mercury will be held
- U.S. ban on mercury exports in effect on January 1, 2013
- Regulations currently under development at EPA:
  - Boiler MACT Reconsideration (CAA)
  - Mercury; Use in Certain Products (TSCA)
  - SNUR; Elemental Mercury Used in Barometers, Manometers, and Hygrometers/Psychrometers (TSCA)
  - Review of Mercury Cell Chlor-Alkali Plants MACT (CAA)

PFCs | Health Effects

- Potential health effects for children:
  - Developmental and reproductive: low birth weight, reduced birth length, delays in postnatal growth and development, pregnancy loss



PFOA



PFOS

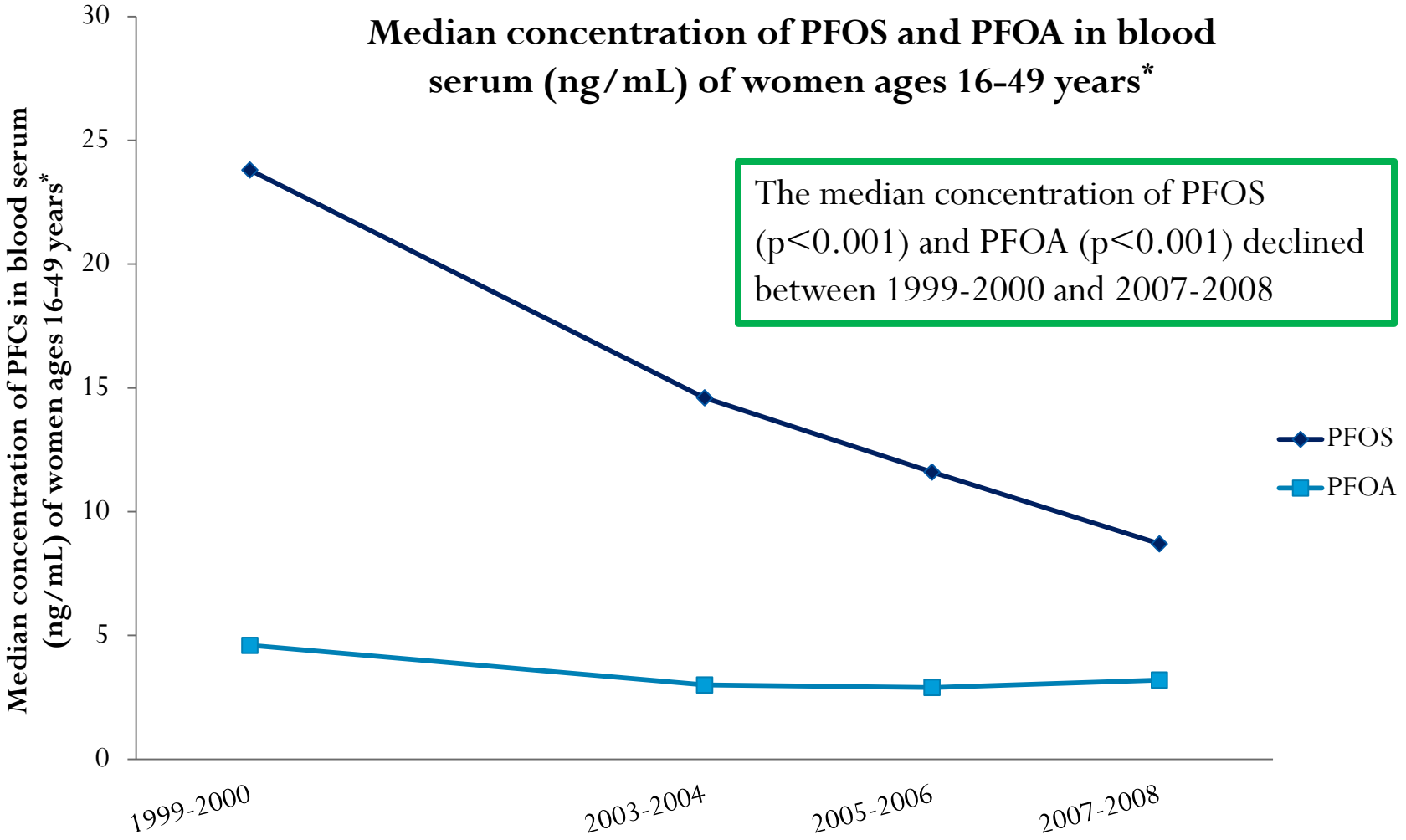
Reference: ACE3
Photos: www.pubchem.ncbi.nlm.nih.gov

