Chemicals in the Indoor Environment

New Threats on the Horizon

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Disclosures

• I have nothing to disclose
Natural Resources Defense Council

MISSION STATEMENT
To safeguard the Earth: its people, its plants and animals and the natural systems on which all life depends.

- Climate change
- Clean energy
- Sustainable communities
- Oceans
- Water
- Health & Pollution
- Endangered wildlife and wild places
Work of NRDC’s Health & Environment Program

ACOG Opinion:
Exposure to Toxic Environmental Agents

“Exposure to environmental chemicals and metals in air, water, soil, food and consumer products is ubiquitous.”

“Prenatal exposure to environmental chemicals is linked to various adverse health consequences, and patient exposure at any point in time can lead to harmful reproductive health outcomes.”

“Prevention: ACOG and ASRM join numerous other health professional organizations in calling for timely action to identify and reduce exposures to toxic environmental agents.”
Environmental health issues I focus on

Outline

- Public health: Why is the indoor environment important?
- Flame retardant chemicals
- Consumer product chemicals in U.S. indoor dust
- Implications for human health
- What can you do?
People in developed countries spend ~90% of time indoors

Indoor environments are unique microenvironments

- Radon
- Mold
- Pest allergens
- Structural & indoor pesticides
- Lead
- Formaldehyde
- Benzene
- Flame retardants
- Phthalates

Klepeis 2001

Weschler & Nazaroff, 2008; Weschler 2009; Bradman 2012; Bolden 2015
Chemicals from products affect indoor environmental quality

- Furniture
- Electronics
- Wire & Cable
- Flooring
- Wall Coverings
- Paint
- Personal care products
- Beauty Products
- Adhesives
- Stain & water resistance

Weschler 2009; Rudel 2009; Bolden 2015

Exposure in the indoor environment:
Product → Emission → Exposure

Weschler & Nazaroff, 2008; Weschler 2012; Rudel 2003
Chemicals from products: exposure and health impacts

High-Throughput Models for Exposure-Based Chemical Prioritization in the ExpoCast Project
John P. Wambaugh,² E. Woodrow Setzer,² David M. Batt,² Samit Gangwal,² Jade Mitchell Blackwood,² Jon R. Arora,² Olivier Jegat,² Aliza Rome,² James Robbins,² Thomas P. Knuckey,³ Richard S. Juden,² Peter Eggleby,² Danial Vailas,¹ and Hana A. Cohen Hubal²

~2,000 chemicals
Strongest predictor of detection in human biomonitoring:

Indoor/ consumer product use

Wambaugh 2013; Gore 2015, Rudel 2009; Robinson 2015

What are flame retardant chemicals?

• Chemicals added to products to meet flammability standards
• Goal is to prevent, slow fires
• Used in products since the 1970’s
• Many associated with health, environmental impacts
• Effectiveness questionable
Flame retardants used to meet Technical Bulletin 117 (TB117) standard

1975 California standard for furniture, juvenile products

Test of filling inside products

Flame retardants added to pass the test

TB117 label on products

NOTICE
THIS ARTICLE MEETS ALL FLAMMABILITY REQUIREMENTS OF CALIFORNIA BUREAU OF HOME FURNISHINGS TECHNICAL BULLETIN 117.
CARE SHOULD BE EXERCISED NEAR OPEN FLAME OR WITH BURNING CIGARETTES.
PBDE flame retardants used in wide variety of products since 1970’s

**PolyBrominated Diphenyl Ethers**

- Foam inside furniture, baby products
- Electronics cases
- Textiles

PBDE flame retardant levels rising in people

![Graph showing concentration (ng/g lipid) vs. collection year (1985-2000)]

**2004**
- 97% of samples contained PBDEs

**PBDEs in blood, breast milk, fat tissue**

*Sjödin 2004; EPA PBDE Biomonitoring Report 2012*
Flame retardants continuously migrate out of products

1. Not chemically bonded to plastic materials
2. Chemicals off-gas. Attach to particles in air
3. Contaminated particles settle in house dust

Flame retardants enter people’s bodies in contaminated air and dust

Weschler & Nazaroff 2008

Frederiksen 2009
California has highest levels of flame retardants in dust

Children are vulnerable to chemical exposures from dust

Median PBDE concentration in serum (ng/g lipid)

Courtesy, Ami Zota Lunder 2010; Rose 2010; Stapleton 2008, Windham 2010
Disparities by race and socio-economic status (SES)

• Highest PBDE levels found in:
  – Dust in low SES homes
  – Non-white children
  – Low SES children

• May be associated with:
  – Older furniture/electronics
  – Building characteristics
  – More time spent indoors

Quiros-Alcala 2011; Windham 2010; Zota 2010; Bradman 2012

Adverse health effects of PBDEs: animal studies

• Endocrine disruption: thyroid hormones
• Affect brain development
• Affect reproductive development and fertility
• Affect immune function
• Cancer
Epidemiological studies: human health associations

Higher PBDE levels associated with lower birth weight
impaired attention poorer coordination lowered IQ
longer time to get pregnant altered thyroid hormones
hormone changes decreased sperm quality, testis size


PBDEs are the “new lead”

