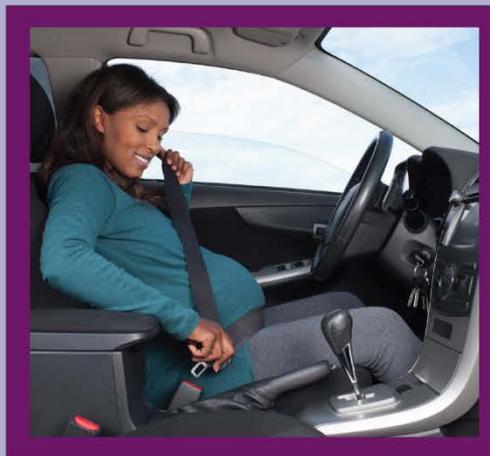
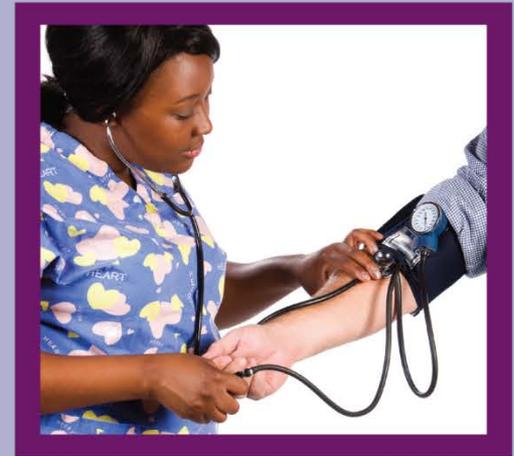


Industrial Chemicals in Virtually Every U.S. Pregnant Woman

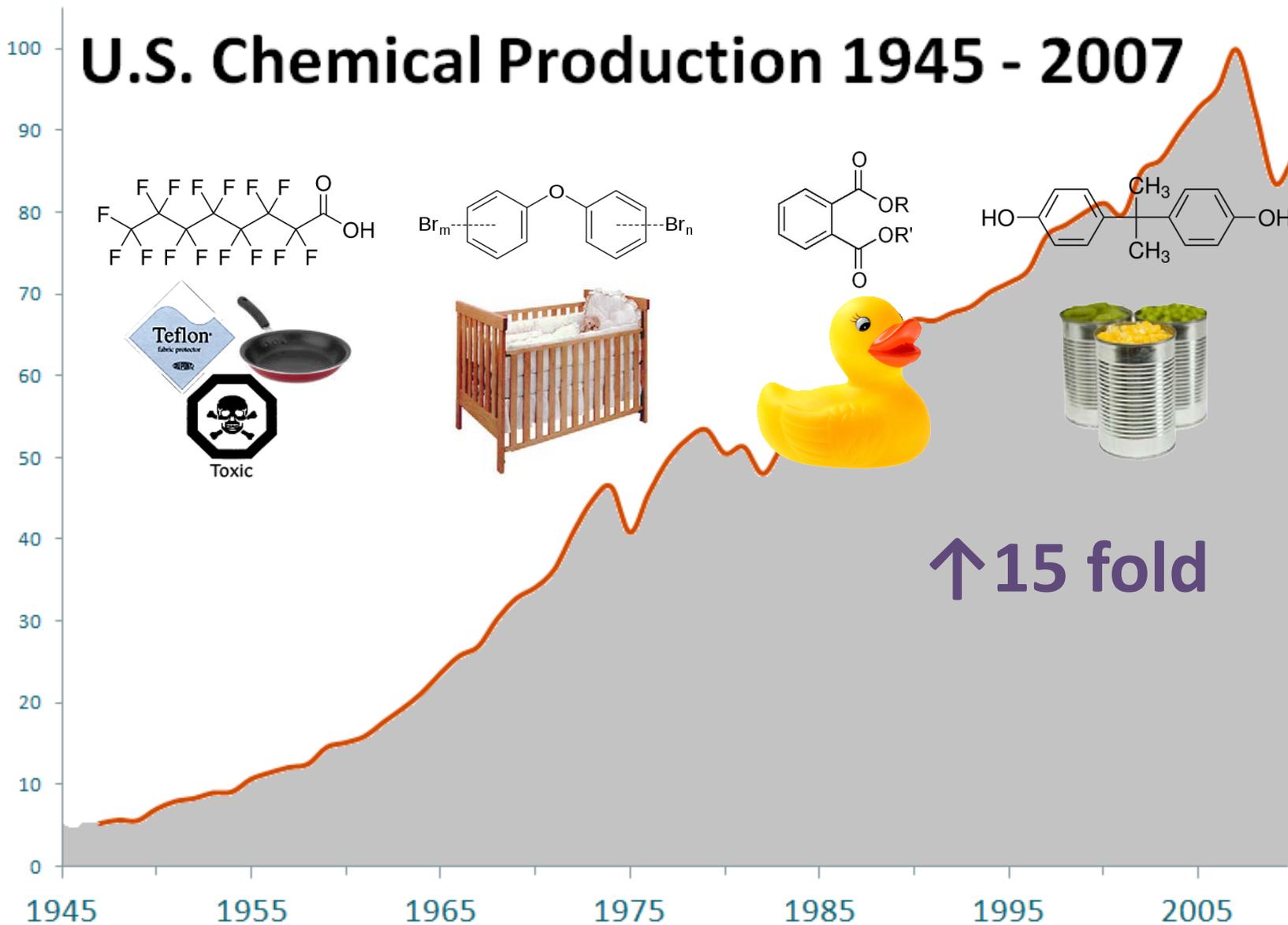
43



Exposure Is Everywhere Everyday



U.S. Chemical Production 1945 - 2007

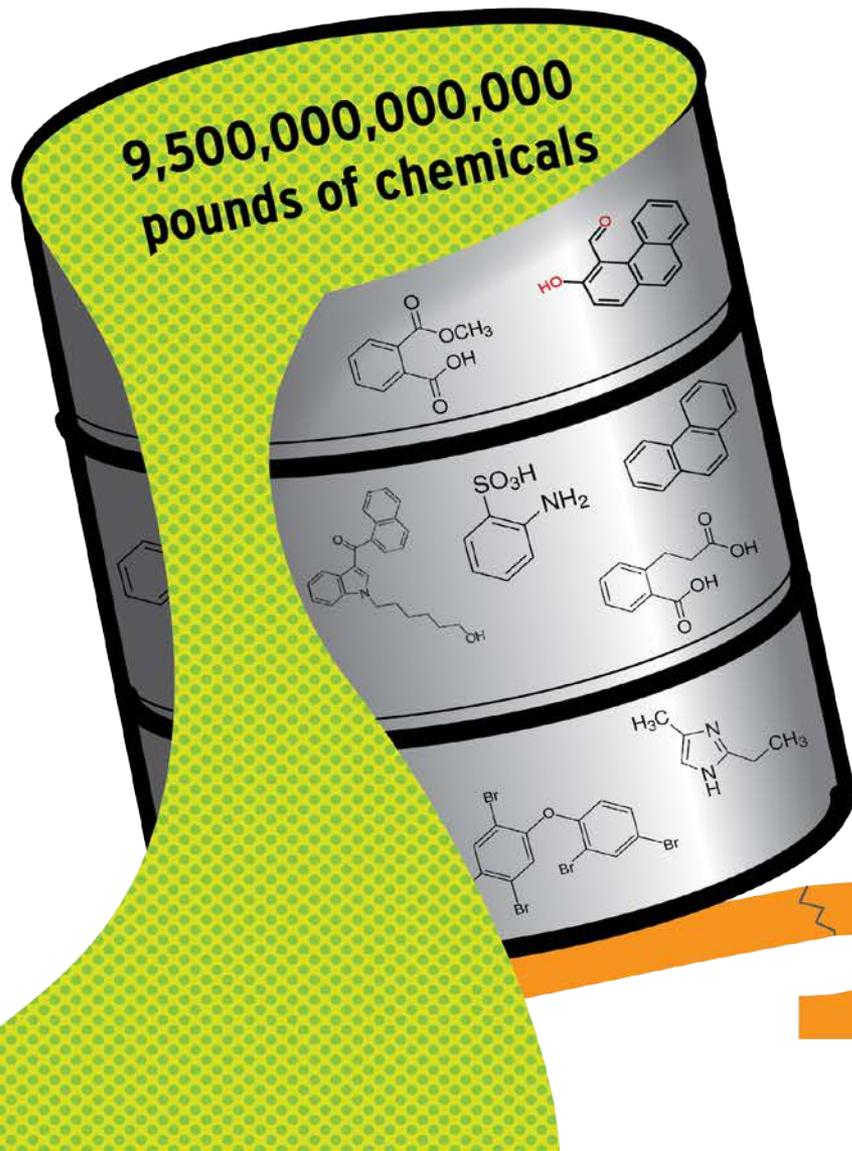


↑ 15 fold

Federal reserve data on chemical production is only offered as relative production, which is unit-less. A specific reference year is chosen and values are calculated relative to that years production. In this particular data set 2007 is the reference year and is assigned a value of 100.

Data from: U.S. Federal Reserve Board, Division of Research and Statistics

U.S. Chemical Production Volume Compared to Population



- 30,000 pounds of chemicals per person 

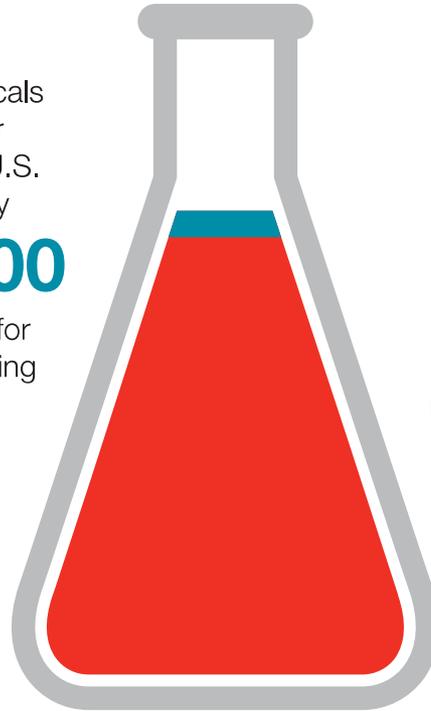
U.S. POPULATION:
313,000,000



US EPA CDR Fact Sheet: Chemical Snapshot, June 2014. The total reported (domestically manufactured and imported) for 2012.

Fraction of Chemicals are Tested for Adverse Health Effects Before Entering the Marketplace

Of the 6700 chemicals
manufactured or
imported into the U.S.
>25,000 lbs, only
about 200
have been tested for
health effects, leaving



6,500 chemicals
untested

Source: University of California, San Francisco, Program on Reproductive Health and the Environment



Advancing the rigor, relevance, and reach of exposure science through community driven research.

SFFD has one of the **largest populations of women** among its ranks in the US (N = ~ 225)



Breast cancer rate alarms SFFD female firefighters

By Will Reisman



MIKE KOOZMIN/THE S.F. EXAMINER

Fighting: San Francisco Fire Department firefighter Jeanine Nicholson, seen at her Berkeley home, has undergone a double mastectomy and chemotherapy.

Mounting concern among SF firefighters about rates of premenopausal breast cancer among the women in their ranks.

