Program on Reproductive
Health and the Environment

Chemicals in the indoor environment:

Implications for human exposure and health

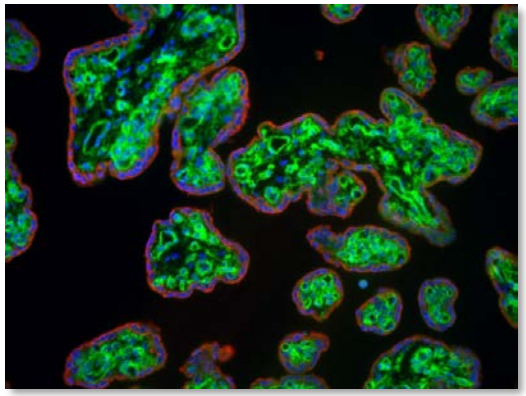
Veena Singla, PhD

Associate Director, Science & Policy

UCSF PRHE

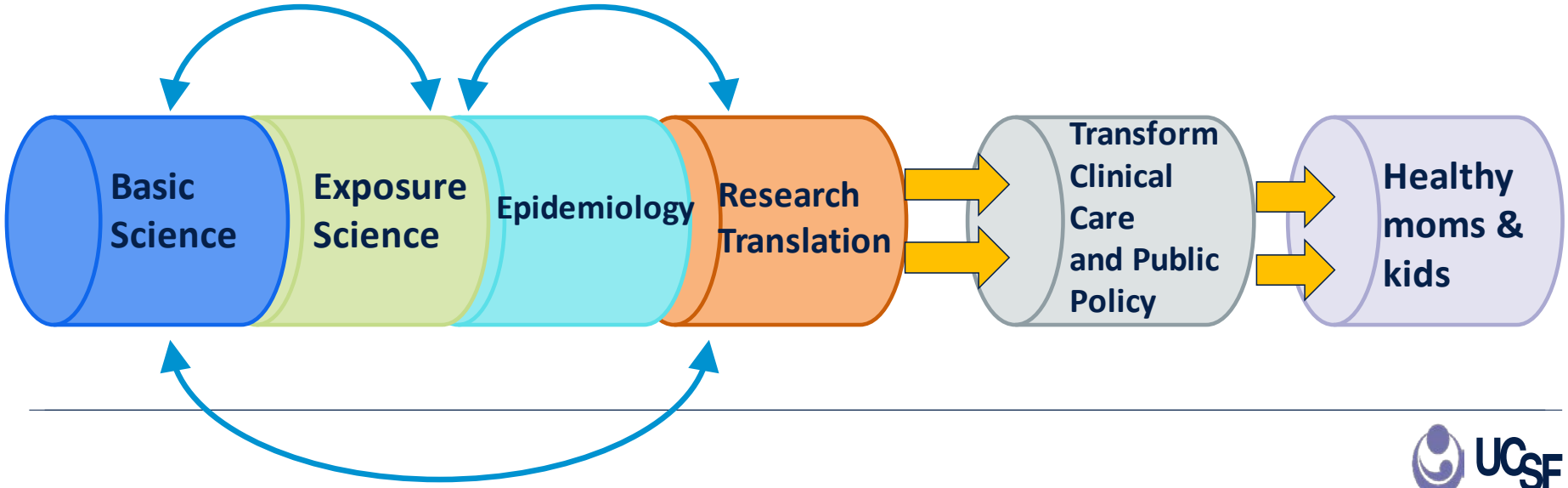
Program on Reproductive Health and the Environment

RESEARCH



CLINICAL ENGAGEMENT

POLICY



UCSF

Roadmap

- Why indoor environment?
- Consumer product chemicals in indoor dust
- Implications for human health
- Highlights for Program

People in developed countries spend **~90% of time indoors**

Klepeis 2001

Indoor environments are unique microenvironments

Radon
Mold
Pest allergens
Structural & indoor pesticides
Lead

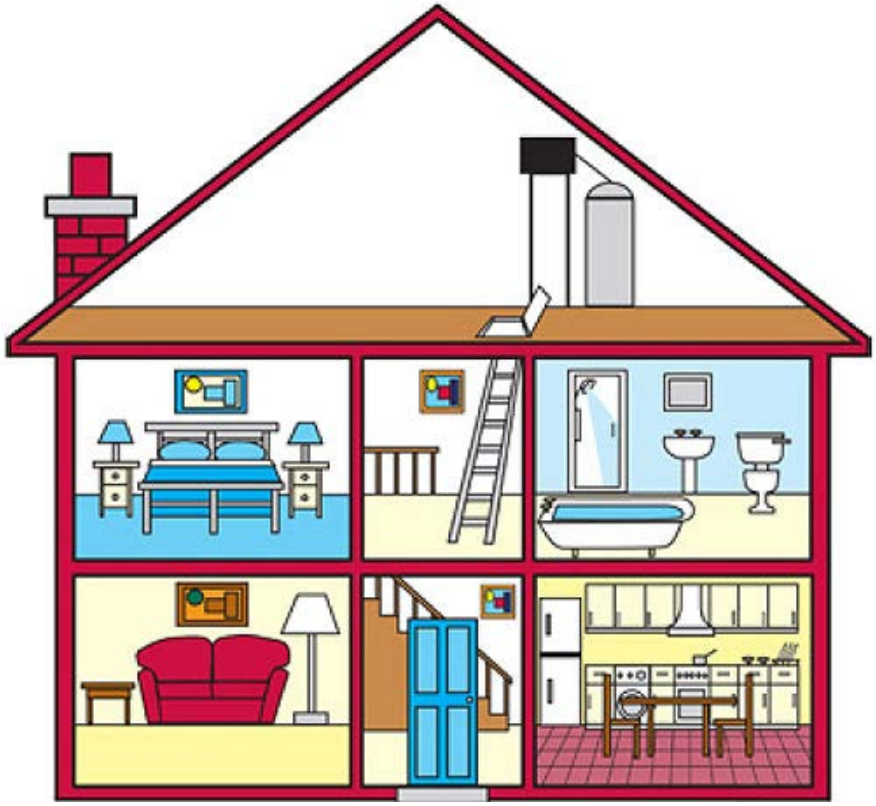
Formaldehyde
Benzene
Flame retardants
Phthalates

Weschler & Nazaroff, 2008; Weschler 2009; Bradman 2012; Bolden 2015

UCSF

Chemicals from products affect **indoor environmental quality**

- **Furniture**
- **Electronics**
- **Wire & cable**
- **Flooring**
- **Wall coverings**
- **Paint**
- **Personal care products**
- **Beauty products**
- **Adhesives**
- **Stain & water resistance**



VOCs

- Formaldehyde
- [illegible]
- Toluene

SVOCs

- **Flame retardants**
- **Phthalates**
- **Fluorinated [illegible] chemicals**
- **Fragrances**

Weschler 2009; Rudel 2009; Bolden 2015

UCSF

Chemicals from products: human exposure

Environmental Science & Technology

Article

pubs.acs.org/est

High-Throughput Models for Exposure-Based Chemical Prioritization in the ExpoCast Project

