Chemicals in Consumer Products: Exposure Science at the Forefront of Regulation

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The Center for Integrative Research on Childhood Leukemia and the Environment
Center Overview

• **Research objective:** Discover the environmental risk factors for childhood leukemia.

• **Approach:** Innovative exposome research, studying mechanisms of immune development, epigenetics.

• **Center mission:** Intervene to prevent future cases of childhood leukemia.
Theme: “Links in a Chain”

CIRCLE helps to link the chain between consumer products and health impacts.
Case Study: PBDEs in Furniture

• **Source:** Polyurethane foam in upholstered furniture, electronic housings of TVs and computers.

• **Purpose:** Ostensibly to slow the spread of fires.

• **Concern:** Structurally similar to PCBs, persistent, bioaccumulative, potential for mobilization.
Link #1: Product-to-home

- PBDEs in Household Furniture
- PBDEs in Settled House Dust
- Human Exposure to PBDEs
- PBDEs as Risk Factors for Leukemia

Manufacturers

Forensics

Sampling

Epidemiology

Regulators

Overview

Future
PBDEs in Settled Dust

- **Rationale:** Dust is a reservoir for persistent chemicals in the home.

- **Sampling:** Settled dust collected via routine vacuum cleaning in 500+ homes.

- **Analysis:** Identify contamination sources via forensic microscopy, participant interviews.

Crumbling or Exposed Foam

- **Consumer product**: Participants asked about furniture condition.

- **Home environment**: Settled dust collected with vacuum cleaners, analyzed for PBDEs.

- **Link**: Upholstered furniture with crumbling or exposed foam resulted in higher levels of PBDEs 28, 47, 99, 153 in settled dust.

Forensic Microscopy

• **Morphology:**
  Angular, suggests abrasion or weathering.

• **Elemental composition:**
  Contains bromine, suggests presence of flame retardant.

• **Chemical composition:**
  Contains polyethylene and BDE-209, suggests treated consumer product.

Link #2: Home-to-human

PBDEs in Household Furniture

PBDEs in Settled House Dust

Human Exposure to PBDEs

PBDEs as Risk Factors for Leukemia

Manufacturers

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Overview Forensics Sampling Epi Future
PBDE Biomonitoring

- **Home environment:** PBDEs are present at high concentrations in dust from CA homes.

- **Human exposure:** Young children move near the floor and put their hands in their mouths.

- **Link:** Children have higher body burdens of PBDEs than mothers due to accidental dust ingestion.

PBDE Biomonitoring – Patients

• **Human exposure:** PBDEs in a small volume of diagnostic blood, 100 µL.

• **Home environment:** Settled dust analyzed for PBDEs, collected separately from blood.

• **Link:** Dust and blood levels of BDE-153 were correlated.


$r_s = 0.52$

$p = 0.02$

$N = 20$
PBDE Biomonitoring – Mothers

- **Human exposure:** PBDEs in 1mL of serum from mother.

- **Home environment:** Settled dust analyzed for PBDEs, collected separately from blood.

- **Link:** Dust and blood levels of BDE-47 were correlated.

Link #3: Human-to-health

- PBDEs in Household Furniture
- PBDEs in Settled House Dust
- Human Exposure to PBDEs
- PBDEs as Risk Factors for Leukemia

Manufacturers → Forensics → Sampling → Epidemiology → Regulators

Overview Forensics Sampling Epi Future
### Established Environmental Risks

<table>
<thead>
<tr>
<th>Overview</th>
<th>Forensics</th>
<th>Sampling</th>
<th>Epi</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
<td><img src="image5.png" alt="Image" /></td>
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</tbody>
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California Childhood Leukemia Study

• **Method:** Measured PBDEs in settled dust from case and control homes.

• **Results:** Comparing homes in the highest tertile to no detections, we found increased leukemia risk for PBDEs 196, 203, 206, 207.

• **Conclusion:** PBDEs may be an environmental risk factor for childhood leukemia.
Follow-up

• **Evaluating mechanisms:**
  Epigenetic changes, abnormal immune development.

• **Controlled experiments:**
  Mouse model of T(12:21) leukemia exposed prenatally to PBDEs.

• **Identifying window of susceptibility:**
  *In utero,* after birth, before conception.
**Method:** Measured OPFRs in settled dust from fire station dust.

**Results:** Found elevated levels of tris(1,3-dichloro-2-propyl)phosphate (TDCPP) or “chlorinated tris”.

**Conclusion:** Firefighters are exposed to flame retardants away from fire events.

Source: Shen *et al.* “Organophosphate flame retardants in dust collected from United States fire stations” (submitted to *Env Int*).
Collaborators

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Questions
Welcome.
Visit: http://circle.berkeley.edu/

- **Tips:** To avoid exposures to chemicals at home.
- **News:** From CIRCLE researchers.
- **Resources:** To find more information about leukemia.