Compliance With Mandated Testing for Lead in Drinking Water in School Districts in New Jersey

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Abstract **Preventing lead exposure from all sources is critical for children's optimal health and development. The crisis in Flint, Michigan, drew attention to the role of drinking water in lead exposure. School drinking water might pose significant risks due to aging infrastructure and the particular conditions of water use in schools. In 2016, New Jersey mandated that school districts test all drinking water outlets for lead and specified procedures that districts must follow. This study assessed compliance with this mandate. Districts were required to report results on their websites, so we used district websites as the unit of analysis to assess compliance with testing and reporting procedures and to identify schools that had reported maximum concentrations of lead in water. Most districts complied with the mandate to test their drinking water (90%) and the majority complied with online reporting requirements to some extent (87%). Most districts (79%) had one or more outlets in their district that exceeded the U.S. Environmental Protection Agency's action level of 15 ppb. Mandated testing for lead in drinking water in schools is an important policy that can prevent childhood lead exposure. New Jersey should consider lowering the action level at which lead in drinking water should be remediated.**

Introduction

Despite dramatic improvements, childhood lead exposure is an ongoing problem in the U.S. An estimated 0.5% of children had blood lead levels (BLLs) exceeding the reference level of 5 µg/dL in 2013–2014, the level at which the Centers for Disease Control and Prevention recommends public health intervention should begin (Tsoi, Cheung, Cheung, & Cheung, 2016). Low-level lead exposure in childhood is associated with developmental effects such as problems with behavior and attention and decrements in IQ (National Toxicology Program, 2012; U.S. Environmental Protection Agency [U.S. EPA], 2013). As no level of lead exposure is thought to be safe for children, there is widespread agreement in the public health community that preventing lead exposure is critical for children's optimal health and development (Centers for Disease Control and Prevention [CDC], 2012).

In the U.S., efforts to prevent lead exposure in children have focused primarily on lead exposure in and around the home due to lead in house dust and in the soil from deteriorating lead paint (CDC, 2004). Though some public health experts have argued that drinking water is an important source of childhood lead exposure, there has not been coordinated state and federal action to address this issue (Renner, 2010). The U.S. Environmental Protection Agency (U.S. EPA) estimates that exposure to lead in drinking water could account for as much as one fifth of a person's total lead exposure (U.S. EPA, 2018). There is a growing understanding from a prevention perspective that it is important to control and minimize all sources of lead exposure in a child's environment, including from drinking water (Levallois, Barn, Valcke, Gauvin, & Kosatsky, 2018).

Lead in drinking water recently has become a significant national issue as a result of the crisis in Flint, Michigan. In 2014 and 2015, growing resident complaints, independent water testing by researchers at Virginia Tech, and media attention brought the Flint lead crisis into public view. Many households in Flint were found to have lead in water above U.S. EPA's action level. An epidemiologic study comparing children's blood lead levels before and after the city changed its source of drinking water attributed increases in elevated blood lead levels among children in certain Flint neighborhoods to contaminated drinking water (Hanna-Attisha, LaChance, Sadler, & Champney Schnepp, 2016). The Flint crisis heightened awareness among professionals and the public that lead in drinking water might be a more widespread problem in the U.S. than previously acknowledged due to aging infrastructure and a history of using lead in solder, pipes, service lines, and fixtures.

Lead in Water Standards

In 1991, U.S. EPA set the action level for lead in drinking water at 15 ppb and required drinking water providers to take action to reduce lead in water if 10% of their tap water samples exceed this level. U.S. EPA's nonenforceable maximum contaminant level goal for lead is 0 ppb, in recognition of lead's toxicity and the public health imperative to prevent any lead exposure, particularly among infants, children, and pregnant women (U.S. EPA, 2018).

After water leaves the water treatment facility, lead enters drinking water typically from lead service lines, lead-containing solder, or through lead-containing fixtures such as faucets or bubblers. Water that is corrosive is particularly of concern, as corrosive water can contribute to more leaching of lead from pipes or fixtures (U.S. EPA, 2018).