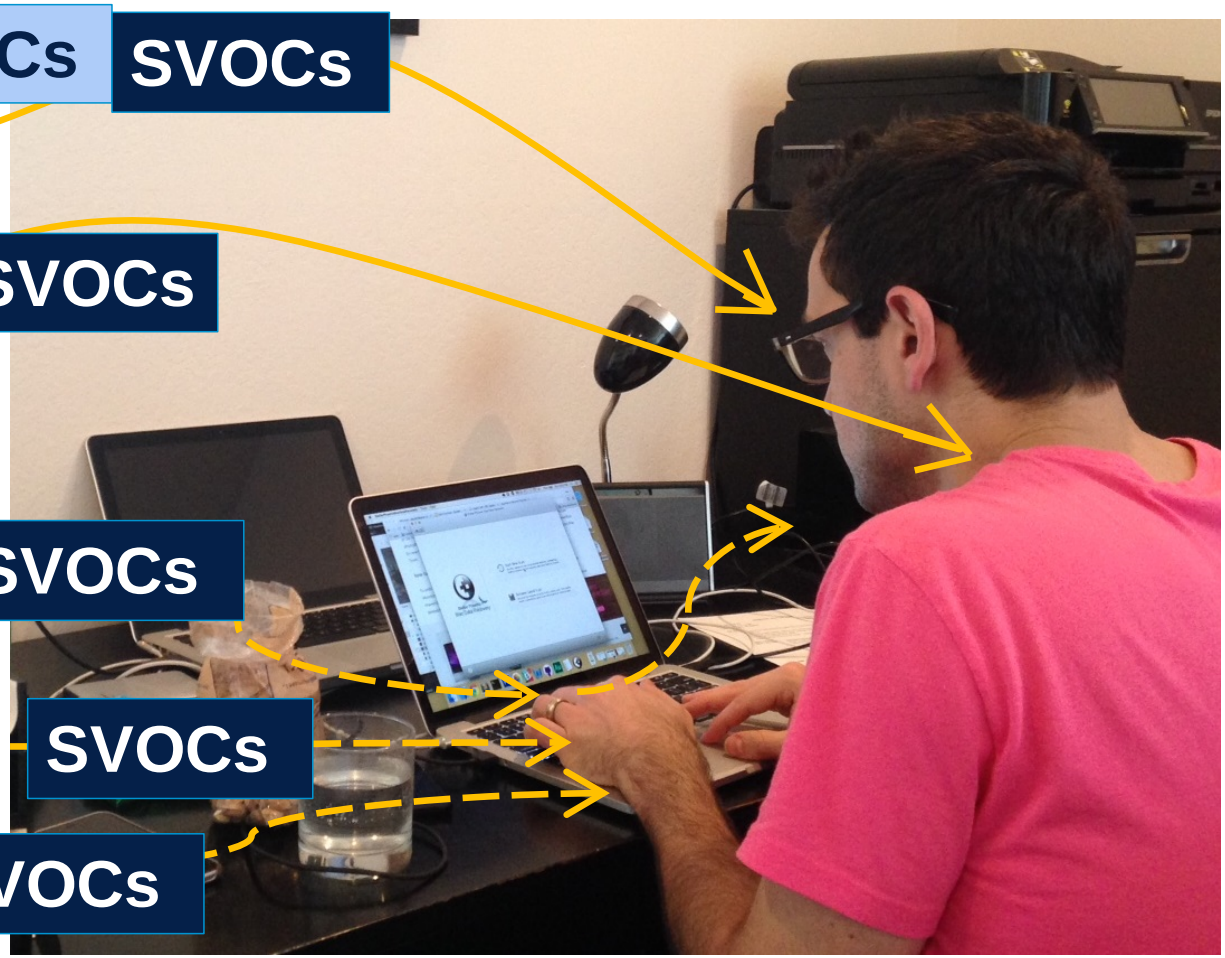
John F. Wambaugh,*[,†] R. Woodrow Setzer,[†] David M. Reif,[†] Sumit Gangwal,[†] Jade Mitchell-Blackwood,[‡] Jon A. Arnot,[§,∥] Olivier Joliet,[⊥] Alicia Frame,[†,#] James Rabinowitz,[†] Thomas B. Knudsen,[†] Richard S. Judson,[†] Peter Egeghy,[‡] Daniel Vallero,[‡] and Elaine A. Cohen Hubal[†]

~2,000 chemicals

Strongest predictor of detection in human biomonitoring:

Indoor/ consumer product use

Exposure in the indoor environment: Product → Emission → **Exposure**



AIR

Inhalation
Air-to-skin

DUST

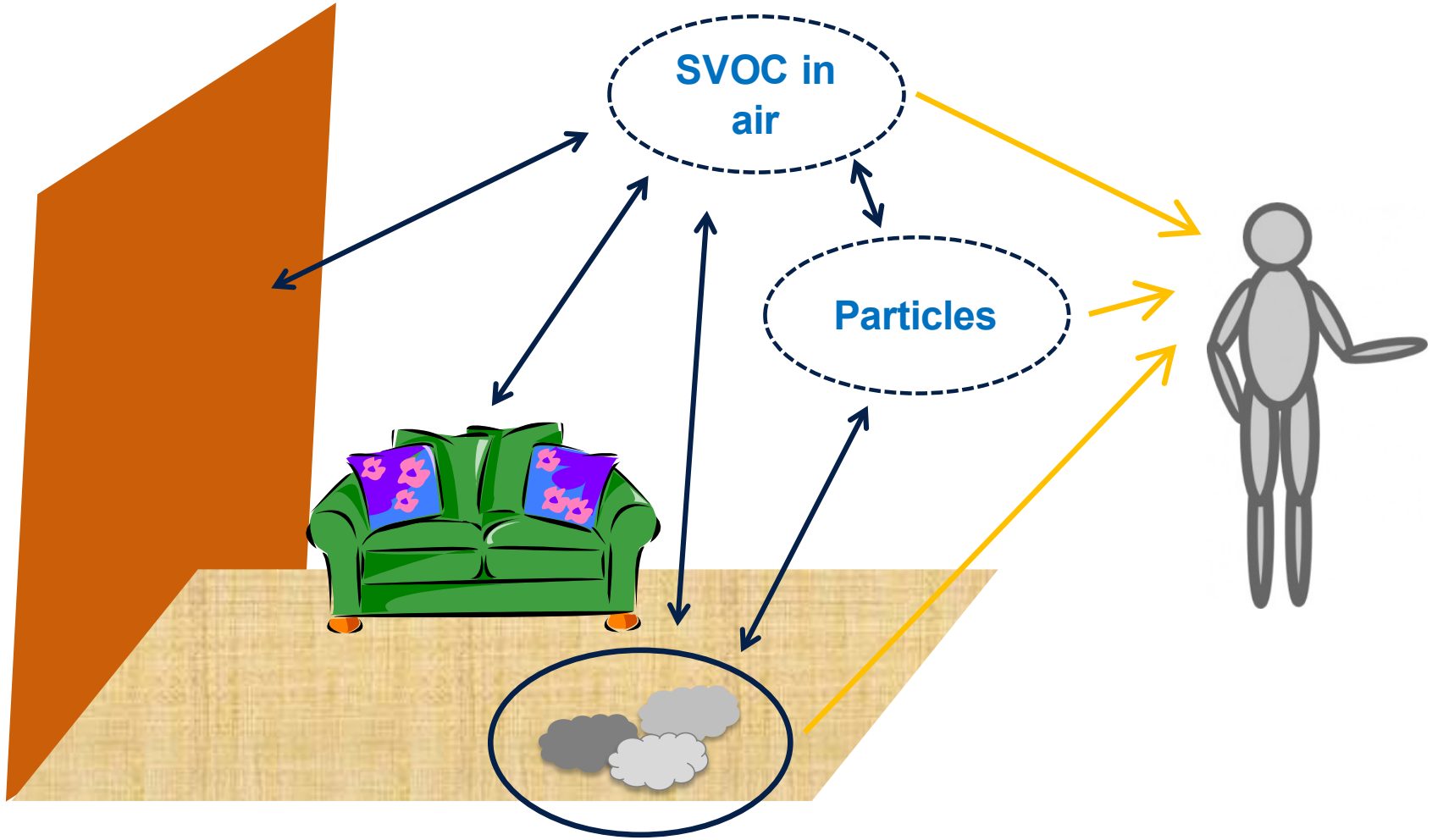
Inhalation
Ingestion (hand to mouth)
Dust-to-skin

