Metals and Halogens in Drinking Water

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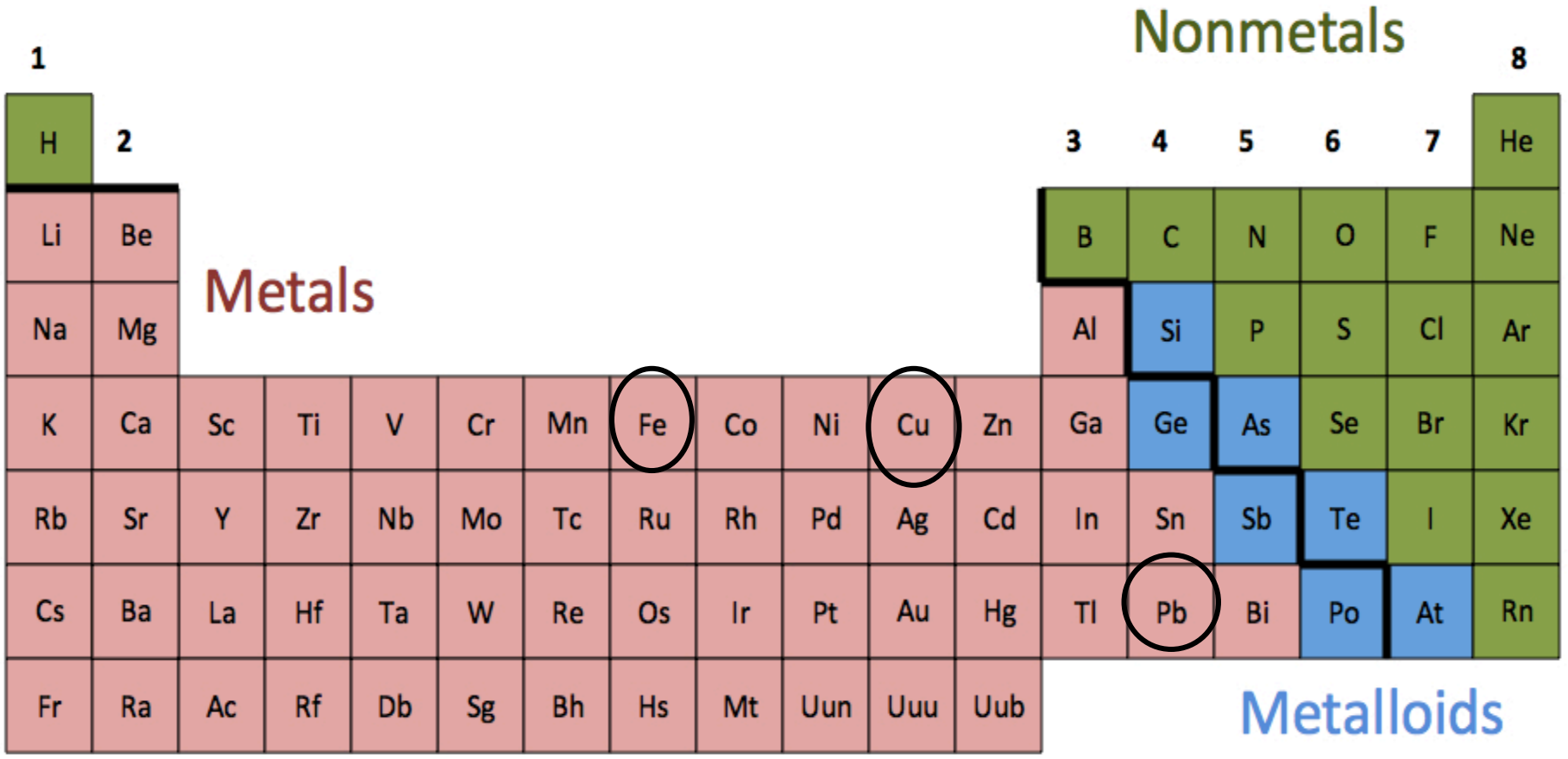
METALS


Nonmetals
1
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Metals
Na
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Al
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Ar
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Ti
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Cr
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Fe
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Br
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Cd
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Sn
Sb
Te
I
Xe
Cs
Ba
La
Hf
Ta
W
Re
Os
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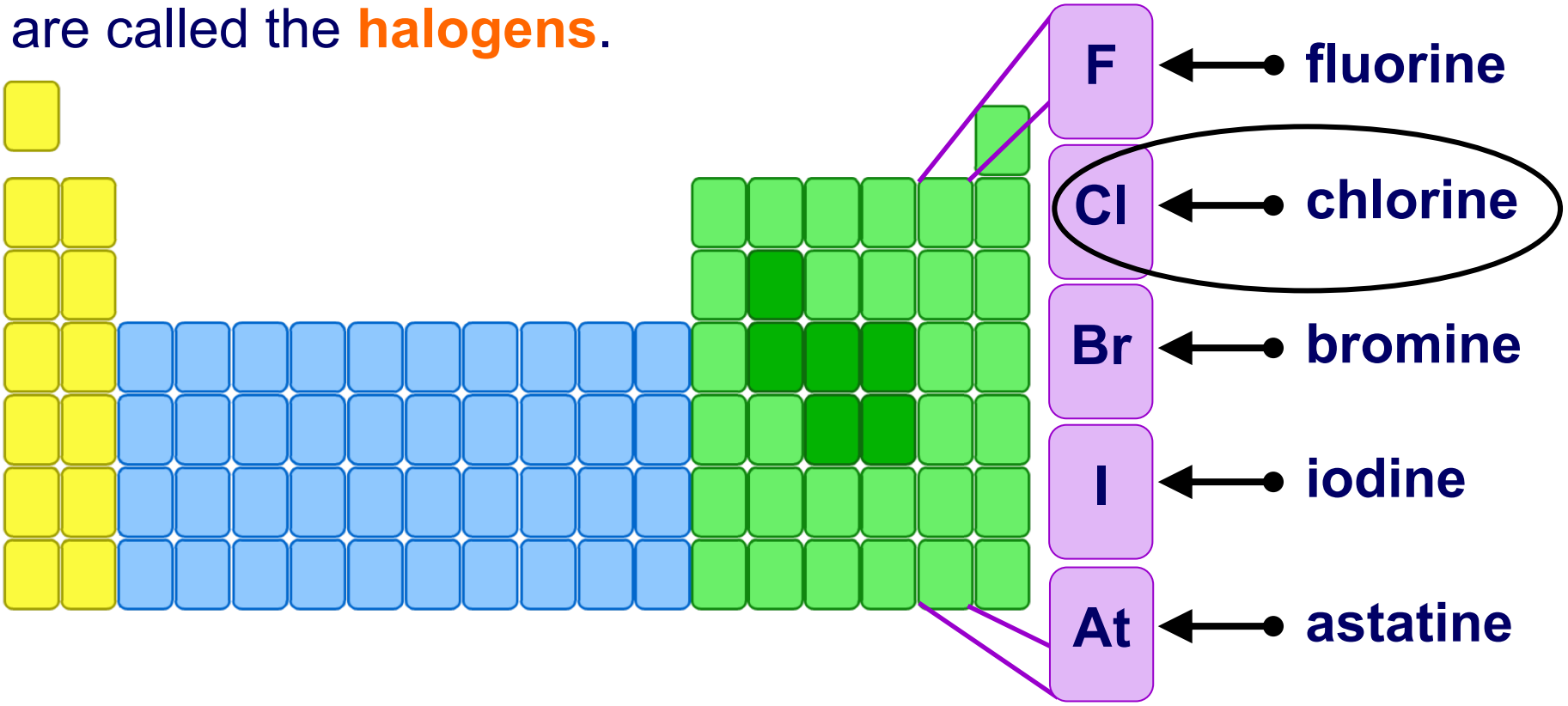
Metalloids

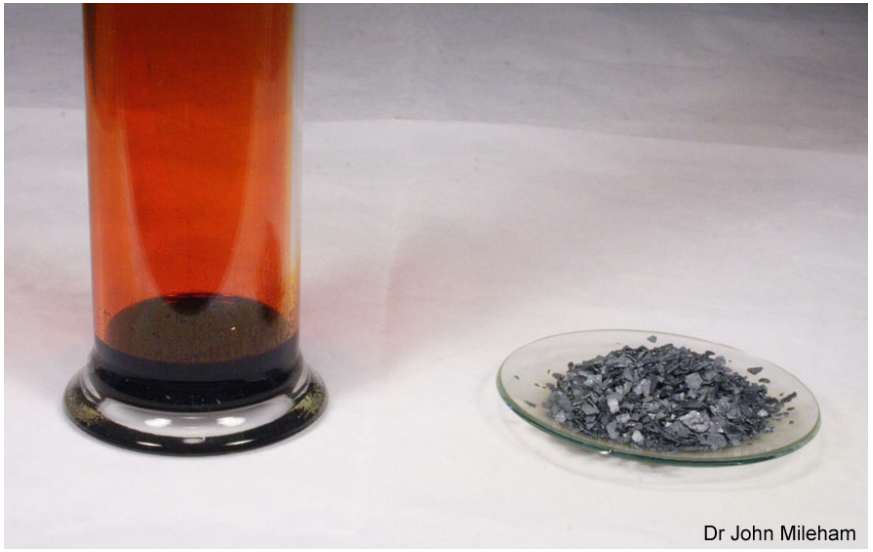
HALOGENS

The elements in group 7 of the periodic table, on the right, are called the **halogens**.



HALOGENS

- **Very reactive non metals**.
- **Never found free in nature** because of reactivity – found as compounds with metals.



- **Halogen-metal compounds are salts – 'halo-gen' means 'salt-former'.**
- **All toxic or harmful because they are so reactive**.
- EX: **Chlorine** gas is extremely dangerous- used in small amounts to **kill bacteria in water supplies**.

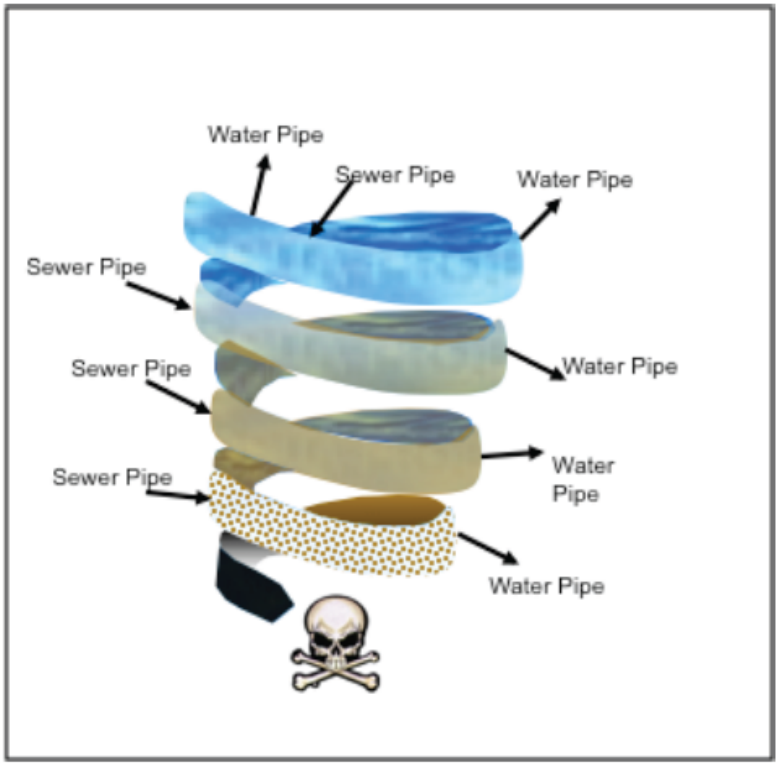
Germs, Disease and Death

- In 1890s and early 1900s, waterborne diseases and deaths were facts of life in the U.S.

- Public health movement to remove “filth” from cities encouraged sewer construction

Germs, Disease and Death (cont.)

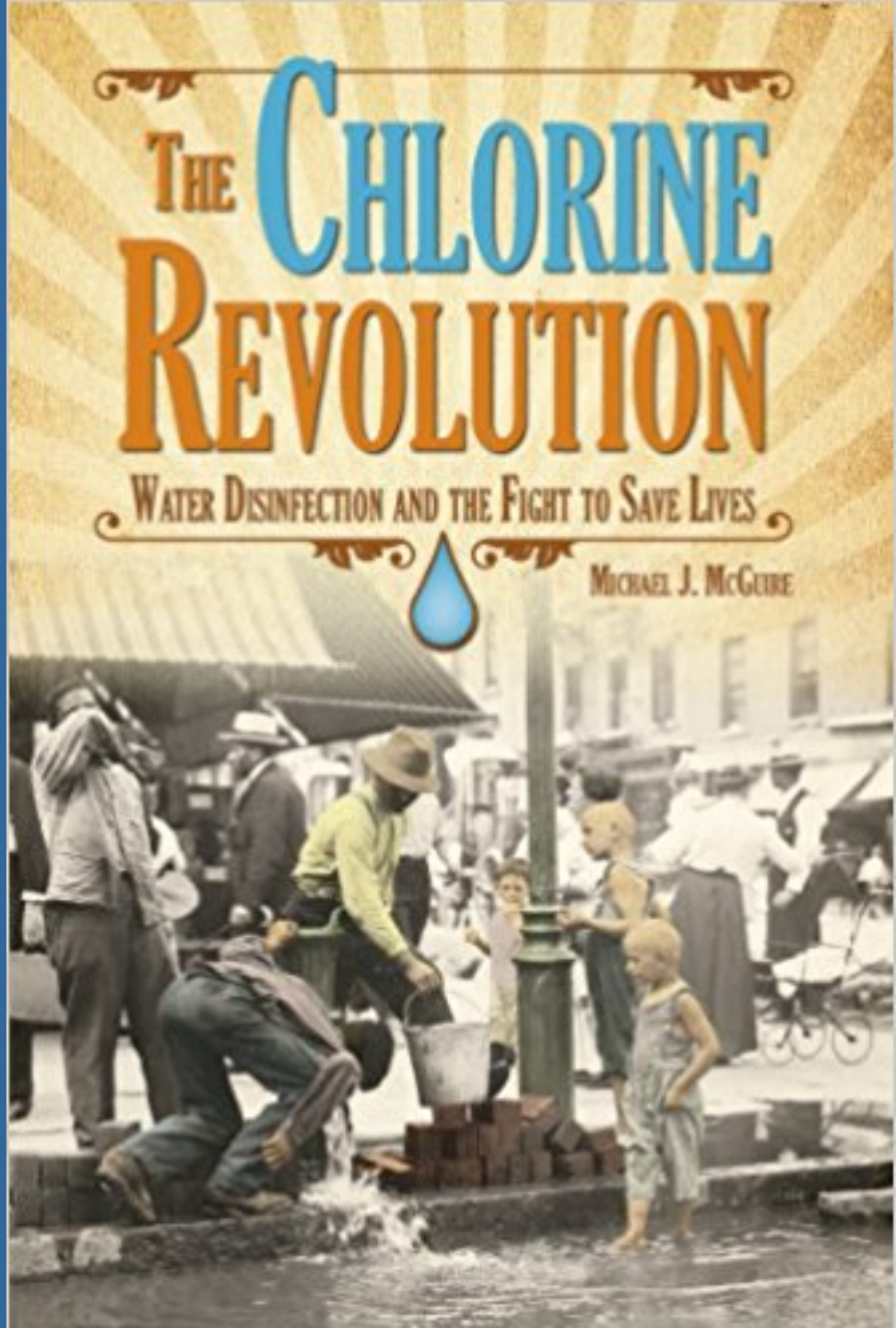
- High death rates for a variety of diseases (later proved to be waterborne) were accepted as facts of urban life



The Sewer Pipe, Water Pipe Death Spiral

- In **1908** Jersey City, NJ, became first facility to chlorinate drinking water

- **Uncertain of amount of chlorine to add**

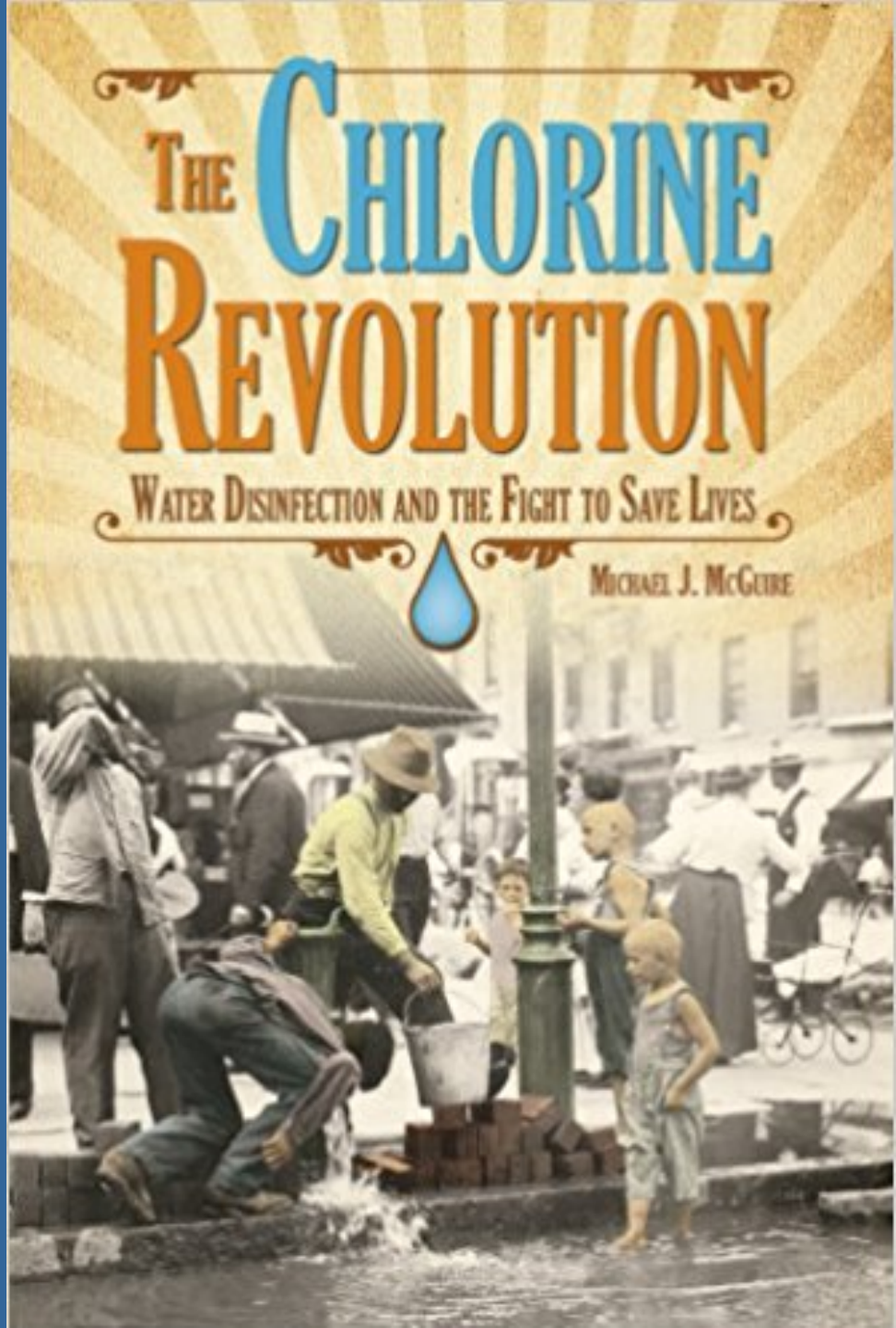


- **1919**, civil engineer **Abel Wolman** and chemist **Linn H. Enslow** developed **formula for chlorination of urban water supplies**.
  - To determine correct dose, Wolman and Enslow analyze bacteria, acidity, and factors related to taste and purity.
- **Wolman overcame strong opposition** to convince governments that adding correct amount of poisonous chemicals to water is beneficial—& crucial—to public health.

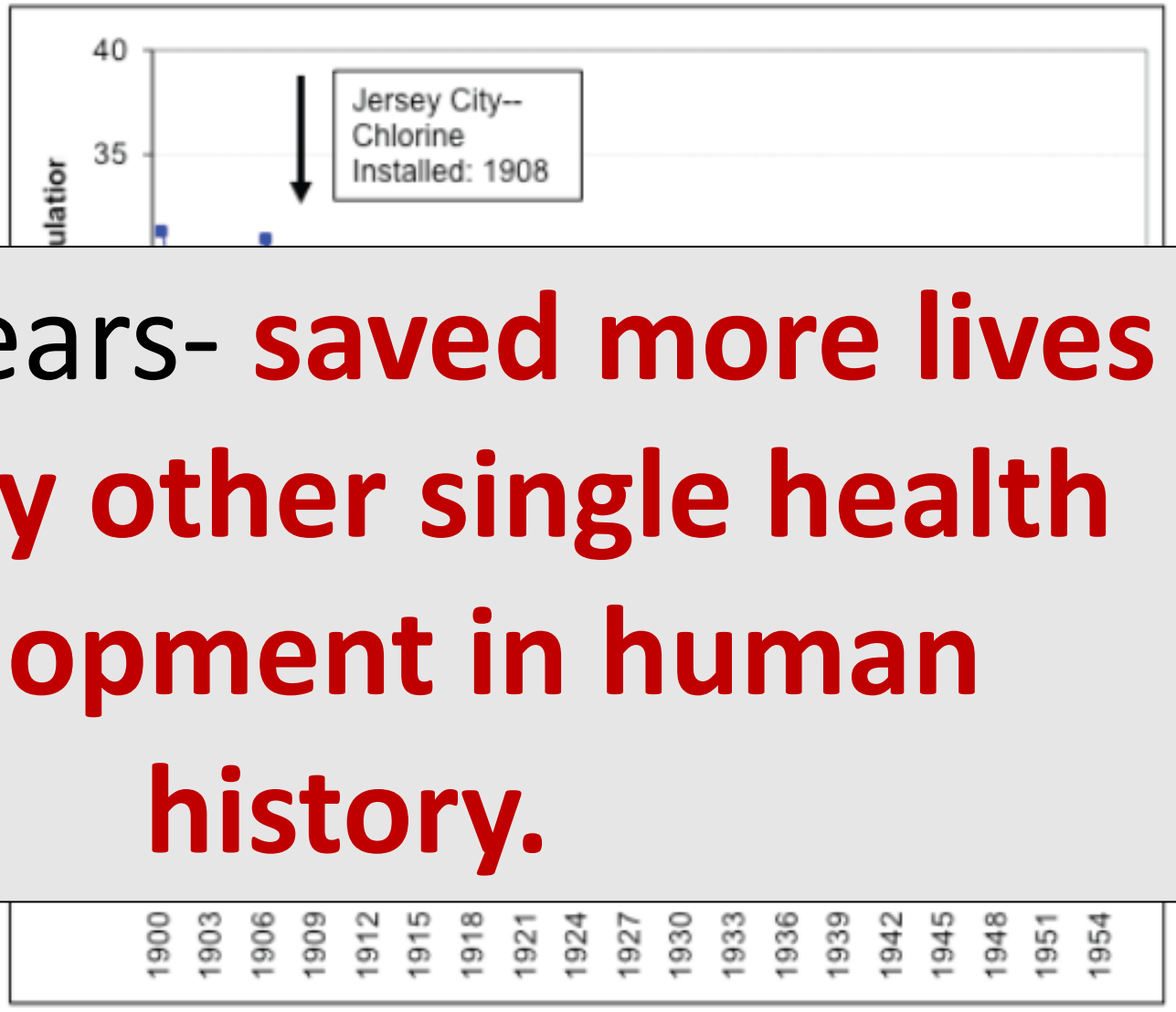

Abel Wolman


Linn Enslow

- Their **formula is still used today** by treatment plants around the world.
- **Wolman & Enslow** are credited for saving 177 million lives
- Life Magazine (1997)
  - **"probably the most significant public health advance of the millennium."**
- Scientific American (2007)
  - **"one of the great advancements of 20th century"**



By **1930s** chlorination and filtration of



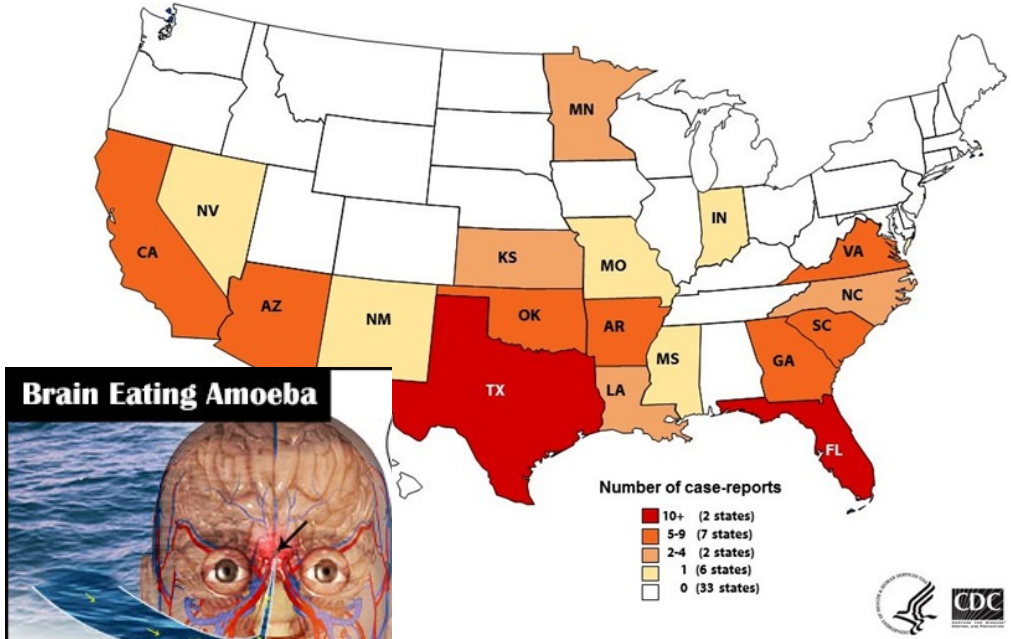
hepatitis A, and dysentery.

