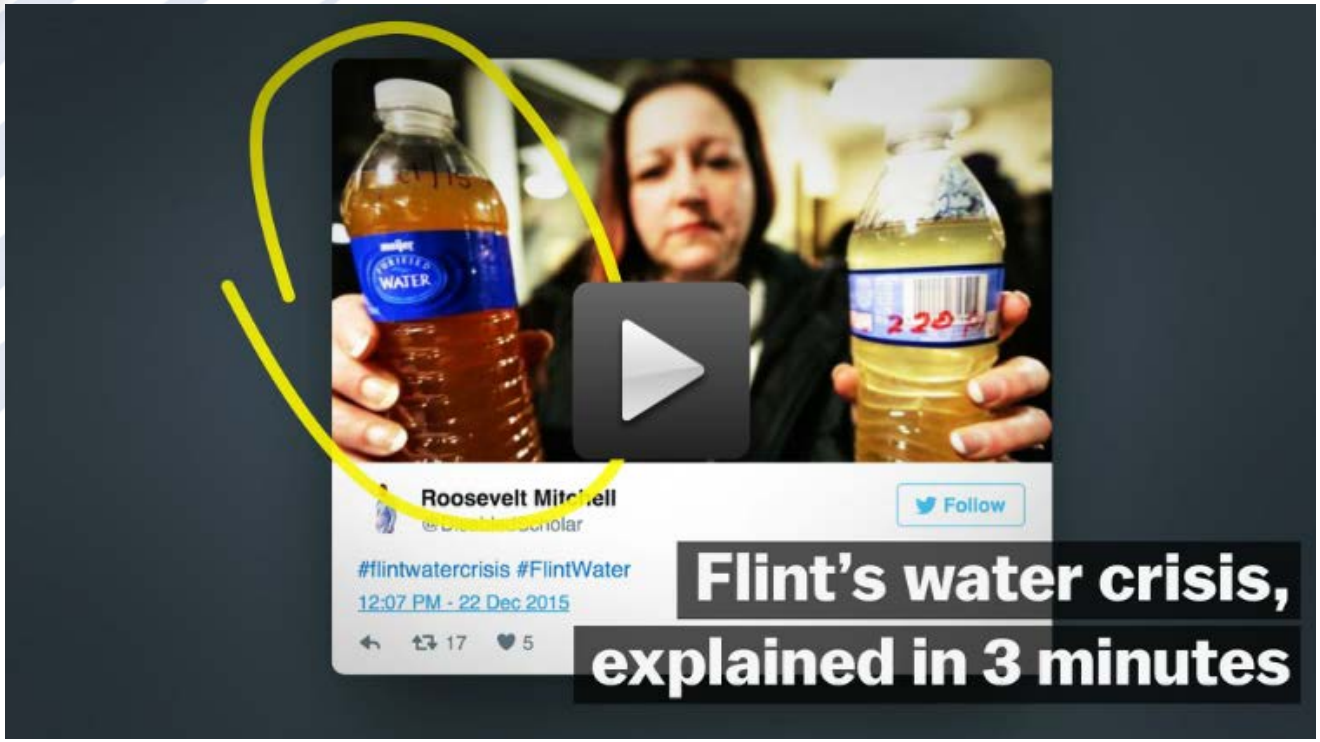
Water as a Source of Lead Exposure

Ohio Healthy Homes and Lead Poisoning Prevention Program

For the Ohio Lead Advisory Council on 2/25/2016

Summary of Flint, MI Lead in Water



Source: http://www.vox.com/2016/1/21/10811004/lead-poisoning-cities-us

Flint, MI: What went wrong

http://www.cnn.com/videos/us/2016/01/21/flint-michigan-water-crisis-ganim-dnt-ac.cnn

Lead in Water in Flint, MI

Elevated Blood Lead Levels in Children Associated With the Flint Drinking Water Crisis: A Spatial Analysis of Risk and Public Health Response

Mona Hanna-Attisha, MD, MPH, Jenny LaChance, MS, Richard Casey Sadler, PhD, and Allison Champney Schnepp, MD

Objectives. We analyzed differences in pediatric elevated blood lead level incidence before and after Flint, Michigan, introduced a more corrosive water source into an aging water system without adequate corrosion control.

Methods. We reviewed blood lead levels for children younger than 5 years before (2013) and after (2015) water source change in Greater Flint, Michigan. We assessed the percentage of elevated blood lead levels in both time periods, and identified geographical locations through spatial analysis.

Results. Incidence of elevated blood lead levels increased from 2.4% to 4.9% ($P<.05$) after water source change, and neighborhoods with the highest water lead levels experienced a 6.6% increase. No significant change was seen outside the city. Geospatial analysis identified disadvantaged neighborhoods as having the greatest elevated blood lead level increases and informed response prioritization during the now-declared public health emergency.

