Putting it into Practice: Pediatric Environmental Health Training Resource

Persistent Organic Pollutants

Children's Environmental Health Network

Authors

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Outline

- Introduction
- Epidemiology and Exposure pathways
- Health effects
- Prevention
  - Policy level
  - Individual level
- Summary
- Key references

Picture from UNEP, 2005

INTRODUCTION

What are the Persistent Organic Pollutants?

- Building blocks of living organisms are organic compounds which contain carbon and hydrogen. Many of these compounds break down relatively easily.
- However, humans make organic compounds that are extremely difficult to break down, and as a result, have become widely dispersed throughout the environment.
- These chemicals are termed Persistent Organic Pollutants (POPs).

Ritter L et al. "Persistent organic pollutants". United Nations Environment Programme. http://www.chem.unep.ch/pops/ritter/en/ritteren.pdf. Accessed November 16, 2013.

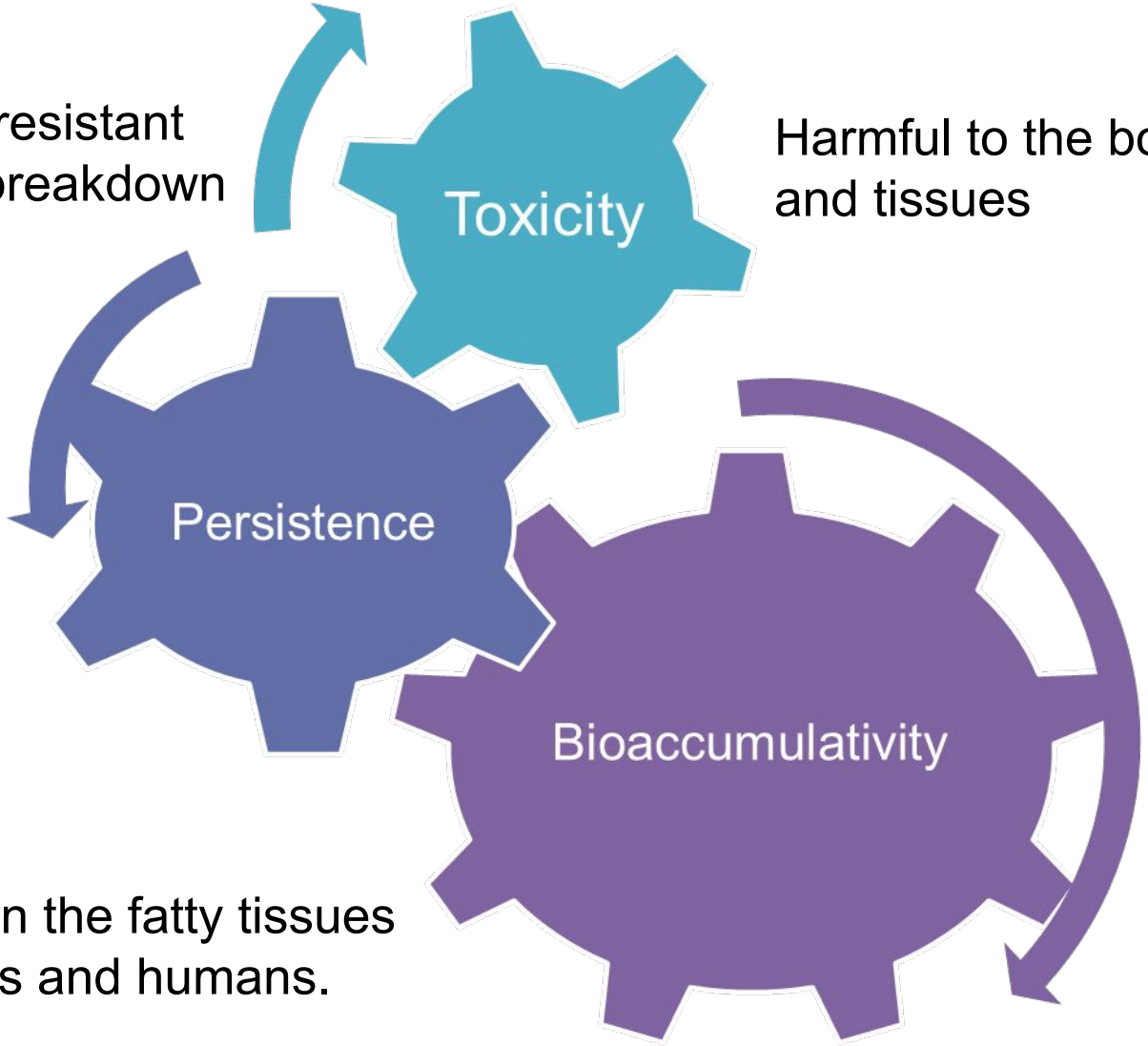
More on POPs

- Extremely resistant to natural breakdown processes in soil by bacteria, mold, and in animal species.
- Many POPs persist for years, even decades, in the environment.
- Many are also highly toxic and build up (bioaccumulate) in the fatty tissues of animals and humans.

Guidotti TL and Gitterman BA. *Pediatr Clin North Am*, 2007.

Ritter L et al. "Persistent organic pollutants". United Nations Environment Programme.http://www.chem.unep.ch/pops/ritter/en/ritteren.pdf. Accessed November 16, 2013.

Extremely resistant
to natural breakdown



Harmful to the body cells
and tissues

Build up in the fatty tissues
of animals and humans.

Properties of POPs

- Low water solubility
- High lipid solubility
- Semi-volatility
- High molecular masses.
  - POPs with molecular masses < 236 g/mol are less toxic, less persistent in the environment, and have more reversible effects than those with higher molecular masses.

Lipid solubility

The ability to pass through biological phospholipid membranes and bioaccumulate in the fatty tissues of living organisms.

