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WESTERN STATES
PEHSU
Pediatric Environmental Health Specialty Units

Children's Environmental Health Symposium

Metals (acute and low level exposures)

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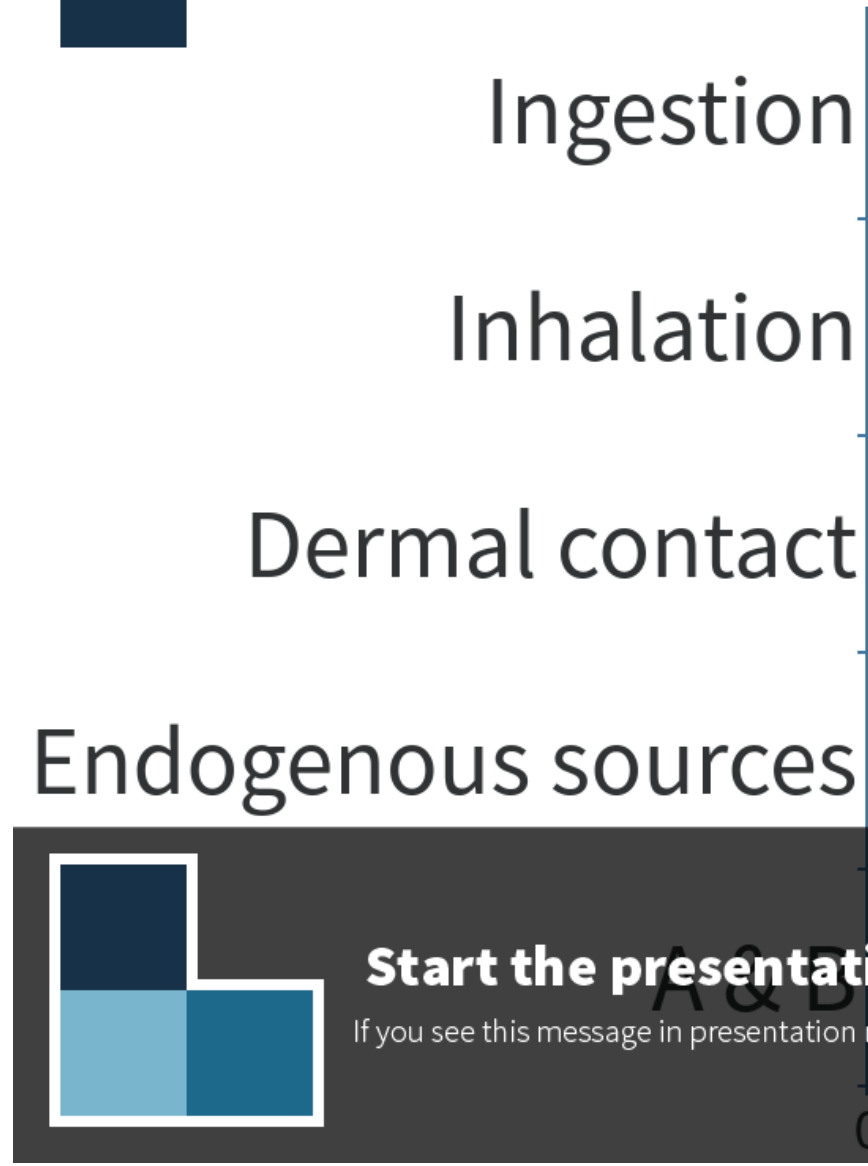
Division of Occupational and Environmental Medicine
Assistant Medical Director, California Poison Control
San Francisco Division

st important route(s) of exposure to lead for
is/are:



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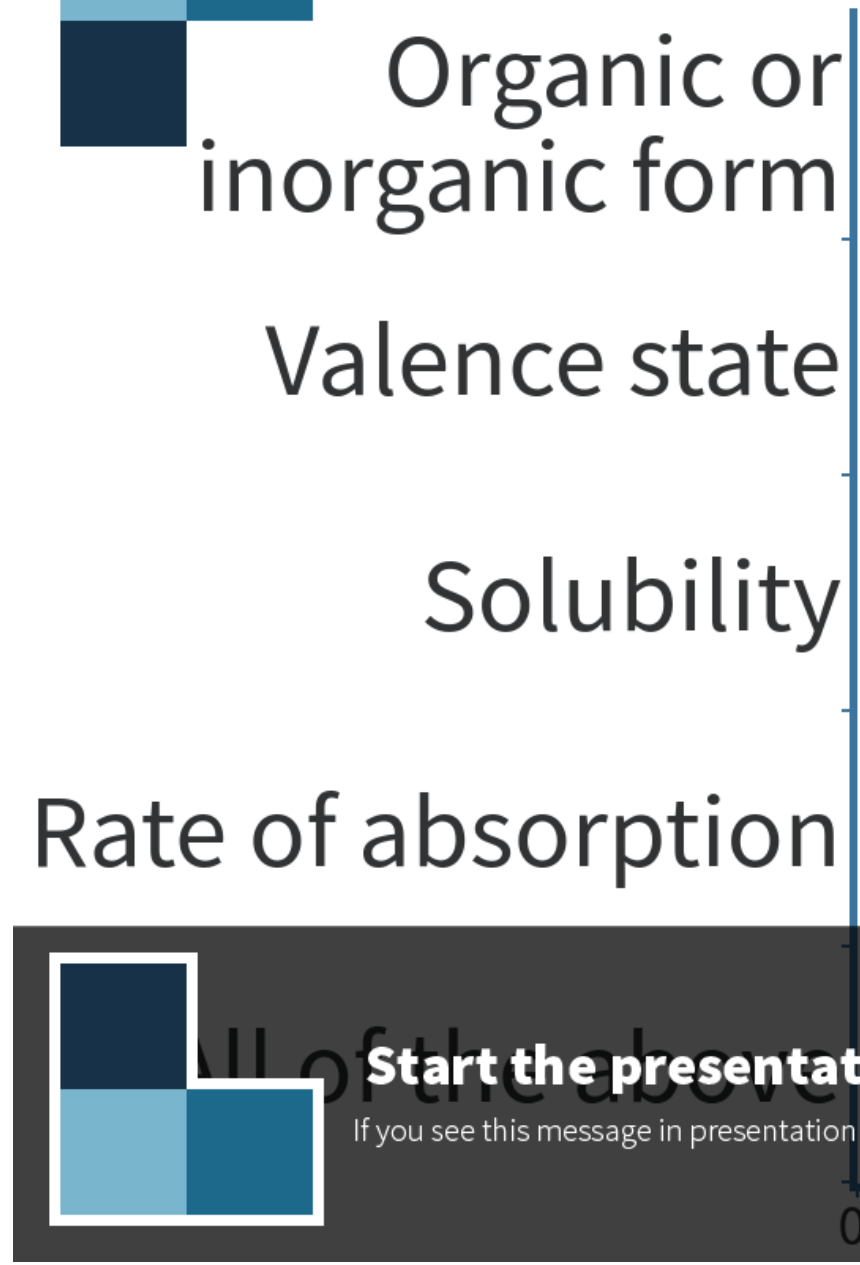
The toxicity of arsenic is related to:



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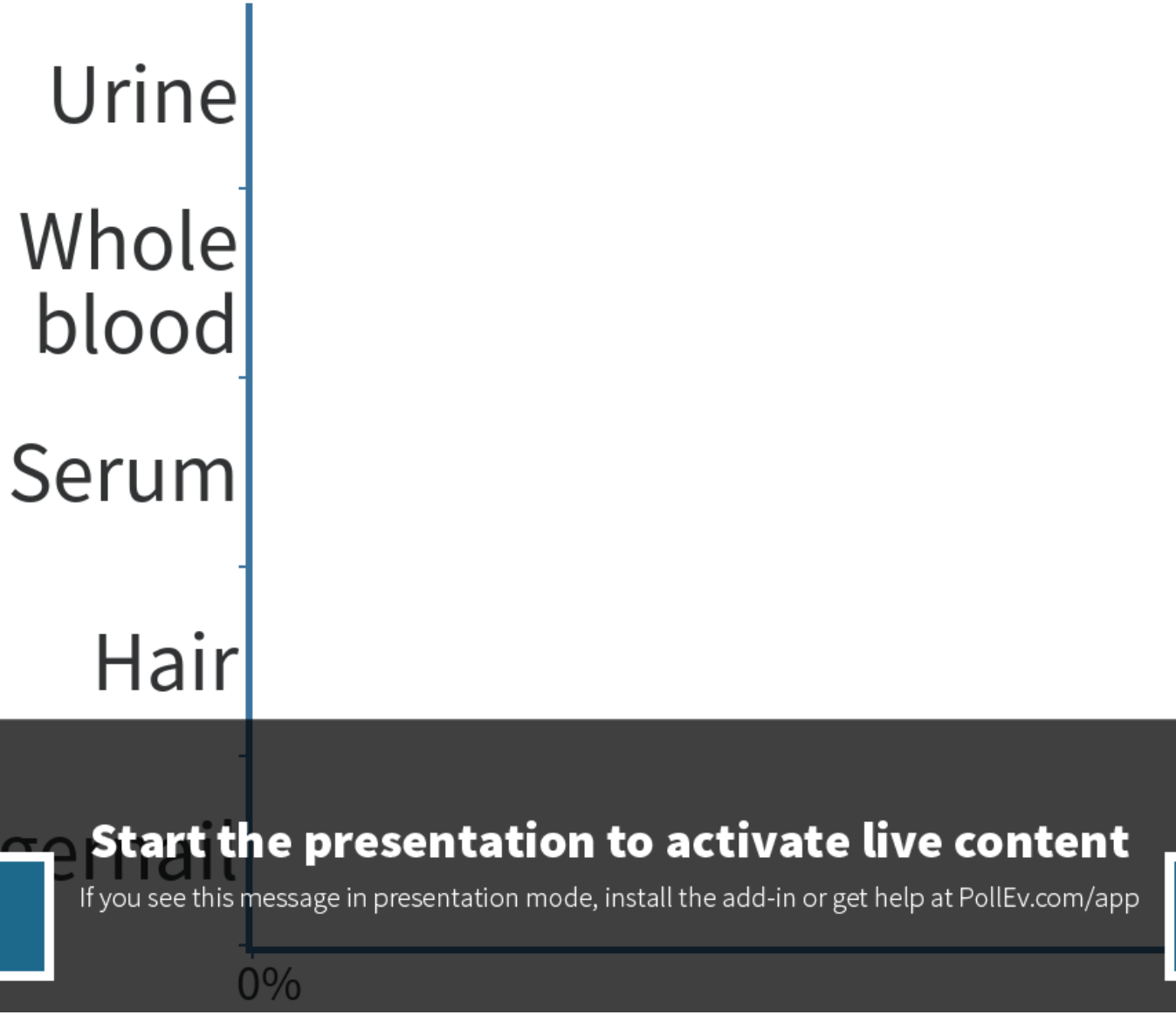
accurate test for measuring levels of organic exposure is:



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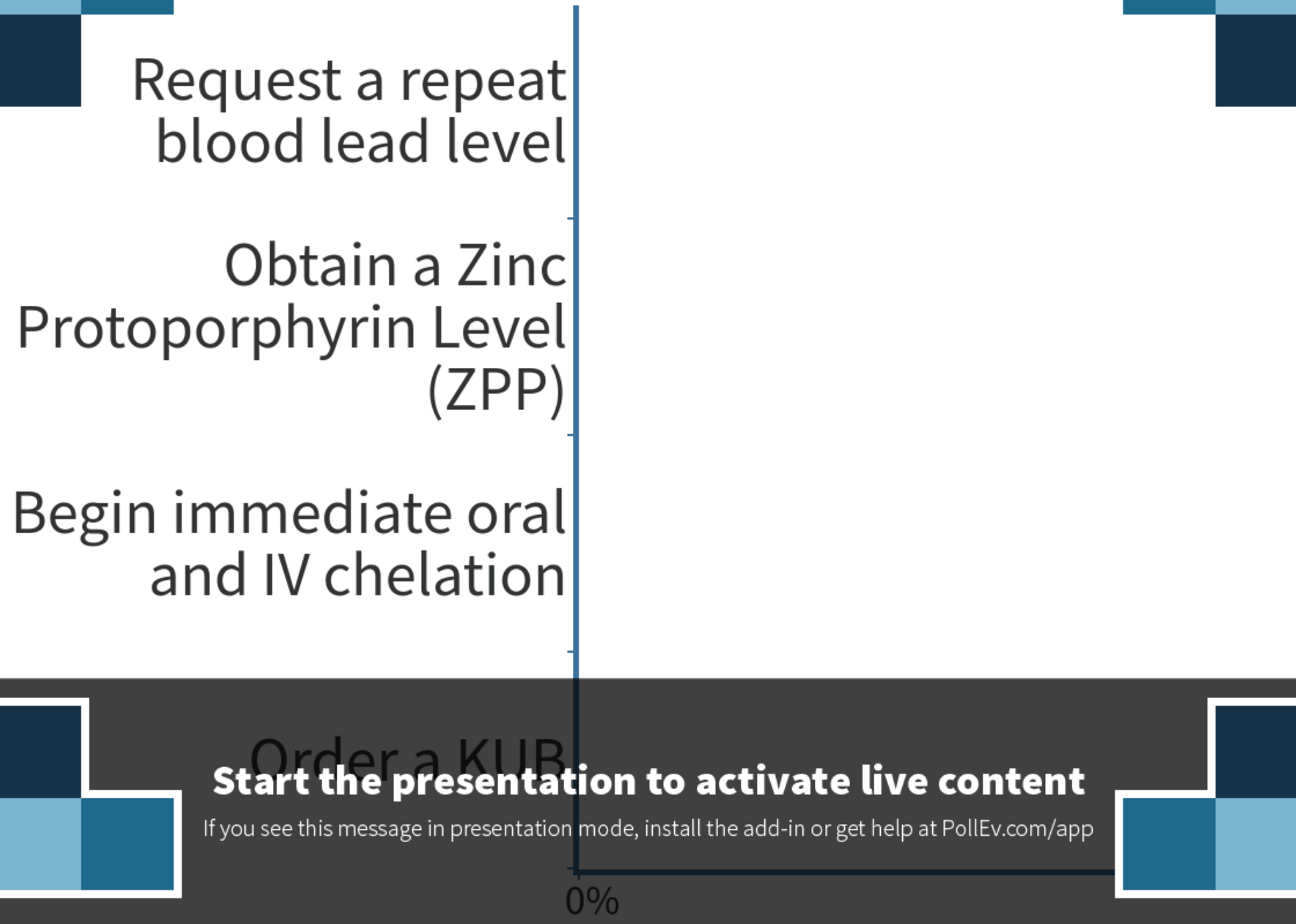
Outline

