Persistent Bioaccumulative Toxins (PBTs) in Hospital and Medical Settings

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The Big Picture: The U.S.

- 80,000 man-made chemicals since 1940's.
- 1,500 new chemicals every year.
- No toxicity information for 40% of the 15,000 “high production volume” chemicals.
- No testing of synergistic effects.
- No testing to account for developmental “windows” of fetuses and young children.
- Many chemicals are stored in body fat and accumulated through time, they can stay in the body for years.

Other Actions Globally

- EU: Registration, Evaluation and Authorization of Chemicals **(REACH)**
  - Puts greater responsibility on chemical manufacturers to manage risks from chemicals and to provide safety information
  - Adoption by EU Parliament is expected by end of 2006
    - Will establish the European Chemicals Agency – based in Helsinki
    - REACH procedures scheduled to be applied in 2008.
- China: Restrictions on Hazardous Substances (RoHS)
- UNEP Global Mercury Programme

Health Effects of Toxic Chemicals

- Carcinogens*
  - *Causes cancer* (examples: Cadmium, PAHs, Lead)
- Developmental or Reproductive Toxicants*
  - *Can damage normal development of fetus, infant or child or our reproductive tissues*
    (examples: Lead, Mercury, PCBs)

*http://www.chm.bris.ac.uk/safety/carcinogens.htm

Health Effects of Toxic Chemicals

- Endocrine Disrupters
  - *Interferes with normal hormone function* (examples: PCBs, Dioxin, PAHs)
- Mutagens*
  - *Damages DNA and cell structure* (example: Benzo(a)pyrene [a PAH])
- Teratogens
  - *Causes birth defects* (examples: PCBs, Mercury)

*http://www.chm.bris.ac.uk/safety/carcinogens.htm

Persistent, Bioaccumlative Toxins (PBTs)

- PBTs considered the “worst of the worst”
- PBTs can cause human health impacts
  - Young children, fetuses, and women of child-bearing age are especially vulnerable
- PBTs impact our environment
  - Orca whales, marine and terrestrial mammals have increasing levels of some PBTs
  - Chronic low dose exposures over time causing impacts
- Ecology PBT Rule is first regulation in U.S. that
  - Identifies and lists PBTs including chemicals and metals of concern
  - Establishes a process to review and update the list
  - Establishes procedures for developing CAPs

The PBT List

- **Metals**
  - Methyl-mercury
- **Combustion By-Products**
  - Polyaromatic Hydrocarbons (PAHs)
  - Chlorinated Dioxins & Furans
  - Brominated Dioxins & Furans
- **Metals of Concern**
  - Cadmium
  - Lead
- **Flame Retardants**
  - PBDEs
  - Tetrabromobisphenol A
  - Hexabromocyclododecane
  - Pentachlorobenzene
- **Organic Chemicals**
  - 1,2,4,5-Tetrachlorobenzene
  - Perfluorooctane Sulfonates (PFOS)
  - Hexachlorobenzene
  - Hexachlorobutadiene
  - Short-chain Chlorinated Parraffins
  - Polychlorinated Naphthalenes

The PBT List

- **Banned Pesticides**
  - **Aldrin / Dieldrin**
  - **Chlordane**
  - **DDT / DDD / DDE**
  - **Heptachlor Epoxide**
  - **Toxaphene**
  - **Chlordecone**
  - **Endrin**
  - **Mirex**
- **Banned Flame Retardants**
  - **Hexabromobiphenyl**
- **Banned Organic Chemicals**
  - **Polychlorinated Biphenyls (PCBs)**

PBTs:

Remain in the environment for a long time

Persistent

Build up in human or animal tissues

Bioaccumulative

Have adverse effects on living organisms

Toxic

Also can readily migrate between the air, land and water and travel long distances

Chemical Action Plans

PBT regulation directs Ecology to develop "Chemical Action Plans" (CAPs) to identify future reduction actions. CAPS are:

- Collaboratively developed with Department of Health for specific high priority chemicals
- To date, CAPs completed for:
  - **Mercury (2003)**
  - **Polybrominated Diphenyl Ethers (PBDEs) (2006)**
- CAPs are expected to be developed for:
  - **Lead (2007)**
  - **Polyaromatic Hydrocarbons (PAHs) (2008)**
  - **Perfluoro Octane Sulfonates (PFOS) (2009)**

Key PBTs Hospitals and Clinics Can Focus On

- Lead
- Mercury
- PCBs
- Polyaromatic Hydrocarbons (PAHs)
- Brominated flame retardants
  - Deca-BDE
  - Tetrabromobisphenol A
  - Hexabromocyclododecane
- Perfluoro Octane Sulfonates (PFOS)