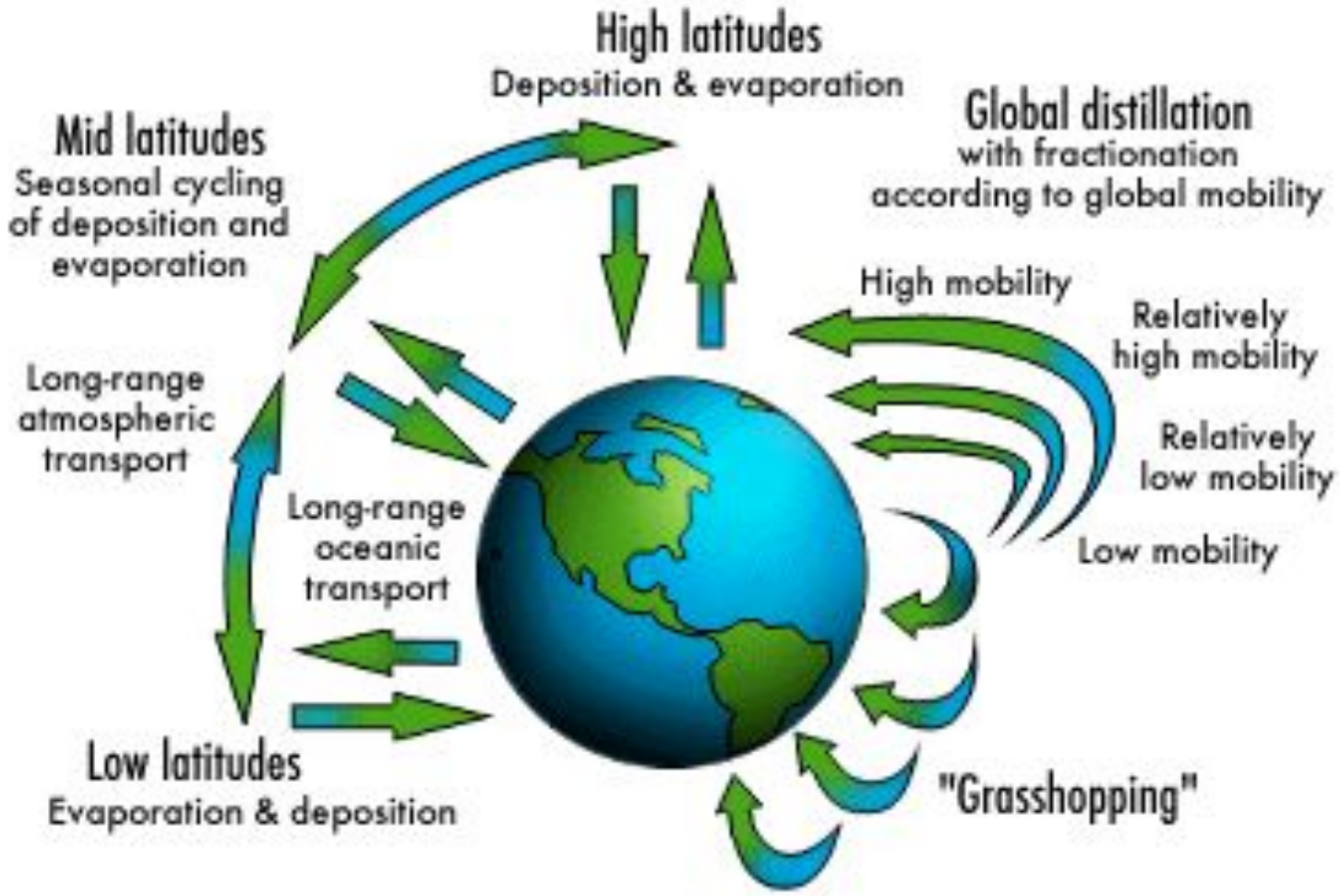
Ritter L et al. "Persistent organic pollutants". United Nations Environment Programme. http://www.chem.unep.ch/pops/ritter/en/ritteren.pdf. Accessed November 16, 2013.

Semi-volatility

- Allows POPs to travel long distances through the atmosphere before being deposited.
  - Thus, found all over the world.
- They tend to volatilize in hot regions and accumulate in cold regions, where they tend to condense and stay.
- Wind may carry chemicals into the countries with bans from places that still use them.
  - Many countries that banned specific POPs are no longer experiencing a decline in their concentrations.

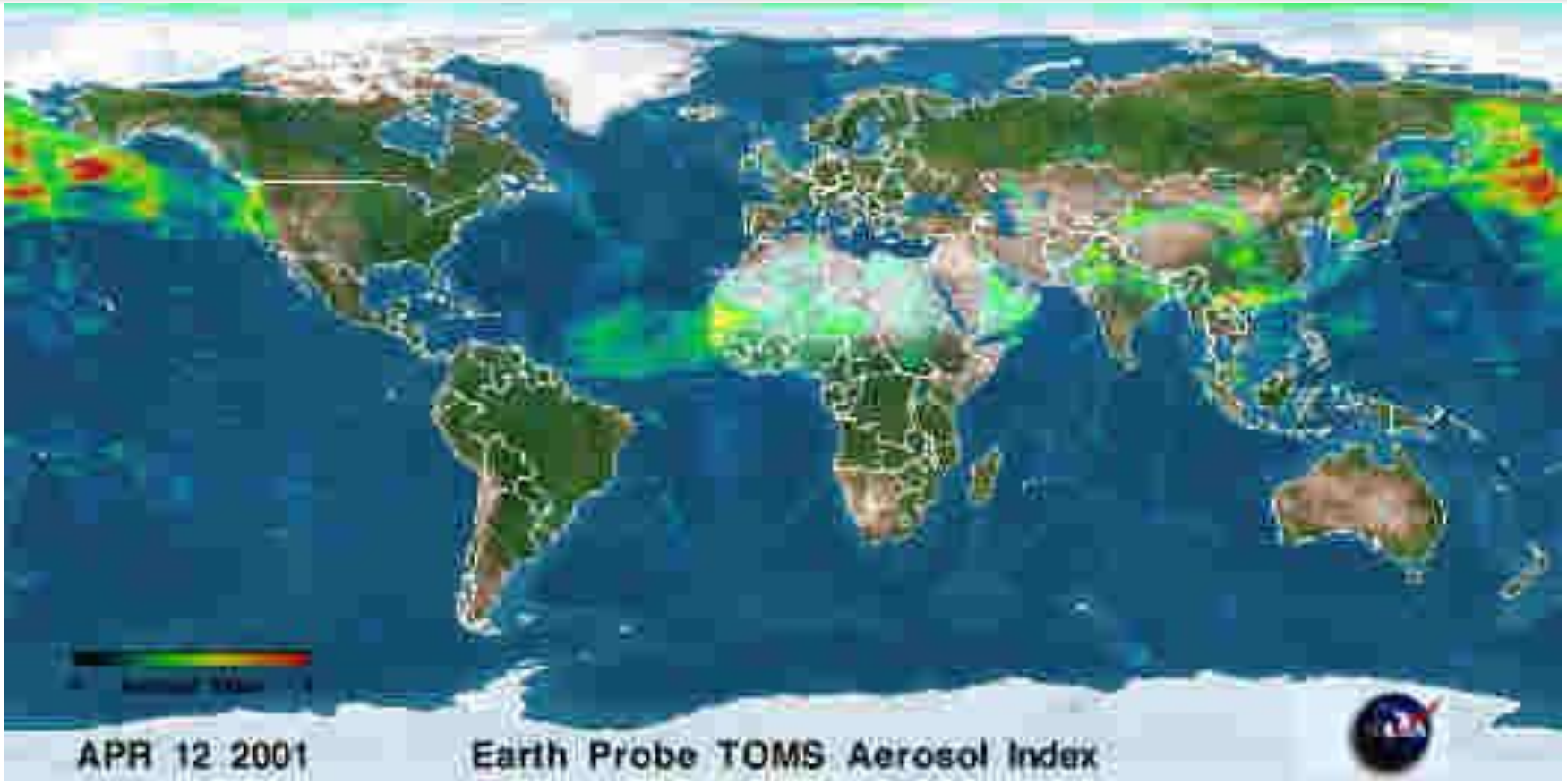
Nordberg Lars. United Nations Economic Commission for Europe. Interview: http://www.unece.org/spot/s01.htm. Accessed November 16, 2013.

