ASTHO Report
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Going Beyond Regulatory Compliance for Lead Testing in Drinking Water

This report serves as a primer for state and territorial health agencies (S/THAs) seeking to assess the public health impacts of lead exposure in drinking water. It also offers a public health perspective on current protocols for testing lead in drinking water, and therefore discusses the need for additional sampling protocols (termed diagnostic sampling and exposure sampling herein) to identify levels of lead found in residential facilities that meet the regulatory standards for tap water (termed regulatory sampling herein).

Although this report focuses on sampling protocols for lead in residential facilities, EPA has additional resources that can be helpful when testing for lead in schools. Through engaging in both diagnostic and regulatory sampling, S/THAs can better understand the comprehensive lead risks to a household or those served by schools, daycares, and other facilities.

Regulatory Sampling

Regulatory sampling protocols for lead in drinking water are useful in assessing community-wide compliance with the regulatory standard. Drinking water systems usually take tap water samples at a pre-determined number of residences across the community. Sampling is required for high-risk sites, such as residential facilities with lead service lines. Currently, drinking water systems in most states and territories rely on the protocol outlined in the EPA's Lead and Copper Rule (LCR) to collect regulatory drinking water samples and test for lead.

Generally, the LCR protocol assesses compliance of the entire drinking water system and does not indicate individual risk levels for a specific residence. If the 90th percentile lead level falls below the EPA's action level of 0.015 mg/L (or 15 ppb), then the water system meets the 90th percentile action level. However, this still means that up to 10% of the sample residences could have lead sample results above EPA's action level.

If the water system's 90th percentile lead level exceeds 15 ppb, the water system administrator is required to implement water quality improvements and take other actions to notify the public of actions that can be taken to reduce lead in their household. The revised LCR, known as LCRR, will be enforced in 2024. Additional LCR improvements (LCRI) are also currently underway and may yield additional regulatory changes that are unknown at this point.

While the LCR (and upcoming LCRR and LCRI) protocol is useful for assessing system-wide corrosivity towards lead, it does not provide conclusions about the level of health risk for lead exposure in drinking water, either across the community or for individual residences. Since there is no safe level of lead exposure, it is important that S/THAs have the tools to adequately test drinking water and protect public health.

Diagnostic Sampling and Exposure Sampling

Unlike regulatory sampling protocols, such as those for the LCR, diagnostic and exposure sampling protocols of drinking water allow S/THAs to assess the level of risk in areas where there are known lead exposures. The term "diagnostic sampling" refers to protocols that help identify (or "diagnose") the sources of lead in drinking water.

Some examples of lead sources in drinking water include lead service lines, lead goosenecks, lead soldered joints, leaded brass faucets, valves, and other leaded brass plumbing fittings. In most cases lead goosenecks and lead service lines will be buried underground or inside walls or floors. Component parts of valves, meters, faucets, and other devices may be made of leaded brass that is not readily visible to the resident. The amount of lead in these alloys generally decreases over time, as plumbing component standards and leaded solder prohibitions have evolved.

EPA's action level for lead in drinking water is a regulatory standard based on technical feasibility. It is not a health-based number and was not designed to support public health intervention for individual residences or buildings. If a building is served by a lead service line or has lead-containing components within the premise plumbing (e.g., lead soldered joints, some brass fixtures), there is always a potential risk for lead exposure, even if the water system complies with the lead action level.

In addition to diagnostic sampling, "exposure sampling" can be helpful when conducting an exposure assessment, especially in older homes, where children are known to have elevated blood lead levels. Exposure sampling would be useful to determine the level of lead exposure from drinking water, for example, when assessing an older home with both lead-based paint and lead service lines. S/THAs can also use exposure sampling in conjunction with lead dust sampling to estimate the cumulative lead risk in homes with lead-based paint, as well as dust and soil.

Differences Among Sampling Types: Regulatory vs. Diagnostic vs. Exposure Sampling

The LCR **regulatory sampling protocol** requires monitoring of tap water at a specific number of sites, determined by the population served by the water system. These sites principally target homes and buildings with lead service lines to capture sites with a high risk of lead ingestion. Before collecting samples, water must sit stagnant in pipes for at least six hours. One liter of cold water is to be collected in a wide-mouth bottle from a regularly used (preferably kitchen) tap.

Regulatory sampling under the upcoming LCRR and LCRI will likely be some combination between the current first-liter protocol and an additional sample representing the lead service line. Sampling frequencies are also likely to change. Results from regulatory compliance sampling are primarily used to generate recommendations for corrosion control measures or treatment plans to improve lead corrosion in the system.

If a water system has lead service lines, it's important to understand that for the system administrator to be fully informed, diagnostic samples must be taken over time to ensure that the corrosion control sufficiently addresses lead release from the different kinds of sources present in the plumbing (e.g., lead pipe, soldered joints if plumbing is older, leaded brass valves and faucets, lead accumulated in old corroded galvanized steel pipes).