Direct product contact

Weschler & Nazaroff, 2008; Weschler 2012; Rudel 2003

UCSF

Dust: Reservoir for SVOC chemicals in indoor environment



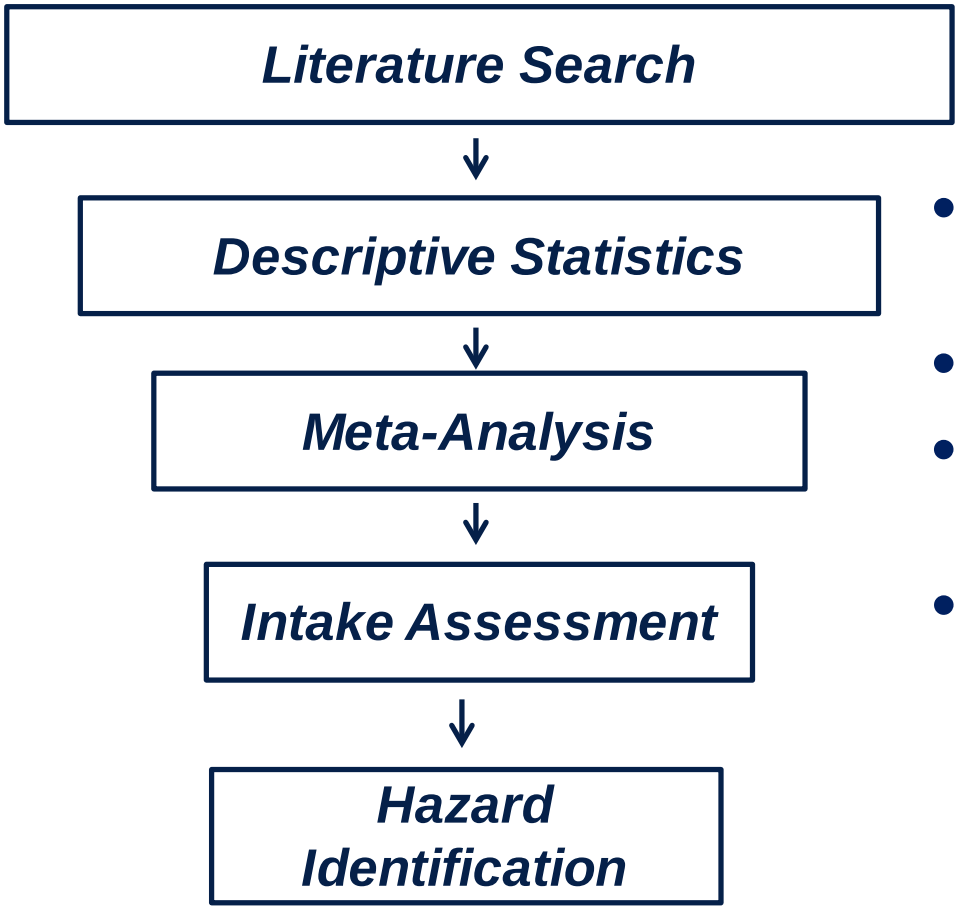
Modified from Weschler & Nazaroff, 2008

Consumer product chemicals in indoor dust: a quantitative meta-analysis of U.S. studies

Susanna D. Mitro, Robin. E. Dodson, Veena Singla, Gary Adamkiewicz, Angelo F. Elmi, Monica K. Tilly, Ami R. Zota

Environmental Science & Technology, 2016

Our approach



Criteria

- SVOC consumer product chemicals
- Current use
- Dust from U.S. indoor environment
- Vacuum cleaner collected

5 SVOC consumer product chemical classes

Phthalates and alternatives

Environmental phenols

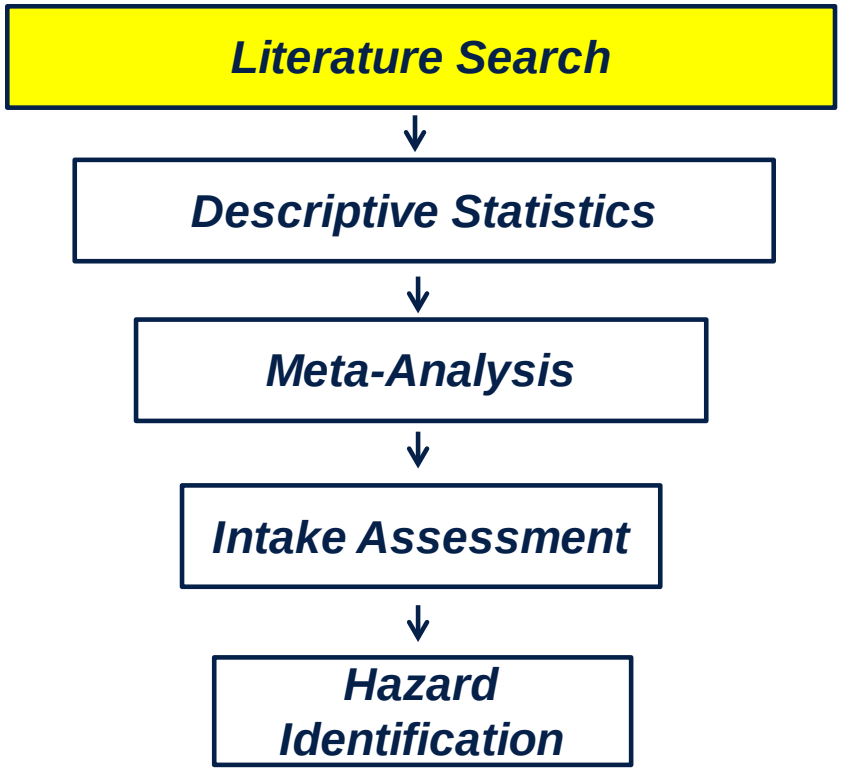
Fragrances

Replacement flame retardants (RFRs)

Fluorinated chemicals (PFASs)