- A case
- Characteristics of metals
- Specific examples: Arsenic, Lead, Mercury
- Common pitfalls

A Case…

- 3 year old male found to have a Blood lead level of 53 ug/dl
- His parents have been remodeling their home.

s your next step in the management of this pa



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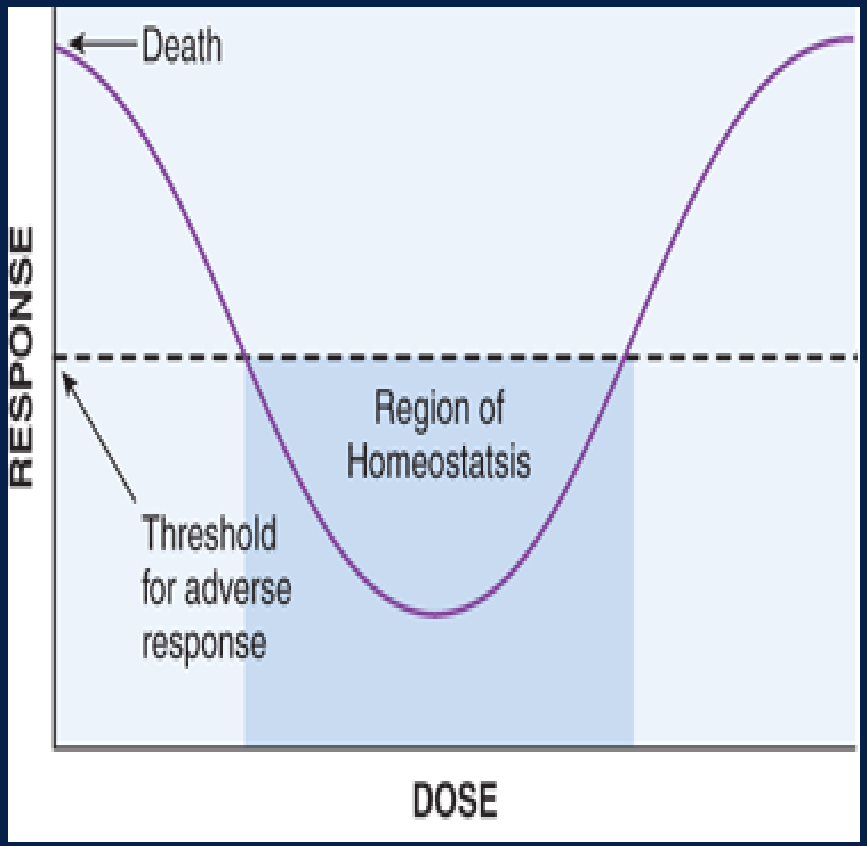
Classification of Metals Based on Characteristics of Health Effects

Nutritionally Essential Metals	Metals with No Known Beneficial Effects
Cobalt	Aluminum
Chromium III	Antimony
Copper	**Arsenic**
Iron	Barium
Manganese	Beryllium
Molybdenum	Cadmium
Selenium	**Lead**
Zinc	**Mercury**
	Silver
	Strontium
	Thallium

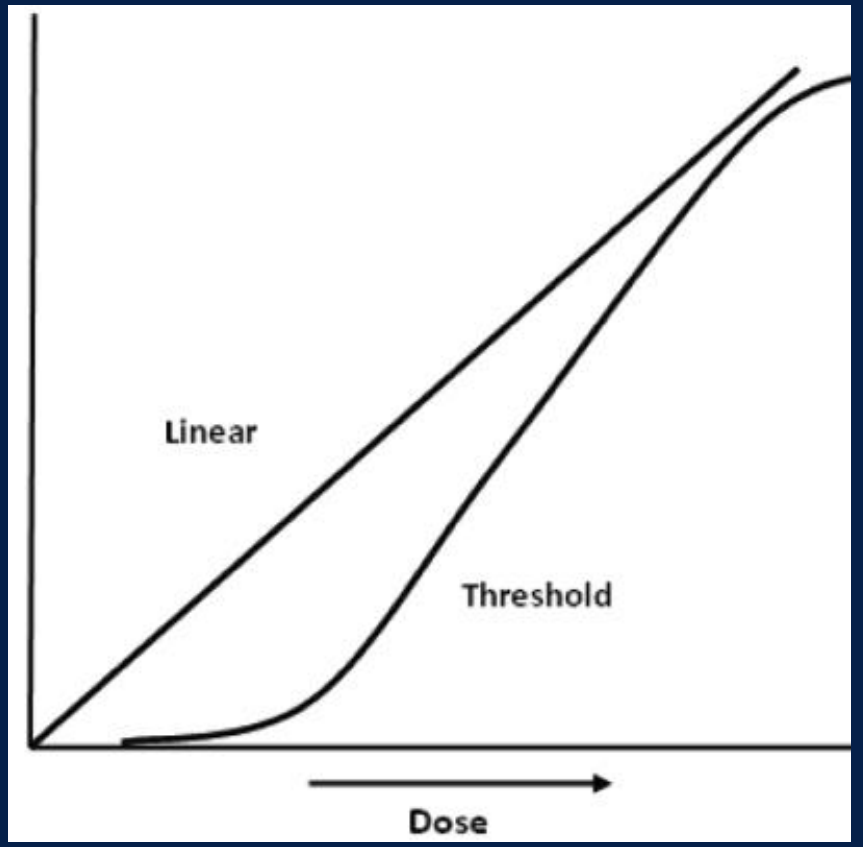
Goyer et al, 2004

Dose Response Curve for Metals

- Essential metals



- Non-essential metals



Source: L.L. Brunton, B.A. Chabner, B.C. Knollman: Goodman & Gillman's: The Pharmacological Basis of Therapeutics, 12ed. www.accesspharmacy.com © McGraw-Hill Education. All rights reserved.

Arsenic, lead and mercury

- Ubiquitous in the environment
- Present in air, water, and soil

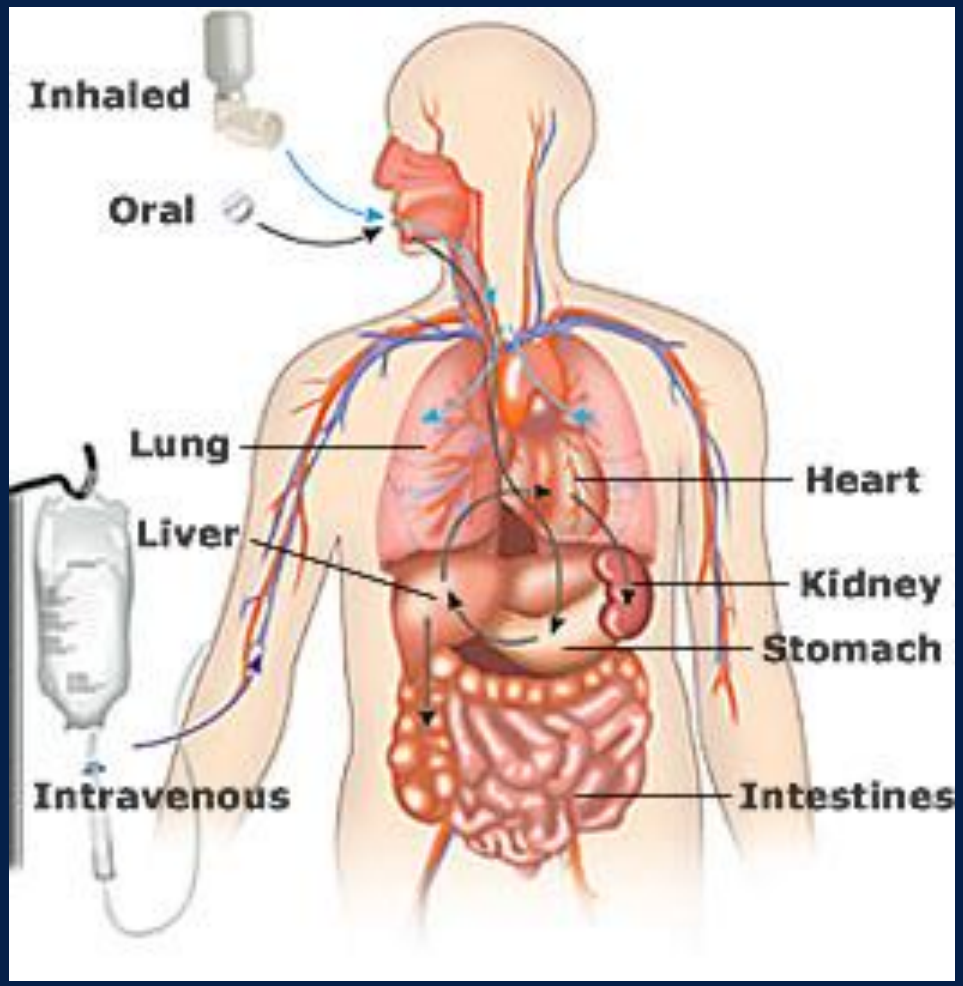
Goyer R, Golub M, Choudhury H, Hughes M, Kenyon E, Stifelman M, Issue Paper On The Human Health Effects Of Metals. Submitted to: U.S. Environmental Protection Agency, 2004

Speciation and of metals affects their toxicity

- Elemental eg. Mercury, Hg
- Organic – bound to a carbon eg Dimethyl Mercury, $Hg(CH_3)_2$
- Inorganic – bound to non-carbon, eg Mercuric Chloride HgCl

Toxicokinetics

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



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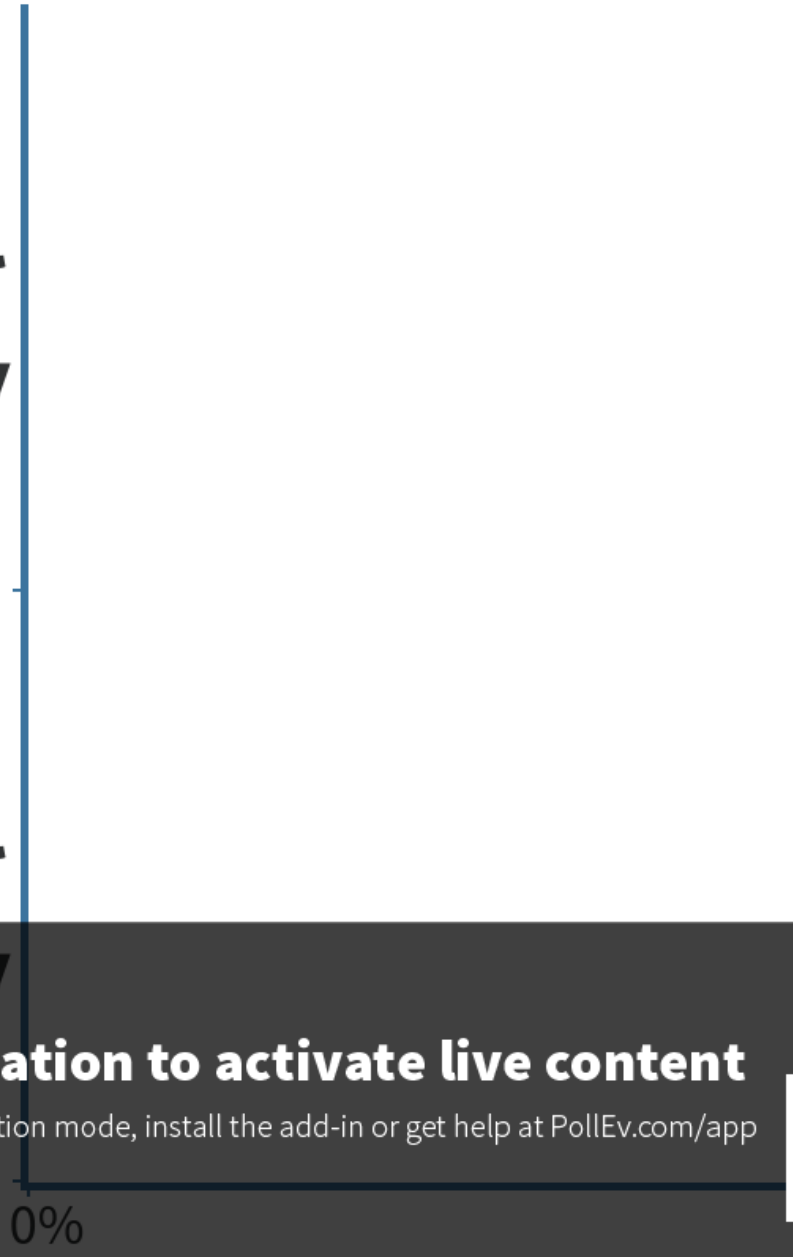
Elemental Mercury

Dimethyl mercury



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ORIGINAL ARTICLE
BRIEF REPORT

Delayed Cerebellar Disease and Death after Accidental Exposure to Dimethylmercury

David W. Nierenberg, M.D., Richard E. Nordgren, M.D., Morris B. Chang, M.D., Richard W. Siegler, M.D., Michael B. Blayney, Ph.D., Fred Hochberg, M.D., Taft Y. Toribara, Ph.D., Elsa Cernichiari, M.S., and Thomas Clarkson, Ph.D.