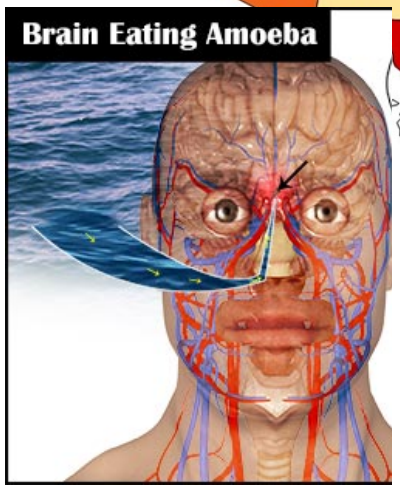
In 100 years- **saved more lives than any other single health development in human history.**

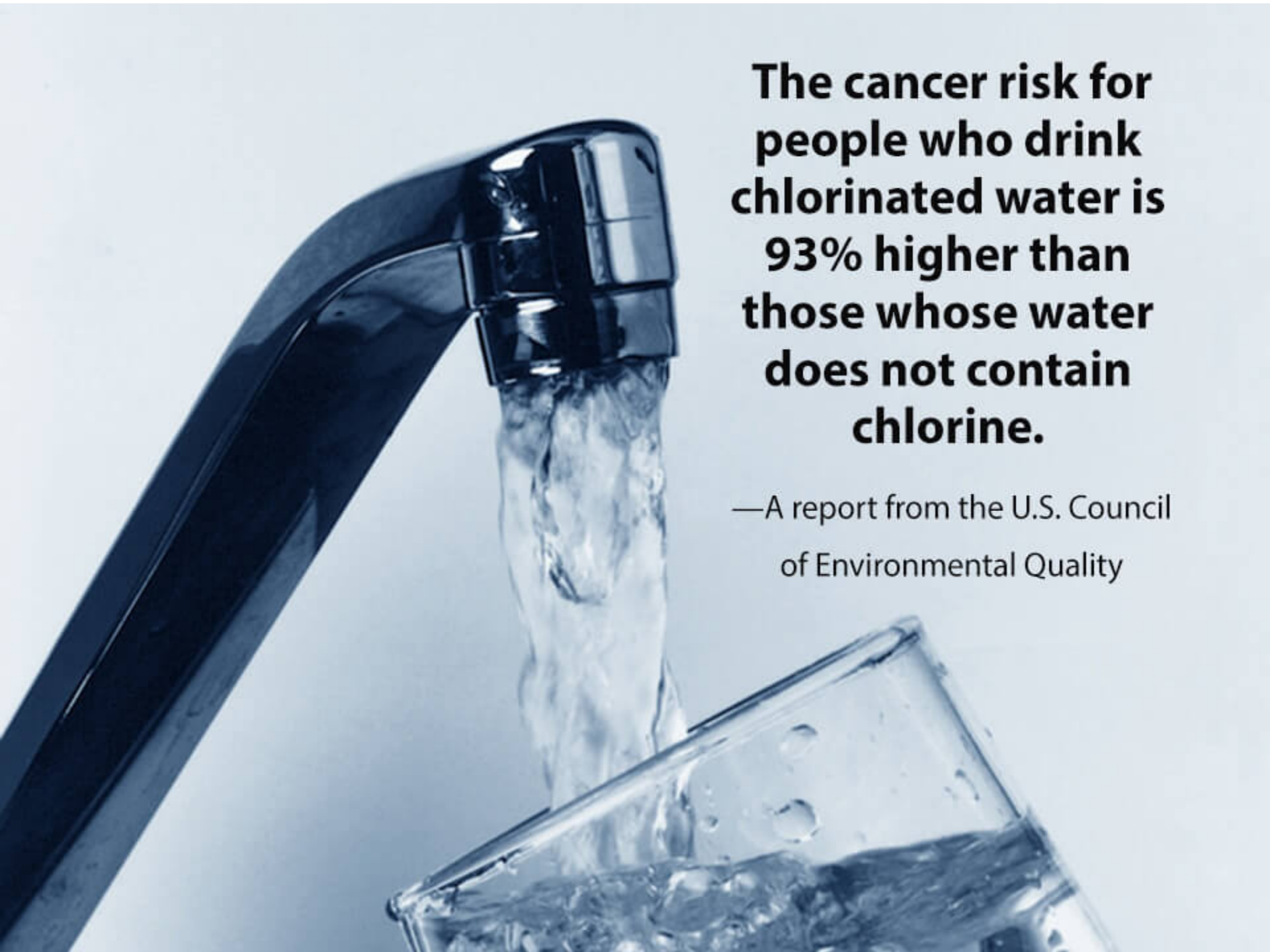
Chlorine and *Naegleria fowleri*

- Deaths in Louisiana are some of the first confirmed in drinking water distribution systems

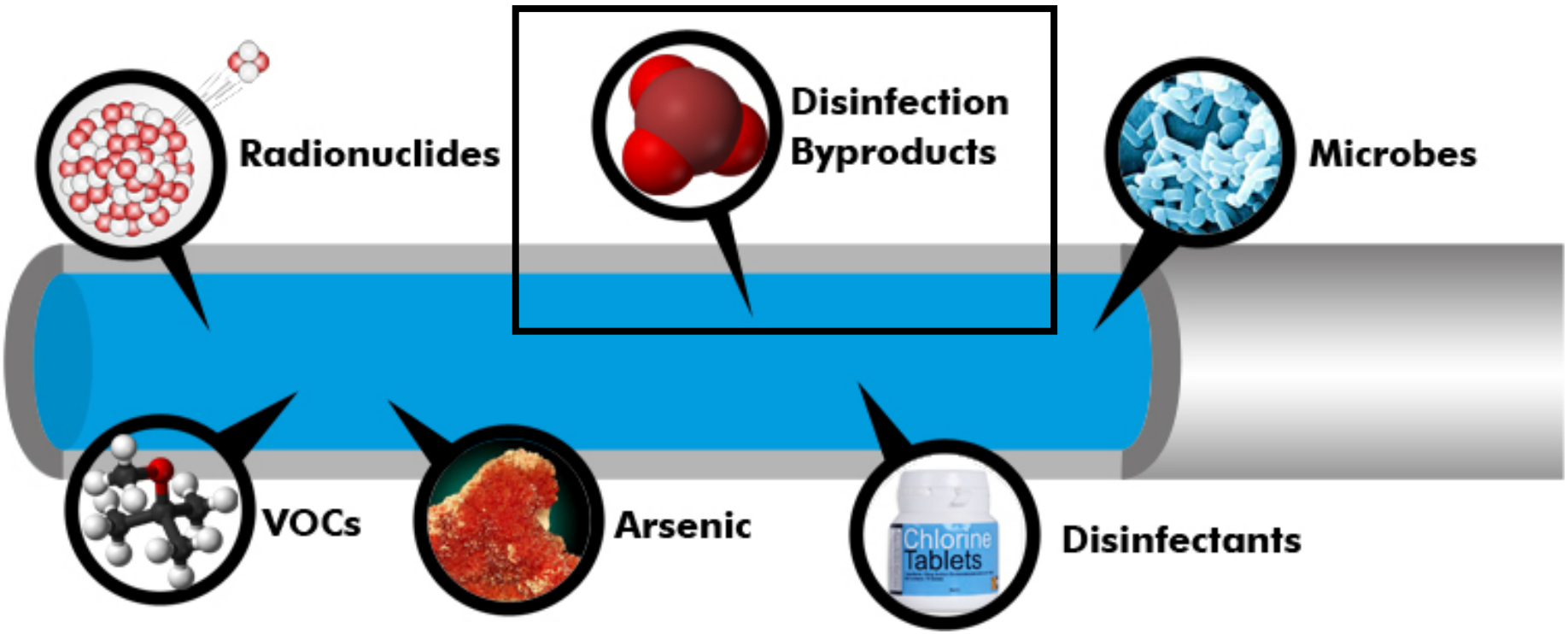
- LA requirement to maintain 0.5 mg/L chlorine residual throughout distribution system was a prudent step to protect public health



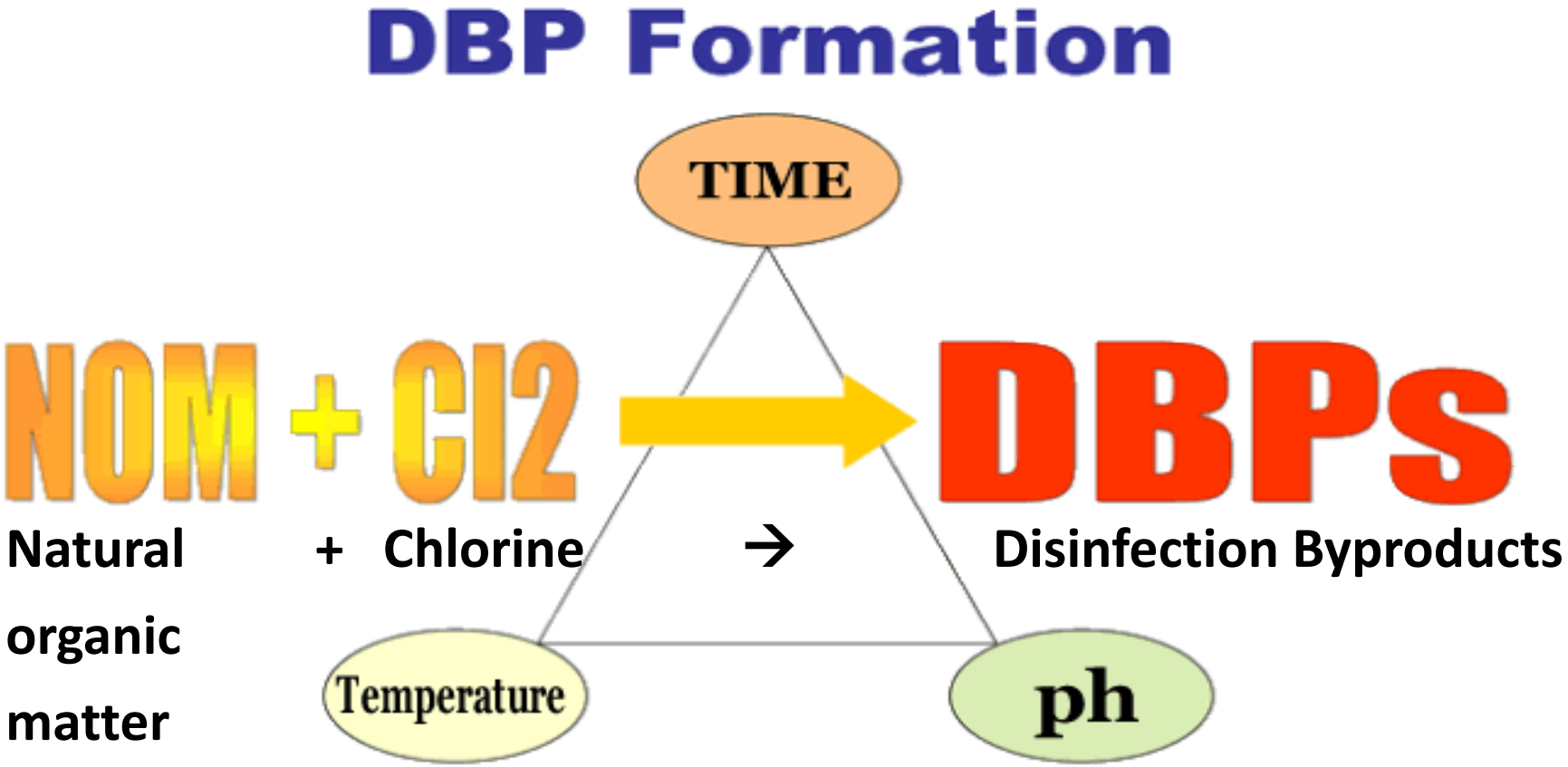



The cancer risk for people who drink chlorinated water is 93% higher than those whose water does not contain chlorine.
—A report from the U.S. Council of Environmental Quality

WATER CONTAMINANTS



CARCINOGENIC DISINFECTION BYPRODUCTS



Primary (Regulated) Drinking Water Contaminants

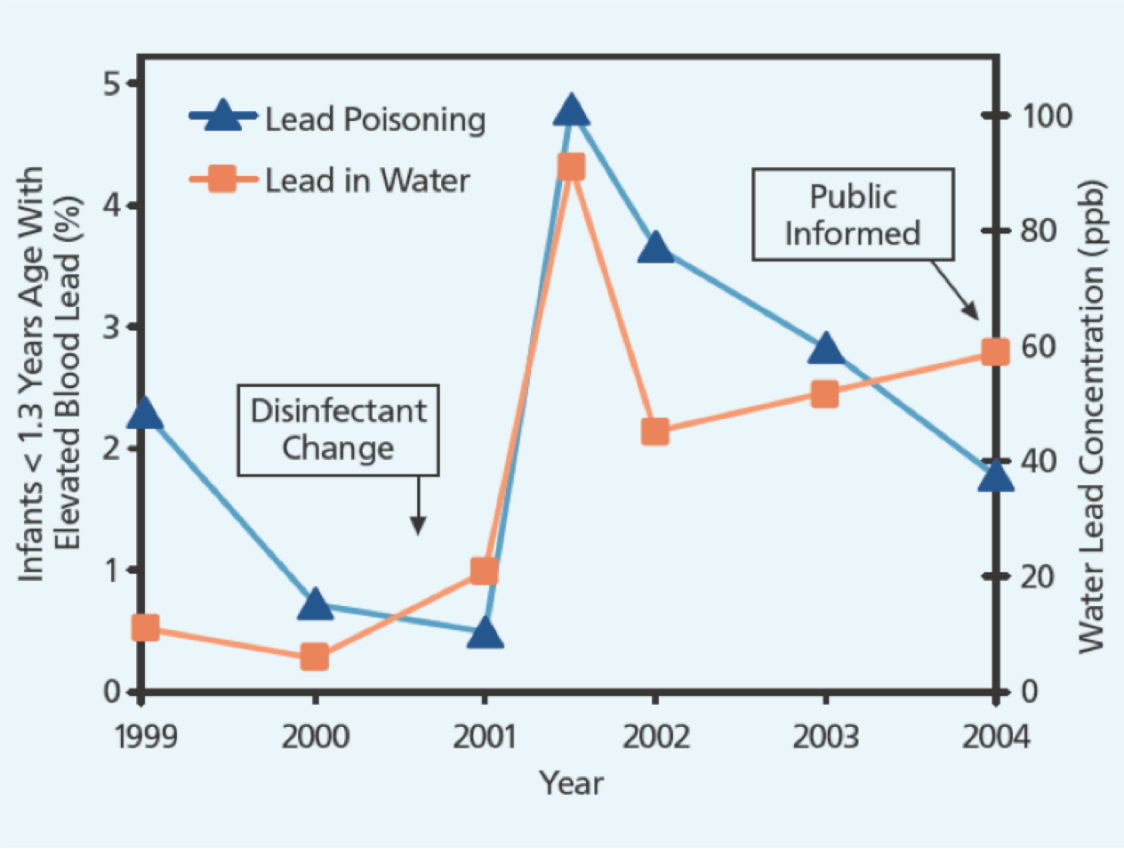
- **Microorganisms**
  - Cryptosporidium, Giardia, Legionella, coliform, viruses
- **Disinfectants**
  - Chloramines, chlorine, chlorine dioxide

- **Disinfection byproducts**
  - Bromate, chlorite, haloacetic acids, trihalomethanes

- **Inorganic Chemicals**
  - Ex: Arsenic, asbestos, chromium, copper, fluoride, lead, mercury, nitrate, nitrite
- **Organic Chemicals**
  - Ex: Benzene, benzo(a)pyrene, carbon tetrachloride, dioxin, ethylbenzene, PCBs, styrene, toluene, xylene, TCE, vinyl chloride
- **Radionuclides**
  - Alpha, beta, radium, uranium

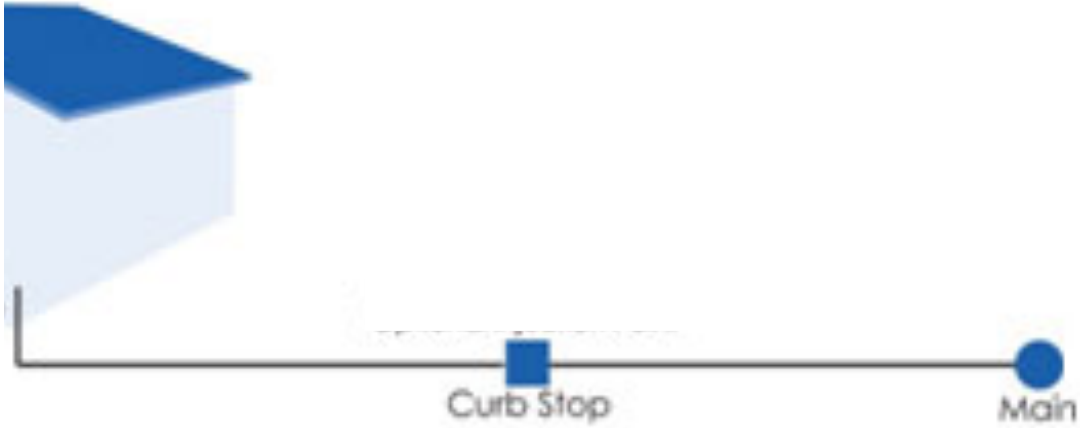
DISINFECTANT CHANGE TO REDUCE DBPS

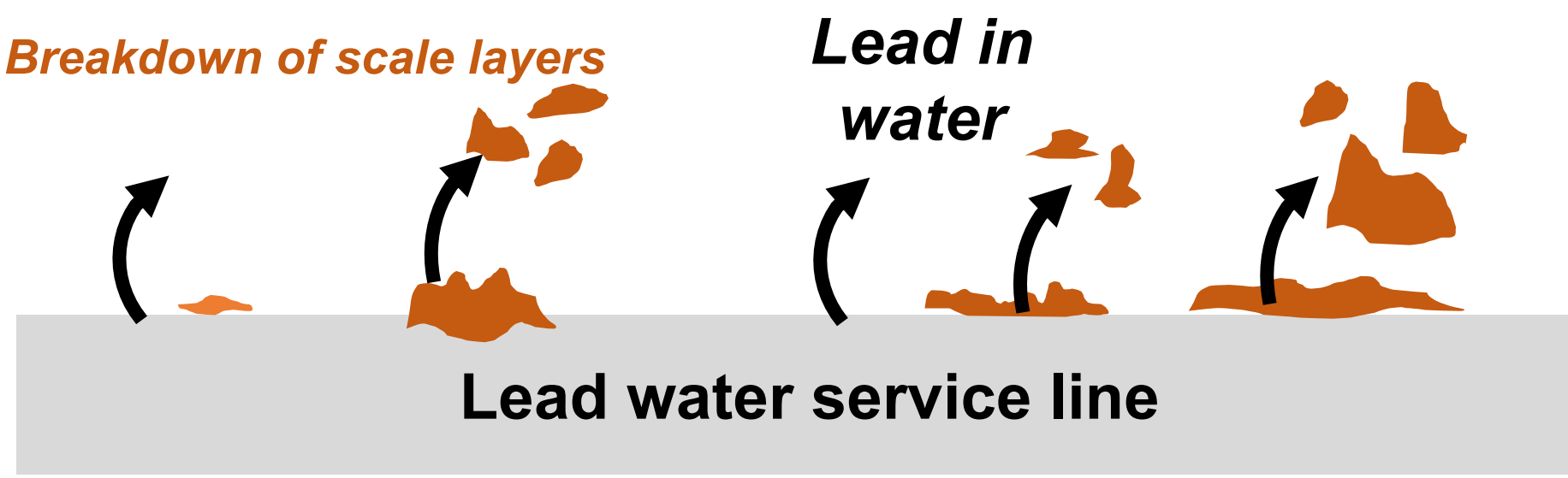
- **EPA standards for DBPs**
  - Need to reduce carcinogenic DBPs
  - **Recommended utilities switch from chlorine to chloramine**
- **Washington DC (2001-4)**
  - Switch to chloramine
  - **Spike in Pb poisonings**
  - Correlated with switch to chloramine
  - Chloramine→**more corrosive water**



Source: Edwards et al 2009

More corrosive water
= lead, iron & other metal particulates
(chromium, nickel, copper, zinc, cadmium, tin)





Slide and picture courtesy of Drs. Marc Edwards and Kelsey Pieper, VA-Tech

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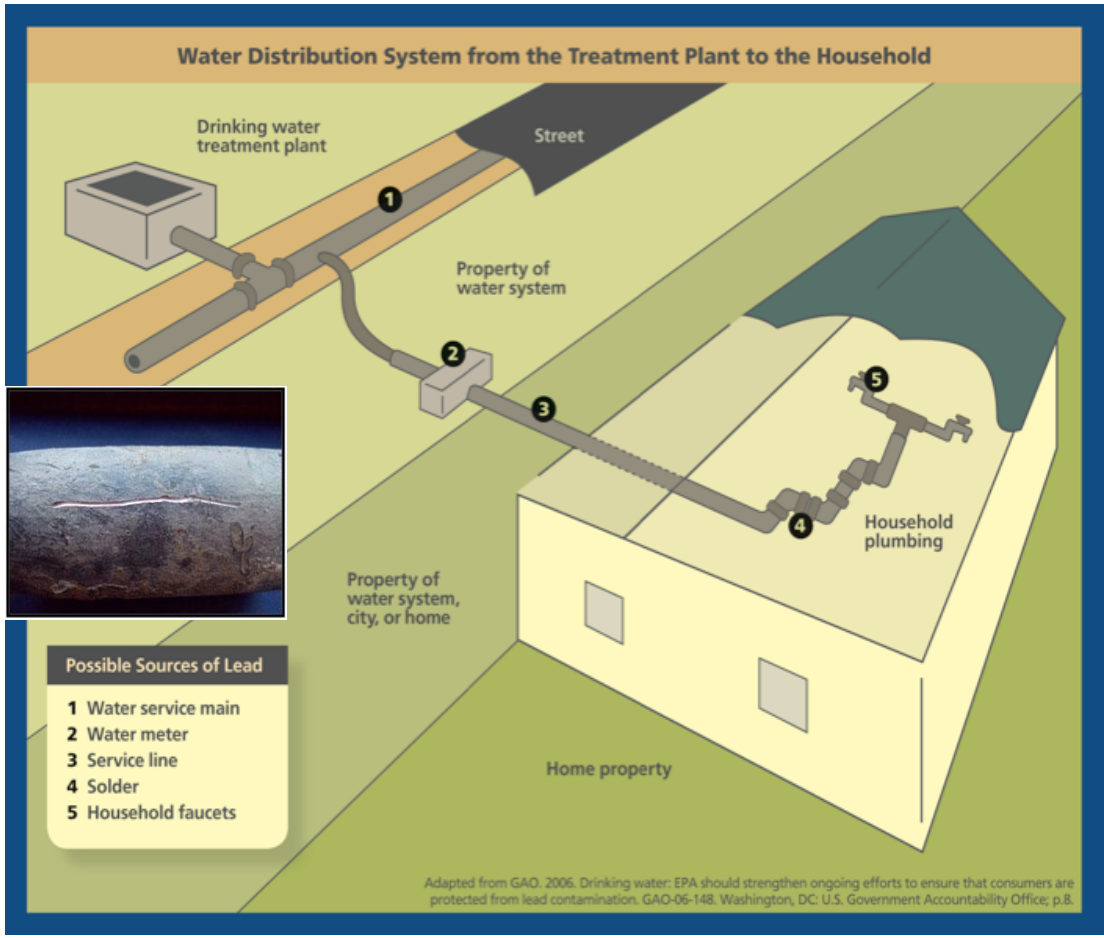
- **Radionuclides**
  - Alpha, beta, radium, uranium

Sources of Lead in Drinking Water

- **Lead service lines (LSLs)**
  - Banned in **1986**
- **Leaded brass**
  - Meters, faucets, valves, connectors, etc
- **Leaded solder**
  - Common in homes before 1986
- **Lead in zinc coating of galvanized steel**

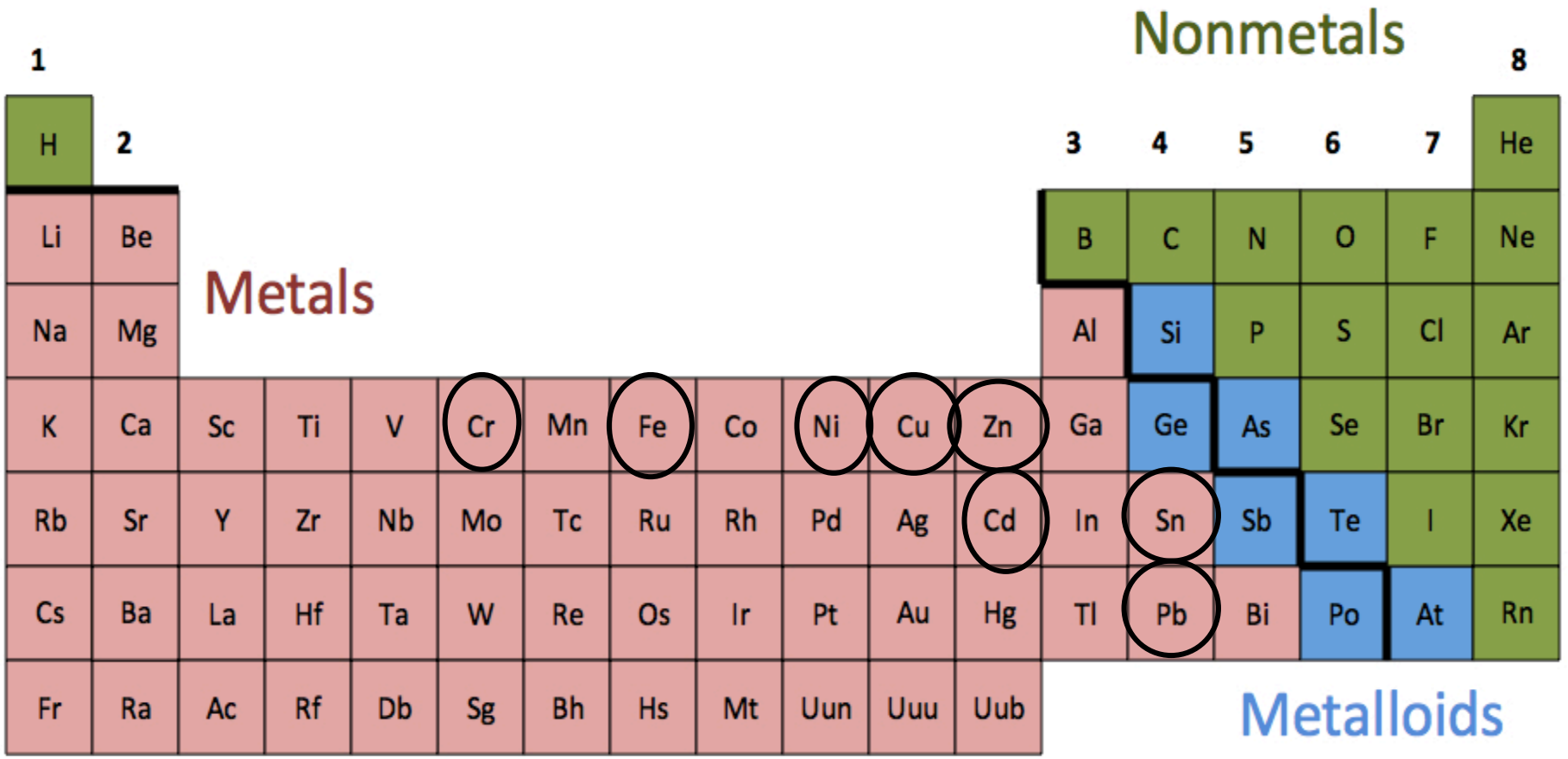


Lead Service Lines

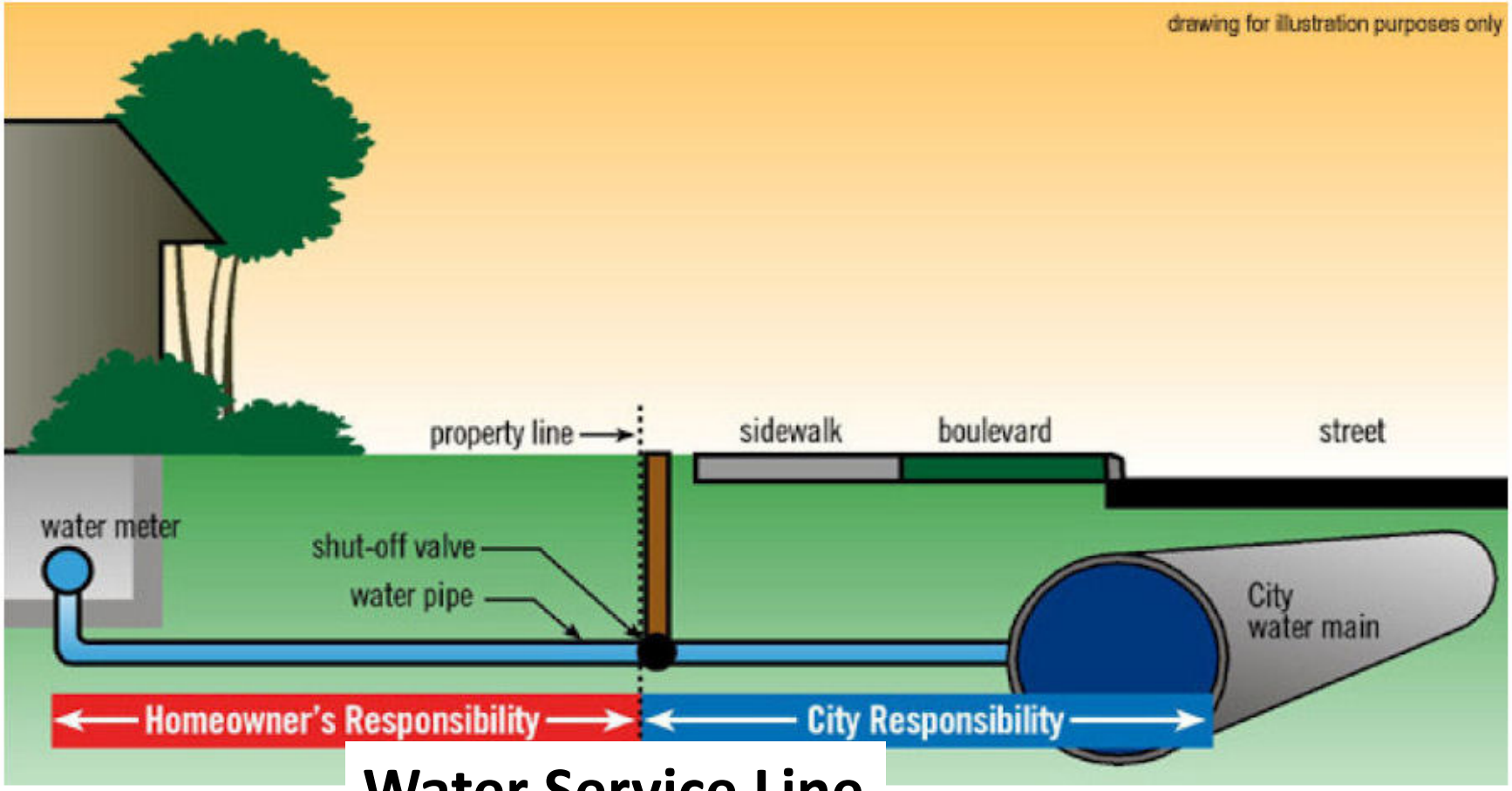
Vitruvius 312 BC

"…water ought by no means to be conducted in lead pipes, if we want to have it wholesome"

Metals in water associated with pipe corrosion



EPA's Lead & Copper Rule (LCR) (1991)



Water Service Line

Only lead and copper required to be monitored at the tap

LEAD AND COPPER RULE

Pitting corrosion

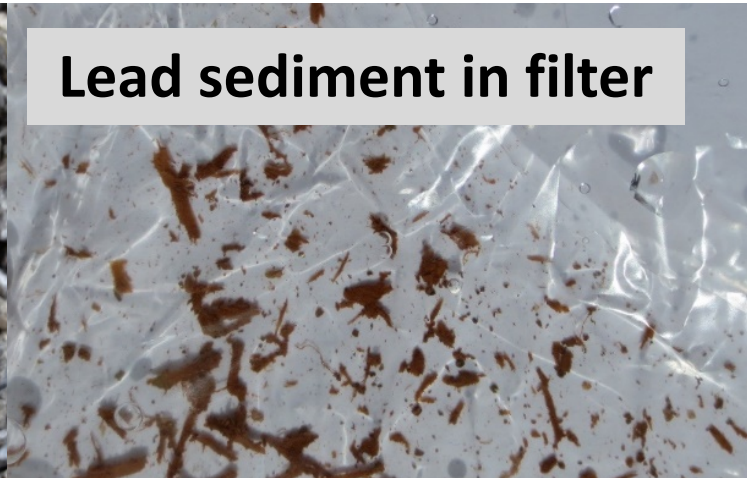
- Copper contamination generally occurs from the corrosion of household plumbing.
- Copper is an essential nutrient, required by the body only in small amounts normally obtained through normal food consumption.

