



Lead and Drinking Water: Information for Health Professionals Across the United States

This fact sheet was developed to help health care professionals respond to concerns about potential exposures to lead in drinking water across the United States.

Key messages to share with families include:

- The primary source of childhood lead exposure in the US is from lead in dust and soil from deteriorated paint in pre-1978 housing.
- Drinking water in the US is typically not the major source of exposure to lead.
- Given the known health hazards related to lead, lead in water is regulated. If you have concerns about lead in drinking water, contact your local health department.
- Flush water pipes for up to 2 minutes before drinking or drawing water, this is especially important when preparing baby formula.

Background

- No measureable level of blood lead is known to be without deleterious effect. In 2012, the Centers for Disease Control and Prevention (CDC) established a new “reference level” for blood lead levels ($\geq 5 \mu\text{g/dL}$), thereby lowering the level at which evaluation and interventions (public health and clinical) are recommended.
- The National Toxicology Program and U.S. Environmental Protection Agency’s (US EPA) Lead Integrated Science Assessment both concluded that adverse neurodevelopmental cognitive impacts occur at blood lead levels less than $5 \mu\text{g/dL}$. New findings also suggest that the adverse health effects of chronically elevated blood lead levels (BLLs) extend beyond cognitive effects to include cardiovascular, immunologic, reproductive, developmental, and endocrine effects. Clinically overt effects such as anemia, abdominal pain, nephropathy, and encephalopathy may occur at BLLs as low as $45 \mu\text{g/dL}$ and are more likely as BLLs increase.
- Lead paint and contaminated dust/soil are the highest dose sources of lead for US children.
- **US EPA estimates that drinking water can make up 20 percent or more of a person’s total exposure to lead. The contribution of exposure to lead from drinking water can be higher for young infants who consume mostly mixed formula.**

At-Risk Populations:

- Children less than six years old, including the developing fetus, are especially vulnerable to health problems from lead exposure.
 - As defined by the CDC, children who are members of racial-ethnic minority groups, live in poverty, in substandard housing, are recent immigrants, and have parents exposed to occupational sources of lead are disproportionately at higher risk of lead exposure.

- Formula-fed infants who are exposed to lead through contaminated tap water are at higher risk because they consume large volumes of formula relative to their body size. Lead levels in breast milk tend to be low; breast milk is highly nutritious and the best choice for most babies.
- Water may be an important source of lead exposure in some communities with lead service lines and unsatisfactory corrosion control. A study conducted by Hanna-Attisha et al. indicates that as much as 50% of lead intake was from water during a 14-month exposure window in Flint, Michigan.

What factors affect how much lead gets into drinking water?

Type of plumbing materials:

- **Homes built before 1986 are more likely to have pipes, fixtures, or solder that contain lead.**

Newer homes may also present a risk: until recently, approved “lead-free” plumbing fixtures may have contained up to 8% lead. As of January 2014, changes to the Safe Drinking Water Act have further reduced the maximum allowable lead content of pipes, pipe fittings, and plumbing fittings to 0.25%.

- Lead can be included in plumbing materials from the water service main to the property line and/or to the internal household plumbing (Figure 1).
- Families can identify if they have a lead service line by inspecting their own plumbing, hiring a plumber, or calling their water provider. Lead service lines are generally a dull gray color that are very soft and are easily scratched with a key.
- **Construction and repair work** on supply and distribution lines can increase water lead content.
- **Corrosiveness of water:** Lead can enter drinking water through corrosion of plumbing materials, especially where the water has high acidity or low mineral content.
- **Length of time water stands in pipes:** Lead can build up in tap water when water stands in the pipes for an extended duration, such as for six hours or longer.

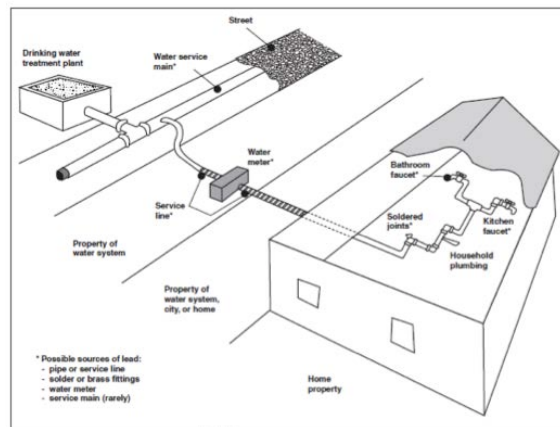


Figure 1. Water Distribution System from the Treatment Plant to Household Plumbing.