Diagnostic and exposure samples should also be collected at kitchen faucets or other water outlets that represent sources for human consumption. Rather than collecting a single one-liter sample, however, diagnostic sampling protocols call for collecting multiple sequential samples of varying sizes to capture the lead profile of the plumbing components and fixtures. Diagnostic sampling protocols are often used to identify locations of lead plumbing sources. A diagnostic sampling profile may include 10-20 sequential samples of defined volume collected after a defined stagnation time.

Exposure assessment sampling protocols may employ cumulative water samples (the simplest of which would be a manual composite sample) that directly capture an approximate average water lead concentration over a prolonged period of normal household water use (typically ranging from one day to two weeks).

Diagnostic and exposure sampling results would also help inform public health interventions, such as blood lead level testing and community education in higher risk areas. As such, it is also important to develop guidelines for risk communication.

Drinking water primacy agencies can help to interpret results for effective communication with the public. Local water suppliers and/or state primacy agencies can give recommendations on certified commercial drinking water laboratories that measure lead in drinking water samples. University laboratories might also be helpful (if using a standard lead quantification laboratory method or EPA-approved method).

Considerations for Adding Diagnostic and Exposure Sampling Protocols

- Interpreting and communicating testing results can be challenging. Lead in water can be variable between different residences and even from the same residential kitchen faucet over time. S/THAs should expect to encounter different results, depending on the sampling procedure and should consider how to communicate risk to the public to foster transparency and avoid confusion.

- If a S/THA cannot develop a diagnostic or exposure sampling protocol, an intermediate step still allows for improvement in public health outcomes. Facilities whose results exceed EPA's action level should get public health follow-up (as well as plumbing-related remediation). Such interventions can be similar to those in facilities with lead-based paint (i.e., child blood lead level screenings).

- For S/THAs with local childhood blood lead monitoring programs, it would be useful to add multiple, spaced-out manual water composite samples from the home the week before testing for blood lead levels. This measure accounts for different water usage patterns during the week, which can impact exposure to lead in drinking water for residents over time. A benefit of the manual water composite sample is that residents can collect samples on their own, provided they have clear guidance. This information can be used to estimate the drinking water contribution to the observed blood lead level.

Outreach to Jurisdictions

In spring 2022, ASTHO queried its Environmental Health Directors peer group about S/THAs' sampling protocols for lead in drinking water. Jurisdictions were asked about requirements for testing drinking water sources, contaminants tested during environmental assessments, and partners engaged in diagnostic sampling of drinking water sources. Fourteen jurisdictions participated in this survey: Arkansas, California, Delaware, Florida, Hawaii, Indiana, Iowa, Maine, Nebraska, Oregon, Texas, West Virginia, Commonwealth of Northern Mariana Islands (CNMI), and American Samoa.

Jurisdiction Requirements of Testing Drinking Water Sources

None of the survey participants reported that their jurisdiction *requires* diagnostic or exposure testing of lead in drinking water for homes with known lead exposures. States *may* test drinking water as a follow-up to a complaint or in homes with children who have elevated blood lead levels. A majority of survey participants reported that their state does not require sampling of lead in drinking water during environmental assessments. However, all of the jurisdictions enforce compliance of community water systems with the Safe Drinking Water Act (i.e., with the LCR).

In addition, private wells have no testing requirement so there may be unknowns associated with their water quality. Jurisdictions may test for lead in drinking water during environmental assessments due to one or more of the following conditions: (1) identified need for further investigation in a home, (2) history of possible lead-exposed drinking water, and/or (3) samples are above the lead action level established under the Safe Drinking Water Act.

Even if sampling is not required during environmental assessments, S/THAs can benefit from coordinating with state drinking water primacy agencies, water systems, and lead abatement professionals to address community concerns about lead poisoning.

During environmental assessments in homes with a child who has an elevated blood lead level, the Indiana Department of Health only tests for lead in drinking water and other possible sources such as toys, food, and cosmetics when exposure to lead-based paint can be completely ruled out.

In CNMI, the Commonwealth Healthcare Corporation, Environmental Health Disease Prevention, and the Bureau of Environmental & Coastal Quality (BECQ), coordinate inter-agency technical assistance when they receive concerns or complaints related to lead exposures. BECQ has a water testing lab and field-testing tools to facilitate water testing when warranted.

More than half of the survey participants indicated that their lead sampling requirements were not influenced by whether they met or exceeded the LCR lead action level of 15 ppb. Jurisdictions generally follow the LCR sampling methods, whereas some jurisdictions may use customized sampling protocols.

Four jurisdictions shared their sampling protocols in the survey: water sample volumes ranged from 125 to 1000 mL, stagnation periods from six to 18 hours, and number of samples collected from one to three. These varying protocols reinforce that there is no consistent protocol being used for diagnostic sampling for lead in drinking water, including during environmental assessments.

