COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT
U.S. HOUSE OF REPRESENTATIVES

HEARING CHARTER

Addressing the Lead Crisis Through Innovation & Technology

Tuesday, October 15, 2019
10:00 am EST

Early Childhood Center at Forest Glen
280 Davey Street
Bloomfield, New Jersey

PURPOSE

The purpose of the hearing is to discuss the prevalence and effects of lead in drinking water and the challenges that local leaders face in addressing lead contamination. The Committee will consider innovative, science-based solutions for anticipating risk and preventing contamination and explore research opportunities to help municipalities reduce lead exposure more quickly and cost-effectively.

WITNESSES

Panel I

- **The Honorable Joe DiVincenzo, Jr.** County Executive, Essex County, New Jersey
- **The Honorable Joseph Scarpelli,** Mayor of Nutley, New Jersey
- **The Honorable Michael Venezia,** Mayor of Bloomfield, New Jersey

Panel II

- **Dr. Diane Calello,** Executive Medical Director, New Jersey Poison Information and Education System and Associate Professor of Emergency Medicine, Rutgers University
- **Dr. Marc Edwards,** University Distinguished Professor, Virginia Polytechnic Institute
- **Mr. Michael Ramos,** Chief Engineer, Chicago Public Schools and inventor, the Noah Auto Flushing device
- **Dr. Eric Roy,** Founder, Hydroviv

KEY QUESTIONS

- How extensive is lead exposure in drinking water and how does it affect human health?
- What are some best practices and facts about lead in drinking water that can help families protect themselves during a lead contamination event?

- What are some new technologies and strategies that municipalities can pursue to identify lead hazards and reduce exposures more quickly and cheaply?
- What is the federal role in helping bring these innovations to the marketplace?

BACKGROUND

The most common material for water service line construction prior to 1950 in the United States was lead. New lead service lines (LSLs) were not outlawed until 1986.[1] The U.S. Environmental Protection Agency (EPA) estimates that 6.5-10 million LSLs remain nationwide. Lead exposure is also caused by remaining lead goosenecks, solder, brass fittings, faucets and valves (which could be manufactured with up to 8% as late as 2014) and galvanized pipes downstream from lead plumbing.[2]

Unfortunately, lead is a severe and irreversible neurotoxin at even low levels of exposure. Children ages six and under are particularly susceptible to effects like behavior and learning problems, lower IQ, hyperactivity, hearing problems, and anemia. The EPA's 2007 Lead and Copper Rule establishes a minimum action standard of 15 parts per billion, but EPA, the Centers for Disease Control and the American Academy of Pediatrics agree that there is no safe level of lead exposure for children.

Given the health effects of lead in drinking water, the ideal solution is to replace all LSLs in the United States, but the status quo methods for replacement are expensive and time-consuming. On October 10, 2019, EPA released a proposed update to the Lead and Copper Rule, which would maintain the action level of 15 ppb but create new requirements for testing and mapping of lead service lines.[3]

IN NEW JERSEY

In January 2019, local New Jersey outlets began to report on alarming lead levels in homes across Bergen and Hudson counties[4]. In February, the New Jersey Department of Health released its annual report on childhood lead exposure.[5] The report found a slight increase in the number of children with elevated lead blood levels. Following these reports, the Suez water company announced as $15 million project to replace about 25% of the LSLs in Bergen and Hudson counties.[6] In March, the City also announced that the Newark Department of Water and Sewer Utilities would continue its "vigorous efforts to distribute replacement filter cartridges to residents throughout the city."[7]

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[1] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2509614/

[2] file:///C:/Users/jthompson5/AppData/Local/Packages/Microsoft.MicrosoftEdge_8wekyb3d8bbwe/TempState/Downloads/SCHOCK%20ET%20AL%202019%20AWWA%20ACE%20AS%20GIVEN%20(1).PDF

[3] https://www.epa.gov/ground-water-and-drinking-water/proposed-revisions-lead-and-copper-rule