POP Migration Processes



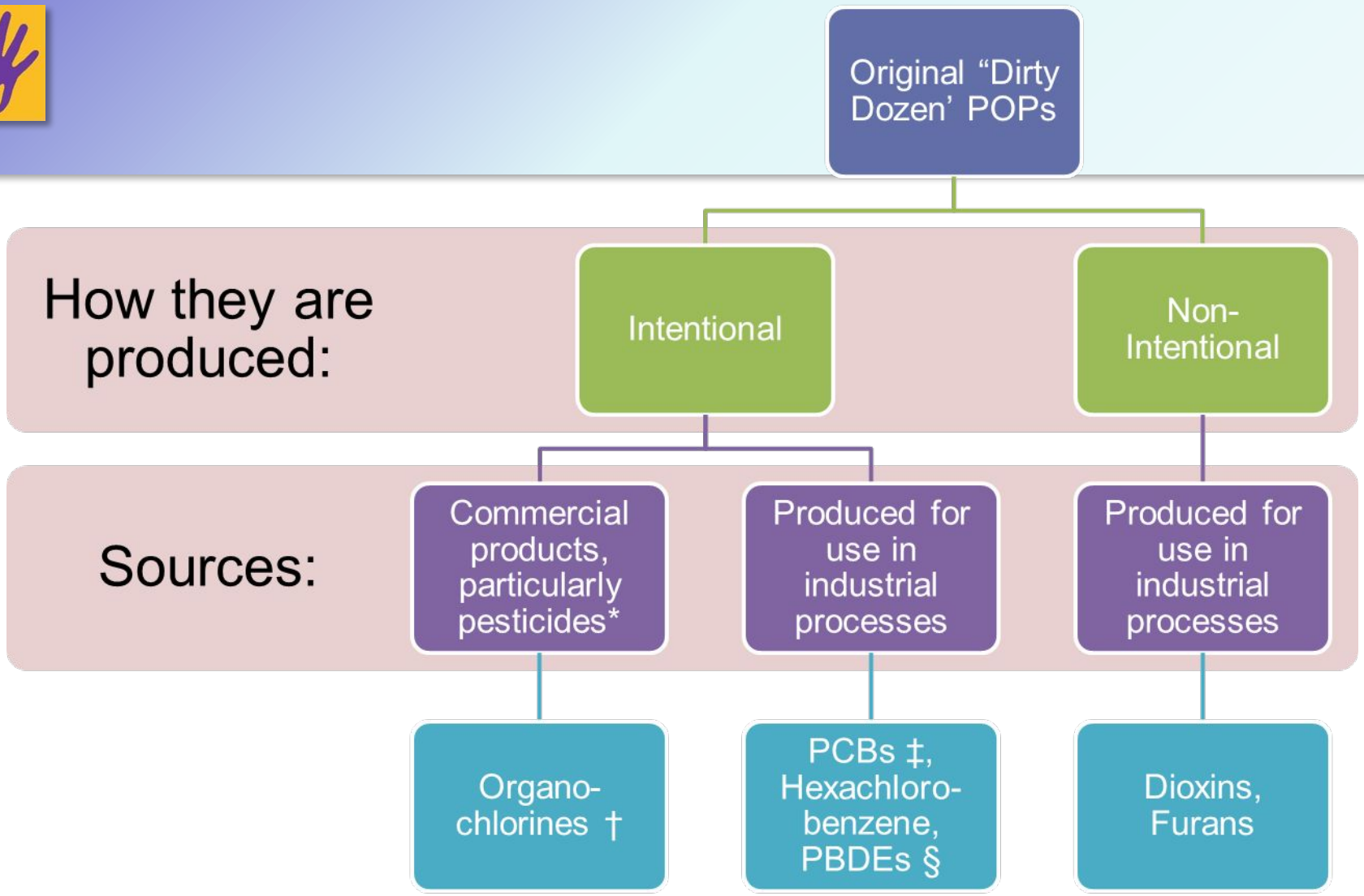
Greenpeace, 1999. “Down to Zero. http://archive.greenpeace.org/toxics/downtozero/POPS/exposure.html.

Global Dust



This figure shows a satellite image of the passage of a cloud of dust across the Pacific Ocean to North America. This dust cloud was raised by a storm in Asia in April 2001. Also shown is a dust cloud from northern Africa traveling West over the Atlantic Ocean.

EPA, 2002 http://www.epa.gov/international/about/index.html.



*See the "Pesticides and Children's Health" module in CEHN's Pediatric Training Resource

† Aldrin, Chlordane, DDT, Dieldrin, Endrin, Heptachlor, Mirex, Toxaphene

‡ Polychlorinated biphenyls

§ Polybrominated diphenylethers

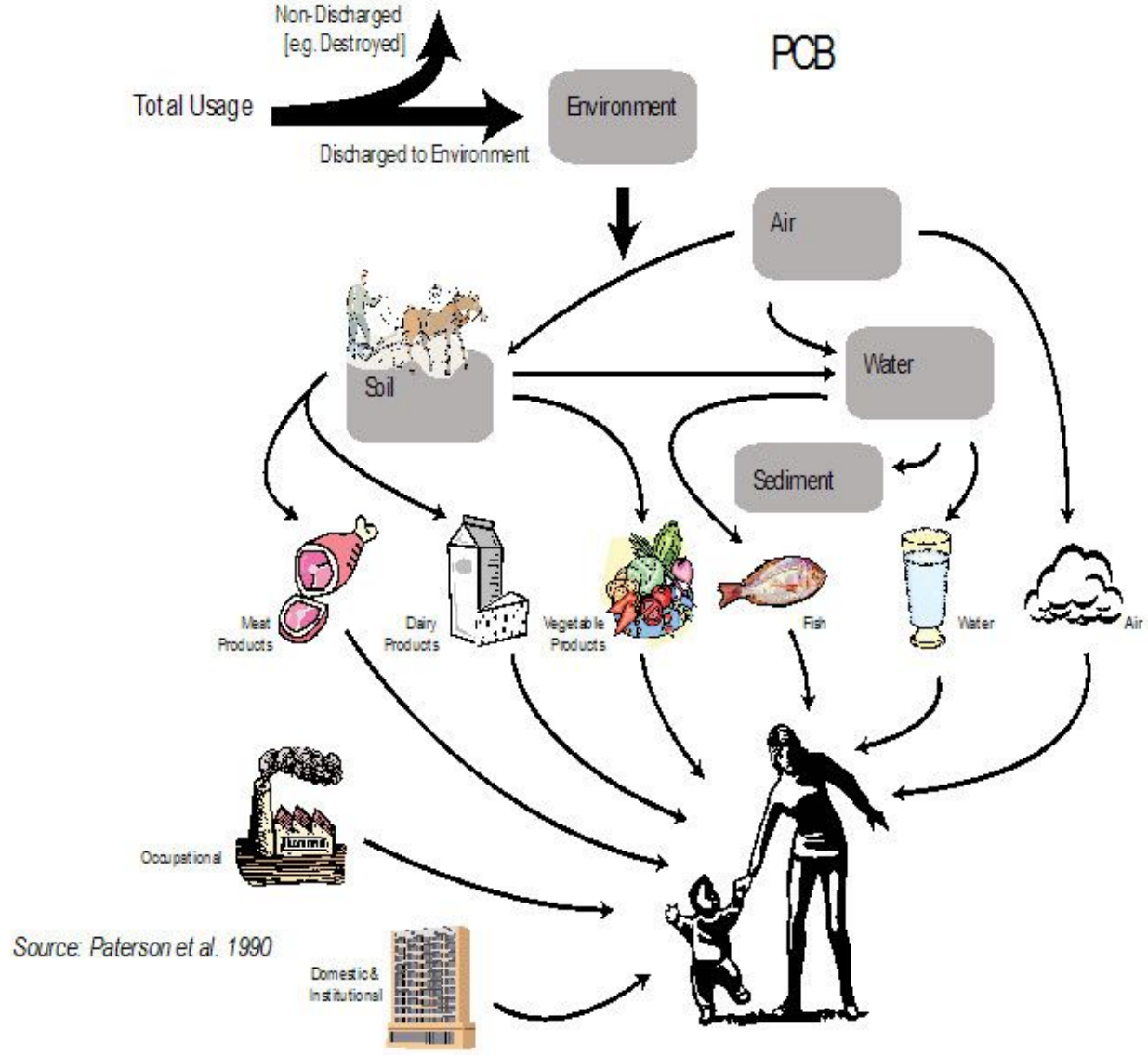
EPIDEMIOLOGY AND EXPOSURE PATHWAYS

How do POPs Enter our Body?

