

Science Policy Outreach Task Force at Northwestern University

Lead Exposure from Lead Pipes



SPOTlight: Lead pipes are widespread in the United States and leach lead into the drinking water supply for many homes. Lead exposure has harmful effects on humans, especially on young children, and can have negative economic impacts. As a result, there has been a recent effort to replace lead pipes across the United States.

What are lead pipes and lead exposure?

- Lead is a metal that is valued for its malleability and corrosion resistance. As such, it was used as the major component in pipes and plumbing in the United States through the 19th century and the early 20th century. [1,2]
- Lead can be released into drinking water from service lines, lead plumbing, copper pipes, and brass fixtures. [2,3]
- Lead leaching into drinking water is dependent upon many factors, such as pH, temperature, standing time, and hardness (the amount of dissolved calcium and magnesium), and is amplified if the water is soft or acidic. [2,3,4]
- A 2016 study found that more than 18 million people were being served with water that violated the permissible levels of lead set by the Lead and Copper Rule (1991). [5]

What are the health effects of lead exposure?

- There is no safe lead concentration in blood, and consistent exposure causes lead accumulation in the brain, liver, kidney, and bone, harming multiple body systems with no major symptoms in most adults and children. [1,4]
- Lead exposure during pregnancy increases the risk of miscarriage, premature birth, and behavioral problems. [6]
- Children are especially susceptible to lead poisoning, and consistent exposure can negatively affect learning and intelligence, while increasing the risk of neurocognitive disorders. [1,7,8]

What are the social impacts of lead exposure?

- Lead contamination in drinking water is disproportionately reported in low income or minority communities. [9]
- A state of emergency was declared in the low-income, predominantly black city of Flint, MI, in 2016 due to the high level of lead contaminants in the drinking water. [10]
- Childhood exposure to lead can reduce cognitive and executive functions later in life resulting in reduced educational and financial outcomes and potentially promoting increased crime. [11]

What are the economic impacts of lead pipes and lead exposure?

- Every lead pipe replaced results in approximately \$22,000 in benefits due to lower cardiovascular disease. [12]
- Homeowners that undertook publicly subsidized lead service line replacement in Madison, WI saw a dramatic increase in the value of their home, resulting in a 75% net return in their property's value. [5]
- Reducing childhood lead exposure reduces crime and improves high school graduation rates, with net societal benefits amounting to \$50,000 annually per child or \$1.2 trillion for US society as a whole. [7,11]

What is the status of lead replacement programs?

- The City of Chicago continued to mandate use of lead pipes until Congress banned it in 1986. The city currently has approximately 400,000 lead service lines, 60% of all known lead service lines in Illinois. [2,5,9,13,14]
 - Chicago has a city-assisted lead service line replacement program, which subsidizes the cost of replacing lead service lines for certain homeowners and waives up to \$5,000 in permitting fees. According to local news sources only 280 service lines had been replaced through the program by the end of 2022. [13,15]
 - Lansing, MI implemented a 10-year plan to replace all of its 14,000 lead service lines and offset costs by increasing water and electric rates across its entire customer base. [16]
 - In Cincinnati, customers are eligible for a subsidy of up to \$1,500 to replace lead pipe service lines on private property which can be paid in their final bill or assessed to their property taxes and paid over a 5-10 years. [16]
 - DC Water provides a 50% discount to all customers for lead service line replacement and 80-100% discount for low income customers. They also replace lead service lines for capital-improvement projects at no cost. [16]
-

References and additional resources:

1. Naranjo, V. I., Hendricks, M., & Jones, K. S. (2020). Lead Toxicity in Children: An Unremitting Public Health Problem. *Pediatric Neurology*, 113, 51–55. <https://doi.org/10.1016/j.pediatrneurol.2020.08.005>
2. Katko, T. S., Juuti, P. S., Schwartz, K., & Rajala, R. P. (2012). *Water Services Management and Governance*. IWA Publishing. <https://doi.org/10.2166/9781780400730>
3. US Environmental Protection Agency. (2016, February 2). *Basic Information about Lead in Drinking Water* [Overviews and Factsheets]. <https://www.epa.gov/ground-water-and-drinking-water/basic-information-about-lead-drinking-water>
4. *Lead in Drinking Water | Sources of Lead | CDC*. (2023, February 28). <https://www.cdc.gov/nceh/lead/prevention/sources/water.htm>
5. Theising, A. (2019). Lead Pipes, Prescriptive Policy and Property Values. *Environmental and Resource Economics*, 74(3), 1355–1382. <https://doi.org/10.1007/s10640-019-00372-5>
6. *Pregnant Women | Lead | CDC*. (2022, July 26). <https://www.cdc.gov/nceh/lead/prevention/pregnant.htm>
7. Gould E. (2009). Childhood lead poisoning: conservative estimates of the social and economic benefits of lead hazard control. *Environmental health perspectives*, 117(7), 1162–1167. <https://doi.org/10.1289/ehp.0800408>
8. Jarvis, P., & Fawell, J. (2021). Lead in drinking water – An ongoing public health concern? *Current Opinion in Environmental Science & Health*, 20, 100239. <https://doi.org/10.1016/j.coesh.2021.100239>
9. Levin, R., Zilli Vieira, C. L., Rosenbaum, M. H., Bischoff, K., Mordarski, D. C., & Brown, M. J. (2021). The urban lead (Pb) burden in humans, animals and the natural environment. *Environmental Research*, 193, 110377. <https://doi.org/10.1016/j.envres.2020.110377>
10. Ezell, J. M., & Chase, E. C. (2021). A Population-Based Assessment of Physical Symptoms and Mental Health Outcomes Among Adults Following the Flint Water Crisis. *Journal of Urban Health*, 98(5), 642–653. <https://doi.org/10.1007/s11524-021-00525-2>
11. Muennig, P. (2009). The Social Costs of Childhood Lead Exposure in the Post-Lead Regulation Era. *Archives of Pediatrics & Adolescent Medicine*, 163(9), 844–849. <https://doi.org/10.1001/archpediatrics.2009.128>
12. *Getting the Lead Out: Employment & Economic Impacts of Lead Service Line Replacement | E2*. (2021, August 3). <https://e2.org/reports/economic-impacts-of-lead-service-line-replacement/>
13. City of Chicago. (n.d.). *Lead-Safe Chicago*. Retrieved August 20, 2023, from <https://www.lead-safe-chicago.org/lead-service-line-replacement>
14. Illinois Department of Public Health. (n.d.). *Lead Service Lines*. Retrieved August 20, 2023, from <https://dph.illinois.gov/topics-services/environmental-health-protection/lead-in-water/lead-service-lines.html>
15. Chase, B. (n.d.). *Lori Lightfoot's plan to replace Chicago's lead water lines has switched out 280 of an estimated 390,000 service lines—Chicago Sun-Times*. Retrieved August 20, 2023, from <https://chicago.suntimes.com/2022/12/2/23488902/lead-water-service-line-replacement-chicago>
16. Pakenham, C., Alkafaji, R., & Philbrick, D. (n.d.). *Municipal Strategies for Full Lead Service Line Replacement: Lessons from across the United States*. https://las.depaul.edu/centers-and-institutes/chaddick-institute-for-metropolitan-development/research-and-publications/Documents/IMPJ_121-139_Municipal_Strategies_Lead_Service_Replacement_copy%5B1%5D.pdf

This document was compiled by the Science Policy Outreach Task Force (SPOT). SPOT is a nonpartisan organization of Northwestern University researchers focused on advocating for science, evidence-based reasoning, and scientifically-sound policy to the voting-aged public and policymakers. This document does not represent an official statement by Northwestern University. It does not contain an exhaustive summary of all scientific issues but rather is intended to provide background information relative to the topic.

August 2023