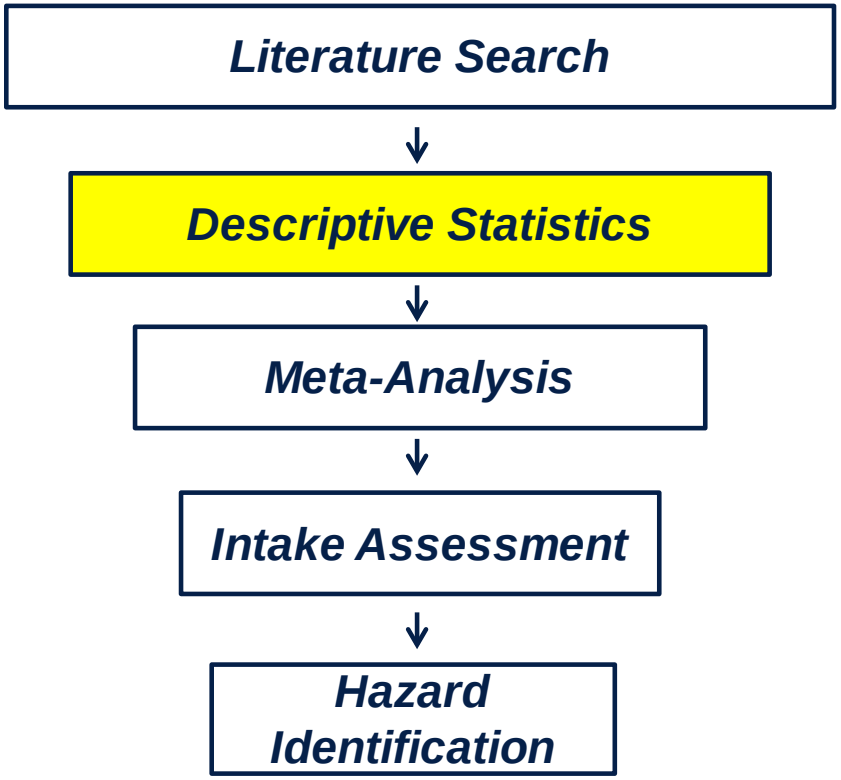
UCSF

Comprehensive literature search: 172 chemicals



- 31 studies
- Phenols, flame retardants = classes with most unique chemicals

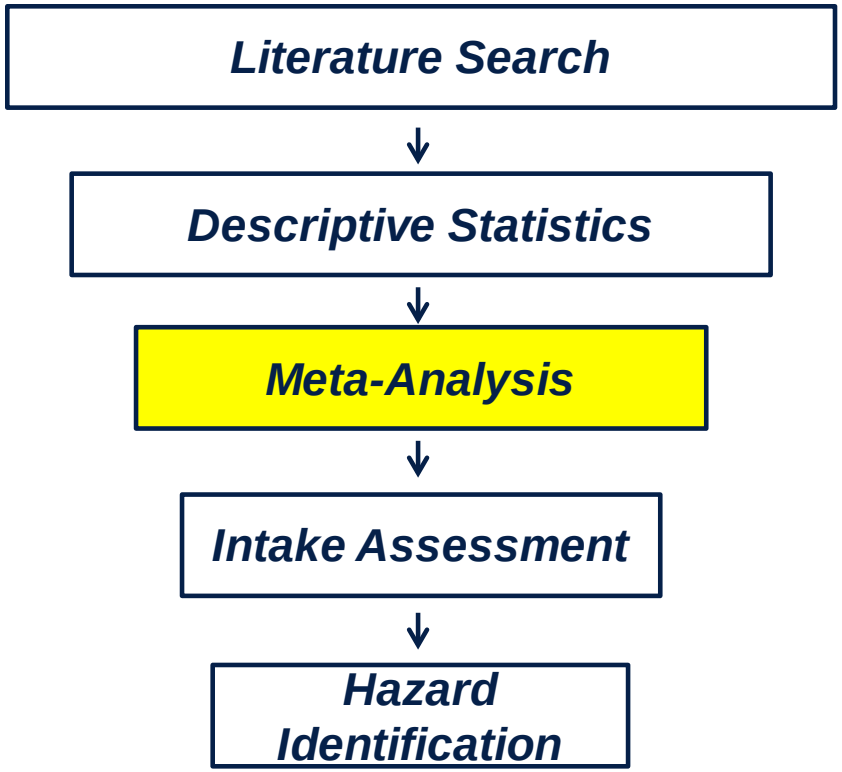
Descriptive info and statistics: **74 chemicals**



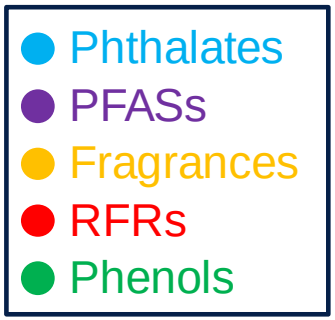
- Chemicals measured in ≥2 datasets
- 96% of fragrances measured in only 1 dataset

UCSF

Meta-analysis: **45 chemicals**

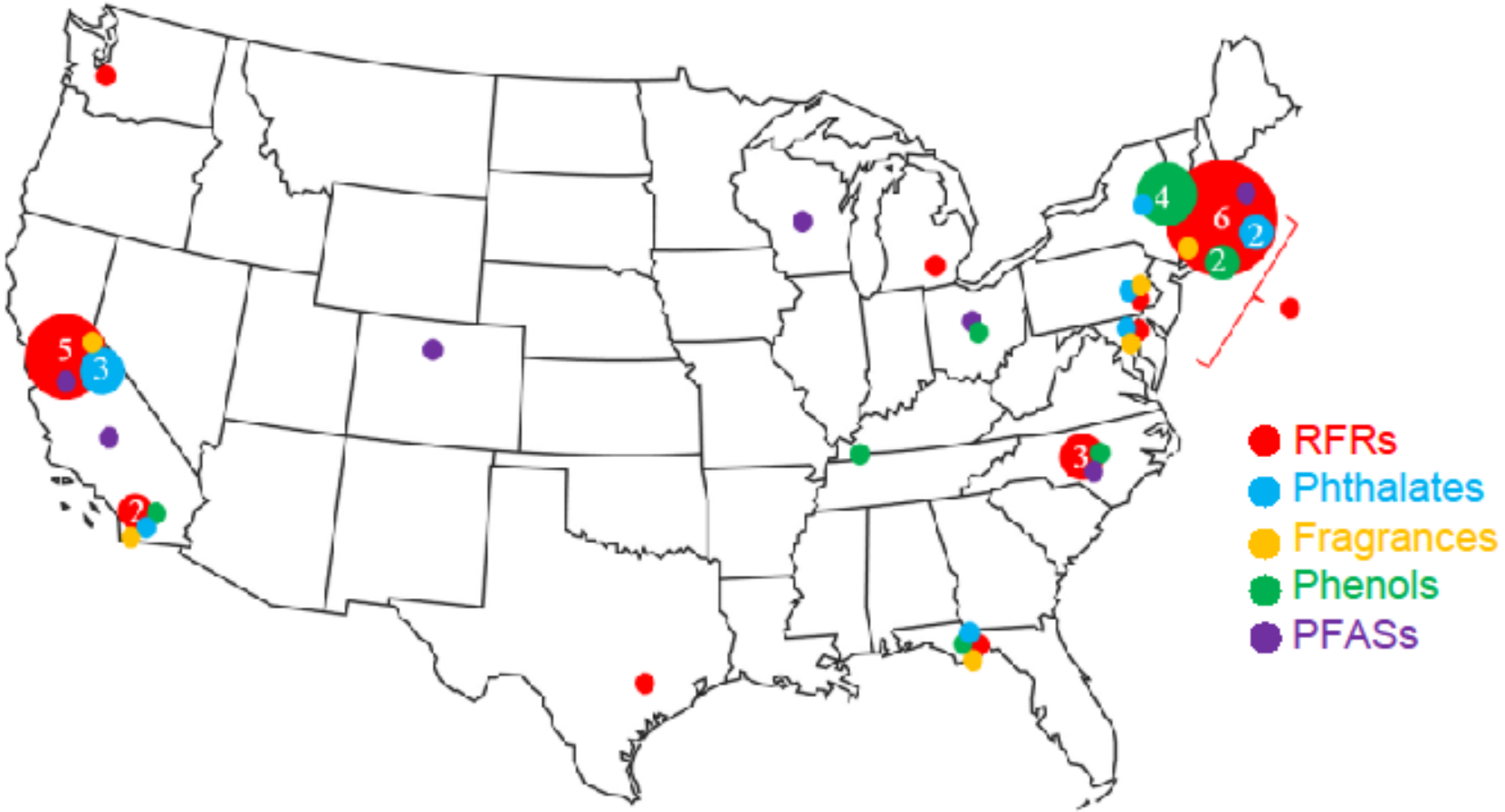


- Chemicals measured in ≥3 datasets
- Geometric Mean (GM) and Geometric Standard Deviation (GSD) available
- Calculated pooled GM and 95% Confidence Interval