PFCs | Exposure

- Used in industrial production since the 1950s (e.g. carpets, packaging products, nonstick cookware, fire-fighting foams)
- PFCs with highest production volume are PFOA and PFOS
- Exposure sources are poorly understood, but may include:
  - Food
  - Water
  - Indoor and outdoor air
  - Breast milk
  - Dust

Reference: ACE3

PFCs | Biomonitoring



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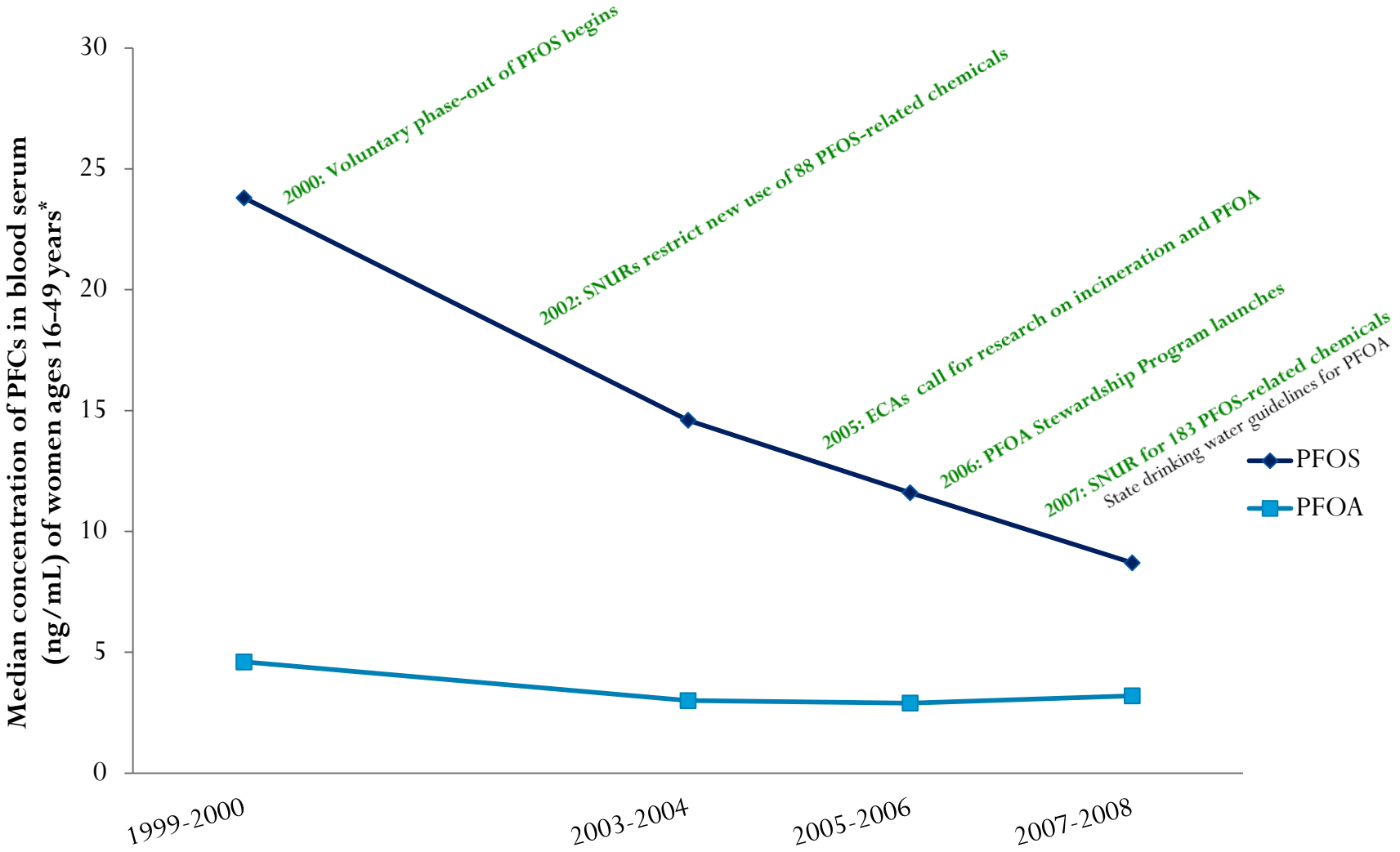
PFCs | Policies



