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Toxins in Your Everyday Environment

Timur S. Durrani, MD, MPH, MBA
Division of Occupational and Environmental Medicine

"What we have to face is not an occasional dose of poison which has accidentally got into some article of food, but a persistent & continuous poisoning of the whole human environment."

Rachel Carson, Silent Spring

Outline

- What is Toxicology?
- Important Concepts
- Toxins in your everyday environment
- Common Pitfalls: 'Testing' & 'Treating'
- What can you do?

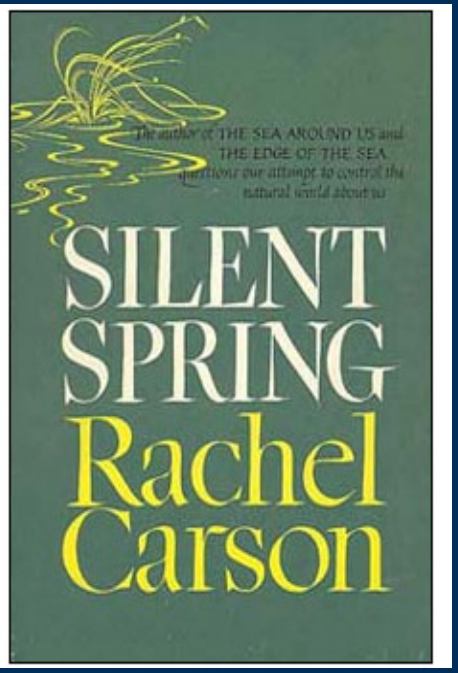
What is (Medical) Toxicology?

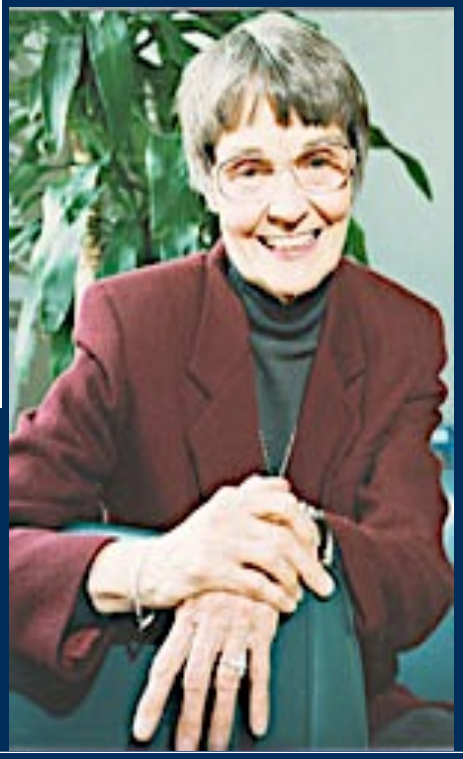
- Medical toxicology is a subspecialty focusing on the diagnosis, management, and prevention of poisoning and other adverse health effects due to drugs, occupational and environmental toxic substances, and biological agents.

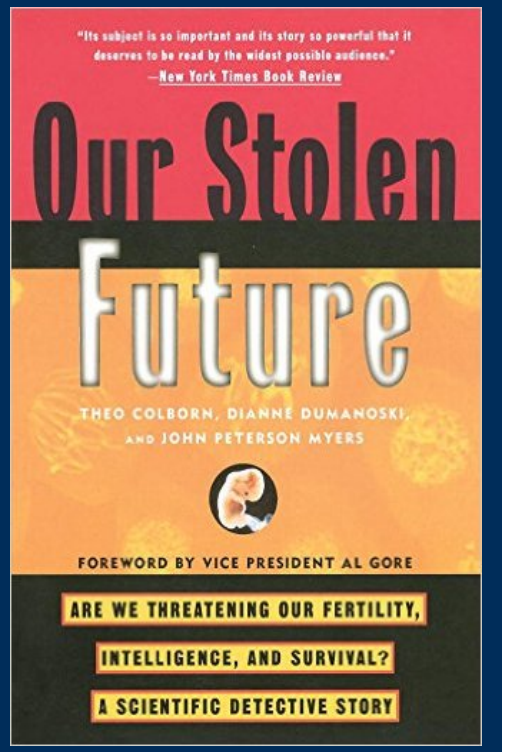
Who is a "Toxicologist"?

- Clinical toxicologist – Pharmacist
- Forensic toxicologist – M.S., Ph.D.
- Medical toxicologist – M.D.

Important References to Toxins in the Environment







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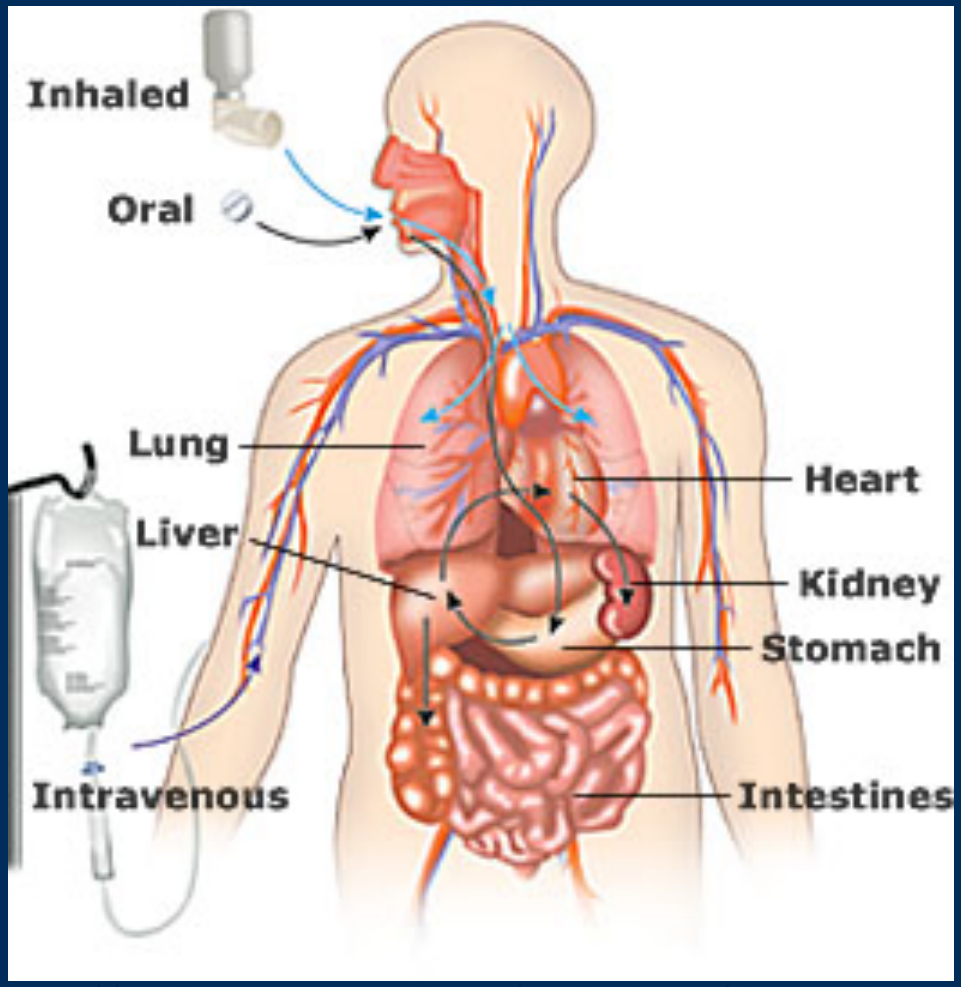
Toxicodynamics & Toxicokinetics

- Toxicodynamics
  - What the poison does to the body
- Toxicokinetics
  - What the body does to the poison

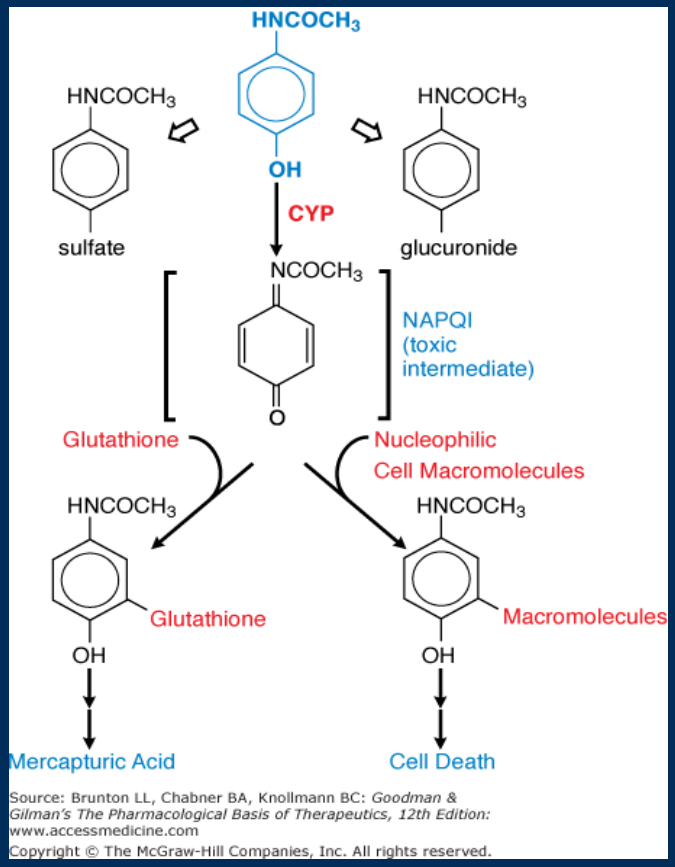
Toxicokinetics

- **A**bsorption
- **D**istribution
- **M**etabolism
- **E**limination



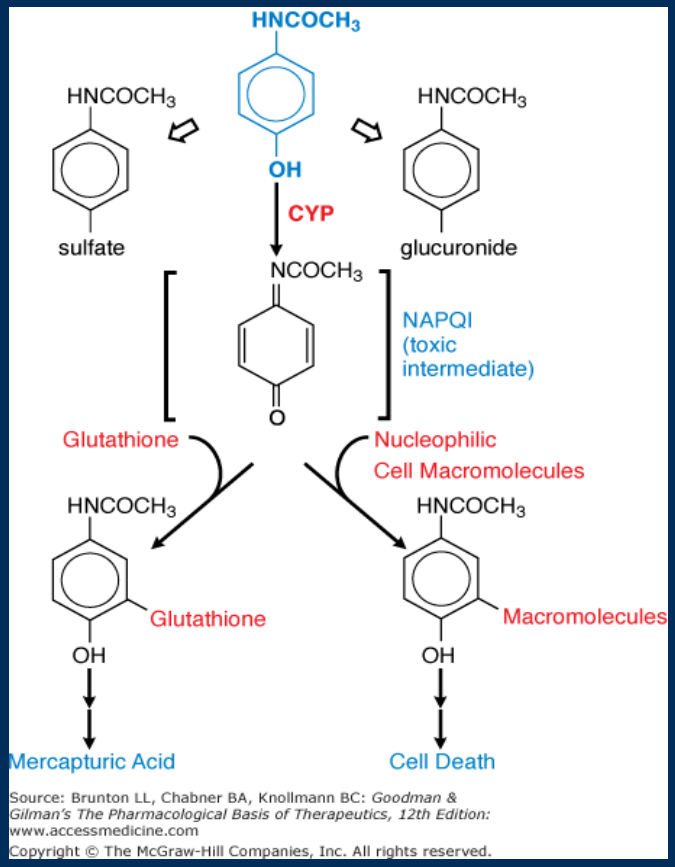
https://publications.nigms.nih.gov/medbydesign/chapter1.html

N-acetyl-p-aminophenol metabolism



Source: Brunton LL, Chabner BA, Knollmann BC: *Goodman & Gilman's The Pharmacological Basis of Therapeutics, 12th Edition:* www.accessmedicine.com

N-acetyl-p-aminophenol metabolism



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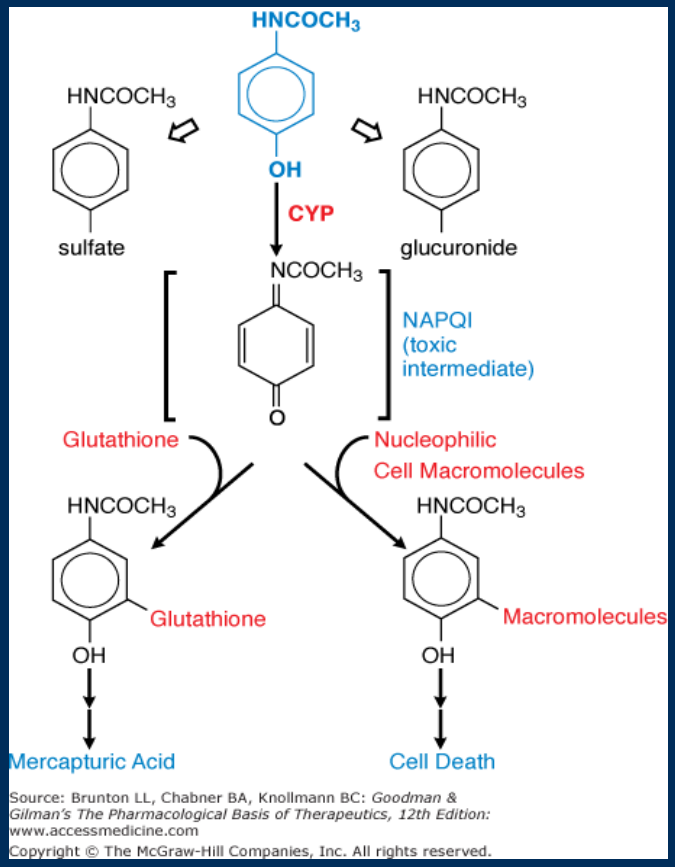

Source: Brunton LL, Chabner BA, Knollmann BC: *Goodman & Gilman's The Pharmacological Basis of Therapeutics, 12th Edition:* www.accessmedicine.com

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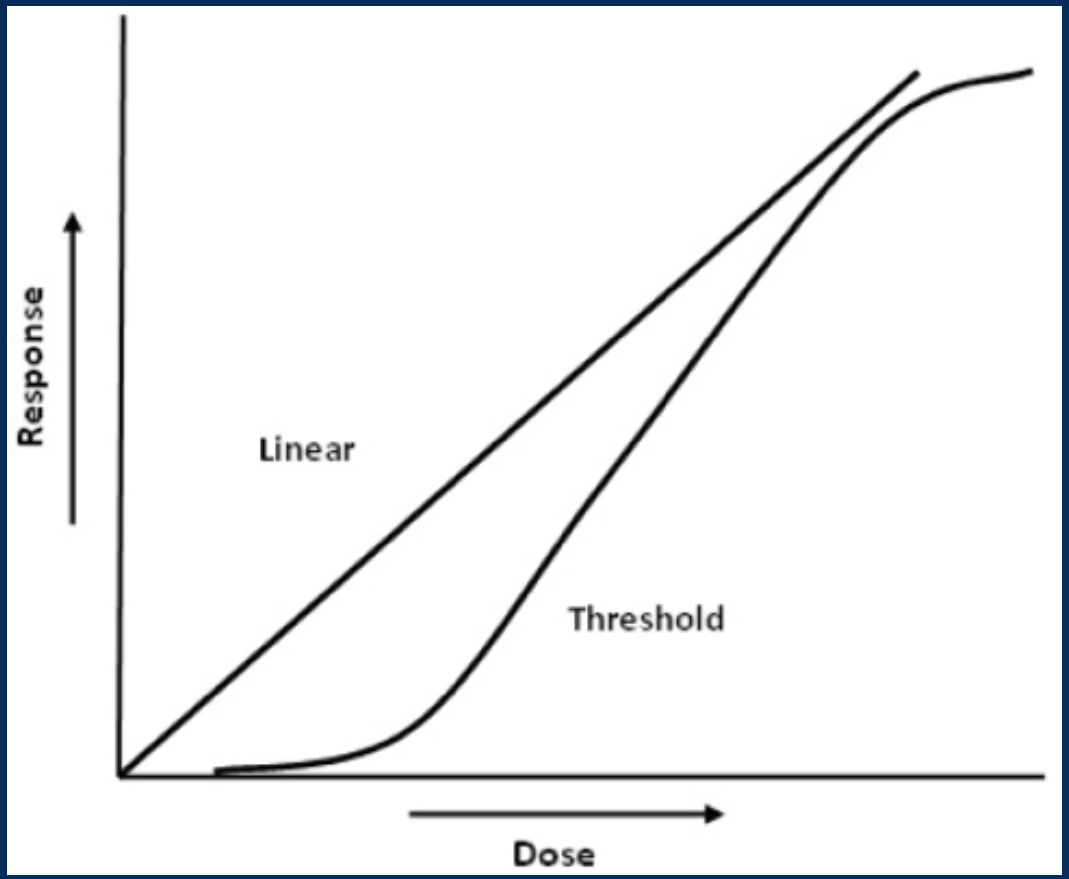
Monotonic Dose Response Curve – slope does not change



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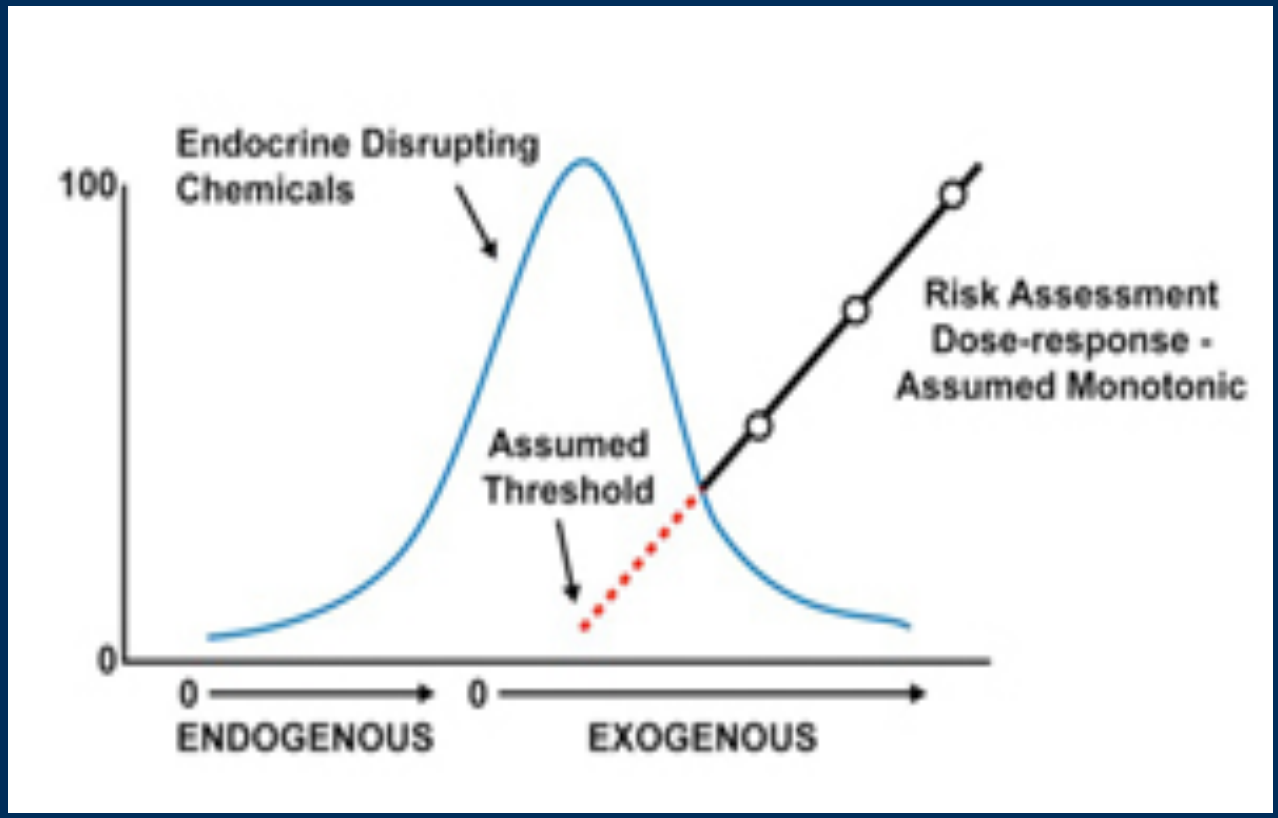
Non-Monotonic Dose Response Curve



