

Endocrine Disrupting Compounds and Indoor Environmental Quality: Lessons Learned from Household Exposure Studies

Robin Dodson, Sc.D.
Silent Spring Institute



Indoor Exposures

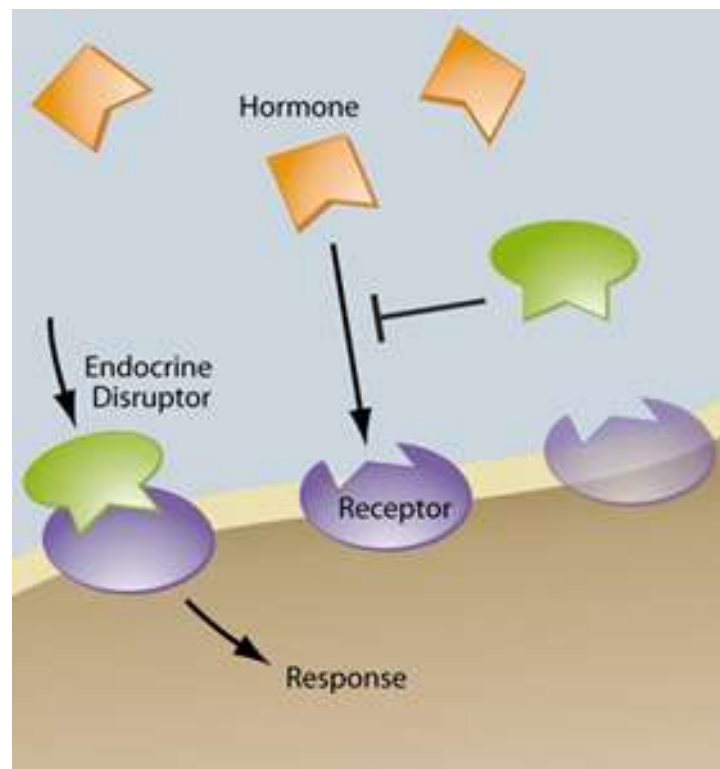
Indoor > Outdoor

- Many indoor sources
- Slower degradation
- Majority of time indoors



What are endocrine disruptors?

- Agents that interfere with **synthesis**, **secretion**, **transport**, **binding**, **action**, or **elimination** of natural hormones

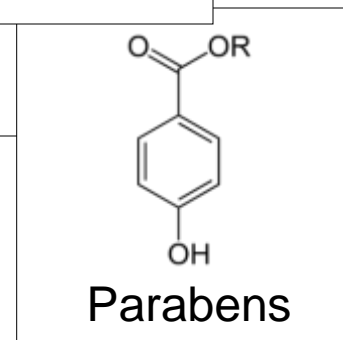
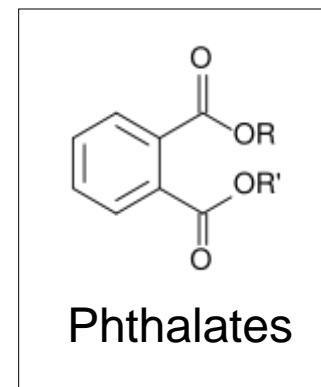
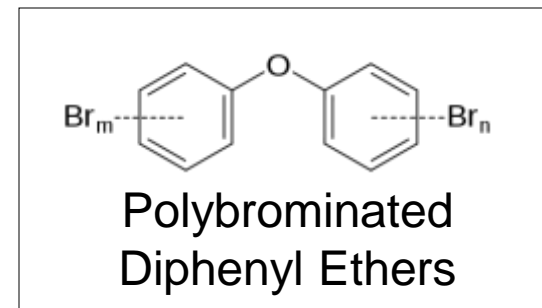