Testing for Other Contaminants During Environmental Assessments

The majority of jurisdictions indicated that copper, arsenic, uranium, and nitrates were not among the other contaminants tested for during an environmental assessment. Some S/THAs noted they test for arsenic, nitrates, and E-coli, while others test for other contaminants depending on the type of environmental assessment conducted. One jurisdiction noted that if water is collected and sent to the state lab as a part of a lead risk assessment, they may also test for copper and arsenic. If levels exceed 10 ppb for arsenic, 1,300 ppb for copper, or 15 ppb for lead, the S/THA sends a fact sheet to the requestor explaining the elevated contaminant levels.

While this report focuses on lead sampling protocols, it is important to note that health-based sampling protocols differ for other contaminants (such as copper) and are triggered by different characteristics, such as the age of a building.

Partner Engagement for Diagnostic Sampling

When asked about who S/THAs could engage when seeking diagnostic or exposure sampling of drinking water, a majority of respondents highlighted the local health department, public health nurses, and homeowners. Other partners could include:

- Drinking water providers.
- Water utilities.
- Occupational health providers (for adult cases).
- State or territorial environmental agencies.
- State or territorial laboratories.

State drinking water primacy agencies can also be engaged to develop consistent messaging about lead in drinking water and increase public trust in tap water. State primacy agencies also have a significant number of resources and knowledge regarding lead sampling to support communication efforts.

Conclusion

It is important to consider how the public health community approaches the total calculation of lead risk in individual residences. While this research did not include participation from all jurisdictions, results were from geographically and structurally diverse S/THAs, and commonalities were seen in survey responses.

Since regulatory compliance sampling with the LCR (and upcoming LCRR/LCRI) alone will likely not capture all water lead exposures in a household, adding exposure sampling protocols and/or diagnostic sampling during environmental assessments can more accurately identify lead plumbing sources and comprehensive lead risk, respectively.

When assessing facilities for LCR compliance, those that exceed the 15 ppb action level may be flagged for additional public health follow-up, depending on the jurisdiction. To identify potential sources of lead in drinking water plumbing, S/THAs could consider diagnostic sampling protocols.

Many homeowners and renters are unfamiliar with the location of their service lines, and most do not know the material composition of their line. Additionally, while public water systems are required to complete lead service line inventories by 2024 to catalogue the location of lead service lines, material composition of service lines on private property may be categorized as unknown.

Consumers may be unaware that drinking water is another source of lead in the home. To assess water lead exposure of individuals, S/THAs could consider exposure sampling protocols. S/THAs may collect these samples during environmental assessments for cases of known childhood lead exposures. Moving forward, collaboration between S/THAs, drinking water primacy agencies, public water systems, and the public to identify and remove lead service lines and assess this and other water lead exposures will be critical.

By better understanding how the public health community approaches comprehensive lead risk in a household, ASTHO can better identify the gaps in sampling protocols and provide additional resources to address these challenges. In all cases, answering the question "is my water safe" should be qualified by an explanation of the specific water sampling protocol used, and the information it can or cannot provide.

Additional Resources

- Public Water Supply Lead and Copper Sampling Plan Requirements | Iowa Department of Natural Resources and Iowa Rural Water Association.
- Lead and Copper Sampling Plan. Vermont Department of Conversation.
- Triantafyllidou, S., Burkhardt, J.,Tully, J., et al. Variability and sampling of lead in drinking water: Assessing potential human exposure depends on the sampling protocol. Environment International. Volume 146, 106269. January 2021.
- Lead and Copper Rule Clarification of Requirements for Collecting Samples and Calculating Compliance | EPA
- Lead and Copper - Suggested Directions for Homeowner Tap Sample Collection Procedures | EPA
- 3Ts for Reducing Lead in Drinking Water | EPA

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Appendix 1. ASTHO Drinking Water Sampling Survey Questions

1. In which state or territory do you work?

2. Does your jurisdiction require testing of drinking water sources for lead in houses with a known lead exposure (e.g., pre-1978 housing)?
   [Yes/No/It depends (please explain)]

3. Does your state require sampling lead in drinking water during environmental assessments?
   [Yes/No/It depends (please explain)]

4. Is the lead sampling requirement affected by whether you have met or exceeded the maximum contaminant level goals set by the Lead and Copper Rule?
   [Yes/No/It depends (please explain)]

5. What other contaminants do you require testing for during environmental assessments? Select all that apply.
   [Copper, Arsenic, Uranium, Nitrites, Other (please specify), None of the above]

6. Which partners do you engage when seeking lead or copper diagnostic sampling for drinking water? Select all that apply.
   [Public health nurses, Drinking water providers or utilities, Homeowners, Local health departments, Other (please specify)]

7. Please share any written plans and supporting documents your state has for diagnostic sampling for lead and copper in drinking water. Please select whether you prefer to paste a URL or upload a document.