School drinking water has been identified as an important point of exposure to lead for U.S. children because many schools in the U.S. contain aging infrastructure such as pipes with lead solder and lead-containing bubblers, water fountains, or faucets. Additionally, because schools typically are in use for only 8–10 hours per day and not on weekends or during holidays, there are long periods of time in which water sits in the pipes, which can increase the migration of lead into drinking water (Lambrinidou, Triantafyllidou, & Edwards, 2010).

Lambrinidou and coauthors (2010) noted that the problem of lead in school drinking water has suffered from "systemic neglect," as U.S. EPA regulation has been minimal. Currently there are no federal requirements to test for lead in school drinking water unless the school "operate(s) their own public water system" (e.g., schools that use well water). In this instance, schools must follow the testing and remediation requirements of the Lead and Copper Rule (LCR), a federal regulation that requires periodic lead testing; however, the testing is not comprehensive and there is no requirement under the LCR to test all outlets where exposure could occur (U.S. EPA, 2017). According to the U.S. EPA (2017), approximately 8,000 schools and child cares in the U.S. are routinely required to test drinking water under the LCR; however, the vast majority of schools (598,000 schools and child cares) are not required to do so.

Childhood Lead Exposure in New Jersey

New Jersey requires blood lead testing for all children at 12 and 24 months of age. In 2015–2016, 26.8% of all New Jersey children <6 years were tested, and of those, 2.7% had BLLs of ≥5 µg/dL (4,824 children). A total of 881 children <6 years were identified as having BLLs of ≥10 µg/dL. The data indicate that childhood lead exposure is an important ongoing issue in the state (New Jersey Department of Health, 2016).

In New Jersey in 2016, likely due to heightened awareness of the issue because of the lead water crisis in Flint, Michigan, several high-profile cases of lead in school drinking water were reported in the press. One such case was the Newark Public School District: lead in excess of 15 ppb had been found in some drinking water outlets in district schools dating back to 2010. In 2016 the district was said to be taking steps to test all outlets and to publicly report results (McGeehan, 2016). Other districts also began to test and report on lead levels in their drinking water and some elevated results were reported.

Responding to public concerns, in May 2016 Governor Chris Christie ordered the New Jersey Department of Education to ensure that all New Jersey public school districts test for lead in all drinking water outlets in all district schools within 1 year and that the results be publicly posted for parents and students to view. Additionally, parents would have to be notified if lead in water at their child's school exceeded 15 ppb (Santora, 2016).

In July 2016 the New Jersey Department of Education, in consultation with the New Jersey Department of Environmental Protection, released the regulation corresponding to the Governor's Order, which provided detailed procedures for districts to follow when testing water for lead. The regulation specified that districts must develop a plumbing survey at all schools and sample all drinking water outlets in all schools and facilities within 1 year of promulgation, although extensions for another year were possible. Other requirements included

- samples must be first draw, the water must sit in pipes for 8–48 hr prior to testing, and signs must be posted to indicate not to use water for 8 hr prior to testing;
- aerators must not be removed and the samples must be "collected in pre-cleaned high-density polyethylene (HDPE) 250 milliliter (mL) wide-mouth, single-use rigid sample containers that are properly labeled;"
- analysis must be done by a certified laboratory according to the requirements of the federal Safe Drinking Water Act;
- quality control and chain of custody procedures must be followed;
- results must be posted on the district's website and if exceedances are found, districts must notify parents and employees in writing of "measures taken to immediately end use of each drinking water outlet" in excess of 15 ppb; and
- districts must retest drinking water every 6 years (New Jersey Administrative Code, 2016).

Notably, as of July 2018, New Jersey is one of eight states to require lead testing in the state's schools (U.S. Government Accountability Office [GAO], 2018).

Purpose

This study examined New Jersey school district compliance with New Jersey Department of Education regulations testing water for lead in 2016–2017 in New Jersey schools. We assessed whether districts tested their water, publicly reported their data, and followed the state's guidelines for testing, reporting, and communication of results to parents and the school community.

