



# Lead in Drinking Water

## Executive Summary

The use of lead in plumbing was not federally prohibited in the U.S. until 1986. As a result, many existing household water service lines still contain lead. Lead service lines are more commonly found in older cities and houses built before 1986. Lead can leak from pipes via corrosion into the water supply. While most contaminants are detected and treated at a water treatment facility, this does not protect against contamination that enters the water supply while it travels to its final destination. Permanent solutions to reduce lead exposure include replacing lead service lines and can cost from \$1,200 to \$12,300 for the entire line according to the Environmental Protection Agency (EPA). A less permanent solution is to treat water to be less corrosive. The EPA has also shown that, when properly installed and used, filters designed for lead removal are effective at removing lead. In the 2022 Missouri Legislative Session, three bills have been introduced ([HB 2532](#), [HB 2610](#), [SB 1075](#)) that aim to lower the levels of lead in school drinking water sources to one part per billion.

## Highlights

- Nearly every organ of the body can be adversely affected by lead toxicity.
  - Long-term exposure to lead can result in **decreased cognitive performance**, and in children it can cause **behavioral problems, learning deficits, lower IQs, and overall severe brain damage**.
- The EPA estimates that 20% of a person's lead exposure comes from drinking water.
- Between 792,000 to 1,188,000 people in Missouri may be affected by lead service lines.
- Children are especially vulnerable to lead intake as their organ tissues are generally softer and in the developing stage; one study found over 80% of Missouri children tested had detectable levels of lead.
- Black children are three-times more likely to have elevated levels of lead in their blood than White children; children in poverty are twice as likely to have elevated blood lead levels.

## Limitations

- Detailed maps of the locations of lead service lines are not available.

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## Research Background

### Common Lead Exposures

Lead is an important heavy metal in commercial and industrial uses, but is toxic to humans

*MOST Policy Initiative, Inc. is a nonprofit organization that provides nonpartisan information to Missouri's decision-makers. All legislative Science Notes are written only upon request by members of the General Assembly. **This Science Note was published on 4/17/2022 by Dr. Ramon Martinez III, Health & Mental Health Policy Fellow and Dr. Tomotaroh Granzier-Nakajima, Energy & Environment Policy Fellow -** [ramon@mostpolicyinitiative.org](mailto:ramon@mostpolicyinitiative.org), [tomotaroh@mostpolicyinitiative.org](mailto:tomotaroh@mostpolicyinitiative.org).*

even at low levels of exposure. In recent history, humans have been exposed to lead via leaded gasoline, smelting, pottery, boat building, lead paints, batteries, the arms industry, book printing, and lead piping.<sup>1</sup>

**The U.S. Environmental Protection Agency (EPA) estimates that 20% of a person's lead exposure comes from drinking water.**<sup>2</sup> Most contaminants in public water supplies are detected and treated for at a water treatment facility.<sup>3</sup> However, this does not help with the management of contamination that enters the water supply after it has left the treatment facility. The pipes that connect a home to the water main are sometimes made of lead, and are commonly known as lead service lines (LSLs). These pipes are often the most significant source of lead in drinking water.<sup>2</sup> Ownership of water service lines varies by the community and can be wholly or partially owned by the property owner or the community water system that provides water services. Other sources of lead exposure in drinking water include brass or chrome-plated brass faucets and plumbing with lead solder.

LSLs were regularly used until the 1930s when concern over lead started to grow. In 1986 the [Safe Water Drinking Act](#) was amended to prohibit the use of plumbing that contained lead and in 1996 this was expanded to include fixtures as well.<sup>3</sup> Many homes, particularly those in older cities or built before 1986, still use LSLs for their household water usage.<sup>2,3</sup>

According to the EPA, there are somewhere between 6.3 million to 9.3 million LSLs in the U.S.<sup>3</sup> One study from 2016 estimated that each LSL serves 2.4 to 3.6 people, impacting 15 million to 22 million people nationally.<sup>4</sup> Missouri is estimated to have the 6<sup>th</sup> largest amount of LSLs in the nation, with approximately 330,000 LSLs. **Applying the same estimation to Missouri, between 792,000 to 1,188,000 people in the state are affected by LSLs.**

### **Lead Leakage into the Water Supply**

Lead can enter the water supply when plumbing and fixture materials containing lead corrode.<sup>2,3</sup> This is especially likely when the water is acidic or has a low mineral content. Several factors affect the amount of lead introduced into the water supply as a result of corrosion including: the acidity of the water; the presence of different minerals in the water; the water temperature; the amount of lead in plumbing and fixture materials; water use patterns; and the presence of protective mineral coatings that have accumulated on the interiors of pipes. Residents in Flint, Michigan saw large increases in the amount of lead in their water after the city switched water sources in 2014. A primary reason for this was due to the lack of a corrosion control treatment with the new water source, which resulted in a more corrosive water supply, releasing high levels of lead from LSLs.<sup>5</sup>