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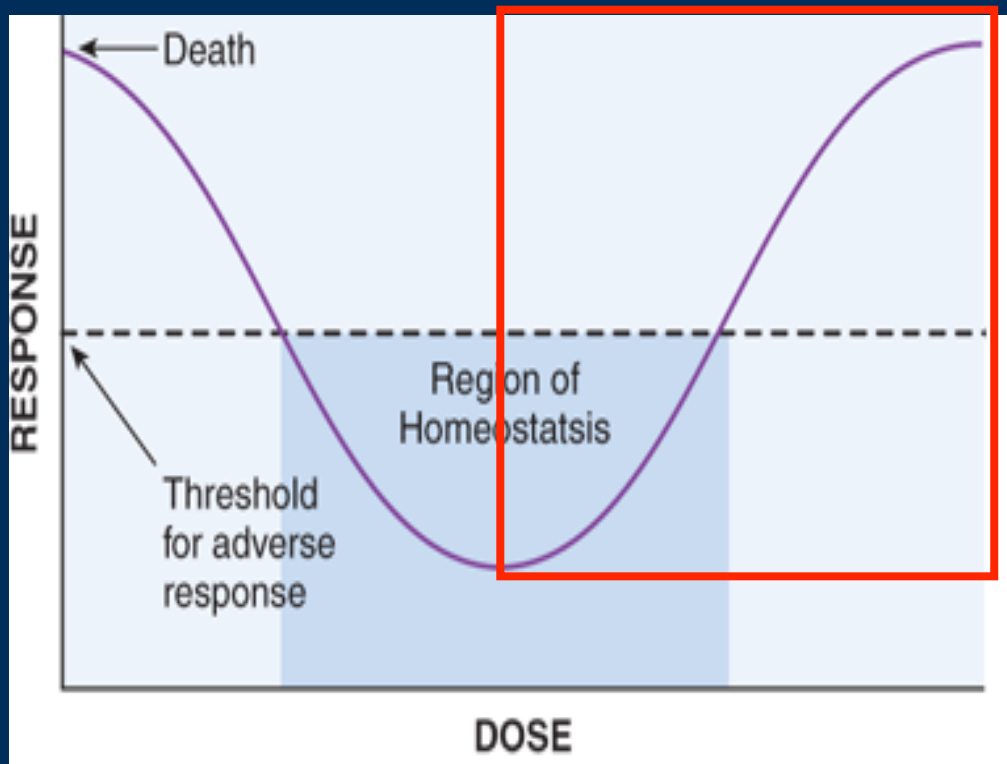
Non-Monotonic Dose Response Curve



Hormesis

Source: L. L. Brunton, B. A. Chabner, B. C. Knollmann: Goodman & Gilman's: The Pharmacological Basis of Therapeutics, 12ed.
www.accesspharmacy.com

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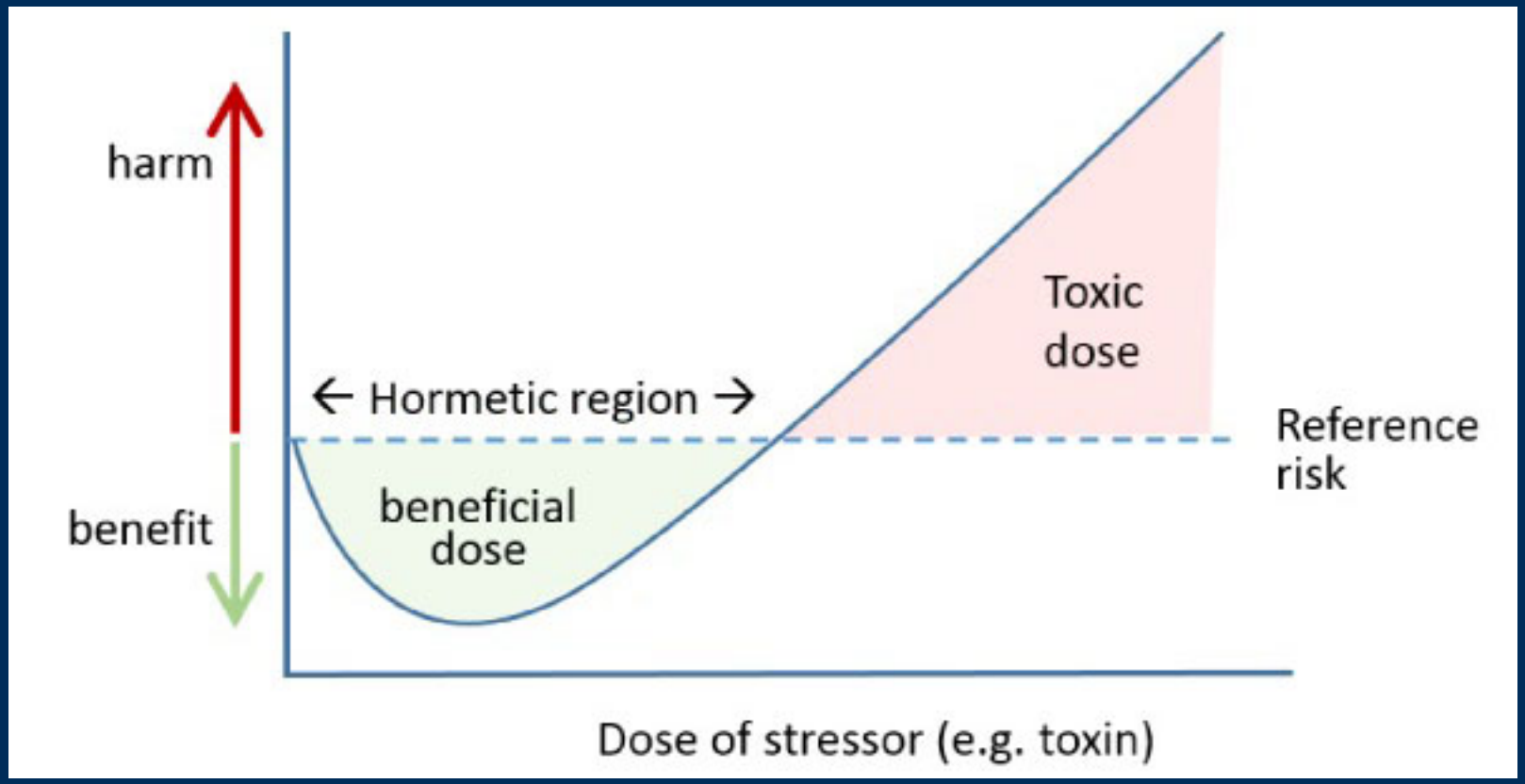
Hormesis



http://smartdrugsmarts.com/episode-108-hormesis/

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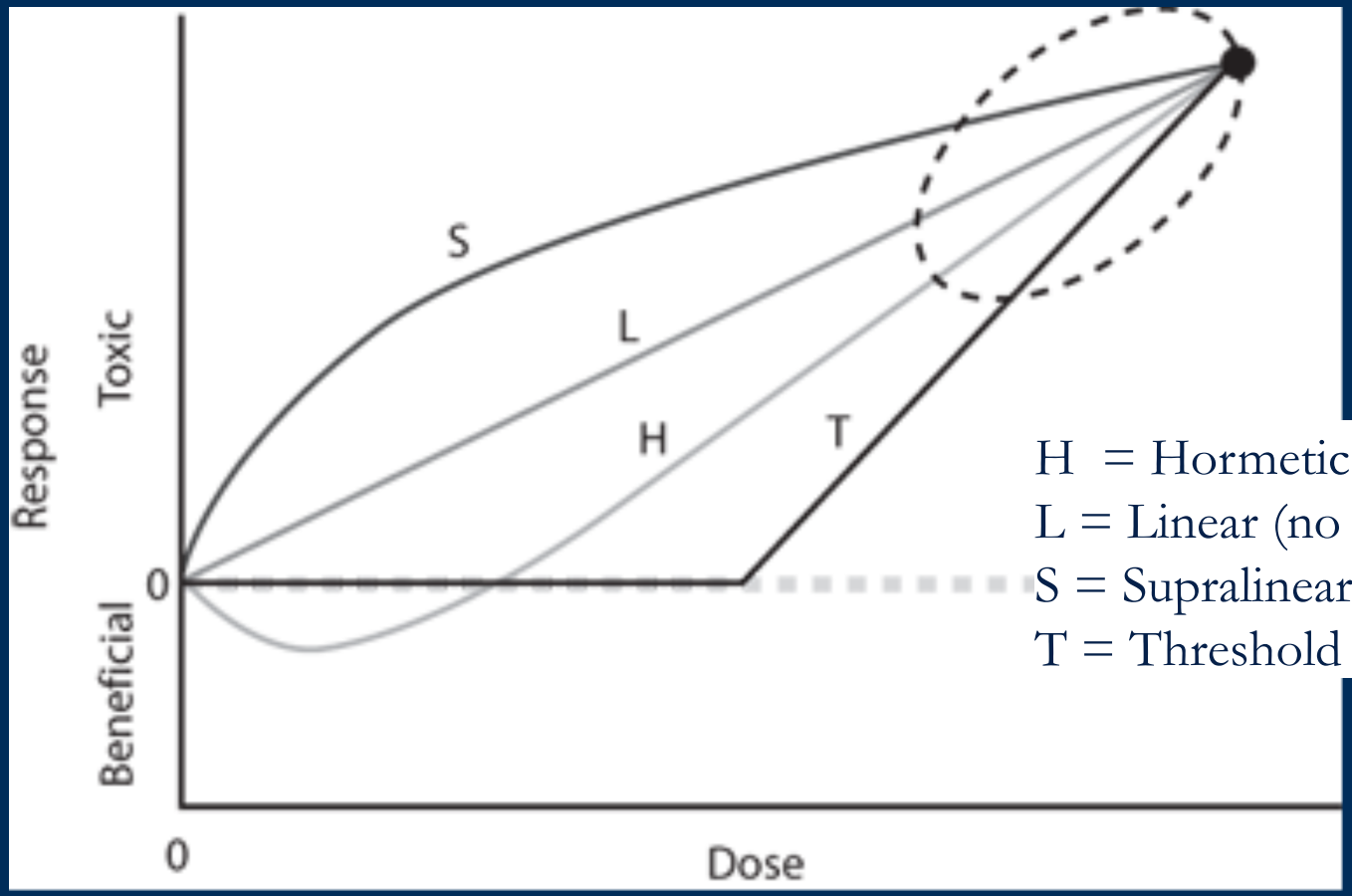
Summary of Dose Response Curves



H = Hormetic
L = Linear (no threshold)
S = Supralinear
T = Threshold

Source: Medical Toxicology, *CURRENT Diagnosis & Treatment: Occupational & Environmental Medicine, 5e*

Citation: LaDou J, Harrison RJ. *CURRENT Diagnosis & Treatment: Occupational & Environmental Medicine, 5e*; 2013 Available at: http://accessmedicine.mhmedical.com/content.aspx?bookid=1186&sectionid=66480247 Accessed: January 18, 2017

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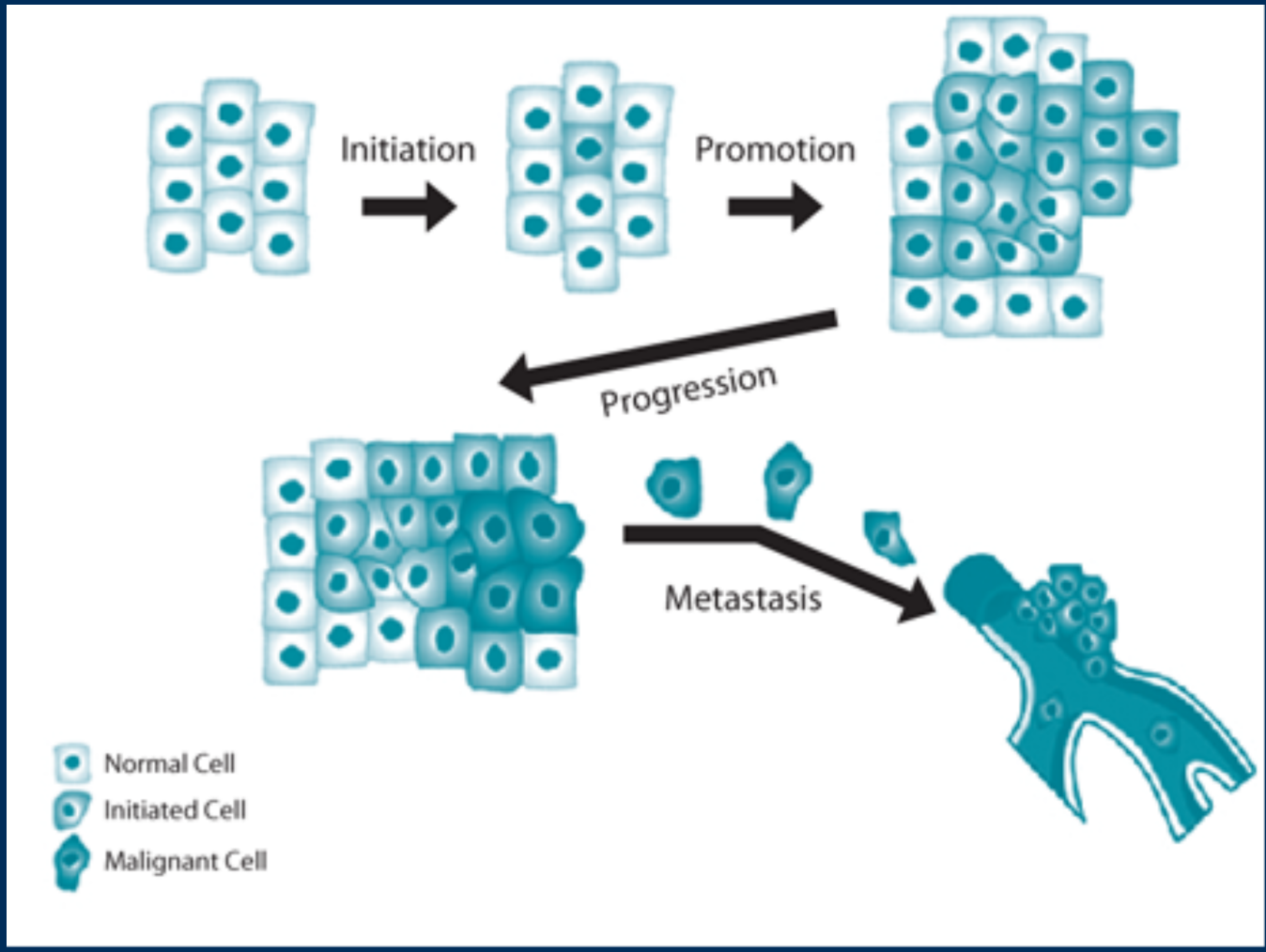
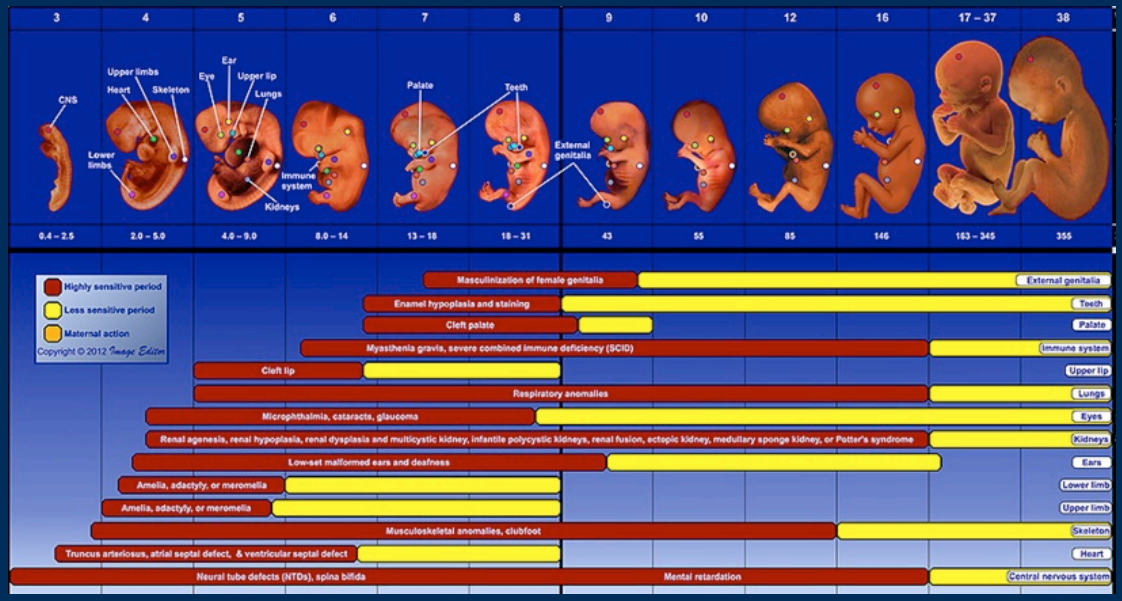
Carcinogenesis progression



Teratogens

- For most chemicals known to have adverse effects on fetal development in test animals, there are **insufficient data in humans**.
- In general, so little is known about the effects of substances on fetal development that it **is prudent to manage all chemical exposures conservatively**.