Conclusions. The percentage of children with elevated blood lead levels increased after water source change, particularly in socioeconomically disadvantaged neighborhoods. Water is a growing source of childhood lead exposure because of aging infrastructure. (*Am J Public Health.* 2016;106:283–290. doi:10.2105/AJPH.2015.303003)

See also Rosner, p. 200.

In April 2014, the postindustrial city of Flint, Michigan, under state-appointed emergency management, changed its water supply from Detroit-supplied Lake Huron water to the Flint River as a temporary measure, awaiting a new pipeline to Lake Huron in 2016. Intended to save money, the change in source water severed a half-century relationship with the Detroit Water and Sewage Department. Shortly after the switch to Flint River water, residents voiced concerns regarding water color, taste, and odor, and various health complaints including skin rashes.[1] Bacteria, including *Escherichia coli*, were detected in the distribution system, resulting in Safe Drinking Water Act violations.[2] Additional disinfection to control bacteria spurred formation of disinfection byproducts including total trihalomethanes, resulting in Safe Drinking Water Act violations for trihalomethane levels.[2]

Water from the Detroit Water and Sewage Department had very low corrosivity for lead as indicated by low chloride, low chloride-to-sulfate mass ratio, and presence of an orthophosphate corrosion inhibitor.[3,4] By contrast, Flint River water had high chloride, high chloride-to-sulfate mass ratio, and no corrosion inhibitor.[5] Switching from Detroit's Lake Huron to Flint River water created a perfect storm for lead leaching into drinking water.[6] The aging Flint water distribution system contains a high percentage of lead pipes and lead plumbing, with estimates of lead service lines ranging from 10% to 80%.[7] Researchers from Virginia Tech University reported increases in water lead levels (WLLs),[5] but changes in blood lead levels (BLLs) were unknown.

Lead is a potent neurotoxin, and childhood lead poisoning has an impact on many developmental and biological processes, most notably intelligence, behavior, and overall life achievement.[8] With estimated societal costs in the billions,[9–11] lead poisoning has a disproportionate impact on low-income and minority children.[12] When one considers the irreversible, life-altering, costly, and disparate impact of lead exposure, primary prevention is necessary to eliminate exposure.[13]

Historically, the industrial revolution's introduction of lead into a host of products has contributed to a long-running and largely silent pediatric epidemic.[14] With lead now removed from gasoline and paint, the incidence of childhood lead poisoning has decreased.[15] However, lead contamination of drinking water may be increasing because of lead-containing water infrastructures, changes in water sources, and changes in water treatment including disinfectant.[16–18] A soluble metal, lead leaches into drinking water via lead-based plumbing or lead particles that detach from degrading plumbing components. ("Plumbing" is derived from the Latin word for lead,

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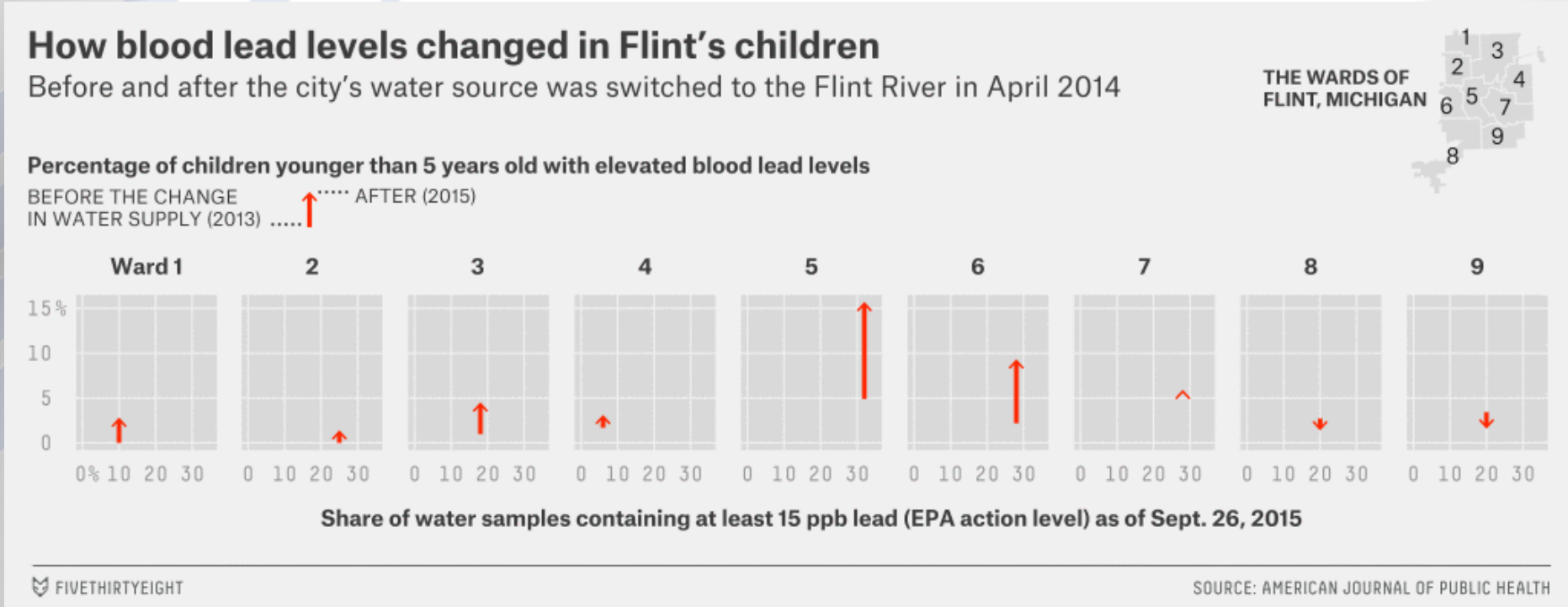
Lead in Water in Flint, MI