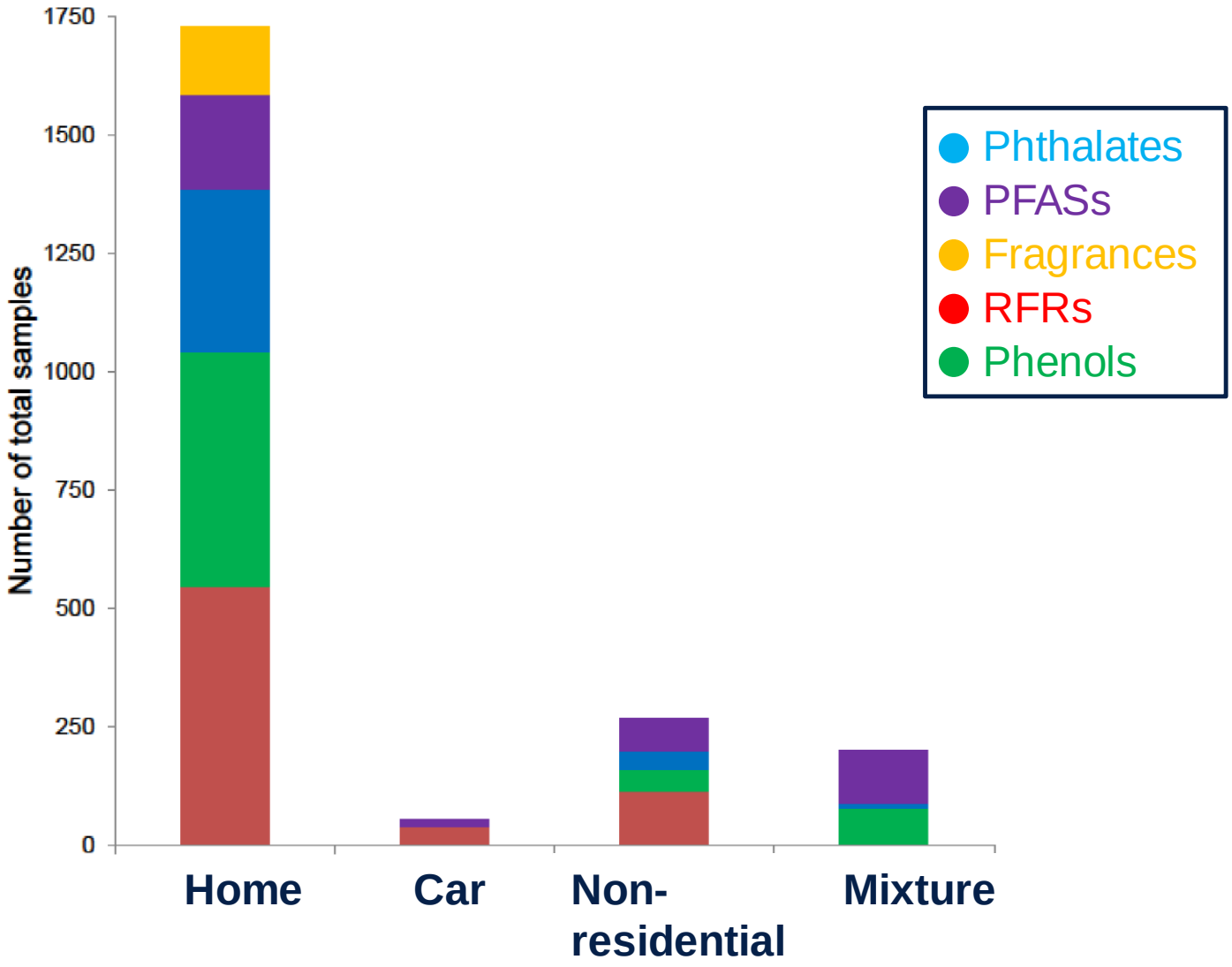


UCSF

Samples taken in 14 states



Samples mostly from home environments



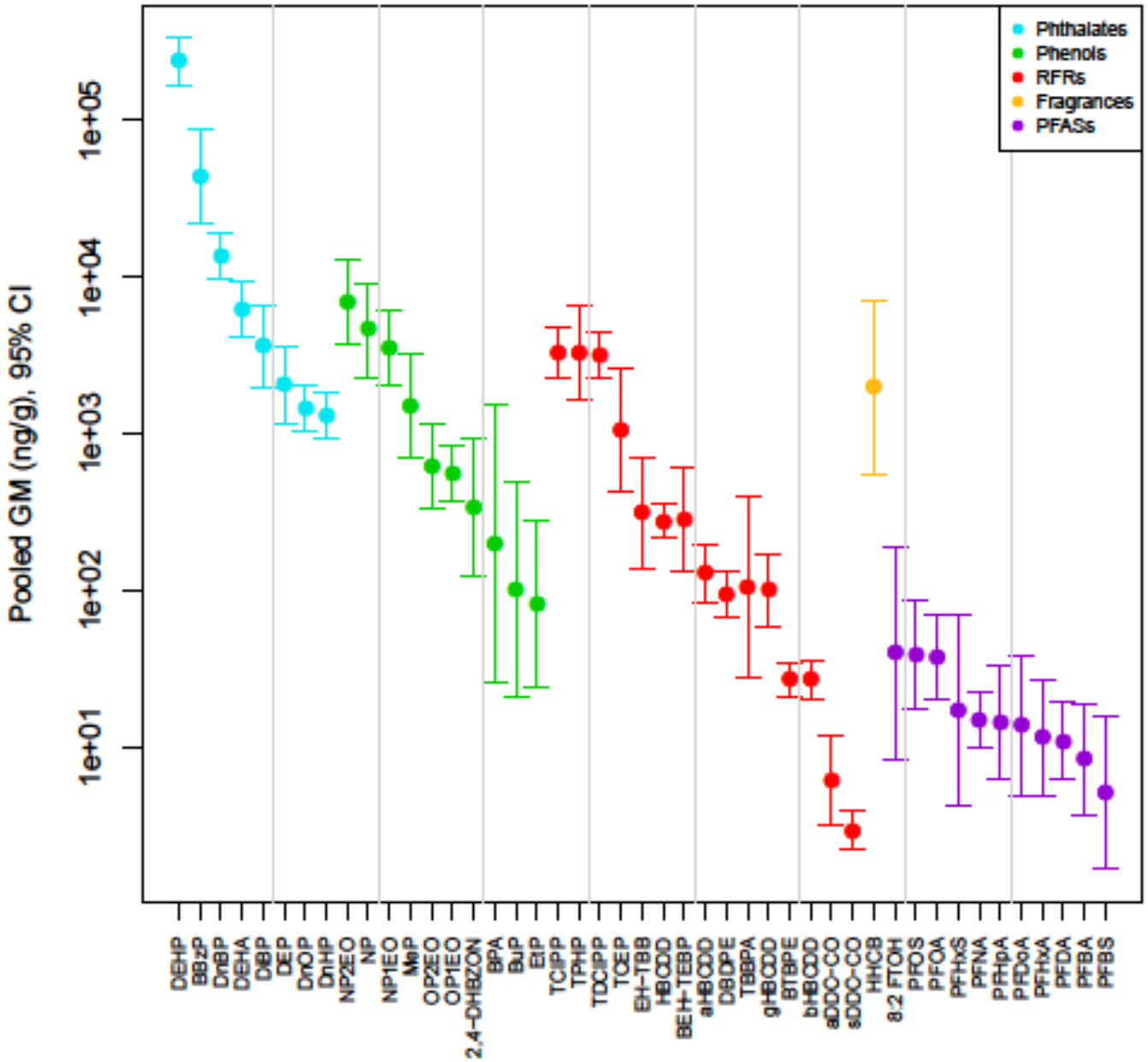
Ten chemicals consistently detected across data sets

Chemical	# datasets	Detected
DEHP	8	100%
DEHA	4	100%
HHCB	3	100%
BBzP	8	98-100%
TPHP	8	98-100%
TDCIPP	14	95-100%
DnBP	7	95-100%
DiBP	7	95-100%
HBCDD (and isomers)	10	92-100%
MeP	3	90-100%