Williams Obstetrics, 24e > Teratology, Teratogens, and Fetotoxic Agents

Timing of organogenesis during the embryonic period

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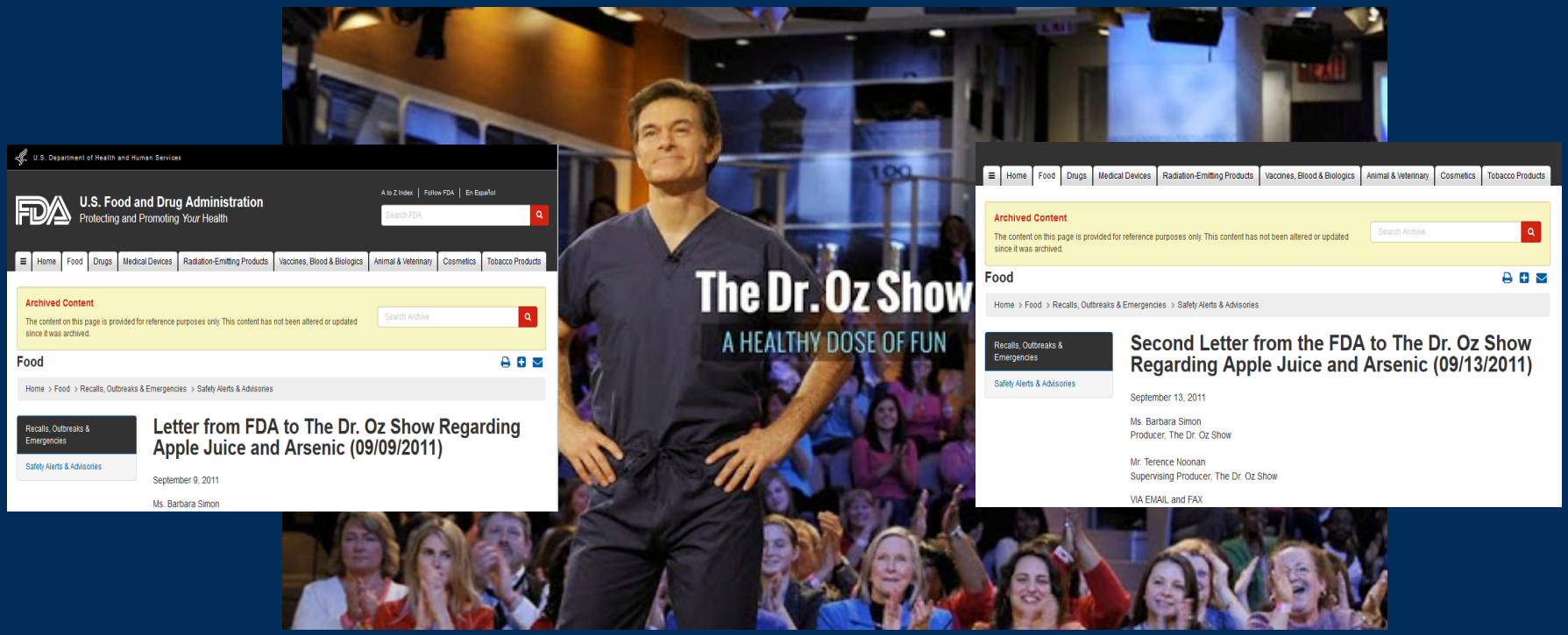
Arsenic

Arsenic in apple juice

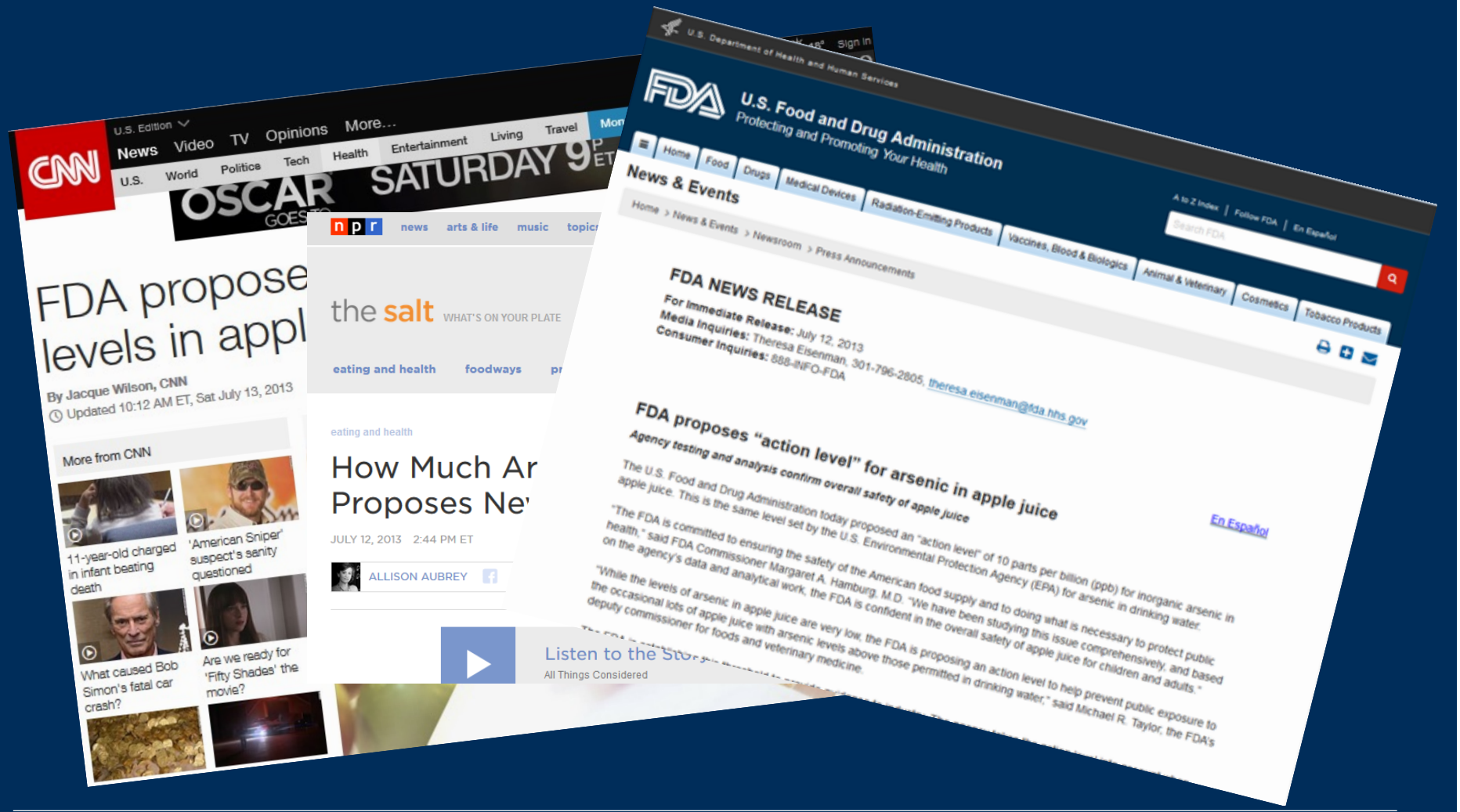
- Arsenic made national headlines in 2011 by the Dr. Oz Show



Arsenic in apple juice

- Consumer Reports (January 2012)

Arsenic in apple juice



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What is arsenic?

- Inorganic arsenic (iAs)
  - Free
  - Known to be highly toxic
  - Human carcinogen
  - Examples: As^{III}, As^{V}
  - Metabolized to
    - MMA, DMA
- Organic arsenic (oAs)
  - Bound to carbon
  - Toxicity varies
  - Not always known
  - Examples: Arsenobetaine, Arsenolipids

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Health Effects

- Acute
  - Typically starts in the GI tract
  - Multi-organ failure:
    - Heart Failure
    - Brain: Altered Mental Status
    - Blood: Anemia
    - Skin: Soughing
- Chronic
  - Lung, bladder and skin cancer; possibly other cancers
  - Emerging evidence links high exposure early in life to children's health, with potential lifelong consequences
    - Pulmonary diseases
    - Immunological effects
    - Growth
    - Neurodevelopmental effects
  - Chronic effects of low dose exposure are less studied

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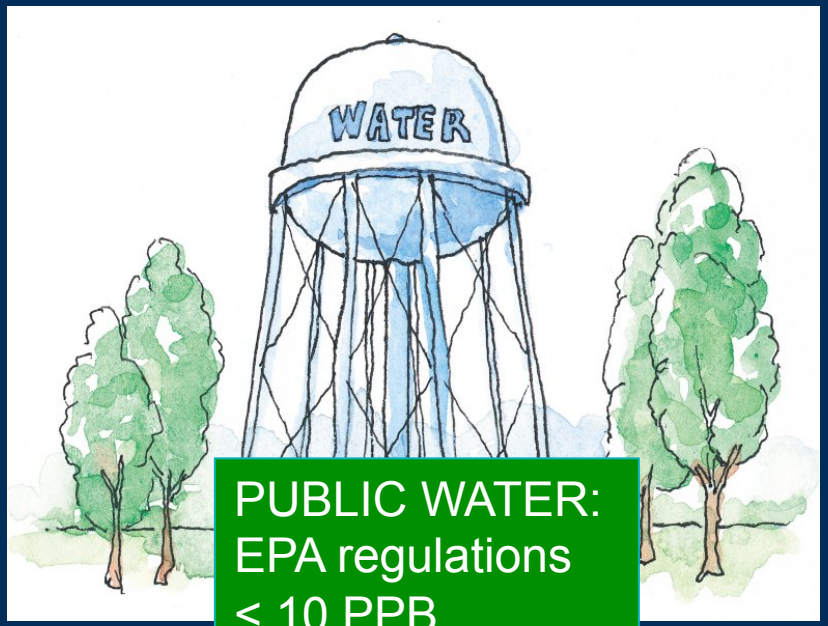
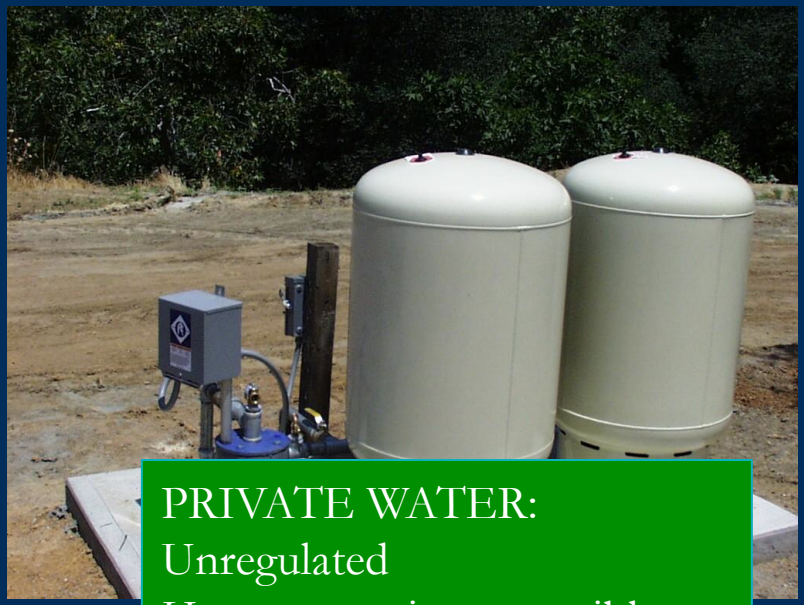
Arsenic exposure via water



PUBLIC WATER:
EPA regulations
< 10 PPB



PRIVATE WATER:
Unregulated
Homeowner is responsible
For testing and treatment

2 million of people in US on wells exceeding U.S. water standard

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Arsenic exposure via water

Is an arsenic level of 10 ppb in our drinking water safe?

3ppb -> 1 excess cancer* in 1,000

5ppb -> 1.5 excess cancer* in 1,000

10ppb-> 3 excess cancer* in 1,000

20ppb-> 7 excess cancer* in 1,000

*cancer refers to bladder and lung cancer

Arsenic levels in common foods

Arsenic intake occurs through food and drinking water with recent concerns focused on high levels in rice. Elevated levels of arsenic can cause lung, bladder and skin cancers, cardiovascular disease and hypertension and could cause neurological deficits and diabetes.

RECOMMENDED MAXIMUM ARSENIC INTAKE

220-lb. person
30 µg

50-lb. child
14 µg

Health threat = **50+ µg**

RICE, RICE PRODUCTS
3.5-6.7 µg per cup

MEAT*

Beef
0.1 µg per half pound

COOKED SPINACH
1.1 µg per cup

Chicken
0.2 µg per half pound

UNREGULATED

Shrimp
0.4 µg per half pound

***FISH**
Fish has high amounts of organic arsenic that are not as risky to human health as inorganic arsenic.

Arsenic in water

WELL, SPRING, NATURAL WATER
- Concentration can reach 100-200 ppb (parts per billion)
- 200-400 µg per 2 liters of water.

REGULATED

PUBLIC WATER
- Typical concentration: 2-4 ppb = 4-8 µg per 2 liters of water.

NOTE: 10 ppb is the maximum concentration allowed, or 20 µg per 2 liters of water.

Sources: "A Market Basket Survey of Inorganic Arsenic in Food," Food and Chemical Toxicology 37 (1999), by R.A. Schoof, et. al.

James Hilston/ Post-Gazette

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Arsenic in rice

Is there a health concern?

- FDA 2013
  - 1343 samples
  - 30% contained levels > 4.0 ppb per serving (excesses drinking water limit if > 4 servings/day)
  - Arsenic also in Infant and children's food products

- 2008 Study looking at arsenic in Baby Rice cereals
  - Drinking water 10 ppb: 0.17 µg/d/kg
  - Baby rice cereal: 0.21 µg/d/kg

Meharg AA, Sun G, Williams PN, Adomako E, Deacon C, Zhu YG, Feldmann J, Raab A. Inorganic arsenic levels in baby rice are of concern. Environ Pollut. 2008 Apr;152(3):746-9.

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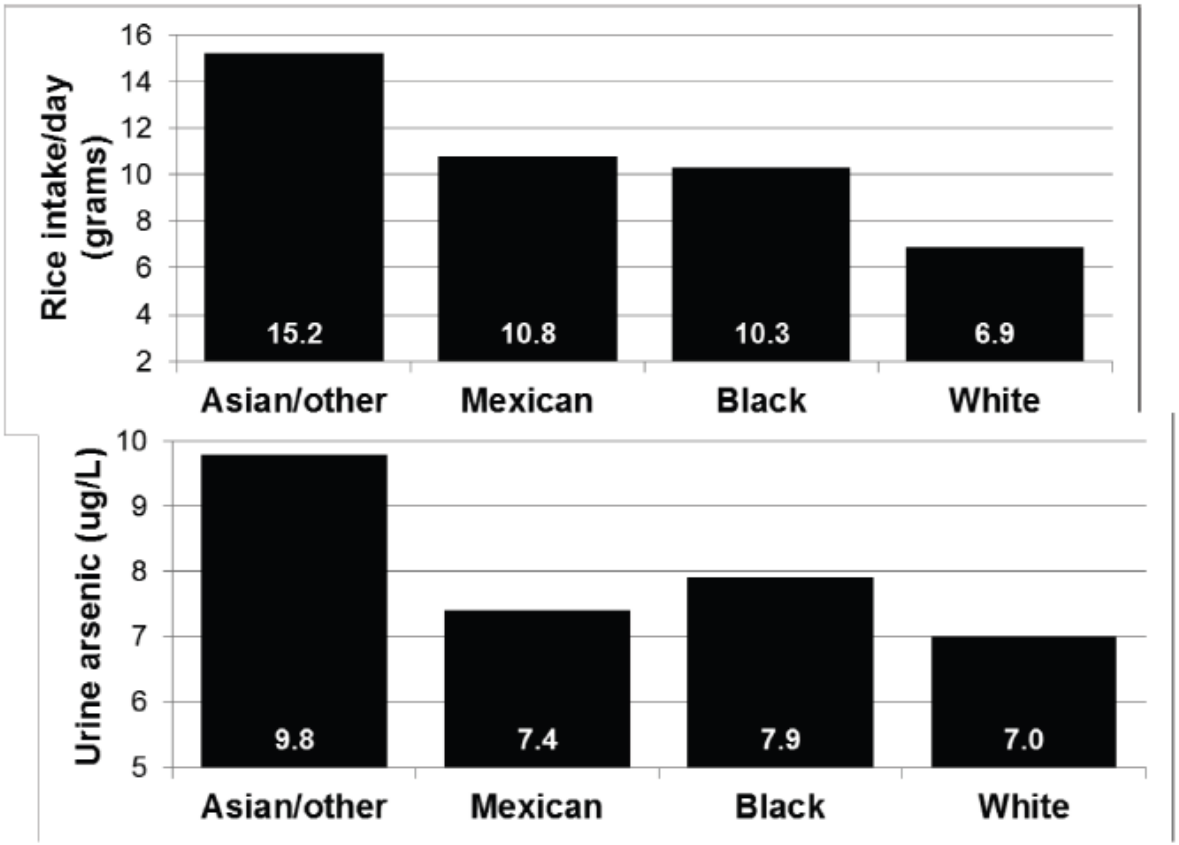
Is there a health concern?

Figure 4. Urinary arsenic and rice intake levels in children by race, NHANES 2003-2008.



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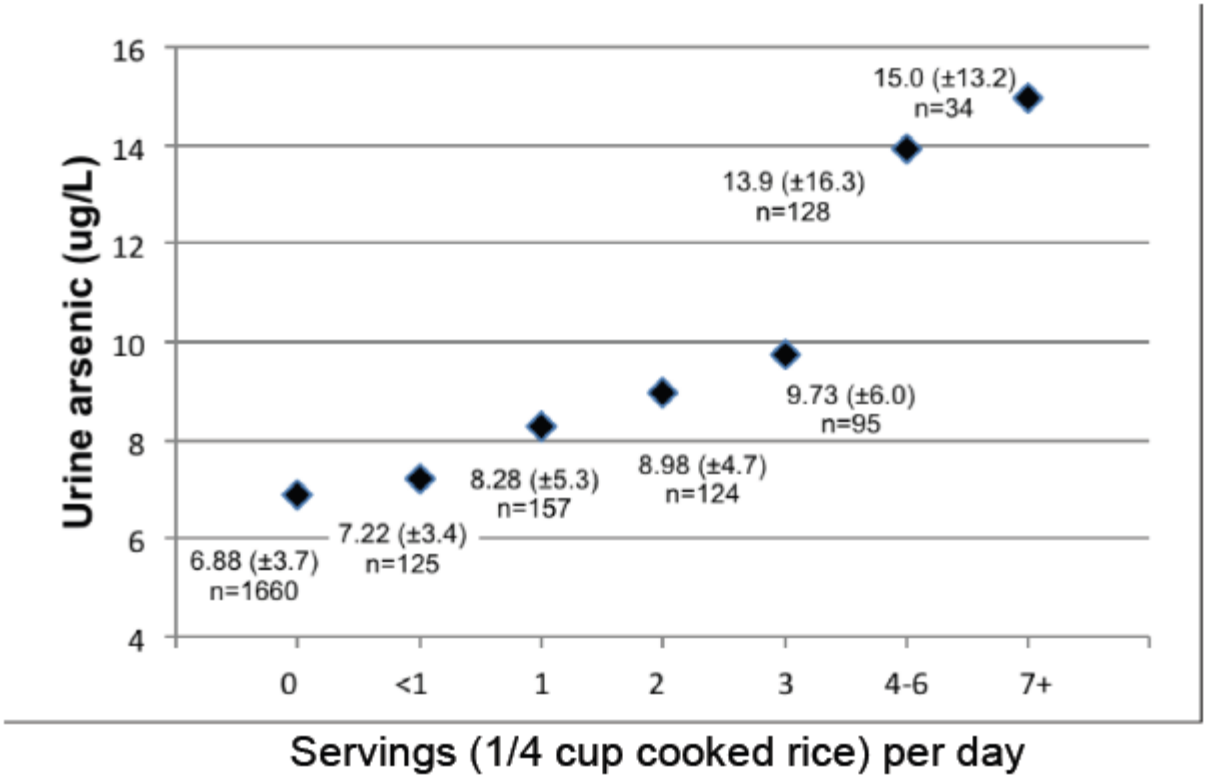
Is there a health concern?

Figure 3. Increasing median urine arsenic with increasing rice intake in children. NHANES 2003-2008.



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What do we know?

- Rice > other grains
  - Anaerobic growing environment
  - Unique physiology
- Brown rice > white rice
  - Arsenic accumulates in the bran
  - Brown rice has more fiber and vitamins
- South Central U.S. > California
- Basmati and sushi rice less than other types of rice

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What can you do?