NIEHS, 2009

***EDCs = endocrine disrupting compounds**

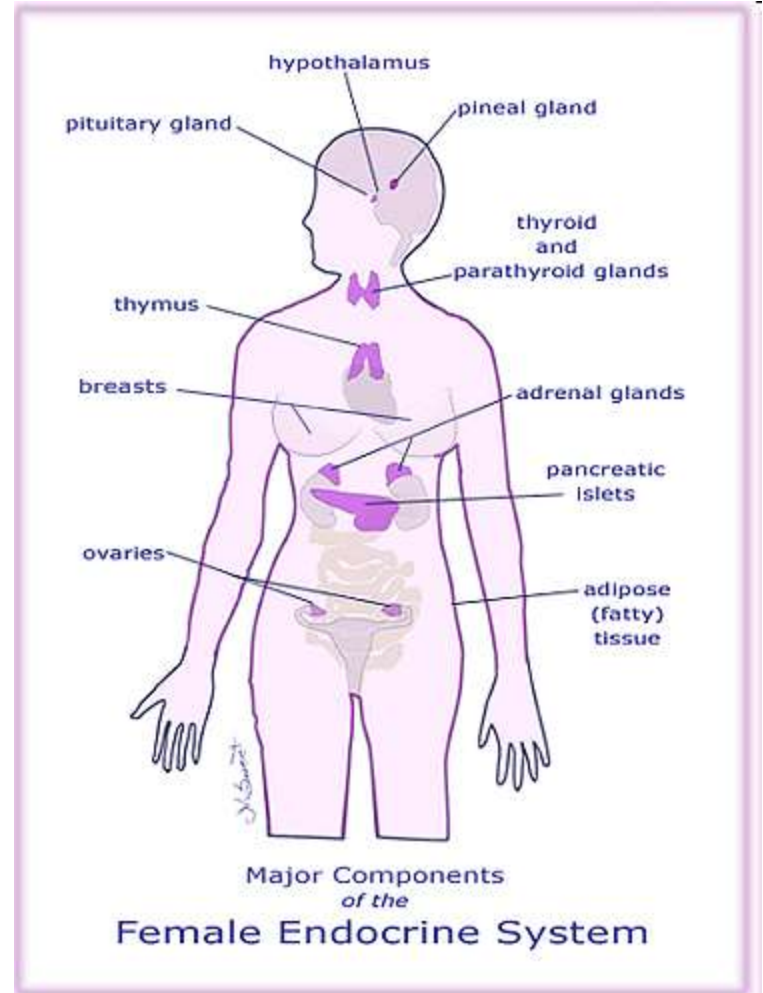
EDCs can be defined by the hormone systems they interact with

- Thyroid
 - PCBs, PBDEs, perfluorinated compounds
- Estrogen
 - bisphenol A, nonylphenol, parabens
- Androgen
 - dibutylphthalate, DEHP



Health Endpoints

- Reproductive health (incl. puberty)
- Hormonal Cancers
- Neurodevelopment
- Obesity
- Diabetes
- Heart disease
- Immune function



Examples

- Pharmaceuticals: oral contraceptives, diethylstilbesterol (DES)
- Pesticides: DDT
- Flame retardants: PBDEs
- Associated with plastics: bisphenol A, phthalates
- Industrial compounds: PCBs, dioxins
- Metals: Cd, Pb, Hg
- Natural substances: phytoestrogens, soy



Household Exposure Studies

- Cape Cod – 120 homes
- California
 - Richmond (urban) – 40 homes
 - Bolinas (not urban) – 10 homes
- Air, dust, urine (Cape only)
- 89-106 endocrine disrupting compounds (EDCs)
- 30 measured for the first time indoors in Cape study



Lesson #1: Residential exposure to EDCs is widespread and consistent across demographically different communities

On Cape Cod....

- 67 EDCs
- 27 pesticides
- DDT 2/3 of homes
- Phthalates - 100% homes
- Phenols, parabens abundant
- Flame retardants higher than Europe
- All homes above guidelines
- 28 detected EDCs have no health guidelines
- Some people - very high levels