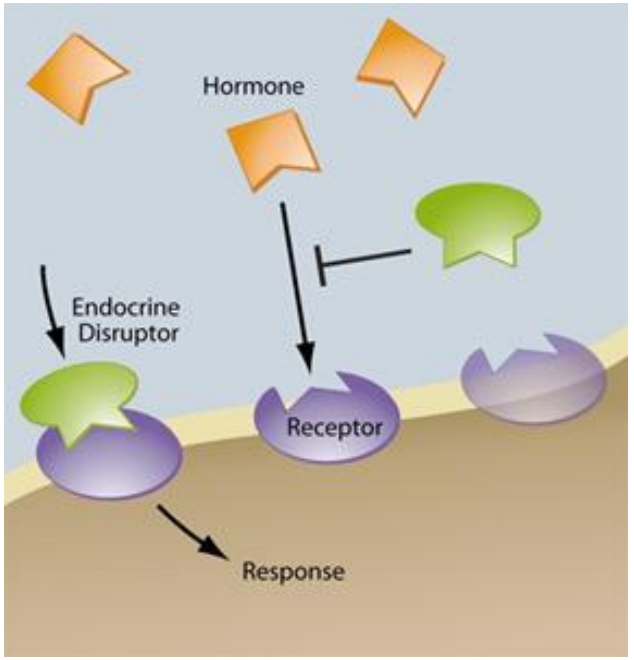
*Birth rate adjustment applied

PFCs | Policy Updates

- January 2009: EPA develops health advisories for short-term exposure to PFOA and PFOS in drinking water
- December 2009: EPA releases action plan for PFCs
- Regulations currently under development at EPA:
  - Long-Chain PFCs: Consideration of Regulations under TSCA
- July 2, 2012: FDA announces voluntary phase-out of chemicals similar to PFOA in food wrappers

BPA | Health Effects

- BPA may be an endocrine disruptor that could cause developmental, reproductive, immunological, and behavioral effects
- The National Toxicology Program at NIH concluded that there is "some concern" for effects of BPA on the brain, behavior, and prostate gland in fetuses, infants, and children



Reference: ACE3
Photo: http://www.niehs.nih.gov/news/newsletter/2009/july/extramural-update.cfm