N Engl J Med 1998; 338:1672-1676 | June 4, 1998 | DOI: 10.1056/NEJM199806043382305

Karen Wetterhahn

Cerebellar Hemispheric Sections from the Patient (Left) and from a Woman of Approximately the Same Age without Neurologic Disease (Right). Widespread shrinkage of the folia and diminution of the cerebellar cortical thickness are evident in the section from the patient.

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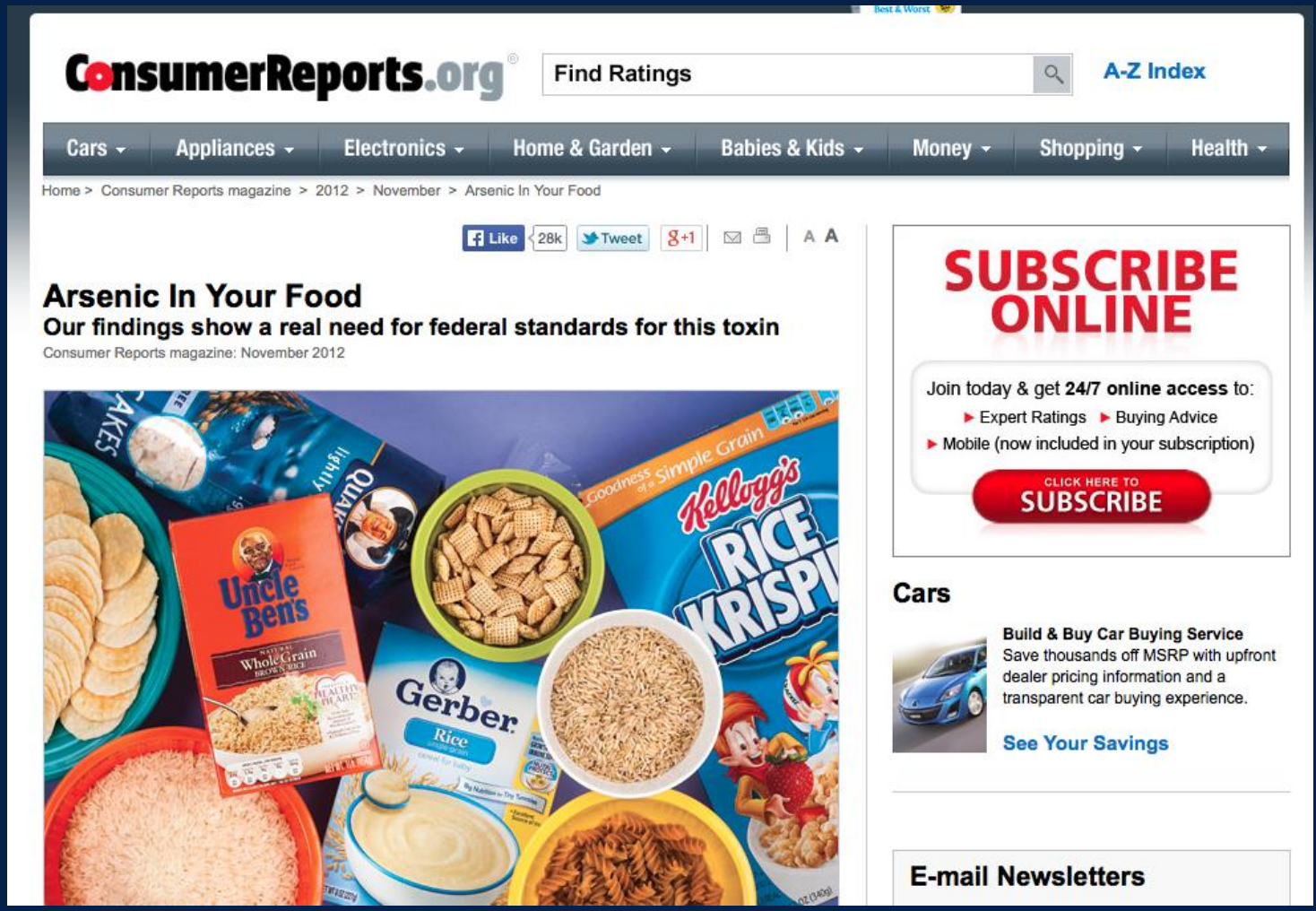
Arsenic

Is there a health concern?



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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:
    - Dimethylarsenic acid, methlyarsonic acid
- Organic arsenic (oAs)
  - Bound to carbon
  - Toxicity varies
  - Not always known
  - Examples: Arsenobetaine, Arsenolipids

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

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

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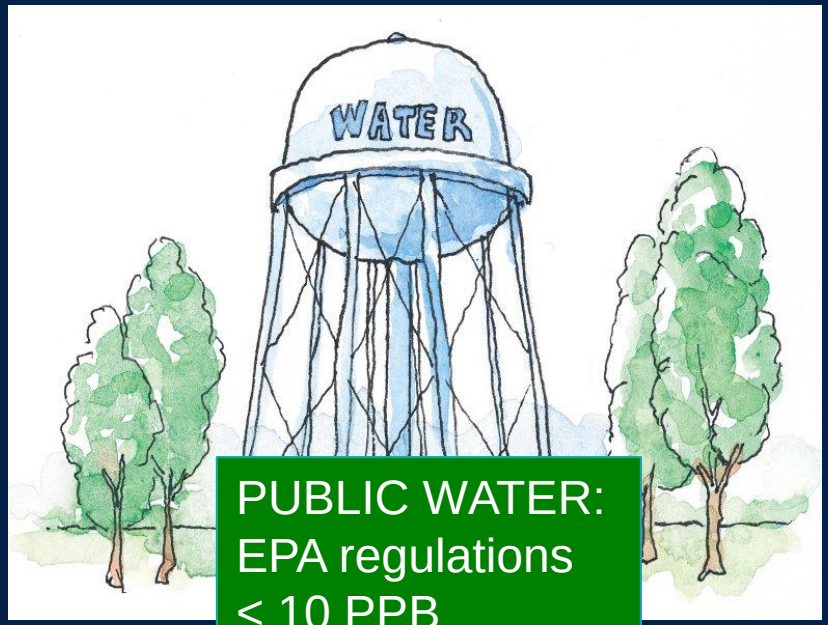
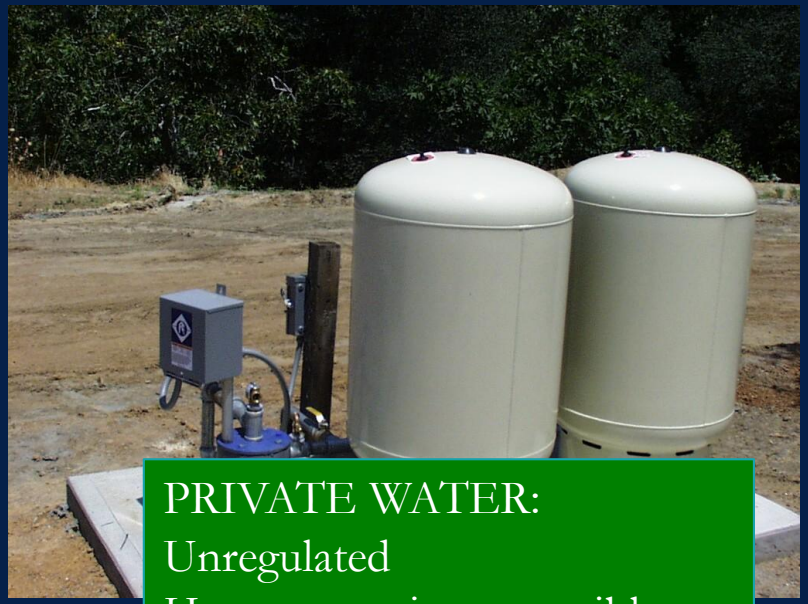
Arsenic exposure via water



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 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

Chicken
0.2 µg per half pound

COOKED SPINACH
1.1 µg per cup

GRA… …hrimp
0.4 µg per half pound

UNREGULATED

REGULATED

Arsenic in water

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

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.

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

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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Is there a health concern?

- 2008 Baby Rice cereals study
  - Drinking water 10 ppb: 0.17 µg/d/kg
  - Baby rice cereal: 0.21 µg/d/kg

- 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

- 2017 Gluten free diet study
- Higher concentrations of urinary total arsenic,
- Mean concentration of estimated urinary total arsenic was **nearly double** among those on a gluten-free diet versus not on a gluten-free diet

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.

Bulka CM, Davis MA, Karagas MR, Ahsan H, Argos M. The Unintended Consequences of a Gluten-Free Diet. Epidemiology. 2017 Feb 1.

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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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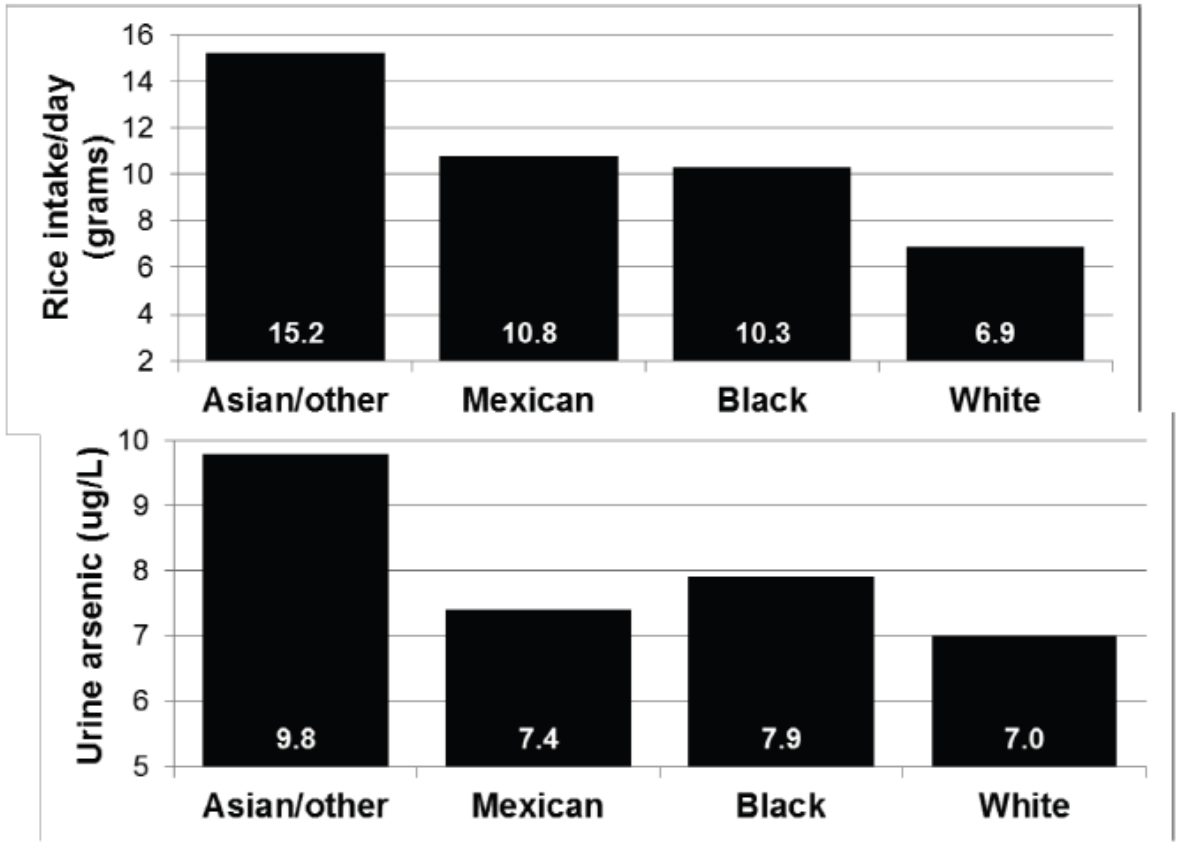
Is there a health concern?