Lead in Sebring, OH

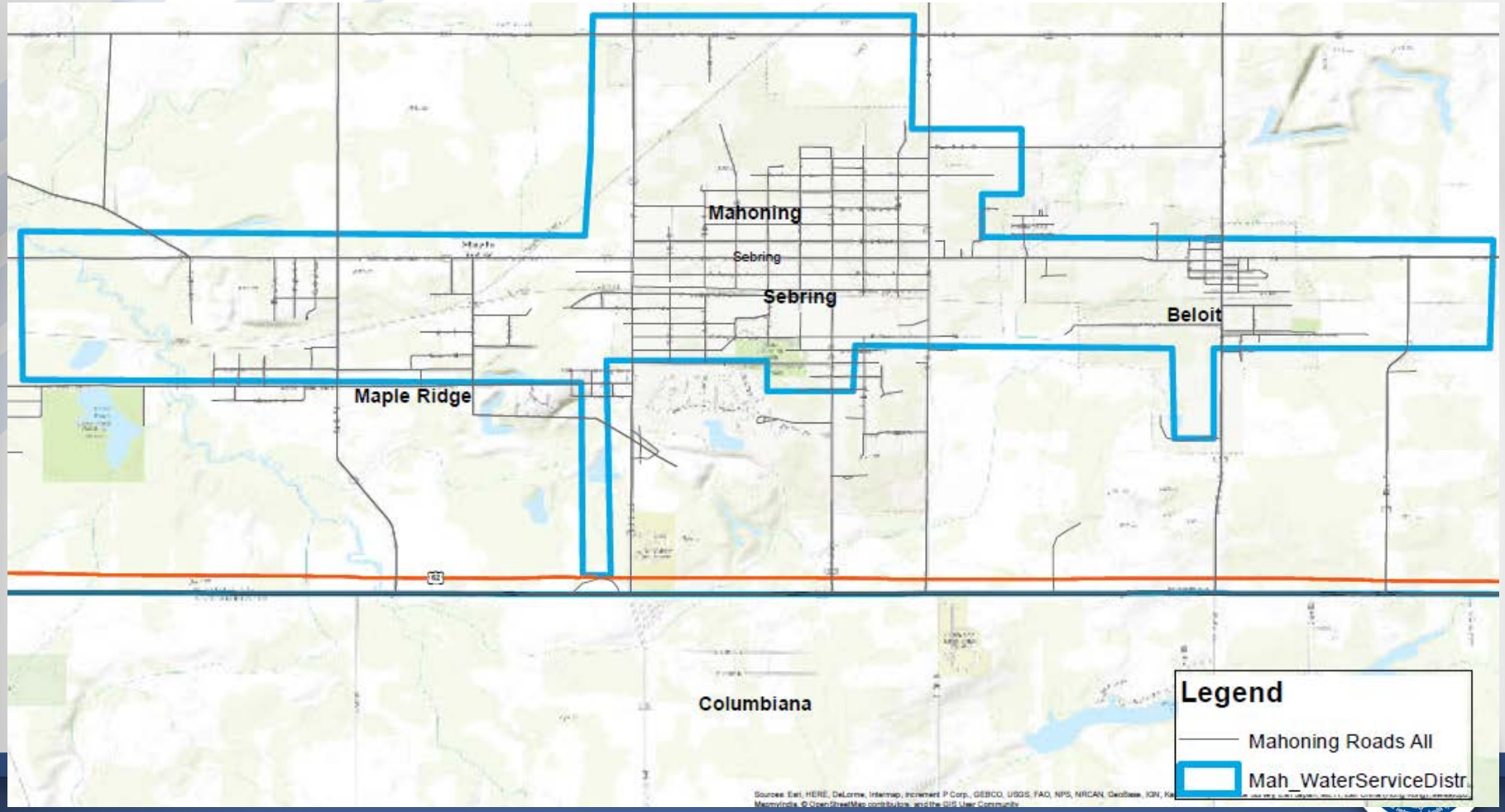
September 2015: Ohio EPA official expresses concern with Sebring water superintendent water testing.