Source: GAO. 2006. www.gao.gov/assets/250/248883.pdf

How do I counsel a family about identifying if lead is in their drinking water?

- The US EPA regulates lead in public water supplies with more than 50 customers under the Safe Drinking Water Act Lead and Copper Rule, which requires certain actions by municipal water utilities when more than 10% of customer taps sampled have a lead concentration that exceeds 15 parts per billion (ppb). The 15 ppb action level is an administrative tool to evaluate and mitigate community level exposure; it is not a health-based standard.
- Clinicians should recommend families learn more about the water coming into their home. US EPA requires all community water systems to prepare and deliver an annual drinking water quality report entitled Consumer Confidence Report for their customers (<http://www.epa.gov/ccr>).

- Homes may have internal plumbing materials containing lead. At a minimum, clinicians should encourage families to discuss the need for water testing with local public health officials when certain risk factors are present (e.g., infants on formula made with tap water). These agencies may provide lead testing at low cost. A list of certified laboratories are available from state or local drinking water authorities. In Table 1, there are references to help locate these laboratories; alternatively, contact the State Drinking Water Officer or the EPA Safe Drinking Water hotline at 1-800-426-4791.
- The US EPA does NOT recommend water test kits available at local hardware stores.

How do I counsel a family if they have well water?

- Over 15 million U.S. households (approximately 15 to 20 percent of Americans) rely on private water wells for drinking water.
- Pediatricians should ask whether a family drinks water from a private well. Households that use private wells should take special precautions to ensure the safety of their drinking water supplies, with minimum of annual testing and more frequent testing as indicated based on well and household changes requiring repeat of baseline tests. Further guidance can be found at <http://pediatrics.aappublications.org/content/123/6/1599.full>

How do I counsel a family about lead in drinking water in schools or childcare facilities?

- Schools and childcare facilities that meet the definition of a public water system are regulated under the Lead and Copper Rule and may be included as sampling locations. Regulations ensure that licensed childcare facilities with 25 or more children and staff must comply with drinking water standards even if the facility has an individual water supply such as a private well.
- We advocate for states and local jurisdictions to establish additional programs for testing for lead in drinking water and other medium in schools and to develop a coordinated health messaging response for families. US EPA has developed a toolkit to assist school and childcare facilities to address lead in drinking water in their local communities available at <https://www.epa.gov/dwreginfo/training-testing-telling-3ts-full-toolkit>.

What can a family do to decrease lead in their drinking water?

- **Flush water pipes for up to 2 minutes before drinking or drawing water** especially when preparing baby formula. The amount of time and whether to run the water will depend on whether the home has a lead service line or not and whether the water in the home has been utilized for several hours. A study conducted by Maas et al found that among water samples that had first-draw lead level > 15 µg/L, US EPA's action level, 83% of cases could be reduced to < 15 µg/L simply by running the tap for one full minute.
- **Use only the cold water tap** for drinking, cooking, and especially for making baby formula. Families can fill a pitcher with water after flushing the tap and keep it in the refrigerator for drinking, cooking, and making baby formula.
- **Regularly clean and remove any debris from faucet aerators** to clear out any particles of lead that may become trapped in the aerator

- **To identify a pitcher or faucet device to remove soluble and particulate lead**, families can be referred to NSF International, an independent organization that provides voluntary certifications on specific water filter products and a useful source of information on filtering drinking water to remove lead. <http://info.nsf.org/Certified/DWTU/>
 - Lead in drinking water is present in both soluble (dissolved) and particulate forms. Most faucet-mounted filter devices effectively remove both soluble and particulate lead, but most pour-through water pitcher devices are not effective in removing the particulate lead.
- **Purchase lead-free faucets and plumbing components.**
- **Identify lead service lines.** Be aware of any work that could disturb lead service lines, such as water main replacement, lead service line repair, or replacement of part of the service line.
- **Consider removal of the lead service line**, although studies demonstrate that lead levels in the water may rise for months afterwards due to this disruption. Given this risk, proper precautions must be taken for full replacement of water services lines.
- Contact your regional Pediatric Environmental Health Specialty Unit (PEHSU) with any further questions. www.pehsu.net