- Conception
- Placental Transfer
- Breast Feeding
- Inhalation
- Dermal exposure
- Ingestion

How do POPs Enter our Body?

- Mostly through ingestion
- Some from occupational exposures
- Some from consumer or medical products



http://www.popstoolkit.com
http://www.popstoolkit.com/

Populations at Highest Risk

- Fishermen & consumers of fatty fish in contaminated areas.
- Populations who rely on foods high on the food chain; e.g. Arctic Inuits who feed on marine mammals.
- Adults working with POPs (such as certain pesticides).
- Populations that live near heavily polluted sites (POPs stockpiles) or where waste is burned.
- The PBDEs are widely used in household products such as rugs, upholstery and electronics.

WHO. Persistent Organic Pollutants: Impact on Child Health. 2010. Accessed November 16, 2013. http://www.who.int/ceh/publications/persistent_organic_pollutant/en/index.html

Public Health Field

- DDT is used in indoor residual applications for vector borne diseases control (malaria, leishmaniasis).
- Lindane is still used widely as a pharmaceutical agent for the treatment of head lice.
- In some countries, lindane and DDT were used as wood preservatives, and were detected in hair of pre-school children

WHO. Persistent Organic Pollutants: Impact on Child Health. 2010. Accessed November 16, 2013. http://www.who.int/ceh/publications/persistent_organic_pollutant/en/index.html

Susceptibility of Infants and Children

- Children and infants are vulnerable because of increased inhalation rates & body surface:weight.
- Toddlers crawl and put their hands and objects in their mouths. They are unaware of or ignore environmental risks. They are unable to read labels.
- Children have more years of future life ahead; thus more time to develop chronic diseases

Environmental Defense. Polluted Children. Toxic Nation. 2006. Accessed November 16, 2013. http://environmentaldefence.ca/reports/polluted-children-toxic-nation-report-pollution-canadian-families

Susceptibility in Newborns: *Conception and Pregnancy*

- Maternal and/or paternal exposures prior to conception. POPs are toxic to sperm.
- Exposure occurs during pregnancy when maternal fat stores are mobilized, resulting in transfer of toxicants to the embryo and to the fetus

Campagna C et al, *Biology of Reproduction*, 2001.
Long M et al. *Reproduction,* 2007.
Aneck-Hahn NH et al, *Journal of Andrology,* 2007.
Hauser R et al, *Environmental Health Perspectives,* 2003.
Mocarelli P et al, *Journal of the American Medical Association,* 1986;256:2687–2695
Leino O et al, *Food Chem Toxicol*. 201;54:59-69
Greenpeace."Down to Zero." 1999.
http://archive.greenpeace.org/toxics/downtozero/POPS/exposure.html. Accessed November 16, 2013.

Susceptibility in Newborns: *Breast Milk*

- Lipophilic POPs (Dioxins, PCBs) are transferred into human milk (~20% of the maternal body burden). DDT was first reported in breast milk in 1951.
- Although there has been concern about the potential risks of POPs in human milk, breast milk is considered the optimal food source for newborn babies; presence of POPs in human milk is not an indication to avoid breastfeeding.

WHO. Persistent Organic Pollutants: Impact on Child Health. 2010. Accessed November 16, 2013.
http://www.who.int/ceh/publications/persistent_organic_pollutant/en/index.html
Laug EP et al, *Archives of Industrial Hygiene and Occupational Medicine*, 1951.
Hooper K. *Environ Health Perspect*, 1999.
Pronczuk J, Moy G, Vallenas C. *Environmental Health Perspectives*, 2004.
Thundiyil JG et al. *Pediatr ClinNorth Am*, 2007.

Other Toxic Substances

- Additional classes are added to the list of POPs as persistent toxic substances (PTS) and other “living chemicals” that are still produced and in use.
- PTS include heavy metals* such as mercury, cadmium and lead. It also include toxic substances as Pentadecafluorooctanoic acid (PFOA)(Teflon), Polychlorinated naphthalenes (PCNs) Polycyclic aromatic hydrocarbons (PAH) and others

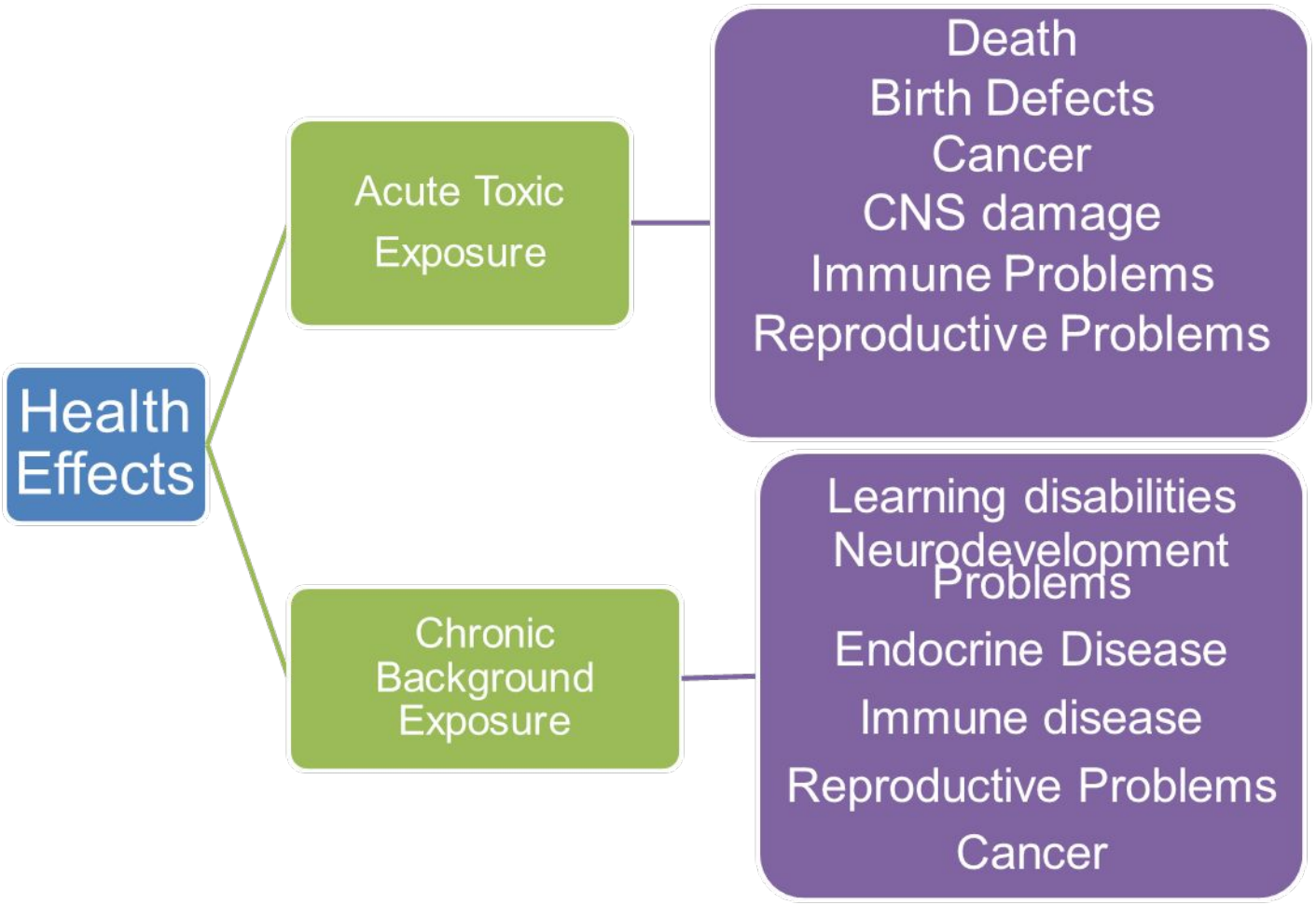
*See the “Childhood Lead Poisoning” and “Mercury, Arsenic and Cadmium Toxicity in Children” modules in CEHN’s Pediatric Training Resource.