Alert 63° Sign In | Subscribe

THE SACRAMENTO BEE

FULL MENU NEWS SPORTS ENTERTAINMENT CLASSIFIEDS

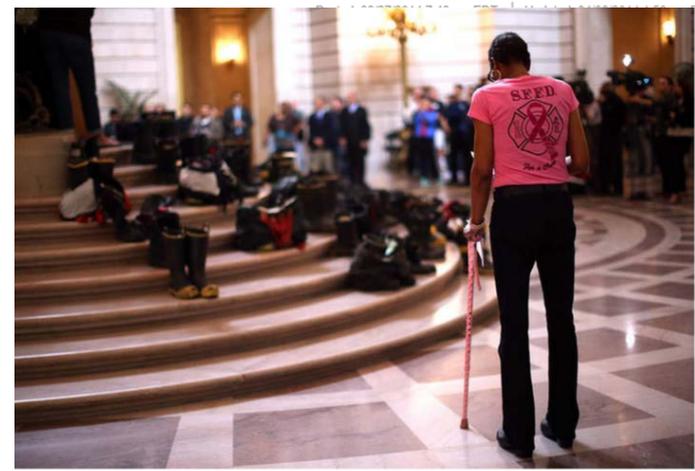
Concern grows in firefighters, others after cancer-causing flame retardants found in test subjects

HIGHLIGHTS



San Francisco firefighters Casey McElheney and Karen Heald with their German short-haired pointer puppies Raven and Nahiku at their home in Davis, are sitting on a couch with flame retardant chemicals. **Manny Crisostomo** - mcrisostomo@sacbee.com

Firefighters Sound Alarm On Toxic Chemicals



Former San Francisco firefighter and cancer survivor Denise Elarms waits Wednesday to speak during a remembrance ceremony held for San Francisco firefighters who have died of cancer. (Photo by Justin Sullivan/Getty Images)



Women Firefighter Biomonitoring Collaborative Team

Firefighter Organizations:

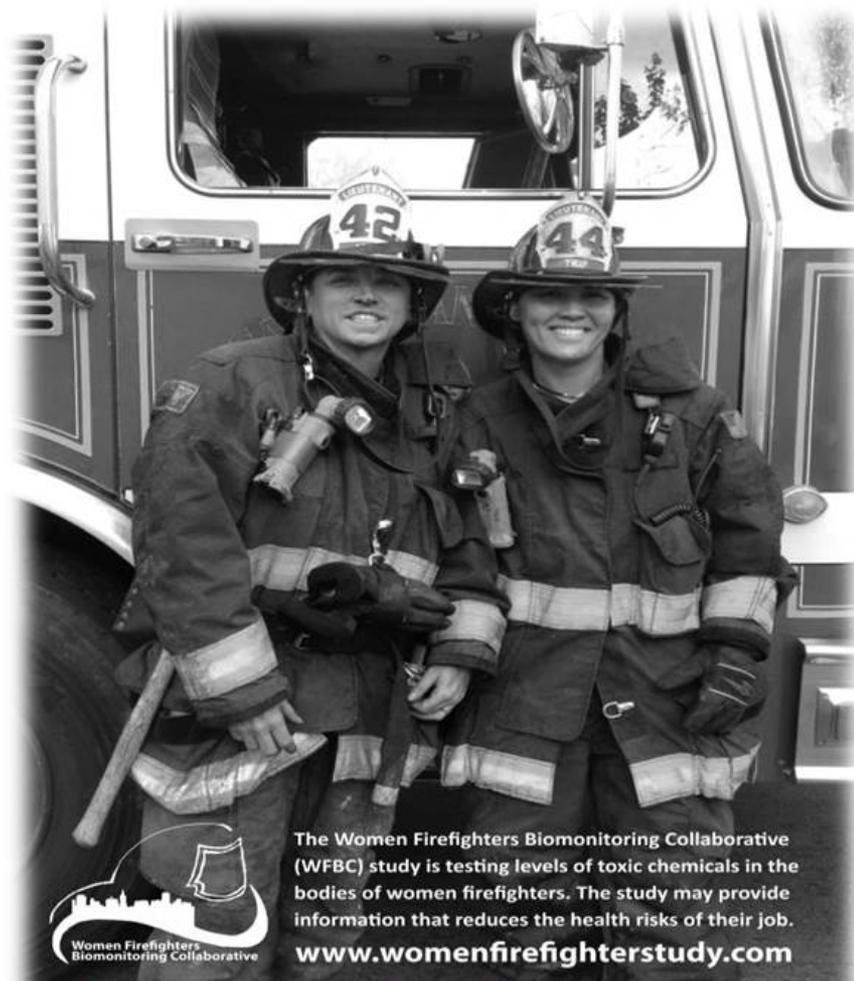
- United Fire Service Women
- San Francisco Firefighters Cancer Prevention Foundation

Science Team:

- UC Berkeley
- UC San Francisco
- Silent Spring Institute

Environmental Health Advocates:

- Commonweal
- Breast Cancer Fund



Natural Resources



COMMONWEAL



Previous studies show firefighters have higher exposures to:

- Polycyclic Aromatic Hydrocarbons (PAHs)
 - Products of combustion
- Diesel exhaust – nitro-PAHs
 - Fire equipment
- Flame retardants
 - burning furniture, protective clothing, etc.
- Perfluorinated chemicals
 - Chemical in firefighter turnouts
- Dioxins and Furans
 - Combustion by-products during fire events

Studies almost exclusively on men.



Photo: Terray Sylvester / The Chronicle
Lieutenant Patty Lui
<http://www.sfgate.com/health/article/S-F-Fire-Department-joins-study-into-breast-5833837.php#photo-7019384>

Chemicals Causing Mammary Gland Tumors in Animals Signal New Directions for Epidemiology, Chemicals Testing, and Risk Assessment for Breast Cancer Prevention

Ruthann A. Rudel, MS
Kathleen R. Attfield, BS
Jessica N. Schifano, BA
Julia Green Brody, PhD

Identifying chemical carcinogens in animal studies is currently the primary means of anticipating cancer effects in humans. Animal studies to evaluate potential chemical carcinogenicity are particularly important for breast cancer because environmental and occupational epidemiologic research is sparse.



Many of these chemicals have been shown to be mammary carcinogens in animal toxicology studies and warrant further study.

- Characterize exposures in humans.
- Inform regulatory, occupational and individual actions to reduce exposures.

What we want to learn:

- Are chemicals known or suspected to cause mammary tumors more elevated among women firefighters than non-firefighters?
- Are there other unknown or unmeasured chemicals that are higher among women firefighters?
- Is higher chemical exposure or exposure to night shift work associated with early health effect biomarkers of potential relevance for breast cancer?
 - thyroid hormone disruption
 - altered melatonin levels
 - telomere length

Study Aim 1

Measure and compare levels of environmental chemicals between women firefighters (N=80) and non-firefighter female controls (N=80)

Targeted analysis:

- Flame retardants
 - Polybrominated Biphenyl Ethers (PBDEs) and their metabolites (OH-PBDEs)
 - Firemaster 550 and other current use flame retardants
- Perfluorinated Compounds (PFCs)
- Polycyclic Aromatic Hydrocarbons (PAHs & nitro-PAHs)

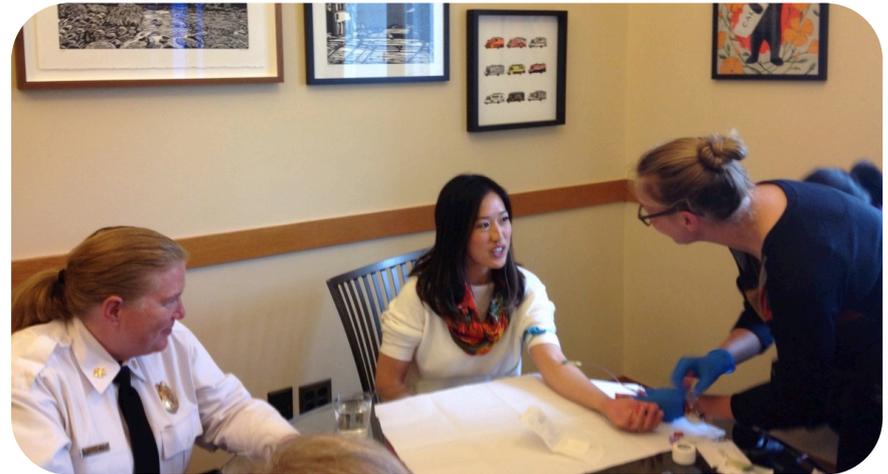
Non-targeted chemical analysis:

- Time of Flight (TOF) LC/MS
- Reveals exposures we might not have thought about

Biospecimen Collection



Firefighter Karen Heald bleeding for a cause. WFBC team provided blood and urine samples to help with methods development to measure chemicals.



Chief Joanne Hayes-White and colleague having their blood drawn.

Sample processing at UCSF Lab



(R-L): Jessica Trowbridge, WFBC Study Coordinator (UCB), Emily O'Rourke (UFSW) & Nancy Carmona (UCB), processing blood and urine samples.

Final Cohort

| | Recruited | Collected samples | YES to bank |
|-------------------------|------------------|--------------------------|--------------------|
| Firefighters | 86 | 85 | 84 |
| Non-firefighters | 88 | 85 | 84 |
| TOTAL | 174 | 170 | 168 |

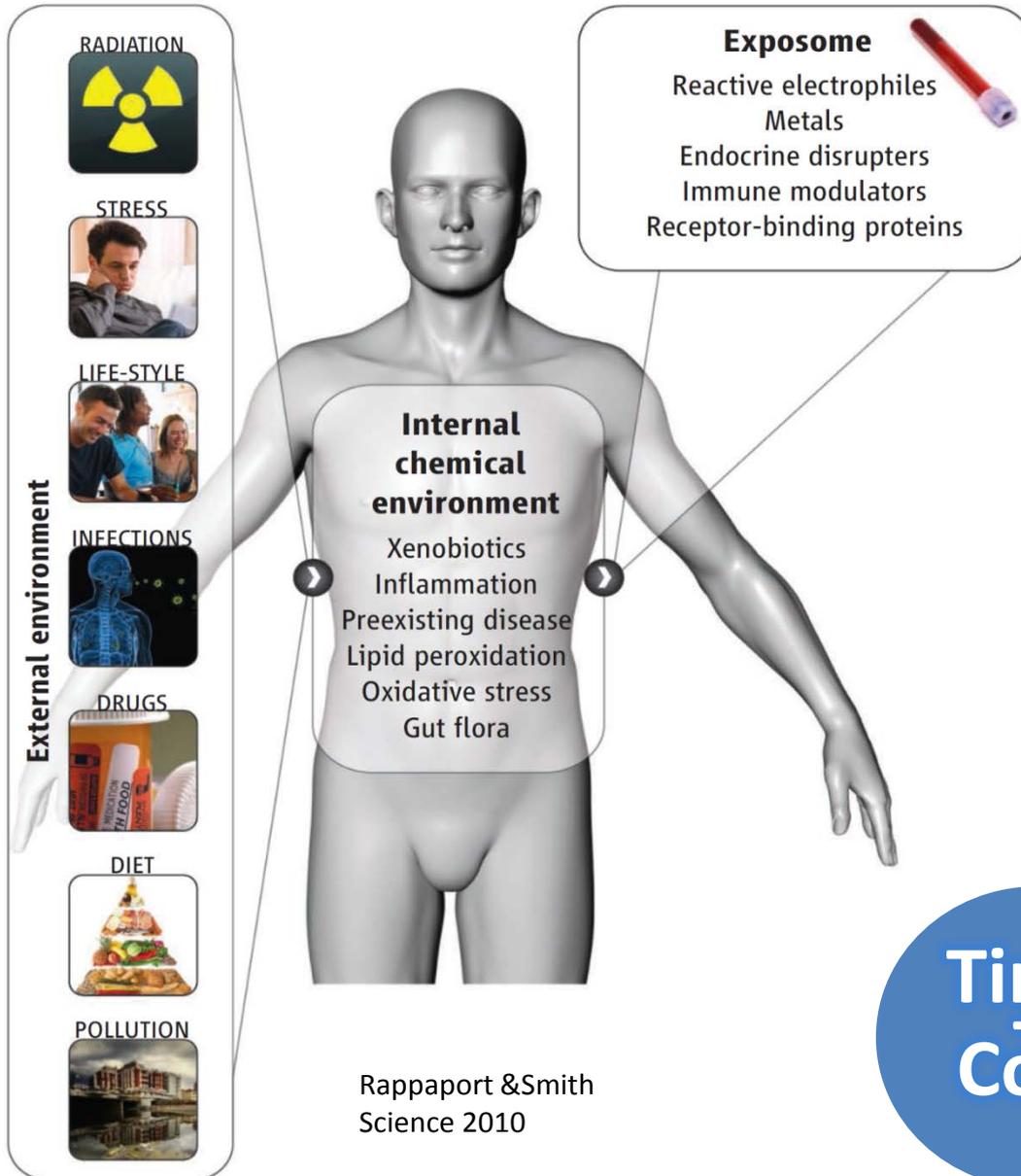
Exposure Assessment Interview



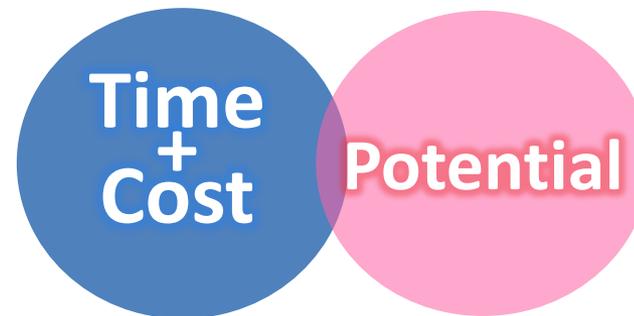
- Occupation and work activities
- Shift work and sleep
- Chronic stress
- Diet
- Personal product use
- Consumer and home products, hobbies, etc.