Key PBTs Hospitals and Clinics Can Focus On

Chemical	Health Effect	Source(s)
Brominated flame retardants, including **PBDEs**, especially Deca-BDE and also including **Hexabromocyclododecane** and **Tetrabromobisphenol A**	**Accumulate in the food chain and in human tissues. Adversely affects brain development and thyroid.**	**Flame retardant in furnishings and consumer electronic goods.**
Lead, Mercury, Cadmium	**Cause lowered IQ, developmental delays, behavioral disorders and cancer at doses found in the environment.**	**Lead – paint, stabilizer in PVC products.** **Mercury – thermometers, blood pressure devices, fluorescent lamps, switches, pharmaceutical preservative.** **Cadmium – Ni-Cd batteries, pigments.**

Key PBTs Hospitals and Clinics Can Focus On

Chemical	Health Effect	Source(s)
Perfluorinated chemicals (PFOS/PFOA)	Accumulate in the environment and in the food chain. Linked to cancer and birth defects.	Active ingredients or breakdown products of Teflon, Scotchgard fabric and carpet protectors and food wrap coatings.
PAHs (Polyaromatic Hydrocarbons)		Group of over 100 chemicals formed from incomplete combustion of coal, oil, garbage, tobacco and/or are manufactured for use in medicines, dyes, plastics & pesticides

Other chemicals of concern

Chemical	Health Effect	Source(s)
Phthalates **[NOT considered a PBT by Ecology, but presented due to continuing interest]**	**Birth defects of male reproductive organs. Some phthalates are banned in toys and cosmetics in Europe.**	**Plasticizers. Found mostly in soft vinyl products, cosmetics and personal care products.**
Polyvinyl chloride **[NOT considered a PBT by Ecology, but presented due to continuing interest]**	**Combustion of PVC forms carcinogenic and reproductive toxins such a dioxins and furans.**	**End-of-life combustion of PVC in electronics, wire and cable, plastic pipe, flooring and footwear. PVC may also contain lead or phthalates.**

Some Example Pharmaceuticals of Concern*

Substance	Primary use
Busesonide	Antidiarrheal; Nasal preparations/obstructive airway preparations
Orlistat	Antiobesity preparations
Amiodarone	Cardiac therapy
Felodipine	Calcium antagonists
Isradipine	Calcium antagonists
Miconazole	Dermatological - antimycotics
*Stockholm County Council. 2006. Environmentally Classified Pharmaceuticals.	Website: http://www.janusinfo.se/imcms/servlet/GetDoc?meta_id=7240

Some Example Pharmaceuticals of Concern*

Substance	Primary use
Acitretin	Dermatoligical - antipsoratics
Bromocriptine	Gynecological uses; Anti-Parkinson's drug
Ethinyl Estradiol	Sex hormones
Megestrol or Tamoxifen	Endocrine therapy
Leflunomide or Everolimus	Immunosuppressives
*Stockholm County Council. 2006. Environmentally Classified Pharmaceuticals.	Website: http://www.janusinfo.se/imcms/servlet/GetDoc?meta_id=7240

What can you do to reduce uses of persistent pharmaceuticals?* (Continued)

- Always take cost-effectiveness and environmental impact into account when comparing medications that are equally safe and suitable for the purpose.
- Prescribe starter packs or prescribe refill packs if available.
- Encourage patients to return unused medications to the pharmacy.
- Inform patients of the importance of returning used estrogen patches to the pharmacy and avoid flushing them down the toilet, since most of the estrogen remains in the patch after use.

*Stockholm County Council. 2006. Environmentally Classified Pharmaceuticals. Website: **http://www.janusinfo.se/imcms/servlet/GetDoc?meta_id=7240**

What can you do to reduce uses of persistent pharmaceuticals?*

- Do not prescribe more medications than can be used; if in doubt, repeating the prescription is preferable.
- Review and regularly reassess the patient's total consumption of medication in order to reduce waste.
- Learn more about which drugs have a large environmental impact by using this website and by asking for information from the pharmaceutical companies' representatives.

*Stockholm County Council. 2006. Environmentally Classified Pharmaceuticals. Website: **http://www.janusinfo.se/imcms/servlet/GetDoc?meta_id=7240**

Challenges

- Many PBTs are ubiquitous through out environment
- Some PBTs lack analytical testing procedures
- Don’t always know if alternative chemicals are safer
- Many PBTs in consumer products
  - agencies regulate waste, not the product
- Difficult to know which products contain PBTs
- General dearth of information for everyone

Web site resources

- Persistent Bioaccumulative Toxins Rule
  - http://www.ecy.wa.gov/programs/eap/pbt/rule/index.html
- Mercury Chemical Action Plan
  - http://www.ecy.wa.gov/mercury/
- PBDE Chemical Action Plan
  - http://www.ecy.wa.gov/programs/eap/pbt/pbde/

Web site resources

- Toxic Use Reduction Institute (TURI)
  - http://www.turi.org/
- Interstate Mercury Education and Reduction Clearinghouse (IMERC)
  - http://www.newmoa.org/prevention/mercury/imerc.cfm
- REACH
  - http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm
- Stockholm County Council
  - **http://www.janusinfo.se/imcms/servlet/GetDoc?meta_id=7240**