Methods

The New Jersey Department of Education regulations for testing water are directed at school districts and require that results be reported on district websites, so we used school districts as the unit of analysis and assessed what a parent, student, and/or community member would see if they were to search online for their district's data testing water for lead. The New Jersey State Department of Education maintains a publicly accessible database of all school districts in the state that includes district name, location, and website address for 599 districts. We used this database to identify our sample, which consisted of 581 school districts that were operational at the time of our study.

We visited all 581 school district websites and searched for lead test results. If no results were found, we performed a Google search that included the district name and the phrase "lead in water testing." We assessed

all 581 school districts on three primary outcomes: compliance with testing, reporting, and maximum lead concentration. In addition, we selected a subset of schools to investigate compliance in more detail using a simple random sample of every fifth district in the database (n = 120). The database is organized alphabetically and we did not detect any periodicity in the database.

For the subsample, data were collected on

- adherence to sampling and testing requirements,
- accessibility of results on websites,
- parent/community notification and explanation of results, and
- communication of corrective course of action taken for test results over U.S. EPA's action level (15 ppb) for lead in water.

Each school website was assessed for the variables of interest between October 2016–January 2018. If a district did not have data on their website prior to July 2017 (the last date for compliance), we rechecked the district to see if data had been posted between September 2017–January 2018.

Results

Of the 581 operational school districts in New Jersey during our study period, we found that the large majority of New Jersey School Districts (520, 90%) tested their water either immediately prior to or within the 1-year period stipulated by the state (July 2016–July 2017). We found that some New Jersey school districts carried out extensive water testing prior to the issuance of the state law. If the testing was extensive (not simply in compliance with U.S. EPA's LCR), we included the district as complying with the state's rules. For the approximately 10% of districts for which we did not find results reported on the Internet, we were unable to determine if they did test their water but did not comply with the web-based reporting requirements, or if their results were taken off of their website after posting and not accessible to us.

We were able to find some form of test results posted online, as required, for the majority of districts that tested (87%), which could either include laboratory results, a summary of results, or a letter to parents explaining the test results—or all three. For a small number of districts (n = 14), we found evidence somewhere on their website (e.g., minutes of a school board meeting) that the district had tested their water in compliance with state law, but we were unable to find their results online—this finding accounts for the discrepancy between the number of districts that we report tested their water and the number for which we found online results.

TABLE **1**

Maximum Reported Concentration Distribution of Lead in Drinking Water in New Jersey School Districts

Maximum Lead Concentration (ppb)	#	%
<15	103	21.2
15.00–44.99	122	25.1
45.00–99.99	92	18.9
100.00–999.99	130	26.7
>1,000	39	8.0
Total	486	

Note. Of the 581 districts in the study, we could not find maximum concentrations for 95. Out of the 95, there were 61 for which we could not find any results to indicate if they tested their water and 34 tested their water but we could not find the maximum concentration report online for their district.

The majority of school districts in New Jersey that reported results had one or more outlets in their district equaling or exceeding the U.S. EPA's action level for lead in drinking water. Of the 486 districts that provided enough information online to identify maximum lead levels in school water, 383 (79%) reported that at least one drinking water outlet in the district had a lead concentration that equaled or exceeded U.S. EPA's 15 ppb action level.

Additionally, more than one half of all reporting districts (261, 54%) had at least one maximum lead concentration in school drinking water outlets of ≥45 ppb, triple the U.S. EPA's action level; 39 districts reported maximum lead concentrations of ≥1,000 ppb. Table 1 shows the distribution of maximum lead concentrations reported.

The maximum lead value detected among all of the school districts was 23,980 ppb in a bubbler in the girl's locker room in the Hanover Park Regional High School District. The fountain was removed so that exposure to this extremely high source of lead was corrected. This concentration of lead in water is nearly 5 times the level that is considered hazardous waste (Roy, 2015). Additionally, five other New Jersey school districts reported maximum concentrations of lead in water that would qualify as hazardous waste (5,000 ppb or higher).