- The FDA advises consumers to:
  - Eat a well-balanced diet
  - Vary your grains
  - Consider diversifying infant foods
- The AAP advises parents to:
  - Offer children a wide variety of foods, including other grains such as oats, wheat and barley
  - Parents commonly feed infants rice cereal as a first food, but other foods are equally acceptable as a first food
  - Additional research is needed

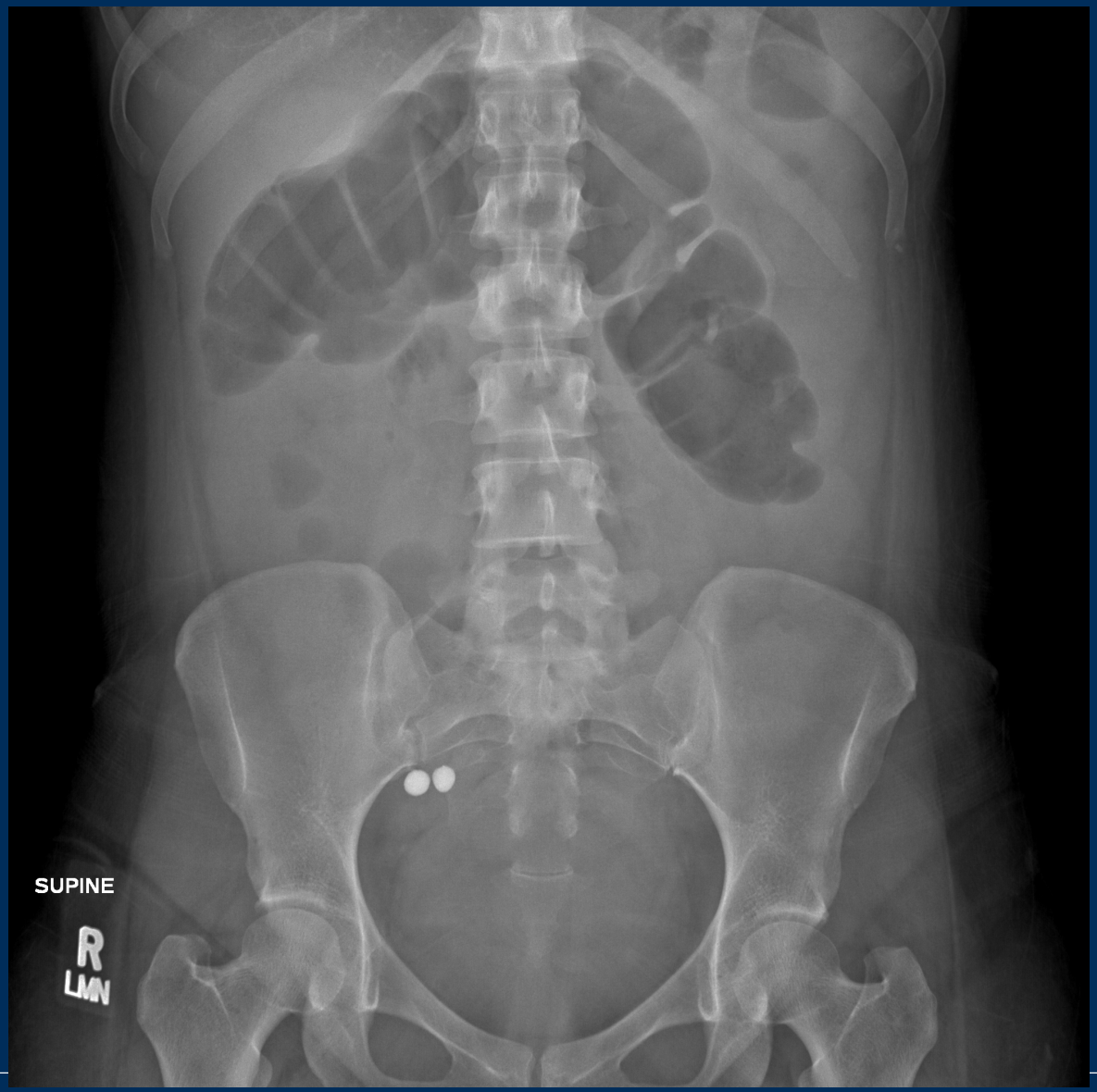
Lead

A Case…

- A 32 year old female, with a 7 year history of abdominal pain is admitted to UCSF internal medicine service for intractable abdominal pain.
  - She says it feels as if its “Squeezing my guts from the inside out".
  - She has with nausea, anorexia, and a 15 lb weight loss.
    - Mild constipation. Not associated with food or reflux.
    - Occasional headaches.
    - Generalized fatigue. Mild pain in multiple joints.

Role of Delta-aminolevulinic Acid in the Symptoms of Acute Porphyria D. Montgomery Bissell, MD,a Jennifer C. Lai, MD,a Raymond K. Meister, MD, MPH,b,1 Paul D. Blanc, MD, MSPHc

Abdominal X Ray



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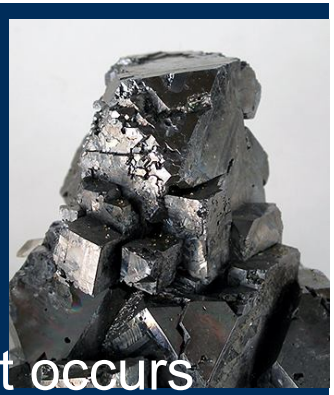
What is lead?



- Inorganic lead is a malleable, blue-gray, heavy metal that occurs naturally in the Earth's crust. It has a low melting point, high density and corrosion resistant. These properties allow it to be used in a variety of products with minimal technical equipment or expertise.
- Lead was one of the first metals used by humans and consequently, the cause of the first recorded occupational disease (lead colic in a 4th century BC metal worker).
- In 2012, U.S. production of lead was estimated at 1.6 million metric tons; primarily from secondary refining of scrap metal.
- U.S. mines produced 342,000 metric tons, ranking third in the world behind China and Australia.

https://www.osha.gov/SLTC/lead/

Where is lead?

Damaged paint in homes built pre-1979

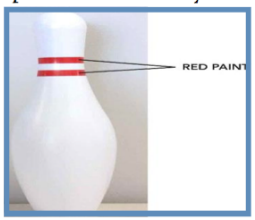
Cracked or peeling paint creates paint chips and lead dust that can be accessible to children in the home and through contact with bare soil.

Lead dust from work and hobbies

Working in construction, painting, gardening or recycling centers as well as doing activities like fishing or making jewelry, pottery or stained glass can track lead dust back to the house. Shower as soon as getting home.

Children s Toys

Lead has been found in the paint, glaze & metal parts of various toys.



Children s Clothing

Coatings, jewelry & decals on some children's clothing.

Home Remedies

Some remedies from foreign countries contain lead.

Unsafe Work Practices

Homes can become contaminated with lead due to improper remodeling. Always hire a lead-certified contactor to do home repairs. Requiring lead safe work practices in your home will protect children, pets and the environment.

Children s Art Items

Some children's arts and crafts products are recalled due to violation of paint standard. Unless labeled "Meets ASTM D-4236".

Handmade & Imported Ceramic Ware

May have lead glaze. Do not purchase if item has Prop. 65 Warning.

Makeup

Some lipsticks have been found to have lead, as well as eyeliners from the Middle East.

Metallic Jewelry & Keys

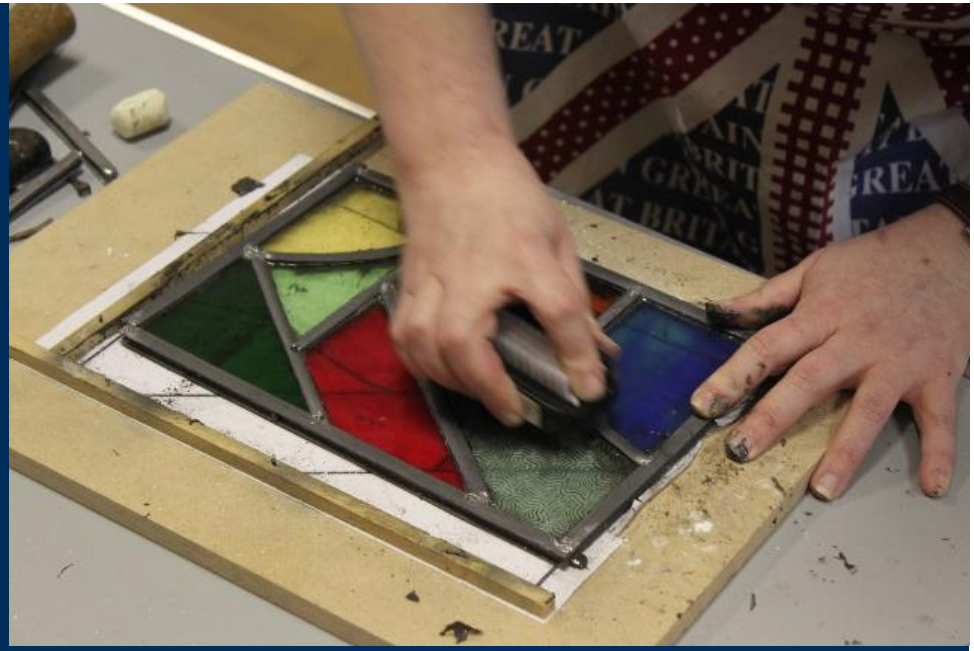
Some necklaces, rings, bracelets, charms and keys contain lead. Swallowing an item can be fatal.

Imported Candies

Numerous foreign candies have been found to contain lead. Consider fruit instead of candy.

Soft Cables & Cords

Lead in the plastic coatings may be swallowed when cables/cords are sucked on or chewed.



Worries About Lead for New York's Garden-Fresh Eggs

A study suggests eggs from neighborhood gardens show elevated levels of lead, but whether the amounts are alarming is not clear.

NYTIMES.COM | BY JULIE SCELFO

Spliethoff HM, Mitchell RG, Ribaudo LN, Taylor O, Shayler HA, Greene V, Oglesby D. Lead in New York City community garden chicken eggs: influential factors and health implications. Environ Geochem Health. 2014 Aug;36(4):633-49. doi: 10.1007/s10653-013-9586-z. Epub 2013 Nov 28.

Guidance Documents & Regulatory Information by Topic

Acidified and Low-Acid Canned Foods

Allergens

Biotechnology

Bottled Water & Carbonated Soft Drinks

Chemical Contaminants, Metals, Natural Toxins & Pesticides

Dietary Supplements

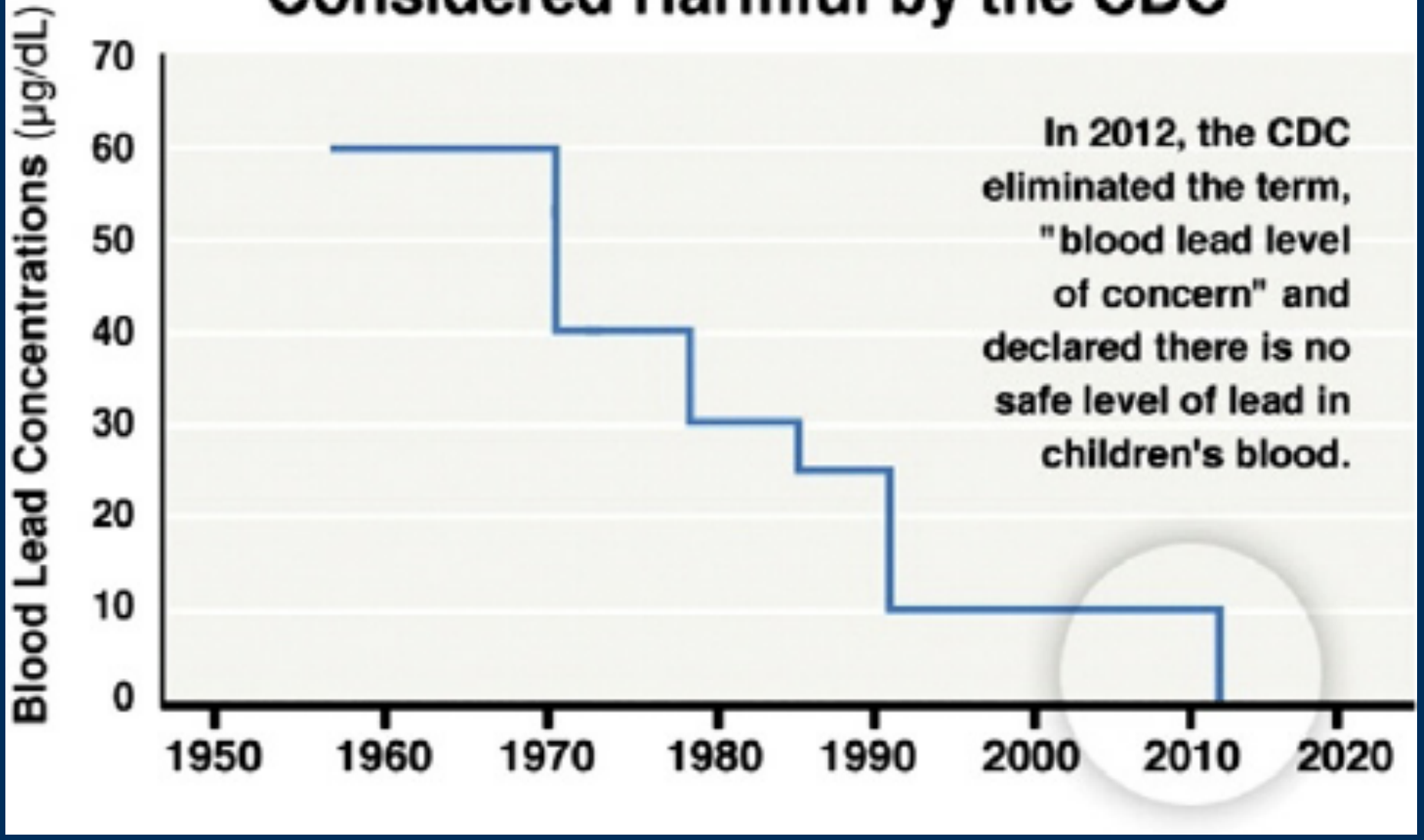
Eggs

Guidance for Industry: Lead in Candy Likely To Be Consumed Frequently by Small Children: Recommended Maximum Level and Enforcement Policy

December 2005; Revised November 2006

Additional copies are available from:
Office of Plant and Dairy Foods, HFS-300
Center for Food Safety and Applied Nutrition
Food and Drug Administration
5001 Campus Drive
College Park, MD 20740
(Tel) [redacted] *(Updated phone: 240-402-2022)*

Blood Lead Concentrations Considered Harmful by the CDC



Taylor MP, Winder C, Lanphear BP. Australia's leading public health body delays action on the revision of the public health goal for blood lead exposures. Environ Int. 2014 Sep;70:113-7.

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Childhood Lead Exposure

Amid growing evidence that even low levels of lead exposure can cause long-term damage to children's development, the American Academy of Pediatrics urges stronger federal action to eliminate exposure.

Common sources of lead in the home:

- Dust
- Soil
- Water in lead pipes
- Toys
- Nutritional supplements
- Dishware
- Fishing sinkers
- Bullets
- Residue from parent occupations
- Paint/hobby materials

37 million

Estimated number of housing units in United States that contain lead-based paint

U.S. housing built from 1940-1959: **39 percent**

U.S. housing built from 1960-1977: **11 percent**

U.S. housing built from 1978-1998: **3 percent**

None

Level of lead exposure considered safe for children

$50 billion

Annual cost of childhood lead exposure in the United States

$17 to $221

Money saved for every $1 invested to reduce lead hazards in U.S. housing

535,000

Estimated number of U.S. preschool children with blood lead levels high enough to call for medical management (more than 5 ug/dl)

23 million

Estimated total loss of IQ points among U.S. children today from lead toxicity

1 in 5

Attention Deficit Hyperactivity Disorder cases attributed to lead exposure

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

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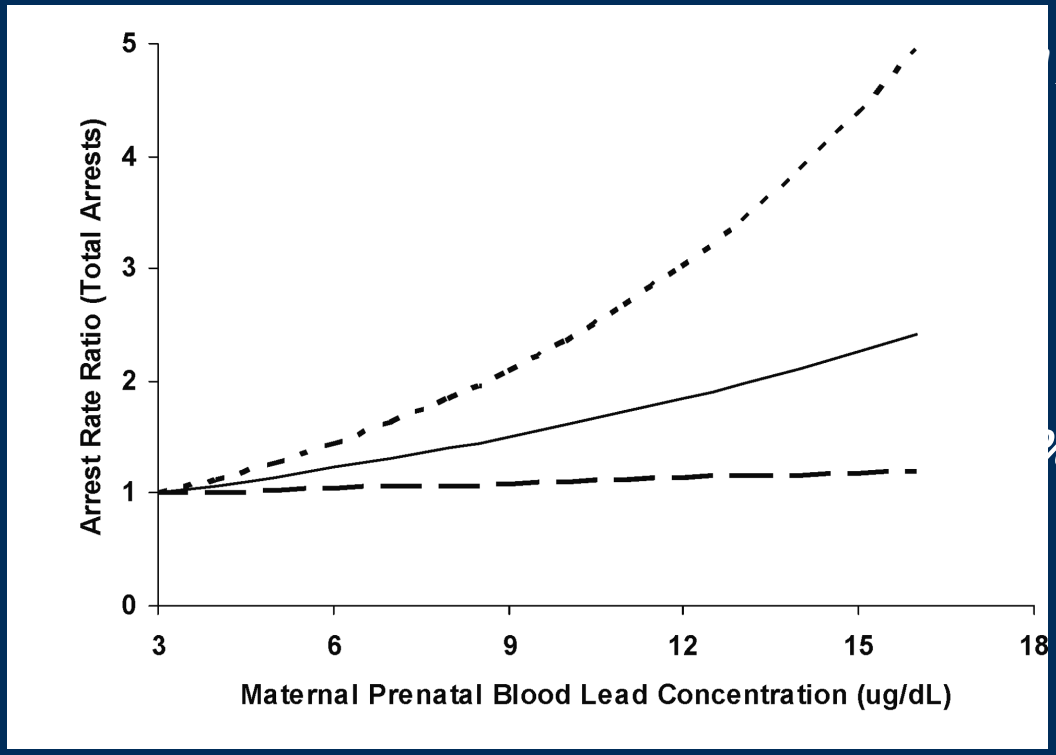
Societal Costs

- The costs of lead hazard control range from $1.2-$11.0 billion/yr.
- The benefits range from $192-$270 billion/yr, this includes the sum of the costs for medical treatment, lost earnings, tax revenue, special education, lead-linked ADHD cases, and criminal activity.



Wright JP, Dietrich KN, Ris MD, Hornung RW, Wessel SD, et al. (2008) Association of Prenatal and Childhood Blood Lead Concentrations with Criminal Arrests in Early Adulthood. PLoS Med 5(5): e101.

Gould, E. (2009). Childhood Lead Poisoning: Conservative Estimates of the Social and Economic Benefits of Lead Hazard Control. Environmental Health Perspectives, 117(7), 1162–1167.

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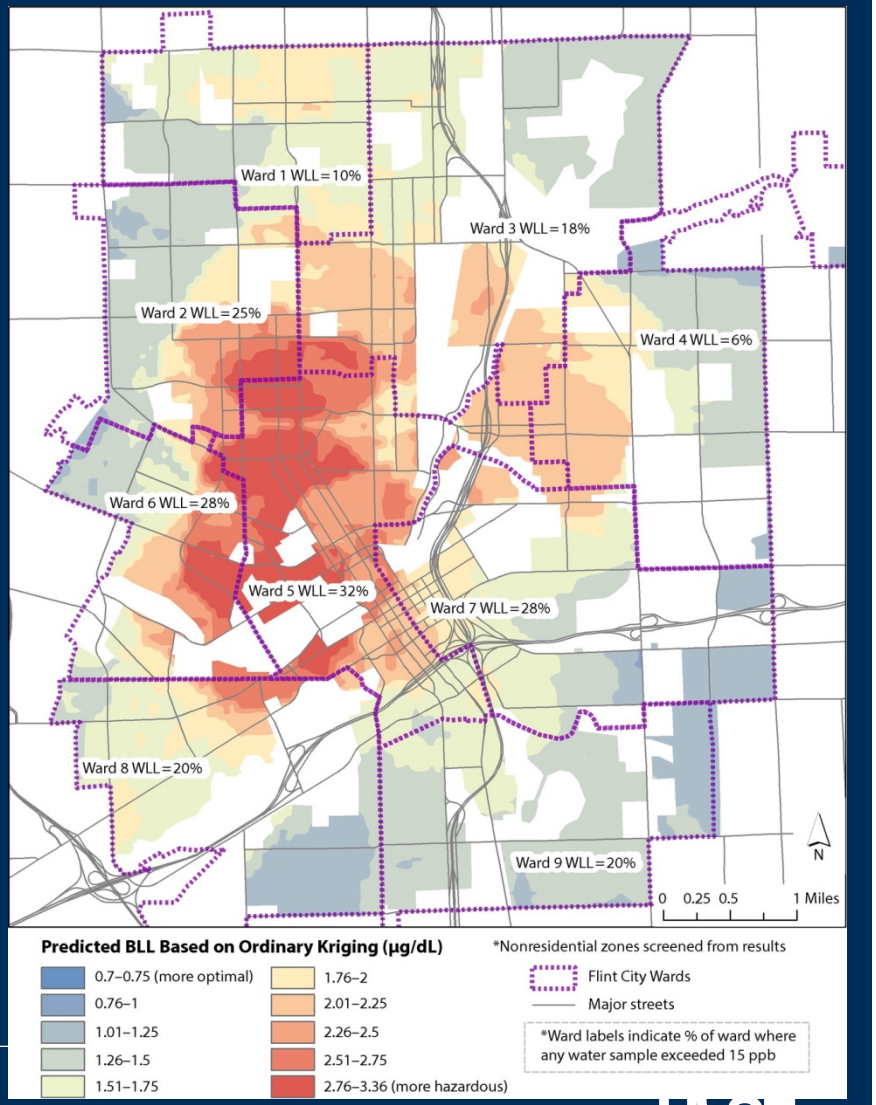
Flint, Michigan

- April 25, 2014: Michigan state officials changed the water source for the City of Flint from Detroit's municipal system to the Flint River.
- Anti-corrosives weren't used, lead began to leach from aging water lines.