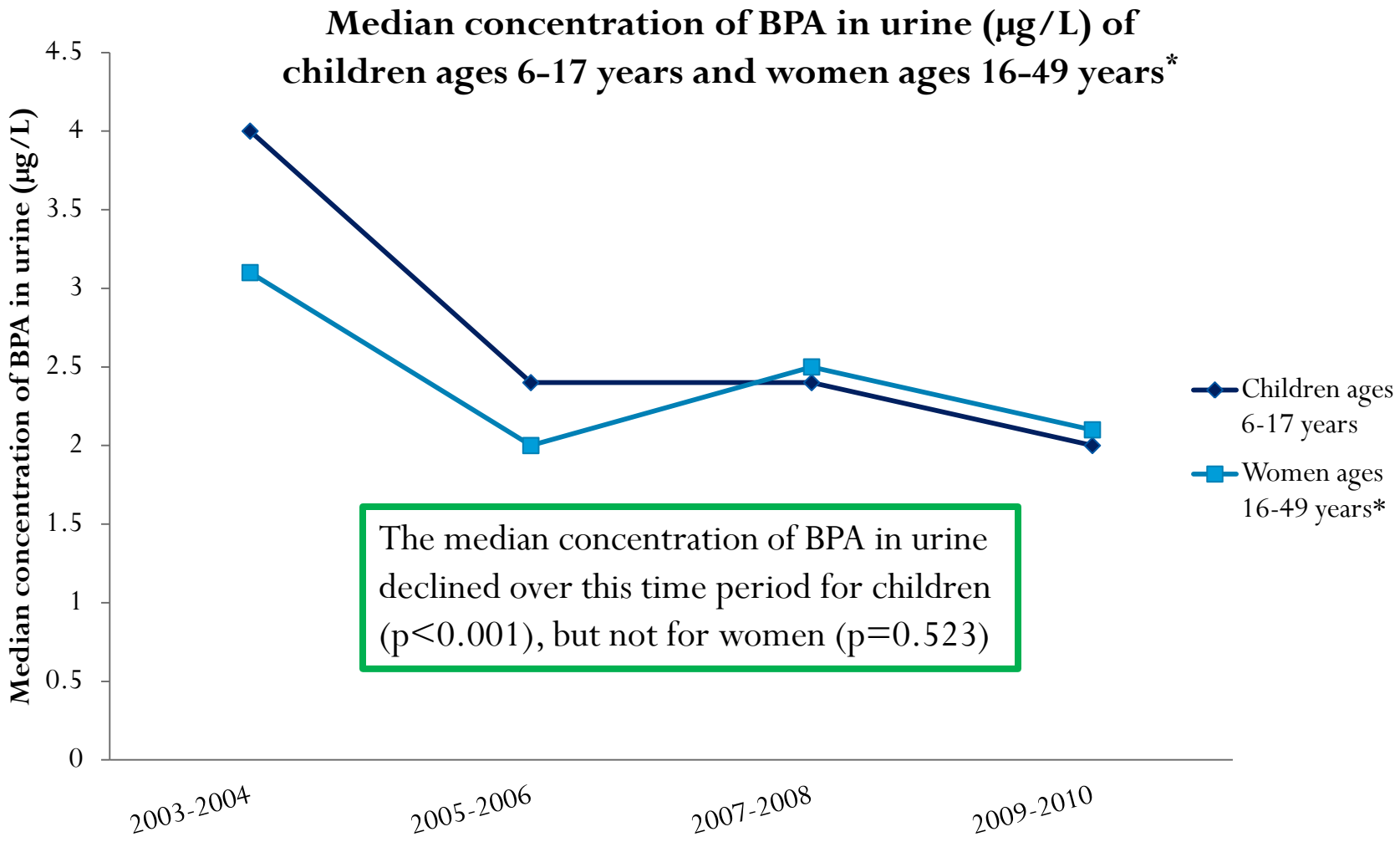
BPA | Exposure

- Uses:
  - Epoxy resins and poly-carbonate plastics (e.g. food and drink containers, thermal paper receipts, contact lenses)
- Diet is the most common source of exposure, though exposure through other media (air, dust) may also occur

Note: Urinary BPA levels reflect recent exposure

References: ACE3; NIEHS. Bisphenol A. Online at: http://www.niehs.nih.gov/health/topics/agents/sya-bpa/
Photo: http://www.ksro.com/GreenProducts/Story.aspx?id=1075132

