Halogenated Fire Retardants (HFRs) in Healthcare

Sarah Janssen, M.D., Ph.D., M.P.H.
Senior Scientist, Natural Resources Defense Council
Assistant Clinical Professor, UCSF
sjanssen@nrdc.org
What are Halogenated Flame Retardants (HFRs)?

- Organic chemicals containing a halogen element, most commonly bromine or chlorine.
- Added to products to inhibit ignition or spread of flames.
- Brominated flame retardants most commonly used but some are being replaced by chlorinated chemicals.
- Dozens of halogenated flame retardants currently in use – products containing them are not labeled.
Brominated Flame retardants

- Polybrominated biphenyls (PBBs)
- Polybrominated diphenyl ethers (PBDEs)
- Tetrabromobisphenol A (TBBPA)
- Hexabromocyclododecane (HBCD)
- 1,2-bis(2,4,6-tribromophenoxy) ethane (TBE)
- bis(2,4,6-,tribromophenoxy) ethane (BTBPE), 2,4,6-tribromophenol (TBP)
- decabromodiphenyl ethane (DBDPE),
- brominated components in Firemaster 550 (FM 550):
  - 2-ethylhexyl 2,3,4,5-tetrabromobenzoate (TBB)
  - Bis (2-ethylhexyl) tetrabromophthalate (TBPH)
- Brominated Tris (Tris (2,3-dibromopropyl) phosphate)
- 1,2-Dibromo-4-(1,2-dibromoethyl)cyclohexane (TBECH)
Chlorinated Flame Retardants

- Tris (1,3-dichloro-2-propyl) phosphate (TDCP)
- Tris(2-chloroisopropyl phosphate) (TCPP)
- Tris(2-chloroethyl) phosphate (TCEP)
- Chloroparaffins
- Bis(hexachlorocyclopentadienyl)cyclooctane (Dechlorane Plus)

- Hexachlorocyclopentadienyl-Dibromocyclooctane (HCDBCO)
Where are HFRs used?

Polyurethane foam – furniture, mattress pads, carpets
Electronics casings and circuit boards
Building materials
Wiring
Health Care and HFRs

Foams: egg crate pads, chair cushions, insulation board, carpets.
Textiles: curtains, chair covers
Electronic Equipment: TVs, computers, faxes, patient monitors, IV pumps, ventilators, dialysis machines, etc.
HFRs in indoor dust

- BFRs have been found in indoor dust samples
- Sources may include treated carpets, furniture, computers or other electronics.
- Levels in dust are associated with breast milk levels

(Source: Butt, 2004; Rudel, 2003, Stapleton, 2005)
HFRs in people

• PBDEs have been measured in serum, breast milk, placenta and cord blood.

• HBCD has been found in blood, breast milk.

• TBBPA has been found in serum, cord blood, and breast milk.

• (Frederikson, 2009; Kakimoto, 2008; Eljarrat, 2009; Thomsen, 2008; Cariou, 2008)
California residents most highly exposed

PBDE fire retardant concentration in household dust

Source: Zota et al., Environ. Sci. Technol., 2008,
Toddlers have about three times the flame retardant level of their parents

Potential Routes of Exposure

• Inhalation or ingestion of contaminated dust particles.

• Ingestion of contaminated food, especially fish.

• For fetuses and infants, absorption across the placenta or ingestion of contaminated breast milk.

• Occupational exposure
Structural similarities

PBDEs

TBBPA

PBB/PCBs

Thyroid hormone
Endocrine Disruption: Interference with Thyroid Hormone Action

• Interference with thyroid hormone function in fetuses and young children up to age 2-3 can affect brain development.

• Historically, exposures to PCBs, has been associated with alterations in thyroid hormone function and lower IQ, lower reading comprehension, and behavioral abnormalities in children.

• Exposures to some BFRs has been shown to cause alterations in thyroid hormone function.
Endocrine disruption – thyroid hormone

Neurodevelopment impacts: Decreased memory, learning deficits, altered motor behavior, hyperactivity

Reproductive system effects: Abnormal gonadal development, reduced ovarian follicles, reduced sperm count

Cancer

Immune suppression
PentaBDE Human Health Associations

- **Neurological Effects**
  - Herbstman et al, 2010
  - Decreased IQ

- **Cryptorchidism**
  - Main et al, 2007

- **Reproductive Hormone Effects**
  - Meeker et al., 2009 — Decrease in Androgens and LH; Increase in FSH and Inhibin
  - Meijer et al, 2008 — Decrease in Testosterone

- **Reproductive Effects**
  - Eskenazi et al., 2009, 2011 — Low Birth Weight; Altered Behaviors
  - Harley et al, 2010 — Increased time to pregnancy

- **Decreased Sperm Quality**
  - Akutse et al, 2008

- **Diabetes?**
  - Lim et al, 2008
  - Turyk et al, 2009 (only in hypothyroid subjects)

- **Thyroid Homeostasis**
  - Turyk et al, 2007 — elevated T4
  - Meeker et al, 2009 — elevated T4, TBG
  - Dallaire et al, 2009 — Elevated T3 ~BDE47
  - Eskenzai et al, 2009 — Low TSH
  - Chevrier et al 2010 — Changes during pregnancy

Courtesy, Linda S. Birnbaum, Director, NIEHS and NTP
How has this happened?