Addressing Health Impacts of Lead Exposure

- According to the CDC and the American Academy of Pediatrics (AAP), routine blood lead screening is recommended for high-risk populations and for children insured by Medicaid at age 1 and 2 years.
- These screening criteria were chosen because of children's oral-exploratory and motor developmental milestones important at those ages. These guidelines may not adequately capture the risk of lead in water, as formula-fed infants are at highest risk.
- **The most effective treatment for lead poisoning is removal of the source.** Oral chelation in children who continue to be exposed can be dangerous. Chelation therapy is not recommended and has not been shown to be effective in mitigating adverse neurodevelopmental health effects in the setting of BLLs < 45 µg/dL.
- Lead shares common absorptive mechanisms with iron, calcium, and zinc. Nutritional deficiencies in these minerals promote lead absorption. Ensure iron sufficiency with laboratory testing and treatment per AAP guidelines. Consider starting iron supplementation, as indicated. Manufacturers of dietary supplements are not required to demonstrate that a product is lead-free prior to marketing so caution should be exercised with "dietary supplements."
- Perform structured developmental screening evaluations at child health maintenance visits per the recommendations in Bright Futures (<https://brightfutures.aap.org>). Refer to therapeutic programs such as Early Intervention Programs and Individualized Education Programs as appropriate, since the effect of lead on development may manifest over years.
- Public health, environmental, housing and school policies are needed to ensure protection from lead exposure. Doctors and other healthcare providers are in a unique position to promote safe and healthy environments for children in their homes and throughout their communities.

Table 1. Resources

Pediatric Environmental Health Specialty Unit (PEHSU) Network	www.pehsu.net or 888-347-2632 - <i>Recommendations on Medical Management of Childhood Lead Exposure and Poisoning:</i> www.pehsu.net/ Childhood Lead Exposure.html - Northwest PEHSU: "Lead Removal from Drinking Water: Pour Through and Faucet Mounted Point-of-Use Devices: http://depts.washington.edu/pehsu/sites/default/files/Lead%20Removal%20from%20Drinking%20Water_Nov%202013.pdf
American Academy of Pediatrics (AAP)	- "Lead in Tap Water & Household Plumbing: Parent FAQs." HealthyChildren.org. American Academy of Pediatrics. Updated January 25, 2016. Web. Accessed February 12, 2016. www.healthychildren.org/English/safety-prevention/at-home/Pages/Lead-in-Tap-Water-Household-Plumbing.aspx - AAP Council on Environmental Health. Prevention of Childhood Lead Toxicity. <i>Pediatrics</i>. 2016;138(1): e20161493. - AAP Committee on Environmental Health and Committee on Infectious Diseases. Drinking Water from Private Wells and Risk to Children. <i>Pediatrics</i> 2009; 123: 1599-1605. - Bright Futures https://brightfutures.aap.org
Centers for Disease Control and Prevention (CDC)	www.cdc.gov/nceh/lead/ or 800-232-4636
U.S. Environmental Protection Agency (US EPA)	<i>Safe Drinking Water Hot Line:</i> 1-800-426-4791 www.epa.gov/lead/ or 800-424-5323 <i>Basic Information About Lead in Drinking Water</i> www.epa.gov/your-drinking-water/basic-information-about-lead-drinking-water <i>State Drinking Water Officer and accredited laboratories:</i> water.epa.gov/scitech/drinkingwater/labcert/statecertification.cfm <i>US EPA Actions to Reduce Lead in Drinking Water:</i> www.epa.gov/safewater/lead/lead1.html <i>US EPA Private Wells Guidance</i> www.epa.gov/privatewells/about-private-water-wells#keeping <i>US EPA Home Water Testing:</i> www.epa.gov/safewater/faq/pdfs/fs_homewatertesting.pdf <i>US EPA Training, Testing, Telling (3Ts) Toolkit</i> - /www.epa.gov/dwreginfo/training-testing-telling-3ts-full-toolkit - www.epa.gov/sites/production/files/2015-09/documents/toolkit_leadschools_3ts_training_factsheet.pdf <i>Advice to Flint Residents:</i> www.epa.gov/flint/advice-flint-residents
Agency for Toxic Substances Disease Registry (ATSDR)	<i>Lead -ToxFAQs</i> www.atsdr.cdc.gov/toxfaqs/tfacts13.pdf
Poison Control Center (PCC)	www.aapcc.org/ or 800-222-1222

Suggested Resources and References

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Author’s Note: The information in this factsheet applies to most situations and to a large majority of the U.S. population. Community and individual-level circumstances may vary. Your local water authority is always the first source for testing and identifying lead contamination in tap water.

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