WHO. PBDE document WHO Food Additive Series 55. Sixty fourth meeting of the Joint FAO/WHO Expert Committee on Food Additives. WHO, 2006.
http://whqlibdoc.who.int/publications/2006/9241660554_PDE_eng.pdf.
Accessed November 16, 2013.

Examples of Persistent Toxic Substances

- **PFOA (Teflon):** household surface finishes, a by-product during the fabrication of water- and stain-resistant clothes and food packaging
- **PCNs:** insulation, wood preservatives, engine oil additives and dye production-similar to TCDD; associated with liver toxicity
- **PAH:** incomplete burning of coal, oil, gas, wood, garbage, tobacco, charbroiled meat, asphalt and roofing tar; carcinogenic in humans

HEALTH EFFECTS



Acute Toxic Effect to POPs

Country	Year	POP	Poisoning Effect
Turkey (3-4000 people)	1956-1961 (Cam, 1960, Peters, 1976).	Hexachlorobenzene added to wheat seedlings	Adults developed porphyria; Babies: weakness, seizures and an annular rash; Mortality: High among breast fed babies
Japan (1200 people)	1968 [over 20-90 days] (UNEP, 2005).	Cooking Oil, mixed with PCBs (High contamination from PCDF (partially oxidized PCBs)	Reproductive dysfunction, severe chloracne, hyperpigmentation, eye discharge, headache, vomiting, fever, visual disturbances and respiratory problems. One stillborn pigmented; Some live-born children were small, hyperbilirubinemic, pigmented, had conjunctival swelling. Neurologic signs till 9 years
Taiwan (117 exposed in utero)	1979 (Chen et al, 1994)		Ectodermal defects such as excess pigmentation, dental caries, poor nail formation, and short stature. Persistent behavioral abnormalities

Cam C, Annals of Dermatology and Syphiligraphy 1960;87:392-397
Peters HA , Federation Proceedings2003 1976; 35(12):2400-3.
American Academy of Pediatrics. Pediatric Environmental Health, 2nd Edition 2003
Chen YC et al, American Journal of Public Health 1994, 84:415–421.

Acute Toxic Effect to POPs *cont.*

Country	Year	POP	Poisoning Effect
Italy Sevesto	1976 (Mocarelli et al, 1986).	Chemical plant explosion: 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), a congener of dioxin	Children had chloracne; most prominent on areas that were not protected by clothing; some had abnormal liver function tests).
Vietnam	1962 and 1971 (Schecter et al, 1995).	Herbicides, including Agent Orange (TCDD)	Soft tissue sarcoma, non-Hodgkin's lymphoma, Hodgkin's disease, chloracne, chronic lymphocytic leukemia, diabetes, hypertension, heart disease and chronic respiratory conditions; Detected in breast milk many years later
Belgium France, Germany Nether-lands	1999 (van Larebeke, 2002).	Animal feed (500 tons) were contaminated with PCBs and dioxins	2 million chickens had to be destroyed; Neurobehavioral and cancer effects are expected in humans

Mocarelli P et al, Lancet 2000; 355(9218):1858–1863
Schecter A et al, American Journal of Public Health 1995;85:516–522.
van Larebeke N, Environmental Health Perspectives 2002; 109:265-73.

Chronic Background Effect of POPs

- Epidemiological findings and experimental evidence suggest an association between low level chronic exposures to certain POPs and disease outcomes.
- Lower persistent exposures to POPs cause adverse neurodevelopment at significantly lower exposures than were experienced from mass poisonings.

WHO. Persistent Organic Pollutants: Impact on Child Health. 2010. Accessed November 16, 2013. http://www.who.int/ceh/publications/persistent_organic_pollutant/en/index.html

Neurological Toxicity

- Low-level PCB exposure from Lake Michigan fish consumption associated with:
  - Negative effect on memory in 4-year-olds
  - Lowered IQs in 42-month-olds
  - Visual recognition memory impairment at 6 and 12 months of age
  - Neural tube defects
- Hyporeflexive and hypotonia
  - Could be due to effects of PCB on thyroid gland; also, possible subclinical effects of PCB on newborn thyroid function

Jacobson JL, et al. *Journal of Pediatrics*, 1990. Patandin S et al. *Environmental Health Perspectives,* 1999a.
Patandin S et al. *Journal of Pediatrics*, 1999b. Walkowiak J et al. *Lancet*, 2001.
Jacobson JL and Jacobson SW. *New England Journal of Medicine*, 1996.
Darvill T et al. *Neurotoxicology*, 2000. Ren A et al. *Proc Natl Acad Sci USA*, 2011.
Jacobson JL et al. *Developmental Psychology*,1984. Rogan WJ et al, *Science*, 1988.
Huisman M et al. *Early Human Development*, 1995.
Collins Jr WT and Capen CC. *American Journal of Pathology*, 1980.
Brouwer A et al. *Environmental Health Perspectives*, 1999.

Neurodevelopment Impairment

- Lower mental development among infants of pregnant Mexican immigrants exposed to DDT and DDE and later to those exposed to polybrominated diphenyl ethers (PBDEs).
- Children had adverse effects in their mental and physical development in relation to cord blood PBDE concentrations.

Eskenazi B et al, Pediatrics 2006;6(118):233–241.
Gascon M et al, Environ Health Perspect. 2012 Dec;120(12):1760-5.
Herbstman JB et al, Environmental Health Perspectives 2010; 118:712–719.

Endocrine Disruptors

- Alterations of thyroid hormones related to either *in utero* or childhood exposure to PCBs or dioxins.
- Diabetes prevalence was strongly positively associated with POPs (DDT, dioxins, PCBs and Chlordane). Individuals were found to be 38 times more likely to be insulin resistant.
- Background exposure to PCBs and DDE was associated with obesity. Children exposed prenatally to PCBs and PCDFs had smaller penises. Endocrine disruption occurs earlier in life.

Collins Jr WT and Capen CC. *American Journal of Pathology*, 1980.
Brouwer A et al. *Environmental Health Perspectives*, 1999. Mazhitova Z et al, *Acta Paediatr*, 1998.
Thundiyil JG et al. *Pediatr ClinNorth Am*, 2007. Lee DH et al, *Diabetes Care*, 2006.
Rogan WJ, Gladen BC. *Pediatrics*, 2003. Rogan WJ et al, *Science*, 1988.
Newbold R et al, *International Journal of Andrology*, 2007.