Results From Subsample

Compliance With Testing and Communication of Results

For the randomly selected subsample (n = 120) we assessed compliance with New Jersey's testing regulations in more detail. Compared with the entire sample, we found a similar percentage of the subsample had tested their water (84%) and a similar percentage had some form of results online (84%). We also assessed whether test results were easy to find online. Results were judged to be easy to find if they could be accessed within two clicks from the homepage (60% were judged to be easy to find; 40% were judged to be difficult). We observed that districts put results in many different places online. While many result reports were linked to district home pages, results were also often found on buildings/grounds, parent information, or district news pages. Often it was necessary to do a Google search to find results, as they were not readily locatable on district websites.

Of the subsample schools for which we found some report of test results online (n = 101), 73% provided actual laboratory results on the district's website as required and 68% provided a qualitative description of the results, either in addition to or in lieu of the

laboratory results. We found that 61% of districts provided a risk communication letter to parents on the website, following a template that covered the purpose, methods, results, and health risks of lead. This communication was required only of schools with lead concentrations in water above the U.S. EPA's action level.

Compliance With Sampling and Testing Procedures

The New Jersey Department of Education regulation specified that first-draw samples were required from all drinking water outlets. We assessed whether the districts reported using first-draw samples by looking for this information either in the report of laboratory results, in the qualitative summary, or in the letter to parents. Of the 101 subsample districts with results online, 59% reported using first-draw samples; however, 39% of districts in the subsample did not state the type of sample they used and one district did not use first-draw samples.

Districts were also supposed to ensure that water sat for between 8–48 hr prior to sampling. Few districts, however, reported compliance with this testing requirement when reporting out their findings—in fact, only 25% affirmatively stated following this requirement. Similarly, other testing requirements were not thoroughly reported on district websites, including posting signs not to use outlets prior to testing (only 7% reported posting signs), the use of HDPE 250 mL bottles (only 20% reported using them), and not removing aerators prior to testing (none of the districts included this information in the reports of testing). Additionally, 62% of districts in the subsample that reported results said they used a certified laboratory. The majority (81%) of district results indicated that testing had been done in compliance with the Safe Drinking Water Act.

Lead in Water Findings and Remediation

We found that 95% of the districts in the subsample for which results were available reported finding any lead in their water. In 76% of districts with results, there was at least one outlet that exceeded the U.S. EPA action level for lead in drinking water. Of those exceeding 15 ppb, we determined that at least 63% had excessive lead in at least one fixture that a child drinks from or could possibly drink from (e.g., water fountains, bubblers, or classroom sinks). This finding was difficult to evaluate, however, because not all laboratory reports provided descriptions of the outlets tested: some were identified only numerically, so this percentage likely is an underestimation.

We found that 81% of districts with lead >15 ppb provided information on their plans to remediate drinking water outlets. Schools were required to end the use of drinking water outlets exceeding 15 ppb.

Discussion

The majority of school districts in New Jersey complied with state Department of Education requirements to fully test all drinking water outlets in all schools within their districts during the 365-day period from 2016–2017. Lead was detected in at least one drinking water outlet in the majority of districts in New Jersey and the majority also found lead in excess of the U.S. EPA action level in at least one outlet. Extremely high levels of lead in drinking water were found in some schools. The results argue for the importance of requiring comprehensive lead testing and remediation in schools.

We noted the majority of schools complied with key testing requirements such as testing within the year, first-draw sampling, use of certified laboratories, and conducting analysis according to Safe Drinking Water Act requirements. Other testing requirements, although they might have been followed (such as posting signage and not removing aerators), were not adequately reported. This reporting gap should be addressed in subsequent rounds of testing and reporting as they are key aspects of ensuring accurate results.