[4] https://www.northjersey.com/story/news/environment/2019/02/01/lead-new-jersey-drinking-water-towns-pressure-suez-speed-up-pipe-replacements-bergen-hudson-county/2729904002/

[5] https://www.state.nj.us/health/childhoodlead/documents/reports/childhoodlead2017.pdf

[6] https://www.northjersey.com/story/news/environment/2019/03/21/suez-water-nj-to-replace-9-miles-of-lead-pipes-in-nj-in-2019-lead-water-nj/3206123002/

[7] https://www.newarknj.gov/news/city-continues-vigorous-campaign-to-distribute-filter-replacement-cartridges-to-residents

Unfortunately, reporting in May 2019 saw additional municipalities served by Newark's water system showed elevated lead levels in the drinking water.[8] "Lead levels in Newark's water supply tested at 52 parts per billion between January 1 and June 30 of 2019, the highest levels ever recorded in Newark".[9] These statistics sent shockwaves through the region, causing the City to provide filters and bottled water to its constituents. On August 9, 2019, U.S. EPA sent a letter to the City noting that "use of the specific filtration devices distributed by Newark may not be reliably effective.[10]

In order to address the problem, in May 2019 the Pequannock Water Treatment system announced a new corrosion control program, and the Suez utility rolled out adjustments to its anti-corrosion strategies in September. In August 2019 Essex County announced a $120 million bond program with the City of Newark to expedite service line replacements.[11] In September, Newark Mayor Ras Baraka introduced an ordinance requiring Newark homeowners to replace lead service lines.[12] And the New Jersey Department of Education has announced that it will require schools to test for lead every three years, rather than every six years.

CHALLENGES IN ADDRESSING LEAD IN DRINKING WATER

The price and time needed to replace LSLs: Newark is in the process of rolling out a $75 million program to replace 18,000 LSLs. The program is expected to take 8 years. The NJ State Department of Environmental Protection estimated that "It could cost up to $2.3 billion to replace all of the estimated 350,000 water-service lines in New Jersey with lead issues.[13] The cost to replace a full lead service line (public and private side) that serves a residence is $2,500-5,500 per line, but some industry estimates are as high as $8,700. According to EPA, the cost for replacing all LSLs in the United States would be as high as $80 billion.[14]" The National Conference of State Legislatures estimates the national cost at $30 billion.[15]

Where are the LSLs? Although EPA requires cities to maintain an active inventory of lead service line locations, few cities satisfy the full requirement. Most LSLs were installed long before digital records were kept and as such, data about where they may be located is limited. The status quo strategy for locating LSLs with absolute confidence is to dig them up with a backhoe, a disruptive approach which can cost thousands per household.

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[8] https://www.nj.com/morris/2019/05/another-nj-town-finds-spiked-lead-levels-in-its-drinking-water.html
[9] https://www.insidernj.com/press-release/newark-lead-levels-hit-record-endangering-families/
[10] https://www.epa.gov/sites/production/files/2019-08/documents/r2letteraugust092019.pdf
[11] https://www.nj.com/essex/2019/08/newarks-fix-to-lead-water-crisis-wont-take-so-long-thanks-to-120m-county-bond.html
[12] https://www.nj.com/essex/2019/09/newark-wants-to-replace-lead-pipes-on-private-property-with-or-without-owners-ok.html
[13] https://www.njspotlight.com/stories/19/04/04/state-dep-getting-lead-out-of-nj-water-pipes-could-cost-2-3-billion/
[14] https://www.epa.gov/sites/production/files/2016-10/documents/508_lcr_revisions_white_paper_final_10.26.16.pdf
[15] http://www.ncsl.org/research/environment-and-natural-resources/lead-water-service-lines.aspx

Hardware for lead testing remains expensive: While at-home lead test kits are relatively cheap, residents must send their samples back to their water utility or a water quality lab for evaluation. No rapid, inexpensive and user-friendly kits for homeowners to do their own evaluation of water samples exist today. The devices that meet federal standards for reading a water sample usually cost over $100,000, and state-of-the-art portable handheld lead analyzers can still cost over $20,000.[16]