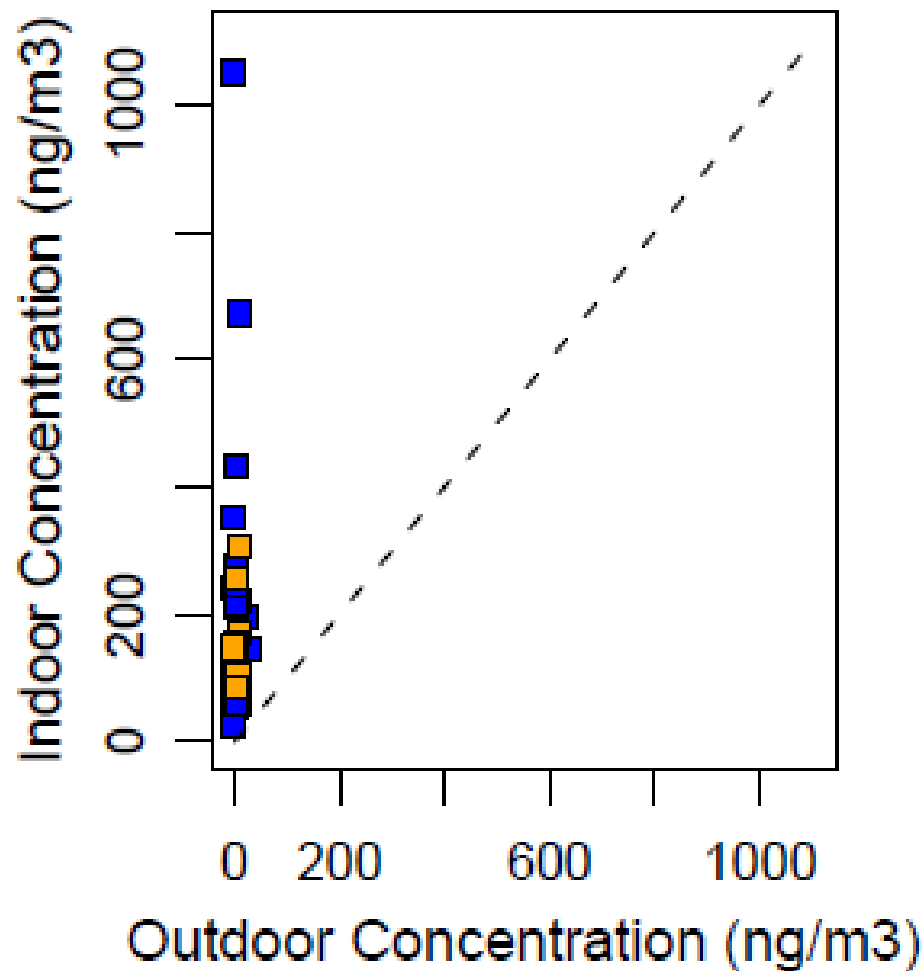
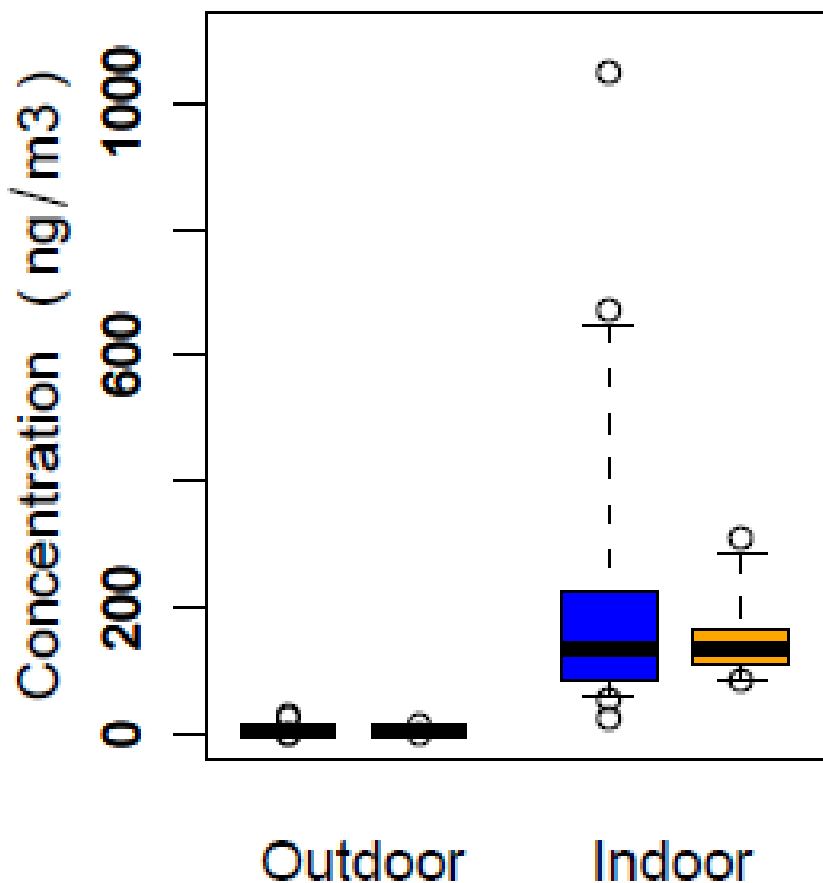
In California...