BPA | Biomonitoring



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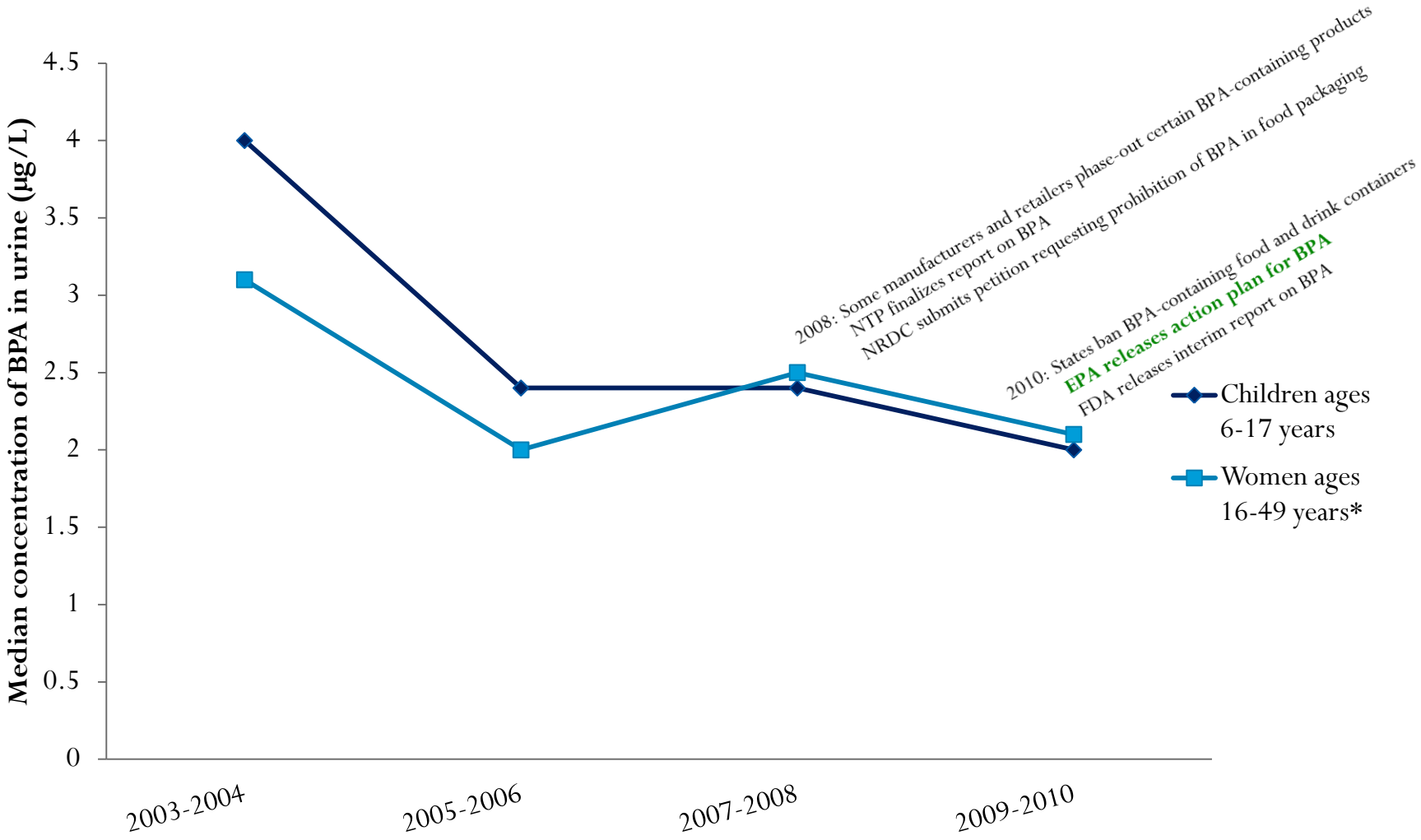
BPA | Policies