Public/private ownership of LSLs: Typically, a lead service line is owned by the local water utility from the water main up to the property line for a household or business, and then the property owner is responsible for the portions of the line under their land and into the home. This means that multiple parties must participate – and pay – in order to do a full LSL replacement. Research has shown that ironically, partial LSL replacements can result in a *surge* of lead exposure over several months. This is because the replacement process disturbs the remaining lead material and affects their scale buildup.[17] In March 2019, the state of Michigan banned partial replacements in order to avoid such exposure surges.[18]

Deficiencies in sampling methods: A June 2019 EPA study found sampling methods under the current Lead and Copper Rule sometimes missed peak lead concentrations or did not accurately capture actual lead exposure.[19] Furthermore, home lead test kits allow a lot of opportunity for user error, because they require the test to be conducted when the pipes have not been flushed (i.e. water run or a toilet flushed) for several hours.

As lead contamination concerns have grown in the public conscience, new innovative strategies for detection, exposure reduction and LSL replacement have emerged. See the Addendum for a sampling of innovative strategies for addressing lead in drinking water.

FEDERAL RESEARCH RESPONSIBILITIES

The EPA Office of Research and Development (ORD) is authorized in Section 1442 of the Safe Drinking Water Act, Section 104 of the Clean Water Act, and the Environmental Research, Development, and Demonstration Authorization Act (ERDDAA) to conduct research on new technologies to identify and address water-borne exposures to lead. The Fiscal Year 2020 budget request outlines the Safe and Sustainable Water Resources Research Program's (SSWR) priorities for lead in drinking water as follows:[20]

(1) establishing reliable models for estimating lead exposure from drinking water,
(2) developing improved sampling techniques and strategies for identifying and characterizing lead in plumbing materials, including lead service lines
(3) developing guidance on optimizing lead mitigation strategies, and
(4) testing and evaluation of treatment processes for removing lead from drinking water.

[16] https://www.the74million.org/article/boser-holman-new-innovation-fund-seeks-affordable-ways-to-test-for-eliminate-toxic-lead-in-and-around-our-nations-schools/
[17] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2866705/
[18] https://www.evart.org/N.%20DEQ-Partial%20Lead%20Service%20Line%20Replacement%20Ban.pdf
[19] https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NRMRL&dirEntryId=345550
[20] https://www.epa.gov/sites/production/files/2019-04/documents/fy20-cj-03-science-technology.pdf Page 118

The EPA ORD budget set aside for Safe and Sustainable Water Resources to cover all contaminants, not just lead, was $106.26 million in Fiscal Year 2019.[21]

The EPA Drinking Water State Revolving Fund is already available to help states finance a wide variety of drinking water infrastructure projects, including LSL replacement programs. The Revolving Fund creates no specific limitations on the use of innovative technologies.

Performance certifications of the physical components of the drinking water system – e.g. paint coatings, valve filters, fittings, and pipes – are conducted by independent standards bodies. NSF/ANSI Standard 61 is the standard for components and Standard 53 addresses point of use filters. The Federal government does not require the use of NSF/ANSI, but 49 of 50 states adhere to their requirements under the state primacy responsibilities they are granted under the Safe Drinking Water Act.

[21] https://www.epa.gov/sites/production/files/2019-04/documents/fy20-cj-03-science-technology.pdf Page 115

Appendix:
Innovative Methods and Technologies for Identifying and Addressing Lead in Drinking Water

For Locating Lead Service Lines

Machine learning statistical models: In 2016, researchers from Georgia Tech and the University of Michigan worked with officials in Flint, Michigan create a new statistical model to find lead service lines by digitizing historical records and comparing it to field data from ongoing removal efforts and information from home inspections. The city recently mandated the use of this statistical model.[22] Its success led to the creation of Blue Conduit, a public-private-partnership now working with multiple cities to locate pipes. Another startup, Indiana-based 120Water Audit, has developed a user-friendly predictive module that can pinpoint properties that are likeliest to have LSLs.