Hanna-Attisha M, AJPH 2016

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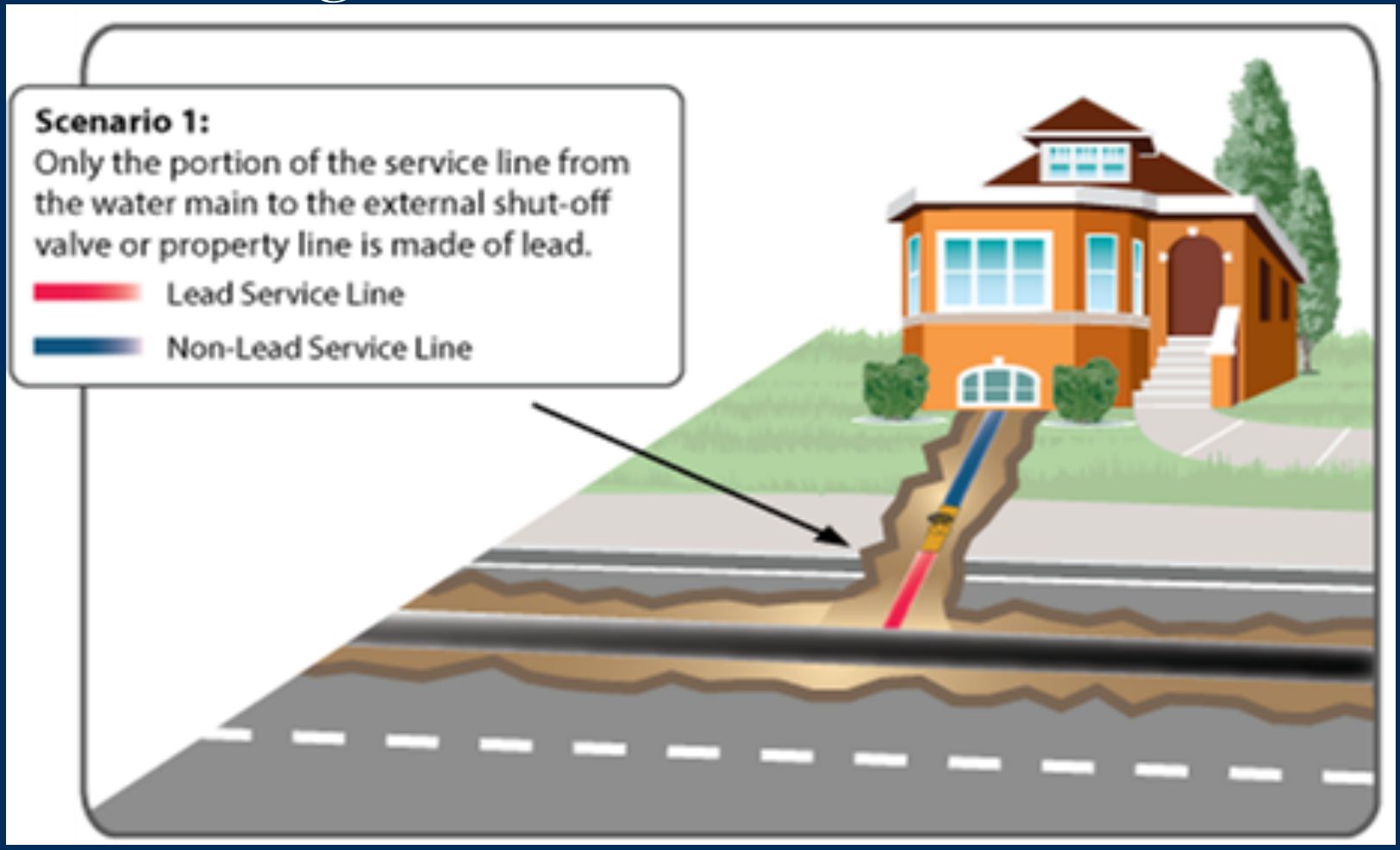
How lead gets into home water



https://www.epa.gov/sites/production/files/2015-10/lead-service-line-scenario1.png

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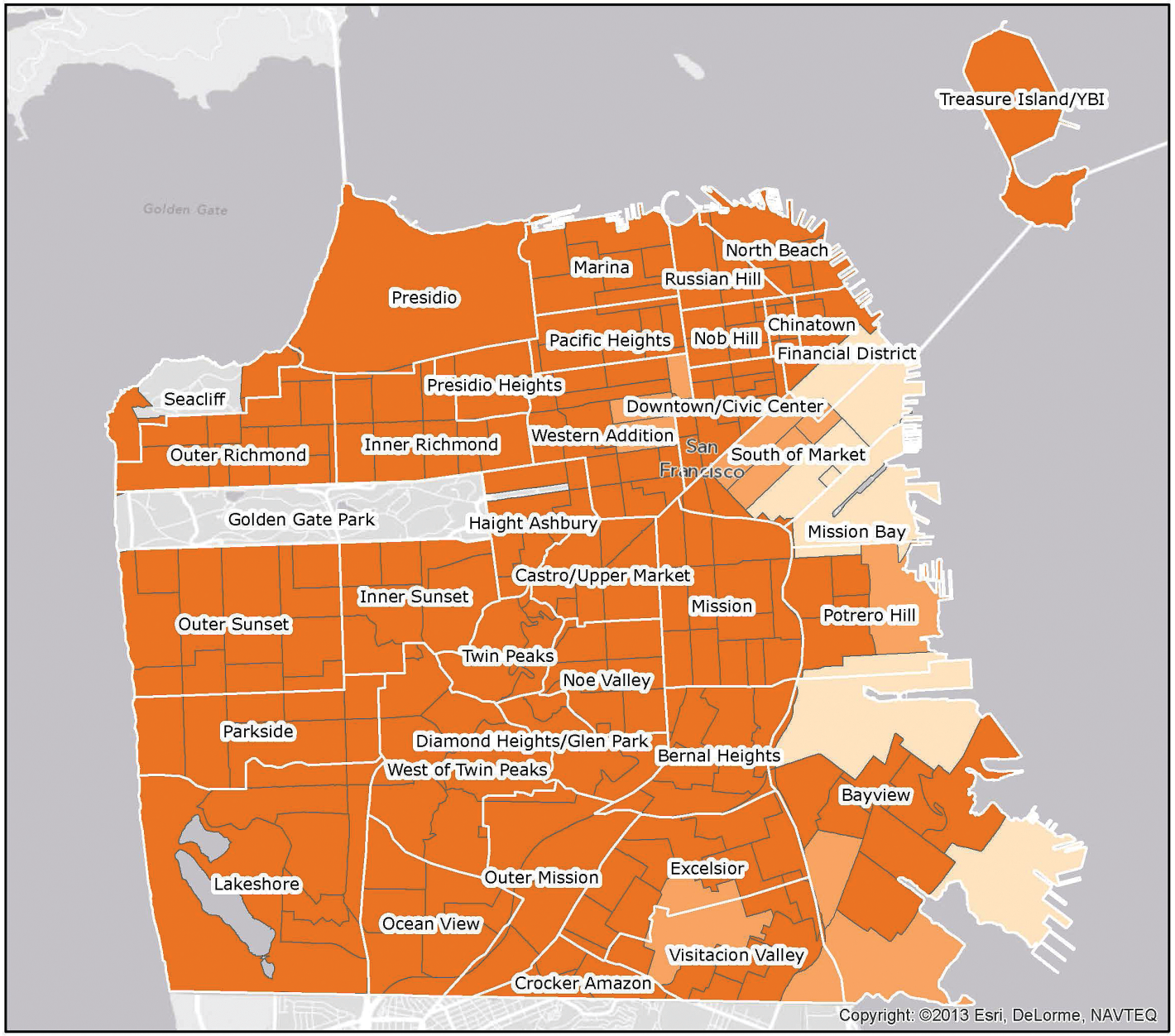
San Francisco Homes Built in 1979 or Before



Percentage of Homes Built in 1979 or Before

- 30% or Lesss
- 30.1% - 60%
- Greater than 60%

Source: U.S. Census Bureau, 2011 American Community Survey (5-year estimates)

San Francisco Department Of Public Health, Environmental Health, 2013

Wholesale Prices for Calcium Disodium Edetate (Calcium EDTA) – 5 ml ampules (200mg/ml)

Manufacturer	Package Size (# of ampules)	Effective Date	Wholesale Acquisition Cost - Package	Average Wholesale Price – Package	Average Wholesale Price per ml	Percent Increase per ml
Graceway Pharmaceuticals	6	10/02/2008	$464.24	$557.09	$18.57	
Valeant Pharmaceuticals North America	5	12/22/2014	$26,927.33	$33,659.16	$1346.37	7,150 %

[Source: Red Book Online Database – Micromedex Solutions® accessed 1/23/2016]

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Valeant Ex-CEO, Ex-CFO Are a Focus of U.S. Criminal Probe

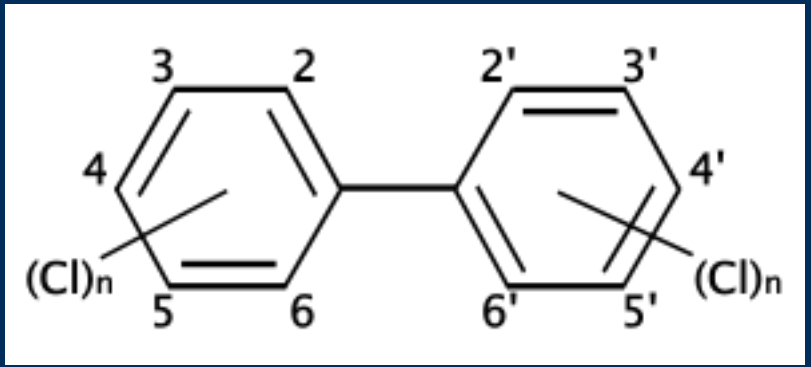
by Christian Berthelsen @CBerthelsen1 Greg Farrell gregfarrel Neil Weinberg NeilAWeinberg Cynthia Koons CynthiaLKoons

October 31, 2016 – 12:24 PM PDT *Updated on* October 31, 2016 – 1:49 PM PDT

Pharmaceuticals.

CaEDTA entered the US pharmacopoeia in the 1950s as a chelating agent that accelerates the removal of lead from the body. When prescribed by medical toxicologists, it is administered by parenteral (i.e. intravenous or intramuscular) injection in a hospital setting to patients with extremely high blood lead concentrations, usually in excess of 100 µg/dl, who are suffering from severe or life-threatening complications of

Polychlorinated Biphenyls (PCBs)



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What are PCBs? Where are they?

- The fire-resistant nature of PCBs, combined with their outstanding thermal stability, made them excellent choices as hydraulic and heat-transfer fluids.
- PCB's take a very long time to break down in the environment. Between 1950 and 1980, many building materials like caulk, light fixtures, and adhesives were made using PCBs.
- It is estimated that between 1⁄4 and 1⁄2 of the 48,000 schools built between 1950 and 1980 may have used these materials.
- PCBs were banned in 1979, but many schools built between 1950 and 1980 still contain PCBs.

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How are people exposed?

- Most PCB poisonings are chronic occupational or environmental exposures, with delayed-onset symptoms the first indication that an exposure has occurred.
- The majority of exposure occurs through the consumption of meat, fish and dairy because of biomagnification up the food chain with PCBs, followed by inhalation in contaminated indoor or outdoor environments.
- Farm raised fish using feed from land animal sources are a source of exposure

Why are PCBs a problem?

- PCBs build up in the body over many years.

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PCB Effects

- Skin rash (chloracne)
- Weakness, weight loss, anorexia
- Numbness and tingling of extremities
- Decreased IQ and other neurobehavioral effects in newborns and children
- Decreased birth weight and immune system effects in babies as a result of transplacental transmission or breastfeeding by mothers exposed to elevated levels of PCBs.
- There is evidence that PCBs cause adverse estrogen activity in male neonates.

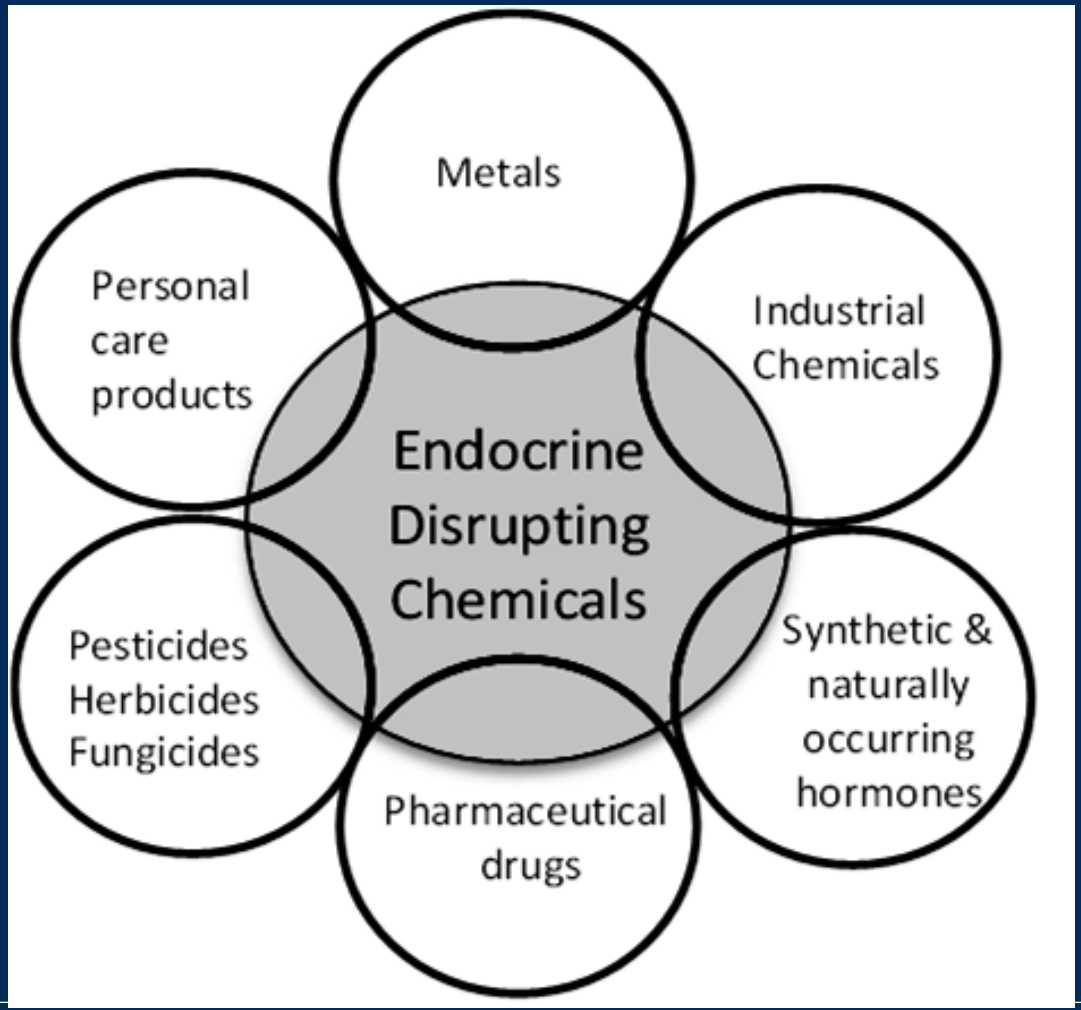
Chloracne

Source: Goldsmith LA, Katz SI, Gilchrest BA, Paller AS, Leffell DJ, Wolff K: *Fitzpatrick's Dermatology in General Medicine, 8th Edition*: www.accessmedicine.com

Endocrine Disrupting Chemicals (EDCs)

Endocrine Disrupting Chemicals:

Substances that interfere with normal hormonal activity



Helmestam 2013

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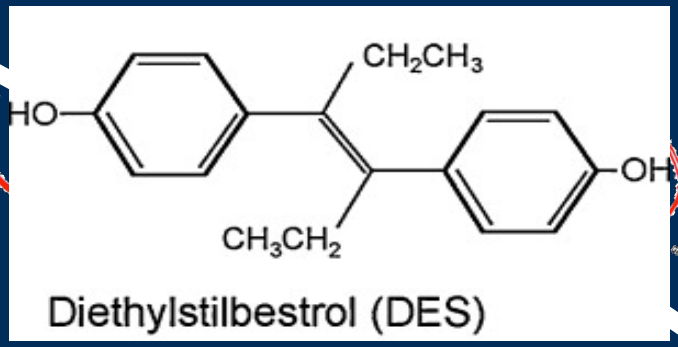
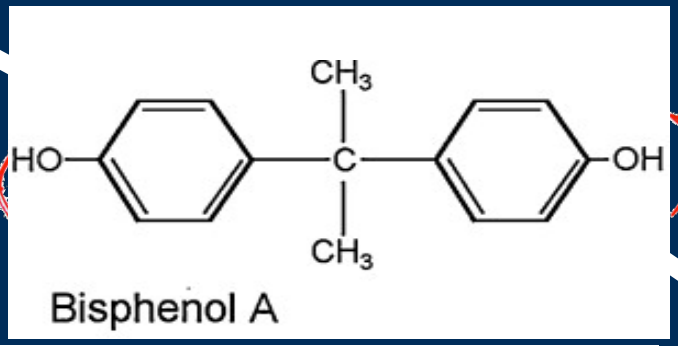
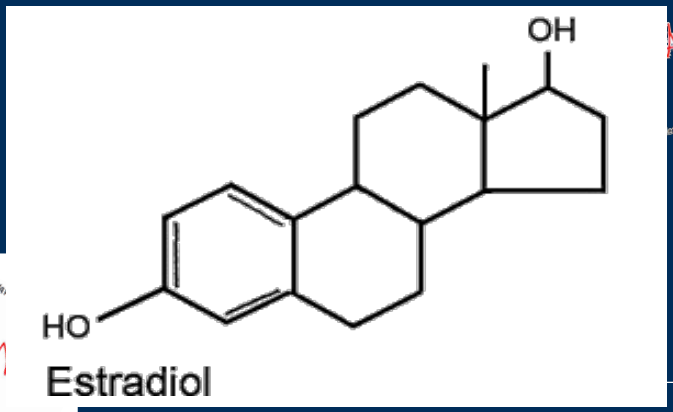
Estrogen, DES and BPA: Endocrine Disruption