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



Lai P, Cottingham K, Steinmaus C, Karagas M, Miller M. Arsenic and Rice: Translating Research to Address Health Care Providers' Needs. The Journal Of Pediatrics 2015

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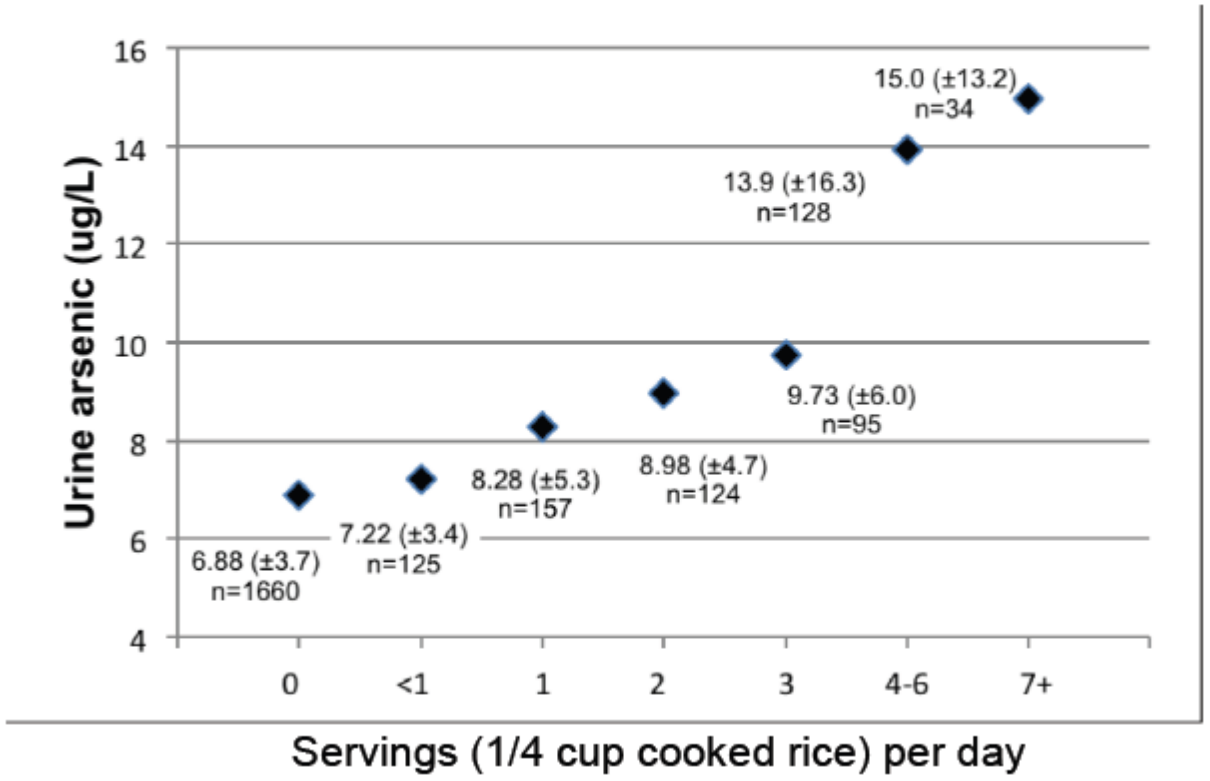
Is there a health concern?

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



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What 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

Summary: Arsenic

Sources of Exposure	Rice, fish, water
Primary concern (chronic exposure)	Bladder, lung, skin cancer
$T_{1/2}$	Blood 10 hours, urine 48 hours
Screening:	24 hour urine collection is best
National average ages 6- 11 total arsenic - urine	7.78 µg/L (creatinine corrected)
National average ages 6- 11 inorganic arsenic - urine	7.38 µg/L (creatinine corrected)
95% Percentile ages 6- 11 inorganic arsenic - urine	17.8 µg/L (creatinine corrected)
Treatment	Removal from exposure

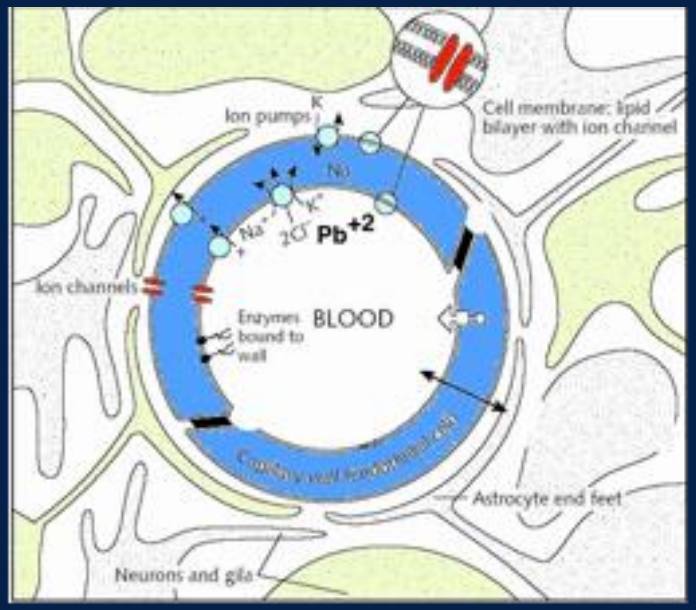
Lead

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/

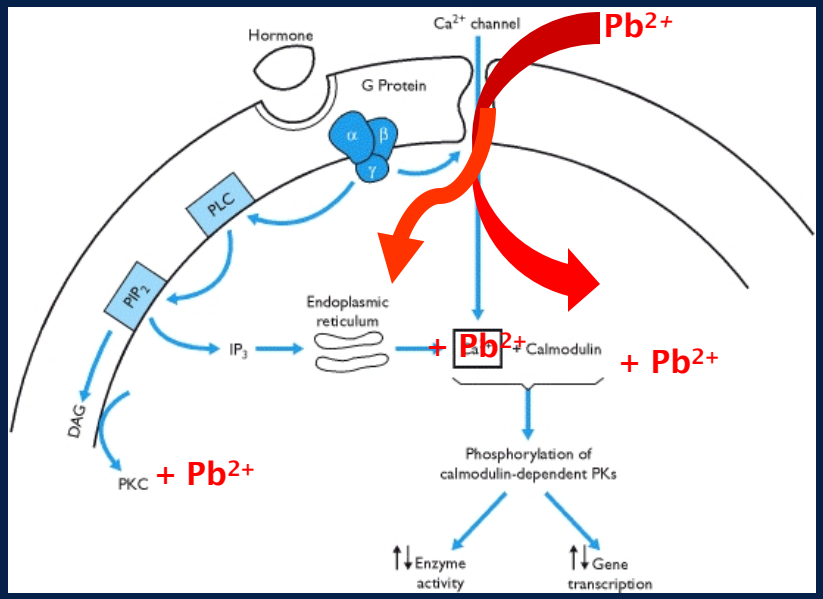
Leads movement through the blood brain barrier



- Substitutes for Ca^{2+} and passes through ion channels
- Interferes with astrocyte and endothelial cell communication
- In children <6 (12 – 24 months) have incomplete blood brain barrier that permits the entry

Brochin, R., Leone, S., Phillips, D., Shepard, N., Zisa, D., & Angerio, A. (2008). The cellular effect of lead poisoning and its clinical picture. Issues, 5(2).

Lead's multiple toxic mechanisms



Nussey S, Whitehead S. Endocrinology: An Integrated Approach. Oxford: BIOS Scientific Publishers; 2001. Chapter 5, The parathyroid glands and vitamin D. Available from: http://www.ncbi.nlm.nih.gov/books/NBK24/

- Pb^{2+} enters through Ca^{2+} channel, and binds with calmodulin with a higher affinity than Ca^{2+}
- Pb^{2+} may also be stored in the endoplasmic reticulum, in place of Ca^{2+} , and released when the G-protein activates phospholipase C, leading to abnormal enzyme activity and gene transcription
- Protein kinase C binds Pb^{2+} more readily than Ca^{2+} resulting in cellular dysfunction

Sanders T, Liu Y, Buchner V and Tchounwou P. Neurotoxic Effects and Biomarkers of Lead Exposure: A Review. Rev Environ Health. 2009 Jan–Mar; 24(1): 15–45.

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Where is lead?

Damaged paint in homes built pre-1979

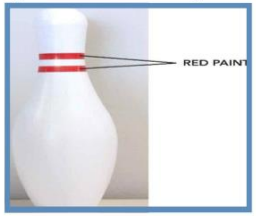
Cracked or peeling paint creates paint chips and lead dust that can be accessible to children in the home and through contact with bare soil.

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.

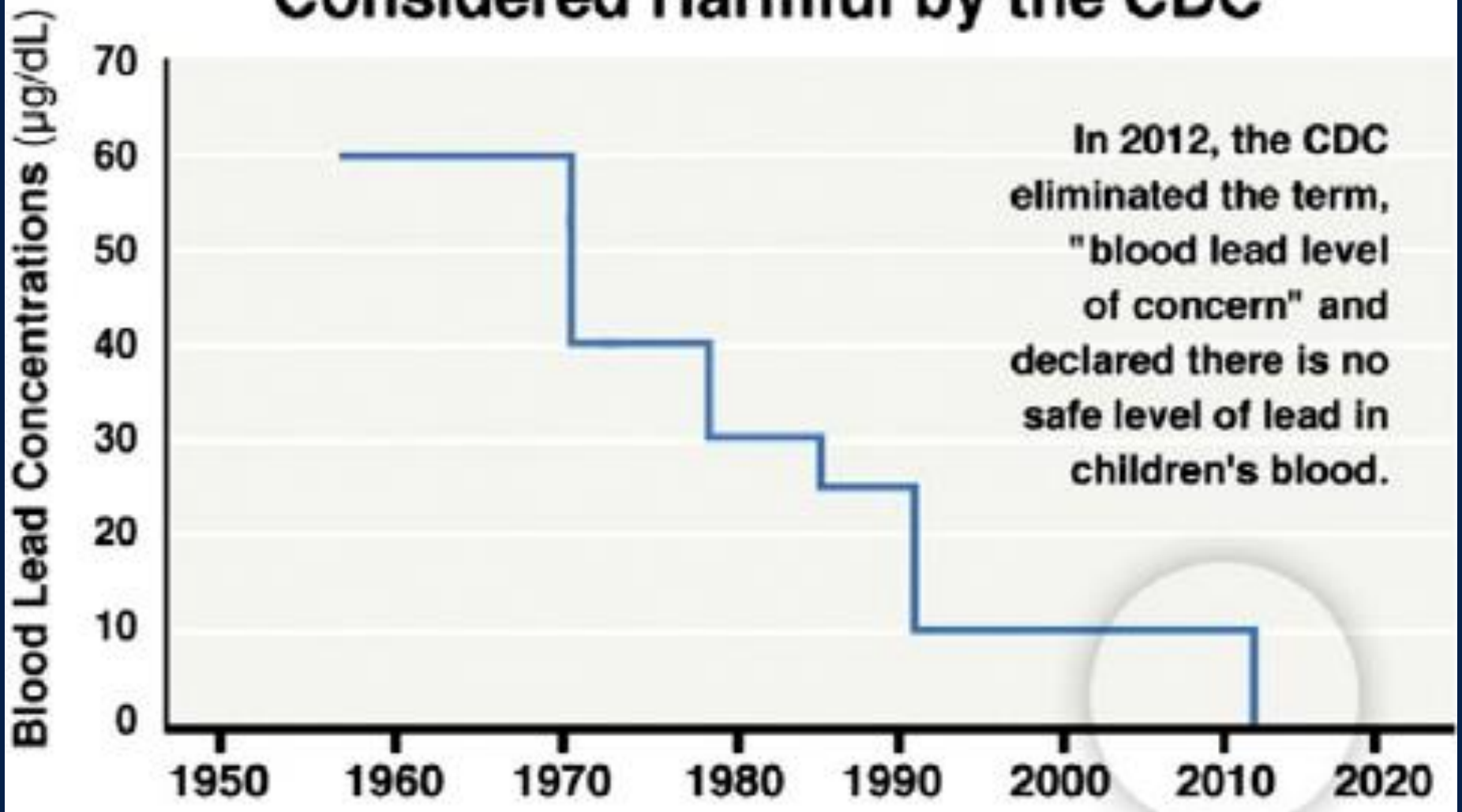
Worries About Lead for New York's Garden-Fresh Eggs

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.

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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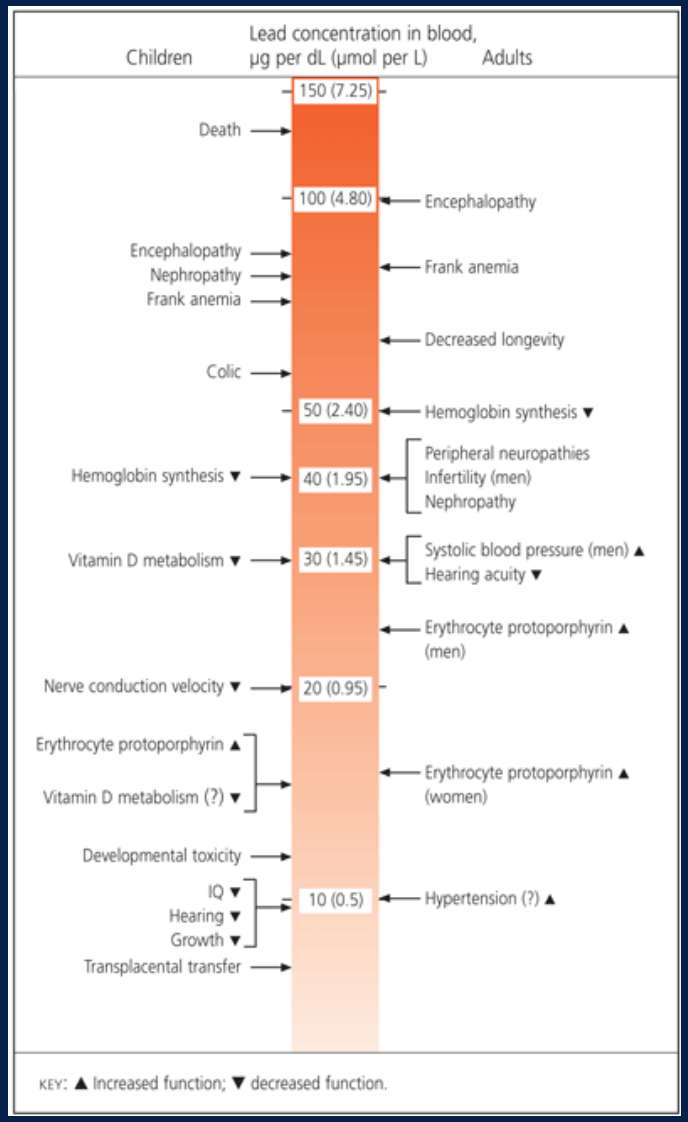
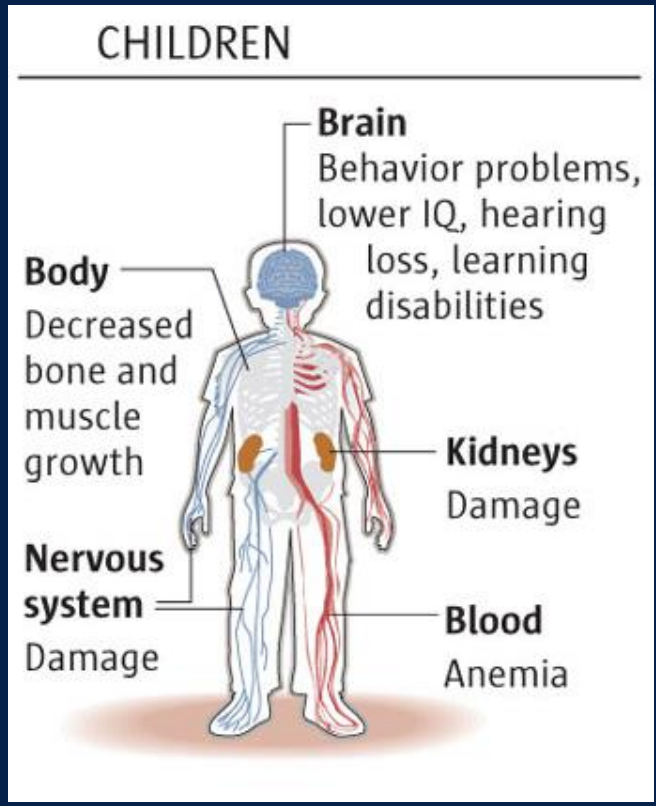
Organ System toxicity