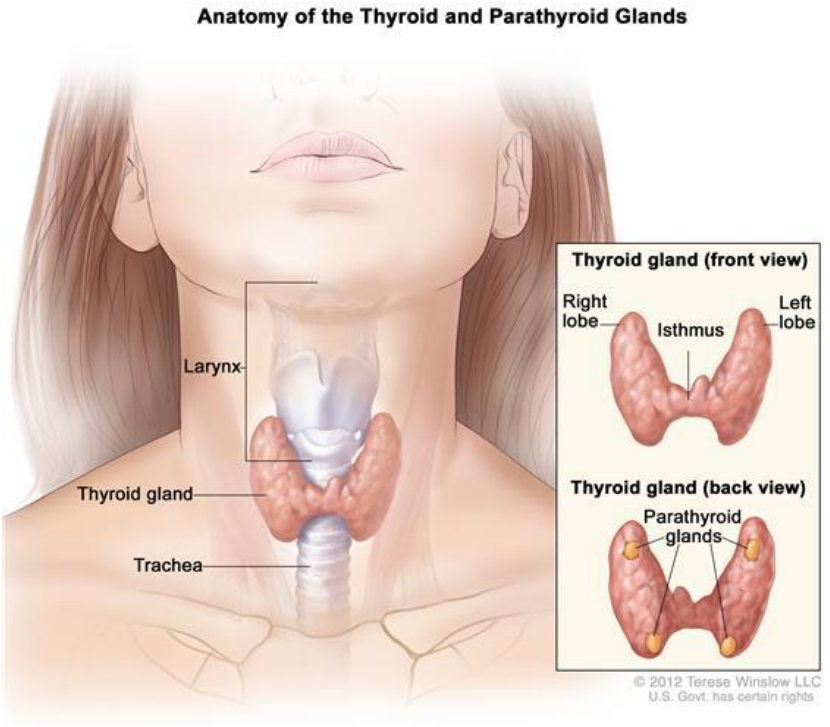
*Birth rate adjustment applied

BPA | Policy Updates

- 2011-2012: Bans on BPA in children's food and drink containers go into effect in a number of additional states
- March 30, 2012: FDA denies petition to eliminate BPA from food packaging, citing need for continued scientific research
- July 17, 2012: FDA bans BPA in baby bottles and sippy cups

Perchlorate | Health Effects

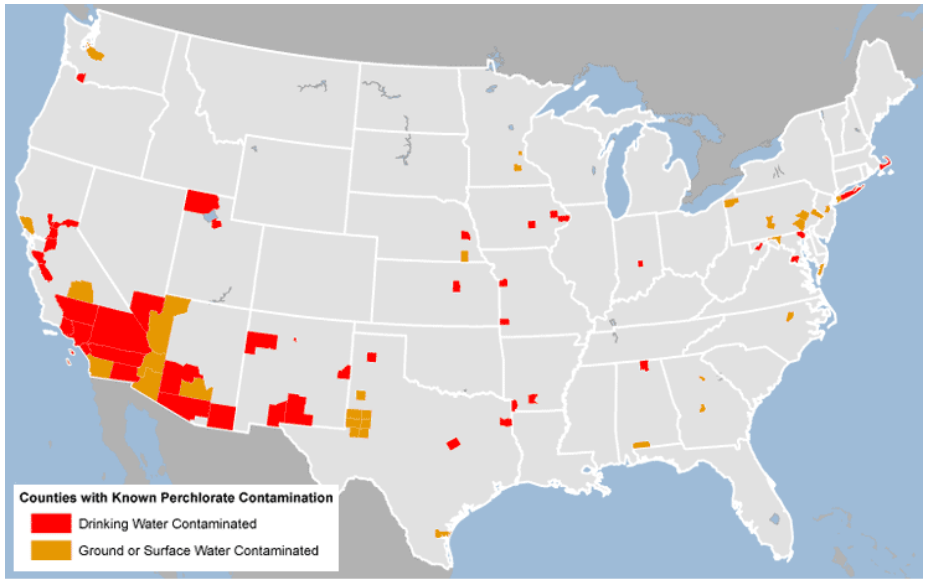
- Perchlorate is known to block uptake of iodide into the thyroid gland
- Iodide deficiency in pregnant women may lead to neuro-developmental deficits in their offspring



Reference: National Academy of Science (2005). Health Implications of Perchlorate Ingestion.
Photo: http://www.cancer.gov/cancertopics/pdq/treatment/thyroid/Patient/page1

Perchlorate | Exposure

- Uses:
  - Manufacture of fireworks, explosives, flares, and rocket fuel
- May leach from natural sources in soil during irrigation
- Exposure:
  - Drinking water
  - Food