Immunologic Effect

- Dioxin is associated with low immunoglobulin (IgG), down-regulation of cytotoxic T- or B-lymphocytic differentiation, poorer antibody response and reduced lymphocytes, activation-Inferred immune defect. Increased frequency of otitis media in Inuit children was reported.
- PCBs (toxaphene and chlordane) associated with 4 x lower vitamin A levels

Baccarelli A et al. Environmental Health Perspectives, 2002.
Thundiyil JG et al. Pediatr ClinNorth Am, 2007.
Guidotti TL and Gitterman BA. Pediatr Clin North Am, 2007.
Canadian Arctic Resources Committee (CARC). Northern Perspectives, 2000;26(1):1-20. http://www.carc.org/pubs/fall2000/Northern_Perspectives_26.pdf. Accessed November 16, 2013.

Carcinogenecity

- Dioxins, Heptachlor Epoxide, Dieldrin, Oxychlordane, DDE have been associated with an 80% to 240% increase in non-Hodgkin's lymphoma.
- DDT is associated with an increase in liver cancer, lung cancer, and lymphoma.
- Electric workers have increased risk of malignant melanoma, biliary cancer, stomach cancer, and thyroid cancer.
- The high POP exposure in the arctic had been associated with breast cancer.
- PCB exposure is associated with lung and liver cancer and high mortality.

Lai ZW, et al,. *Toxicol Appl Pharmacol*, 1998. Quintana PJ et al, *Environ Health Perspect*, 2004.
Fredslund SO and Bonefeld-Jørgensen EC. *Int J Circumpolar Health*, 2012.
International Agency for Research on Cancer(IARC). WHO.1987;1-42(7):322–6.
Thundiyil JG et al. *Pediatr Clin North Am*, 2007.

Policy Level

PREVENTION

Policies and Treaties

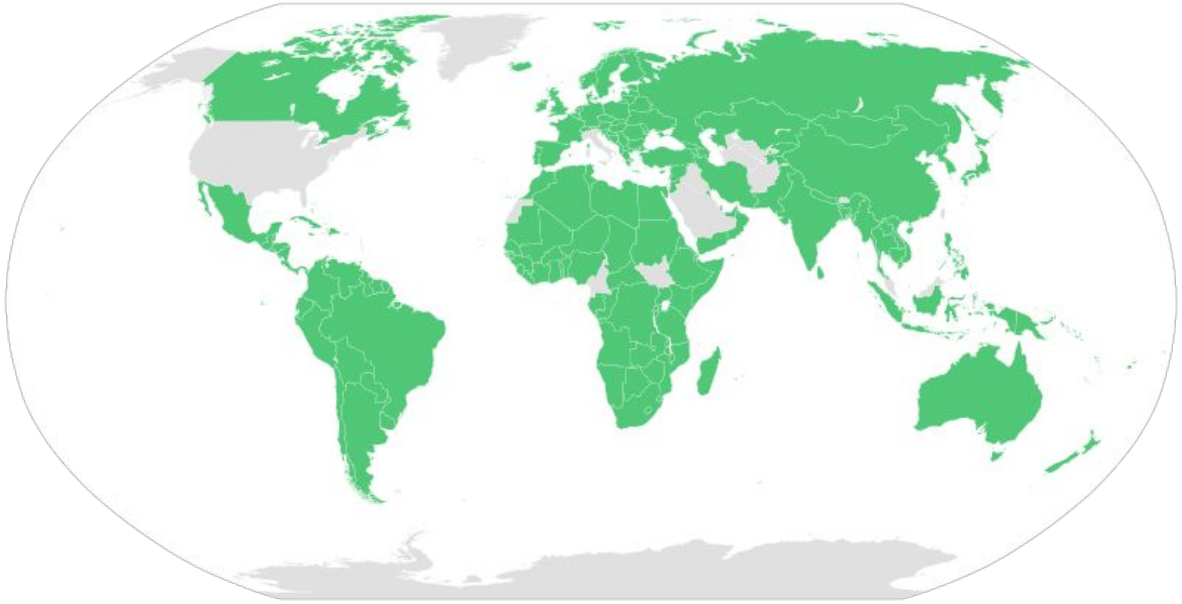
- In 1995, the Governing Council of the United Nations Environment Programme (UNEP) called for global action to be taken on POPs.
- Following this, the Intergovernmental Forum on Chemical Safety (IFCS) and the International Programme on Chemical Safety (IPCS) prepared an assessment of the 12 worst offenders, known as the **dirty dozen**.

www.youtube.com/watch?v=60gsFJX0hCQ

- **Stockholm Convention on Persistent Organic Pollutants** (next slide).

Stockholm Convention on Persistent Organic Pollutants

- **Stockholm Convention on Persistent Organic Pollutants** is an international environmental treaty signed in 2001 and effective from May 2004, that aims to eliminate or restrict the production and use of persistent organic pollutants (POPs).



State parties to the Stockholm Convention on Persistent Organic Pollutants

http://en.wikipedia.org/wiki/POP_Air_Pollution_Protocol

Stockholm Convention

Exemptions/Exceptions for Intentionally Produced POPs:

1. Are used for laboratory-scale research or as a reference standard.
2. Occur as unintentional trace contaminants in products and articles.
3. Are used in closed-system, site-limited processes.
4. Exist in articles manufactured or already in use on the date that the Convention enters into force for that Party.

Exemptions are on a country-by-country basis. Subject to review and expire after 5 years (EPA,2002, revised 2012)

Stockholm Convention

- While the Convention initially focused on 12 intentionally and unintentionally produced chemicals, it began adding additional substances to the agreement in May of 2009 and will continue to do so.
- *The most updated list of substances covered by the Convention is at* www.pops.int

Individual Level

PREVENTION

Policy: Organizations and Agencies

- Nonprofit organizations that promote environmental-focused and child-focused policy, stimulate prevention-oriented research, educate professional audiences and community members, and elevate public awareness
  - Children's Environmental Health Network (CEHN)
  - International Network on Children's Health, Environment and Safety (INCHES)
- At the US Federal government level:
  - EPA Office of Children's Health Protection
  - National Institute of Environmental Health Sciences
  - Centers for Disease Control and Prevention

International Network on Children's Health, Environment and Safety (INCHES). http://www.inchesnetwork.net/
Children's Environmental Health Network (CHEN). http://www.cehn.org/.
Guidotti TL and Gitterman BA. Pediatr Clin North Am, 2007.

Public Education

- The IOM in the US recommended that the government increase the availability of foods low in animal fats in government sponsored breakfast and lunch programs and in child- and adult-care food programs.
- Families should be encouraged to eat “low on the food chain”; increasing consumption of fruits, vegetables, whole grains and consumption of meat products low in fat should be encouraged.

Institute of Medicine (IOM) Food and Nutrition Board (FNB). National Academy Press, Washington DC. 2003

Public Education

- Some POPs in fruits and vegetables are concentrated mainly in the outer skins; washing is recommended, as is peeling of root and wax-coated vegetables.
- Organic produce is grown with fewer pesticides but tends to be more expensive and less readily available than non-organic.
- Locally grown and in-season produce is less likely to contain pesticides.

Mahoney DB and Moy GC. In: Pronzcuk-Garbino J, editor. Geneva:World Health Organization; 2005. p. 133–52.

Public Education

- Families should be encouraged to choose fish low in PCBs and mercury when possible.
- Fish grown in farms and closed lakes tend to concentrate chemical pollutants at higher levels than fish from open seas.
- POPs concentrate in fat and skin; fish should be trimmed of visible fat and the skin before it is consumed.
- Broiling the fish allows the fat to drip away from food.