- GI
  - Lead colic, which includes sporadic vomiting, intermittent abdominal pain, and constipation,
- Renal
  - < 10 µg/dL = Lead nephropathy/chronic interstitial nephritis, renal tubular dysfunction: aminoaciduria, glycosuria, proteinuria
- Nervous System
  - *Any Level* = cognitive deficits.
  - 20 µg/dL = Peripheral Neuropathy
  - Hearing Loss
  - 100 µg/dL = encephalopathy

Target Organs

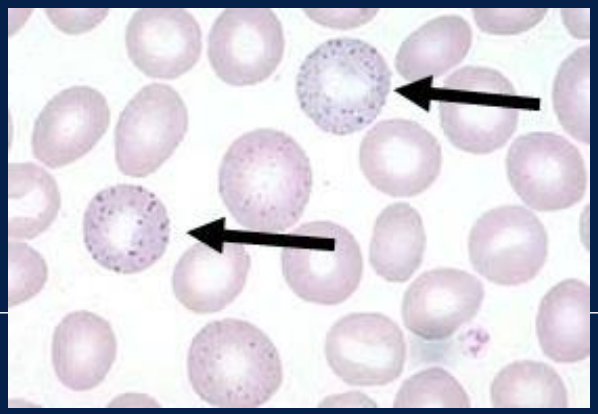




Lead induced anemia

Ineffective erythropoiesis

- <40 µg/dL likely iron deficiency anemia (same risk factors as lead toxicity)
- 40 µg/dL = anemia 2/2 to hemoglobin precursors:
  - Inhibition of delta aminolevulinate dehydratase and ferrochelatase
  - Results in accumulation of heme intermediates such as free protoporphyrin in erythrocytes



http://quizem.org/quizem-11-answers/

Hemolysis (>70 µg/dL)

- Acquired deficiency of erythrocyte pyrimidine 5'-nucleotidase

or

- Inhibits alpha chain synthesis, mimicking alpha thalassemia

or

- Inhibition of RBC membrane ATP-ase

Aly MH, Kim HC, Renner SW, Boyarsky A, Kosmin M, Paglia DE. Hemolytic anemia associated with lead poisoning from shotgun pellets and the response to Succimer treatment. Am J Hematol. 1993 Dec;44(4):280-3.

Wright RO, Tsaih SW, Schwartz J, Wright RJ, Hu H. Association between iron deficiency and blood lead level in a longitudinal analysis of children followed in an urban primary care clinic. J Pediatr. 2003 Jan;142(1):9-14.

Kwong WT, Friello P, Semba RD. Interactions between iron deficiency and lead poisoning: epidemiology and pathogenesis. Sci Total Environ. 2004 Sep 1;330(1-3):21-37. Review.

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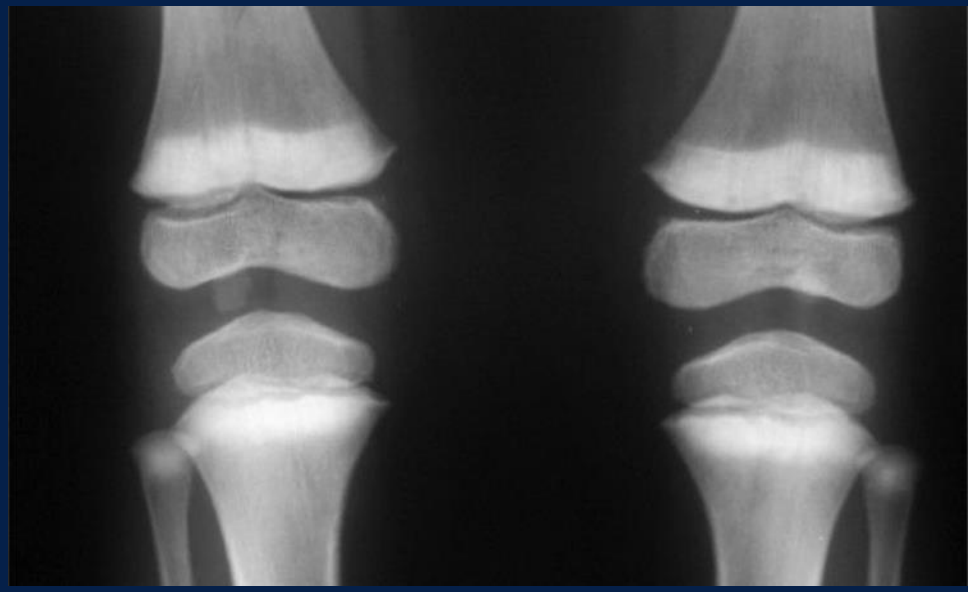
Lead lines

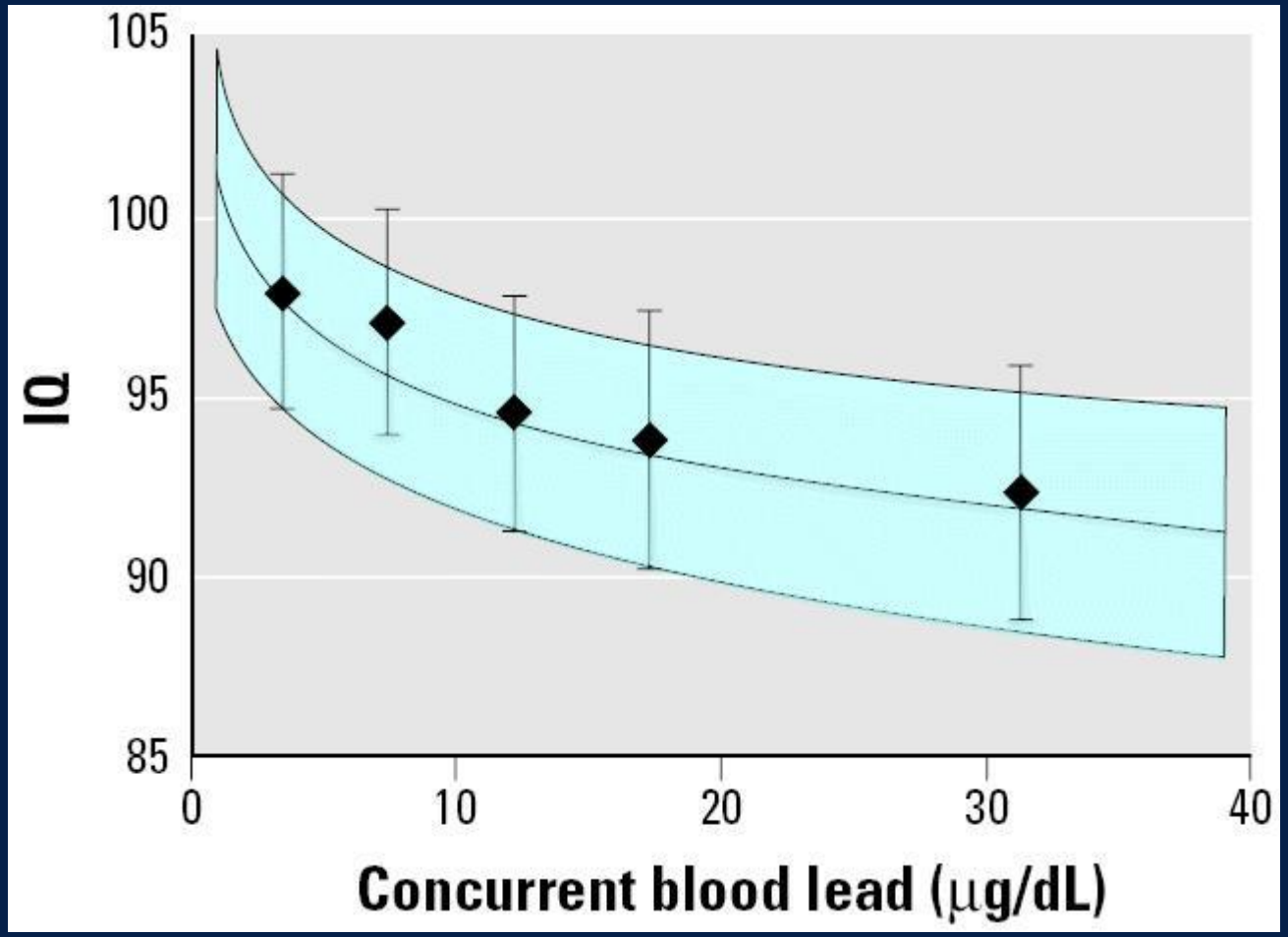
- At 30 μg/dL as BLL↑, Vitamin D ↓ affecting tooth/bone maturation
- Bands of increased density at metaphyses of tubular bones (growing bone)
- Metaphyses of growing bones may be dense normally
- Lead lines more apt to be seen in proximal fibula and distal ulna where growth is not as great as other long bones

Frontal radiograph of both knees of a child with lead poisoning



http://www.learningradiology.com/notes/bonenotes/leadpoisonpage.htm#sthash.5lp8J7M4.dpuf

Blood Lead and IQ scores in 1,333 children followed from birth to age 10.



Lanphear B et al.. Low-level environmental lead exposure and children's intellectual function: an international pooled analysis. Environ Health Perspect. 2005 Jul;113(7):894-9.

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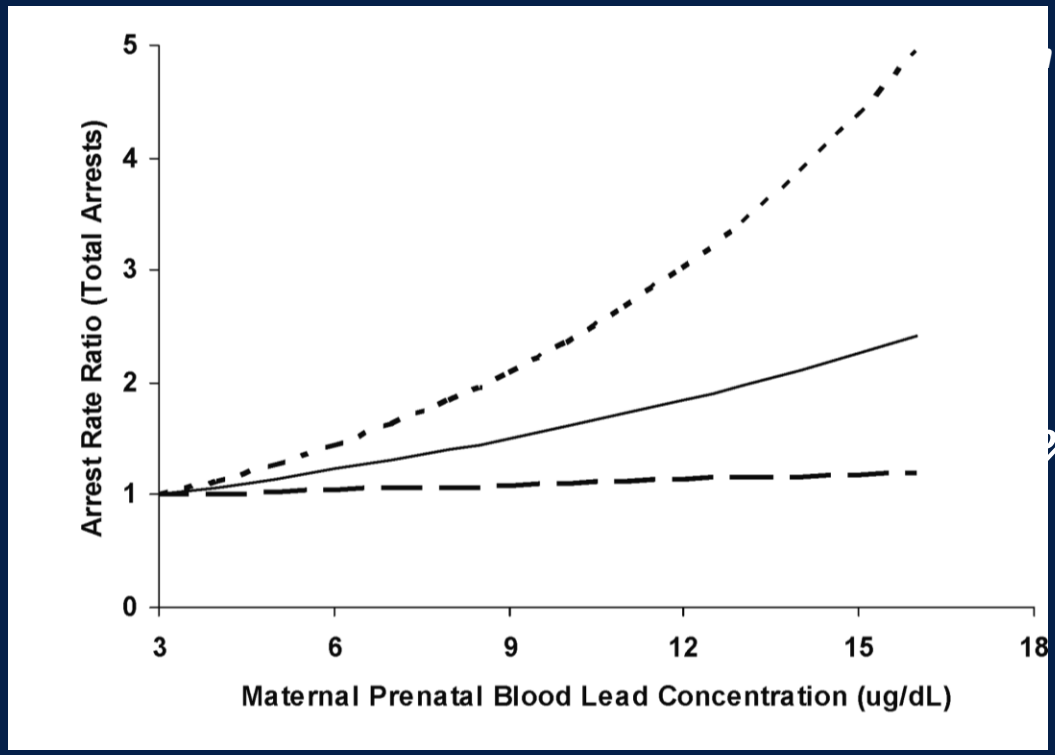
Societal Costs

- 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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Levels of Prevention

	Primary Prevention	**Secondary Prevention**	**Tertiary Prevention**
Definition	Intervention implemented before there is evidence of injury	Intervention implemented after a disease has begun, but before it is symptomatic	Intervention implemented after a disease is established
Intent	Eliminate causative factor	Early identification and treatment	Prevent sequelae
Example	Eliminate lead Exposure	Screen for lead exposure	Prevent anemia, encephalopathy, and renal failure

PRIMARY PREVENTION:

- Hygiene Guidance
  - Change out of work clothes and shoes before going inside the home.
  - Take off shoes or wipe them on a doormat before going inside the home
  - Keep the home clean and dust-free.
  - Keep furniture away from paint that is chipped or peeling.
  - Never sand, dry scrape, power wash or sandblast paint
  - Always wash hands before eating and sleeping.
- Nutrition Guidance
  - Balanced diet two daily servings of dairy or other calcium rich foods and two servings of fruit or fruit juice provide sufficient calcium and vitamin C in the diet

Secondary Prevention

- **AAP***
- A risk assessment and anticipatory guidance to parents of children particularly **6 months to 6 years**
- **BLL's ideally at 1 and 2 years of age**, unless lead exposure can be confidently excluded.