COPPER HEALTH EFFECTS

However, copper can cause health effects:

- **Stomach and intestinal distress**
- **Liver and kidney damage**
- **Anemia**

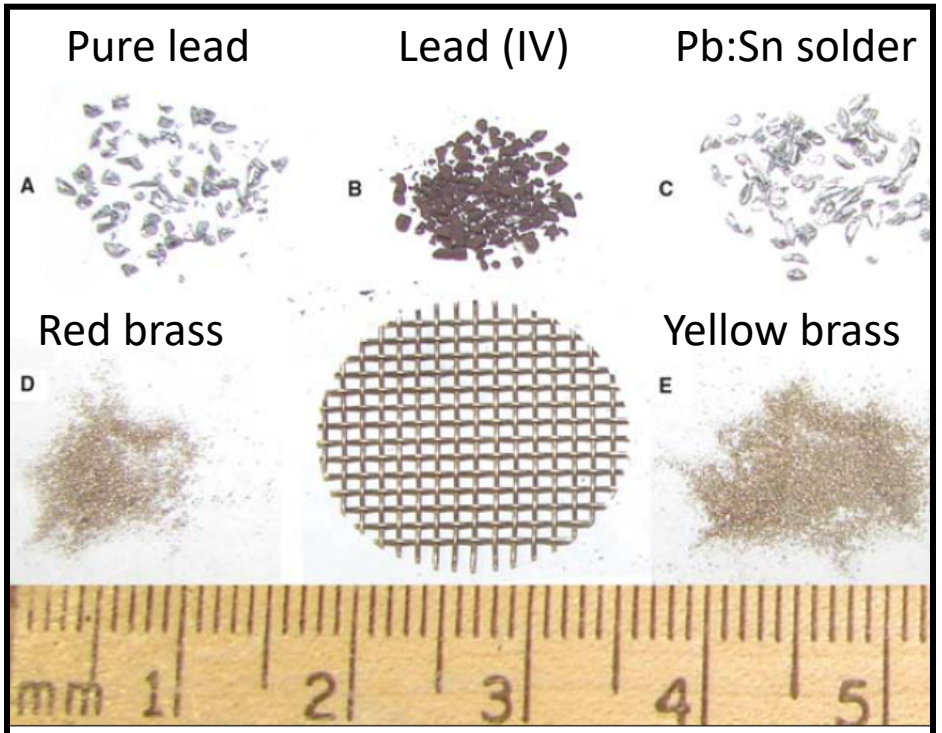
Persons with Wilson's Disease (copper accumulates in liver, brain and other organs) **more sensitive than others to effects of copper contamination.**



Copper pipe upstream of galvanized steel pipe can worsen lead release from steel's zinc coating

System Corrosion: Particulate Lead

- **Strategies to reduce soluble Pb → increase particulate Pb**
  - Corrosion inhibitors that form scale can increase particulate lead
- **Pb particulate: dissolved by stomach acid**
  - Can **lodge in GI tract** to cause **severe poisoning**



Particulate lead (>45 µm filter):

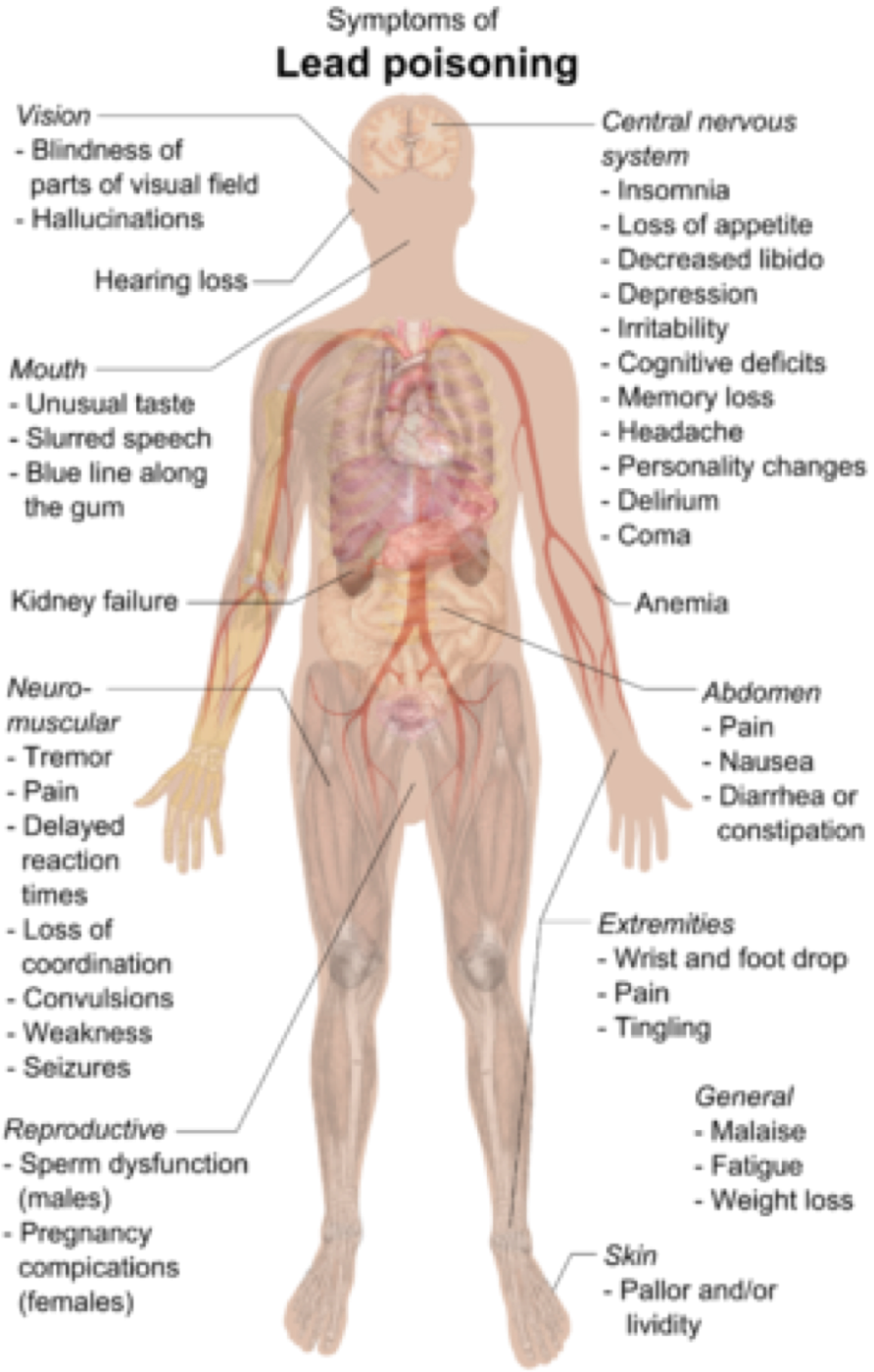
Passes through 1 mm **faucet aerator** screen pore

(Source: Triantafyllidou et al 2007)

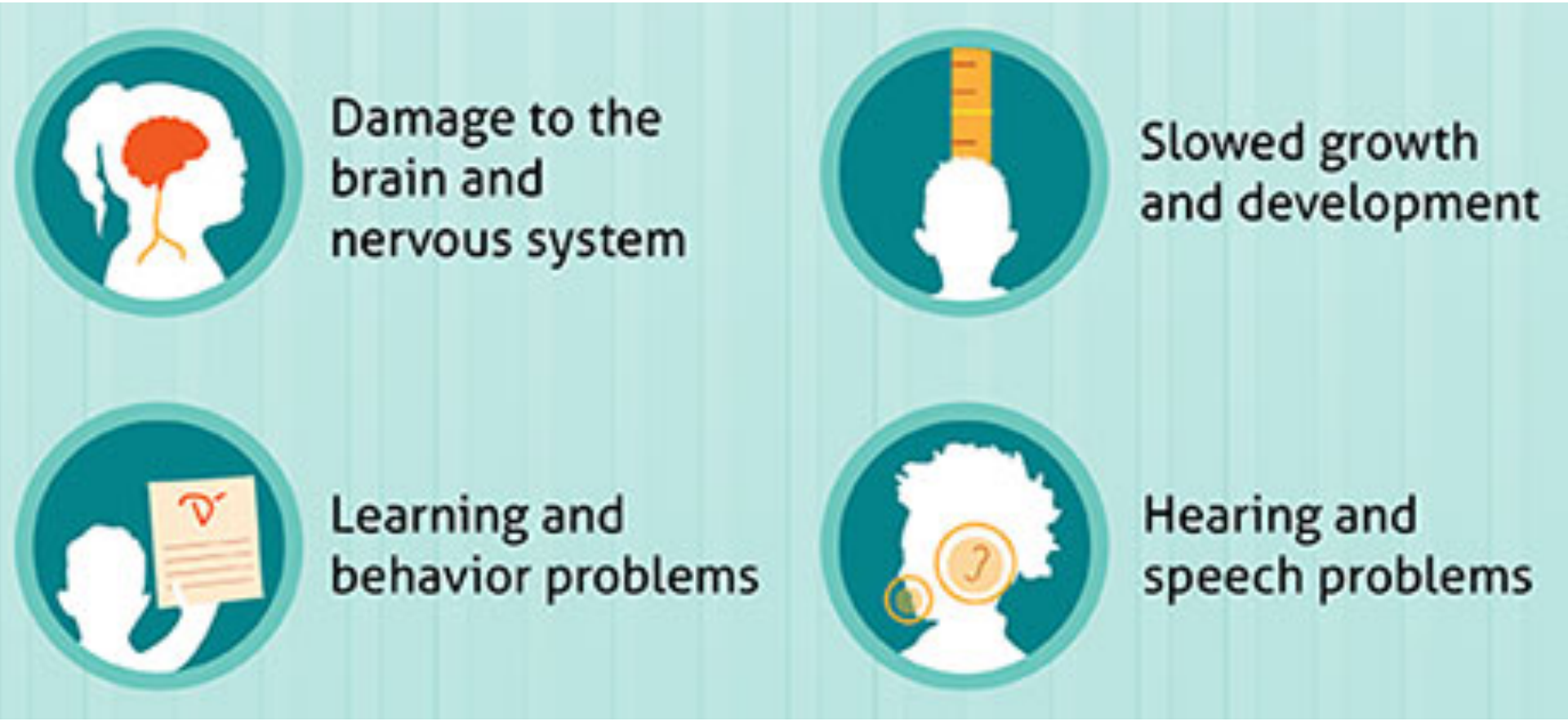
Source: Schock 1990, 2011; Triantafyllidou *et al.*2007; Mahaffey 1977; Masters and Edwards 2015; Triantafyllidou and Edwards 2012)

LEAD HIGHLY TOXIC

- **Effects can be permanent**
- **Effects everything**
  - Vision
  - Hearing
  - Mouth
  - CNS
  - Kidney
  - Neuromuscular
  - Abdomen
  - Extremities
  - Skin
  - Reproductive System



LEAD HEALTH EFFECTS IN CHILDREN



CDC: No safe blood lead level

Reference Value is 5 ug/dL

Children's Vulnerability

CHILDREN more vulnerable than ADULTS

- **Size**
  - Consume more food per size
  - Inhale more air per size
- **Developing**
  - Nervous system
  - Increased need for calcium
- **Absorb lead well orally**
  - ~50% absorbed in kids vs ~10% for adults
- **Hand to mouth activity**
  - Pica- appetite for substances that are largely non-nutritive

Signs and Symptoms

- Patient may appear **asymptomatic**
  - Symptoms vary by exposure level

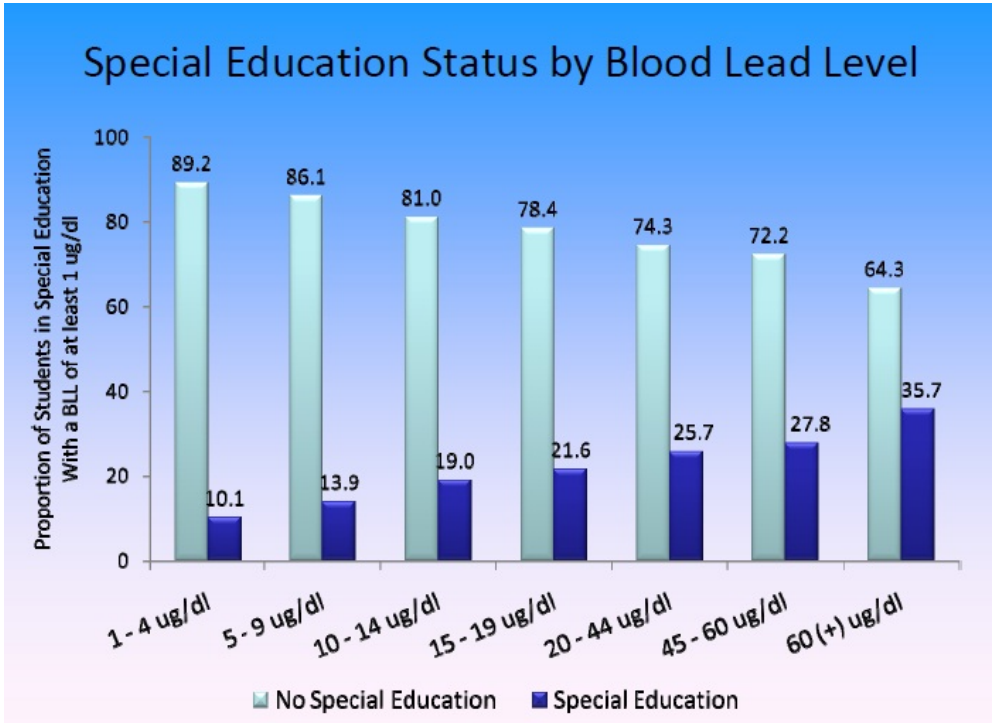
- **Impacts seen later in child's life:**
  - Decreased learning & memory
  - Decreased verbal ability
  - Impaired speech and hearing functions
  - Early signs of hyperactivity or ADHD
  - Lowered IQ

Childhood Lead Exposure

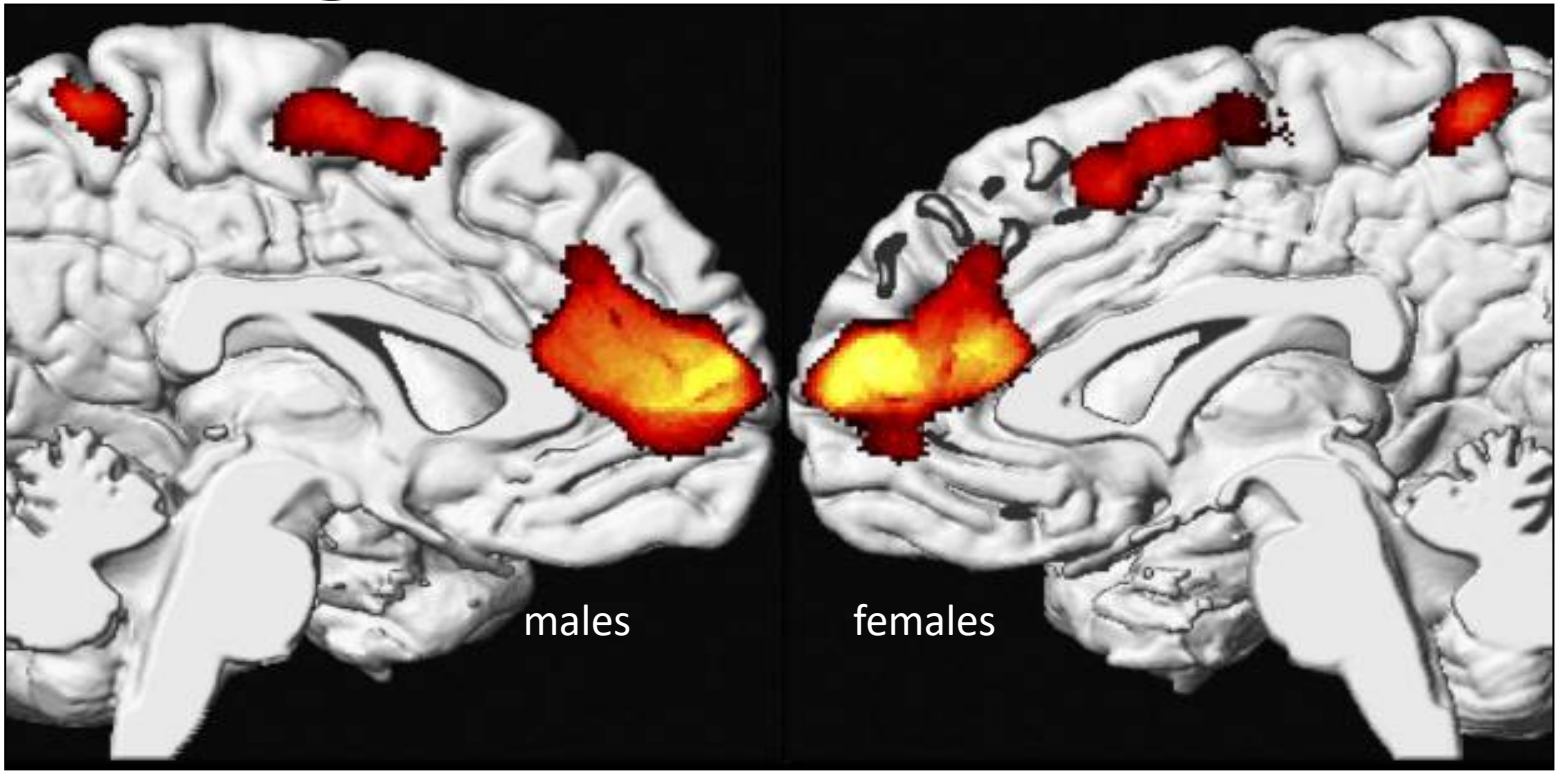
-- EARLY LIFE EXPOSURES CAN RESULT IN

LONG TERM PROBLEMS --

- **Low Grades**
- **Absenteeism**
- **Reading Disability**
- **High School Drop Out**



Brains of Adults Exposed to High Pb in Childhood



Pb damage to brain is established by 6 months old

Red and yellow areas: reduced brain volume

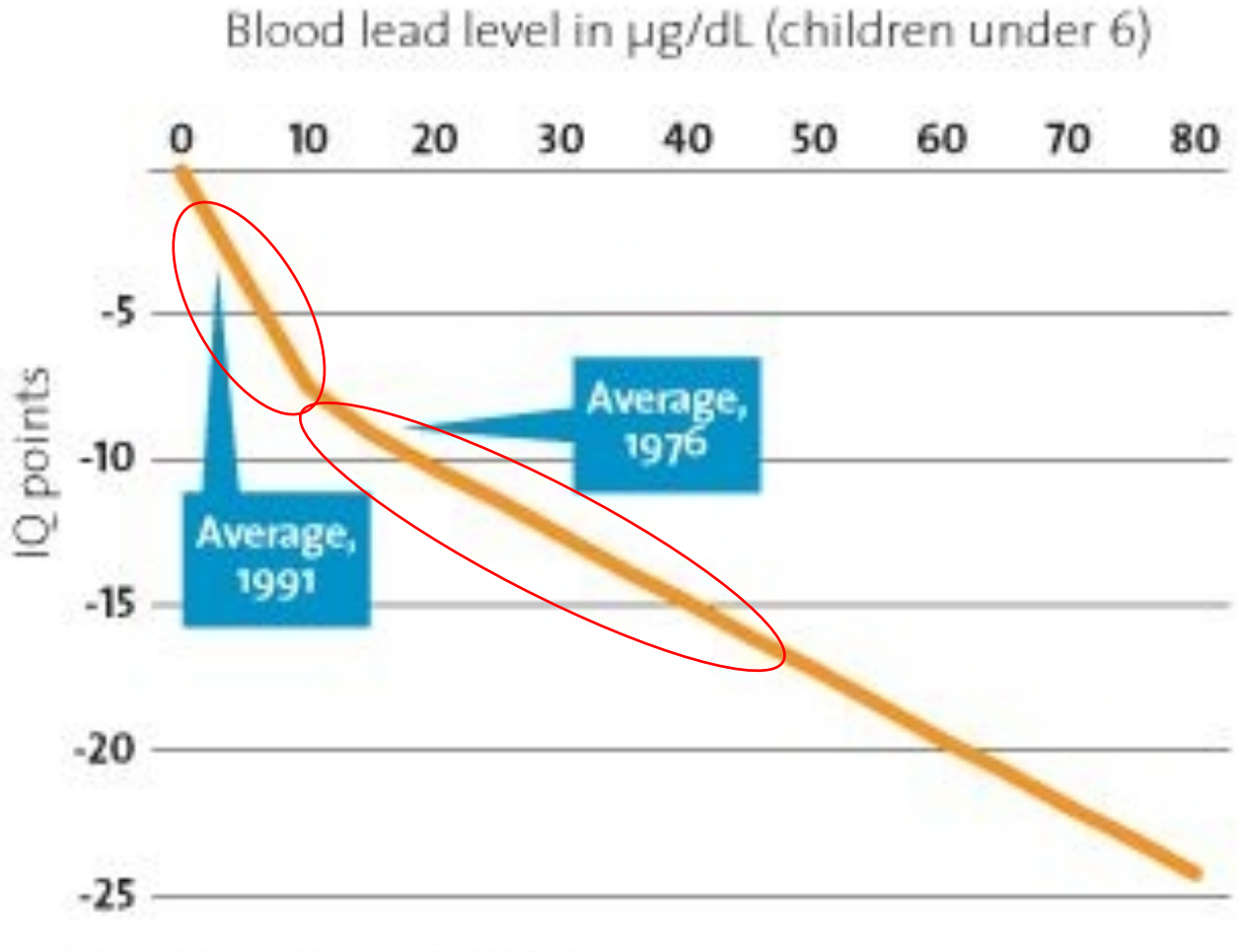
Source: Cecil et al. 2008. doi:10.1371/journal.pmed.0050112

Toxicology of Lead

- **Lead disrupts:**
  - Structural components of **blood-brain barrier**
  - Processes regulated by **calcium**
    - Stronger affinity for Ca binding sites
    - Impacts development of **synapses & nervous system**
- Within brain, Pb damages:
  - **Prefrontal cerebral cortex**
    - Moderates social behaviour
  - **Hippocampus**
    - Memory
  - **Cerebellum**
    - Motor control
    - Attention
    - Language

Canfield et al. 2003: Lead and IQ

Low exposures have steeper effect on IQ rate of decrease than higher exposures



LDH's NOLA Pediatrician Survey (2012)

- **32%** not aware of LA's Pb **screening requirements**
- **33%** do not routinely **screen children** at least once
- **21% never received education** on lead poisoning, diagnosis and treatment during residency
- **54%** did **not think lead was a problem** in New Orleans

Contribution of Lead Exposure to Children's Blood Lead Levels

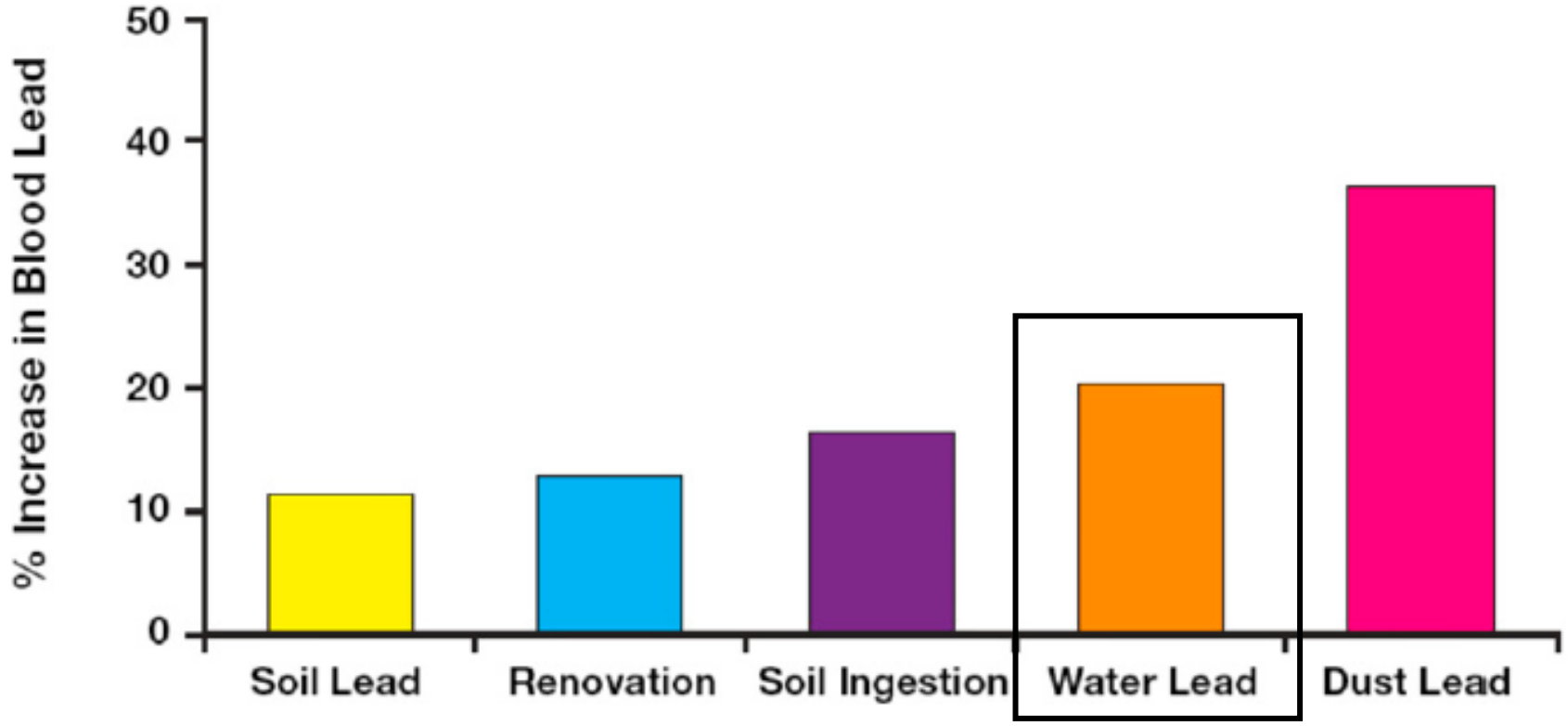


FIGURE 3
Contribution of lead exposure to children's blood lead concentrations. Adapted from Lanphear et al[31] and Spanier et al.[45]

FLINT, MI

- 18 months
- 100,000 residents
- 9000 Pb-exposed kids
  - **Doubling of childhood rates of elevated lead**
  - 200 confirmed child lead poisoning cases

Slide courtesy of Dr. Marc Edwards, VA-Tech

Lead Poisoning Prevention Programs

- **CDC guidelines to prevention programs**
  - ”Managing EBLLs Among Young Children”(‘02)