- 106 EDCs targeted in indoor air, **outdoor air**, and dust, 50 homes
 - Found 66 in indoor air
 - Found 42 in outdoor air
 - Found 58 in house dust
- 20 EDCs significantly higher indoors than outdoors



Lesson #2: Outdoor pollutants penetrate indoors, although indoor levels typically far exceed outdoor levels

di-n-butyl phthalate



■ Richmond ■ Bolinas

Lesson #3: Banning a chemical doesn't necessarily eliminate it

4,4'-DDT

- Banned in 1972
- Detected in 65% of Cape Cod dust samples
- Detected in 86% of California dust samples

Other banned/restricted pesticides still detected:
chlordane, heptachlor, methoxychlor, dieldrin and
pentachlorophenol



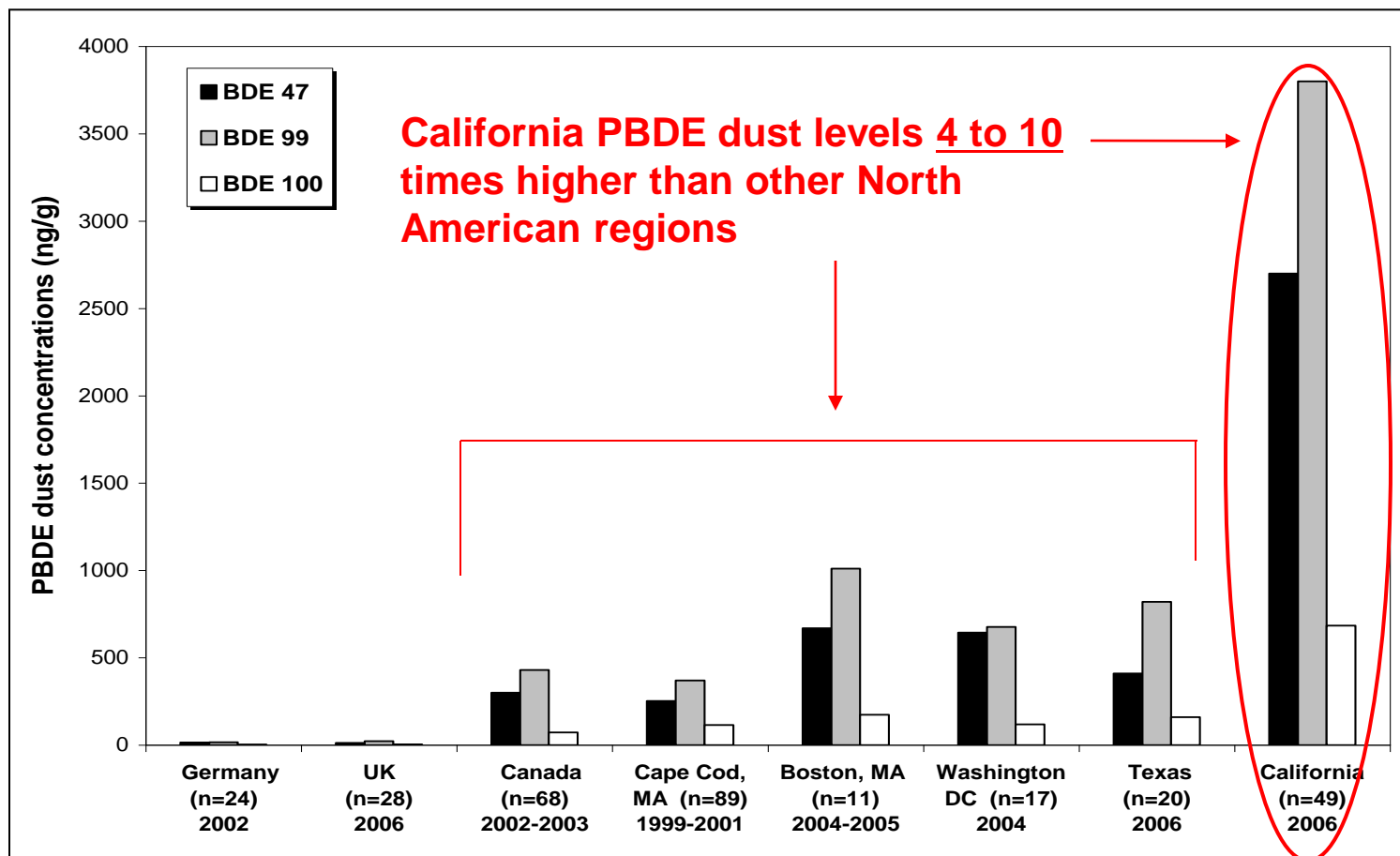
Cape Cod homes with high levels of PCBs: 5 years later