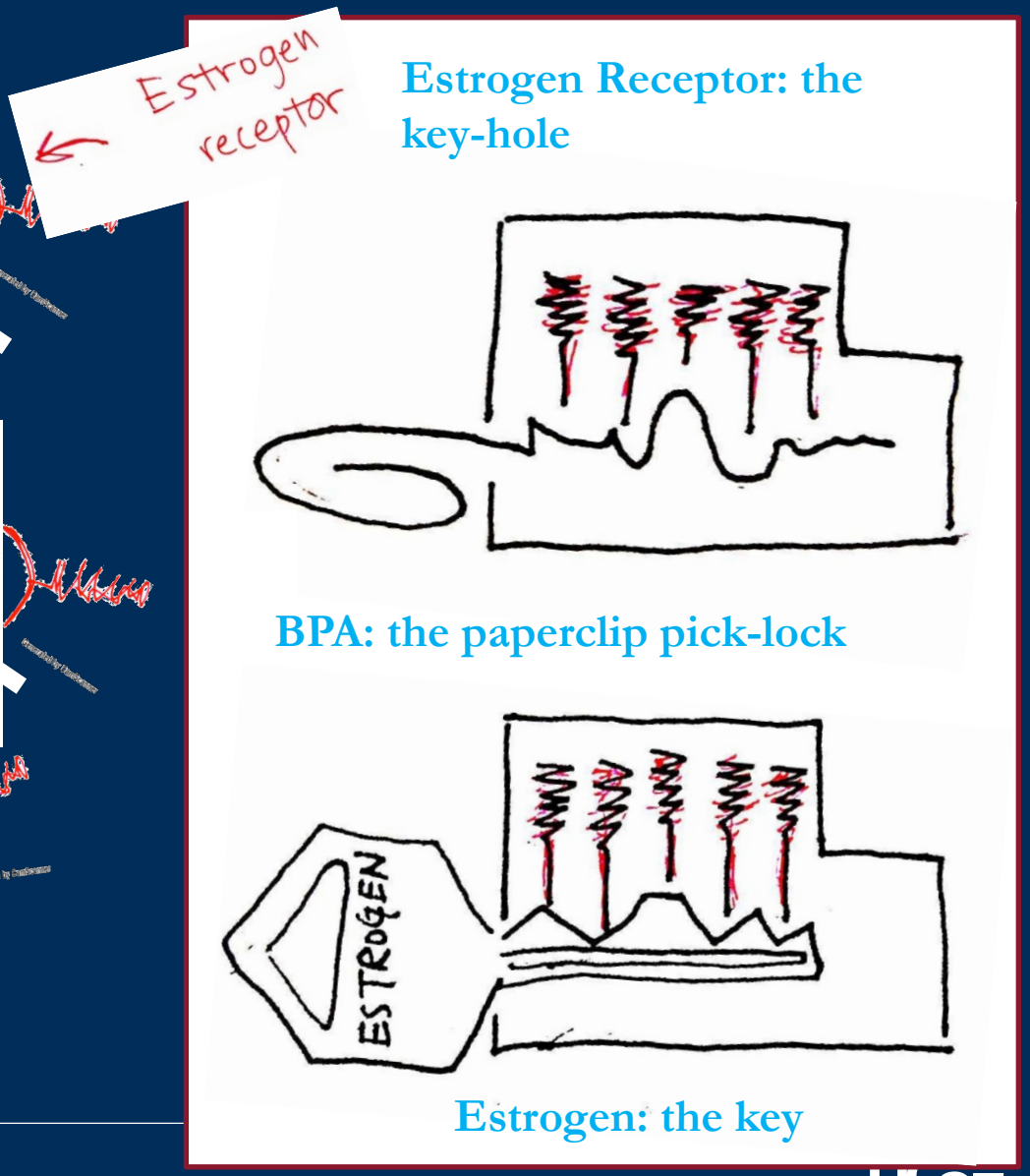
Diethylstilbestrol (DES)



Bisphenol A



Estradiol



Science in Products http://scienceinproducts.blogspot.com
Ruben et al. 2011

BPA has many biological effects

- 1930s: BPA = artificial estrogen, developed by same chemist who developed DES
- 3.6 million tons/year
- Found in ~95% of sample of US pregnant women

Woodruff, Zota, Schwartz EHP 2011

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PBDEs – Ubiquitous Exposure (flame retardants)

Upholstered Furniture

Electronics

Food Supply

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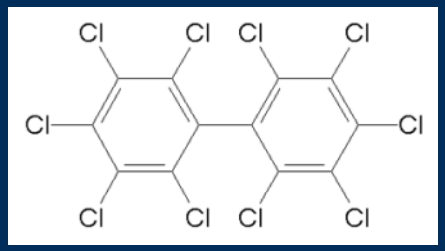
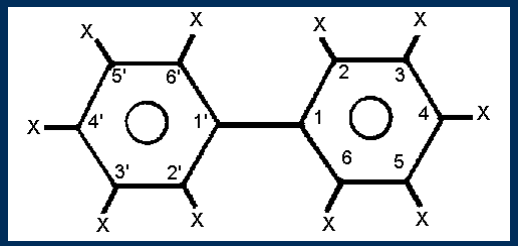
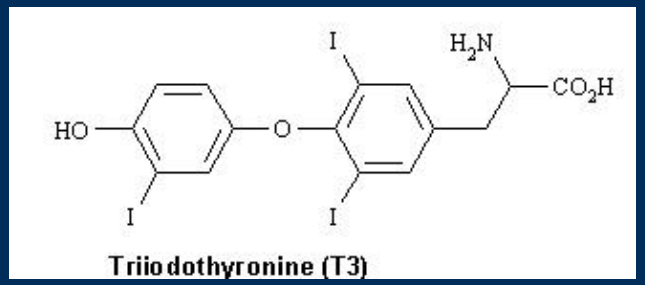
PBDE Structures Similar To Thyroid Hormones

PCBs

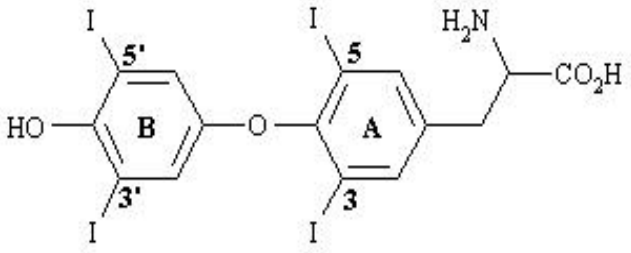




Thyroid Hormones

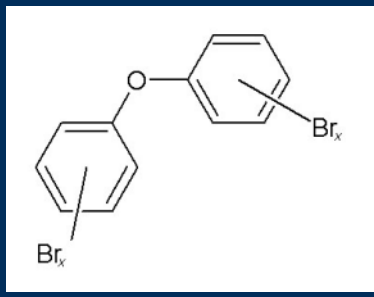


Triiodothyronine (T3)



Thyroxine (T4)

PBDEs



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Pesticides

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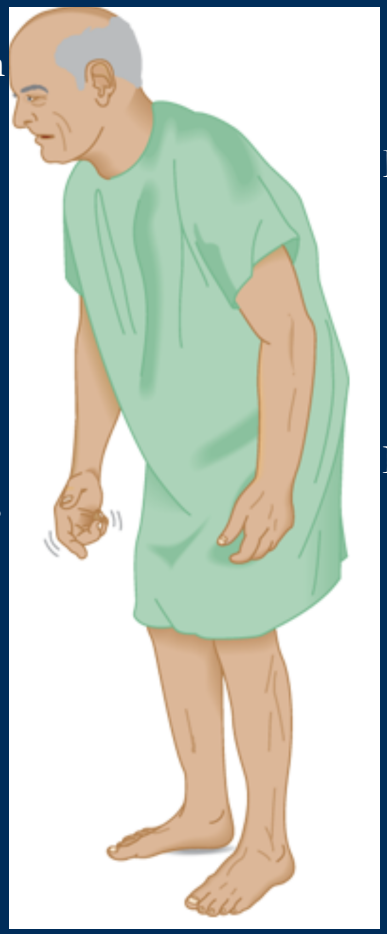
Parkinsonism

Blank facial expression

Slow, Monotonous slurred speech

Rigidity and tremor of extremities and head

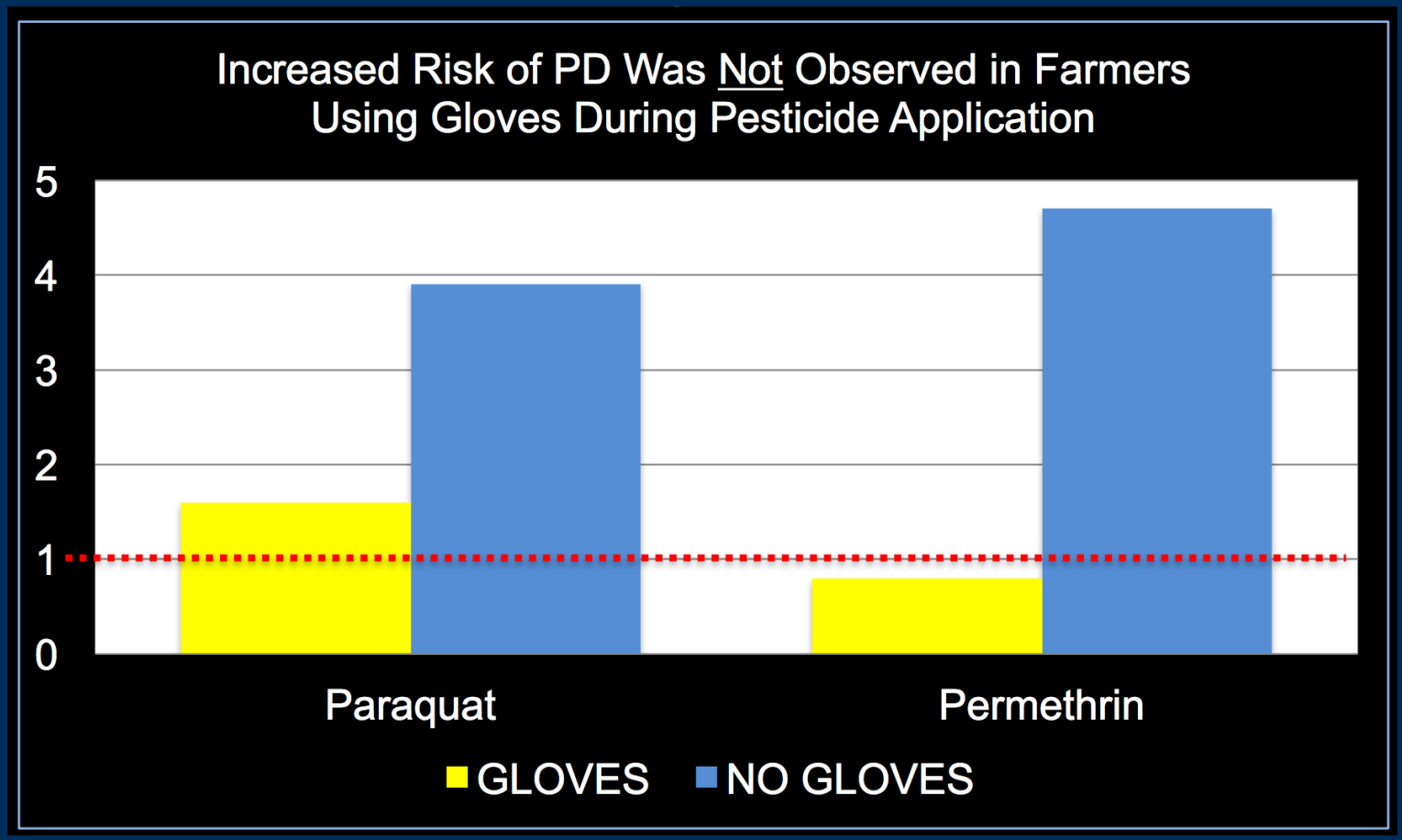


Forward tilt posture

Reduced arm swing

Short shuffling gait

Risk of Parkinson's disease in Farmers using gloves when applying two common pesticides



Furlong M, Tanner CM, Goldman SM, et al. Protective glove use and hygiene habits modify the associations of specific pesticides with Parkinson's disease. Environment international. 2015;0:144-150.

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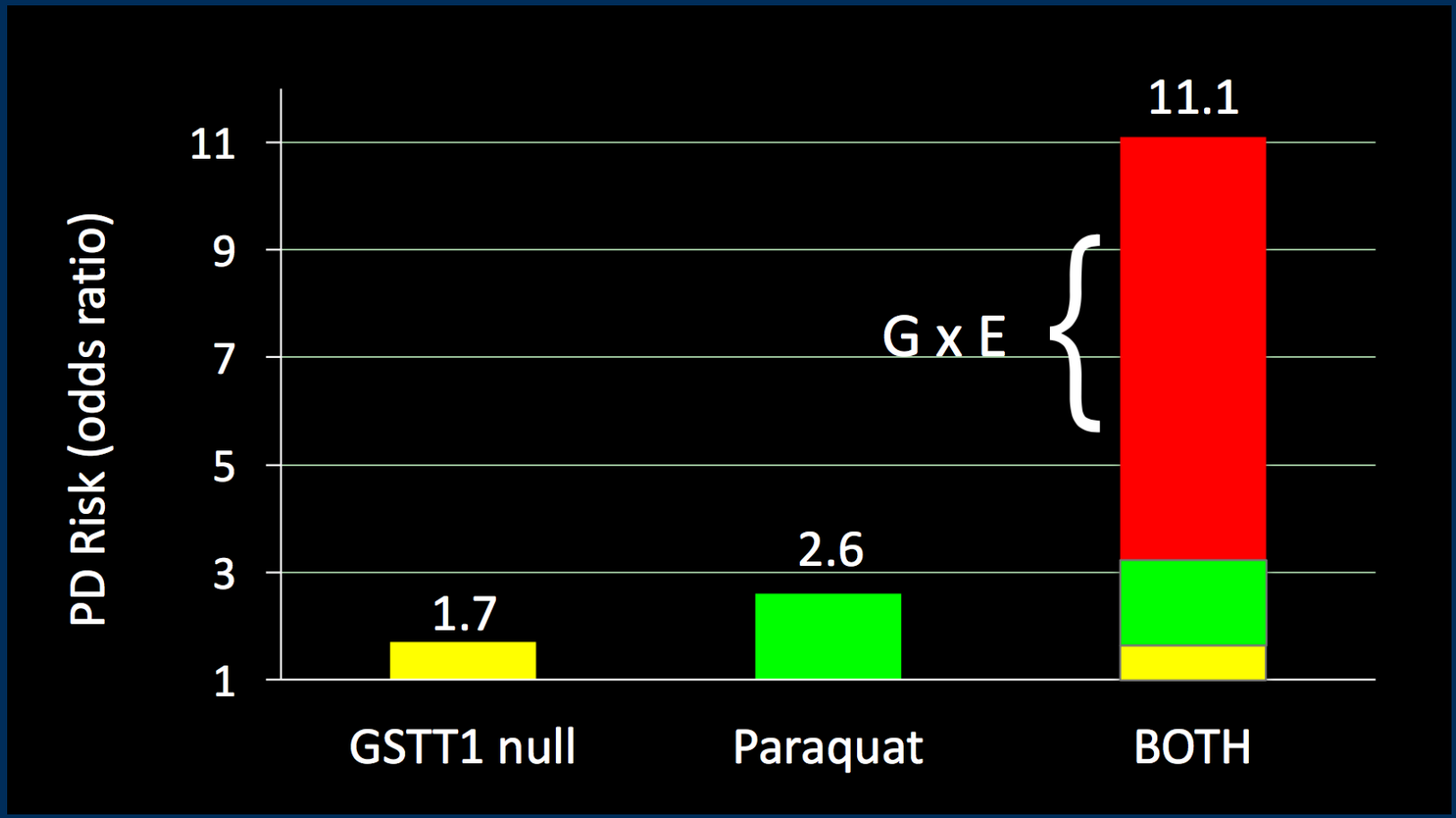
Genetics and Environment: Parkinsonism



Goldman SM, Kamel F, Ross GW, et al. Genetic Modification of the Association of Paraquat and Parkinson's Disease. Movement disorders: official journal of the Movement Disorder Society. 2012;27(13):1652-1658. doi:10.1002/mds.25216.

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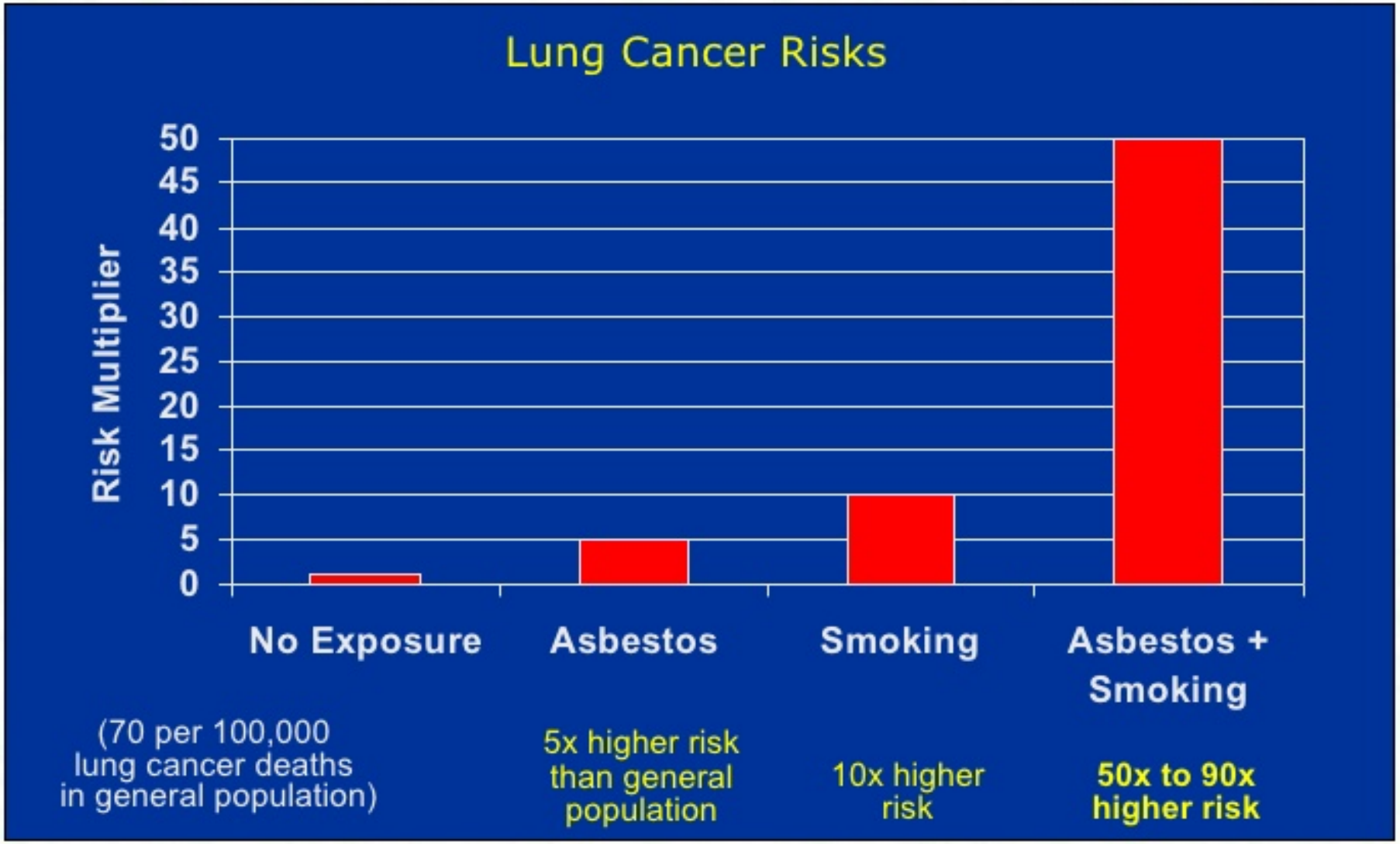
Lung Cancer

Lung cancer causes the largest number of deaths from asbestos exposure. The risk greatly increases in workers who smoke.