Why Non-Targeted Analysis?



1. Discovery-driven approach to screening biospecimens for novel environmental chemicals
2. Not limited *a priori* selection of chemical targets
3. General suspect screening optimizes selection of chemicals for confirmation and quantification



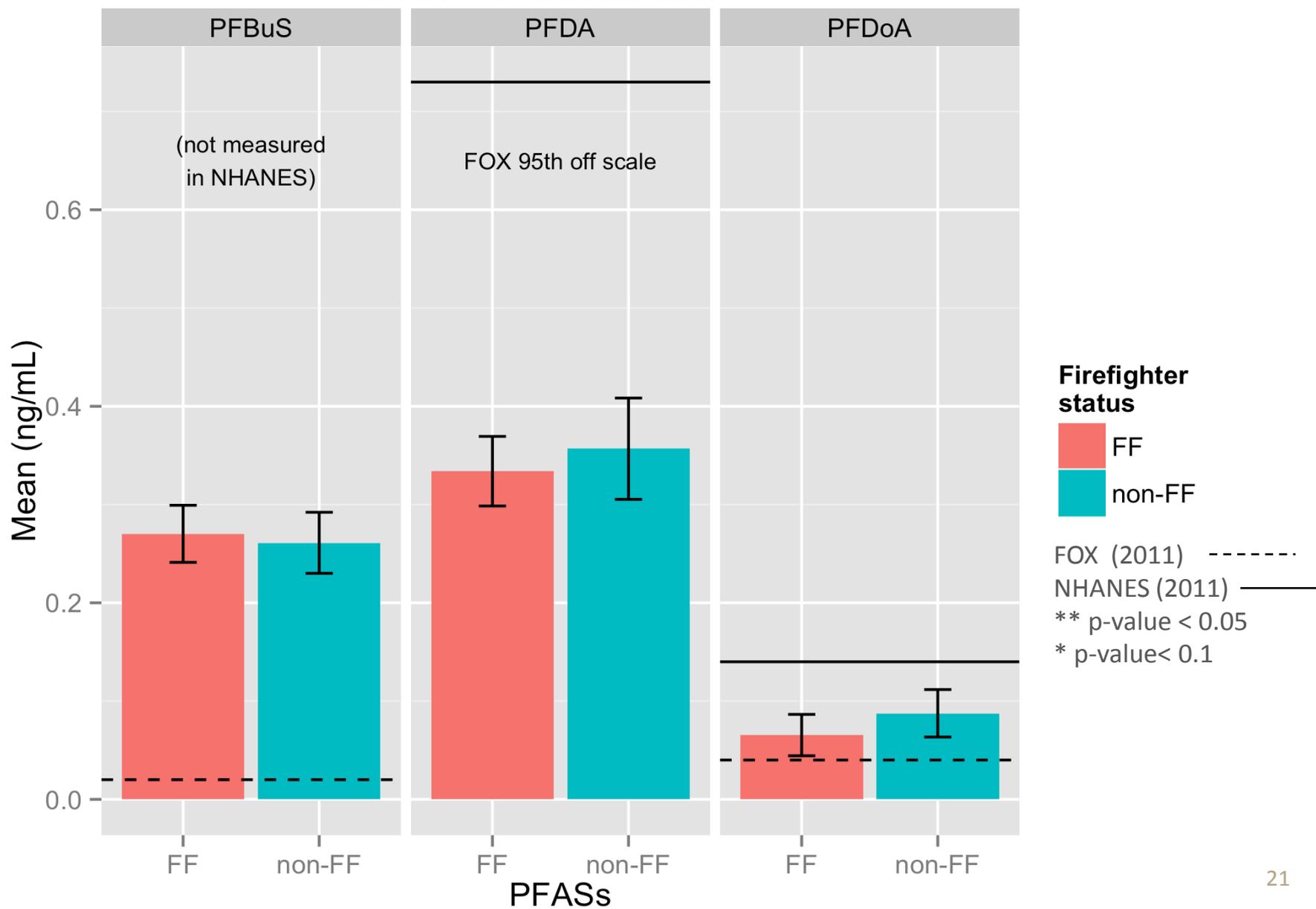
Study Aim 2

Evaluate the impact of chemical exposures and chronic exposure to night shift work on biomarkers of early effect of potential relevance to breast cancer

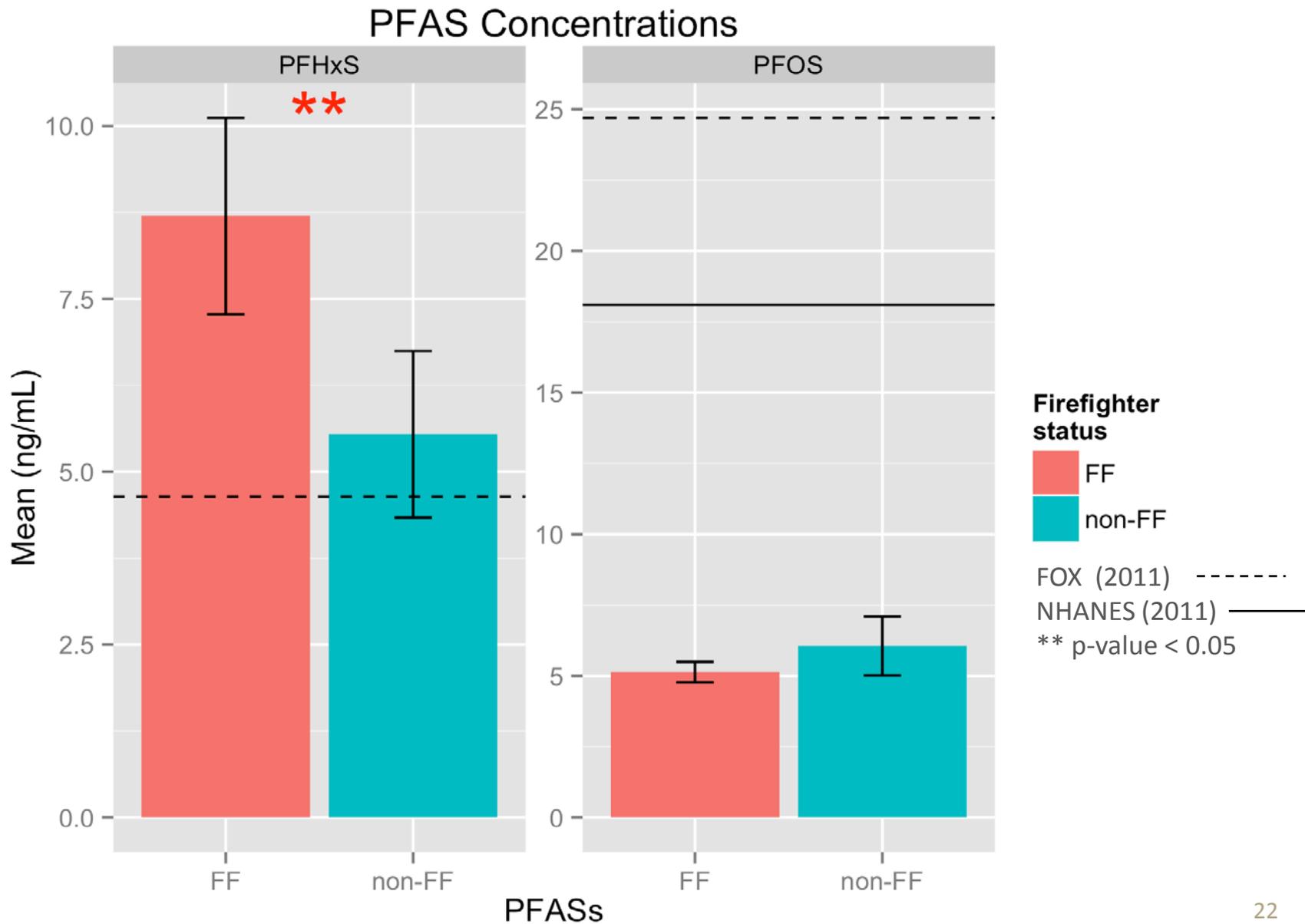
- Night shift work and melatonin
- PBDE and OH-PBDE exposures and thyroid hormone disruption (T4 and TSH)
- Chemical exposure and shortened telomere length (Exploratory)

Preliminary Results: PFAS (ng/mL)

PFAS Concentrations

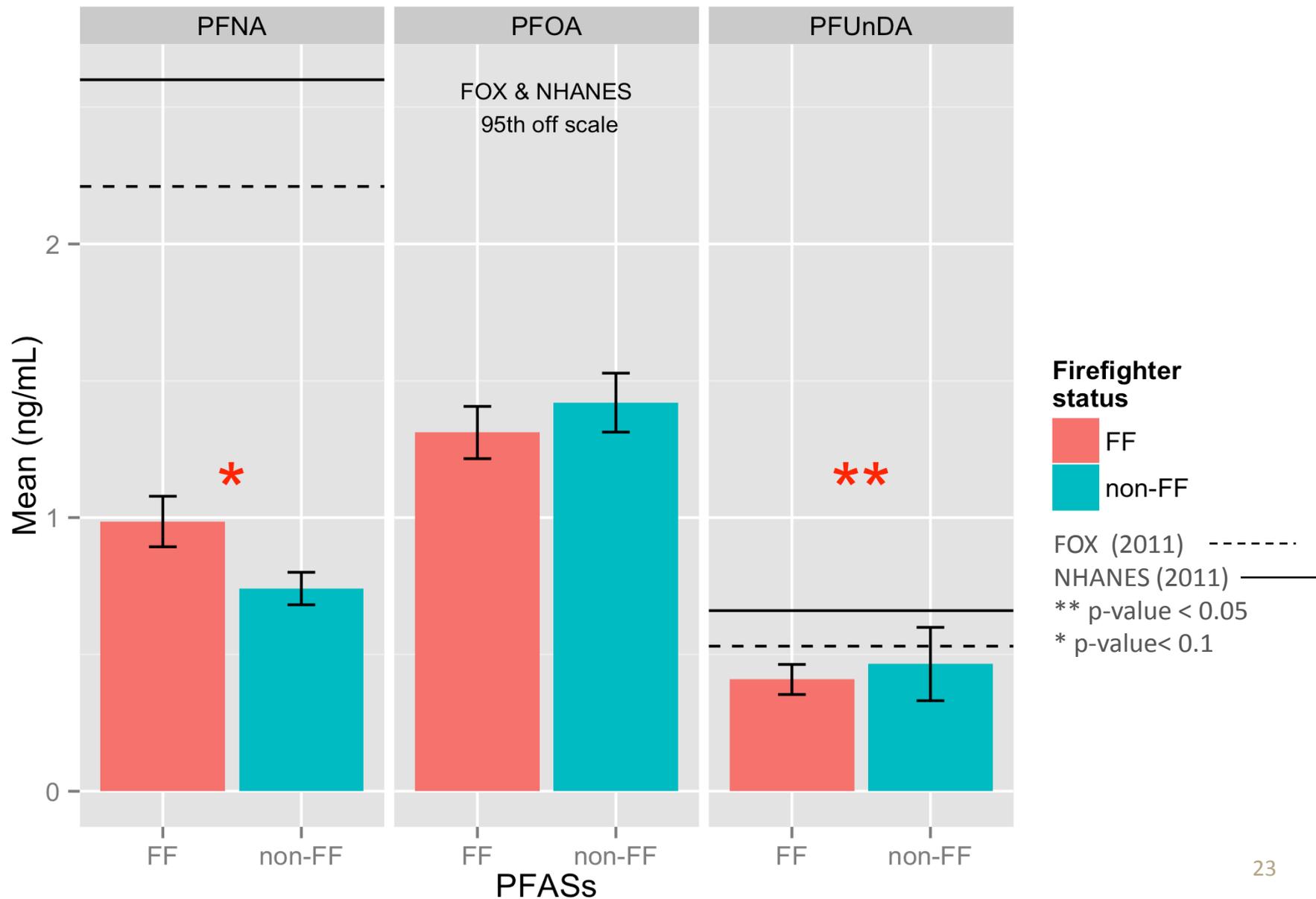


Preliminary Results: PFAS (ng/mL)



Preliminary Results: PFAS (ng/mL)

PFAS Concentrations



Study Aim3

Report back individual-level and aggregate results to study participants who want them

- Focus groups and usability testing with study participants to develop report-back materials
- Aggregate dissemination to broader firefighter community, decision-makers, policy arena, and broader public

Digital Report-back Interface



This web site provides your study results from the Women Firefighters Biomonitoring Collaborative Study. It shows:

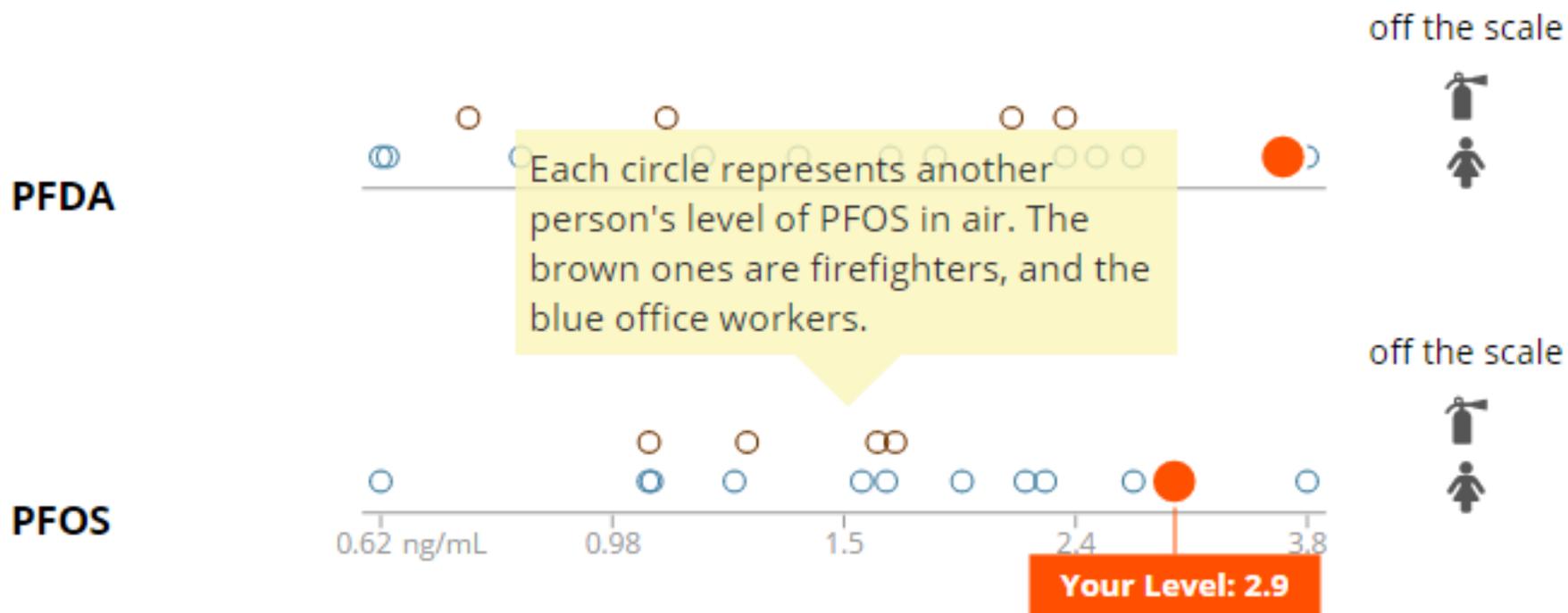
- + The levels of chemicals found in your samples.
- + How your levels compare with other people.
- + Where these chemicals come from.
- + How they can affect health.
- + How you can reduce levels of these chemicals in your body, your home, and at work.

[Start Here](#)

<http://wfbcreport.org>

[i More PFASs than most others.](#)

Your samples had more PFASs than most others in the study. PFASs can come from non-stick sprays on pots and pans or in stain-resistant clothing.



[Click here to see all of your results for PFASs](#)

WFBC Emphasizes Prevention Evidence

**Biological
mechanism**

+

**Human
exposure**

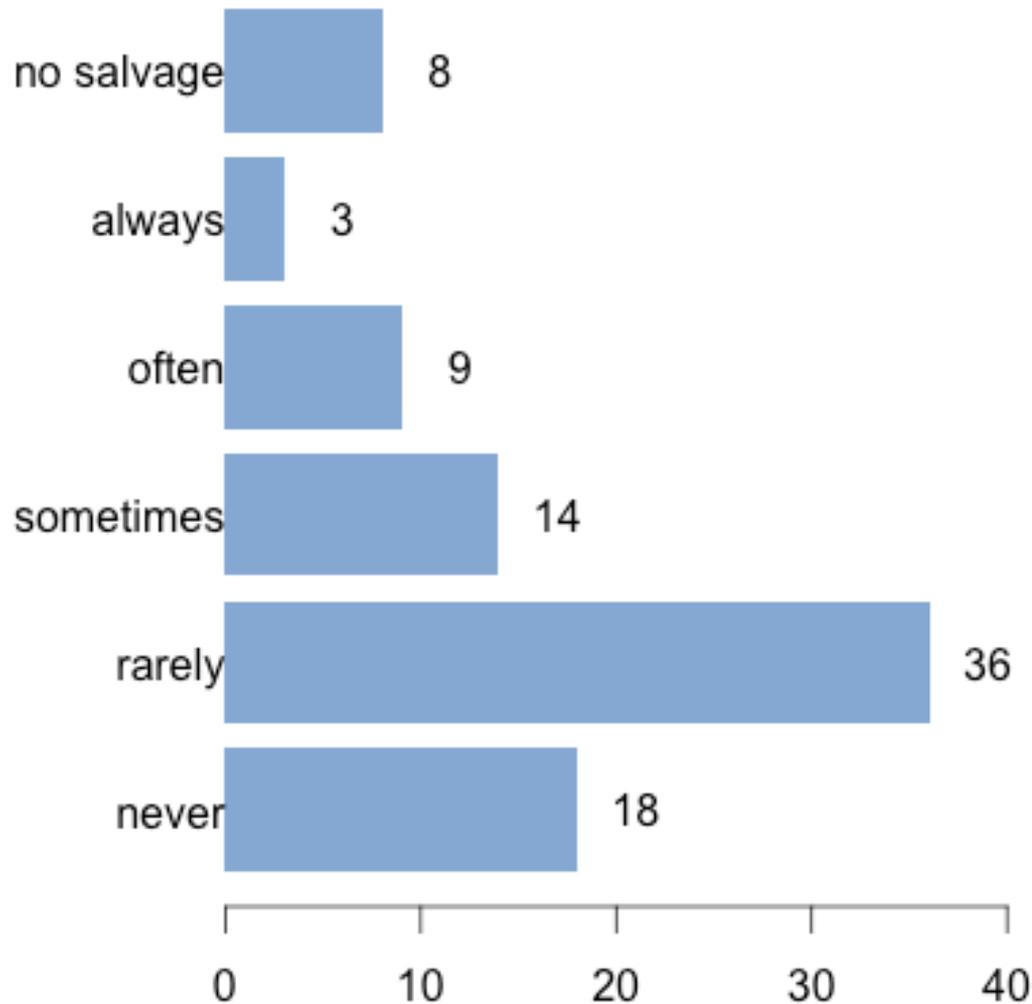
**Basis for
action**

**Education
Policy
Regulation
Reformulation**

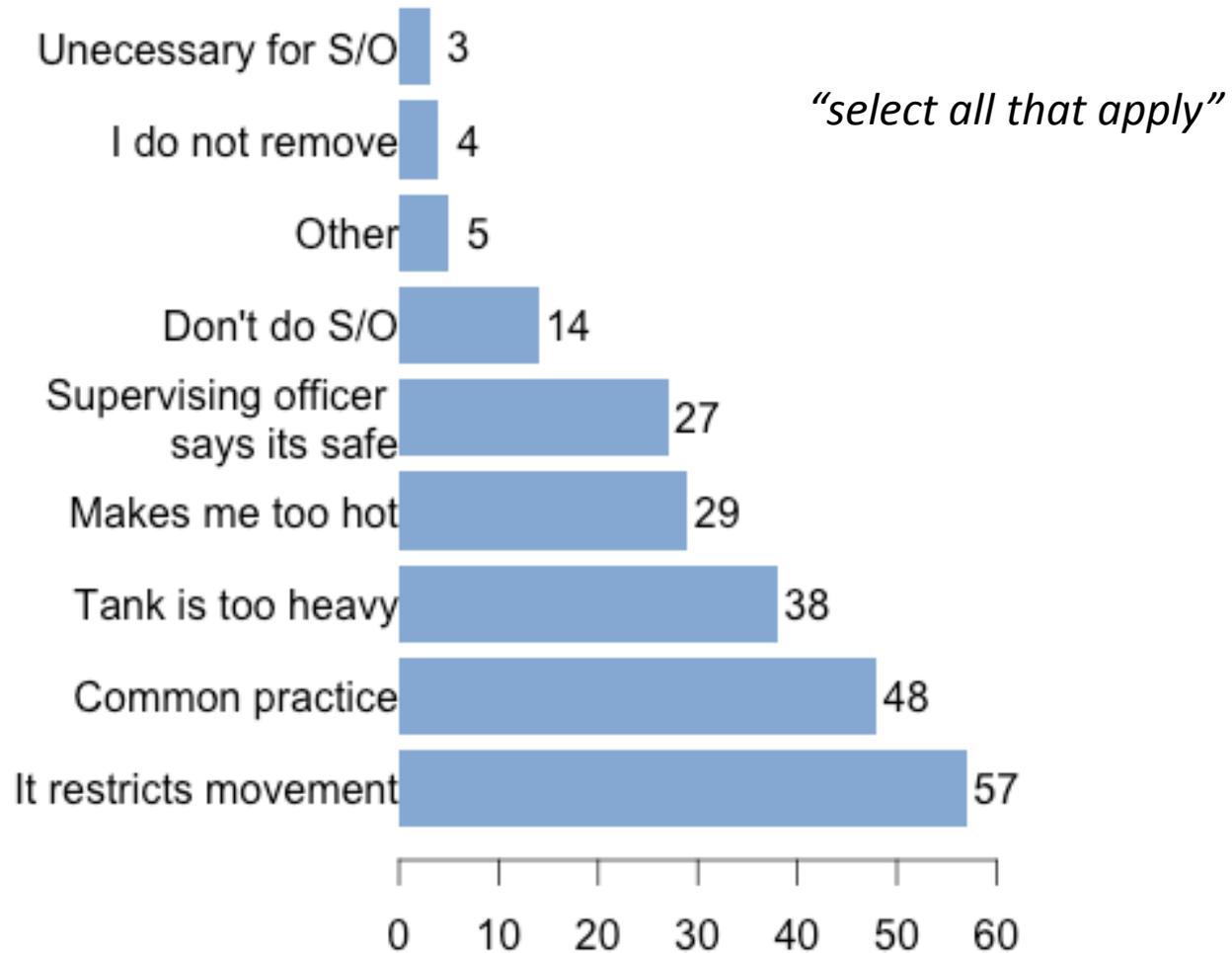
Extinguishing Breast Cancer from the Fire Service



B.11. During **salvage/overhaul** activities, how often do you wear your SCBA?



B.13. If you remove your SCBA or turn the air off during salvage/overhaul please tell us **why you do this.**



Implications for policy

- **LOCAL:** Changes to protective equipment policies, station design for any new stations, purchasing ordinances
- **OCCUPATION-SPECIFIC:** Policy work with state, national, and federal firefighting organizations to develop appropriate worker exposure protections
- **STATE & FEDERAL:** Chemicals Policy Reform. If the products that burn in fires are less toxic, then firefighters will have fewer exposures

Impact – Rigor, Relevance & Reach

Rigor: Advance biomonitoring science in new directions

- First study to examine the range of exposures to potential breast carcinogens and other EDCs among women firefighters compared to female controls
- Measuring biomarkers potentially relevant to breast cancer risk.
- Use of non-targeted biomonitoring techniques in a firefighter population

Relevance: Potential to extend to other female occupational groups

- Future recruitment of women from other occupations, such as nursing, nail salon workers, teachers, etc.