Herbstman 2001
Eskenazi 2000
Lamphair 1989-2003
Yule 1979

Change in IQ Score

PBDEs
Lead

Courtesy, Ami Zota
Good news: PBDE bans/phase out → declining levels in dust and people

PBDEs in repeat CA house dust samples

Bad news: many “regrettable substitution” replacement flame retardants

Also found:
- TDCIPP
- TCEP
- TCIPP
- TPHP
- HBCD
- DBDE
- BTBDE

PBDEs in pregnant women
San Francisco

Dodson 2012; Zota 2013
Dust: a window into SVOC chemicals from products and potential human exposures

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 Kaitz, Ami R. Zota

Submitted, 2016
Our approach

Systematic literature search and meta-analysis

Systematic literature search: **172 chemicals**

- Found 1,561 published papers and abstracts
- After exclusions, 34 papers + 2 unpublished datasets included
Descriptive statistics: **74 chemicals**

- Chemicals measured in ≥2 datasets
- Methods and descriptive statistics

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
Samples taken in 14 states

Samples mostly from home environments
Ten chemicals consistently detected across all studies

<table>
<thead>
<tr>
<th>Chemical</th>
<th># datasets</th>
<th>Detected</th>
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<tbody>
<tr>
<td>DEHP</td>
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<td>100%</td>
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<tr>
<td>DEHA</td>
<td>4</td>
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</tr>
<tr>
<td>HHCB</td>
<td>3</td>
<td>100%</td>
</tr>
<tr>
<td>BBzP</td>
<td>8</td>
<td>98-100%</td>
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<tr>
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<tr>
<td>DnBP</td>
<td>7</td>
<td>95-100%</td>
</tr>
<tr>
<td>DiBP</td>
<td>7</td>
<td>95-100%</td>
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<tr>
<td>HBCD (and isomers)</td>
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<td>92-100%</td>
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<tr>
<td>MeP</td>
<td>3</td>
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</tr>
</tbody>
</table>

Pooled concentrations in dust

- Phthalates
- Phenols
- RFRs
- Fragrance
- PFASs
Intake Assessment: **44 chemicals**

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

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**Child: Highest estimated residential intake of flame retardants and phthalates**
Hazard Identification: **35 chemicals**

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

High intake chemicals have **multiple hazards**
Multiple chemicals associated with reproductive, endocrine, developmental toxicity

Some dust levels exceed EPA screening guidelines
Summary and future directions

• Wide array of chemicals from consumer products and building materials in indoor environments
• People likely co-exposed to similar chemicals in indoor environments
• Phthalates and phenols - highest levels in dust
• Phthalates and RFRs - highest estimated intakes
• Phthalates and PFASs - most hazard traits
• Policy actions focused on phthalates

California SB 1019 requires labeling for added flame retardants in 2015!

Senator Mark Leno

The upholstery materials in this product:

☐ contain added flame retardant chemicals
☒ contain NO added flame retardant chemicals

The State of California has updated the flammability standard and determined the fire safety requirements for this product can be met without adding flame retardant chemicals. The State has identified many flame retardant chemicals as being known to, or strongly suspected of, adversely impacting human health or development.
RecommendaHons for clinicians

"Reproductive care providers can be effective in preventing prenatal exposures to environmental threats to health because they are uniquely poised to intervene before and during pregnancy, which is a critical window of human development."

“ACOG and ASRM call on their members to advocate for policies to identify and reduce exposure to environmental toxic agents while addressing the consequences of such exposure.”

General recommendations to reduce indoor exposures

Reduce contaminated dust and dust contact
Resources

NEW LABELS EXPOSE TOXIC COUCH CHEMICALS

For nearly 10 years, an antiquated California regulation caused sales, reactions, and claims related to the many chemicals in use of foam couches and other products. After a coalition of health professionals petitioned the California Air Resources Board (CARB) in 2008 to provide clearer labeling, the state updated its labeling laws in 2012. This move was supported by a coalition of health professionals who have written letters to the Environmental Protection Agency (EPA) in support of pesticide restrictions.

AAP and NHMA petition Consumer Product Safety Commission for flame retardant restrictions

Health professionals advocate for policy to protect health

January 5th, 2016

Comments to EPA from Environmental Health Scientists and Healthcare Professionals in support of EPA’s Proposal to Revoke Chlorpyrifos Food Residue Tolerances

Docket ID EPA-HQ-OPP-2015-0653

Over 60 doctors, nurses and scientists write to EPA in support of pesticide restrictions

American Academy of Pediatrics

NHMA

National Hispanic Medical Association
1. Which of the following factors have a significant effect on flame retardant exposures?

A. Age
B. Geographic location
C. Socio-economic status
D. All of the above

2. Consumer products commonly contain the following kinds of semi-volatile organic chemicals:

A. Formaldehyde, lead, and benzene
B. Phthalates, flame retardants and fluorinated chemicals
C. Radon, pesticides and lead
D. None of the above
3. In which of the following would you expect to find the most similar chemical profile?

A. A home in New York city and a park in New York city
B. A park in New York city and Yosemite National Park
C. A home in New York city and a home in San Francisco
D. These would all have vastly different chemical profiles

THANK YOU