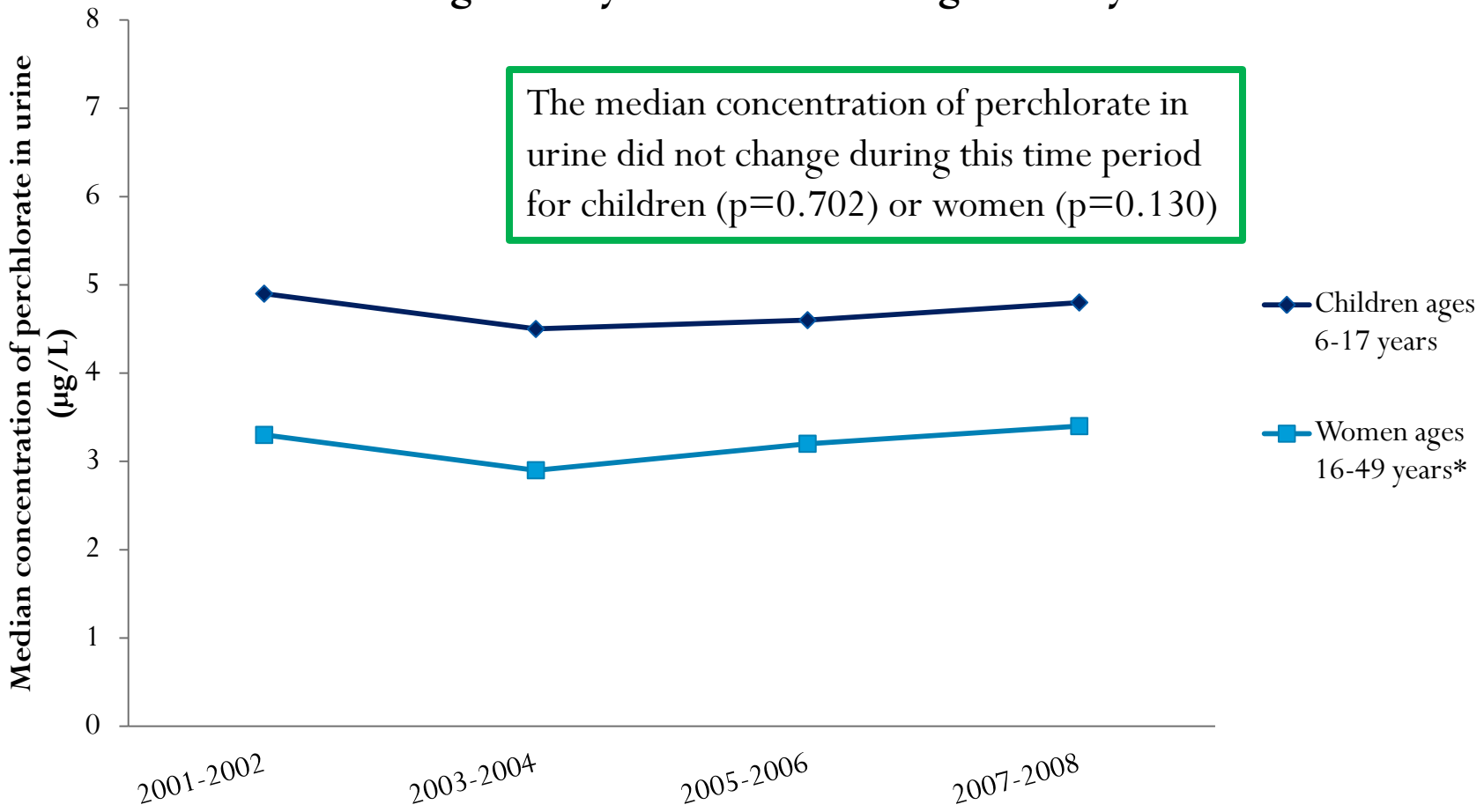


Note: Urinary perchlorate levels reflect recent exposure

Reference: ACE3
Map: http://www.ewg.org/node/8355

Perchlorate | Biomonitoring

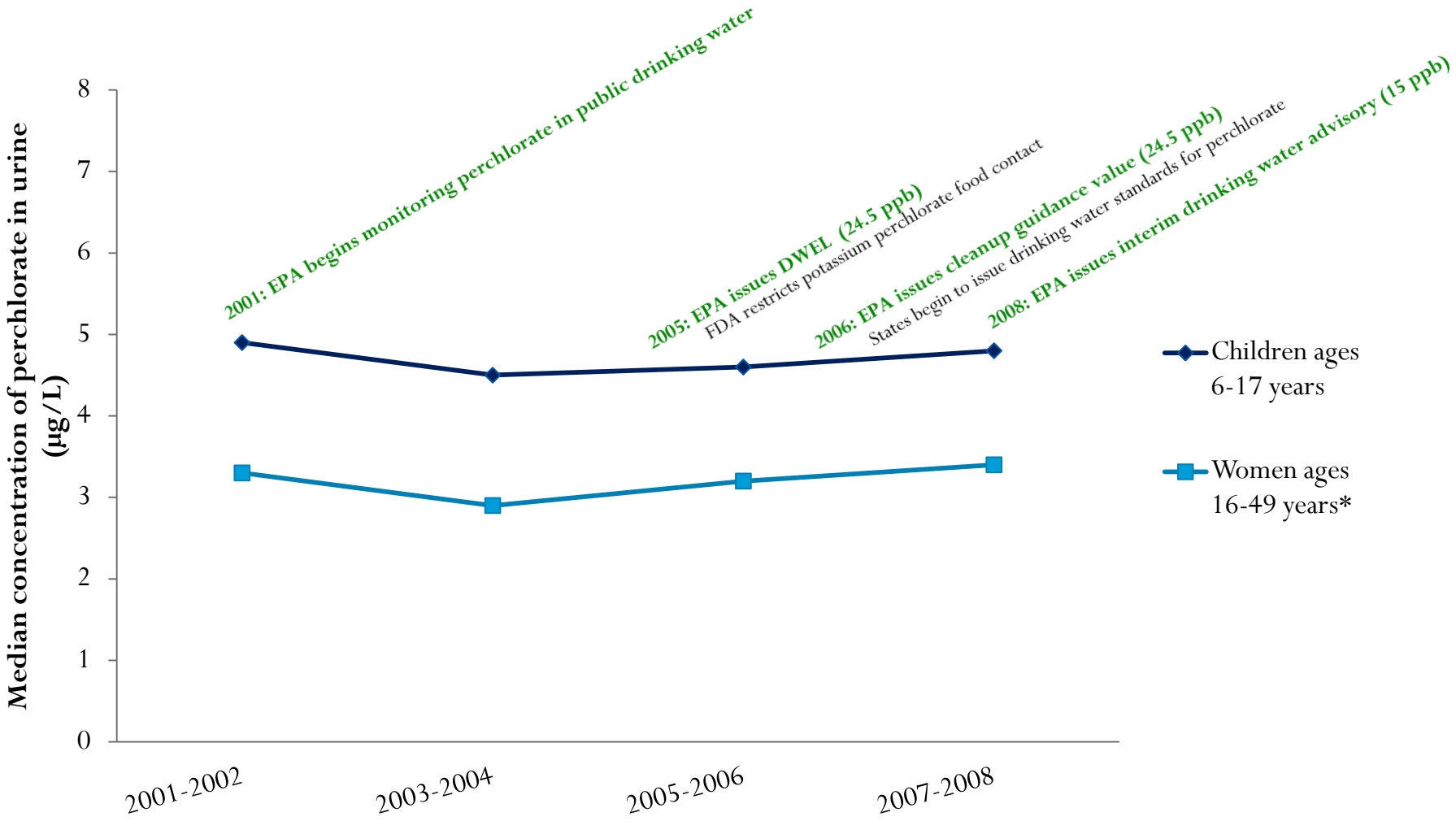
Median concentration of perchlorate in urine (µg/L) of children ages 6-17 years and women ages 16-49 years*



The median concentration of perchlorate in urine did not change during this time period for children (p=0.702) or women (p=0.130)

*Birth rate adjustment applied

Perchlorate | Policies



*Birth rate adjustment applied

Perchlorate | Policy Updates

- February 2, 2011: EPA decides to develop enforceable drinking water standards for perchlorate
- Regulations currently under development at EPA:
  - National Primary Drinking Water Regulations: Regulation of Perchlorate (SDWA)

Conclusions

- Policies, including regulations and voluntary efforts, initiated at the national level appear to have played a role in reducing exposure to lead and PFCs.
- Although many regulations have addressed mercury, national policy efforts have only recently addressed the largest source of mercury emission in the U.S. and mercury emissions outside the U.S. remain high. Accordingly, the median exposure level has not declined.
- Levels of exposure to BPA and perchlorate have remained relatively stable over time in the absence of comprehensive and enforceable federal policy.

Thank You!

Feel free to contact me via e-mail (lorenz.alyson@epa.gov)