October 2015: Ohio EPA identified lead in water triggering government response

December 2015: EPA sends letter to Sebring Village stating that public should have already been notified

January 2016: Sebring issues drinking water advisory

Sebring Water District



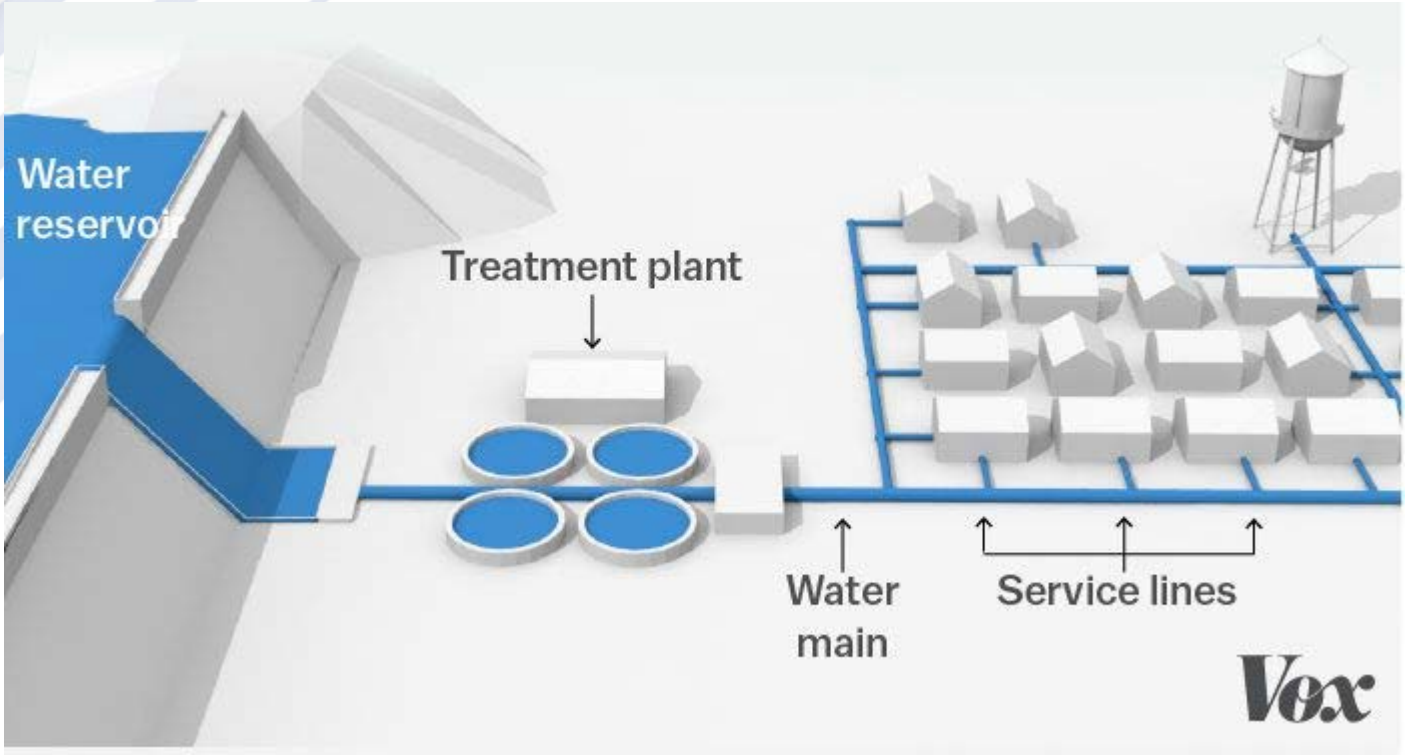
Sebring Testing Events

Lead Care II Analyzers available to test children and pregnant/lactating mothers for lead exposure