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San Francisco

Common Pitfalls

Common Pitfalls

Treating

- Chelation
  - Nausea, vomiting
  - Electrolyte disturbances
- "Detoxification"
  - Colon cleanse
  - Cyanide
  - Hydrogen peroxide

Testing

- Personal Testing:
  - Hair
  - Nails
  - Excreta
  - $$$
- Environmental testing

Environmental testing

Non-Viable Bioaerosol Analysis

Client Project Identification ⇨	1344412 Outside Front			1344403 Outside Back			1344413 Secretary's Office			1344402 Entryway Lobby		
	raw ct.	Cts/m³	% Area	raw ct.	Cts/m³	% Area	raw ct.	Cts/m³	% Area	raw ct.	Cts/m³	% Area
Alternaria												
Arthrinium												
Ascospores	348	4639	17%	246	3279	57%	105	1400	6%	51	680	7%
Aureobasidium												
Basidiospores	54	720	3%	24	320	6%	18	240	1%	9	120	1%
Botrytis												
Chaetomium							150	2000	8%	12	160	2%
Cladosporium	384	5119	19%	69	920	16%	153	2039	8%	45	600	6%
Epicoccum												
Fusarium												
Other Hyaline												
Fragments							45	600	2%	6	80	1%
Penicillium/Aspergillus*	1176	15676	59%	66	880	15%	1278	17036	69%	636	8478	84%
Pollen												
Rusts				1	13	0.2%						
Scopulariopsis												
Smuts/Peric/Myxomycetes	32	427	2%	24	320	6%						
Stachybotrys							111	1480	6%	1	13	0.1%
Stemphylium												
Torula												
Ulocladium												
Mucor/Rhizopus												
Total Spores (Cts/m³):	1,994	26,580		430	5,732		1,860	24,794		760	10,131	
Sample Volume (Liters)	75			75			75			75		
Sample Time Minutes:	5			5			5			5		
Background Debris**	Few			Few			Abundant			Many		

*The spores of ***Penicillium/Aspergillus*** cannot be differentiated by non-viable sampling methods.

**Fibers, skin fragments and dust are indicated by few, moderate, many, and abundant.

Comments:

Technologist: Rebecca Hutty, *MicroTest Labs™, Inc.*

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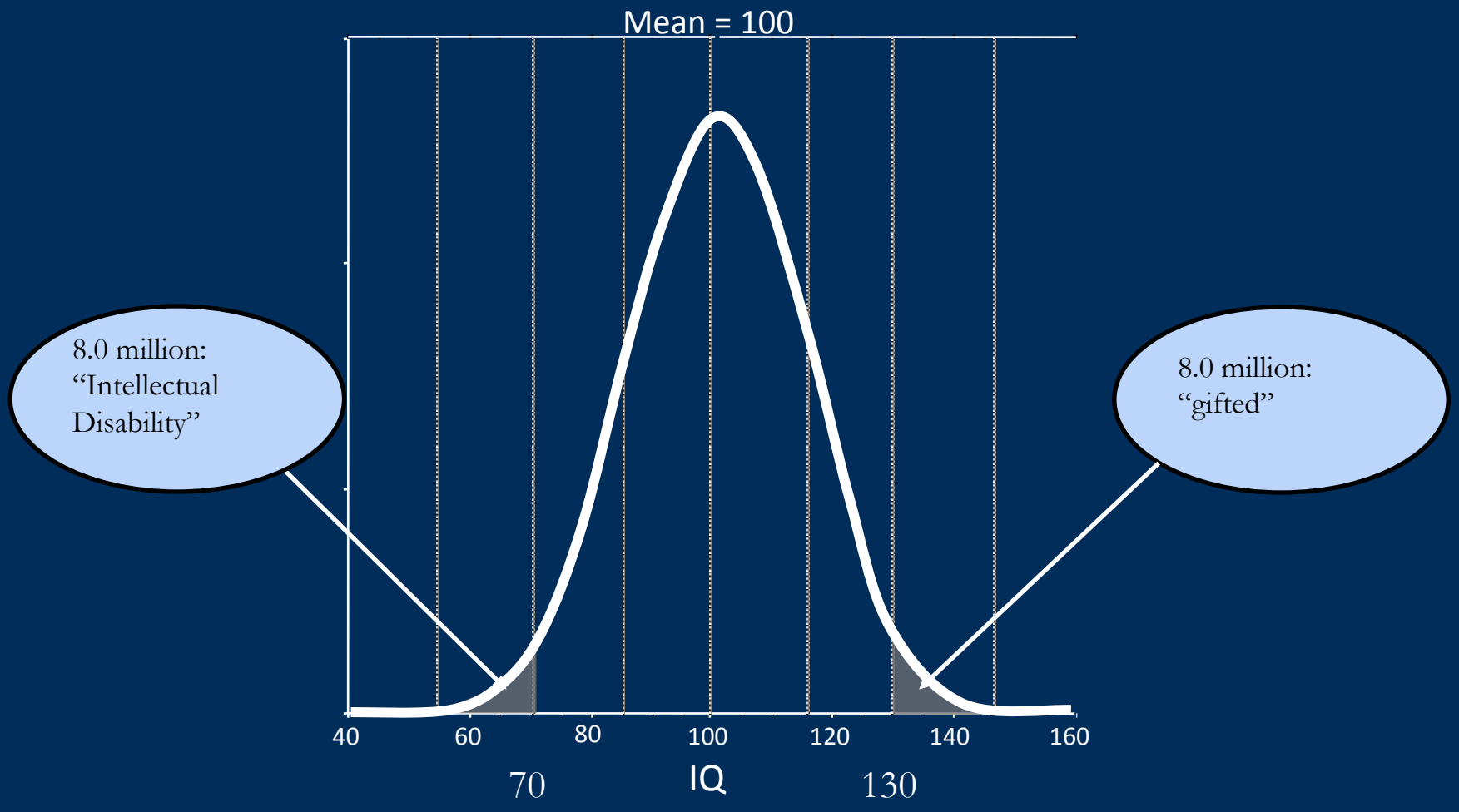
Personal testing example: Urine mycotoxin testing

- Mycotoxins are naturally occurring in the environment including food such as corn, cereals and fermented beverages
- They can be detected in human urine to assess for exposure
- Detection of trichothecene mycotoxins (such as deoxynivalenol) in environmental samples; however there is no standard method of detection
- FDA has established advisory levels of deoxynivalenol for safe foods and livestock feeds.

Why this matters.

Small Effects Can Have Large Significance



Adapted from Weiss B. Neurotoxicology. 1997.

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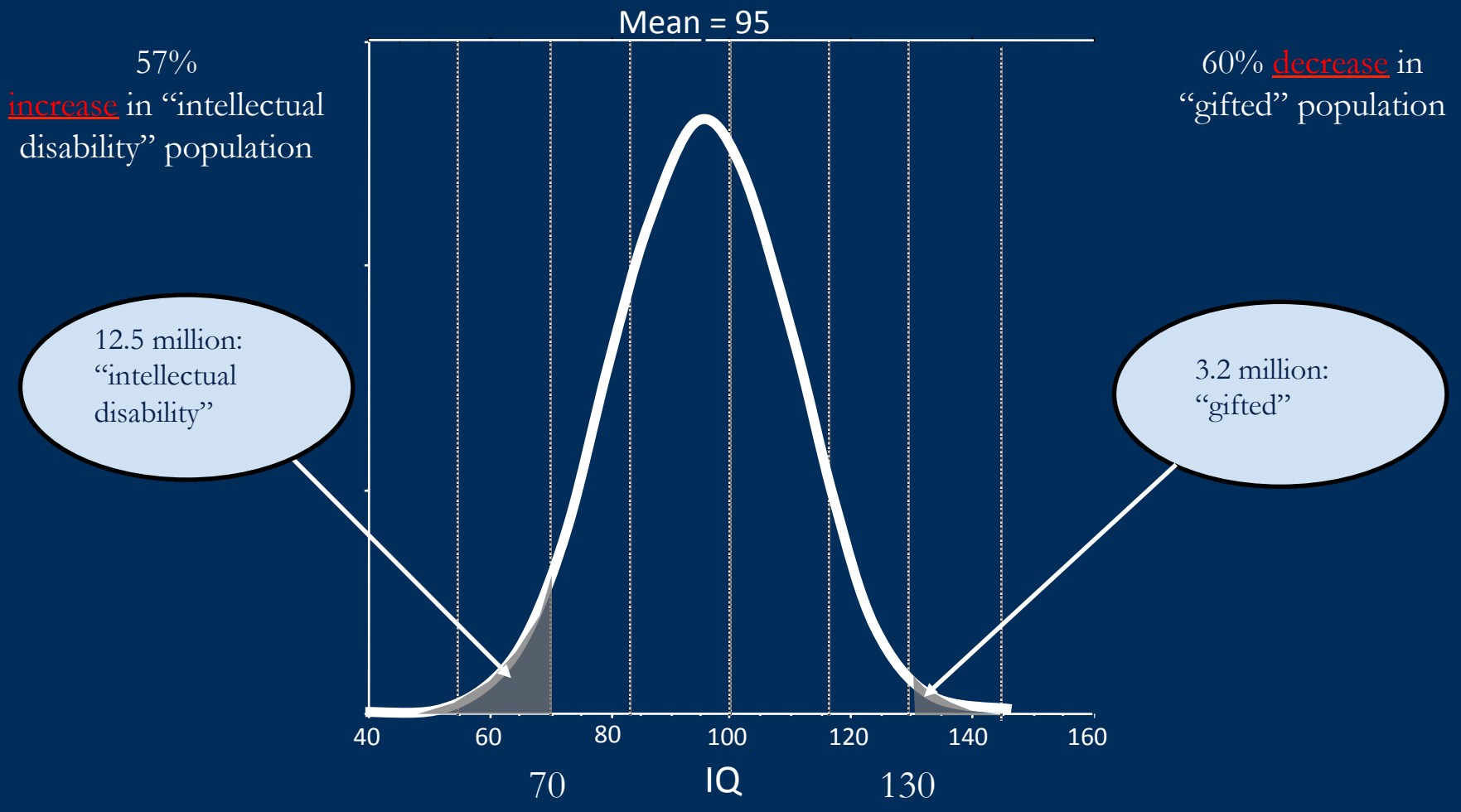
Small Effects Can Have Large Significance
(continued)



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Approximately 1 in 6 US children diagnosed with a developmental disability

Program on Reproductive Health and the Environment

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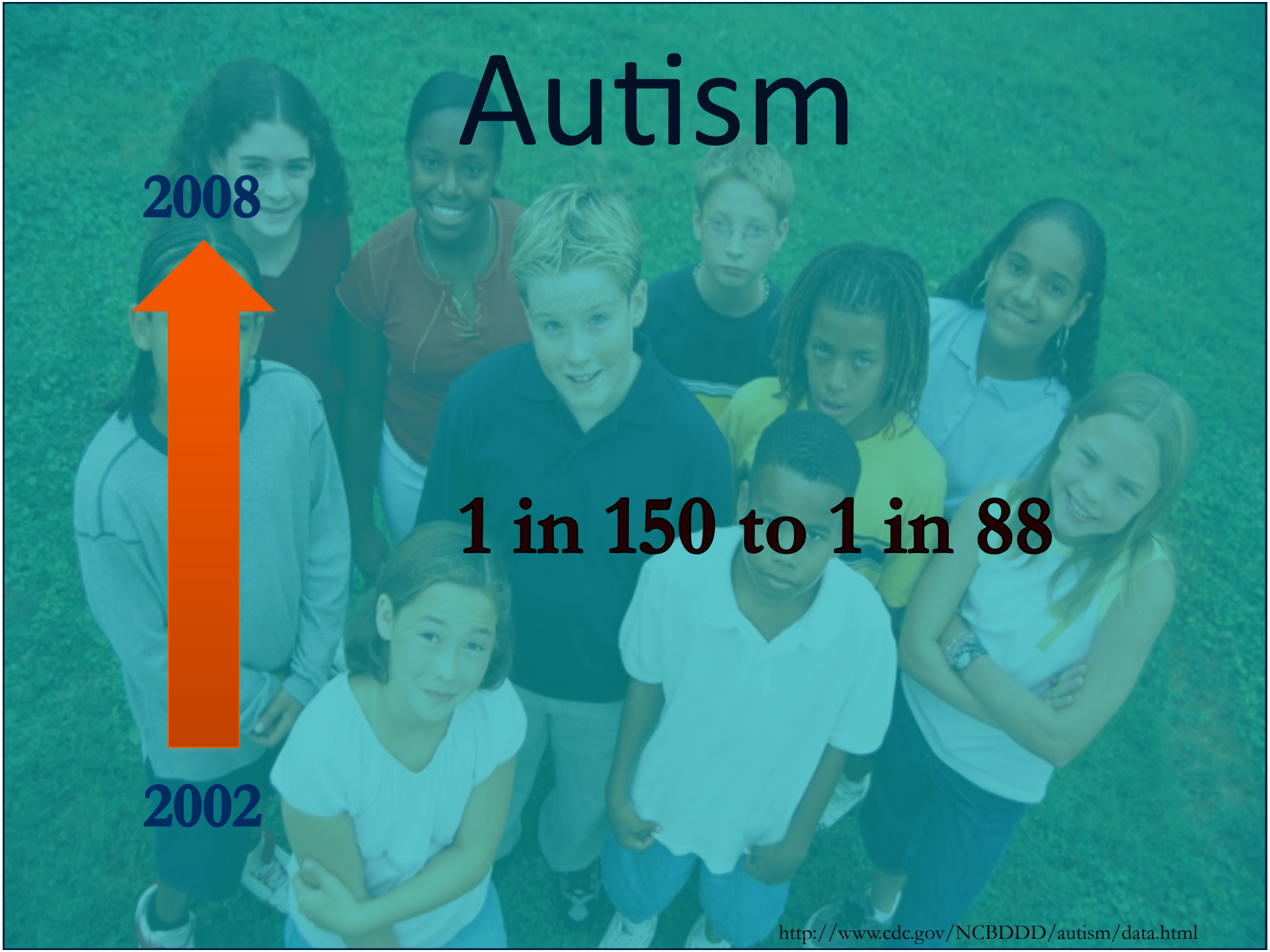
Source: Based on data from 2006–2008. Boyle (2010)

Autism



http://www.cdc.gov/NCBDDD/autism/data.html

Brain Drain Chemicals in Pregnant Women

Chemical	Found in >80% of Pregnant Women	Decrease in Child IQ
Lead	X	X
Mercury	X	X
PCBs	X	X
Flame Retardants	X	X
Pesticides	X	X
Air Pollution	X	X
Arsenic	X*	X

* As measured in total US, assumes also represents pregnant women

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What can you do?

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Ignoring Health Determinants

painting by Erica Layton

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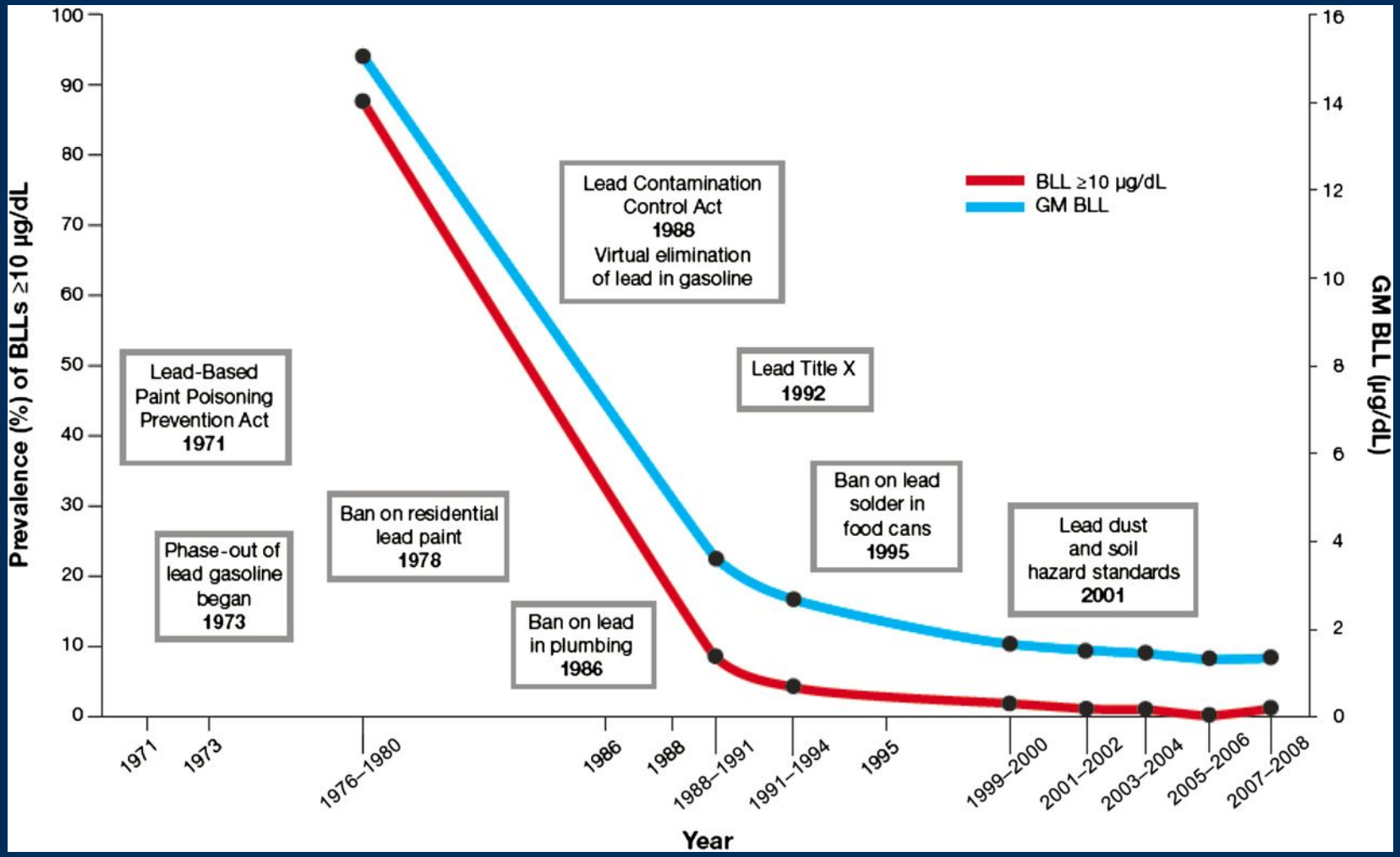
- Putting burden on consumers is not enough (or fair)
- Need regulatory change to prevent harmful chemicals entering our food, etc.

Timeline of lead poisoning prevention policies and blood lead levels in children aged 1–5 years, by year—NHANES, United States, 1971–2008.



COUNCIL ON ENVIRONMENTAL HEALTH Pediatrics 2016;138:e20161493

PEDIATRICS®

Toxics Substances Control Act (TSCA)

- 1976 – TSCA signed into law. TSCA directed the Environmental Protection Agency (EPA) to regulate chemicals introduced and used in the United States (Service, 2006).
- Many chemicals **already in use were declared safe** and not subject to the new regulation.
- 2010 - the EPA had required testing of less than 1 percent of the chemicals in commerce and had banned or restricted a total of only 5 (NCI, 2010). Asbestos is still not banned, which has caused lethal mesothelioma in over 107,000 people worldwide annually.
- 85,000 or more synthetic chemicals are approved for widespread use in the United States, and more than 600 new chemicals are being approved by EPA each year.
- 2016 – TSDCA reform act passed. Many deficiencies addressed.