- RFRs
- Phthalates
- Fragrances
- Phenols

UCSF

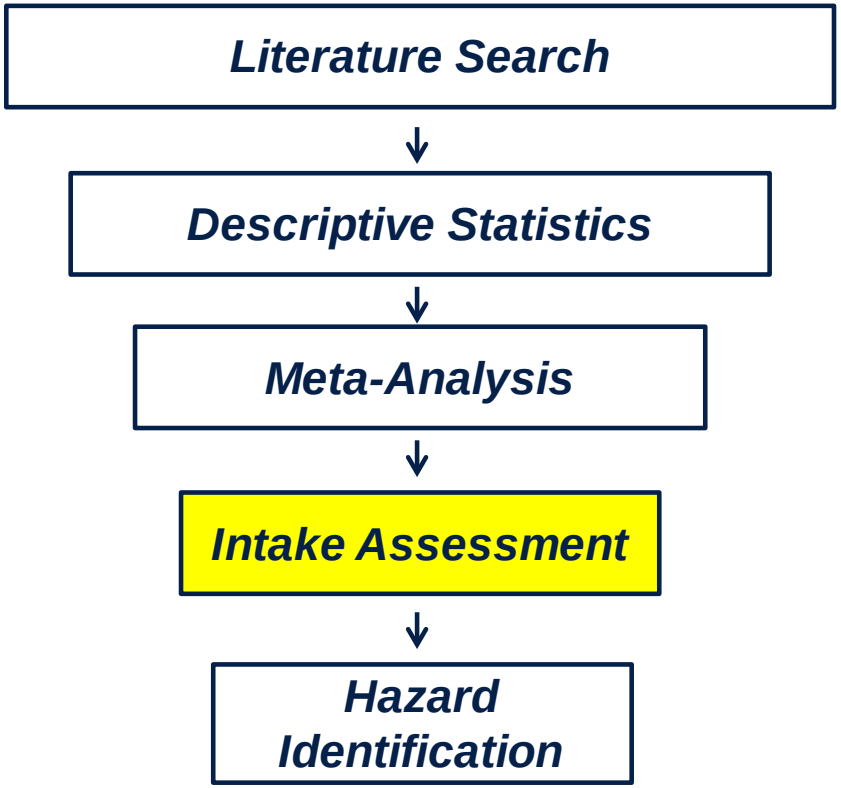
Average concentrations in dust



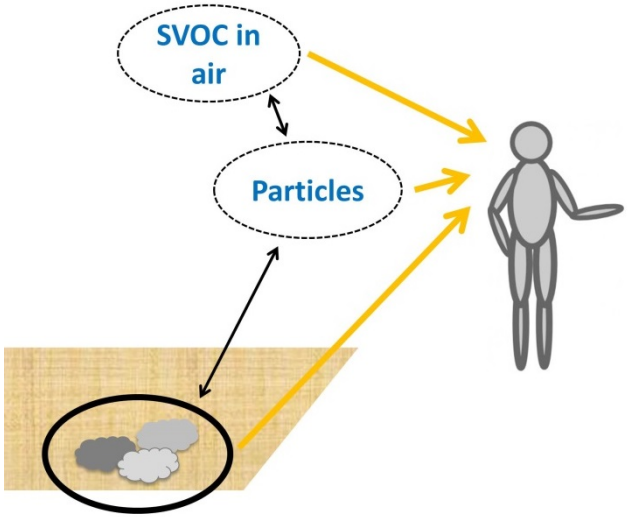
- Phthalates
- Phenols
- RFRs
- Fragrances
- PFASs

UCSF

Intake Assessment

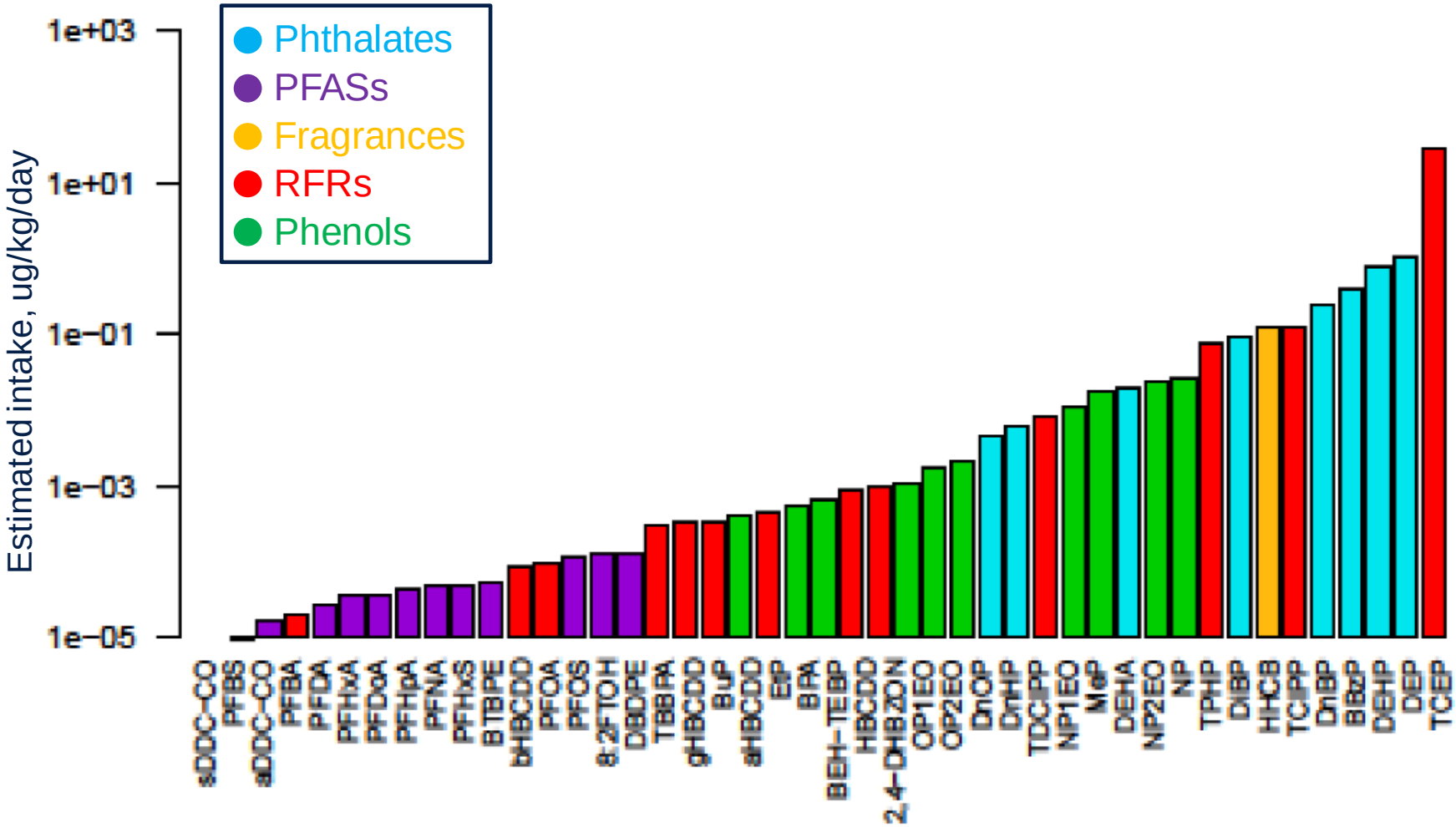


- Estimated total residential intake
- Adult female
- Child (3-6 years old)



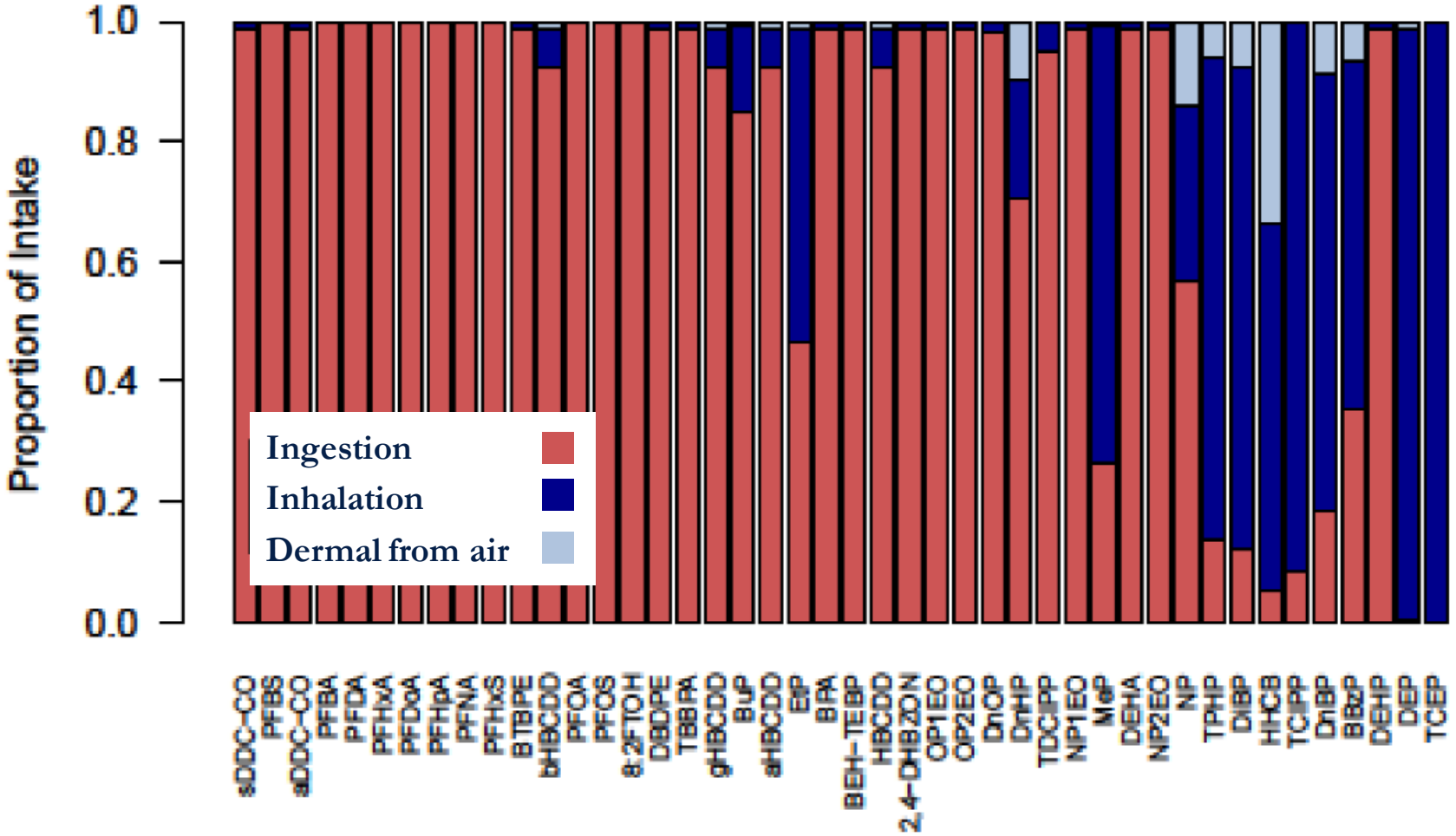
UCSF

Child: Highest estimated residential intake of **flame retardants and phthalates**