- 1/24/16, 2/1/16, and 2/3/16 Events
- 236 individuals received capillary test

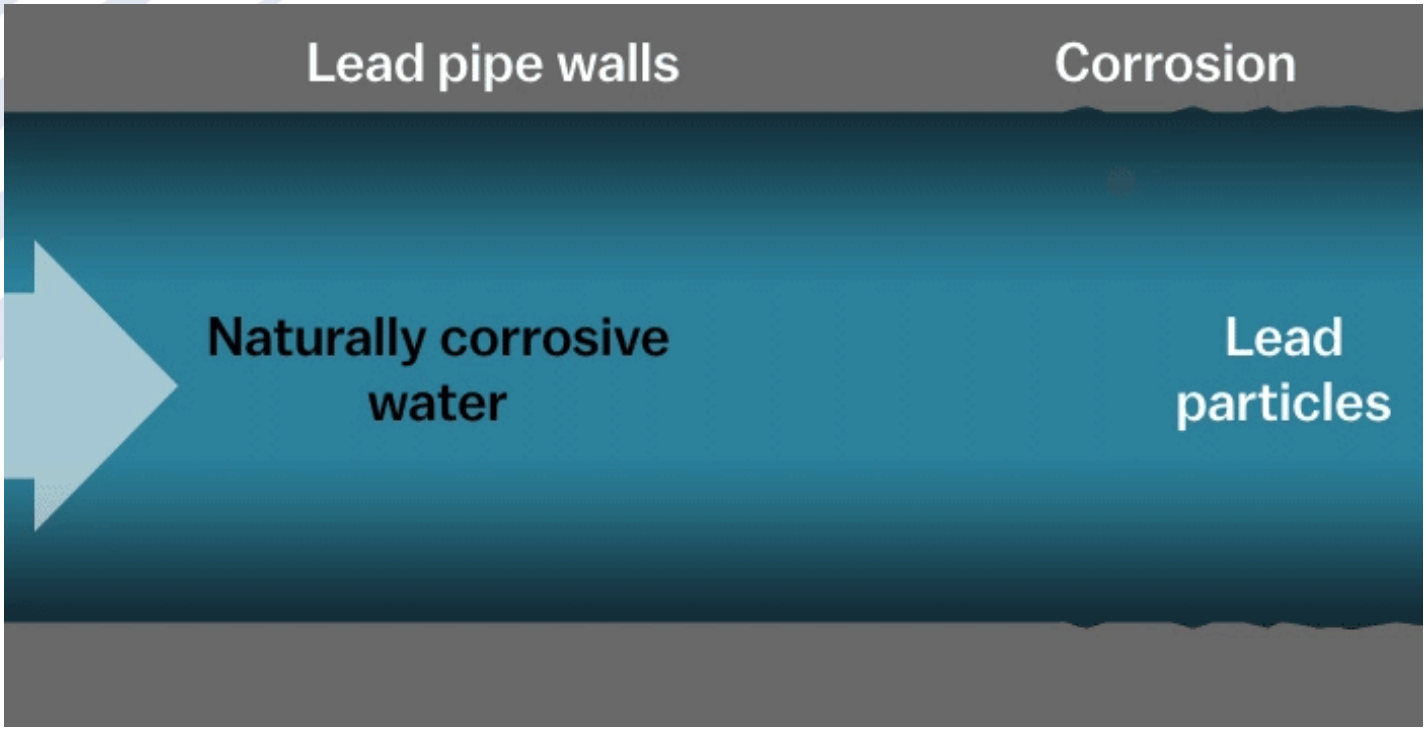
All testing since 1/1/2014 provided to CDC

Water System



Source: http://www.vox.com/2016/2/19/10972256/the-visual-guide-to-lead-poisoning

Corrosion



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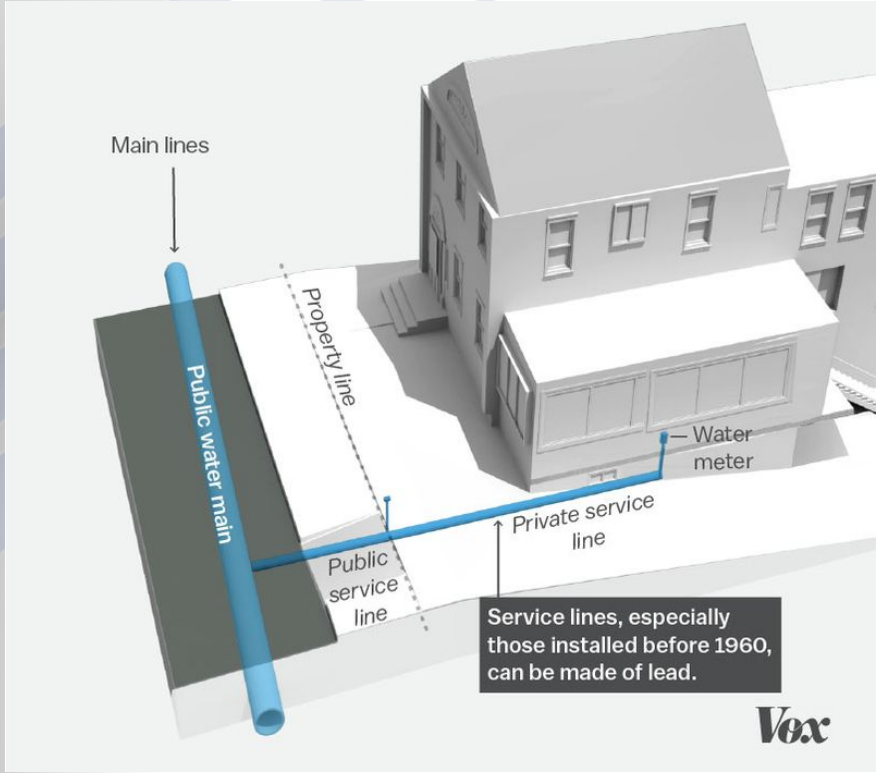
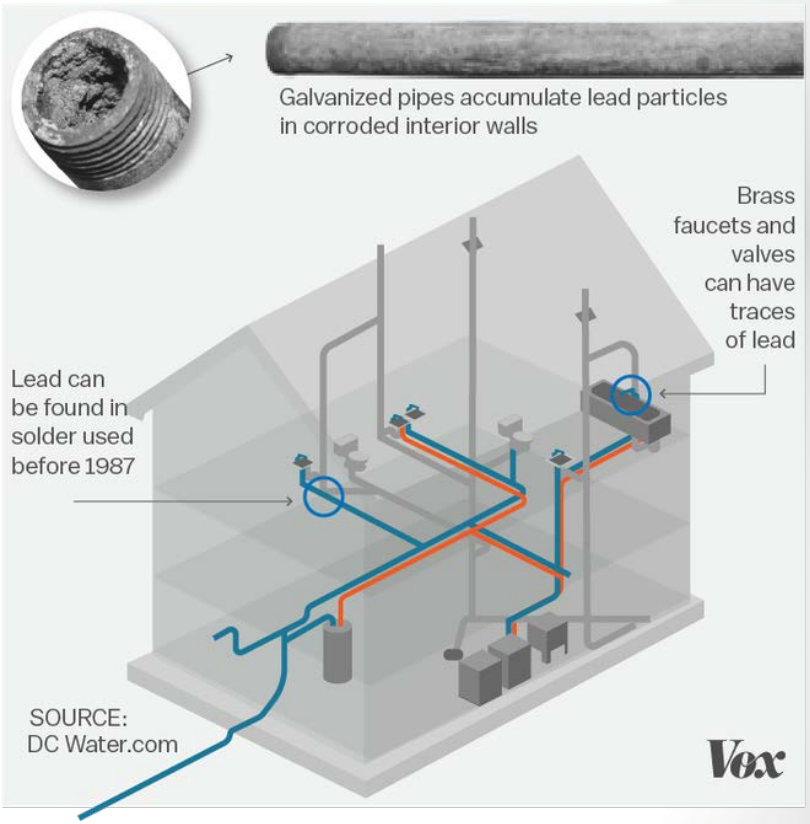
Lead in Service Lines and Home