- **USPSTF (2006)**
- There is **INSUFFICIENT** evidence to recommend for or against routine screening for elevated blood lead levels in asymptomatic children aged 1 to 5 who are at increased risk.
- Recommends **AGAINST** routine screening for elevated blood lead levels in asymptomatic children aged 1 to 5 years who are at average risk.

- **CA DPH**

Screen:

- Children in publicly supported programs at both 12 months and 24 months.
- Children age 24 months to 6 years in publicly supported programs who were not tested at 24 months or later.
- **Lives in a place built before 1978** that has peeling or chipped paint or that has been recently remodeled

* Bright Futures

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Tertiary Prevention

- Any level = **REMOVAL FROM EXPOSURE**!
- >45 µg/dL
  - Gut Decontamination
  - Hospitalization or other Lead free environment
  - Oral Chelation (Succimer/DMSA)
- >70 µg/dL
  - Oral + IV (Succimer + Ca EDTA)
- >100 µg/dL
  - IV + IM (Ca EDTA + Dimercaprol/BAL)

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]

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

Description of 3,180 Courses of Chelation with Dimercaptosuccinic Acid in Children ≤5 y with Severe Lead Poisoning in Zamfara, Northern Nigeria: A Retrospective Analysis of Programme Data

Natalie Thurtle[1], Jane Greig[2]*, Lauren Cooney[1], Yona Amitai[3], Cono Ariti[4], Mary Jean Brown[5], Michael J. Kosnett[6], Krystel Moussally[1], Nasir Sani-Gwarzo[7], Henry Akpan[8,9], Leslie Shanks[1], Paul I. Dargan[1,10]

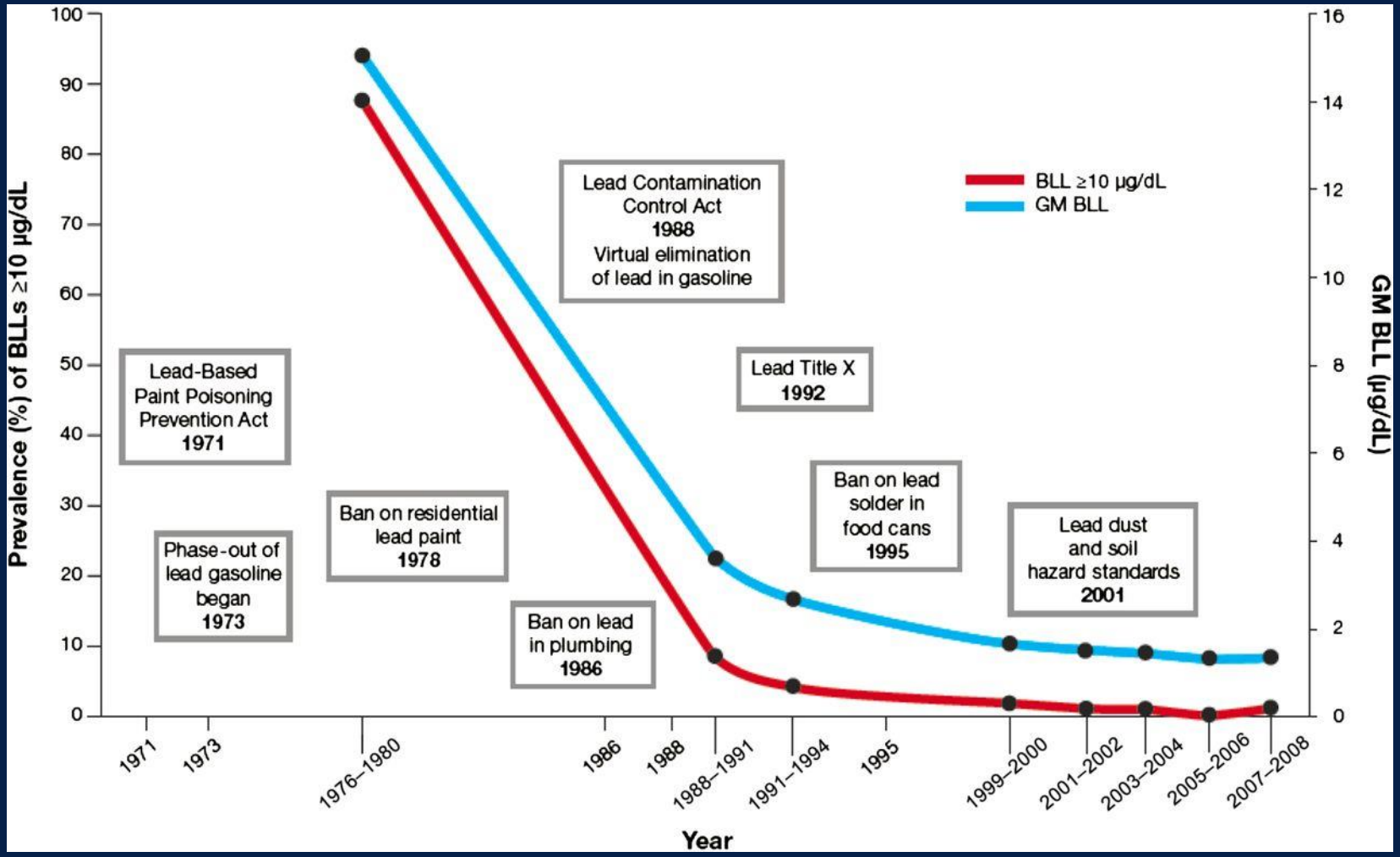
1 Médecins Sans Frontières, Amsterdam, Holland, **2** Médecins Sans Frontières, London, United Kingdom, **3** Department of Management, Bar Ilan University, Ramat Gan, Israel,

Over a 2-month period until in May 2010, nearly 300 children aged <5 years old presented with intractable seizures of unknown etiology, with a mortality of 48%.

Table 3. Baseline characteristics.

Characteristic	Pre-Chelation† (*n*=1,156 Children)	Pre-Course (*n*=3,180 Courses)
Age at start of course		
0 to <6 mo	48 (4%)	63 (2%)
≥6 mo to <1 y	128 (11%)	300 (9%)
≥1 y to <2 y	190 (16%)	689 (22%)
≥2 y to <3 y	115 (10%)	342 (11%)
≥3 y to ≤5 y	675 (58%)	1,786 (56%)
Sex		
Male	599 (52%)	1,638 (52%)
Female	557 (48%)	1,542 (48%)
VBLL (μg/dl)		
45–64.9	709 (61%)	1,856 (58%)
65–79.9	68 (6%)	187 (6%)
80–119.9	295 (26%)	945 (30%)
120–199.9	69 (6%)	174 (5%)
200–345	15 (1%)	18 (1%)

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®

Summary: Lead

Reference value	<5 µg/dL in whole blood
Screening:	12 and 24 Months
Sources of exposure	Paint chips, demolition, construction
Treatment (asymptomatic, levels <45 µg/dL)	Removal from exposure, KUB, ZPP, CBC, CMP
Treatment (symptomatic, >45µg/dL)	Succimer x 19 days x 1
$T_{1/2}$	30 Days -blood
Primary Concern	Neurologic, renal, hematologic

Mercury

Forms of Mercury

Elemental

Hg^0

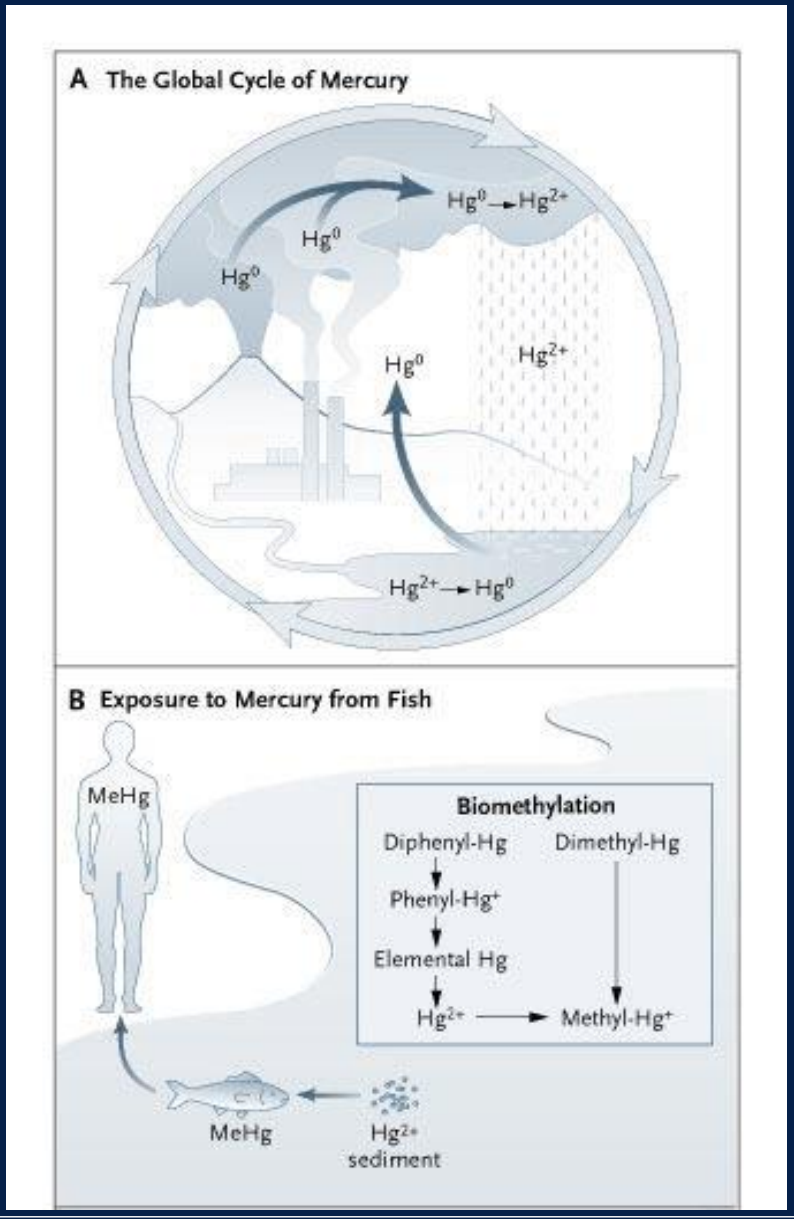
Inorganic

$HgCl_2$

Organic

CH_3Hg^+

The Global Cycle of Mercury.



Clarkson TW et al. N Engl J Med 2003;349:1731-1737.

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Elemental

- Absorption: Inhalation
- Source: thermometers, old barometers and electrical switches, fluorescent light bulbs, mercury mining, smelting and artisanal gold mining
- Situation: Generally accidental
- Health Effects:
  - **Neurologic**: tremor, ataxia, polyneuropathy, abnormal reflexes, mercurial erethism (excitability, loss of memory, insomnia, extreme shyness); neurocognitive disorders
  - **Dermatologic:** acrodynia with painful, swelling of extremities, pinkish discoloration, desquamation, erythema
  - **Pulmonary**: cough, dyspnea, **Oral**: gingivitis, stomatitis, **Renal**: proteinuria
- Symptoms may not correlate with levels

Inorganic

- Absorption: Dermal, inhalation, oral
- Source: Skin-lightening creams, soaps, Ayurvedic medicine
- Situation: Exposure/application of products from developing countries
- Health Effects:
  - Nephritic syndromes
  - Acrodynia
  - Tremor

Organic

- Absorption: Oral, dermal
- Source: Prenatal exposure
- Situation: Mother's diet high in methylmercury
- Health Effects:
  - Chronic low level: Neurodevelopment: loss of IQ points, decreased performance on tests, including memory, attention, language, and spatial cognition.
  - Extremely high level: microcephaly, cerebral palsy, severe mental retardation, seizure disorders, blindness, deafness, a

Advice About Eating Fish

What Pregnant Women & Parents Should Know

Fish and other protein-rich foods have nutrients that can help your child's growth and development.

For women of childbearing age (about 16-49 years old), especially pregnant and breastfeeding women, and for parents and caregivers of young children.

- *Eat 2 to 3 servings of fish a week from the "Best Choices" list OR 1 serving from the "Good Choices" list.*
- *Eat a variety of fish.*
- *Serve 1 to 2 servings of fish a week to children, starting at age 2.*
- *If you eat fish caught by family or friends, check for fish advisories. If there is no advisory, eat only one serving and no other fish that week.**

Use this chart!