- **24% of lead poisoning programs never test water** (Edwards ’09)
- **No standard protocol**

Analyze water from homes of lead-poisoned children, ***“when no other source of lead is found”***, when utility ***“is not in compliance”,*** *or when on private wells*

“inspectors …are ***haphazardly sampling*** ***in a way that defeats any ability to make comparisons to other sites****….”*

– Michael Schock, EPA chemist

Drinking Water: Underestimated Source of Lead

- **BLLs correlate with WLLs even when city meets regulatory requirements** (Lanphear '98)
  - **Cumulative exposure to 1 µg/L water Pb→ increase child BLL by 35% after 150 days** (Ngueta '15)
  - **WLLs as low as 5 µg/L significantly increased BLL in young women** (Fertmann et al '04)
    - Excluding water dropped BLL by 37%

Indirect Lead Exposure from Water is Underestimated

- Cases of lead poisoning from water documented in cases where water used for cooking only- not drinking (Triantafyllidou et al 2007)

- Vegetables can absorb >90% of Pb in water from cooking (Moore 1983)

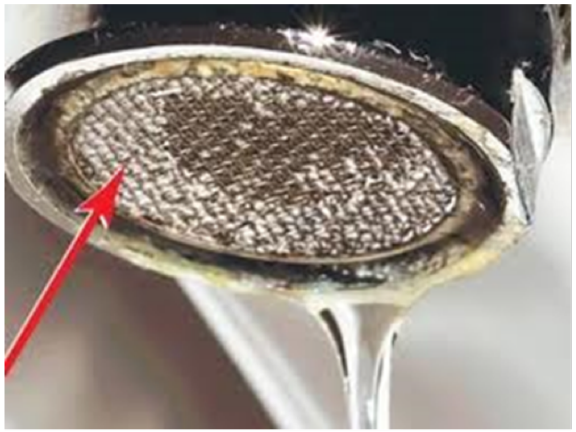
CDC's Pb Brochure

- Blood tests
- Test paint and dust
- Renovate safely
- Recalled toys

Nothing about preventing exposure from soil and water

WAYS TO REDUCE WATER LEAD EXPOSURE

- Free
  - Clean home faucet aerators once every 2 wks
  - Flush water before use
  - Use only cold tap water for cooking, drinking, and preparing baby formula
- Small to medium cost (<$100)
  - Pur™, Brita™, or ZeroWater® pitcher filters reduce dissolved lead and other metals (cation/anion exchange)
- Expensive (>$100)
  - Reverse osmosis
  - Water distilling systems



Faucet aerator screens collect lead solder particles

LEAD ALSO EFFECTS ADULTS

REPRODUCTIVE HEALTH

Men:

- Decreased **fertility**
- Decreased sex drive

Women:

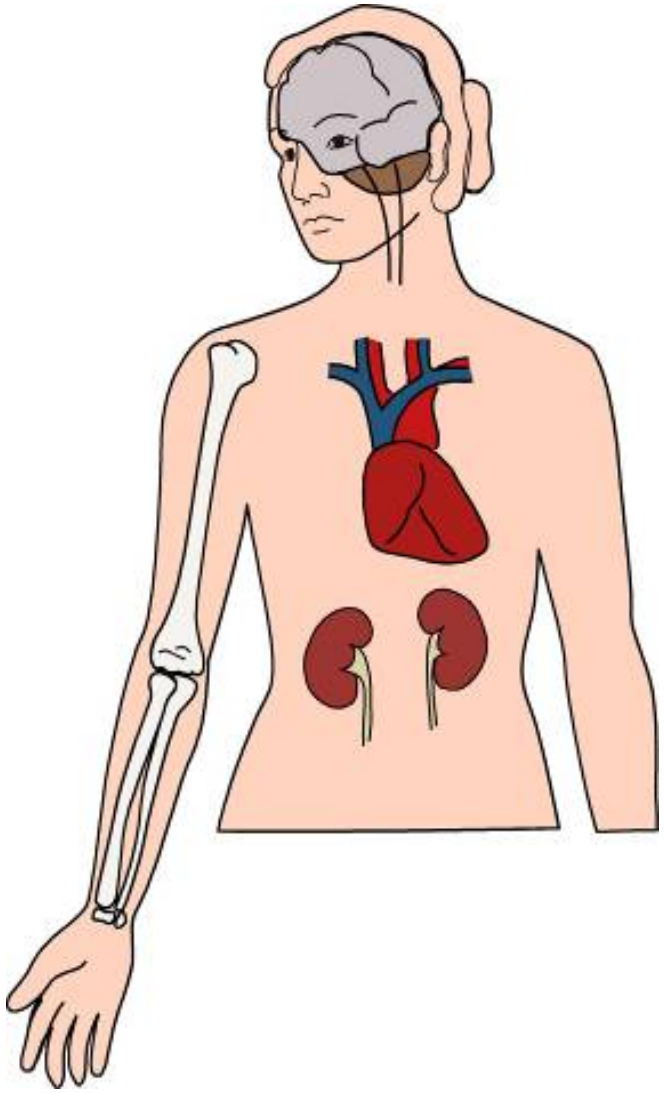
- **Crosses placental barrier**
- Reduced **fetal growth**
- Miscarriages & still birth
- Preterm birth

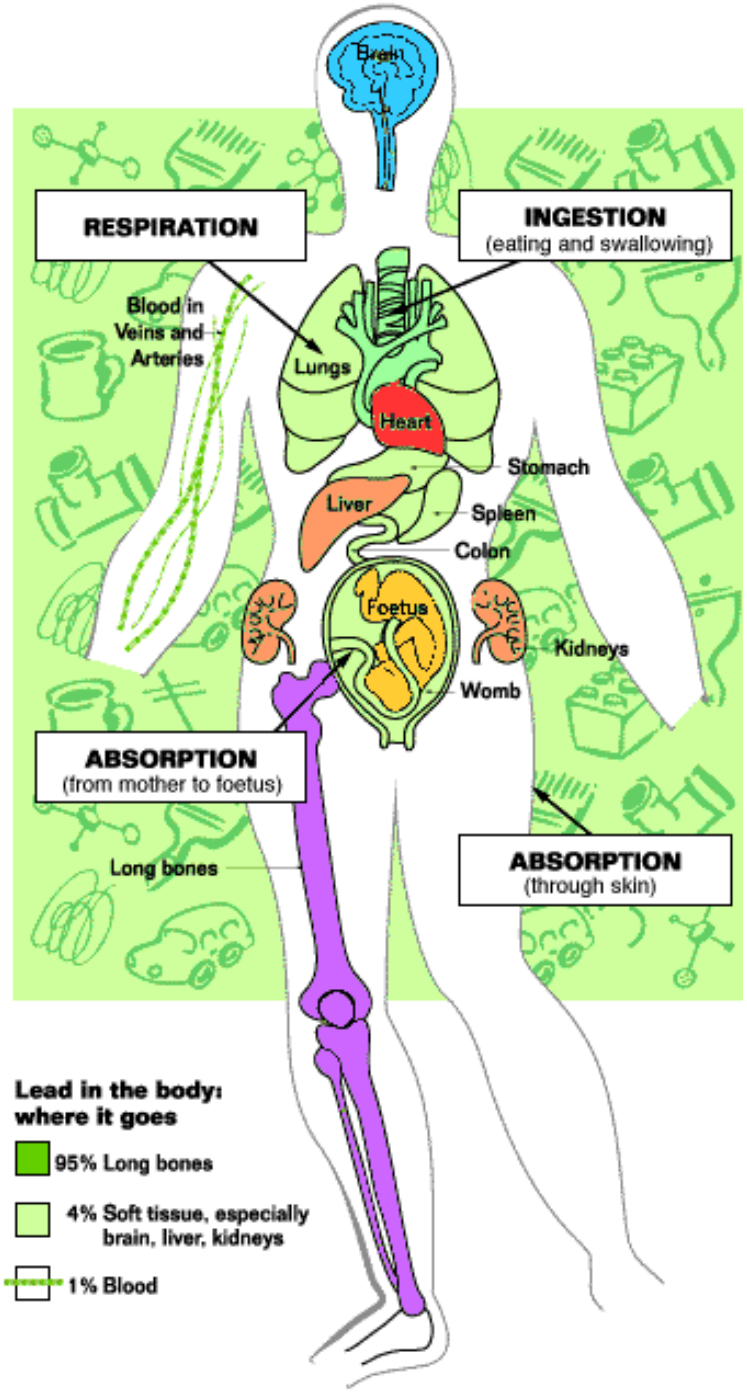
CARDIOVASCULAR HEALTH

- Increased risk of **high blood pressure** & hypertension

Biologic Fate

- Most lead is **excreted**
- Rest **accumulates** in body & is exchanged between:
  - **Blood**
  - **Soft tissues**
  - **Mineralizing tissues**





BONES

- **95%** remaining in body absorbed into bones
- Half-life: **20 years**

BRAIN, LIVER, KIDNEYS

- **4%** to soft tissue
- Half-life: **40 days**

BLOOD

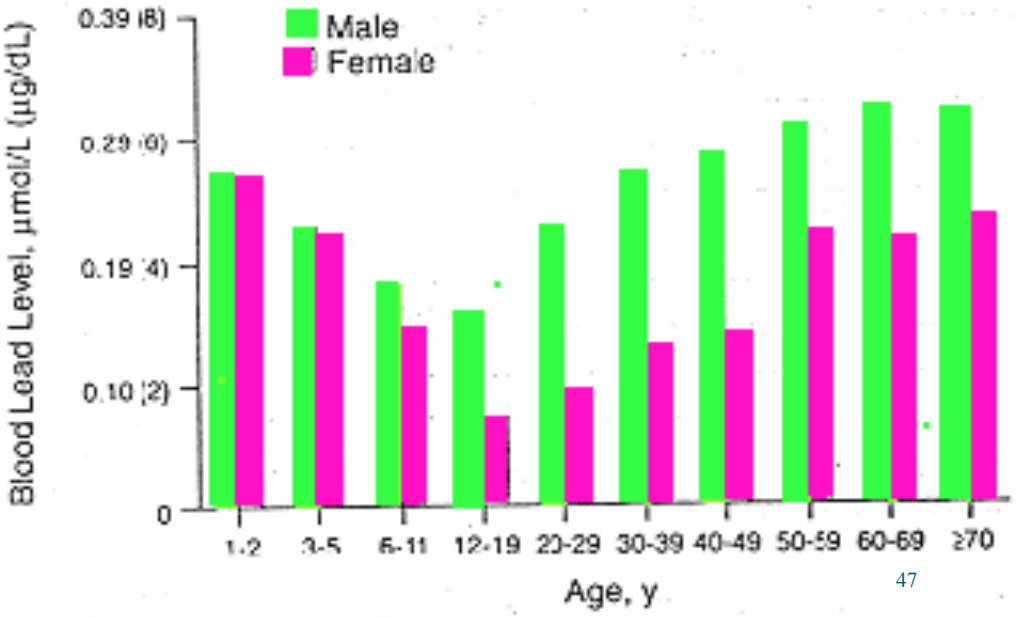
- **1%** circulates in blood
- Half-life: **25 days**

Release of Lead During Bone Breakdown

- Lead in mobilized from skeleton during **pregnancy,** the post-natal period, **menopause, stress and in osteoporosis**

- Lead **follows calcium into and out of bone**

- Lead levels **peak in childhood & middle age**

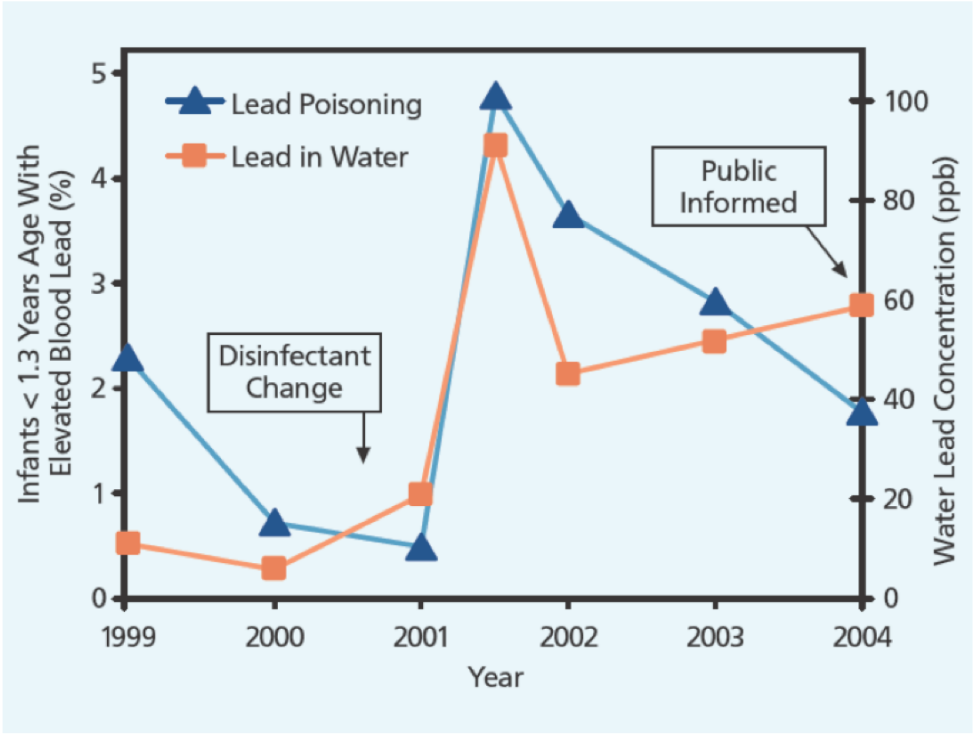


Washington DC Lead in Water Crisis (2001-2004)

- Thousands of children lead poisoned (>5 ug/dL)

- 200 **fetal deaths** (>28 weeks)

- 2000 **miscarriages** (12-28 weeks)



Source: Edwards 2009, 2014

Preliminary Data:

Pb Impact on Reproductive Health in Flint

- Working paper
  - U Kansas & WV Univ
  - MI birth & death certificates in Flint & comparable cities
  - Before & after Flint's April 2014 water switch

- **Findings**

  - Flint fertility rates decreased by 12%
  - Flint fetal death rates increased by 58%

"Women who miscarried, had a stillbirth or a newborn with health complications should enter registry of residents exposed"

“Flint water is safe to drink.”

“It’s only an iron issue- which is totally safe”

Sephia8 – mlive.com

Sam Owens/AP

Slide courtesy of Dr. Marc Edwards, VA-Tech

Flint:
Compliant with EPA Regulations

- Utilities **monitor** **tap samples for lead and copper**
- If **90th percentile** exceeds Lead **Action Level (AL) of 15 ppb** utility **action required**
- AL **not health-based** value

10% of homes allowed to have any level of Pb >15 ppb

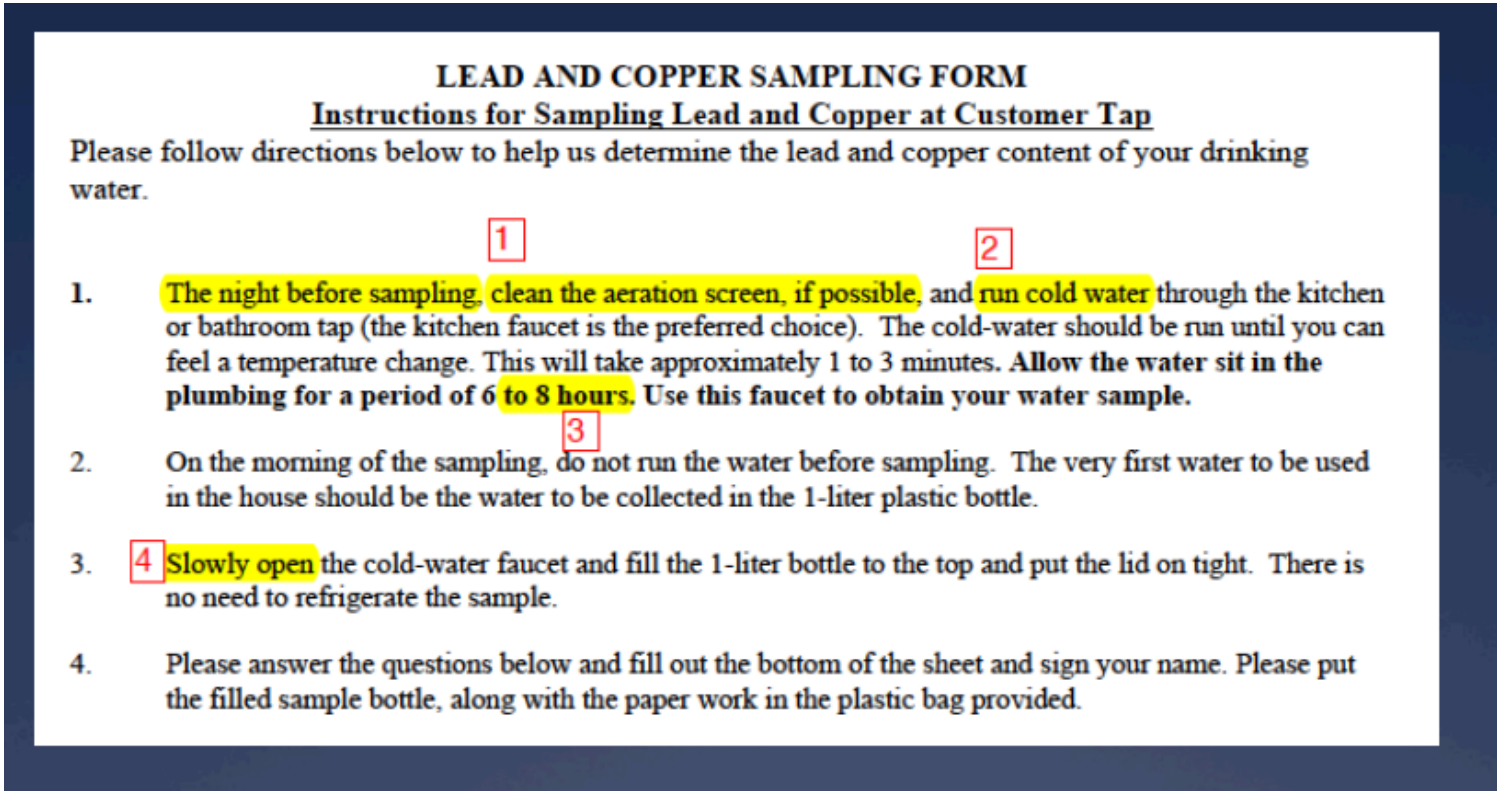
EPA Alerts

"Compliance with the lead action level does not guarantee, or even imply, that all individuals in the city are protected from lead-in-water hazards"

Simoni Triantafyllidou, **EPA Office of Research and Development**

(Crit Rev Env Sci Tech, 2012)

How Utilities Meet Regulations: Inadequate Sampling



LEAD AND COPPER SAMPLING FORM

Instructions for Sampling Lead and Copper at Customer Tap

Please follow directions below to help us determine the lead and copper content of your drinking water.

1. The night before sampling, clean the aeration screen, if possible, and run cold water through the kitchen or bathroom tap (the kitchen faucet is the preferred choice). The cold-water should be run until you can feel a temperature change. This will take approximately 1 to 3 minutes. **Allow the water sit in the plumbing for a period of 6 to 8 hours. Use this faucet to obtain your water sample.**

2. On the morning of the sampling, do not run the water before sampling. The very first water to be used in the house should be the water to be collected in the 1-liter plastic bottle.

3. Slowly open the cold-water faucet and fill the 1-liter bottle to the top and put the lid on tight. There is no need to refrigerate the sample.

4. Please answer the questions below and fill out the bottom of the sheet and sign your name. Please put the filled sample bottle, along with the paper work in the plastic bag provided.

"Current sampling protocols will often considerably underestimate peak lead levels and overall mobilized mass of waterborne lead in a system with lead service lines."

- Miguel Del Toral, EPA Region 5

MDEQ/City of Flint **Cheated** on Lead Monitoring

Original LCR Report. Red highlights from Flintwaterstudy

N DEPARTMENT OF ENVIRONMENTAL QUALITY
...R DRINKING WATER AND MUNICIPAL ASSISTANCE
...D AND COPPER REPORT AND
...ONSUMER NOTICE OF LEAD RESULT
CERTIFICATE FOR COMMUNITY WATER SUPPLY

DRAFT

DEQ

Issued under authority of 1976 PA 399, MCL 325.1001 et al., and Administrative Rules, as amended.
Failure to submit this information is a violation of Act 399 and may subject the water supply to enforcement penalties.

Administrative Rule R 325.10710d requires water supplies to report lead and copper monitoring information within 10 days after the end of the monitoring period. This form may be used to meet this requirement. Submit the information to the appropriate Department of Environmental Quality (DEQ) district office. For district office addresses, visit www.michigan.gov/deq and click on Locations.

1. Water Supply Name: City of Flint Water Plant
2. County: Genesee 3. WSSN: 2310
4. Population: 99,763 5. Monitoring Period: From: 1/1/15 To: 6/30/15
6. Minimum # of Samples Required: 100 60 7. # of Samples Taken: 71 ~~75~~ 69
8. Name of Certified Laboratory: DEQ Drinking Water Laboratory

9. SAMPLE CRITERIA:

Yes	No	Explain No responses in Comments block.	
☐	☒	a. Are the same sampling points used as in the previous monitoring period?	For more information see *Instructions* paragraph 11, subparagraph "Sample Category."
☐	☒	b. Are all samples from Tier 1 sites?	
☒	☐	c. Are all samples from Tier 1, 2, or 3 sites giving Tier 1 priority?	
☒	☐	d. If no Tier 1, 2, or 3 sites are available, do all sites have plumbing materials commonly found at other locations in the system?	
☒	☐	e. Is the minimum number of lead service line samples taken (when applicable)?	

Comments:
A total of 175 sample bottles and instructions were distributed to city residents. We are continuing to solicit samples due to the fact that we did not reach the minimum number for this monitoring period.

Lead service - majority (30000?)

ACTUALLY FAILED
W/ 71 SAMPLES

10. NAME:

Name: Michael Glasgow
Title: Utilities Administrator Phone: 810-766-7135 Date: 7/28/2015

FLINTWATERSTUDY and ACLU-MICHIGAN FOIA
Red highlights from FLINTWATERSTUDY

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF DRINKING WATER AND MUNICIPAL ASSISTANCE
LEAD AND COPPER REPORT AND
CONSUMER NOTICE OF LEAD RESULT
CERTIFICATE FOR COMMUNITY WATER SUPPLY

DEQ

Issued under authority of 1976 PA 399, MCL 325.1001 et al., and Administrative Rules, as amended.
Failure to submit this information is a violation of Act 399 and may subject the water supply to enforcement penalties.

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1. Water Supply Name: City of Flint Water Plant
2. County: Genesee 3. WSSN: 2310
4. Population: 99,763 5. Monitoring Period: From: 1/1/15 To: 6/30/15
6. Minimum # of Samples Required: 60 7. # of Samples Taken: 69
8. Name of Certified Laboratory: DEQ Drinking Water Laboratory

9. SAMPLE CRITERIA:

Yes	No	Explain No responses in Comments block.	
☐	☒	a. Are the same sampling points used as in the previous monitoring period?	For more information see *Instructions* paragraph 11, subparagraph "Sample Category."
☐	☒	b. Are all samples from Tier 1 sites?	
☒	☐	c. Are all samples from Tier 1, 2, or 3 sites giving Tier 1 priority?	
☒	☐	d. If no Tier 1, 2, or 3 sites are available, do all sites have plumbing materials commonly found at other locations in the system?	
☒	☐	e. Is the minimum number of lead service line samples taken (when applicable)?	

Comments: Revised report after conference call with DEQ staff. Two samples were removed from list for not meeting sample criteria, and due to population the number of samples required was reduced to 60.

NOW PASSED!
W/ 69 SAMPLES

10. NAME:

Name: Michael Glasgow
Title: Utilities Administrator Phone: 810-766-7135 Date: 8/20/2015

Slide courtesy of Dr. Marc Edwards, VA-Tech

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

"A **major concern** from a **public health** standpoint is the **absence of corrosion control** treatment in the City of Flint"

June 24, 2015

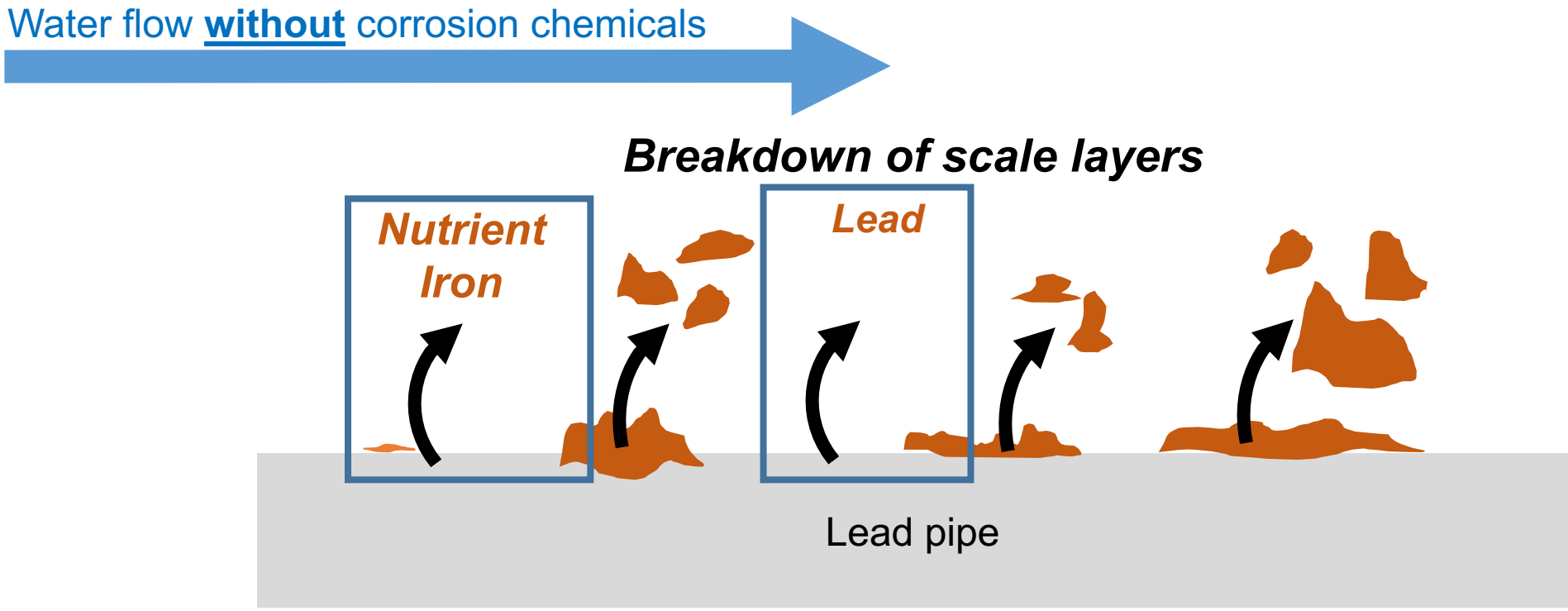
MEMORANDUM

SUBJECT: High Lead Levels in Flint, Michigan – Interim Report

FROM: Miguel A. Del Toral
Regulations Manager, Ground Water and Drinking Water Branch