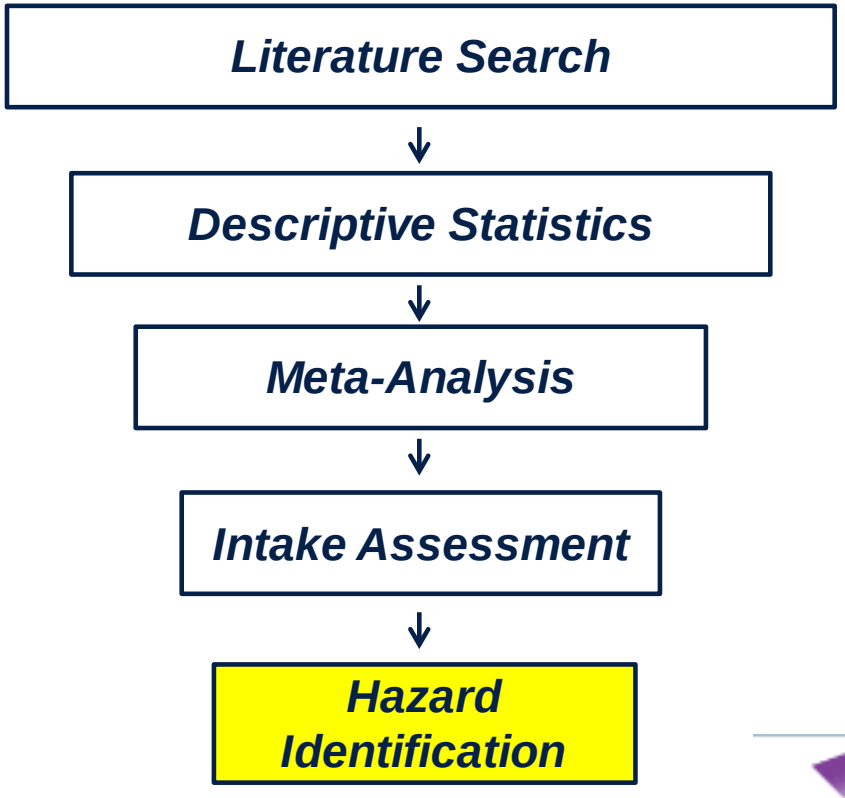
UCSF

Dust contribution to exposure varies by chemical



UCSF

Hazard Identification: 35 chemicals

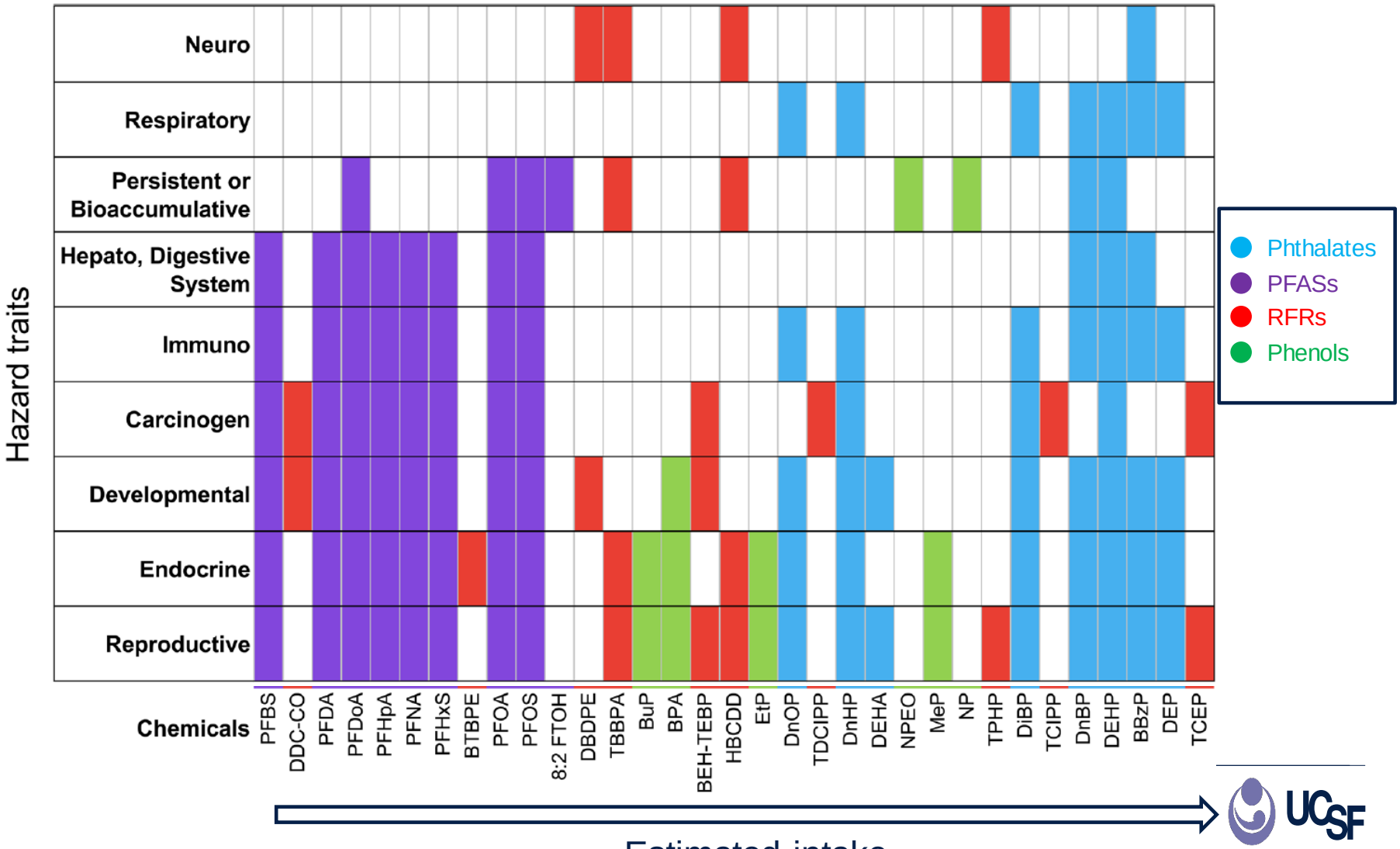


- California Safer Consumer Products Candidate Chemical list
- Hazard traits identified by authoritative bodies