You can use this chart to help you choose which fish to eat, and how often to eat them, based on their mercury levels. The "Best Choices" have the lowest levels of mercury.

What is a serving?

To find out, use the palm of your hand!

For an adult
4 ounces

For children, ages 4 to 7
2 ounces

Best Choices EAT 2 TO 3 SERVINGS A WEEK

- Anchovy
- Atlantic croaker
- Atlantic mackerel
- Black sea bass
- Butterfish
- Catfish
- Clam
- Cod
- Crab
- Crawfish
- Flounder
- Haddock
- Hake
- Herring
- Lobster, American and spiny
- Mullet
- Oyster
- Pacific chub mackerel
- Perch, freshwater and ocean
- Pickerel
- Plaice
- Pollock
- Salmon
- Sardine
- Scallop
- Shad
- Shrimp
- Skate
- Smelt
- Sole
- Squid
- Tilapia
- Trout, freshwater
- Tuna, canned light (includes skipjack)
- Whitefish
- Whiting

OR

Good Choices EAT 1 SERVING A WEEK

- Bluefish
- Buffalofish
- Carp
- Chilean sea bass/ Patagonian toothfish
- Grouper
- Halibut
- Mahi mahi/ dolphinfish
- Monkfish
- Rockfish
- Sablefish
- Sheepshead
- Snapper
- Spanish mackerel
- Striped bass (ocean)
- Tilefish (Atlantic Ocean)
- Tuna, albacore/ white tuna, canned and fresh/frozen
- Tuna, yellowfin
- Weakfish/seatrout
- White croaker/ Pacific croaker

Choices to Avoid HIGHEST MERCURY LEVELS

- King mackerel
- Marlin
- Orange roughy
- Shark
- Swordfish
- Tilefish (Gulf of Mexico)
- Tuna, bigeye

*Some fish caught by family and friends, such as larger carp, catfish, trout and perch, are more likely to have fish advisories due to mercury or other contaminants. State advisories will tell you how often you can safely eat those fish.

www.FDA.gov/fishadvice

www.EPA.gov/fishadvice

EPA United States Environmental Protection Agency

FDA U.S. FOOD & DRUG ADMINISTRATION

4/17/2017

THIS ADVICE REFERS TO FISH AND SHELLFISH COLLECTIVELY AS "FISH." / ADVICE UPDATED JANUARY 2017

Summary: Mercury

	Elemental	Inorganic	Organic
Route of absorption	Inhalation	Dermal, inhalation (chronic), oral	Transplacental
Clinical effects	Tremor, Acrodynia	Erethism, tremor, Acrodynia	"Minamata" disease
Screening	Urine	Whole Blood/Urine	Whole Blood
Average value*	0.241µg/dL	ND (blood)	0.209 µg/dL
Source	Thermometers	Skin creams	Predator fish diet
$T_{1/2}$	90 days in urine	4-45 days in urine	50 days in blood

*Ages 6- 11, NHANES 2011-2012
ND = Not detectable

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San Francisco

Common Pitfalls

Common Pitfalls

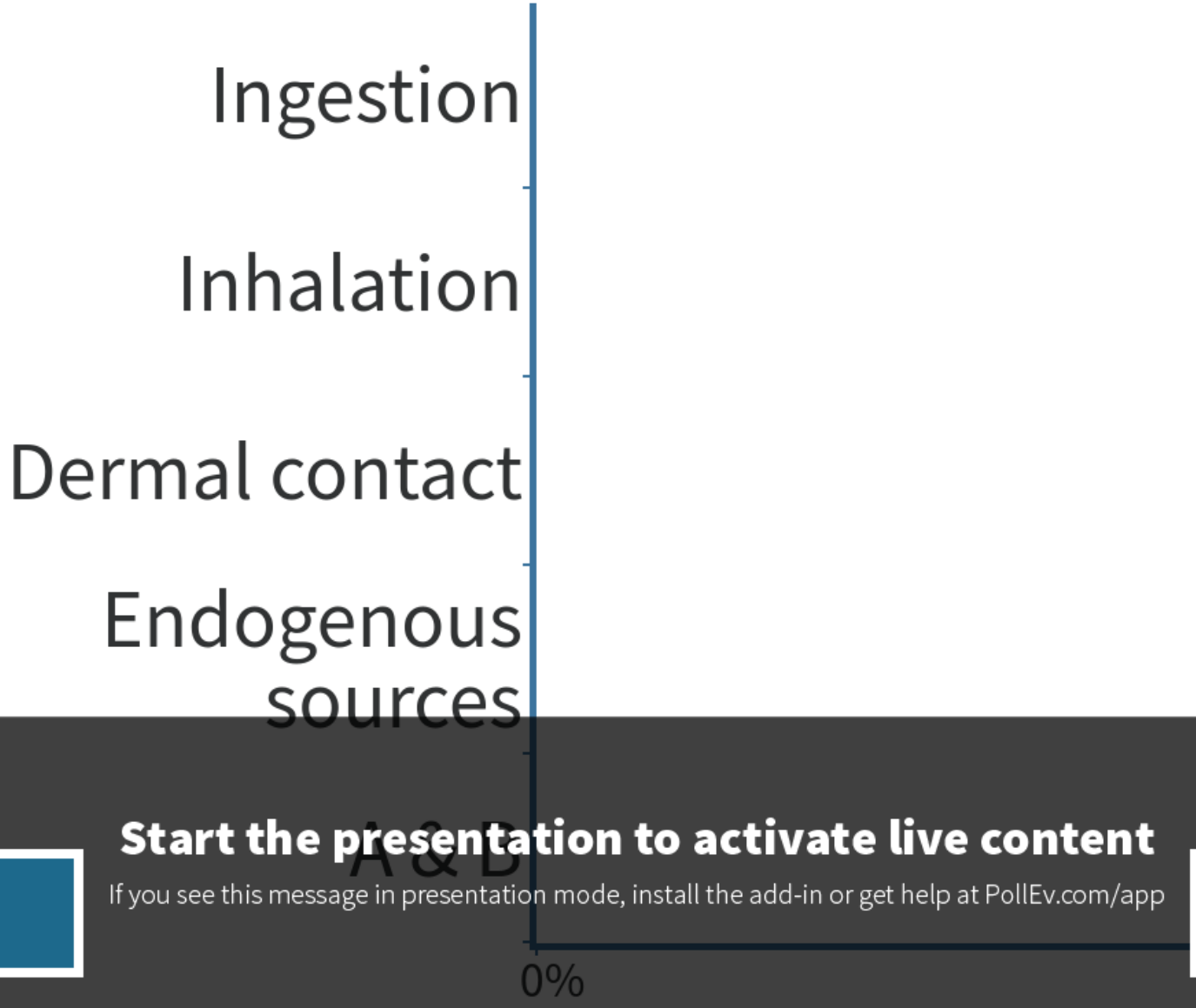
Treating

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

Testing

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

st important route(s) of exposure to lead for
is/are:



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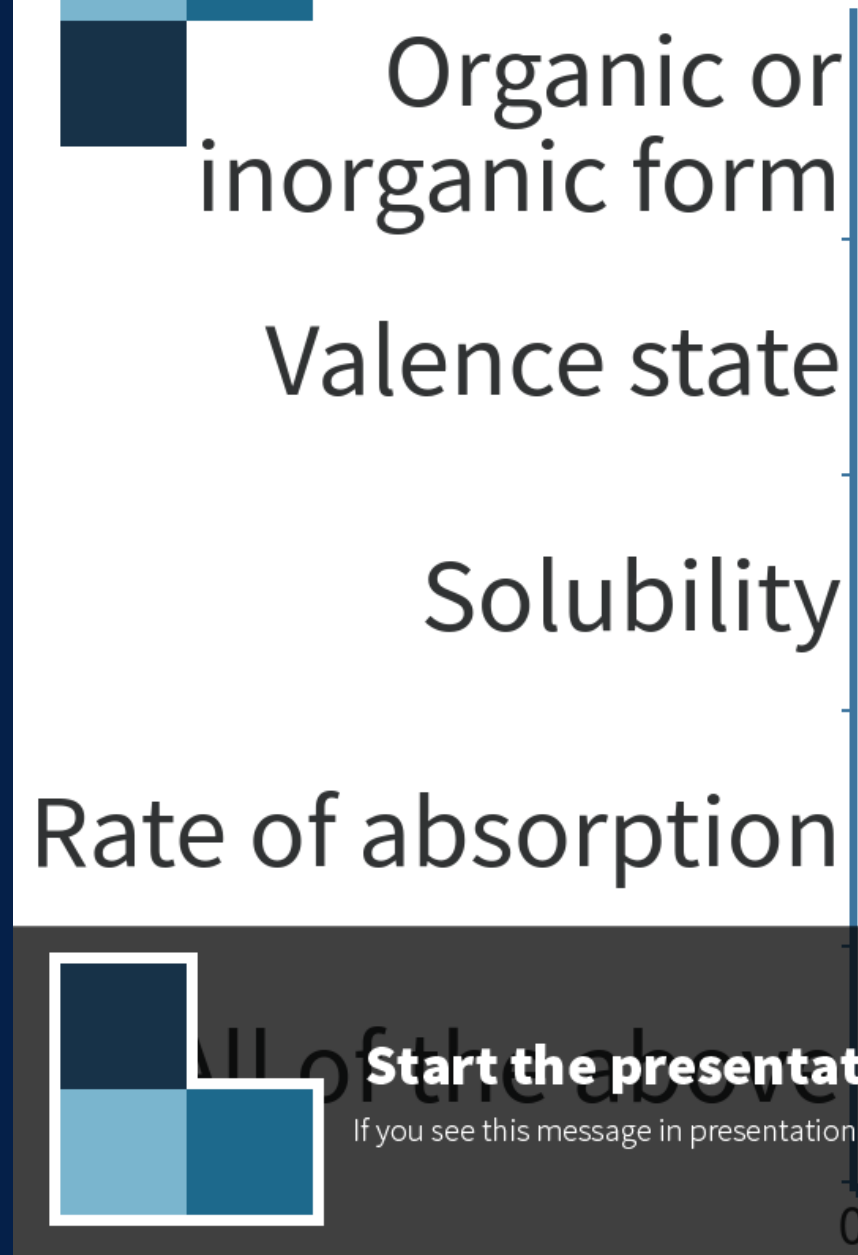
The toxicity of arsenic is related to:



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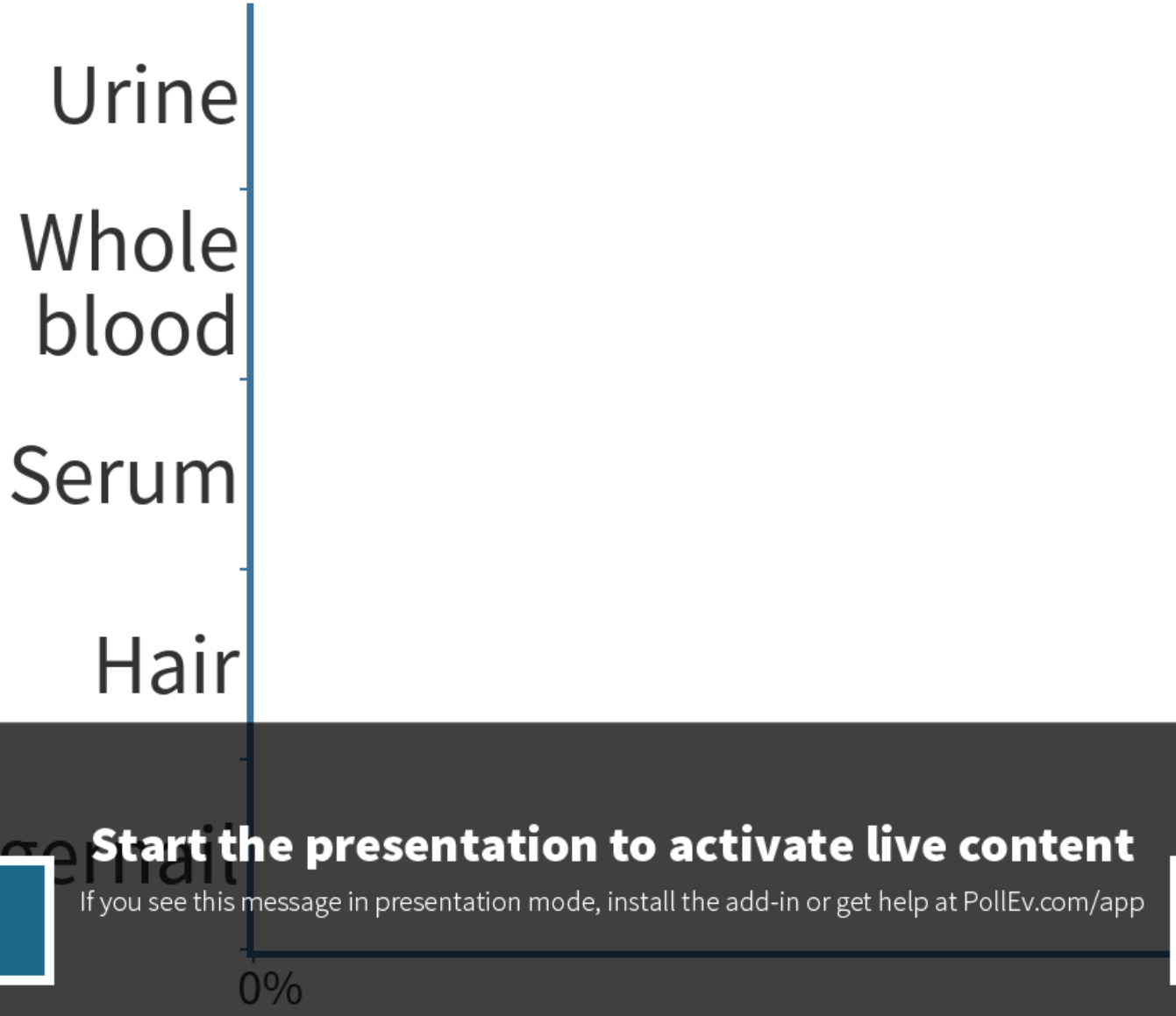
accurate test for measuring levels of organic exposure is:



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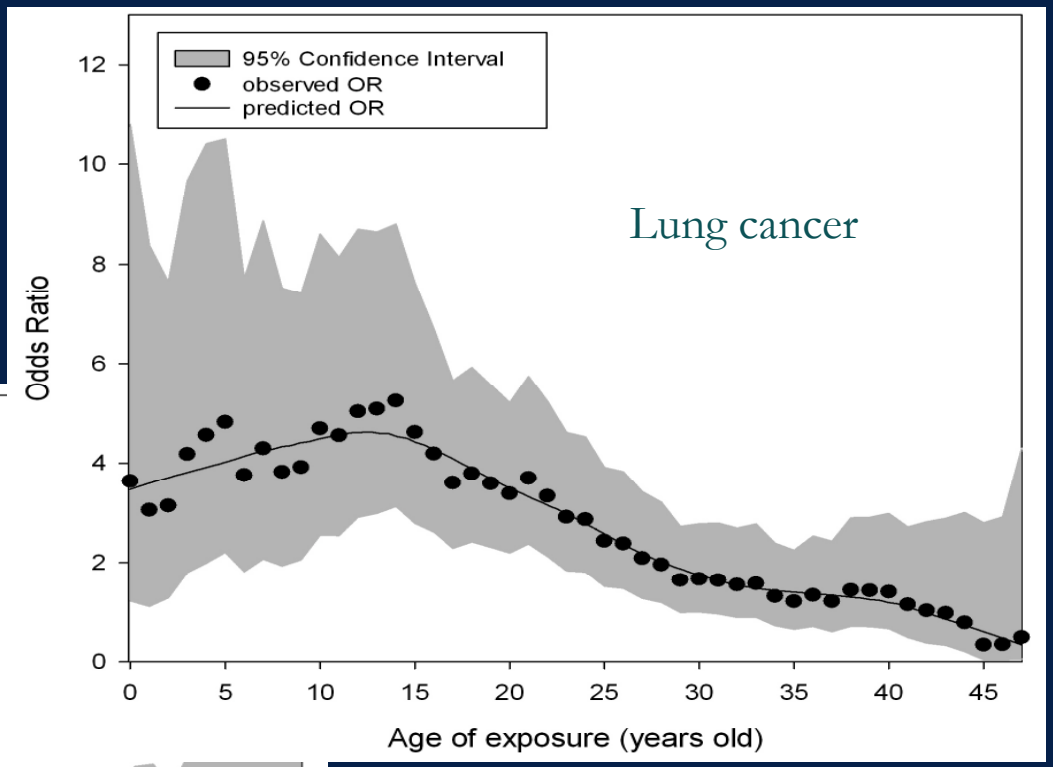
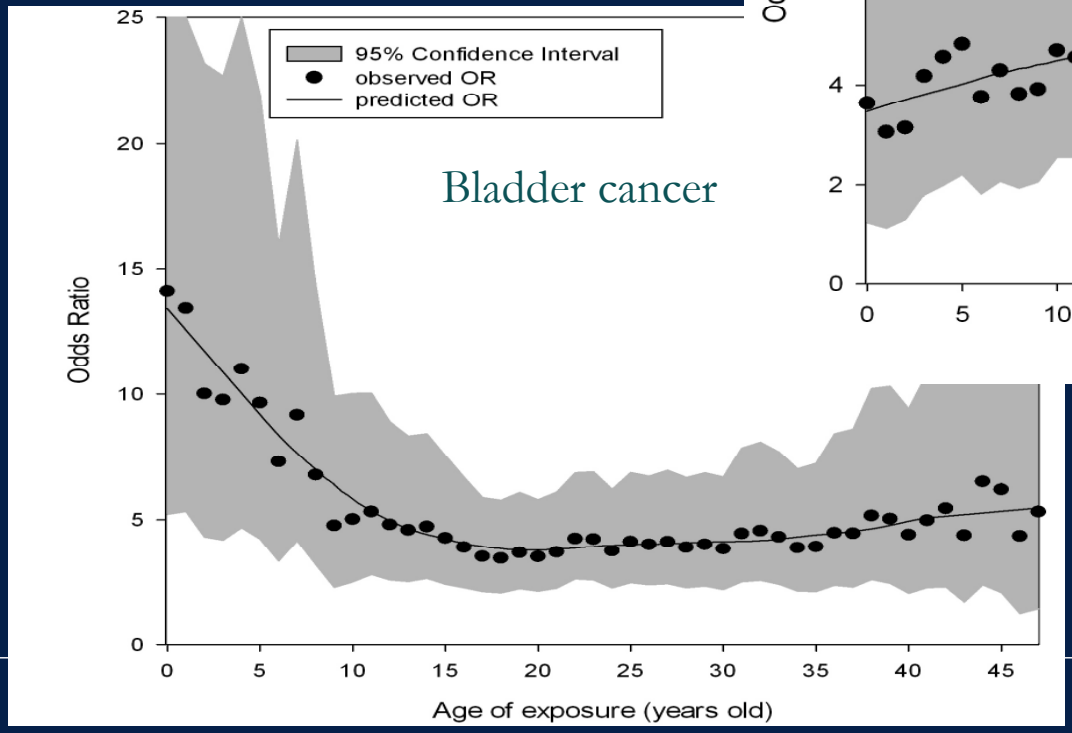
Early life exposure: greater lung and bladder cancer risk





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- Arsenic Backup slides

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

Who are at risk?

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

- Lead Backup slides

California Rental Laws

- The landlord must disclose the presence of known lead-based paint and lead-based paint
- The landlord is not required to conduct any evaluation of the lead-based paint, or to remove it

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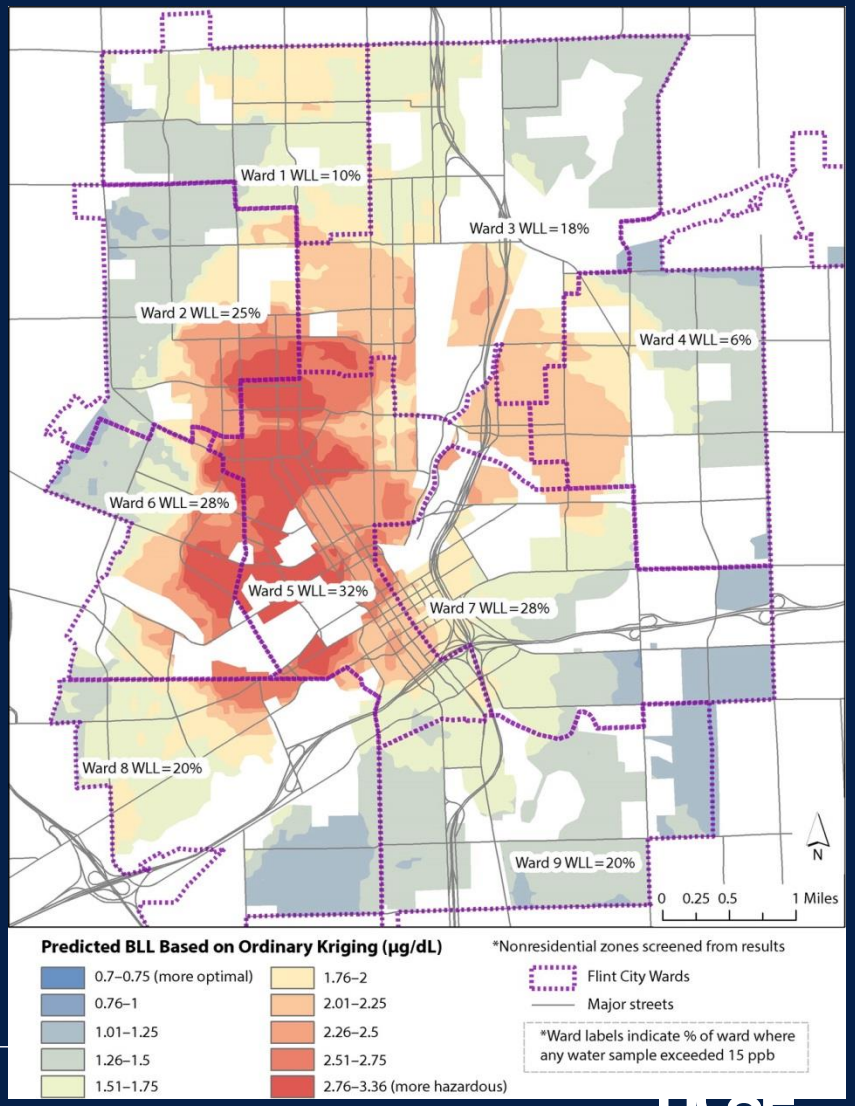
Flint, Michigan

- 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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Community Development Agency
Chris Bazar, Agency Director

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Healthy Homes Department
Including the Lead Poisoning Prevention Program

Maricela Narvaez-Foster
Director

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20 Years of Making Homes Healthier for Children

Welcome!

We provide services to prevent lead poisoning and to promote health and safety in the home.

Main Phone Line: 510-567-8280

Alameda County Healthy Homes Department
November 3 at 5:26pm

Landlords renting to families with children age 6 and under

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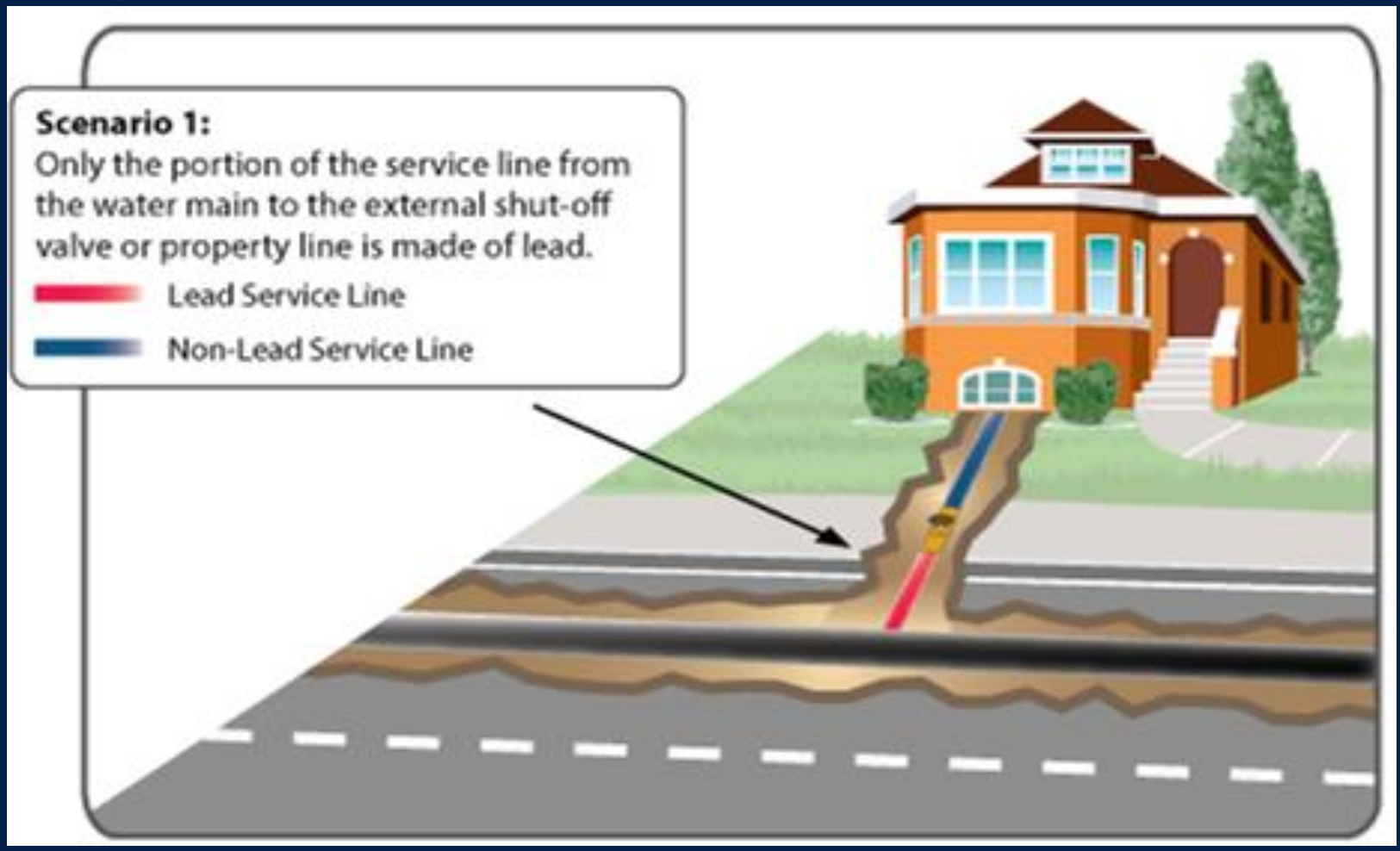
How lead gets into home water



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

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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

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