Precision or hydro vacuuming: Springfield, Illinois uses precision vacuuming to inspect underground pipes through tiny, concentrated holes drilled into the curb box, a less disruptive and cheaper method of visually identifying LSLs. Precision vacuuming has been used to locate LSLs outside Springfield daycares. Michigan has directed the City of Flint to use a similar method called hydrovacing, which costs $300 or less per LSL to dig. Flint has used hydrovacing in conjunction with their statistical modeling to precisely pinpoint the location of LSLs.

Remote sensing techniques: In 2018, an Environmental Defense Fund project to remove lead piping in a Chicago daycare center used ground radar and sonar detection technologies to locate a LSL after an unsuccessful search using traditional digging methods.[23] Radar and sonar techniques that were originally used by the Department of Defense to locate land mines may be a scalable strategy for locating LSLs without digging.

Crowdsourcing LSL locations: The Greater Cincinnati Water Works runs an LSL replacement program that allows residents to do low-tech tests in their own homes to kickstart the replacement process.[24] Identification of private LSLs is often possible through simple "scratch tests," magnet tests, and a GCWW-provided test kit. Residents send their findings and pictures of their service line through an online form. However, this method only applies to the private side of the service line, and only to service lines accessible to the homeowner.

For Sampling Methodology, Home Testing and Data Sharing

Improved sampling methods: EPA researchers issued new findings this summer that sequential sampling and proportionate composite sampling may more accurately reflect home lead exposure. One new method would take multiple samples in a row to build a profile of a "plug" of

[22] https://www.mlive.com/news/flint/2019/02/flint-agrees-to-return-to-data-driven-approach-to-find-remaining-lead-service-lines.html
[23] https://www.edf.org/sites/default/files/documents/edf_child_care_report-062518.pdf
[24] https://la.mygcww.org/do-i-have-a-lead-service-line/

water passing through the house's piping. Another would install a filter to capture the lead content in 5% of the water passing through a faucet over a the course of a week..[25]

Platinum electrode sensors: Researchers from the University of Michigan recently tested inexpensive platinum electrodes to determine heavy metals exposure in drinking water.[26] These sensors could distinguish lead from other metals. The study recorded no false positives and estimated a cost of about $20 per sensor.

Carbon nanotube testing: In 2017, 12-year old Gitanjali Rao from Lone Tree, CO designed Tethys, a prototype of an at-home lead testing device using detachable, disposable carbon nanotube sensors. The device, which aims to be available publicly in the next two years, connects via Bluetooth to an app interface to communicate test results to homeowners.[27]

Biosensors: FREDsense Technologies of Calgary, Alberta is developing a biosensor platform to detect water-borne lead. The company currently has commercially available biosensors aimed at detecting arsenic, iron, and manganese.[28]

Smartphone nanocolorimetry: University of Houston researchers published a 2018 study on a smartphone-based technique to detect and quantify dissolved lead in drinking water.[29]

Mitigating Exposure where Lead Service Lines Remain

Chemical additives for corrosion control: A common method for reducing lead exposure is to add chemicals to the water supply that create scales on the inside of pipes, which act as a protective barrier. The most common chemical additive, orthophosphates, have been demonstrated effective over decades, but water managers must implement these programs with care.[30] Changing water supplies to a more corrosive source can break down the scaling created by corrosion control additives, resulting in new lead leaching. This is the phenomenon that led to the Flint water crisis.[31] Furthermore, it takes many months or years for a new corrosion control program to develop an adequate layer of protection on previously-untreated pipes.

Automatic flushing: The chief engineer for Chicago Public Schools, Michael Ramos, recognized that water stagnation overnight, when schools are empty and the water system is stagnant, creates a surge of lead content in the first few sips of a water fountain at the beginning of the school day. He developed a device called the NOAH that automatically flushes drinking water systems to eliminate students' exposure to the morning lead surge.