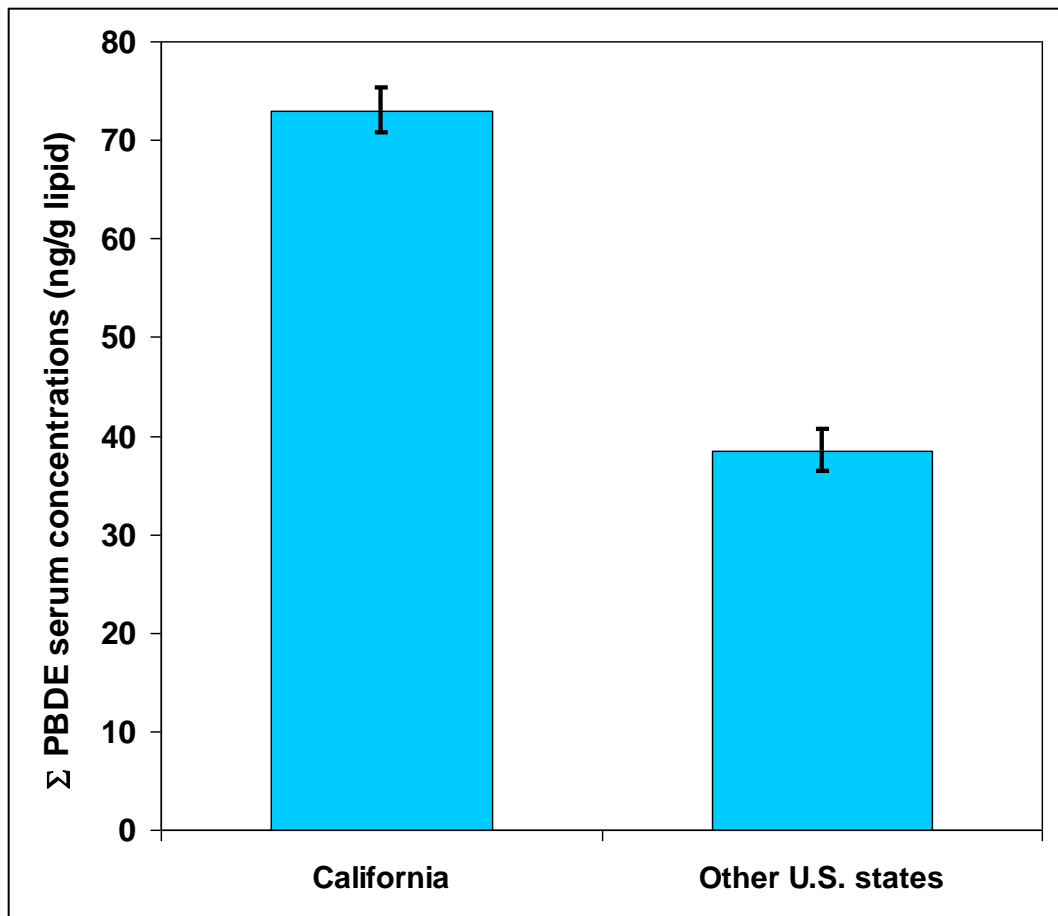
- Air concentrations 3-10x higher than EPA guideline (3 ng/m³)
- Dust 10-1000x higher than EPA guideline (0.22 mg/g)
- Blood levels above 95%tile of NHANES
- What is the source?



Lesson #4: Consumer product standards influence exposures

Median PBDE household dust concentrations across 8 regions in North America and Europe





Blood PBDE levels in Californians nearly two fold higher than rest of the U.S.

Σ PBDEs = sum of BDE-28, -47, -99, -100, -153, -154

CA Furniture Flammability Standards

Technical Bulletin 117 (TB 117):

1975 performance-based furniture
flammability standard

Foam in furniture must withstand open
flame for 12 seconds

Historically, compliance achieved through
use of Penta-BDE

Unique standard; no other state has a
parallel standard

***As a result, majority of PUF products
treated with penta-BDE in the U.S.
were sold in California (ATSDR 2004)***



Conclusions

- Widespread exposure is evident; challenge to identify and reduces sources of exposure
- Consider exposures to mixtures
- Consider the impact of chemicals on human health through full product lifecycle, including indoor exposure
- Healthier housing is not just about efficiencies; need to address indoor exposures to EDCs and other emerging chemicals of concern

Acknowledgments

Coauthors: Sarah C. Dunagan, Julia G. Brody, and Ruthann A. Rudel



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