Source: http://www.vox.com/2016/2/19/10972256/the-visual-guide-to-lead-poisoning

Factors Affecting Lead Release

- Mechanical disruption (plumbing work)
- pH—low pH increases corrosion and dissolution of scale
- Oxidation potential—oxidative environmental favors PbO_2 deposition

Lead and Copper Rule

- 1991 EPA regulation
- Updated most recently 2007
- Requires monitoring of customer taps—lead cannot be ≥15 ppb in 10% of taps or:
  - Implement corrosion control
  - Inform/educate public
- 15 ppb is the action level, there is no “safe” level

Ohio
Department of Health

LEAD LEVELS IN DRINKING WATER

The U.S. EPA has identified 15 parts per billion (ppb) as the action level for lead in drinking water. Pregnant women and children should not consume water that has tested above 15 ppb. Recognizing that protecting children from exposure to lead is important to lifelong good health, the Ohio Department of Health is offering the following guidance regarding confirmed lead levels in drinking water above and below the federal action level in homes and schools to prevent or minimize lead exposure.

RESIDENTIAL PARAMETERS FOR DRINKING WATER

Testing Level in Parts per Billion	
>15	Pregnant women and children should not drink the water
NON DETECT to ≤15	Minimize exposure: Filter appropriately, flush, use cold water
NON DETECT	No action

SCHOOL PARAMETERS FOR DRINKING WATER

Testing Level in Parts per Billion	
>15	Pregnant women and children should not drink the water Remove fixture or source (e.g., fountain, faucet)
NON DETECT to ≤15	Minimize exposure: Filter appropriately, flush, use cold water, remove fixture or source
NON DETECT	No action

To minimize lead exposure in residential and school settings, homeowners and school personnel are encouraged to explore and address all possible sources of lead, including:

- Lead pipes in plumbing: Dull gray in color and will appear shiny when scratched. Banned since 1986 and not widely used since the 1930s.
- Copper pipes joined by lead solder: Solder will be dull gray in color and will appear shiny when scratched. Banned since 1986 and many communities banned prior to 1986.
- Brass pipes, faucets, fittings and valves: May contain alloys of lead.
- Sediments in screens on faucets: Debris from plumbing can collect on screens and may contain lead.
- Water service line to residences and schools made of lead: Pipes that carry water from the municipal water system main to residences and schools may contain lead.
- Water fountains in schools may contain lead parts: Specific brands of water fountains contain lead parts or have lead lined water tanks. Since 1988, it has been mandated that water fountains be lead free but older schools may have outdated models.