Reach: Disseminate results to diverse audiences

- Leverage research results to inform policy change
- Report-back to study participants



Women Firefighters Biomonitoring Collaborative



Collaborative Partners:



COMMONWEAL



Berkeley **CNR**



School of
Public Health

UNIVERSITY OF CALIFORNIA, BERKELEY



SILENT SPRING INSTITUTE
RESEARCHES THE ENVIRONMENT AND HUMAN HEALTH

UCSF

University of California
San Francisco

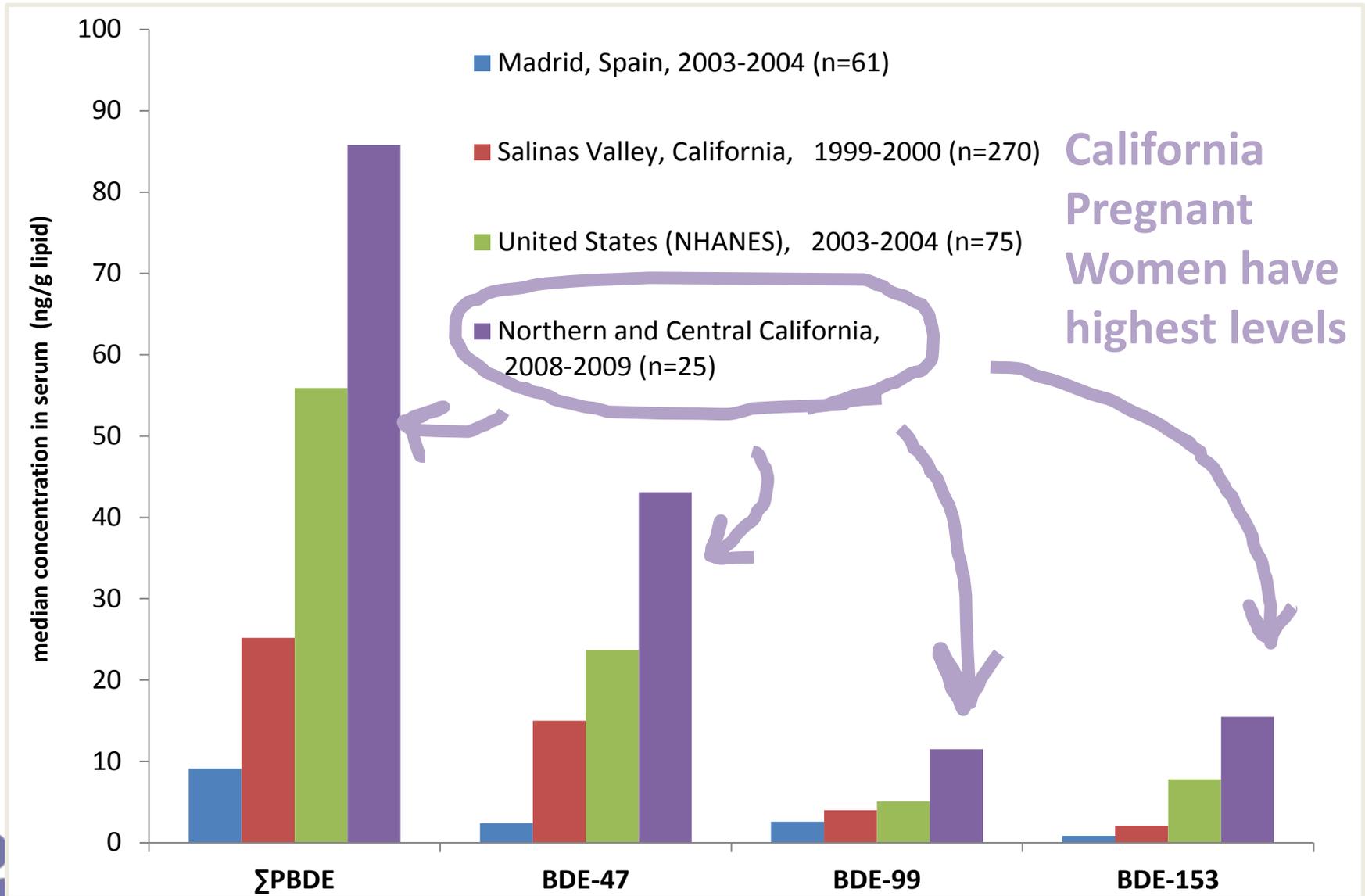
Funders:



- CBCRP: *Community Research Collaboration Fund*
- San Francisco Firefighters Cancer Prevention Foundation
- International Association of Firefighters (IAFF), Local 798

Collaborating with DTSC

Flame retardants in pregnant women worldwide





PBDEs

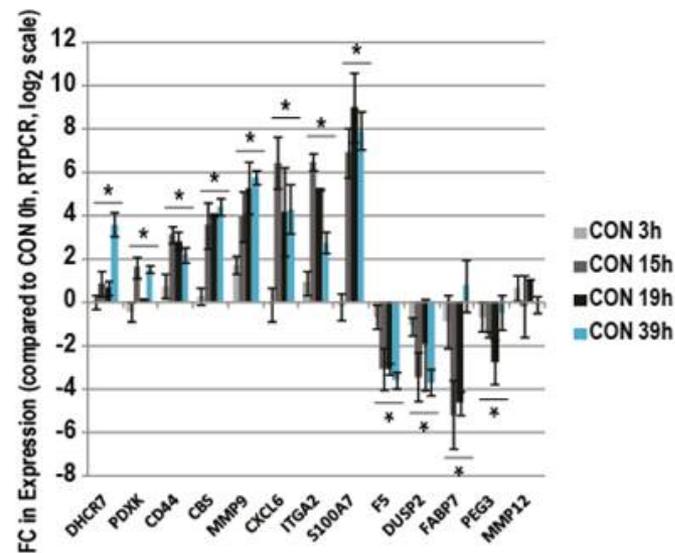
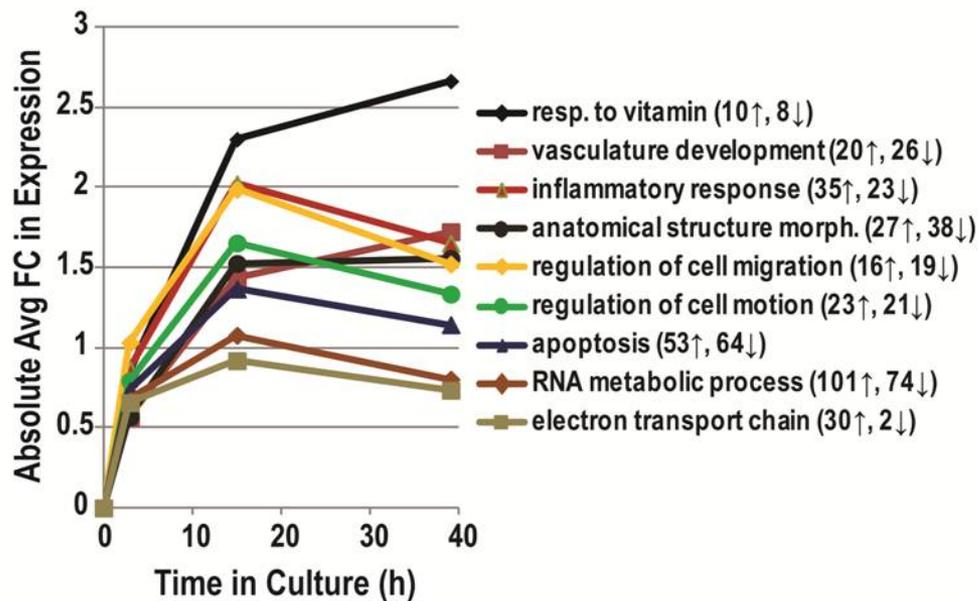
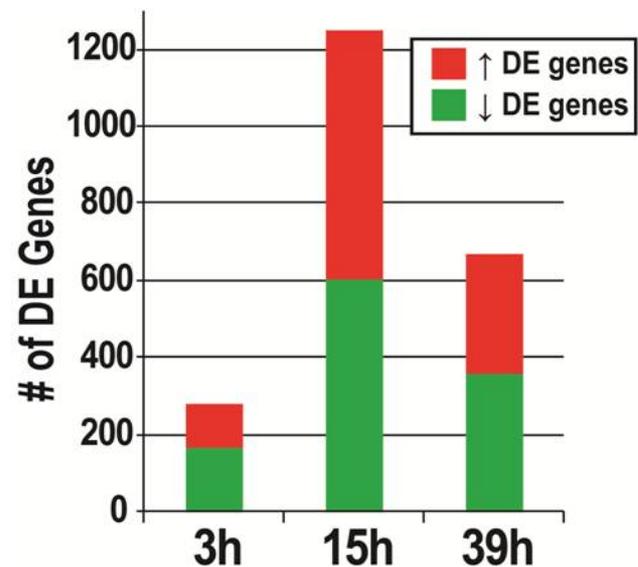
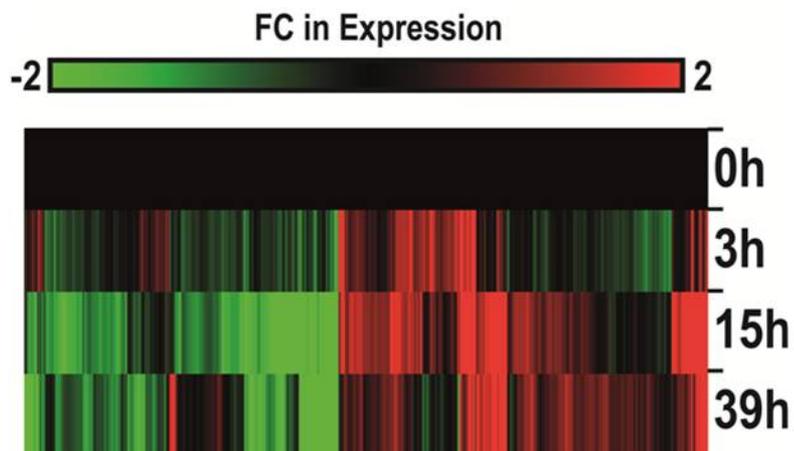


- **In humans**, thyroid hormone disruption identified as possible mechanistic link
- **In vitro**, disruption of developing fetal human brain cells
- **In animals**, affects learning, memory, and attention



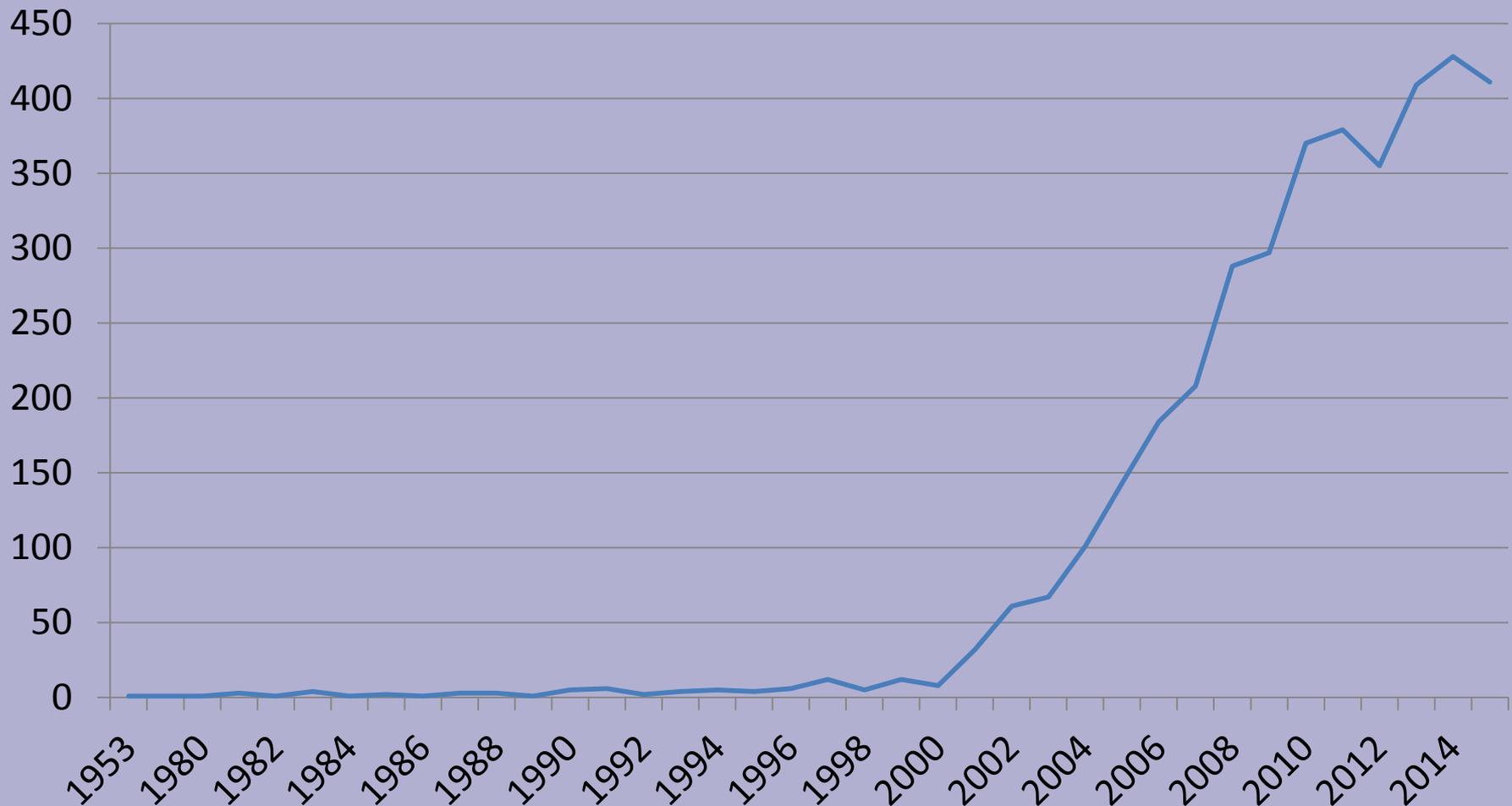
(Schreiber et al., 2010, Driscoll et al., 2008, Viberg et al. 2006)