Slide courtesy of Dr. Marc Edwards, VA-Tech

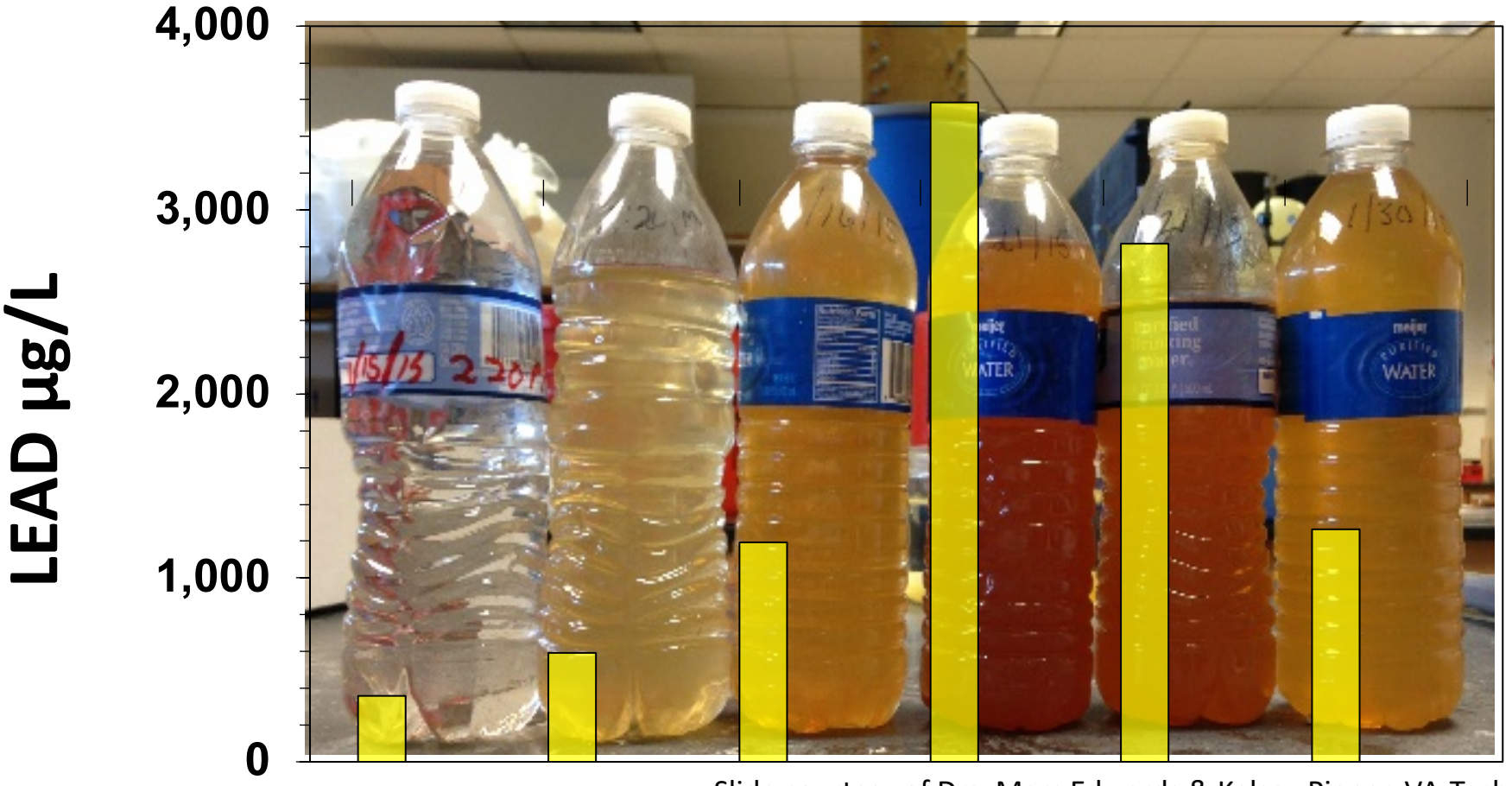
No corrosion control
+ more corrosive Flint River water
= lead & iron



Slide and picture courtesy of Drs. Marc Edwards and Kelsey Pieper, VA-Tech

Flint: High Fe = High Pb

Fe can be indicator of greater problems



Slide courtesy of Drs. Marc Edwards & Kelsey Pieper, VA-Tech

UN-ENFORCED (SECONDARY) DRINKING WATER STANDARDS

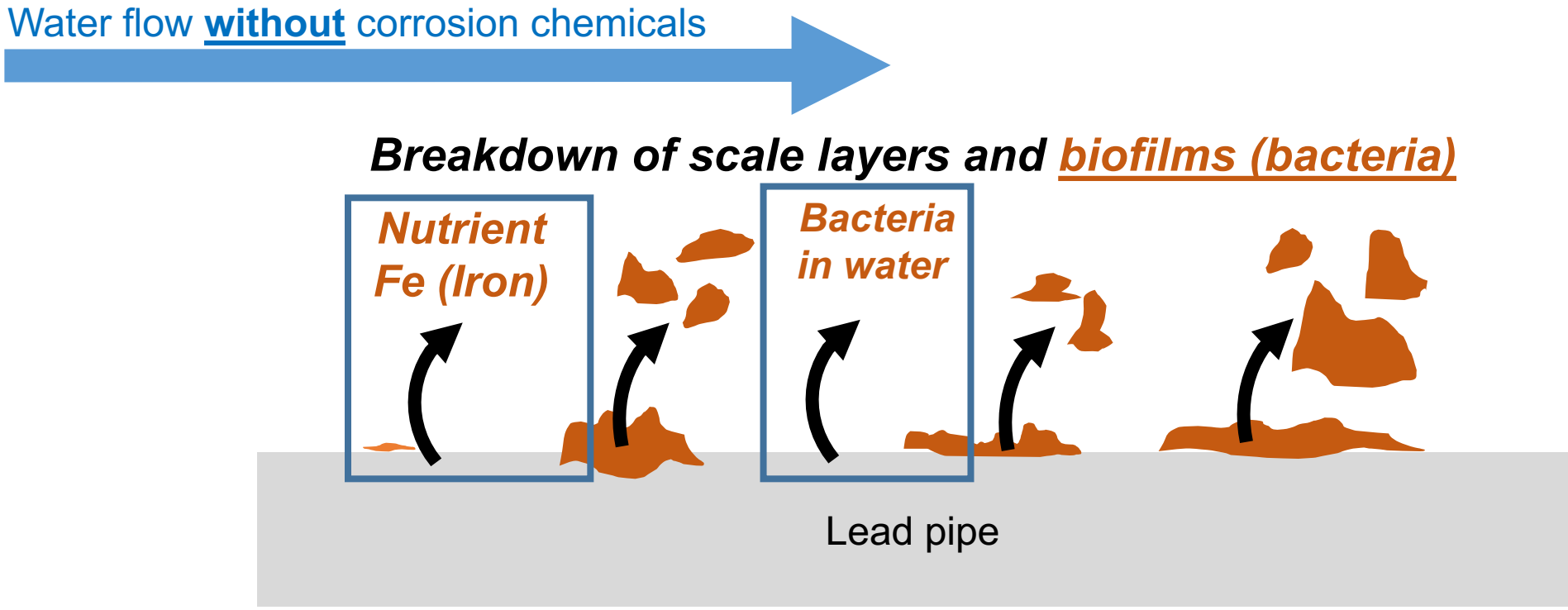
Chemical Parameters

- Chloride (ppm)
- Color (units)
- **Iron (ppb)**
- Manganese (ppb)
- Vanadium (ppb)
- Alkalinity (ppm)
- Boron (ppb)
- Calcium (ppm)
- Hardness (as $CaCO_3$) (ppm)
- Magnesium (ppm)

EPA does not require states to enforce "secondary" standards for contaminants with only aesthetic effects –

e.g., for iron (Fe)- nutrient which causes water to turn red

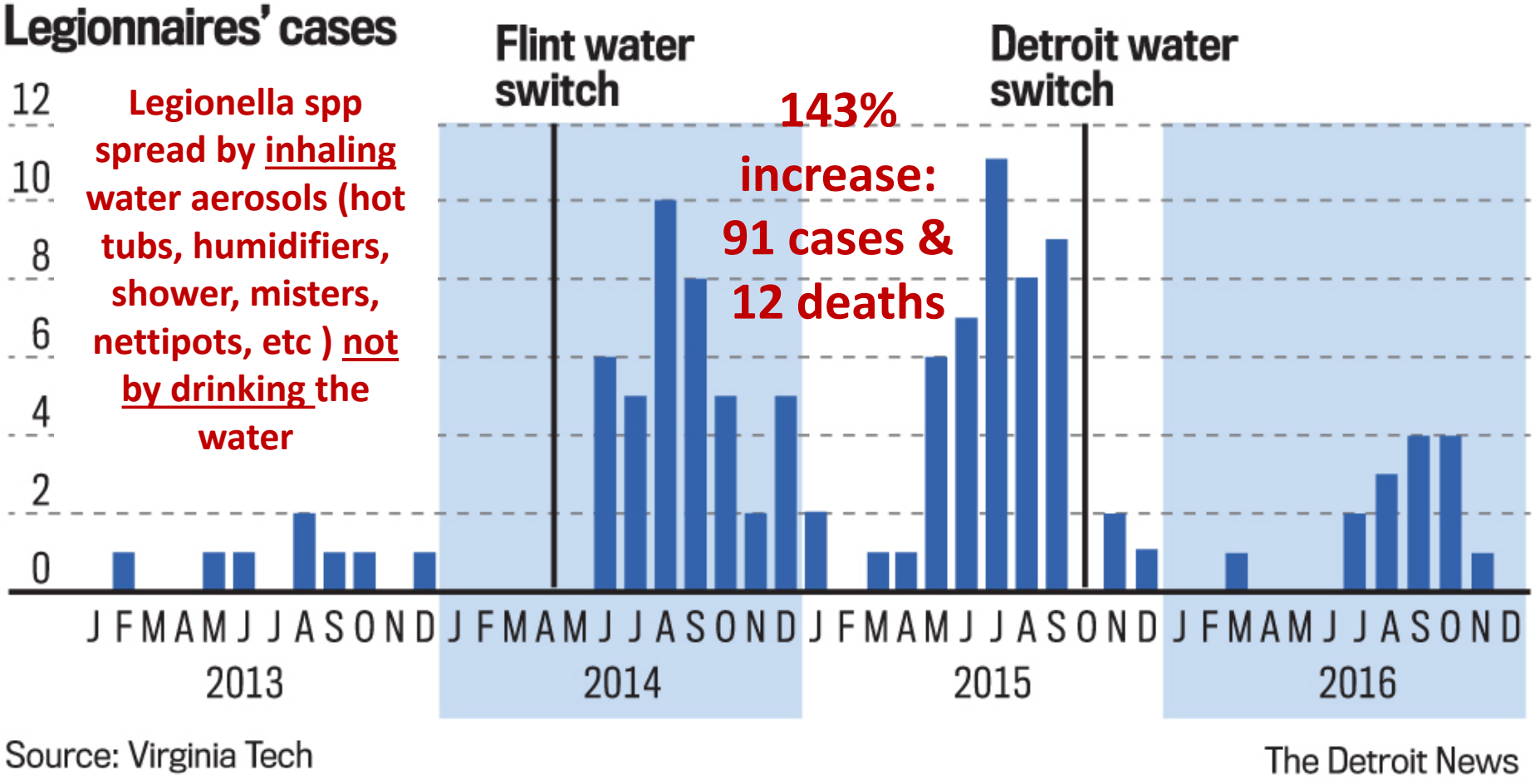
No corrosion control
+ more corrosive Flint River water
= lead, iron and *Legionella*



Slide and picture courtesy of Drs. Marc Edwards and Kelsey Pieper, VA-Tech

Legionnaires' outbreak

Legionnaires' cases spiked soon after the switch to Flint River water in April 2014 and dropped off after the city's return to Detroit water in October 2015.



Source: Reprinted from MI Department of Health and Human Services, Genesee County Health Department report, "Legionellosis Outbreak-Genesee County, May, 2015 – November, 2015, Summary Analysis". Available: http://www.waterandhealth.org/legionella-flints-drinking-water/

Iron-Lead-Pathogen Nexus

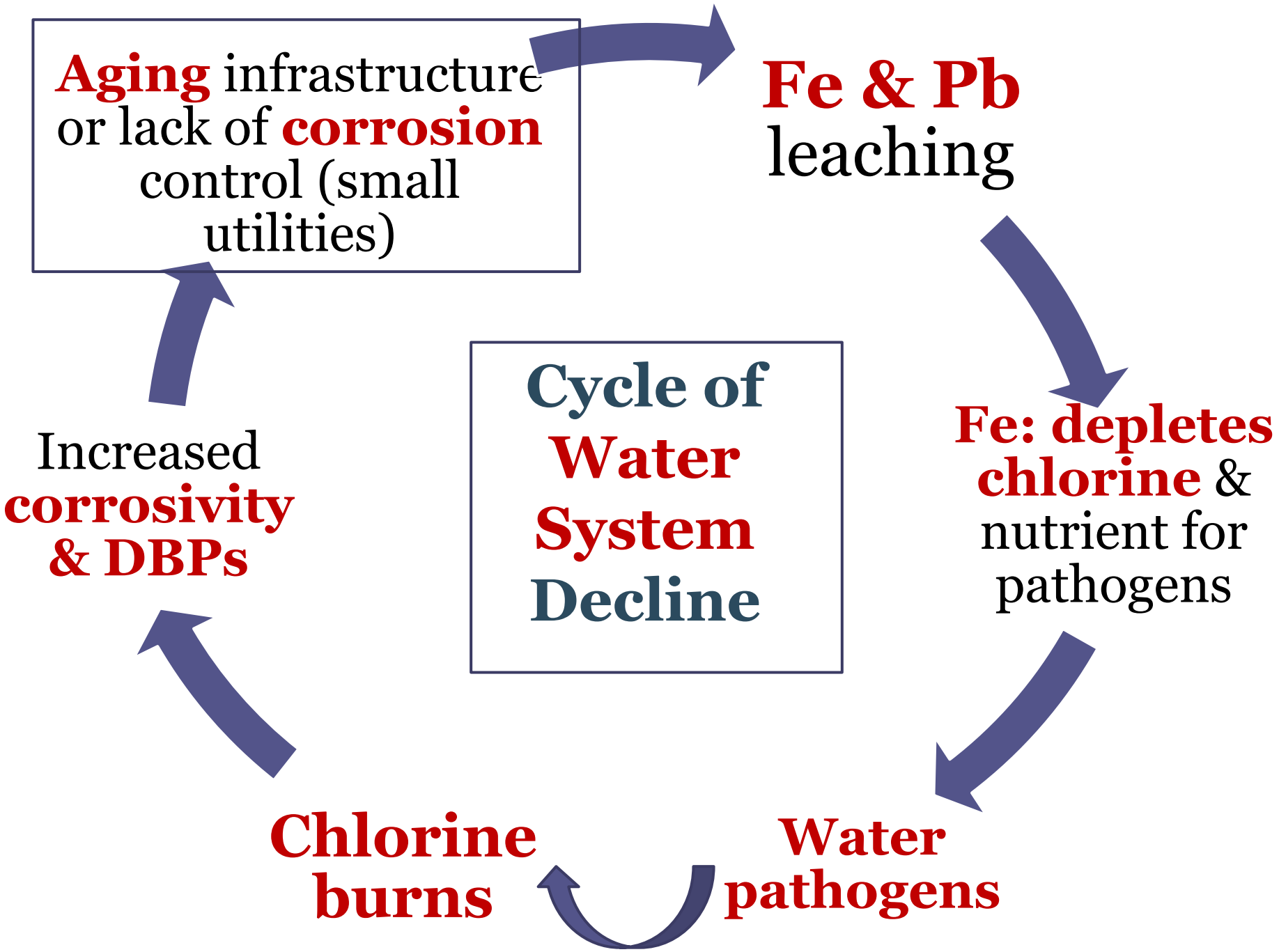
- **Corrosion → Fe leaching**
- **Iron (Fe) oxides→**
  - **Pb:**
    - Fe concentrates & mobilizes trace inorganics (Pb)
  - **Legionella:**
    - Fe depletes free chlorine (Cl oxidizes Fe)
    - Fe can harbor & act as nutrient for water pathogens

- **Iron acquisition**
  - Critical for growth & pathogenesis of *Legionella pneumophila*- causative agent of Legionnaires' disease

***Legionella* bacteria**

(Image: CDC)

Sources: (Rhoades et al 2015, 2016; Masters & Edwards 2015; Masters et al 2015; Wang et al., 2012, 2014, 2015; Cianiotto 2015)


Aging infrastructure or lack of corrosion control (small utilities)
Fe & Pb leaching
Fe: depletes chlorine & nutrient for pathogens
Water pathogens
Chlorine burns
Increased corrosivity & DBPs
Cycle of Water System Decline

Flint, Michigan

St. Joseph, LA

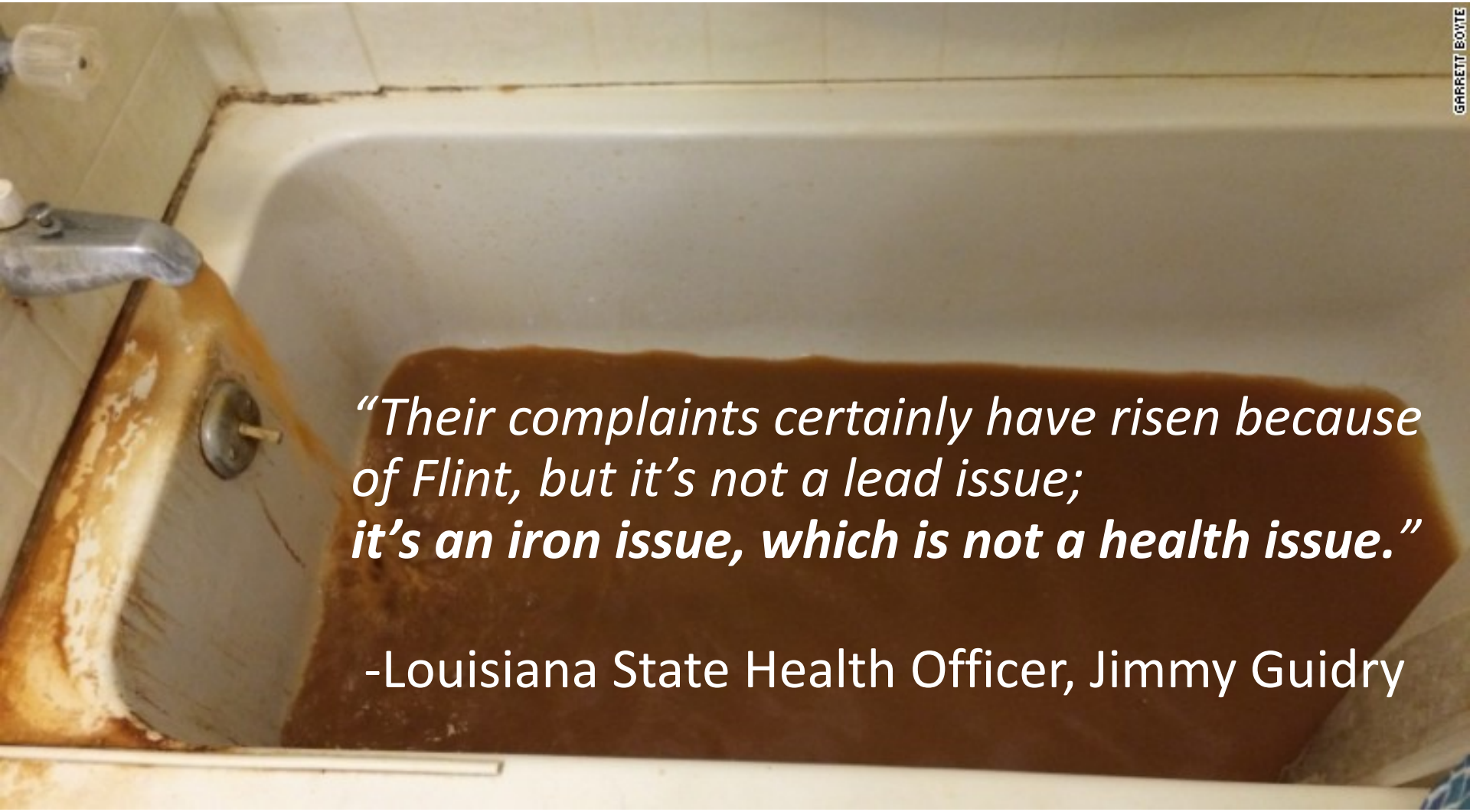
- **No corrosion control** (required)
- **Met Pb standards**
- **High Fe**
- **>1 yr** before response

Source: Kpfa.org

- **No corrosion control** (not required)
- **Met Pb standards**
- **High Fe**
- **10 yrs** before response

Source: CNN

“St. Joe’s Water is Safe”



St. Joseph's Drinking Water

- Filters clog in days- no affordable solution

- 20 boil water advisories (5/2012 -1/2016)

St. Joe Drinking Water Violations (2006-2017)

Failure to Monitor Chlorine

- May 2015
- June 2015
- October 2015
- December 2015
- March 2016

Failure to Report Required Chlorine Concentrations

- October 2015
- December 2015
- January 2016
- February 2016

Inadequate Minimum Chlorine Residual

- May 2015
- October 2015
- March 2016

Failure to Monitor Coliform

- July 2007
- October 2012
- May 2013
- September 2014
- May 2015
- October 2015

Coliform Detections

- August 11, 2014
- August 14, 2014
- April 28, 2015
- May 5, 2015
- September 8, 2015
- September 10, 2015

Public Notice Rule Violation

- October 2012
- May 2013
- May 2015
- June 2015
- March 2016

Consumer Confidence Report Violation

- July 2006
- July 2007
- July 2009
- July 2010
- July 2011
- October 2011
- July 2014
- October 2014
- July 2015
- October 2015
- August 11, 2014
- August 14, 2014
- April 28, 2015
- May 5, 2015
- September 8, 2015
- September 10, 2015

Independent Investigation

St. Joseph Cold Water Tap Samples Analyzed for Lead
(Mar 22 – Apr 18, 2016)

	Site 1	Site 2	Site 3
First Draw	2.1 ug/l	12.0 ug/l	42.0 ug/l
30-45 Second Flush	1.0 ug/l	5.5 ug/l	23.1 ug/l
2 minute flush	2.8 ug/l	3.6 ug/l	5.9 ug/l
3 minute flush (5 min. total)	1.7 ug/l	1.8 ug/l	1.7 ug/l

Researchers: Dr. Adrienne Katner, LSU School of Public Health; Drs. Kelsey Pieper, Jeff Parks and Marc Edwards, VA Tech

St. Joseph State Investigation

- **22%** of St. Joe homes exceeded lead Action Level (AL)(15 ppb)
  - **Violated** Lead & Copper Rule (if >10% exceed AL)

- Max **1810 ppb**
  - **181X >WHO's Pb standard** (10 ppb)

THE ADVOCATE

BATON ROUGE | NEW ORLEANS | ACADIANA

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Lead found in Saint Joseph drinking water in 20-plus percent of homes, businesses

BY MARK BALLARD | MBALLARD@THEADVOCATE.COM DEC 30, 2016 - 12:25 PM (2)

St. Joe's Xmas Present (Dec 2016)

CNN U.S. » Louisiana declares public health emergency in St. Joseph Live TV

Louisiana declares public health emergency in St. Joseph

By **Khushbu Shah, CNN**

Updated 8:52 PM ET, Tue December 20, 2016

Enterprise, Louisiana

Friday September 15, 2017 water sampling event (21 homes)

Enterprise, LA Drinking Water System

- **Enterococcus**
  - In Enterprise drinking water
  - Bacteria in human intestine
- **Triggered chlorine burn**
  - Can increase metal leaching (Fe, Pb) and disinfection byproducts
- **Trihalomethanes (TTHM)**
  - Disinfection byproduct of organic matter and chlorine
  - Frequent exceedances
  - Carcinogen
- **Iron (Fe)**
  - Aesthetic contaminant, nutrient
  - Consistently high
  - Can decrease free chlorine, harbor microbes, concentrate trace inorganics (Pb) & interfere with Pb tests

"It's like we're a third-world country"

- H.C. Lewis, Resident of Enterprise (KNOE 8 News)

Enterprise Results

- **Total Coliform & E Coli**
  - Indicators of fecal contamination
- **Disinfection by-products**
  - 76% exceeded TTHM MCL (80 ppb)

NON-COMPLIANT

- Disinfectant
- 29% no detectable chlorine

- **Iron**
  - 71% exceeded secondary MCL(n=17)(300 ppb)
  - Max=6,947 ppb
  - Avg= 410 ppb

- **Lead**
  - 41% exceeded Action Level (15 ppb)(n=17)
  - Max=103 ppb
  - Avg=8 ppb

Danielle Edwards collecting Enterprise water samples on Sept 15, 2017. (Source: Janie Jones)

Louisiana Water Program Audit

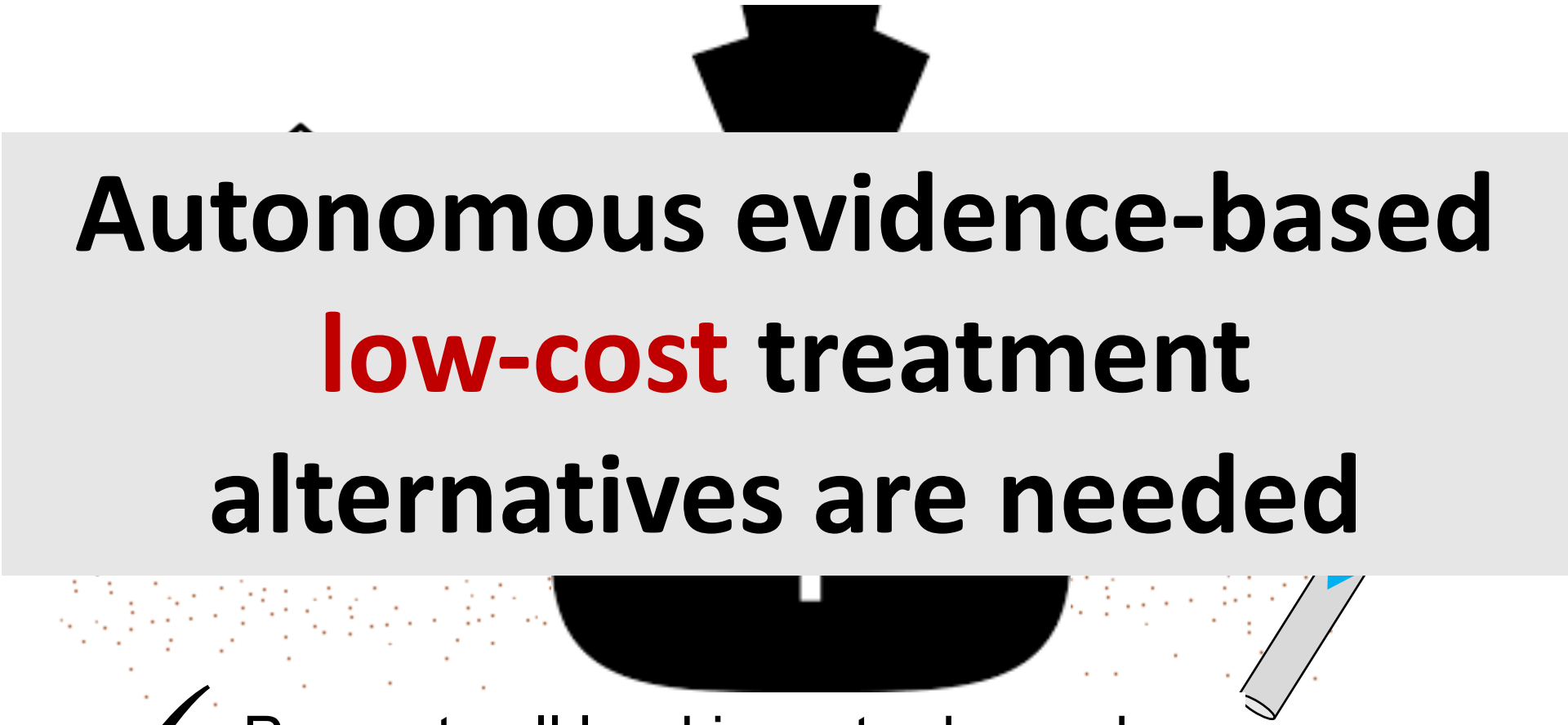
"OPH cannot ensure that it took appropriate enforcement action….