Registration, **E**valuation, **A**uthorization and restriction of **Ch**emicals (REACH)

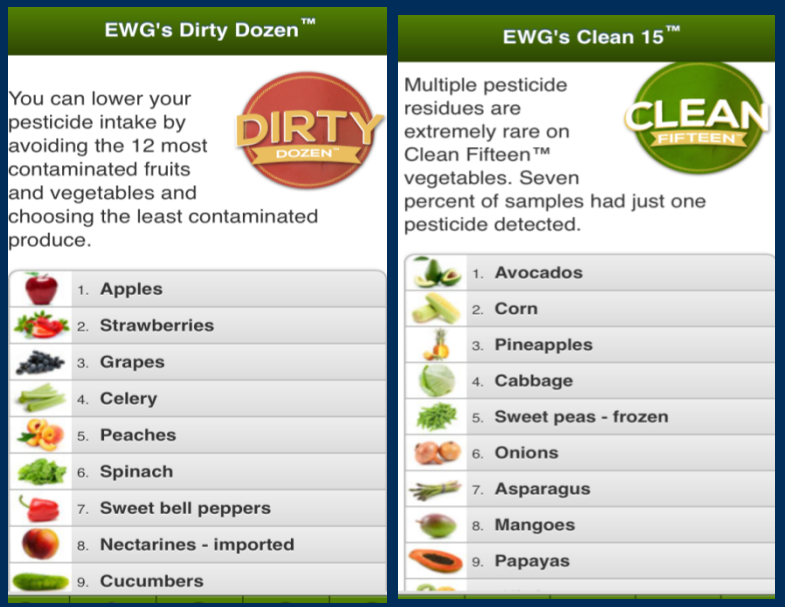
- 2007 - European Union (EU) took action address the safety of chemicals already in the marketplace. The EU relies on the REACH Regulation to protect human health and the environment.
- Implementation began in 2007, being phased in through 2018.
- Manufacturers and importers are required to gather information on the properties of their chemical substances, which will allow their safe handling, and to register the information in a central database.
- Calls for substitution of the most dangerous chemicals when suitable alternatives have been identified.

The "Precautionary Principle"

- The "Precautionary Principle" states that "when an activity raises threats of harm to human health or the environment, precautionary measures should be taken **even if** some cause and effect relationships are not fully established scientifically."

So what can you do do today?-Top 10

1. Buy organic $$$
   - Less pesticide residue
   - Wash produce
2. Don't eat plastic $
   - Avoid food in plastic packaging, use glass or stainless to store food or water
   - Don't microwave in plastic



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Avoid food w/ substantial plastic contact: canned foods/sodas, wet foods in plastic pouches/ boxes)

- Avoid: **#3**: PVC or vinyl, **#6**: PS (Styrofoam), **#7** (= other): polycarbonate (some water bottles, & 5-gallon jugs) or may be untested

- Choose: **#1 PETE, #2 HDPE, #4 LDPE or #5 PP**, likely lower health risks. But, if your community does not recycle these, try to avoid them

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Avoid plastic: Don't microwave it!

- Heating increases leaching of chemicals, especially w/ fatty foods. Use a paper towel or glass lid to cover food in the microwave

http://www.healthandenvironment.org/

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3. Eat low-mercury fish $-$$$

- Smaller fish generally have lower mercury levels
- Up to 12 oz/wk of shrimp, catfish, pollock, canned light tuna, salmon
  - Consumer Reports says no tuna!
- Check local advisories if eating local fish
- http://www.montereybayaquarium.org/cr/seafoodwatch.aspx

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4a. Wash hands prior to eating $

- Especially important when hands are exposed to toxins
  - Agricultural areas
  - Pt or spouse works in occupation w/ pesticides, solvents, lead, etc.

4b. Avoid carbonless receipts (phthalates, BPA)

- Don’t take receipt if you don’t need it
- Cashier work: wear gloves, wash hands before eating

5. Limit pesticide & solvent use in home $

- Clean with soap, vinegar
- Baking soda for ants, etc.
- Keep counters clean
- Use integrated pest management

6. Bust the Dust! $-$$

- Dust/damp mop/vacuum daily, take shoes off outside
- Especially important when dust is particularly likely to have toxins

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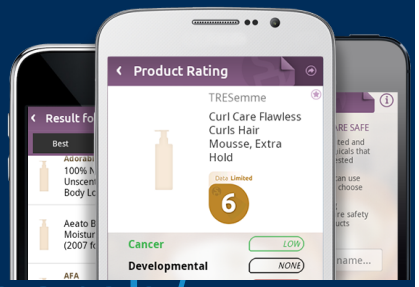
7. Be thoughtful about body products $-$$

- avoid phthalates, fragrances, triclosan
- risk stratify ("windows of susceptibility," dosage, water vs. fat soluble chemicals)
- www.ewg.org (Skin Deep)



- https://safecosmetics.cdph.ca.gov/search/
- (CA Safe Cosmetics Program Database)

8. Ensure foam furniture is covered $$

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9. Avoid tobacco smoke $

- Quit smoking
- Avoid 2nd hand smoke
- No e-cigarettes
  - Nicotine itself not good for reproduction
  - Phthalates, etc.
  - "E-Cigarettes Expose People to More Than 'Harmless' Water Vapor"

10. Avoid lead $-$$$

- Frequent dust-mopping


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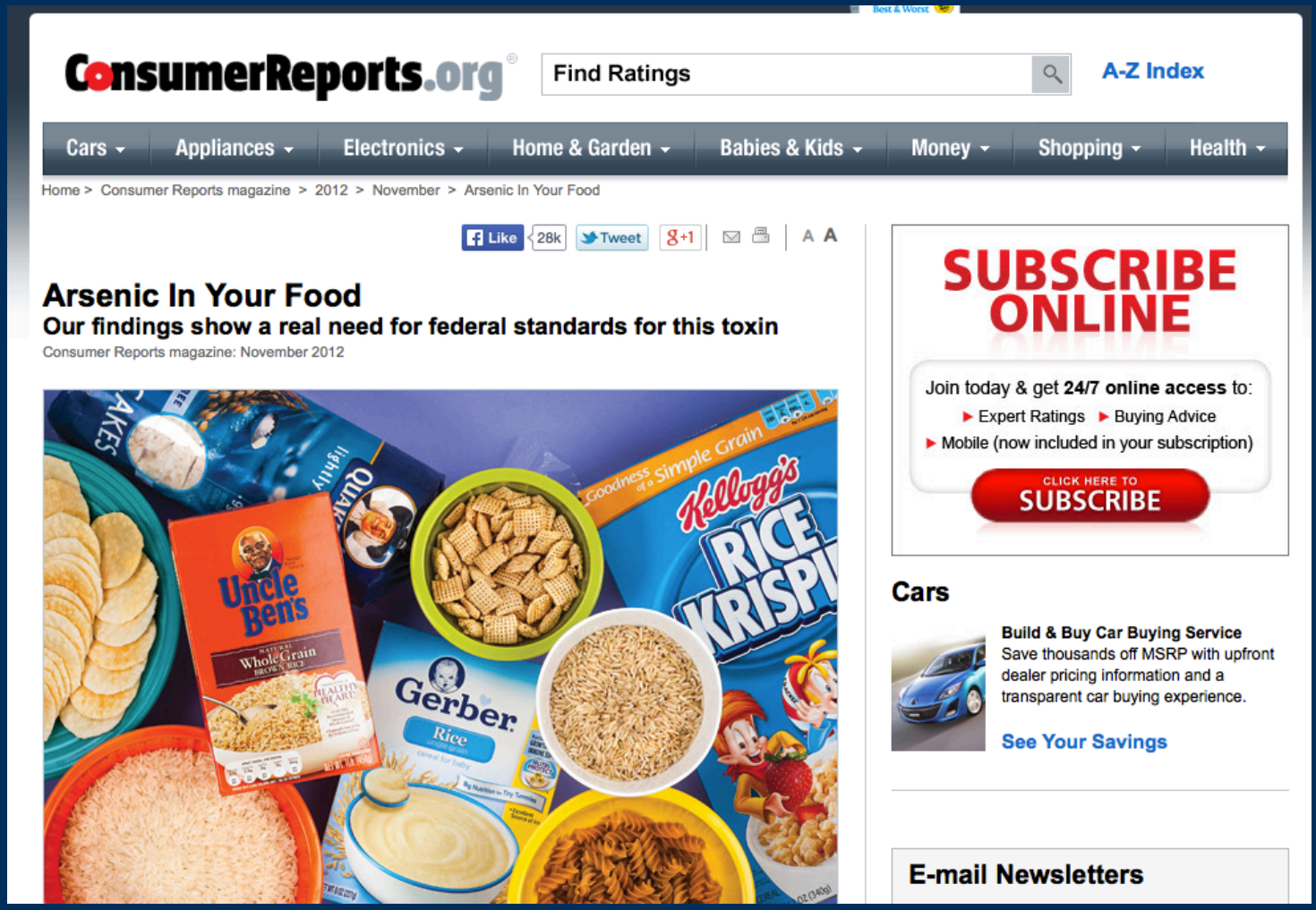
Is there a health concern?



Arsenic Resources

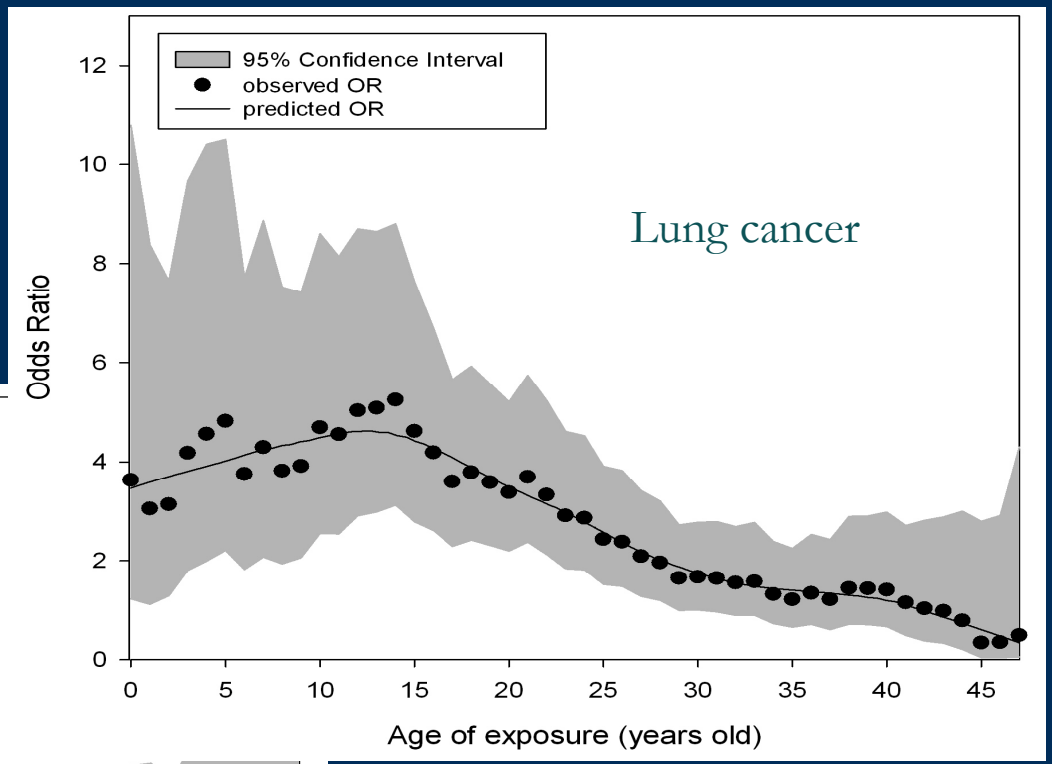
Arsenic

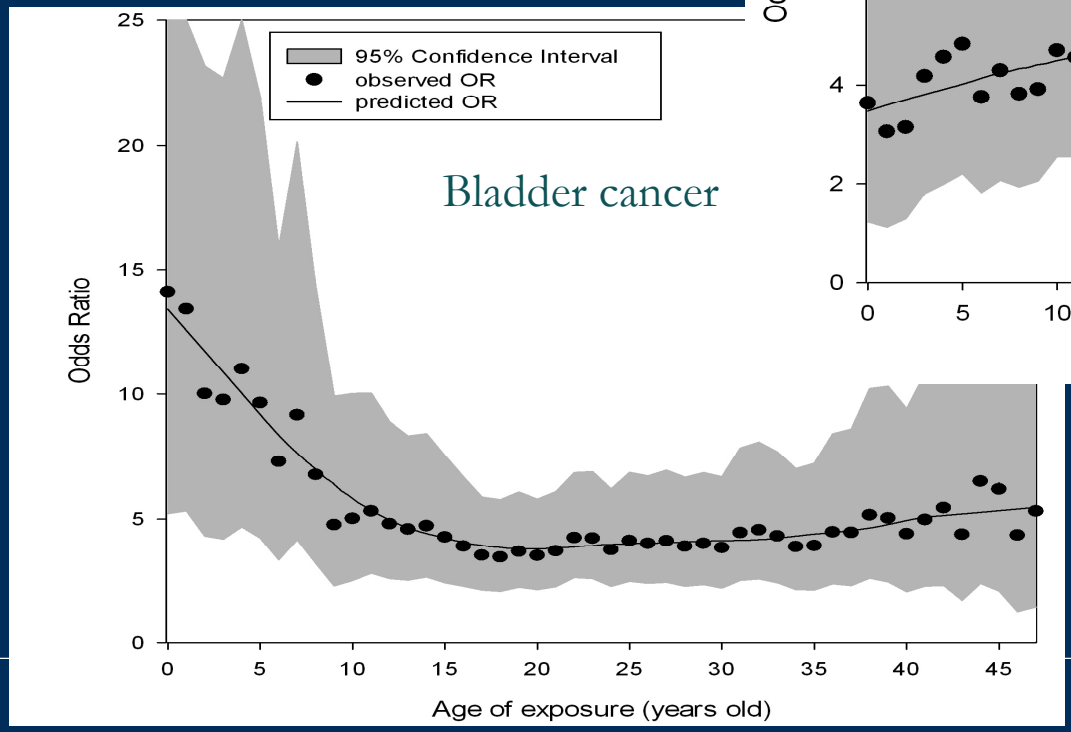
2 forms

- Inorganic: harmful form
- Organic: relatively non-toxic (arsenobetaine, arsenocholine)
- 2 million of people in US on wells exceeding U.S. water standard

- Adverse health effects
  - Cancer : Lung, bladder, skin, kidney
  - Intellectual function, bronchiectasis, immune function, diabetes, cardiac disease, neuropathy

Early life exposure: greater lung and bladder cancer risk





Courtesy Craig Stemmans

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Why Rice?

- Rice more As than other grains
  - anaerobic environment, plant characteristics

Average levels of inorganic arsenic

Product	Inorganic arsenic (mcg/serving)
Bakery mixes and pudding	4.1
Beverages (incl. beer, protein and rice drinks)	2
Cereals	2.6
Grain-based bars	1.8
Rice cakes	4.3
White rice	4.2
Brown rice	7.2
Basmati rice	3.5

Brief summary of rice grain and rice products sampled by the FDA and the corresponding amount of inorganic arsenic per serving, based on data published in 2013.

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US Water Standard
10 µg As/L x 1L/day (adult) = 10 µg/d

- 10 µg/d results in excess cancer risk 1 in 300 *
  - Eating 0.56 cups of cooked rice/d = 10 µg/d**

- Top 1% rice-eating children eat ≥ 1.75 cups

  = >>> 1 in 300 estimated cancer risk

*National Academy of Sciences 2001

**Gilbert-Diamond et al. Rice consumption contributes to arsenic exposure in US women PNAS 2011

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Who are at risk?

- Children
- High rice consumers
  - Asian American, ethnic minorities
  - Poor
  - Celiac disease / Gluten Free Diets
  - Food allergies
  - Vegan
  - Macrobiotic Diet

FDA & AAP: "well balanced diet"

- No clear advice for clinicians
  - Consider other grains than rice for early solids
  - Avoid foods sweetened with brown rice syrup, rice milk under 5 yrs.
  - Vary grains, include barley, oats, wheat
  - More controversial - re
    consumers?
- Need for cultural sensitiv

	FDA	AAP	Consumer Reports	UK Food Standard Agency
Eat well-balanced diet and variety of grains	X	X		
Infants 1 serving of rice cereal per day			X	
Children < 4.5 y.o. no rice milk or beverage as part of daily diet			X	X
Rinse rice			X	
Cook rice in greater volume of water			X	

Food and Drug Administration

- FDA Statement on Testing and Analysis of Arsenic in Rice and Rice Products (9/2013)
  - Level too low to cause any immediate or short-term effects
  - Will continue to evaluate long-term exposure to very low amounts of arsenic in rice and rice products
    - The FDA intends to conduct a risk assessment considering how much arsenic is consumed from rice and rice products, and whether there are variations in health effects for certain segments of the population.

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PCB Resources

How do we know if our school contains PCBs?

- If your school was built between 1950 and 1980 and there is concern that PCBs are present, the EPA recommends that schools test the air, not caulk. If the air levels are above the EPA's suggested levels, your school should contact your regional EPA PCBs Coordinator.

How can children and staff be exposed to PCBs in schools?

- When PCB-containing building materials age, they may release PCBs into dust on surfaces, or into the air.
- Children can be exposed by:
  - touching contaminated surfaces and absorbing PCBs.
  - putting their hands in their mouths and ingesting (eating) PCBs in dust.
  - Inhaling PCBs in the air into their lungs.
- Pregnant teachers and staff are a concern because:
  - A fetus in the womb is at greatest risk of injury. Exposures to even low levels of toxic chemicals during pregnancy may cause injury to the developing fetal brain.

What can we do about PCBs in schools?

- The most effective thing you can do is remove the materials that contain PCBs.
- First, remove old fluorescent light fixtures.
- If it is possible to remove other building materials, this will further reduce PCBs. But, this is very expensive and many schools can't afford it. Contact your regional EPA PCB coordinator for more information before you renovate.
- Until you can renovate, use best management practices to lower PCBs on surfaces and in dust.
- Clean the floor, walls, and window sills regularly with wet microfiber mops and cloths
- • Removing PCB particles from surfaces reduces exposure through skin contact.
- • Do not use dry brooms or dry cloths for dusting – they just stir particles into the air

What can we do about PCBs in schools?

- Wash hands with soap and water often, particularly before eating and drinking to prevent ingestion of dust on hands.
- Use a vacuum with a HEPA filter to reduce dust containing PCBs, allergens and other toxic chemicals found in dust.
- Increase ventilation to remove PCB containing air and bring outdoor air into the building. This reduces exposure to PCBs through inhalation.
- The EPA's Indoor Air Quality Tools for Schools Action Kit is a great place to start.

PCB Resources

- ATSDR, Public Health Statement: PCBs: http://tinyurl.com/zrpsn4q
- EPA guidelines for disposal of PCB construction waste https://www.epa.gov/pcbs/polychlorinated- biphenyl-pcb-guidance-reinterpretation and https://www.epa.gov/pcbs/steps-safe-pcb- abatement-activities
- Exposure Levels for Evaluation of PCBs in Indoor School Air https://www.epa.gov/pcbs/exposure-levels- evaluation-polychlorinated-biphenyls-pcbs- indoor-school-air
- Fluorescent ballasts removal: https://www.epa.gov/pcbs/polychlorinated- biphenyl-pcb-containing-fluorescent-light- ballasts-flbs-school-buildings #procedres
- Caulk removal: https://www.epa.gov/pcbs/summary-tools- and-methods-caulk-removal
- EPA Indoor Air Quality Tools for Schools Action Kit: http://tinyurl.com/haefu5s
- Green Cleaning, Sanitizing and Disinfecting: A Toolkit for Early Care and Education http://tinyurl.com/z82z54x
- EPA's Safer Choice Program: https://www.epa.gov/ saferchoice

Drug Antidotes

Drug	Antidote
Acetaminophen	Acetylcysteine
Anticholinergics	Physostigmine
Benzodiazepines	Flumazenil
Ca Channel Blockers	Calcium Chloride
Cyanide	Hydroxocobalamin Amyl Nitrite, Sodium Nitrite, Sodium Thiosulfate
Digoxin	Digoxin Immune Fab
Heparin	Protamine Sulfate
Iron	Deferoxamine
Insulin	Glucagon
Lead	Dimercaptosuccinic Acid/EDTA
Opioids	Naloxone
Warfarin	Vitamin K