### **Toxicity of Lead**

When drinking contaminated water, between 20–70% of the lead present in the water can be absorbed into bones and organs. Nearly every organ of the body can be adversely affected by lead toxicity, which can result in anemia, increased blood pressure, kidney damage, miscarriage,

reduced fertility, blood disorders, and most of all, neurological damage. **Long-term exposure to lead can cause decreased cognitive performance, and in children it can cause behavioral problems, learning deficits, lower IQs, and severe brain damage.** Children are especially vulnerable to lead intake as their organ tissues are generally softer and more susceptible during early developmental stages. Because lead acts as a potent developmental neurotoxin, exposures should be avoided, as post-exposure treatments cannot reverse the cognitive effects of lead.<sup>1,6</sup>

One study found that more than 80% of Missouri children tested have detectable levels of lead in their blood, and nearly 5% had a level considered to be elevated and medically harmful.<sup>7</sup> Further, roughly 1 in 5 (or 535,000) children enrolled in the U.S. Medicaid program have elevated levels of lead in their blood that are likely to cause health damage.<sup>8</sup> These children are entitled to lead screenings at 12 and 24 months of age, or before the age of 72 months if not already performed, and subsequent treatments may be available.

### Disproportionate Impacts of Lead Exposures

**Children in poverty are twice as likely to have elevated blood levels of lead. Additionally, Black children are three-times more likely to have elevated blood levels of lead than White children.**<sup>9</sup> Black American homes are more likely to have lead exposure hazards, such as lead based paint (45% Black versus 31% White).<sup>10</sup> One study based in Chicago found over twelve year period, children from Black-majority neighborhoods consistently had higher blood-lead levels than White-majority neighborhoods.<sup>11</sup> Black Americans are also 1.5 times as likely to be uninsured compared to White Americans, and Hispanics are 2.5 times as likely to be uninsured, reducing the likelihood of lead health screenings and treatments.<sup>9</sup>

### Treatments for Lead Exposures

There are several methods of treatment for lead exposures. One commonly used treatment for short-term over-exposures is *chelating agents*, which reduce the amount of heavy metals from the soft tissues and body fluids. However these can also cause liver and kidney toxicity, as well as headaches, nausea, and high blood pressure, and therefore should not be used long-term. Certain dietary supplements, such as antioxidants and vitamins like B6, B1, C, E, certain flavonoids present in fruits and vegetables, and certain herbs such as garlic and curcumin, may help alleviate the symptoms of long-term exposures. However, long-term studies of the effectiveness of these compounds are still needed.<sup>12</sup>

### **Mitigation Strategies**

LSL replacement is a permanent solution to remove a source of lead exposure from the water supply, but there are several challenges to replacing all LSLs. For example, community water systems and individuals can face financial barriers towards replacing LSLs. The EPA states that the cost of replacing a single LSL ranges from \$1,200 to \$12,300 per line.<sup>3</sup> Additionally, some LSLs are partially owned by a property owner. Therefore, if the property owner is unable or unwilling to replace their LSL, then only a partial replacement is possible and lead may still leach into the water.

There are also water treatment options that water systems can undergo to attempt to decrease the release of lead. The EPA provides [technical recommendations](#) for identifying and evaluating optimal corrosion control treatments. Among these recommendations are adjusting the pH (i.e., acidity) of the water and introducing corrosion inhibitors to the water, such as silicate and phosphate-based inhibitors.

At the individual level, the Centers for Disease Control (CDC) and EPA provide several recommended actions that can reduce lead exposure including:<sup>2,13</sup>