Autonomous evidence-based low-cost treatment alternatives are needed

– *LA Legislator Performance Audit of LA SDWP, 2016*

LEAD IN WATER EXPOSURE REDUCTION

Remove all leaded components



Autonomous evidence-based low-cost treatment alternatives are needed

✓ Prevents all lead in water hazards

Other Strategies to Reduce Pb in Water Exposure

- **Flushing tap water**
  - 30 sec to 2 min
  - Until it runs cold

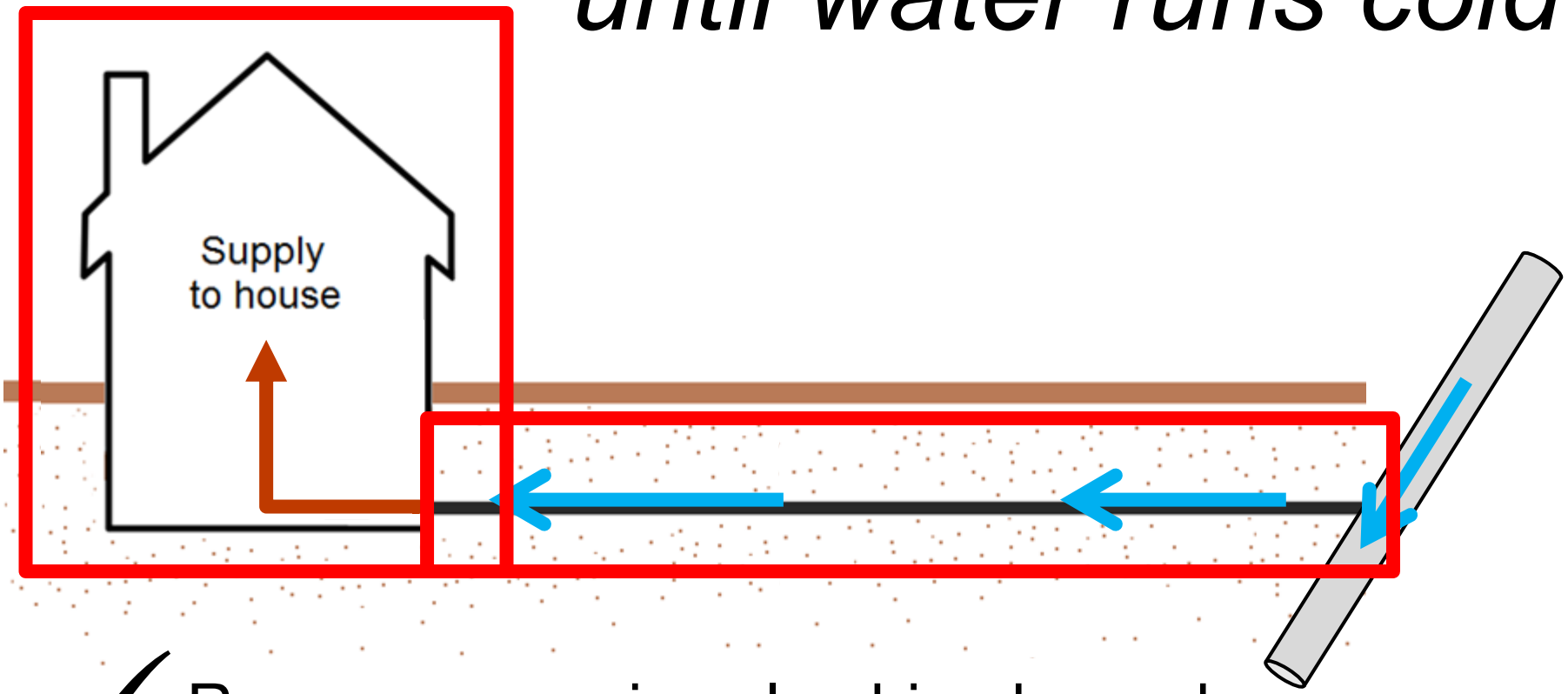
Is There Lead in New Orleans' Tap Water?

No lead is present in the treated water leaving our treatment plants; however, homes that are unoccupied and homes that are undergoing or have recently undergone plumbing renovation may experience elevated lead concentrations in their tap water. Homeowners should thoroughly flush all household plumbing before re-occupying the property.

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. The Sewerage and Water Board of New Orleans is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your drinking water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the US EPA Safe Drinking Water Hotline (1-800-426-4791) or at http://www.epa.gov/safewater/lead.

FLUSHING FOR 30 SEC TO 2 MINS

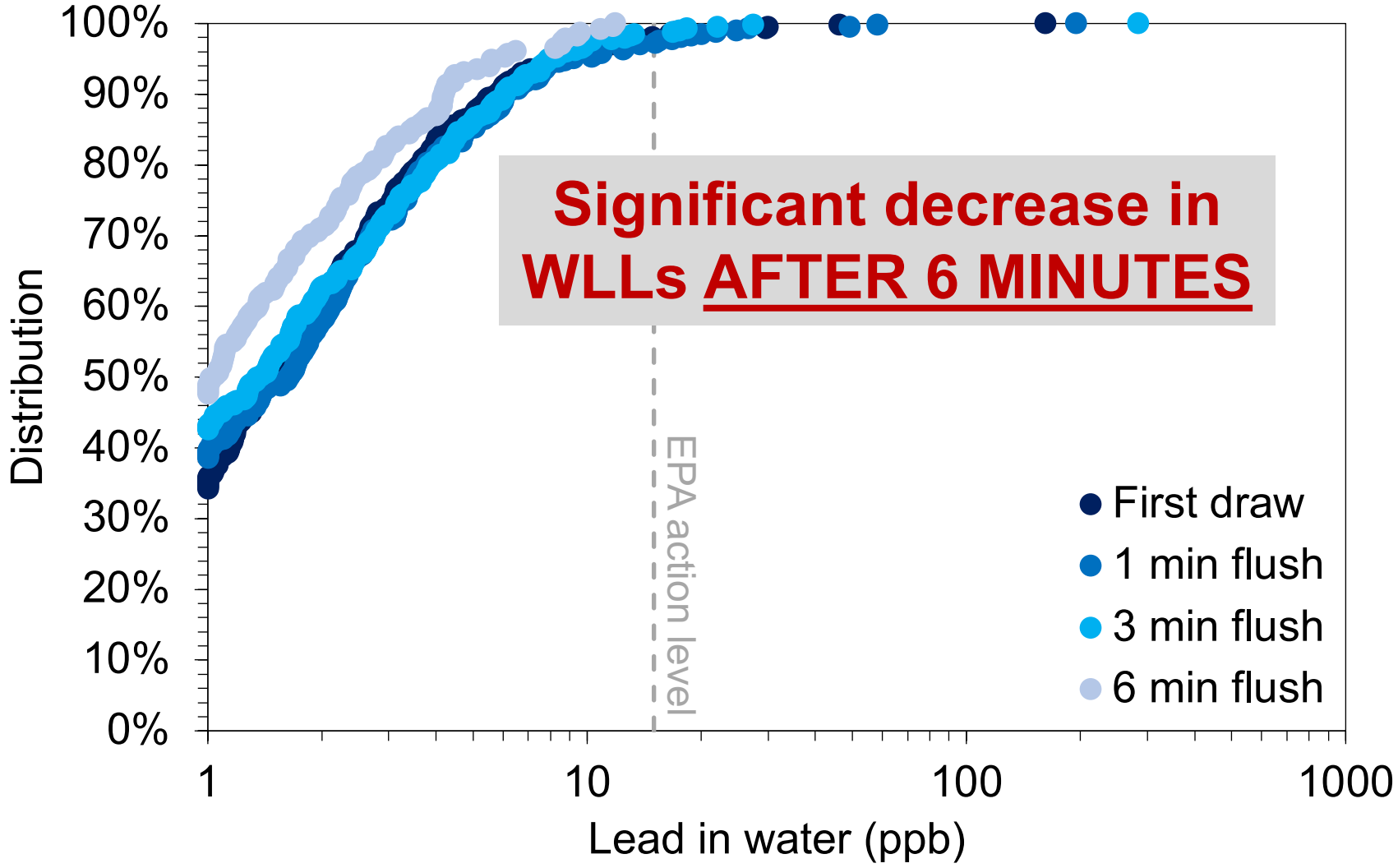
"until water runs cold"



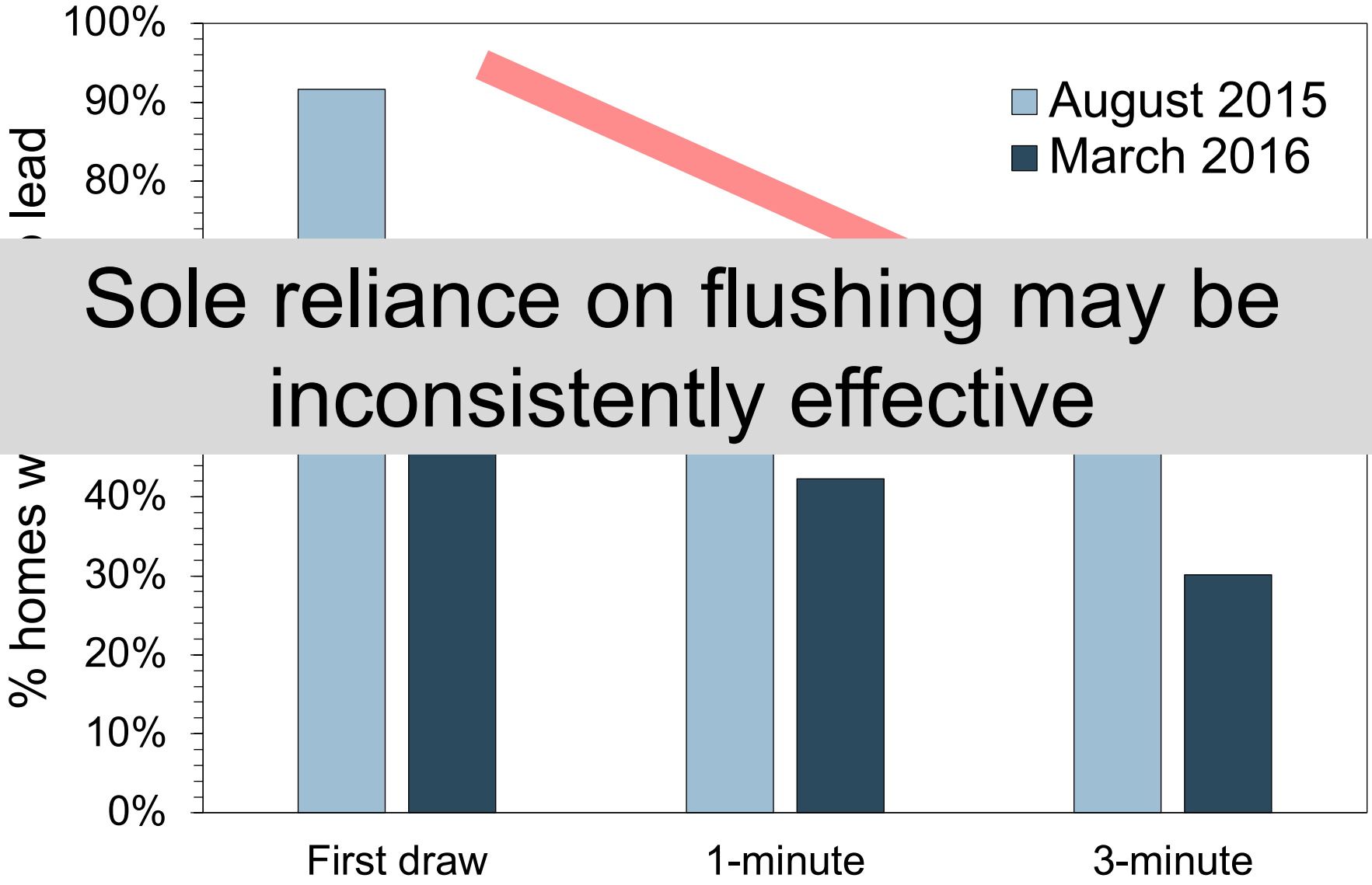
✓ Removes premise plumbing hazards

X Remove service line plumbing hazards or eliminate particulate lead hazard

New Orleans: WLLS after Flushing



FLINT HOMES WITH DETECTABLE LEAD



Sole reliance on flushing may be inconsistently effective

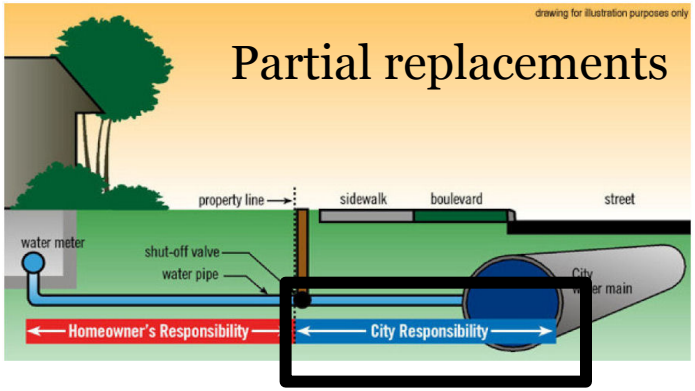
Other Strategies to Reduce Pb in Water Exposure

Lead service line replacements

- **Full** line replacements

NOLA: 16,000 PLSLRs

EPA acknowledged PLSLRs can increase water lead for weeks to years (EPA SAB 2011)



4 of 5 post-PLSLRs: Pb>15 ppb

Max Post-PLSLR (after 3 min flush): **226 ppb**

NOLA OIG Report: PLSLR Risks (7/2017)

"City and S&WB had not alerted residents to risks [of PLSLRs]....New Orleans residents may be—or may have been—unknowingly exposed to elevated levels of lead in drinking water"

Part of a lead service line from a New Orleans home, Treme, 5/2/2016 -Credit: A. Katner

OIG NEW ORLEANS OFFICE OF INSPECTOR GENERAL — *IN BRIEF*

Lead Exposure and Infrastructure Reconstruction

July 19, 2017

What the OIG Found

The City of New Orleans and the Sewerage and Water Board (S&WB) have embarked on $2.4 billion of FEMA-funded infrastructure reconstruction projects in addition to ongoing road construction projects funded by other revenue sources. Many of these projects involve repairing and/or replacing components of the water supply system that may include pipes (service lines) that carry water from the water main to a residence/property.

Lead is a dangerous neurotoxin that can impair the cognitive functioning and health of both adults and children. ***No level of lead exposure is deemed safe.*** In New Orleans an undetermined number of homes have service lines made of lead (Pb). Lead service lines (LSLs) are the main contributor of lead in drinking water at the tap. Many older New Orleans homes are serviced by LSLs, but the S&WB does not have complete or accurate records of their locations.

Portions of lead service line removed from residential street in New Orleans

The S&WB and city contractors replace the publicly-owned portion of service lines (from the water main to the meter or the property line) routinely when replacing water mains or performing maintenance work. However, the privately-owned portion of the service line is the property owner's responsibility and is left in place, even if it is made of lead. This process is known as partial LSL replacement. ***According to the EPA Science Advisory Board, "the weight of the evidence indicates that [partial LSL replacement] often causes tap water [lead] levels to increase significantly for a period of days to weeks, or even several months."*** Other infrastructure work that mechanically or hydraulically disturbs LSLs can also cause spikes in lead levels at the tap.

Evaluators found that the City and the S&WB had not alerted residents to the risk of increased exposure to lead in water caused by the partial replacement or disturbance of LSLs. Nor have they complied with industry best practices by providing residents with ways to reduce the risk of increased lead exposure. ***As a result, New Orleans residents located where infrastructure reconstruction projects occur may be—or may have been—unknowingly exposed to elevated levels of lead in drinking water.***

What the OIG Recommended

Based on best practices and guidance set forth by industry, scientific, and public health experts, the OIG recommended that the City and the S&WB develop a strategic risk communication plan that includes (1) risk communication strategies for educating residents about the potential for increased lead exposure and (2) immediate steps to mitigate residents' risk of lead exposure as a result of LSL replacements or disturbances. At minimum, the plan should include:

- a thorough and persuasive public education campaign that alerts residents to the risk;
- advance notification of impending infrastructure work or other activities that might disturb LSLs;
- clear instructions for flushing service lines and interior plumbing lines;
- distribution of water pitcher kits and six months of filters certified to remove lead; and
- proactive water quality testing after partial LSL replacements or disturbances.

The steps listed above consist of practical strategies that can be implemented to protect residents from elevated lead levels caused by partial LSL replacements and disturbances. However, experts agree that the only long-term solution is to "get the lead out" completely. Evaluators recommended that the City and the S&WB should inform residents about the advantages of full LSL replacement well in advance of construction work that will disturb the public service line and actively encourage property owners to replace privately-owned LSLs by offering options such extending payments by adding the cost to their water or property tax bills.

Purpose of This Report

The OIG learned of an imminent risk to public health due to the partial replacement or disturbance of LSLs during its inspection of the S&WB's water quality testing practices. As a result, the OIG conducted an evaluation of City and S&WB policies and procedures regarding infrastructure work that may involve the disturbance or partial replacement of LSLs.

For more information about this report contact Nadiene Van Dyke at (504) 681-3200 or nvandyke@nolaoig.gov.

Percent of NOLA Taps*Above Standards

Cal-EPA PHG: California EPA's Public Health Goal (2009) for WLLs for fetuses and infants based on neurodevelopmental impacts.

AAP-RL: American Academy of Pediatrics Recommended Level (2016) for WLLs in schools and daycares

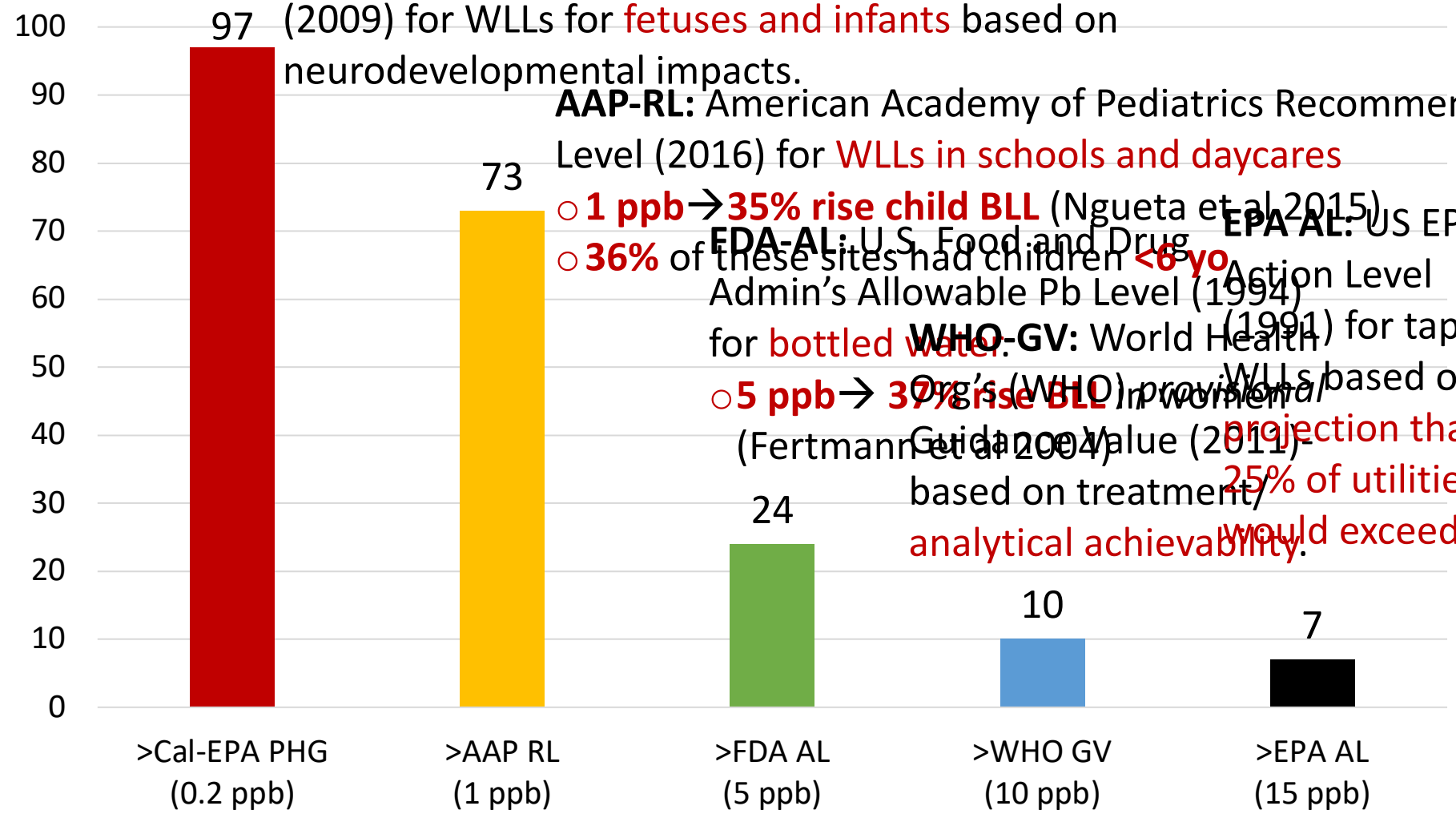
- **1 ppb→35% rise child BLL** (Ngueta et al 2015)
- **36%** of these sites had children **<6 yo**

FDA-AL: U.S. Food and Drug Admin's Allowable Pb Level (1994) for bottled water.

- **5 ppb→ 37% rise BLL** in women (Fertmann et al 2004)

WHO-GV: World Health Org's (WHO) *provisional* Guidance Value (2011)- based on treatment/ analytical achievability.

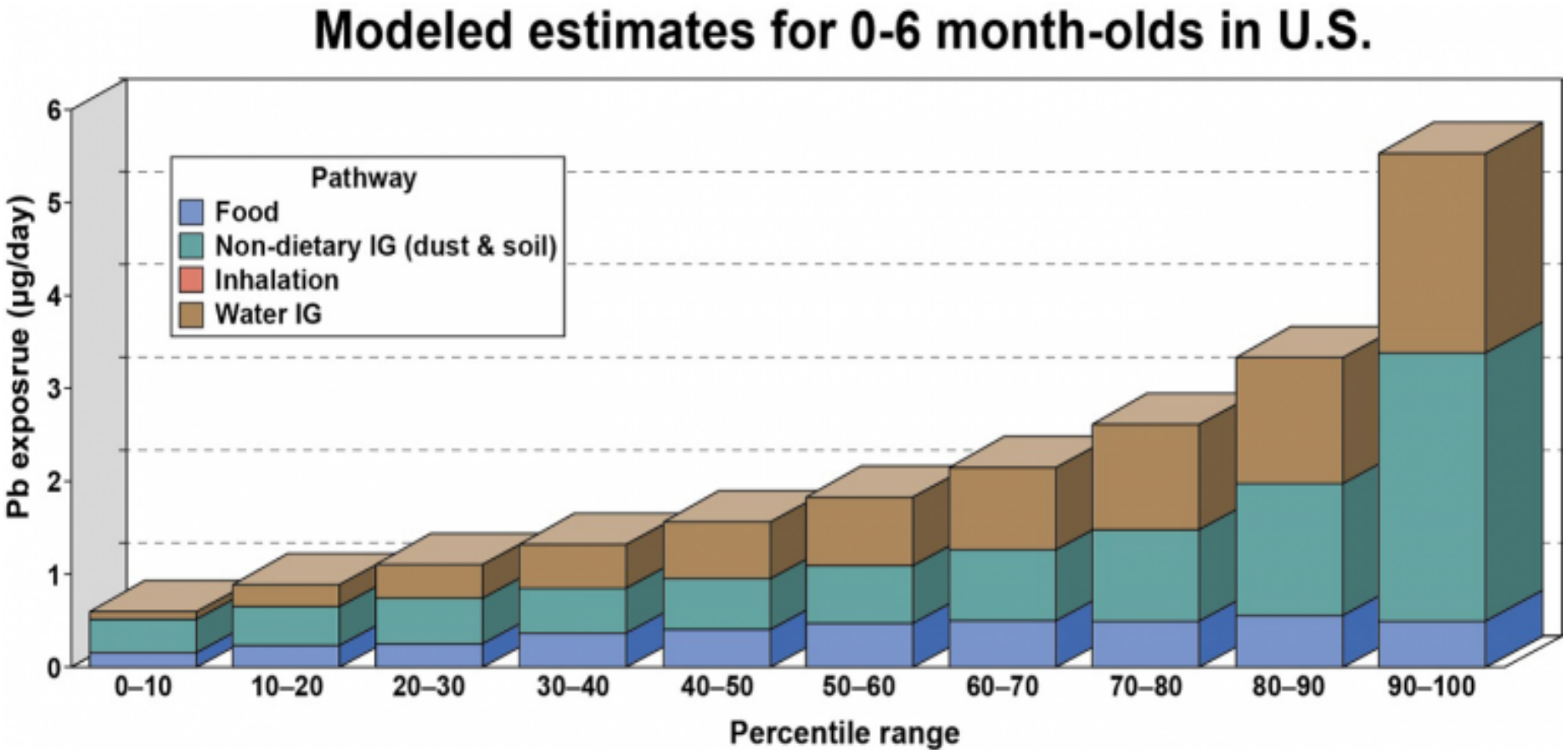
EPA AL: US EPA's Action Level (1991) for tap WLLs based on projection that 25% of utilities would exceed it



*Includes buildings with LSL replacements and low-use buildings (schools, day cares, etc)

EPA Modeling of Major Pb Source by Age

Formal-fed infants: greatest risk of exposure via water



Source: EPA. 2016. DRAFT Proposed Modeling Approaches for a Health-Based Benchmark for Lead in Drinking Water.

Best Low Cost Alternative: Filters

Low-cost:
$15-$50

New Orleans respondents (n=333) with filter:

59% of high-income respondents **(>$75k)**

21% of low-income respondents **(<$25k)**

NSF-53 Faucet Mount Filters

NSF

NSF CERTIFIED

NSF Certified - Full system certified to NSF/ANSI Standards 42, 53, 401 & conforms to protocol P473

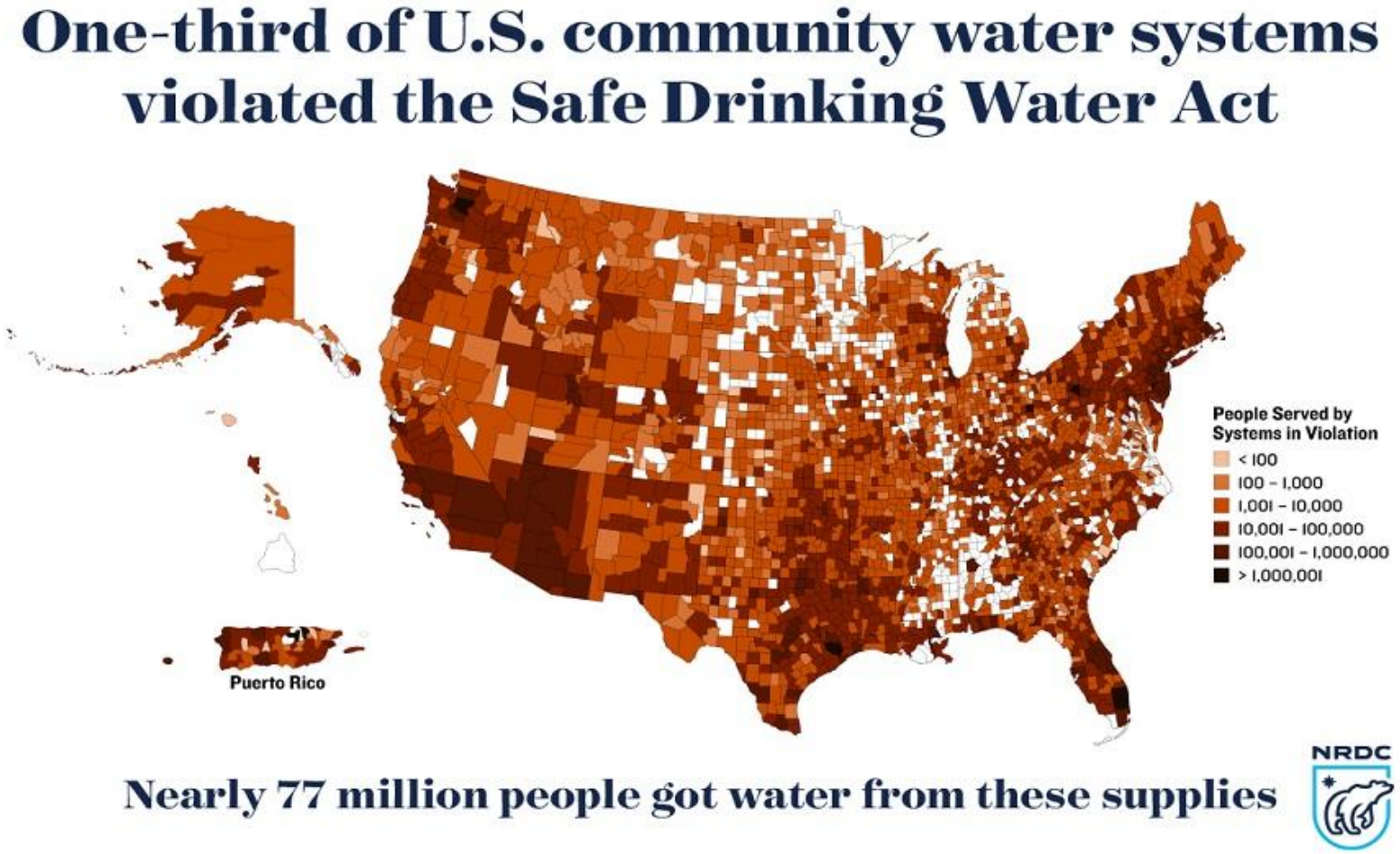
600 GALLONS

6 MONTH FILTER LIFE

1 YEAR WARRANTY

90 DAY GUARANTEE

State of U.S. Drinking Water



Grade of "D" for U.S. drinking water infrastructure

(American Society of Civil Engineers (ASCE))

ARE WATER STANDARDS OUT OF DATE?