Developing Molecular Endpoints: Transcriptomics



Increase in publications on PBDEs over time

Number of Publications

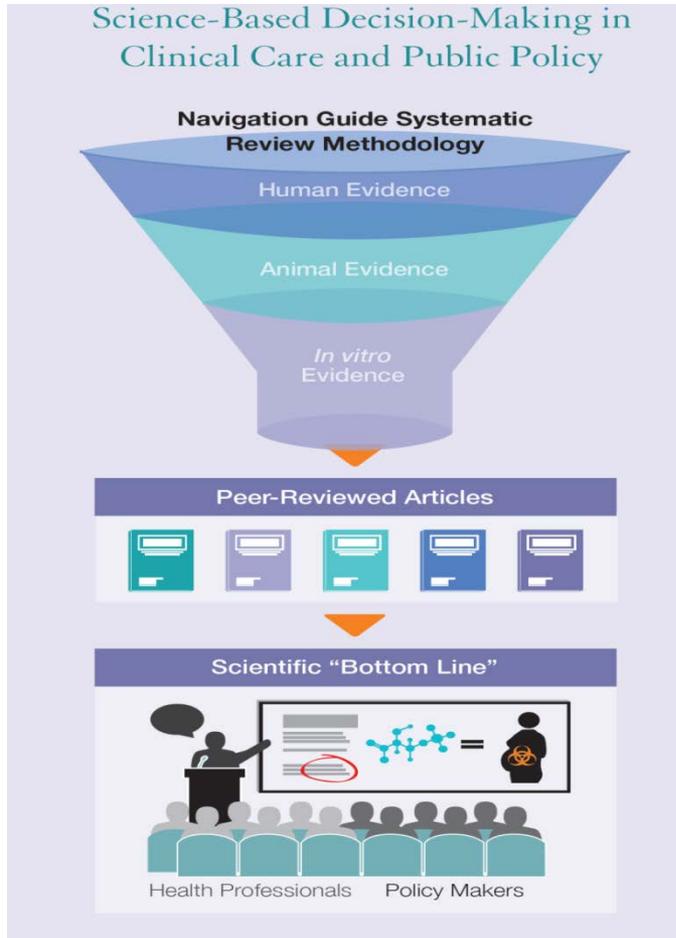


The science is vast, complex, diverse,
and of variable quality



????????

Navigation Guide: A rulebook for “moving from knowing to doing”



BRIDGING CLINICAL & ENVIRONMENTAL HEALTH

By Tracey J. Woodruff, Patrice Sutton, and The Navigation Guide Work Group

An Evidence-Based Medicine Methodology To Bridge The Gap Between Clinical And Environmental Health Sciences

ABSTRACT Physicians and other clinicians could help educate patients about hazardous environmental exposures, especially to substances that could affect their reproductive health. But the relevant scientific evidence is voluminous, of variable quality, and largely unfamiliar to health professionals caring for people of childbearing age. To bridge this gap between clinical and environmental health, we created a methodology to



THE COCHRANE
COLLABORATION®

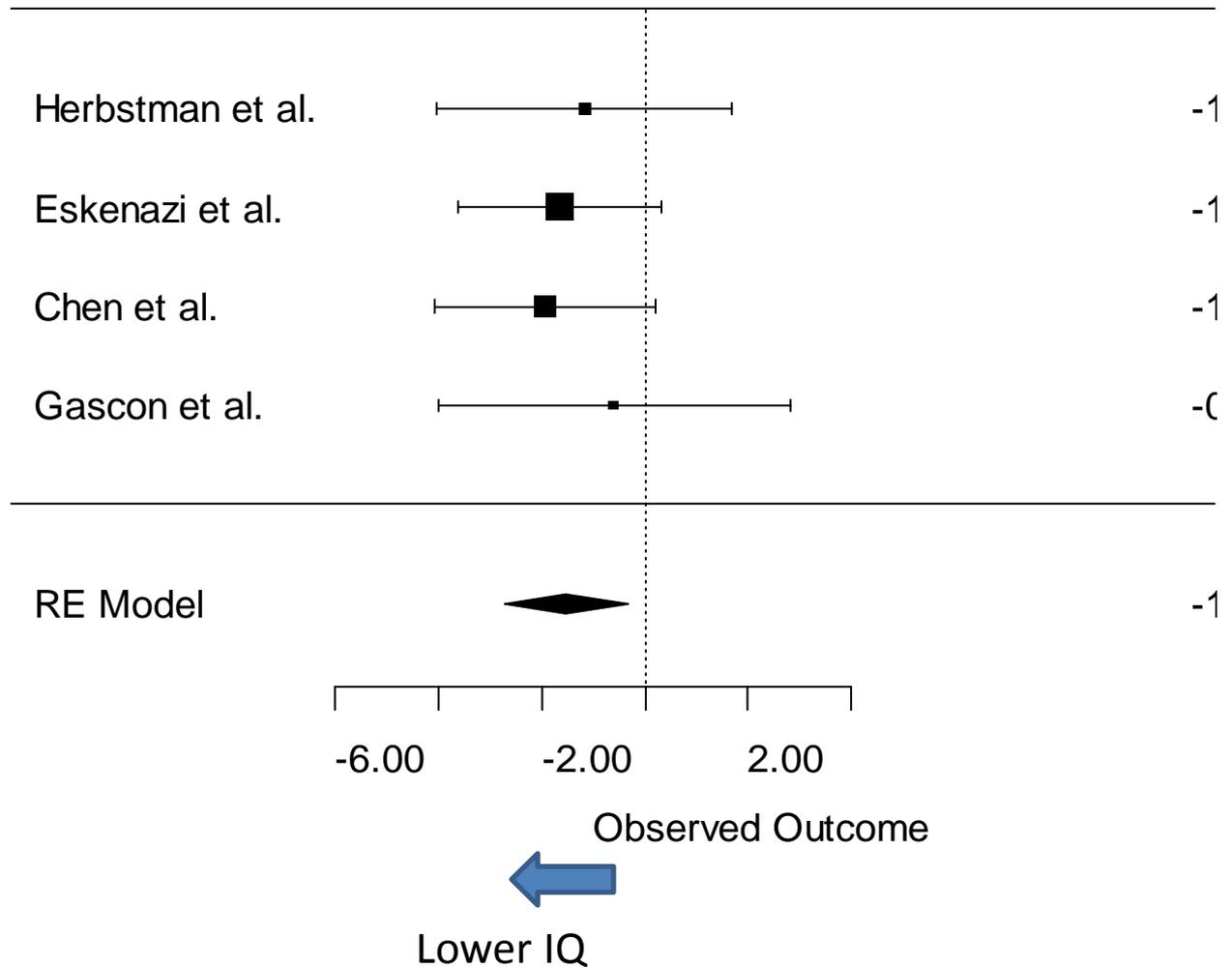
GRADE

PBDE & IQ (9 studies)



- Prospective birth cohorts
- 3 potentially related (Chao, Shy, Ding-Yan)
- Child Age : 8-72 months
- Confounders adjusted for: varying (child's sex, age at testing, HOME score, SES most common)
- Congeners: varying (47, 99, 100, 153 most common)

Prenatal PBDE exposure and IQ outcome ~6 years old – Meta-analysis



Sufficient evidence that PBDEs in humans affects measures of intelligence such as Intelligence Quotient (IQ)

PBDEs, Lead and Decreased IQ

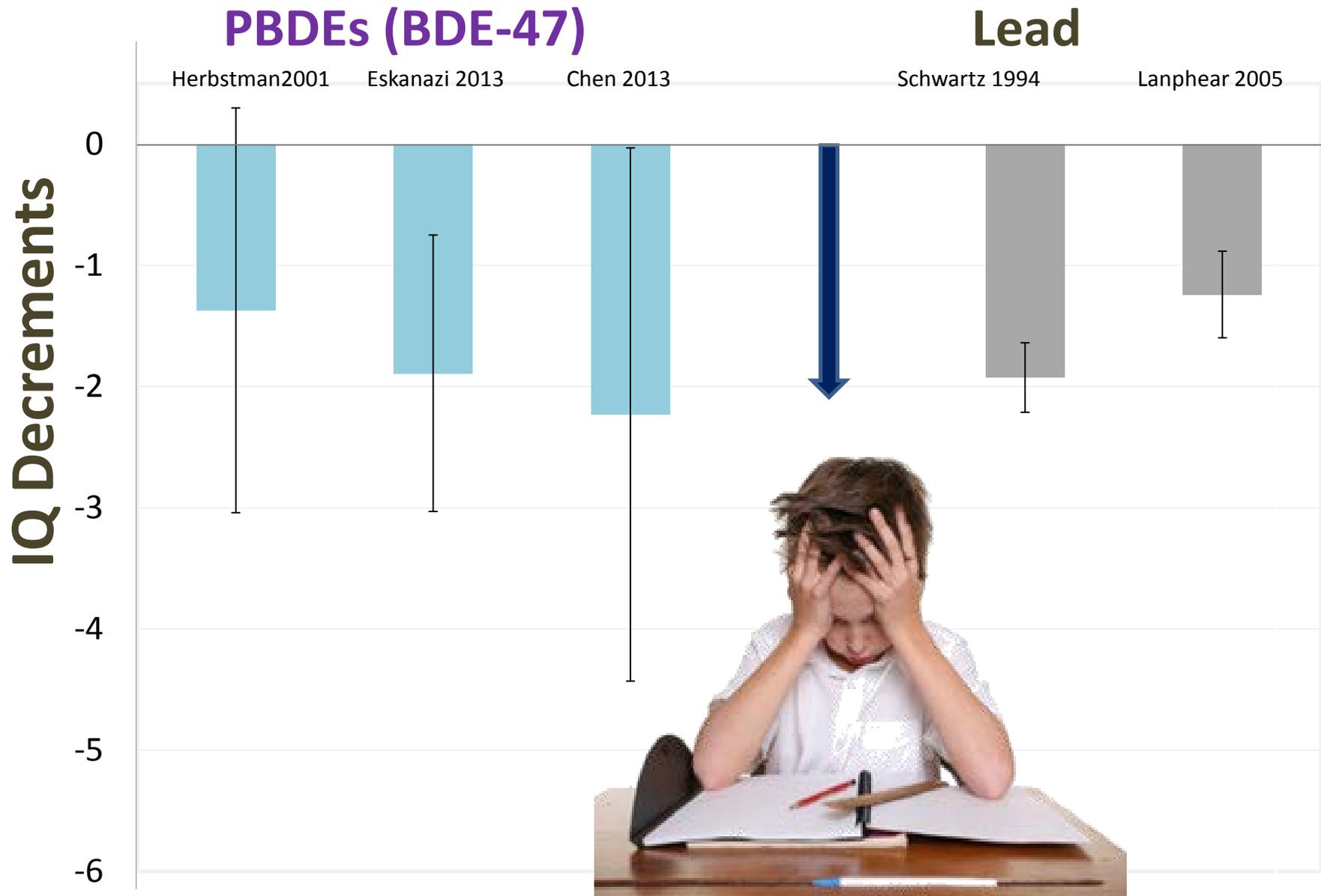


Figure 1. Decrements in IQ per interquartile increase in blood PBDE or lead levels, using data from NHANES

Table 2. Estimated FSIQ point losses associated with different risk factors in a population of 25.5 million children.