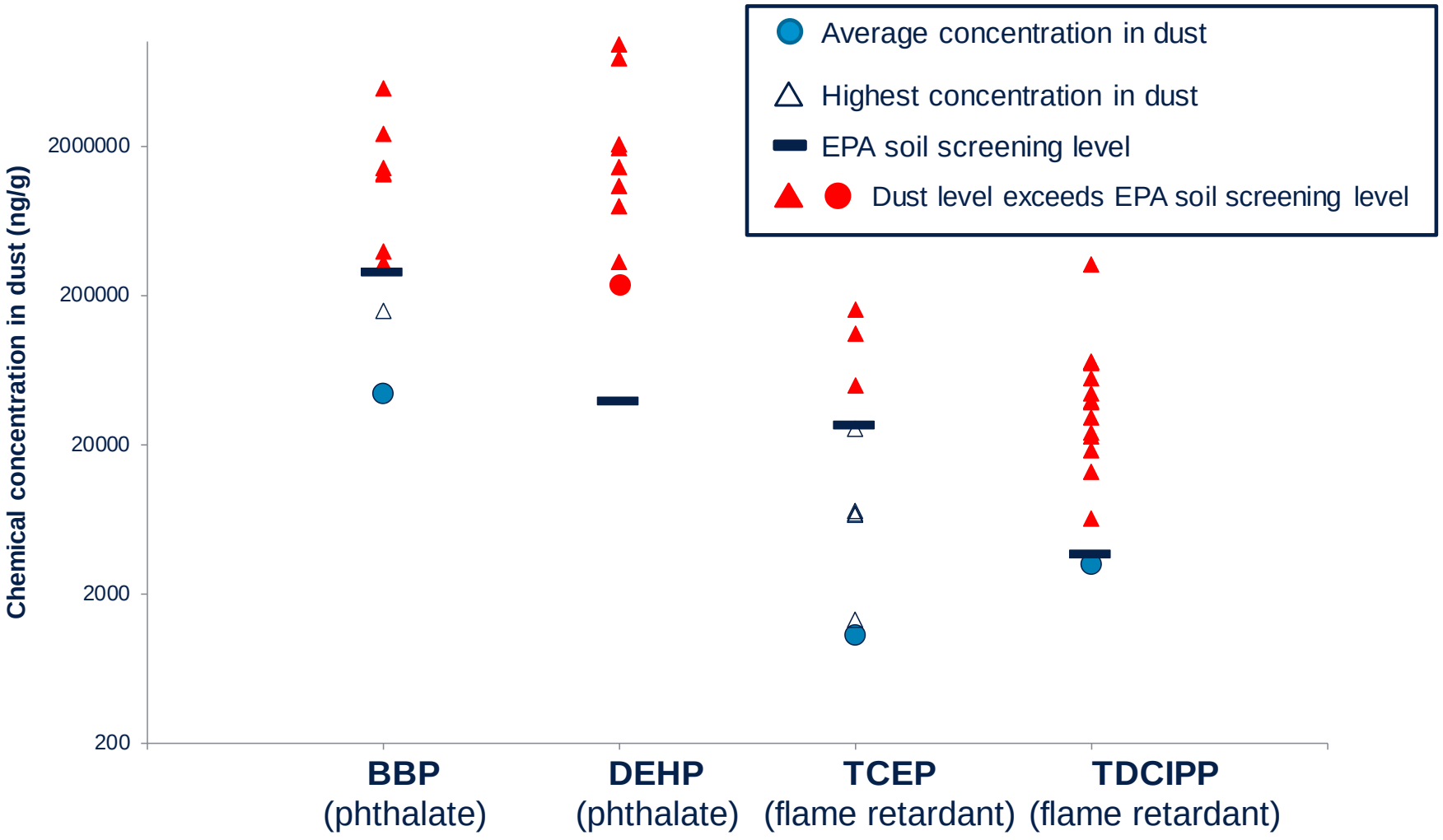
CalSAFER
SAFER CONSUMER PRODUCTS INFORMATION MANAGEMENT SYSTEM

UCSF

High intake chemicals have **multiple hazards**



Some dust levels **exceed EPA screening levels** for cancer health risks



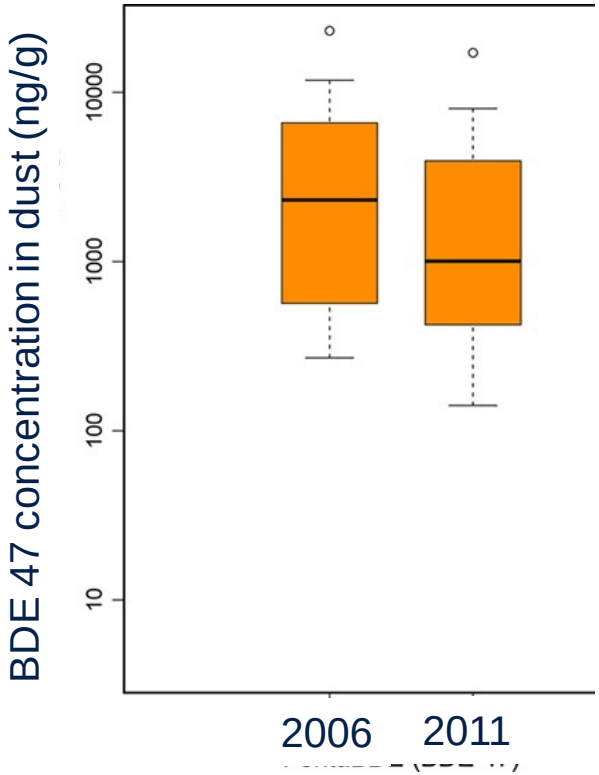
Summary

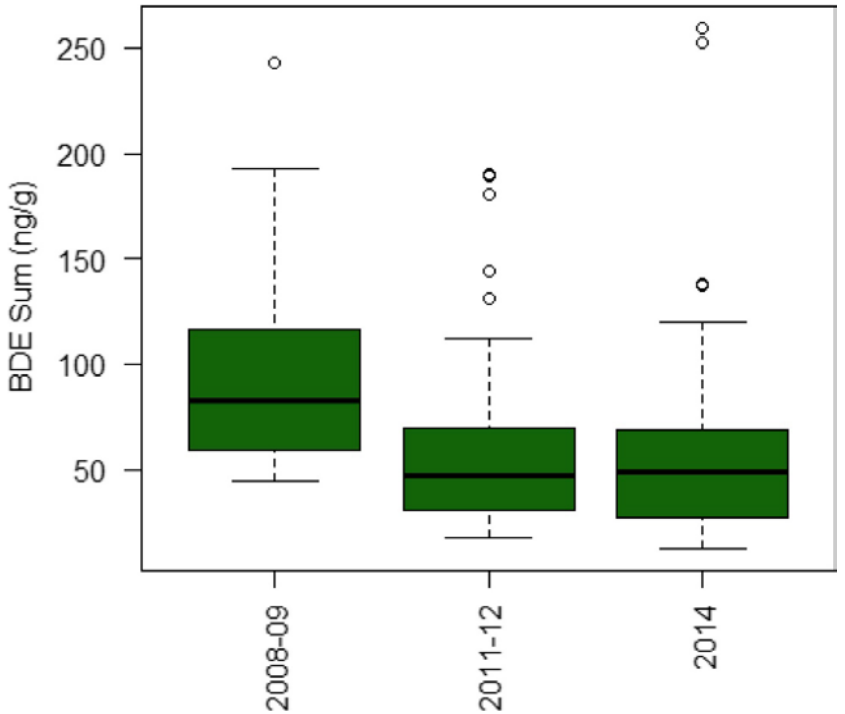
- **Phthalates** and **phenols**- highest levels in dust
- **Phthalates** and **RFRs** -highest estimated intakes
- **Phthalates** and **PFASs**- most hazard traits
- Daily co-exposure to multiple chemicals in indoor environment
- Concern for cumulative exposures and impacts
- Some chemicals' dust levels exceed EPA screening benchmarks

UCSF

Highlights for the program

Longitudinal dust samples track policy changes and exposure trends





PBDEs in repeat CA house dust samples

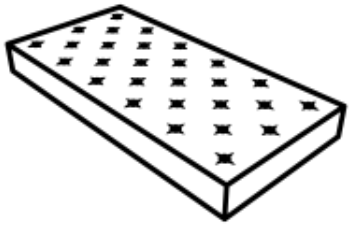
PBDEs in pregnant CA women

Dodson 2012; Parry 2018

UCSF

Highlights for the program

- Studies to explore contributions of indoor sources to exposures for priority chemicals
  - Intervention (ala FREES*) or other designs
- Potential for complementary dust sampling
- CA AB2998 restricts flame retardants in 2020 - track exposure trends

*Foam Replacement Environmental Exposure Study

UCSF



Program on
Reproductive Health
and the Environment

Thank you!

UCSF
University of California
San Francisco

@UCSF.PRHE

@UCSF_PRHE

https://prheucsf.blog/