Resources:

- Information (attached) adapted from "Drinking Water Best Management Practices For Schools and Child Care Facilities Served by Municipal Water Systems" (U.S. EPA)

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Medical Director, Ohio Department of Health

Rick Hodges, MPA
Director, Ohio Department of Health

New USEPA Guidance

- 2/29/2016
- New Sampling Recommendations
  - **No** removal and cleaning of aerators
  - **No** Pre-stagnation flushing
  - Wide-moth bottles

New Ohio EPA Guidance

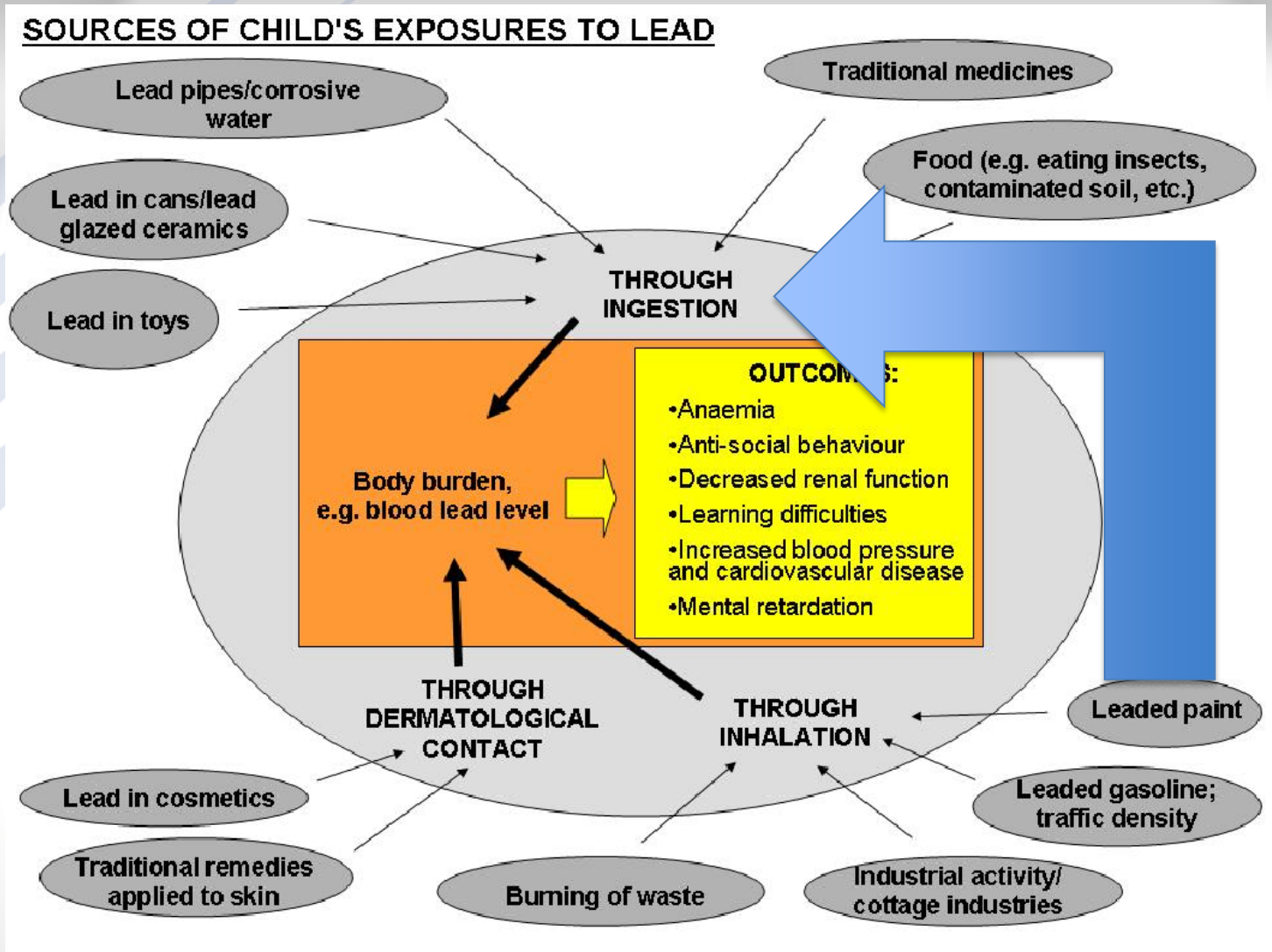
- 3/2/16
- Individual Results
  - Notification within 2 days for any result over 15 PPM (Notify Ohio EPA)
  - Notify LHD of individual results
  - Remove fixtures with results over 15 PPM
  - Additional sampling may be required and reported to Ohio EPA by end of the month

New Ohio EPA Guidance

- Action Level Exceedance
  - Public education via email or posting by next business day
  - Inform LHD by next business day
  - Additional sampling may be required and reported to Ohio EPA by end of month

Public Health Lead Investigations

- OAC 3701-30-07
- When the director becomes aware that an individual under six years of age has lead poisoning the director **shall** conduct a public health lead investigation to determine the source of the lead poisoning.
- Between 6 and 16 years of age: **may**



WHO (2011). *Childhood lead poisoning*. Geneva, World Health Organization (http://www.who.int/ceh/publications/leadguidance.pdf, accessed 13 March 2015)