| Risk factor | Total no. of FSIQ points lost | |
|--|-------------------------------|-------------------|
| Medical conditions | | 34 million |
| Congenital heart disease | 104,805 | |
| Preterm birth | 34,031,025 | |
| Type 1 diabetes | 185,640 | |
| Acute lymphocytic leukemia | 135,788 | |
| Brain tumors | 37,288 | |
| Duchenne muscular dystrophy | 68,850 | 38 million |
| Neurodevelopmental disorders | | |
| ASDs | 7,109,899 | |
| Pediatric bipolar disorder | 8,164,080 | 15 million |
| ADHD | 16,799,400 | |
| Postnatal traumatic brain injury | 5,827,300 | |
| Socioeconomic, nutritional, psychosocial factors | | 40 million |
| Nonorganic failure to thrive | 5,355,000 | |
| Iron deficiency | 9,409,500 | |
| Environmental chemical exposures | | 40 million |
| Methylmercury | 284,580 | |
| Organophosphate pesticides | 16,899,488 | |
| Lead | 22,947,450 | |



"You will see by it, that the Opinion of this mischievous Effect from Lead, is at least above Sixty Years old; and you will observe with Concern how long a useful Truth may be known, and exist, before it is generally receiv'd and practis'd on"

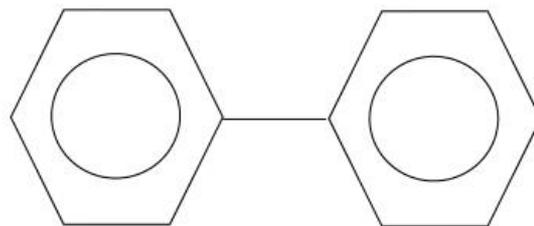
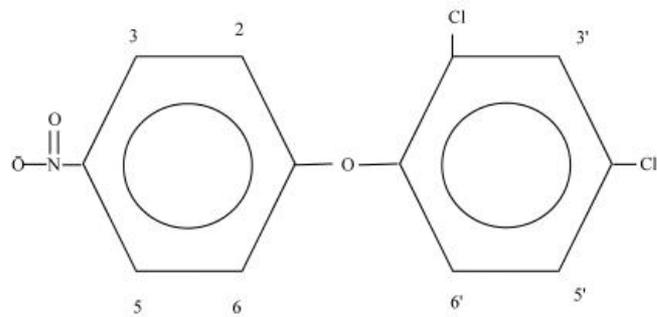
- Benjamin Franklin
'Pernicious effects of lead', 1818



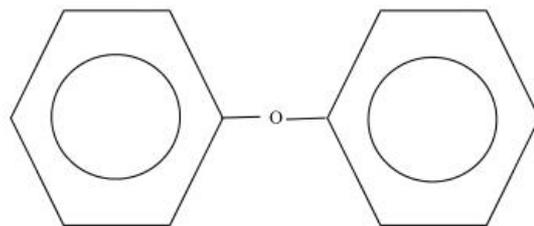
A young child with light hair is standing barefoot on a concrete path. They are wearing a costume made of a large cardboard box that covers their torso and legs. The child is holding the top edges of the box with both hands. The words "PLEASE HELP ME" are written in large, bold, black letters on the front of the box. The child's face is visible above the top edge of the box, and they have a slightly distressed or pleading expression. The background consists of a chain-link fence and some dry grass.

PLEASE
HELP
ME

LOVE CANAL RECIPE:
1. MIX 82 CHEMICALS
2. PLACE IN CANAL FOR
25 YRS.
YIELD: SICKNESS + DEATH



PCB or PBB depending on Chlorine (Cl) or Bromine (Br) substitution



Polybrominated diphenyl ether (PBDE)

Figure 1. A general structure of polybrominated diphenyl ether (PBDE), polychlorinated biphenyl (PCB), polybrominated biphenyl (PBB), and nitrofen . Name of the congener is representative of the total number of bromines (Br) or chlorines (Cl) and their respective position on each ring.

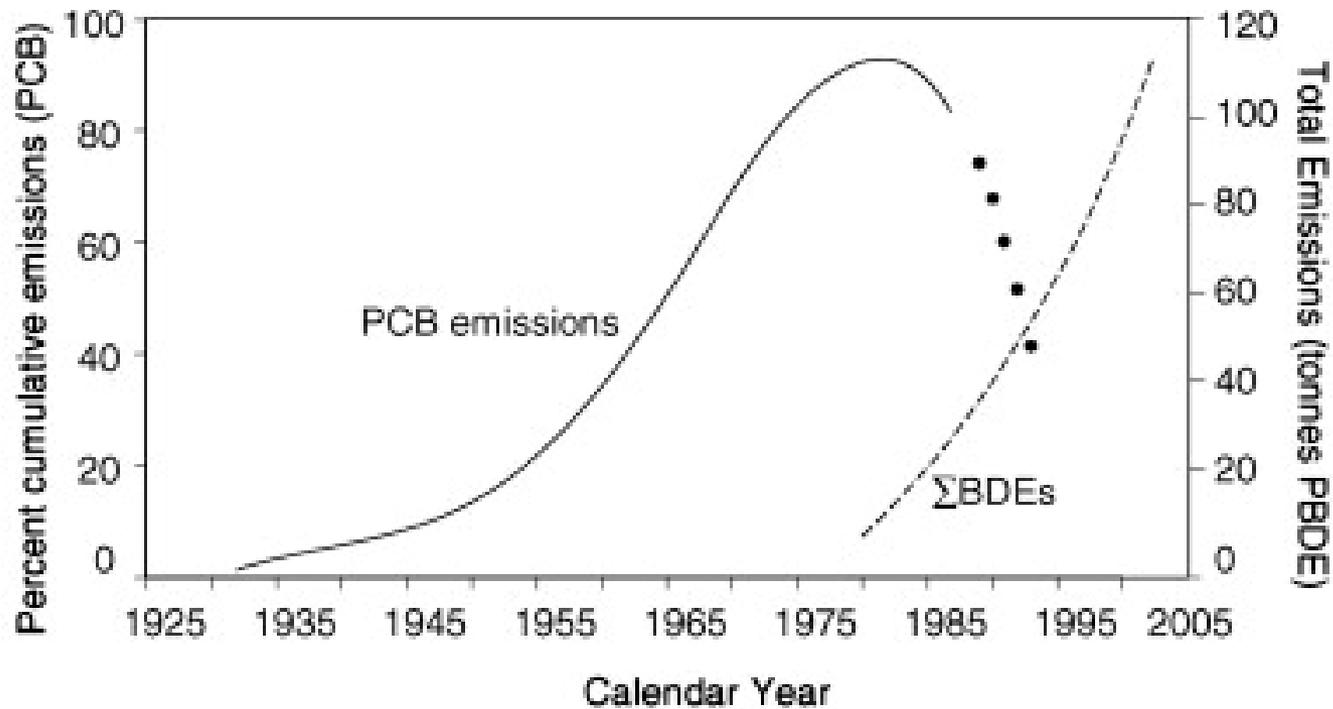


Fig. 1. Emission histories of PCBs and PBDEs, modified from Li et al. (2006) (North American PBDE emission trend) and Rapaport and Eisenreich (1988) (% of cumulative emissions of PCBs to Eastern North America). The last five years of the PCB trend (dotted) rep...

S.C. Johannessen, R.W. Macdonald, C.A. Wright, B. Burd, D.P. Shaw, A. van Roodselaar

Joined by geochemistry, divided by history: PCBs and PBDEs in Strait of Georgia sediments

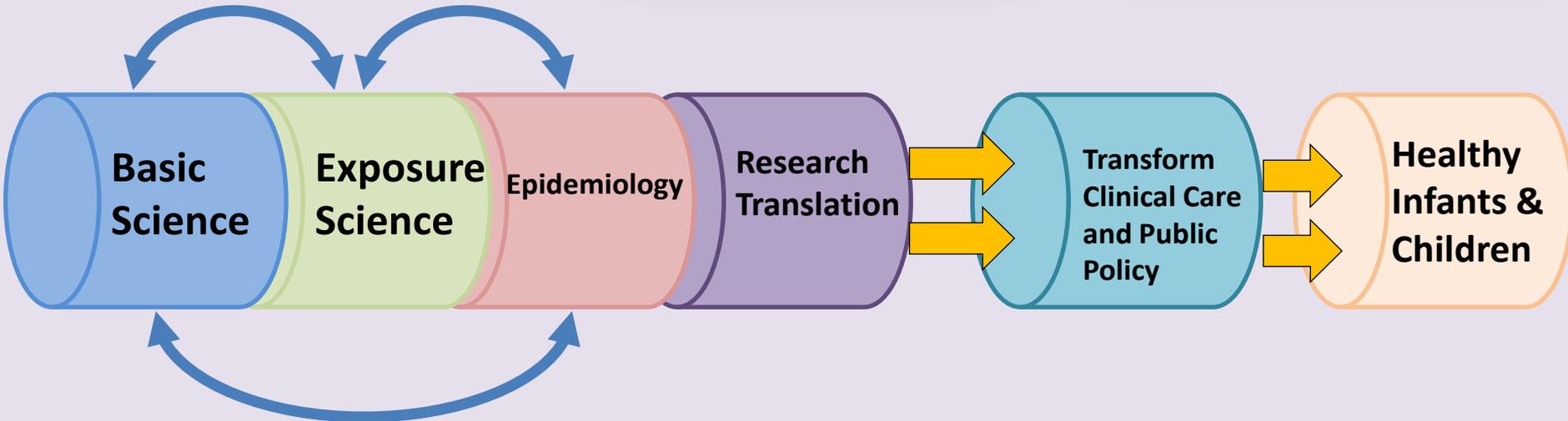
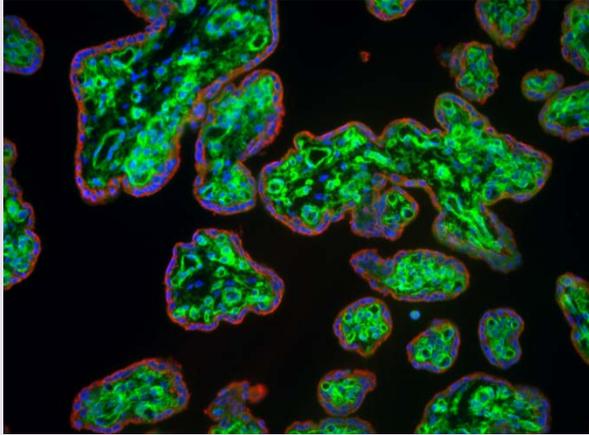
Marine Environmental Research, Volume 66, Supplement, 2008, S112–S120

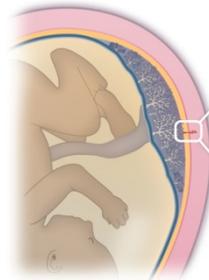
<http://dx.doi.org/10.1016/j.marenvres.2008.03.003>



O u r s t r a t e g y ...

Translational Model





Pregnancy → Environmental Chemicals Center

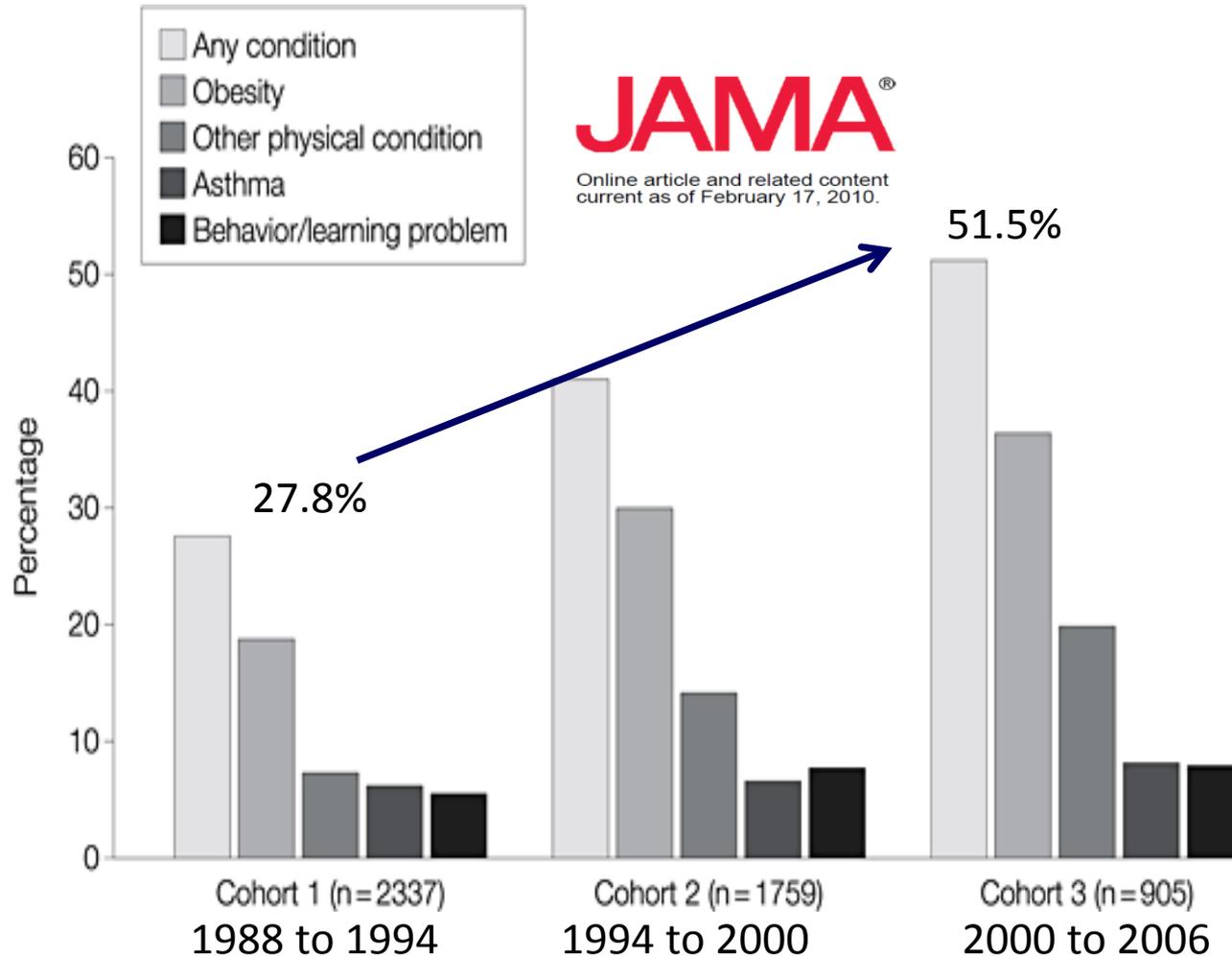


Improves children's health by identifying and preventing harmful environmental chemical exposures that occur during pregnancy.