[25] https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NRMRL&dirEntryId=345550
[26] https://pubs.acs.org/doi/abs/10.1021/acs.analchem.7b00843
[27] https://www.cpr.org/2019/01/28/13-year-old-gitanjali-raos-lead-detecting-invention-lands-her-on-forbes-30-under-30/
[28] https://www.fredsense.com/technology
[29] https://pubs.acs.org/doi/abs/10.1021/acs.analchem.8b02808?journalCode=ancham&
[30] https://www.bu.edu/rccp/files/2018/12/Supplement_4_Corrosion_Study.pdf
[31] https://cen.acs.org/articles/94/i7/Lead-Ended-Flints-Tap-Water.html

Improved filters: Homeowners and businesses may use point of use filters, installed at the water inlet under the sink or tap, or pitcher filters to reduce their exposure. Product certification is conducted by NSF/ANSI, which collects a fee from manufacturers to test filter performance in a controlled laboratory setting. Researchers are exploring strategies to improve the performance of filters themselves – to make them last longer or to control for more contaminants, for example. There are also efforts underway to improve the consumer experience with filters and reduce the risk for misuse, e.g. automatic alerts when it is time for the filter to be replaced.

Epoxy lining: Companies like CuraFlo in Mesa, Arizona, or ACE Duraflo in Santa Ana, California, can coat the inside of pipes with about a 1/16th inch of epoxy or another material through a process that takes 4 hours, creating a lining that purports to eliminate contact between the pipe and the water supply. This technique has been deployed widely in Europe, but concerns remain about the how the lining material itself may degrade or leach into drinking water.

Other methods for corrosion control: In 2019, Denver Water sent a proposal to EPA for an alternative corrosion control strategy to orthophosphates. Denver seeks to use hydroxide to adjust the pH (acidity) of the source water itself, thus reducing its corrosivity to the lead pipe.[32] And researchers at University of California at Berkeley have developed a process that could accelerate the formation of protective scaling around pipes. By running an electrical current through phosphate-treated water in lead piping, they accelerated the chemical reaction to reduce the scale build-up time from months or years to a few hours.[33]

Advanced LSL Replacement Techniques

Trenchless digging / threading: Lansing, Michigan pioneered an LSL replacement technique in which the LSL is pulled out of the ground horizontally while a new pipe is pulled in behind it, a process which requires minimal excavation. Under earlier methods, it cost Lansing $9,000 and a full day to remove an average lead pipe. Using the trenchless method, Lansing was able to reduce the cost to about $3,600 and four hours on average. In 2016 Lansing became one of the first municipalities to completely remove all LSLs, and this method has been adopted by several other U.S. municipalities.[34]

Slip-lining: This method pulls a new, smaller pipe made of PVC or other safe material into an existing lead pipe and seals the ends, leaving the old pipe in place but isolating it from the water. The technique can also help with pipe structural integrity, but there has been little testing of this method to date.

Innovative Financing models

Some municipalities and states have developed creative funding solutions to incentivize replacement with homeowners. The Greater Cincinnati Water Works implemented a 40% cost

[32] https://www.cpr.org/2019/07/01/denver-water-wants-to-replace-the-last-of-the-citys-lead-pipes-with-a-comprehensive-environmentalist-approved-plan/

[33] https://www.scientificamerican.com/article/zapping-lead-pipes-with-electricity-could-make-them-safer-for-drinking-water/

[34] https://www.detroitnews.com/story/news/local/michigan/2016/12/14/lansing-lead-service-line/95435604/

sharing program for homeowners to replace the private-side LSL, with additional support for low-income residents. Madison, Wisconsin reimburses half of the cost of LSL replacement up to $1,500, financing the program by renting space on water towers for cellular antennae. Denver Water and the Denver Urban Renewal Authority help finance homeowners' LSL removal with 5-15 year low-interest loans. Low-income customers may receive a rate as low as 0%.[35]

In some cases, local government and utilities absorb full financial responsibility for the private-side LSL. In September 2019, the city of Newark announced that it would pay for the full replacement of the 18,000 LSL's under city property at zero cost to property owners.

[35] https://www.lslr-collaborative.org/community-access-to-funding.html