Institute of Medicine (IOM) Food and Nutrition Board (FNB). National Academy Press, Washington DC. 2003

Resources to Reinforce

"Testing not typically available nor helpful and breastfeeding is still best."

- CDC and EPA-funded Pediatric Environmental Health Specialty Units are available around the country to advise docs or their patients:

  www.pehsu.net

- Or get the rationale yourself: CDC website (www.cdc.gov/breastfeeding/disease/environmental_toxins.htm) and/or trusted non-profit organizations like NRDC (see next slide)

- Exposure to POPs, may be decreased through consumer education, public health programs, legislation, and environmental health infrastructure.

- Dioxins, dibenzofurans, and PCBs in human tissues are declining. However, PBDEs have been increasing substantially in blood levels in the United States during the past two to three decades.

Schecter A et al, *Environ Health Perspect*, 2006.
WHO. PBDE document WHO Food Additive Series 55. Sixty fourth meeting of the Joint FAO/WHO Expert Committee on Food Additives. WHO, 2006. http://whqlibdoc.who.int/publications/2006/9241660554_PDE_eng.pdf. Accessed November 16, 2013.

- Dietary exposure alone does not appear to account for the very high body burdens measured. The indoor environment (dust, air) may play an important role in PBDE body burdens in addition to food.

- Despite increasing regulatory efforts to curtail production of most POPs, they will continue to persist in the environment, ecosystem, and food supply for years to come.

WHO. PBDE document WHO Food Additive Series 55. Sixty fourth meeting of the Joint FAO/WHO Expert Committee on Food Additives. WHO, 2006. http://whqlibdoc.who.int/publications/2006/9241660554_PDE_eng.pdf. Accessed November 16, 2013.
Thundiyil JG et al. *Pediatr Clin North Am*, 2007. UNEP, 2005.

Research

- Should concentrate on building the capacity of the public health and medical systems to protect children in every country.
- This means raising awareness, creating offices for children's health, building the institutions, knitting together the networks, and educating a generation of practitioners and advocates.
- Single solutions and single-threat approaches may solve one problem at a time but the threats to children's health require commitment and follow-through on many fronts at once.

Guidotti TL and Gitterman BA. *Pediatr Clin North Am*, 2007.

Case example #1

A new mother comes to your clinic saying she's read that breast milk has chemicals that can harm her new son. She wants to know if she should continue breastfeeding and if she could have her milk tested for toxic chemicals. How do you advise?

Case example #2

A dad of twin infant girls wants to buy new carpet for their apartment but just read the Chicago Tribune exposé on flame retardants. Should he be worried?