Reproductive health professionals are a powerful force for change



Prevalence of chronic conditions among children and youth





Close

A cancer patient celebrates her "Quinceanera" in Nicaragua. Ninety percent of children with leukemia in

Independent Task Force Report No. 72

Mitchell E. Daniels Jr. and Thomas E. Donilon, *Chairs*
Thomas J. Bollyky, *Project Director*

The Emerging Global Health Crisis

*Noncommunicable Diseases in
Low- and Middle-Income Countries*

The rise of NCDs (noncommunicable diseases such as cancer and cardiovascular disease) in these countries is not simply a result of reductions in the plagues and parasites that kill children and adolescents.

-

2013

Official Statement on Environmental Toxins and Pregnancy – The Atlantic

5/28/15, 9:11 AM



**The H. John Heinz III Center
for Economics, Science & Environment
and the
Heinz Center Bipartisan Initiative on the
Prevention of Breast Cancer**

You and your staff are cordially invited to a public celebration of the leadership provided by outstanding medical and scientific professional societies in their work to prevent harmful environmental exposures linked to cancer and other adverse women's and children's health outcomes.

NEW VENUE: 101 Constitution Avenue, 7th Floor
Washington, DC 20001

RSVP: Lindl Harvey, Heinz Fellow and Initiative Director
harvey@heinzcenter.org
202-737-6307

PRESIDENTS FOR PREVENTION

**Wednesday, October 2, 2013
6:00 PM – 7:30 PM**

Through a series of groundbreaking position statements on harmful exposure to environmental contaminants, leading professional medical and scientific societies have emerged as champions of environmental health protection. These efforts represent a watershed moment in the advancement of strategies to prevent cancer and other adverse health outcomes that affect our families and may be passed to future generations.

Please join us to honor - and hear from - the visionary presidents of three professional societies that have led the movement for prevention through improved environmental health policy.

Special guests:

Jeanne A. Conry, M.D., Ph.D.
President of American Congress of Obstetricians & Gynecologists

Linda C. Giudice, M.D., Ph.D., MSc
President of American Society for Reproductive Medicine

Richard J. Santen, M.D.
President-Elect of The Endocrine Society

2015



125 countries/Territories

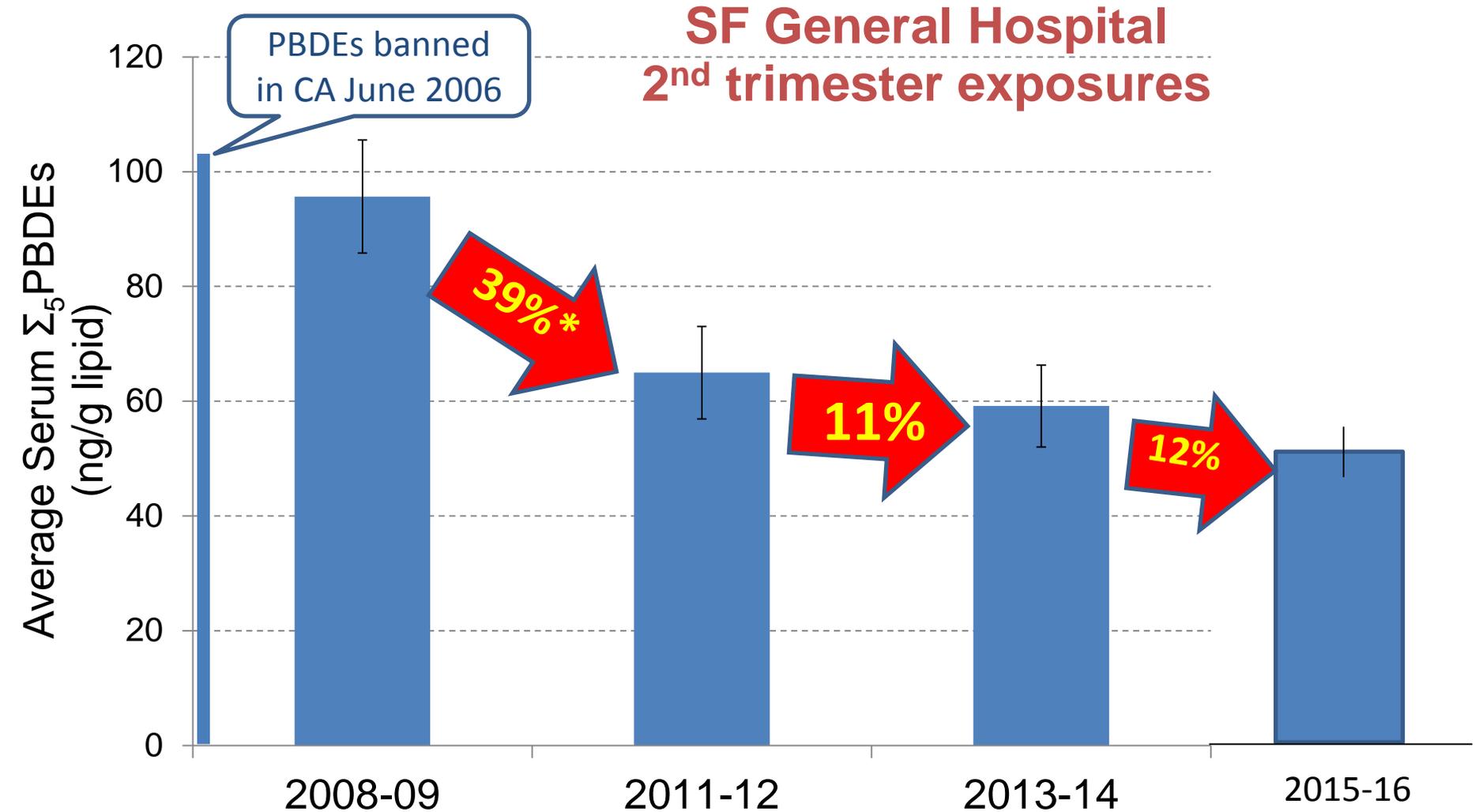
Are You a Toxic Waste Disposal Site?



Nicholas Kristof FEB. 13, 2016



Actions Matter- Policy



*(Zota et al 2013)

New furniture standards remove harmful flame retardants

Comments 8 Email Share 270 Tweet 58 Like 212 +1 2



A woman dumps an old couch at a Tucson landfill. California is tossing out a requirement that foam cushions be treated with flame retardant chemicals that studies have linked to cancer and reproductive defects. (Ron Medresoeck / Arizona Daily Star / December 20, 2001)

"California is curbing toxic chemicals found in everything from high chairs to sofas..... These new standards will keep the furniture in our homes fire-safe and limit unnecessary exposure to toxic flame retardants."

- Gov. Jerry Brown

Concern
Raised on
PBDEs

UCSF
Children's
Env Health
Center



PBDEs banned in CA,
Phased out in US

PBDE &
Neurodevelopment



40 years

Navigation
Guide
Conceived

Navigation
Guide
Published



PFOA &
Birthweight



Air Pollution
& Autism



Formaldehyde
& Asthma



Navigation
Guide
Editorial

Triclosan &
Repro/Dev

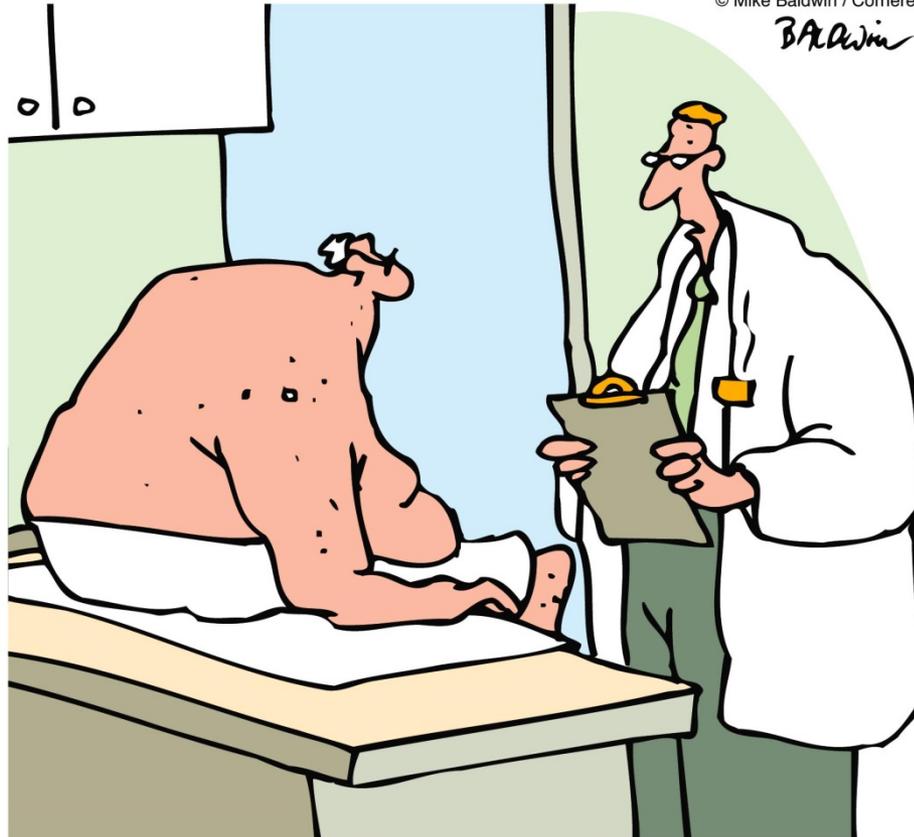


PBDE &
Neurodevelopment



© Mike Baldwin / Cornered

Baldwin



“I’m afraid there’s not much I can do for you now. You should’ve come in sooner, before you got sick.”

Manufactured pharmaceuticals have to have **safety** data before use



Manufactured chemicals do **NOT**

“... we must shift ...**burden of proof** from the individual health care provider and the consumer to the manufacturers **before** ... chemicals are ...released into the environment.” Dr. Jeanne Conry, President ACOG 2013



Linda C. Giudice, MD, PhD, President American Society for Reproductive Medicine and Jeanne C. Conry, MD, PhD, President, American Congress of Obstetricians and Gynecologists – October 2013, Washington, DC





Program on
Reproductive Health and the Environment

Environmental Health Initiative
University of California, San Francisco



Acknowledgements



Our PRHE Team:

Cynthia Melgoza
Canchola

Gardenia Casillas

Annemarie
Charlesworth

Natalyn Daniels

Erin DeMicco

Cheryl Godwin de
Medina

Robert Gould

Erica Koustas

Juleen Lam

Preston Maring

Amy Padula

Anne Sausser

Jackie Schwartz

Kristin Shiplet

Patrice Sutton

Hazel Tesoro

Hanna Vesterinen

Aolin Wang

Tracey Woodruff

Marya Zlatnik



UCSF

University of California
San Francisco