Fluoride MCL (1986)

- 4 mg/L or 4000 ppb

MCL reviewed in 2006

- No change

196 post-2006 studies of fluoride neurotoxicity

- 61 human studies
- **46/54- statistically significant adverse cognitive effect**
  - 3/3 fetal brain studies show adverse effects

Fluoride one of 12 chemicals

"known to cause developmental neurotoxicity in human beings"

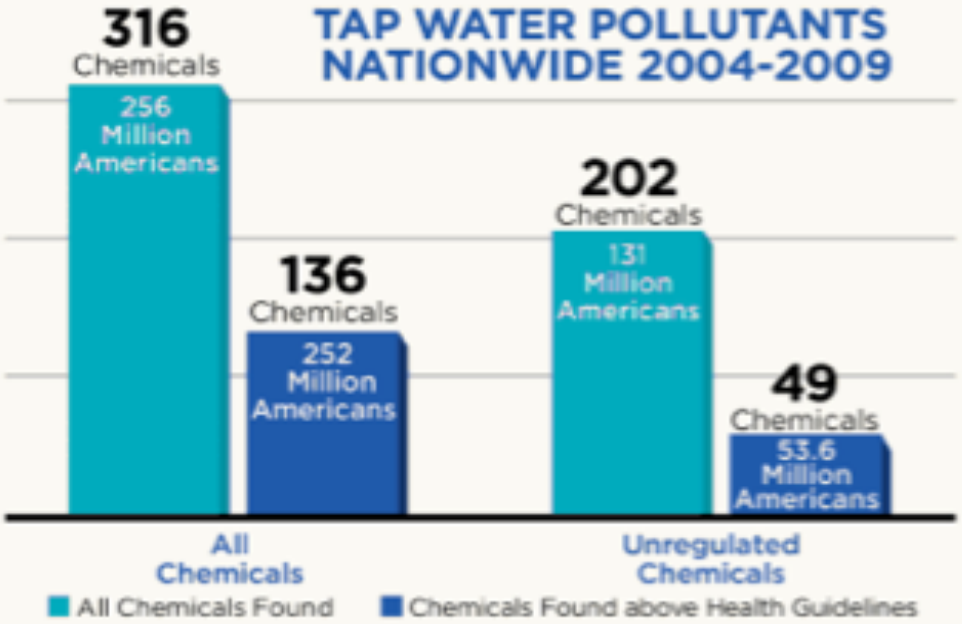
– Grandjean and Landrigan, Lancet Neurology 2014

More Than Half of Existing Chemicals Have No Safety Standard

FACTS ON TAP

316 Contaminants found in nation's tap water, more than half have no safety standards.

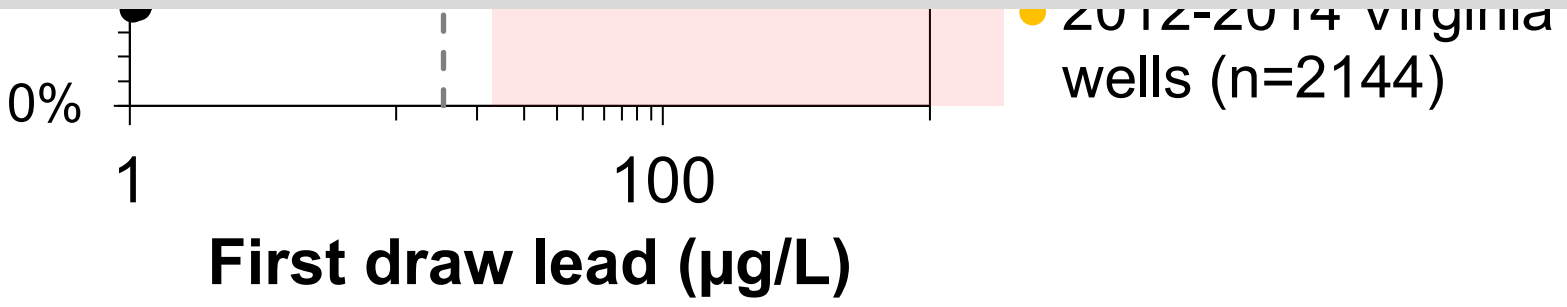
Source: Environmental Working Group (EWG)



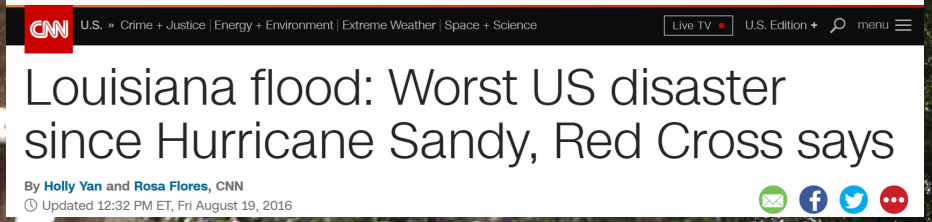
Since 2004, at least 131 million Americans received tap water polluted with unregulated contaminants.

UNREGULATED SYSTEMS: PRIVATE WELLS

1 in 8 people in LA get drinking water from privately-owned domestic water wells- 13% of state or half a million residents.

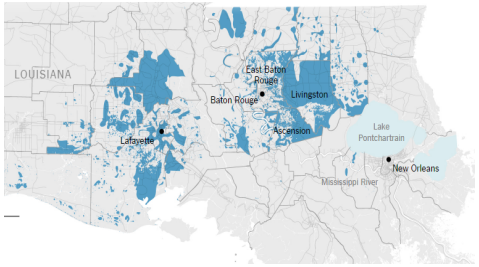


SOURCE: Pieper et al. (2015); Pieper and Edwards (2016)



"water was 4 feet over our well ….under water for about 3 days"

Well Water Quality After 2016 Flood



Flood-impacted wells (n=114):

- 25%: viable **total coliform**
- 10%: viable ***E. coli***
- 57%: ***Legionella*** **DNA**
- 94%: High **sodium (metal)** (saltwater intrusion)

Shock Chlorination

42% of those who shock chlorinated (n=15) didn't know well volume

Invites issues of disinfection failure, excess DBPs, system corrosion & metal leaching

No Disinfection (n=95)

Disinfection (n=19)

Closing Thoughts

- **Water quality solutions→ different problems**
  - Chlorine→ DBPs
  - Chloramine→ Pb
  - Corrosion inhibitors→ part. Pb
  - Partial replacements → Pb
- **Corroding infrastructure→ complex & costly water problems**
  - Metal leaching
  - Premise plumbing pathogens
  - Chlorine burns & more corrosion
  - Leaks, water waste & high rates
- **Regulatory compliance ≠ "safe"**
  - Not all chemicals have standards
  - Not all standards are protective
  - Sampling to minimize detection
  - Weak oversight & enforcement
- **Need autonomous evidence-based low-cost treatment solutions**
  - Unregulated systems
  - Regulated systems with no or little oversight

Partners & Acknowledgements

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- Marc Edwards
- Kelsey Pieper
- Jeffrey Parks

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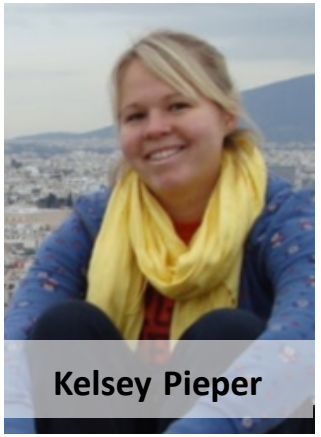
- Beth Butler
- Marie Hurt

U.S. EPA
- Miguel Del-Toral

Tulane University
- Howard Mielke


Marc Edwards


Kelsey Pieper


Howard Mielke

Research support provided by:

LA Board of Regents ***(LA-BOR)***
LSU School of Public Health ***(LSUHSC-SPH)***
LA Clinical & Translational Science Center ***(LACaTS)*** *&*
National Science Foundation ***(NSF)***

QUESTIONS?

Adrienne Katner

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LSU School of Public Health
New Orleans, LA

Krewe Du Vieux, Mardi Gras New Orleans 2015

Credit: A. Katner

END

HISTORY

Hippocrates (400 BC)

- Water pathogens
- Importance of boiling & filtering water

LA's Universal Blood Screening & Mandatory Reporting

- LA Administrative Code: LAC 48: V. §7005, §7007, §7009

- **Mandatory screening** in **ALL LA parishes**
  - Children age 6-72 months
- Medicaid and WIC children must be tested

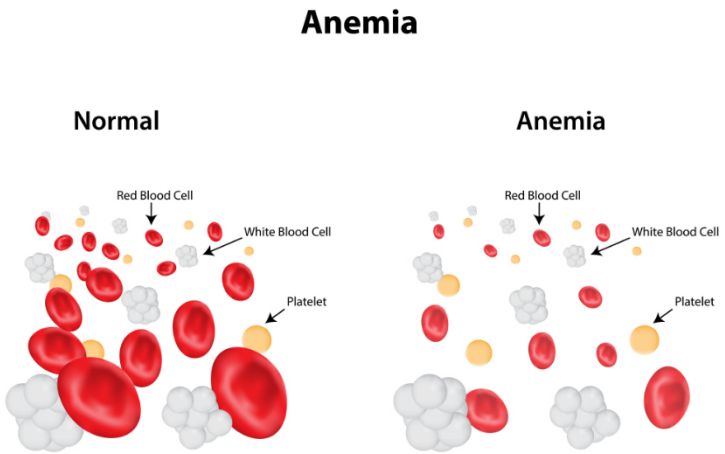
- **Mandatory reporting**
  - Regardless of BLL
  - To LA Healthy Homes and Lead Poisoning Prevention Program

Cochrane Report

- Household Interventions for Preventing Domestic Lead Exposure in Children (2014)
- Reviewed 14 randomized and quasi-randomized studies of interventions for lead poisoning
  - Specialized cleaning, repairs, maintenance
  - Soil abatement (removal and replacement)
  - Painting and temporary containment of lead hazards.
- **Educational and dust control interventions were not effective** in reducing BLLs in children
- **Insufficient evidence** that **soil abatement** or combination interventions reduce BLLs
- **Water-based interventions not evaluated**
- Trials are needed to evaluate interventions for multiple sources

Hematologic Effects

- Interferes with production of hemoglobin
  - Can induce two kinds of **anemia:**
    - Acute exposure → hemo
    - Chronic exposure → synt

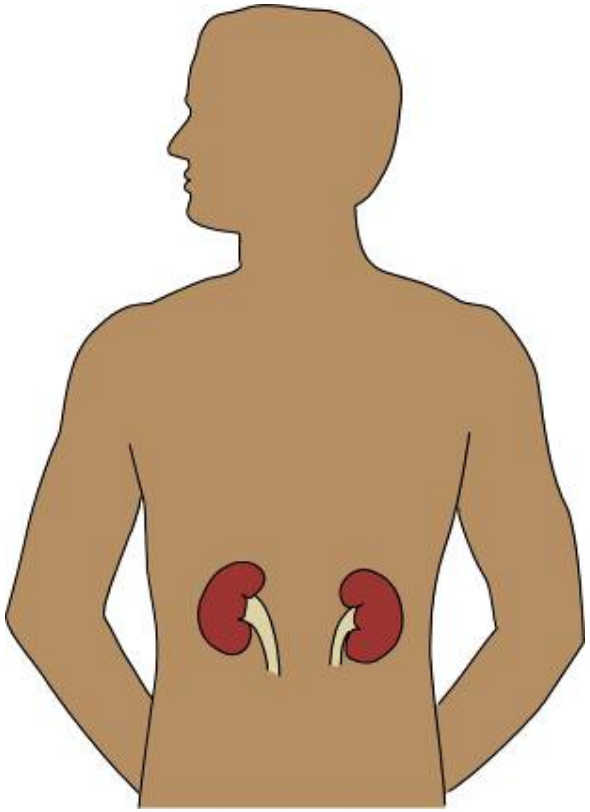


- Threshold for adults: 50 µg/dL

- Threshold for children: 40 µg/dL

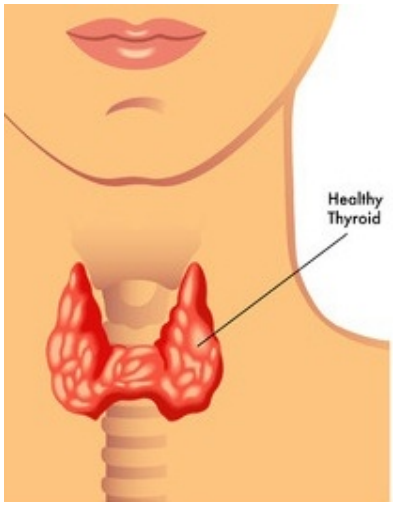
Renal Effects

- Acute exposure (short exposure)
  - Reversible effects
- Chronic exposure (long exposure)
  - **Nephropathy**
    - Spaces between kidney tubules become swollen (inflamed)
  - Childhood exposures → **adult renal disease**

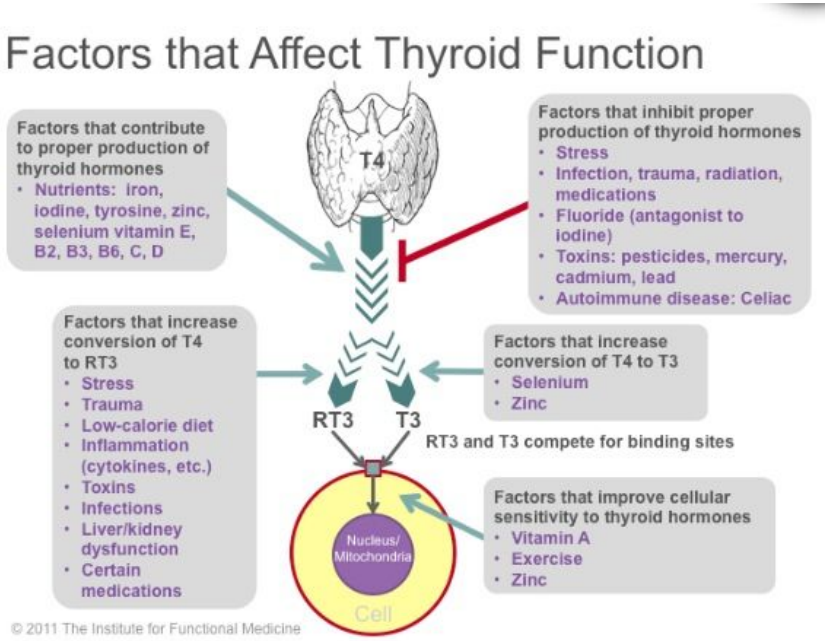


Endocrine Effects

- Chronic exposure may affect **thyroid function**

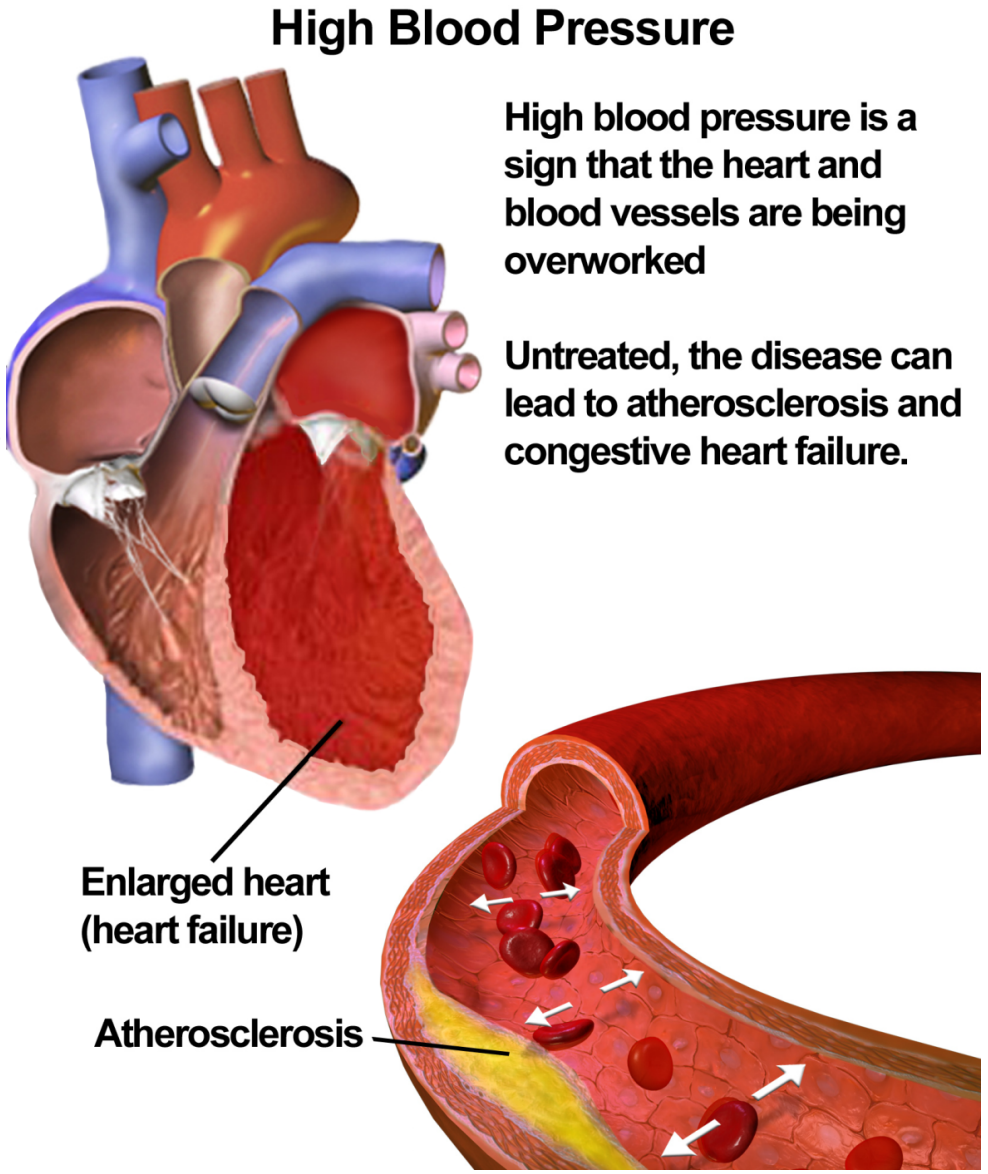


  - Breathing
  - Heart rate
  - CNS & PNS
  - Body weight, etc
  - Muscle strength
  - Menstrual cycles
  - Body temperature
  - Cholesterol levels



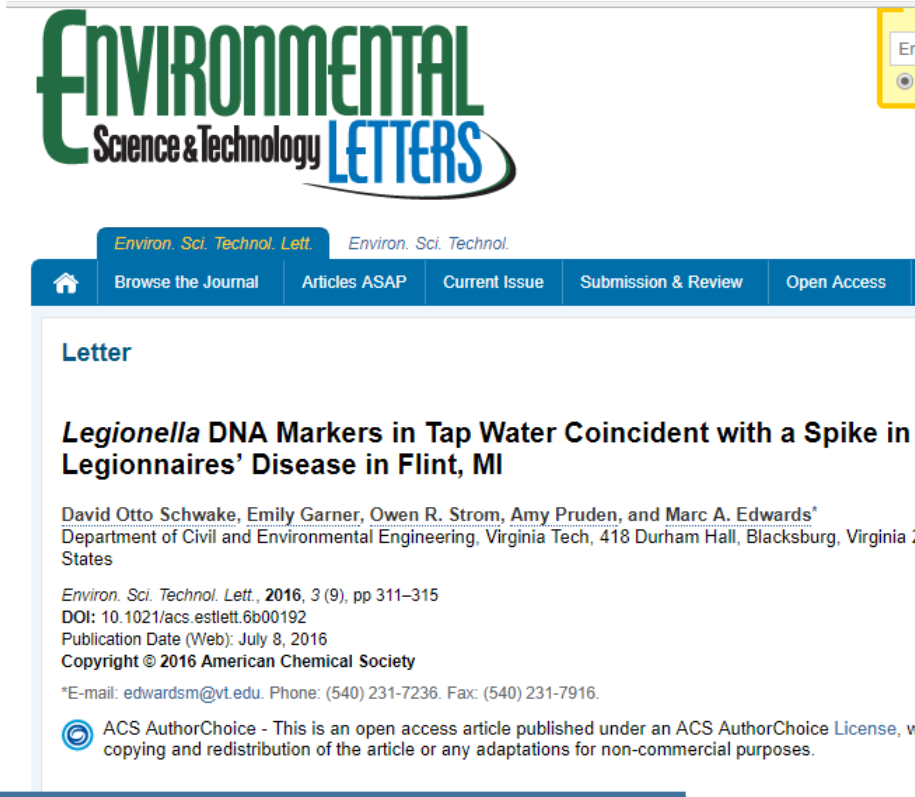
Cardiovascular Effects

- Increases risk of high blood pressure and **hypertension**



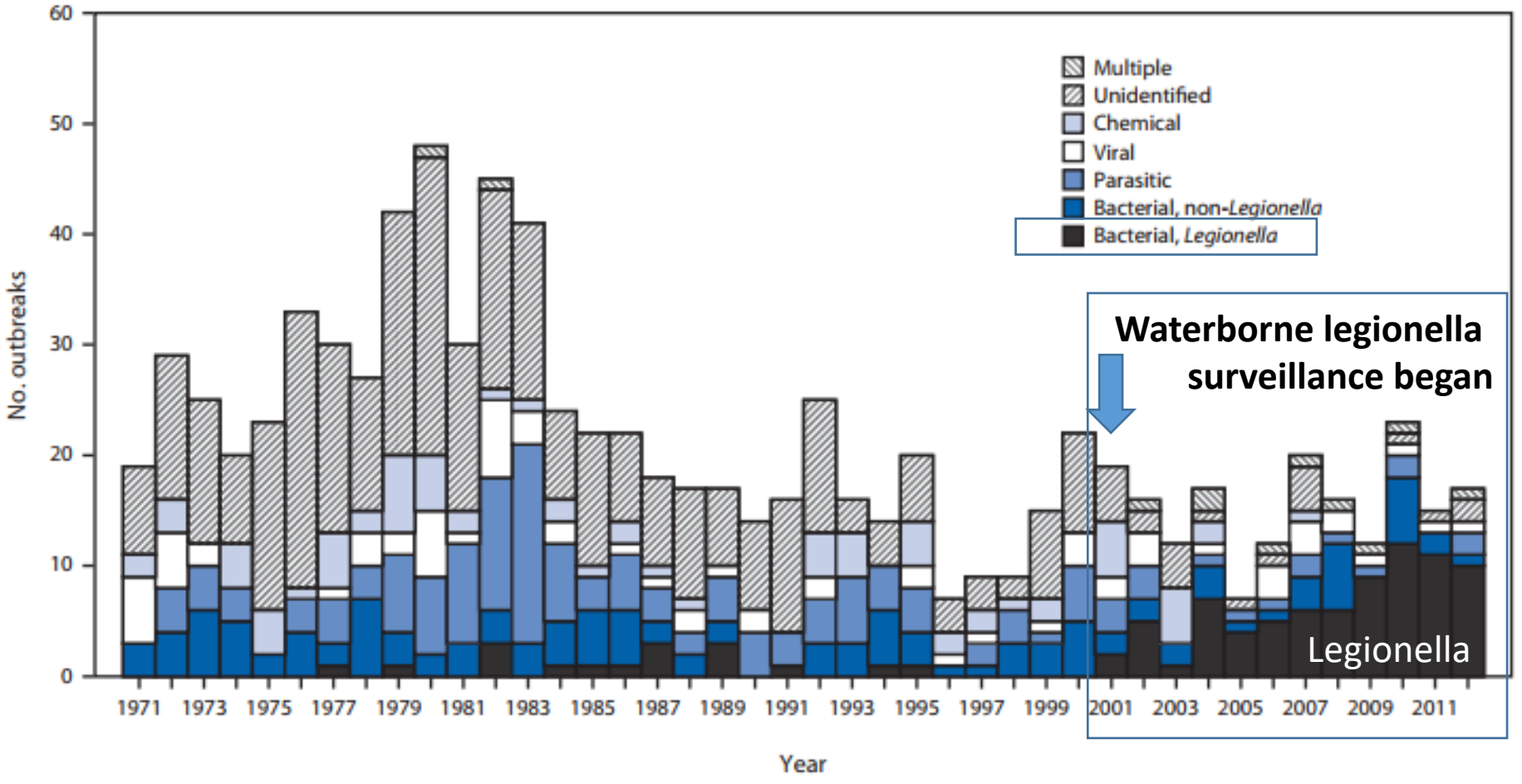
Legionella: Hospital vs Water Supply?

- Bryne and Swanson 2017
  - *Legionella* in 12% of 188 homes
- Schwake et al. 2016 & Edwards et al 2017
  - *Legionella* throughout Flint water system
  - Conditions optimal:
    High turbidity, Fe, low Cl_2



- CDC 2016
  - Strain in hospital water matched 3 clinical samples
  - Including clinical sample from 1 victim never in hospital
    - Same strain present throughout city water supply

Etiology of Drinking Water Associated Outbreaks by Year: 2011-12 (MMWR 2015)



* Legionellosis outbreaks were first reported to CDC Waterborne Disease and Outbreak Surveillance System in 2001; Legionellosis outbreaks before 2001 were added retrospectively during the 2007–2008 reporting period.