Chicago Tribune

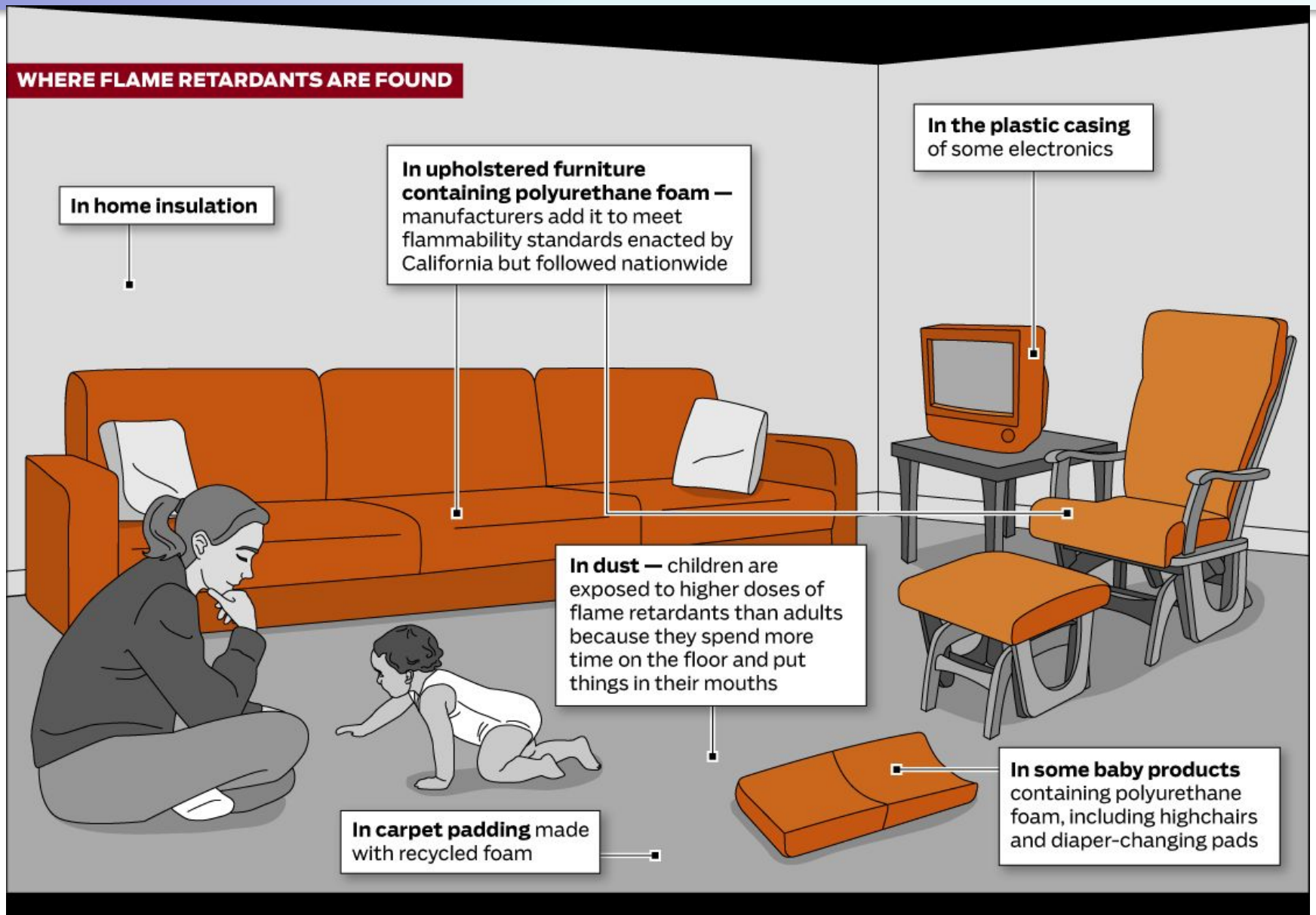
TRIBUNE WATCHDOG

Playing with fire

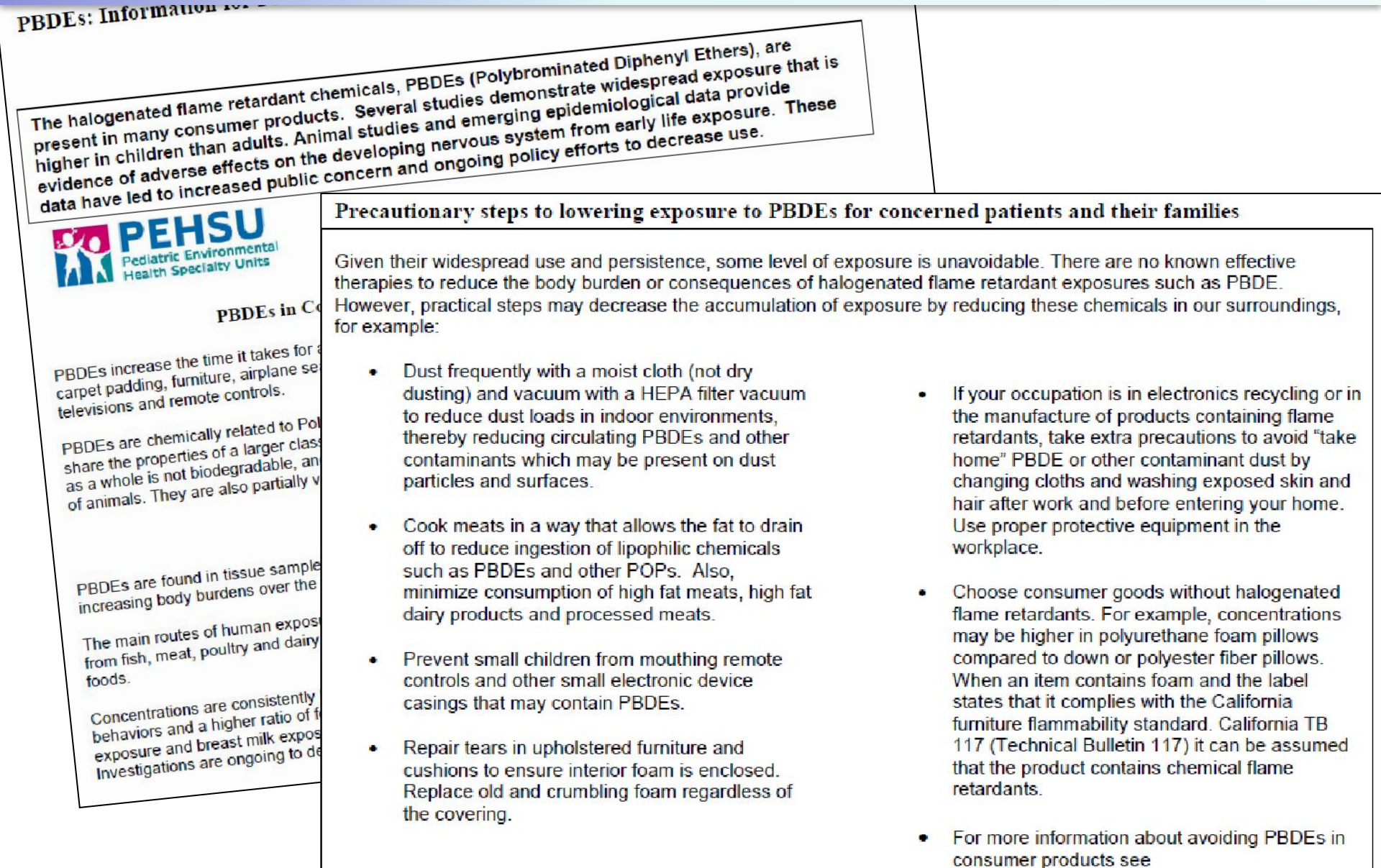
A deceptive campaign by industry brought toxic flame retardants into our homes and into our bodies. And the chemicals don't even work as promised.

May 2012 Chicago Tribune series on flame retardants

Step 1: Educate



Step 2: Empower



PBDEs: Information

The halogenated flame retardant chemicals, PBDEs (Polybrominated Diphenyl Ethers), are present in many consumer products. Several studies demonstrate widespread exposure that is higher in children than adults. Animal studies and emerging epidemiological data provide evidence of adverse effects on the developing nervous system from early life exposure. These data have led to increased public concern and ongoing policy efforts to decrease use.

PEHSU
Pediatric Environmental Health Specialty Units

PBDEs in C

PBDEs increase the time it takes for
carpet padding, furniture, airplane se
televisions and remote controls.

PBDEs are chemically related to Pol
share the properties of a larger class
as a whole is not biodegradable, an
of animals. They are also partially v

PBDEs are found in tissue sample
increasing body burdens over the

The main routes of human expos
from fish, meat, poultry and dairy
foods.

Concentrations are consistently
behaviors and a higher ratio of f
exposure and breast milk expos
Investigations are ongoing to de

Precautionary steps to lowering exposure to PBDEs for concerned patients and their families

Given their widespread use and persistence, some level of exposure is unavoidable. There are no known effective therapies to reduce the body burden or consequences of halogenated flame retardant exposures such as PBDE. However, practical steps may decrease the accumulation of exposure by reducing these chemicals in our surroundings, for example:

- Dust frequently with a moist cloth (not dry dusting) and vacuum with a HEPA filter vacuum to reduce dust loads in indoor environments, thereby reducing circulating PBDEs and other contaminants which may be present on dust particles and surfaces.
- Cook meats in a way that allows the fat to drain off to reduce ingestion of lipophilic chemicals such as PBDEs and other POPs. Also, minimize consumption of high fat meats, high fat dairy products and processed meats.
- Prevent small children from mouthing remote controls and other small electronic device casings that may contain PBDEs.
- Repair tears in upholstered furniture and cushions to ensure interior foam is enclosed. Replace old and crumbling foam regardless of the covering.
- If your occupation is in electronics recycling or in the manufacture of products containing flame retardants, take extra precautions to avoid "take home" PBDE or other contaminant dust by changing cloths and washing exposed skin and hair after work and before entering your home. Use proper protective equipment in the workplace.
- Choose consumer goods without halogenated flame retardants. For example, concentrations may be higher in polyurethane foam pillows compared to down or polyester fiber pillows. When an item contains foam and the label states that it complies with the California furniture flammability standard. California TB 117 (Technical Bulletin 117) it can be assumed that the product contains chemical flame retardants.
- For more information about avoiding PBDEs in consumer products see

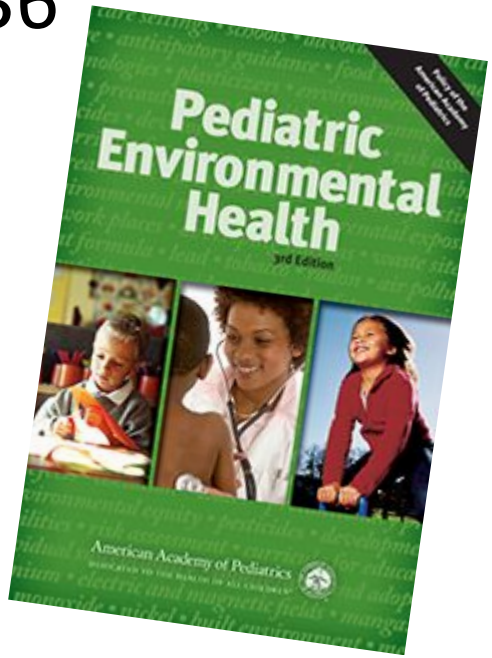
Key points

- Persistent Organic Pollutants are human-made chemicals that last a long time in the environment and in our bodies.
- Associated with many health impacts including cancers, allergies, immune function, and neurodevelopment.
- This issue represents a kind of public health policy win: major international treaty.
- Lots of work to be done regarding protecting the public but individual actions can help reduce exposures.

Resources

- PEHSU (www.pehsu.net) factsheets and experts
- AAP Green Book "Pediatric Environmental Health" 3rd edition, Chapters 35 and 36
- Natural Resources Defense Council (http://www.nrdc.org/breastmilk/)

NRDC
THE EARTH'S BEST DEFENSE



"...imagine for a moment if you will the emotions we now feel...as we discover food which for generations nourished us and keeps us whole physically and spiritually, is now poisoning us."

References

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