Technical Bulletin 117 (TB117):
Twelve second small open flame and smolder standard for filling materials used in upholstered furniture.
Playing with fire

A deceptive campaign by industry brought toxic flame retardants into our homes and into our bodies. And the chemicals don't even work as promised.

By Patricia Callahan and Sam Roe
Tribune reporters

D r. David Heimbuch knows how to tell a story.

Before California lawmakers last year, he related the harrowing tale ofhow a 9-month-old baby girl was burned in a fire that started by a candle; the baby lay on a pillow that lacked flame retardant chemicals.

"Now this is a tiny little person, no bigger than my Italian greyhound at home," said Heimbuch, gesturing to approximate the baby's size. "Half of her body was severely burned, she ultimately died over about three weeks of pain and misery in the hospital."

Heimbuch's passionate testimony about the baby's death made the long-term health concerns about flame retardants voiced by doctors, environmentalists, and even firefighters sound abstract and petty.

But there was a problem with his testimony. It wasn't true.

Records show there was no dangerous pillow or candle fire. The baby he described didn't exist.

Neither did the 9-month-old patient who Heimbuch told lawmakers had died in a candle fire in 2009. Nor did the 9-month-old patient who he told Alameda lawmakers was found burned in her crib in 2016.

Heimbuch is not just a prominent burn doctor. He is a star witness for the manufacturers of flame retardants.

His testimony, the Tribune found, is part of a decades-long campaign of deception that has lured the furniture and electronics industry into American homes with pounds of toxic chemicals linked to cancer, neurological deficits, developmental problems and impaired fertility.

The tactic started with Iglo, the world's leading maker of flame retardants. They marketed their products as "fireproof" to householders, who use the chemicals on their products. According to a Tribune analysis of thousands of government, scientific, and internal industry documents, these powerful industries distorted science in ways that overstated the benefits of the chemicals, acreated a phony consumer watchdog group that stoked the public's fear of fire and helped organize and steer an association of top fire officials that spent more than a decade campaigning for their cause.

Today, scientists know that tens of millions of products made in the U.S. and around the world still contain flame retardants. They still use chemicals that are found in the top 1% of the EPA's list of chemicals that are the most dangerous to human health, and the chemicals that are the most dangerous to human health.

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June 18, 2012

Jerry Brown urges reduction of toxic flame retardants in furniture
Gov. Jerry Brown urged state regulators today to reduce the use of toxic flame retardants in upholstered furniture.

"Toxic flame retardants are found in everything from high chairs to couches and a growing body of evidence suggests that these chemicals harm human health and the environment," the Democratic governor said in a prepared statement. "We must find better ways to meet fire safety standards by reducing and eliminating -- wherever possible -- dangerous chemicals."

Alternatives to HFRs

- Product design plays an important role in fire safety
  - reduce amount of combustible material (plastics)
  - substitute highly flammable components with relatively flame resistant materials (e.g. inherently flame resistant polyester, natural fibers like wool or silk)
    - e.g. Avora and Trevira upholstery for health care use
  - physically separate heat generating components from highly flammable components.
  - lower operating temperature of heat-generating components
Alternatives to HFRs

- Inherently flame-resistant materials are available:
  - Plastics containing sulfur
  - Preceramic polymers
  - Aramide blends (like Kevlar)
  - Melamine
  - Carbonized fibers
  - Natural fibers (wool, silk, hemp, jute)
Alternatives to HFRs

- Materials which are inherently flame-resistant can be substituted for more flammable components.

- Electronics:
  - Toshiba uses an inherently flame-resistant plastic, polyphenylene sulphide, for circuits.
  - Apple uses a chlorine and bromine-free polycarbonate for one version of its computer monitors.
  - NEC has manufactured a bioplastic resin, polylactide for use in electronic products.
Manufacturers who Have Agreed to Phase-out Use of BFRs

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Actions for Healthcare Institutions

- Choose products that meet flame retardant standards without any added chemicals
- Require disclosure of name of all flame retardants used in product purchases
- Express a preference for products made without halogenated flame retardants
- Utilize HCWH resources, “What Health Care Purchasers can do to Reduce Flame Retardants”
More information:

Natural Resources Defense Council
www.nrdc.org/health

Health Care Without Harm:
www.noharm.org

Healthier Hospitals Initiative
www.healthyhospitals.org