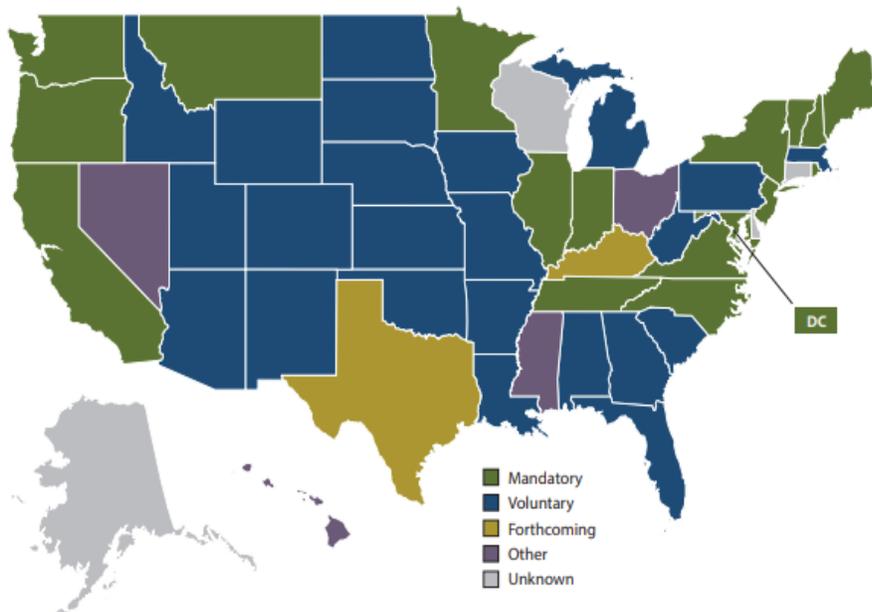
- 1) **Find out if you have a LSL.** To identify one's own risk of exposure, a person should find out if they have a LSL by contacting their water utility or a licensed plumber.
- 2) **Flush your home's water.** Before drinking or cooking with water, the CDC and EPA recommend flushing your home's pipes by running water before use, especially if the water has been sitting in the pipes for more than 6 hours. The recommended flush time depends on the length of the LSL.
- 3) **Use cold water from the tap** for drinking, cooking, and making baby formula. Warm or hot tap water can have higher levels of lead.
- 4) **Use bottled water or a filter** that has been independently tested or certified for lead removal. The former option may not be reasonably cost-effective for long-term use however. An EPA study found that, when properly installed and used, filters designed for lead removal are effective at removing lead from water.<sup>14</sup>

## Federal and State Legislation

In the 2022 Missouri Legislative Session, three bills have been introduced ([HB 2532](#), [HB 2610](#), [SB 1075](#)) that aim to lower the levels of lead in school drinking water sources to one part per billion (as recommended by the American Academy of Pediatrics). These aims include installing filters, annual water testing, requiring the Department of Elementary and Secondary Education to report on the findings of water tests and inform students and families on the health effects of lead, and to utilize various federal resources (such as the 2021 [American Rescue Plan Act](#)) to reimburse the installation projects, with disadvantaged schools among the priority for projects.

At the federal level, the [Safe Drinking Water Act](#) enacted in the mid-1970s has authorized the EPA to control lead and more than 90 other contaminants in public water supplies.<sup>15</sup> A 1986 amendment explicitly prohibited the use of lead pipes and solder. The EPA, while having a working goal of zero lead in drinking water, has a threshold of 15 parts per billion (ppb) before acting under the [Lead and Copper Rule of 1991](#).<sup>16</sup> The [2020 Lead and Copper Revisions](#) further established priority efforts, including requiring water systems to establish an inventory of lead service lines (LSLs) within three years, finding and replacing sources of lead when tests exceed 15 ppb, controlling corrosion, notifying households if tests exceed 15 ppb, developing targeted and procedural sampling methods for schools and care facilities, and replacing municipal lines if private properties have replaced their portions.<sup>15</sup> The 2016 [Water Infrastructure Improvements for the Nation](#) (WIIN) Act also allocated funding through the EPA for lead testing for schools and care facilities.

At the state level, several types of measures have been passed that enforce testing requirements and aim to lower societal lead exposures (Figure 1).<sup>17</sup>



**Figure 1: State Rules for Testing Lead in Water.** Eighteen states (in green) have mandatory statewide testing requirements for water utilities, while a further 23 (in blue) have a voluntary testing program. Four states have programs that fall into neither a mandatory or voluntary category (in purple) while four others have no publicly available information. Map reproduced from the National Association for State Boards of Education.<sup>17</sup>

One response measure (such as in VA and NJ) requires homeowners and/or real estate brokers to disclose the presence of lead in plumbing fixtures to prospective buyers. Further, several states (including CA, IL, LA, MN, NH, VA, and MO; RSMo § [701.200](#)) require school districts to report elevated levels of lead above the EPA standard to parents and/or the state when detected in school drinking sources.

Some states (including MD, NC, and VA) have modified the threshold for when to take lead mitigation actions and how often for municipalities or school districts to test water sources. Other states (such as DE and UT) have further sought to require lead screening for children at early stages and increase education to parents regarding lead exposure.<sup>15</sup> **Importantly, while many states require mandatory reporting of elevated lead levels, some states (such as MO) do not outright require regular intervals for testing or mitigation action plans.**<sup>17</sup> However, Missouri and several other states (such as TN, WI, NJ, NY, CT, and ME) have approved Medicaid or other healthcare provider incentive programs for targeted screening of lead of at-risk populations and directed health services for children.<sup>18</sup>

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