Public Health Lead Investigations

- 5 µg/dL to less than 10 µg/dL
  - Complete comprehensive questionnaire (reviewed and approved by Public Health Lead Investigator)
  - Provide educational materials prescribed by the director

Public Health Lead Investigations

- 10 µg/dL or greater
  - Conduct on-site investigation of a residential unit, child care facility or school
  - Review records and reports
  - Comprehensive questionnaire
  - Visual assessment
  - XRF analysis of deteriorated paint
  - Analysis of non-property samples

Public Health Lead Investigations

- Public health lead risk assessment on one or more residential units, child care facilities or schools in accordance with:
  - OAC 3701-30-08
  - OAC 3701-32-07 (G)(1) to (G)(9)
  - U.S. Department of Housing and Urban Development Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing, 2nd Edition 2012

Public Health Risk Assessment

- XRF analysis & paint chip sampling
- Dust wipe sampling (floors & window sills)
- Soil sampling (areas of bare soil)
- **Water sampling (if warranted)**

Water Sampling for Lead Risk Assessment OAC 3701-30-07 (C)(2)(c)

First draw or flushed water samples for analysis, as appropriate, from the tap most commonly used for drinking water, infant formula, or food preparation. Water samples shall be collected in accordance with sample methods specified in paragraph (B) of rule 3745-81-86 of the Administrative Code.

Example

First draw

Sample Results:

Analyte	Analyte Code	Method Code	Results Sign	Results Value	Results Units
Lead, total	1030	200.9		21.7	ug/L

Flushed

Sample Results:

Analyte	Analyte Code	Method Code	Results Sign	Results Value	Results Units
Lead, total	1030	200.9		7.62	ug/L

Ohio Department of Health

Private Water Systems

Bureau of Environmental Health

"To protect and improve the health of all Ohioans"

Private Drinking Water

Lead in Drinking Water from Private Water Systems

Lead is a metal found in natural deposits and has been commonly used in household plumbing materials and water service lines.

While Lead is relatively uncommon in the ground water supplying private water system wells in Ohio, it can occur. In areas where lead is found in the ground water it is due to the localized geologic occurrence of lead bearing minerals in the aquifer.

In these areas, the construction and depth of the well completion may contribute to the levels of lead found in the groundwater supplying the well.

The more common source of lead in drinking water primarily occurs when water makes contact with plumbing materials and water service lines. Prior to the current knowledge of the health hazards of lead, it was widely used in products such as gasoline, paints, batteries, metal products and ammunition -- just to name a few.

What are the Drinking Water Standards?

The US EPA has no established maximum contaminant level (MCL) for lead in drinking water from public water systems but has instead established a lead action level of 0.015 mg/L or 15 parts per billion (ppb) for public water systems.

For source water supplied by private water systems, the Ohio Department of Health's Residential Water and Sewage Program recommends that owners of private water systems take action to remove the lead or reduce the levels of lead when levels are detected above 15 ppb. If the cause of the lead problem is not from the source water aquifer, contact the Ohio Department of Health Lead Poisoning Prevention Program at (877) 668-5323 or (614) 466-1450 or lead@odh.ohio.gov.

What are the Health Effects?

For information about the health effects of lead visit the Lead Poisoning Prevention Program Web pages for:

Lead Poisoning – Children: (http://www.odh.ohio.gov/odhprograms/cfhs/lead_ch/leadch1.aspx)

Lead Poisoning Surveillance – Adults: (http://www.odh.ohio.gov/odhprograms/hprr/l_adult/leadadults.aspx)

How can the plumbing put lead into the drinking water from my private water system?

There are several **potential risk factors** that affect how much lead can get into your drinking water:

1) The type of plumbing materials, fixtures, and water lines used.

- Because lead is toxic, its use in the U.S. has been dramatically reduced since the 1980s. Homes built before 1986 are more likely to have lead pipes, fixtures and solder. However, new homes are also at risk: even legally "lead-free" plumbing may contain up to 8 percent lead. The most common problem is with brass or chrome-plated brass faucets and fixtures which can leach significant amounts of lead into the water, especially hot water.

2) The amount of time the water stays in the pipes.

- The longer the water sits in the pipes without being used, the more likely lead can be leached into the water.

3) The pH (acidity or alkalinity) of the water.

- Corrosive water (which has a very high or very low pH) can dissolve lead from the supply pipes, faucets, or solder and flux used to connect copper pipes. See the Private Water Systems Program Web page on pH for more information (http://www.odh.ohio.gov/en/odhprograms/eh/water/quality_treatment/pH.aspx).

http://www.odh.ohio.gov/odhprograms/eh/water/PrivateWaterSystems/quality.aspx

Lead-Contaminated Water Pipe Control Options 3701-30-10 (B)(6)

(a) Removal of plumbing fixtures and replacement with lead-free fixtures;

(b) Any other lead safe method of permanently removing the lead hazard as approved by the director; or

(c) Flushing of water lines that are used for drinking or cooking for a minimum of one minute when water has not been used for at least six hours.