Opportunistic Premise Plumbing Pathogens (OPPPs)

- OPPPs
  - Waterborne pathogens which flourish in household (or premise) plumbing
  - Like lead OPPPs introduced in distribution system so can't detect unless sample tap
  - More waterborne disease outbreaks are now caused by OPPPs, vs traditional fecal-borne pathogens

- *Legionella*
  - Most water-related disease outbreaks in US
  - Cause Legionnaires' disease
    - Deadly form of pneumonia
    - Hospitalization rate of 40%
    - Fatality rate of >9%
  - Under-diagnosed and under-reported at hospitals

Growth of Opportunistic Pathogens

- Primary cause of waterborne disease in US

Sampling takes place only at the treatment plant- not at the premise plumbing

Legionella pneumophila

- 8K-18K cases/yr
- $430M/yr
- Cause of all 31 reported respiratory waterborne disease outbreaks 2007-10

Mycobacterium avium

- 100 cases/10^5 people >60yrs
- $425M/yr
- Only recently linked to drinking water

Pseudomonas aeruginosa

- 11,000 HAIs from 1992-93
- No required reporting

Naegleria fowleri

- "Brain eating amoeba" – 2 recent high profile cases linked to drinking water

St. Joseph's Drinking Water

- High Manganese (Mn)
- Filters clog in days- no affordable solution
- 20 boil water advisories (5/2012 - 1/2016)

UNENFORCED (SECONDARY) DRINKING WATER STANDARDS: NUISANCE CHEMICALS

Chemical Parameters

- Chloride (ppm)
- Color (units)
- **Iron (ppb)**
- **Manganese (ppb)**
- Odor-Threshold (units)
- Specific Conductance (µmho/cm)
- Sulfate (ppm)
- Total Dissolved Solvents (ppm)
- Turbidity (NTU)
- Chlorate (ppb)
- Chlorodifluoromethane (ppb)
- Molybdenum (ppb)
- Vanadium (ppb)
- Alkalinity (ppm)
- Boron (ppb)
- Calcium (ppm)
- Hardness (as $CaCO_3$) (ppm)
- Magnesium (ppm)
- pH (units)
- Potassium (ppm)
- Radon (pCi/l)
- Sodium (ppm)
- 1,4-Dioxane (ppb)
- N-Nitrosodimethylamine (NDMA) (ppt)
- Tert-Butyl Alcohol (TBA) (ppb)

Manganese (Mn)

- One of most abundant metals in Earth's crust
  - Usually occurring with iron
  - ~70% of groundwater sites have Mn (USEPA, 2002).
- Essential to functioning of both humans and animals
  - Required for functioning of cellular enzymes (IPCS, 2002)
- Oral 1 of least toxic elements
  - Inhalation associated with Manganism (Parkinson like)
- EPA MCL = 0.05 mg/L
  - 50 ppb or 50 ug/L in water
- Controversy: oral exp > MCL
  - Greece: >10 years DW levels 81–2300 µg/l (Kondakis et al., 1989)
    - Neurological signs of manganese poisoning
  - Germany: > 10 years DW levels 300-2160 ug/L (Vieregge et al., 1995)
    - No neurological effects

UNENFORCED (SECONDARY) DRINKING WATER STANDARDS: NUISANCE CHEMICALS

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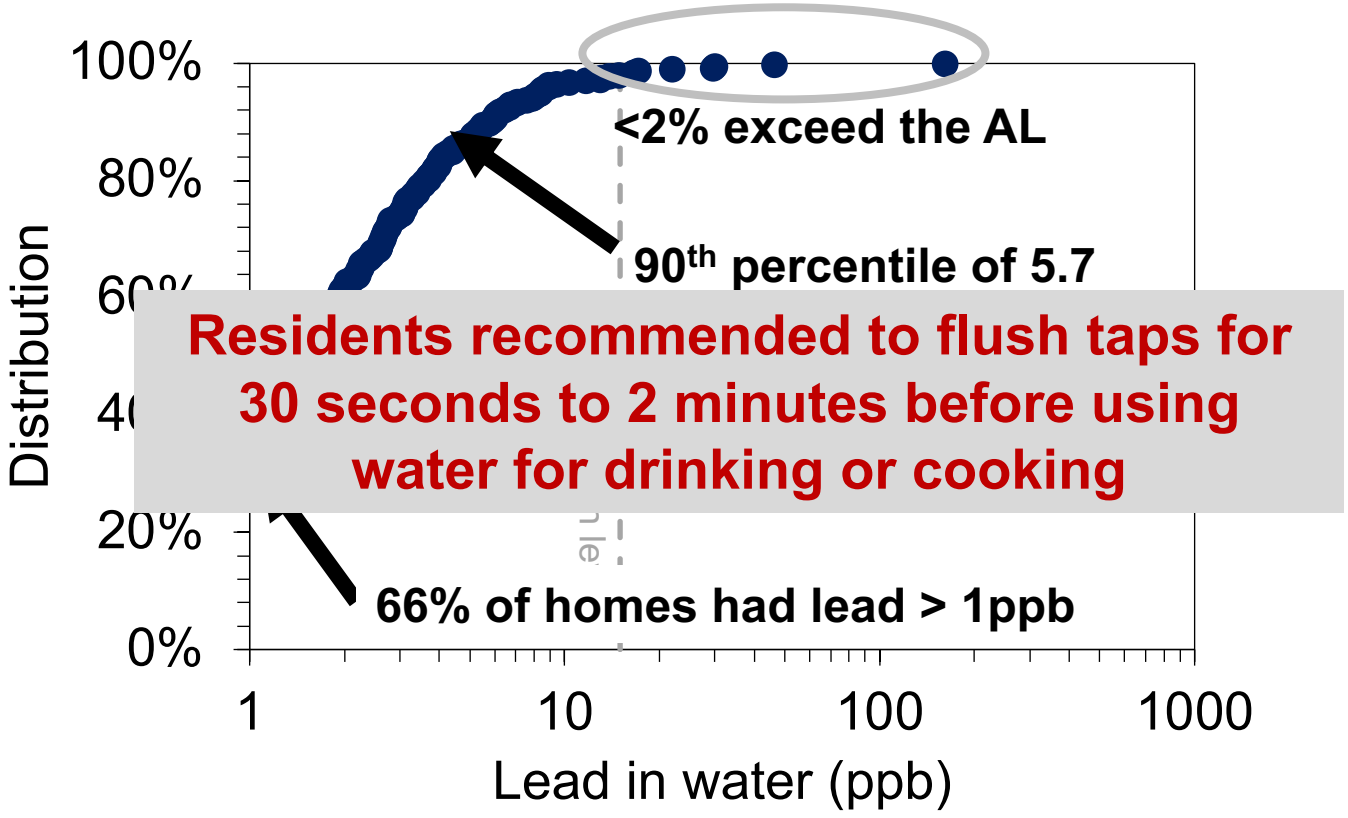
- Tert-Butyl Alcohol (TBA) (ppb)

New Orleans First Draw Water Pb Levels



Residents recommended to flush taps for 30 seconds to 2 minutes before using water for drinking or cooking

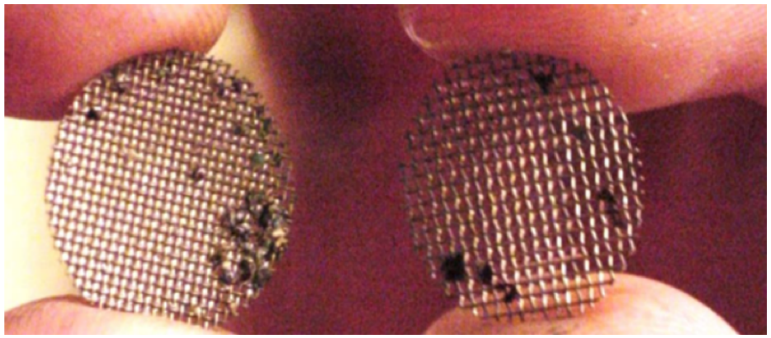
Metal Fingerprints: Main Source of NOLA Lead in Water = Lead Service Lines (LSLs)

- Metals Analyzed
  - Lead, chromium, iron, nickel, copper, zinc, cadmium, tin
- Sustained low WLLs throughout
  - No significant strong correlation between lead and other metals

Part of a lead service line from a New Orleans home, Faubourg Treme, 5/2/2016 -Credit: A. Katner

New Orleans PLSLRs

- **4 of 5 post-PLSLR homes: Pb>15 ppb**
  - Post-PLSLR 3 min flush: **226 ppb**
  - Flushing: short-term decline- random spikes
- Simulated PLSLR with NOLA water & LSL (Boyd et al 2004)
  - Total Pb: **didn't stabilize after 2 weeks** (<AL)

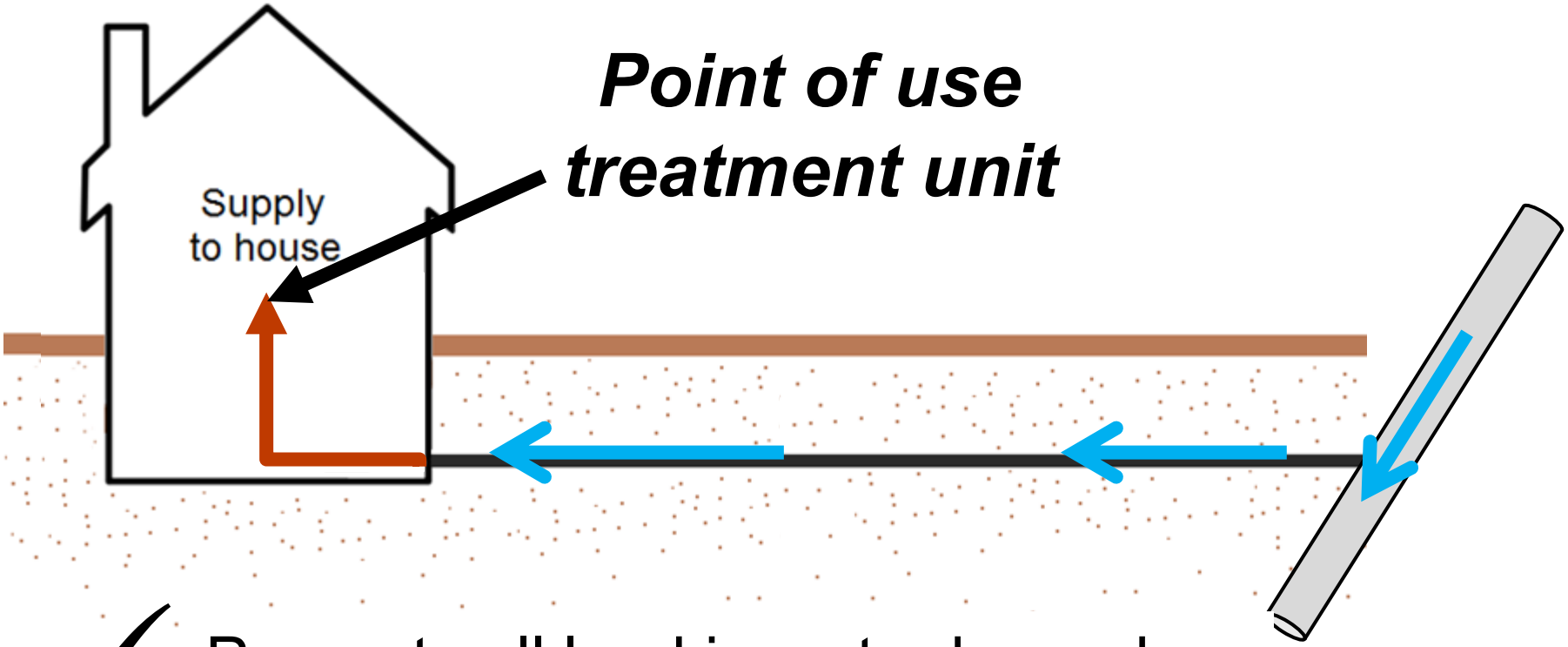


EPA acknowledged PLSLRs can increase water lead for weeks to years (EPA SAB 2011)

NOLA SURVEY: Water Use

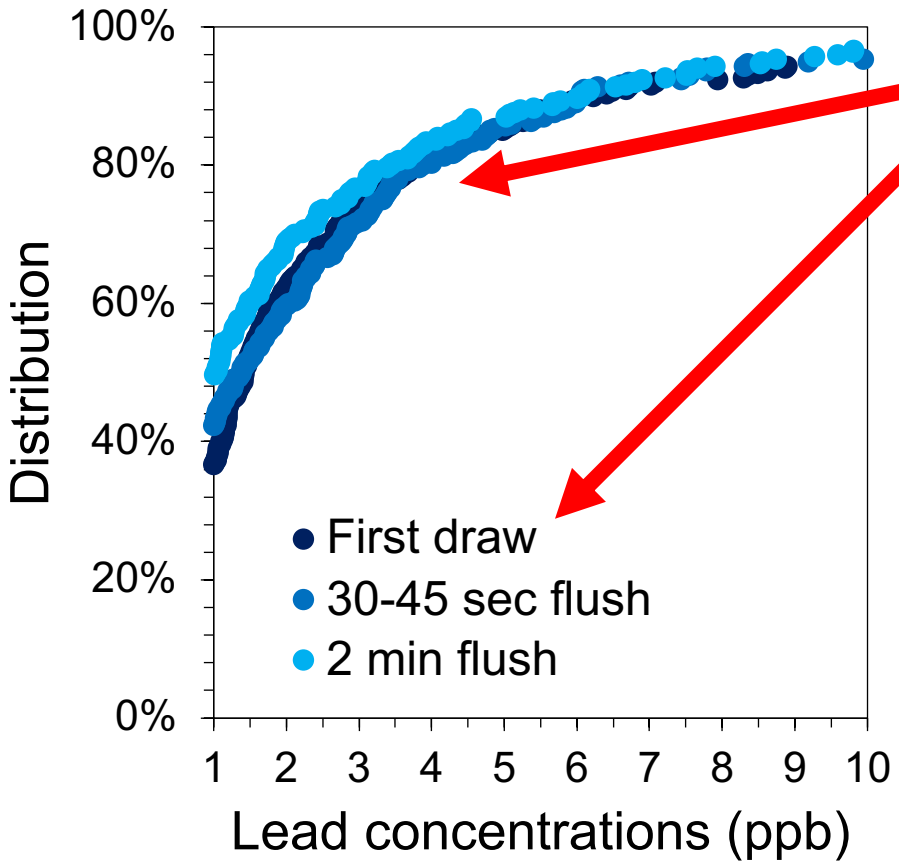
- **UNFILTERED WATER**
  - **93%** drink or cook with **unfiltered tap** (n=272)
    - **15** use unfiltered tap water for **baby formula**

POINT-OF-USE TREATMENT UNITS (E.G., REVERSE OSMOSIS)



✓ Prevents all lead in water hazards

Exposure Reduction Alternatives



New Orleans, LA water

Sustained low-levels of lead in water with flushing

What can low-income communities do?

38% of NOLA residents: household incomes **<$25k** (Census, 2015)

POINT OF USE FILTERS (POUS): FLINT, MI

VA Tech's <u>one sample</u> evaluation: POU **removed 99.85%** of the water lead from the **worst sample (13,200 µg/L**) resulting in filtered water with **20 µg/L lead**

POUs used in Flint, MI

HUD grant to test filters in high risk areas or under high risk conditions: high iron, post- PLSLRs & past filter lifetime

Our team's one sample ev

The POU removed 99.85% o
worst sample (13,200 µg/L)
with 20 µg/L lead

TAP-MOUNTED LEAD FILTERS

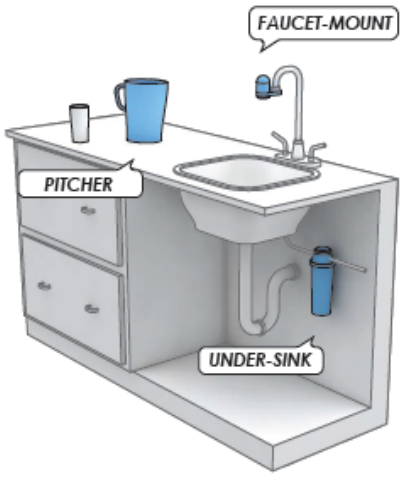
- These are low-cost options: **$15-**$50
  - Low-income families lack financial flexibility
- Replacement needs every 1-3 months depending on filter type

Educational needs with filters

LSU Educational Brochure: How to Select a Water Filter

Filter **LEAD** Out of Your Water.

Learn how to minimize your lead exposure by filtering your water.



LSUHealthNewOrleans
School of Public Health

Lead in water is a big problem in New Orleans and can cause bad health effects. Using a filter to clean your water helps to keep families healthy.

We recommend the: **Faucet Mount Filter**

The filter connects to the faucet using an adapter.

The adapter comes with the filter.

It will easily connect to most home faucets.

Most are effective and are inexpensive.

You can also buy the ***Under-Sink Filter***

The filter connects under the sink directly to the cold or hot water line.

You might need a plumber to install this one.

Do not buy the ***Pitcher Filter***

It is hard to find a certified pitcher filter.

They do not filter lead well.

Most filters can be found at stores like:
CVS, WALGREENS, WALMART, HOME DEPOT

Some **Faucet Mount Filter** options include:

$16.00	Brita Basic Faucet Filtration System Model: SAFF - 100
$20.00	PUR Basic w/ Maxion Filter Technology Model: FM-3333B
$26.00	Brita Complete Faucet Filtration System Model: FF-100
$30.00	PUR Advanced w/ Maxion Filter Technology Model: FM-3700B
$40.00	PUR Ultimate w/ Maxion Filter Technology Model: FM-9000B

NOTE, PRICES ARE APPROXIMATIONS.

When buying a filter, remember to
look for these labels.

NSF

The filter should be

NSF CERTIFIED 53 or 58

The box should say that it filters ***LEAD.***

If the label does not list ***LEAD,*** do not buy the filter.

Remember, there is no safe level of **LEAD.**

By filtering the water in your home you can keep your children healthy.

Know the health risks of lead exposure:

CHILDREN

- SHORT ATTENTION SPAN
  - This can lead to difficulty in school and lower grades.
- LEARNING DISABILITIES
  - This can lead to trouble understanding school subjects.
- BEHAVIORAL PROBLEMS
  - Your child could miss time in school.

PREGNANT WOMEN

- MISCARRIAGE
  - Your baby could die in the womb.
- PREMATURE BIRTH
  - Your child could have health problems.
- LOW BIRTH WEIGHT
  - Your child might be unhealthy and could be at greater risk for disease when older.

ADULTS

- MEMORY PROBLEMS
  - Parents can become forgetful.
- HIGH BLOOD PRESSURE
  - Can damage the heart and arteries.
- KIDNEY PROBLEMS
  - Irritate the body. Can cause fatigue and pains.

The LSU School of Public Health is conducting a study on lead exposure by providing those in need with a **free water test kit**. To find out how to get a free test kit, call or email the contact below:

Call:
E-Mail:

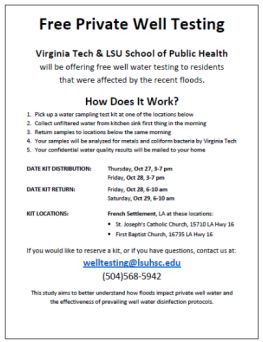
Take action by filtering your water.

Louisiana flood: Worst US disaster since Hurricane Sandy, Red Cross says

By Holly Yan and Rosa Flores, CNN

Updated 12:32 PM ET, Fri August 19, 2016

LSU-Health & Virginia Tech



Free Private Well Testing

Virginia Tech & LSU School of Public Health
will be offering free well water testing to residents
that were affected by the recent floods.

How Does It Work?

1. Pick up a water sampling test kit at one of the locations below
2. Collect unfiltered water from kitchen sink first thing in the morning
3. Return samples to locations below the same morning
4. Your samples will be analyzed for metals and coliform bacteria by Virginia Tech
5. Your confidential water quality results will be mailed to your home

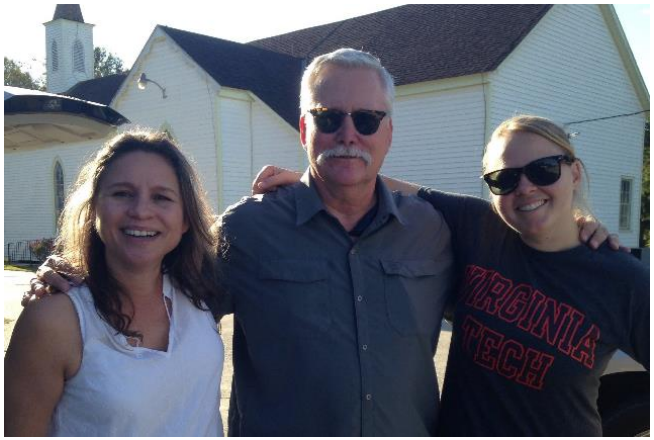
DATE KIT DISTRIBUTION: Thursday, Oct 27, 3-7 pm
Friday, Oct 28, 3-7 pm

DATE KIT RETURN: Friday, Oct 28, 6-10 am
Saturday, Oct 29, 6-10 am

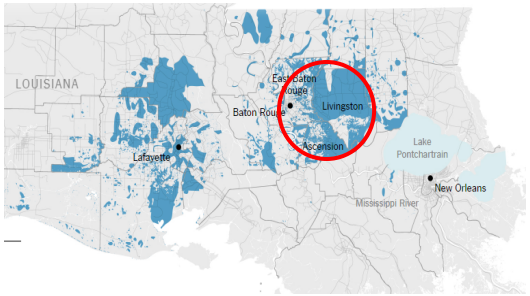
KIT LOCATIONS: French Settlement, LA at these locations:
- St. Joseph's Catholic Church, 15710 LA Hwy 16
- First Baptist Church, 16735 LA Hwy 16

If you would like to reserve a kit, or if you have questions, contact us at:
welltesting@lsuhsc.edu
(504)568-5942

This study aims to better understand how floods impact private well water and the effectiveness of prevailing well water disinfection protocols.



- **Target population:** Livingston Parish
  - 75% of parish flooded
  - 30% on wells

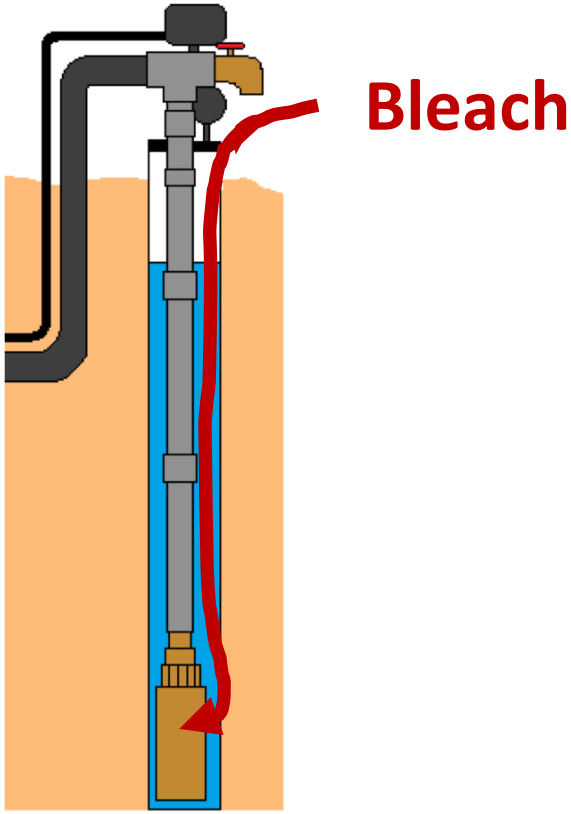


- **Study Criteria:** Flood-impacted well owners
- **Approach:** Distributed 150 free water collection kits & surveys to convenience sample of residents 9-10 weeks post-flood
- **Limitations:**
  - Could not verify study criteria met
  - Sample not representative
- **Response rate:** 75% (113 surveys)

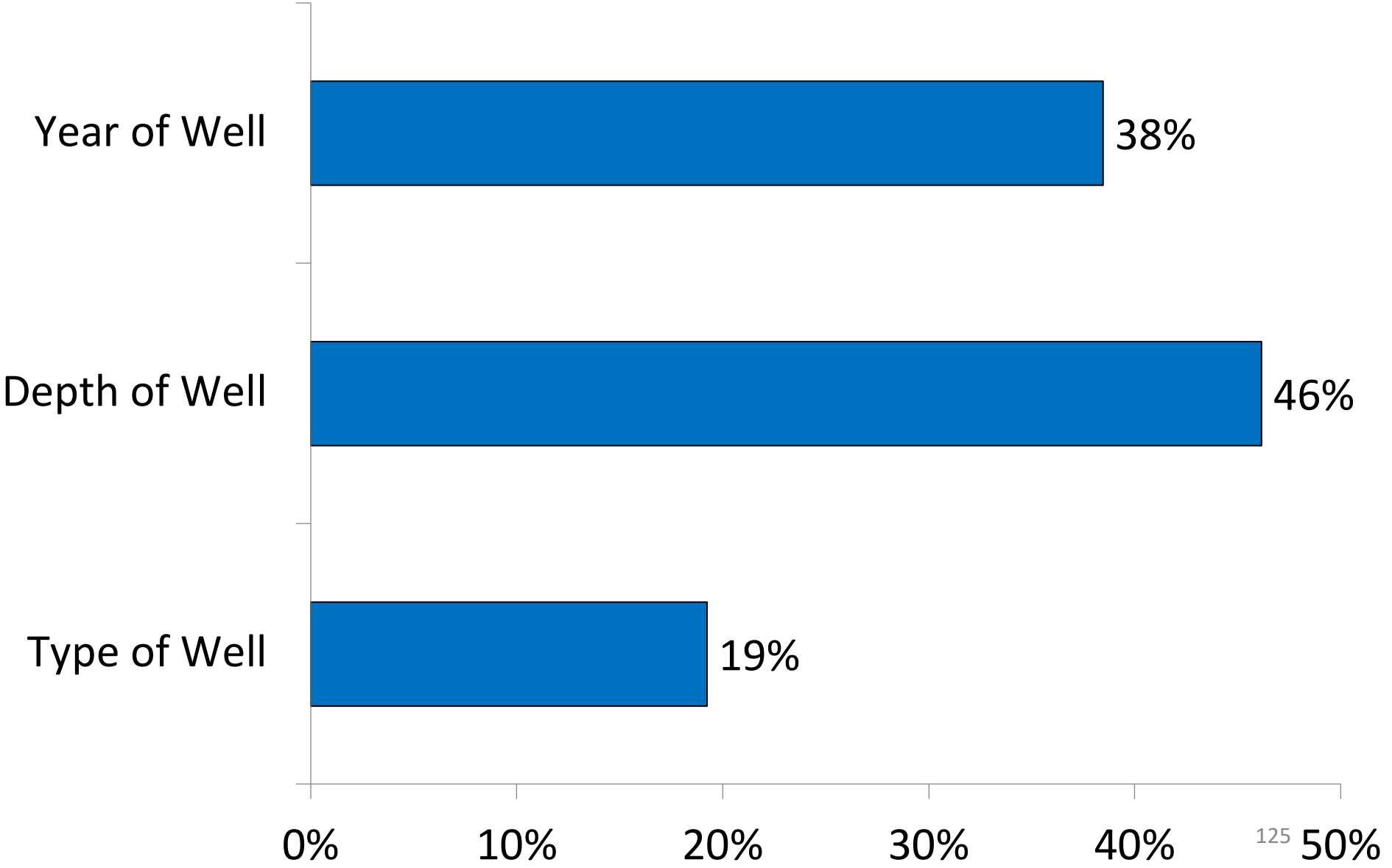
REMEDIATION IN EMERGENCY SETTINGS

No standard protocol or rigorous research investigating effectiveness

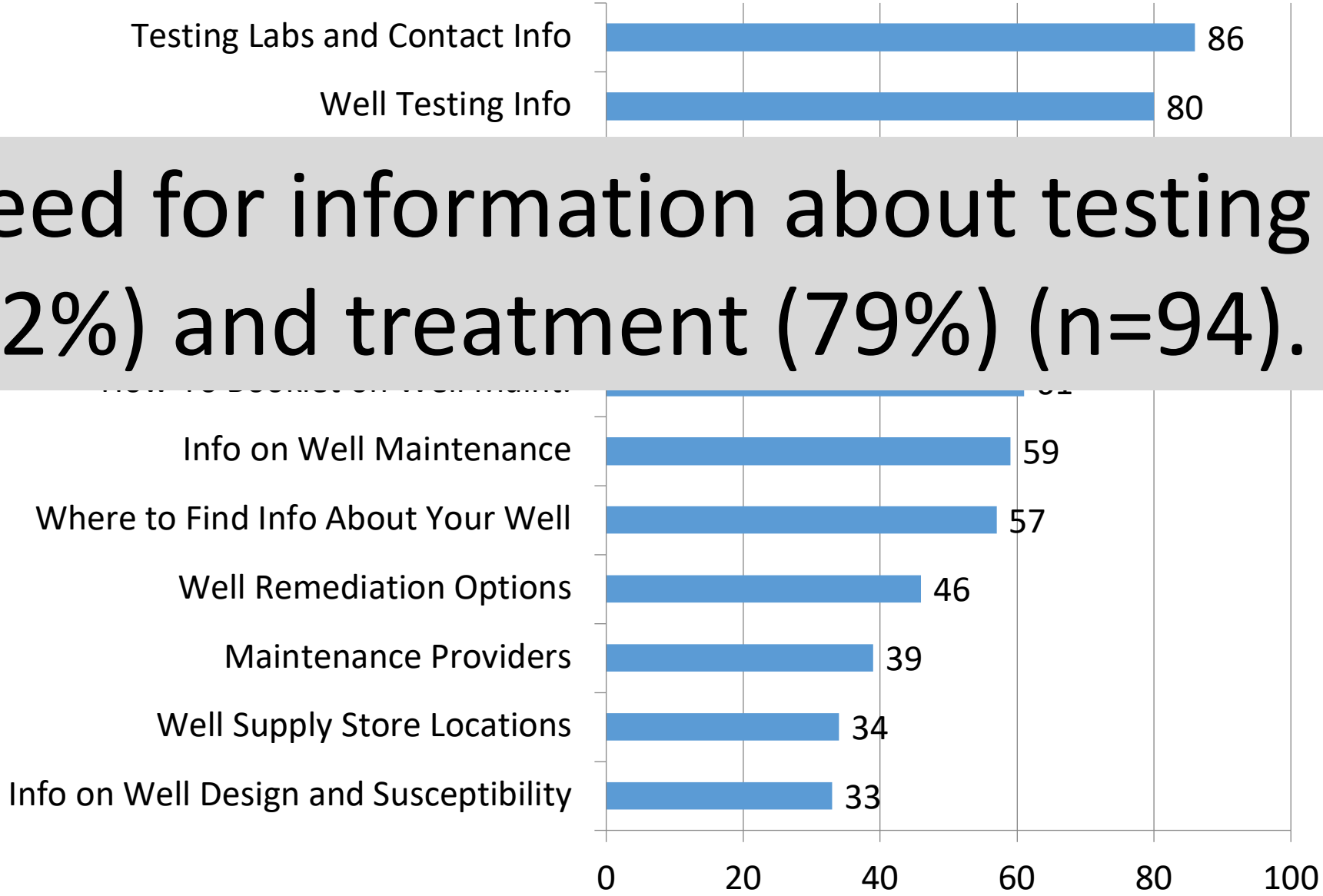
Similar practices in developing countries been proven to be ineffective



Don’t Know Well Characteristics



Information Wanted



Need for information about testing (92%) and treatment (79%) (n=94).

Screening and Case Management Guidelines for Health Care Providers

Children

- CDC's Guidelines: Managing Elevated BLLs Among Young Children (2002)
- Update (2005)
- Low Dose Lead Management (2007)
- Screening of Medicaid Children (2009)
- Update on BLL Reference Level (5 ug/dL) (2012)
- Low Level Lead Exposure Report (2012)

Pregnant & Lactating

Women

- CDC Guidelines: Guidelines for identification and management of lead Exposure in Pregnant and Lactating Women (2010)
- ACOG's Guidelines: Lead Screening During Pregnancy and Lactation (2012)