

## Pharmaceuticals and Personal Care Products in the Environment: Sources, Exposure Routes, and Ramifications.”

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## Overview

- ❖ Definition of “the Environment”
- ❖ Sources
- ❖ Exposure routes for each “Environment”
- ❖ Ramifications in the non-human “environment”



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## The Story of Stuff Project: Planned Obsolescence

- ❖ Project website:  
<http://www.storyofstuff.com/>
- ❖ The Story of Stuff
- ❖ The Story of Cap and Trade
- ❖ The Story of Bottled Water
- ❖ The Story of Electronics (Fall 2010)



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## Do you ever wonder?

- ❖ How much trash each person creates each day?
- ❖ How long your purchases are actually in your possession (on average)?
- ❖ Which population often knows the most about recycling?



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## What about this stuff?



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## Do you ever wonder?

- ❖ What happens to a drug or a personal hygiene product after its original use?
- ❖ What to do with unused or expired meds or personal care products?
- ❖ Is our drinking water safe to drink – isn't it better to drink bottled water?
- ❖ Who/what should I believe?
  - "Experts" advice changes



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## How aware are you?

- ❖ Sewage sludge can be used as agricultural fertilizer
- ❖ Livestock are often fed hormones to increase growth or milk production
- ❖ Water bottles, baby bottles and other types of containers contain bisphenol A (BPA).
- ❖ Children's toys and air fresheners contain phthalates.
- ❖ Rx Disposal: drug diversion vs. environmental protection



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## Elective Course

- ❖ Sources of Pollution; Current U.S. Practices and Laws
- ❖ Acute vs. Chronic Exposure; Water Treatment Strategies
- ❖ Hormones; Endocrine Disruptors
- ❖ Personal Care Products (sunscreen, fragrances)
- ❖ Antibiotics, Antibacterials, and Resistance



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## Sources of Pharmaceuticals

- ❖ Purposeful Entry
  - Hospital, long term care, hospice
  - Domestic sewage, landfill, straight piping, illicit drug manufacturing
- ❖ Inadvertent Entry
  - Excreted "unchanged"; washed off
  - Storm water; pets; agricultural sources
- ❖ Anticipated/Controlled Entry
  - Pharmaceutical manufacturing



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## Do we need to worry?

- ❖ Testicular cancer
- ❖ Sperm count
- ❖ Cryptorchidism
  - Undescended testes
- ❖ Hypospadias
  - Urethra opening underside of penis
- ❖ Ratio of male/female babies
- ❖ Breast cancer
- ❖ Early puberty



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## Are other species at risk?



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## Are other species at risk?

- ❖ Interrupted sexual development
- ❖ Thyroid system disorders
- ❖ Inability to breed
- ❖ Reduced immune response
- ❖ Abnormal mating and parenting behavior
- ❖ Increased incidence of endometriosis (monkeys)



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## What's in the water?




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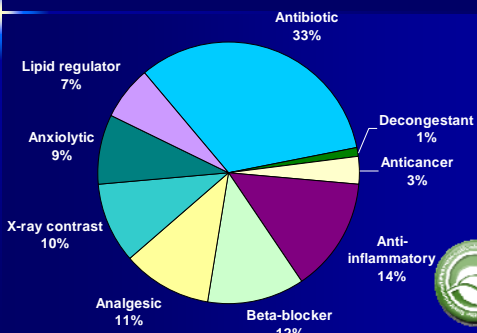
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## What's in the water?




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## What's in the water?

- ❖ Ethinyl estradiol
- ❖ SSRIs
- ❖ Carbamazepine/phenytoin
- ❖ Diclofenac/Ibuprofen
- ❖ Clofibrac acid/Gemfibrozil
- ❖ Clotrimazole
- ❖ Tamoxifen
- ❖ Erythromycin/TMP+SMX
- ❖ Tetracyclines
- ❖ Genotoxic agents
- ❖ 4-Nonylphenol
- ❖ Tri (2-chloroethyl) phosphate
- ❖ Bis (2-ethylhexyl) phthalate
- ❖ Triclosan
- ❖ Bisphenol A




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## Where are the drugs coming from?




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## What are we talking here...

### ❖ Marine Surface Water

- [Clofibric acid] 1-2 ng/L in the North Sea
- [Clotrimazole] 1-34 ng/L in UK estuaries
- [Tamoxifen] 210 ng/L in Tyne estuary

### ❖ Freshwater Surface Water

- [Ibuprofen] 7.8 ng/L in rivers/lakes  
297 ng/L in Tyne river
- [Carbamazepine] 185 ng/L in rivers
- [Naproxen] 207 ng/L in rivers




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## What are we talking here...

### ❖ From WTW effluents:

- [Erythromycin] 145-290 ng/L
- [Diclofenac] 38-489 ng/L
- [Gemfibrozil] 810-4760 ng/L
- [Ibuprofen] 50-7110 ng/L

### ❖ From drinking water:

- [Carbamazepine] 258 ng/L (USA)
- [Dehydronifedipine] 4 ng/L (USA)
- [Primidone] 15 ng/L (Germany)
- [Acetyl salicylic acid] 25-100 ng/L (Neth.)




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## Seriously?



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## Personal Care Products of Concern

- ❖ UV Filters
  - Sunscreen, hair products, cosmetics
- ❖ Synthetic Musks
  - Fragrance (cosmetics, detergents)
- ❖ Microplastics
  - Scrubs (facial, detergents)



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## Routes of Exposure

- ❖ Alkylphenols
  - Plasticizers
  - Laundry detergents
  - Shampoo, cosmetics
  - Emulsifiers in food waxes
  - Polymer resin in food packaging
  - Spermicidal lubricants
  - Industrial detergents (wool washing)
  - Pesticides



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## Routes of Exposure

### ❖ Bisphenol A

- Building block of polycarbonate plastic
  - Baby bottles, sippy cups, hard plastic toys
- Component of epoxy resins
  - Dental sealants
- Resin component to coat metal products
  - Canned food, bottle tops, water supply pipes
- Miscellaneous
  - Fungicides, dyes, flame retardants



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## Routes of Exposure

### ❖ Phthalates

- Construction materials, vinyl tile, flooring materials, tool handles, automobile undercoating and parts
- Medical devices (PVC based)
- Perfumes, cosmetics, shampoo, sunscreen, insect repellents
- Shoes, garden hoses, toys, notebook covers, carpets, pool liners, rain coats
- Coating on timed release products



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## Seriously?



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## What's the solution?

- ❖ Reduce/Reuse/Recycle
  - Educate the public
- ❖ Additional scientific investigation
  - Anticipated vs. documented cause/effect
- ❖ Informed product selection
  - Are there safer choices available?



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## What's a consumer to do?

❖ SMARxT Disposal Program  
<http://www.smarxtdisposal.net/>

- ❖ Take Back programs
  - Barriers:
    - Liability
    - Logistics
    - Longevity



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## Who's paying attention?

- ❖ FDA
- ❖ EPA
- ❖ DEA
- ❖ OSHA
- ❖ National Toxicology Program (NTP)
- ❖ Consumer Product Safety Commission (CPSC)



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## Are there any regulations?

- ❖ Resource Conservation and Recovery Act (RCRA)
- ❖ Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
- ❖ Clean Water Act; Ground Water Rule
- ❖ Safe Drinking Water Act
- ❖ Toxic Substances Control Act
- ❖ Food, Drug and Cosmetics Act



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