Some of the most significant problems we noted were with public reporting of results. Some district results were difficult to find online or were incomplete (e.g., missing laboratory reports). Additionally, the location of reports on district websites varied. Although many districts had a link from the district home page to the results, others did not, making it difficult to find results. If results were not on the district home page, common page locations were buildings/grounds/facilities, district news/notices, or mandated information. Additionally, some districts posted testing results on the district home page, while others posted results on individual school websites within the district.

For future rounds of testing, the state should require standardization of website reporting. We recommend requiring a link in an obvious location on district and individual school home pages. The link should go directly to a letter that explains the health effects of lead, how lead gets into water, the water testing process, and results of the testing. This information should be at an eighth-grade reading level and translated into appropriate languages. Laboratory results should also be accessible through this link.

While most districts provided a letter explaining results to parents along with actual laboratory results, some districts posted only laboratory results, with no explanation of the testing or the results. Particularly unhelpful were the few districts that reported their results as >15 ppb or <15 ppb without providing the actual laboratory results or concentrations of the lead found in the water testing. Only districts where lead in drinking water exceeded 15 ppb were required to provide risk communication letters to parents; this action should be required of all schools regardless of the lead concentrations found, because laboratory results can be difficult for lay people to read and interpret.

Beyond district website reporting, New Jersey should develop electronic reporting requirements that result in a statewide database in which progress toward lowering lead concentrations in school drinking water can be monitored and assessed. New Jersey Future, a nonprofit organization, made a similar recommendation in their preliminary analysis of New Jersey's testing data (New Jersey Future, 2017).

Notably, New Jersey's law for lead testing in school drinking water does not include requirements for addressing health concerns associated with elevated concentrations of lead in drinking water. The school district with the highest concentration of lead in drinking water in this study advised parents in a letter reporting the results to talk to their healthcare providers if they had concerns about their child's exposure. Maryland's lead testing law requires school districts to report elevated samples to the state department of health (Maryland Department of the Environment, 2017). This requirement is one that New Jersey should consider. The New Jersey Department of Health could then determine what type of follow up might be

needed, as well as how to implement that follow up.

While the majority of school districts that found lead >15 ppb in their schools' drinking water reported that they planned to take out of service and/or remediate those drinking water outlets, the state should monitor remediation efforts, ensure that lead concentrations have been reduced under the U.S. EPA action level, and develop a set of best practices for all New Jersey school districts.

According to the U.S. Government Accountability Office, eight states (including the District of Columbia) have implemented lead testing requirements for school drinking water. In most of these states, including New Jersey, the law is limited to public schools and in some cases, charter schools. New Jersey also requires private schools that have contracts with public districts to serve special education students to comply with the lead testing requirements. Maryland is currently the only state to require all private schools to test their drinking water (GAO, 2018).

The testing and reporting requirements for school districts vary by state with New Jersey's law being one of the most stringent and potentially health protective. New Jersey required that all drinking water outlets in every school be testing within the first year after passing the law. In contrast, California's law recommends the sampling of 1–5 drinking water outlets per school by July 2019. The New Jersey law also has provisions for resampling every 6 years while the California law does not. Other states have shorter intervals for retesting, such as Maryland (every 3 years) and Minnesota (every 5 years) (GAO, 2018). New Jersey requires that districts take outlets that are above the U.S. EPA action level offline and communicate remediation plans to parents. In contrast, the Minnesota law only covers testing of school drinking water and not remediation (Minnesota Department of Health, 2019).

New Jersey also reimburses school districts for the cost of testing, while other states expect districts to shoulder the entire cost (GAO, 2018). In light of its strict requirements for testing and remediation, New Jersey's law can be a model for other states considering similar legislation.

Limitations

We assessed compliance by looking for and examining test results and communications with parents on district websites, which was the only format in which the data were available. As such, we might have underestimated compliance with the law due to this approach. Furthermore, test results might have been posted and then removed, leading us to have not counted them. It is also possible that we did not find some test results because they were difficult to find on district websites in some cases. Finally, we might have undercounted compliance with testing requirements if the information was not included in laboratory test results or letters to parents.

Conclusion

Although few states mandate testing of drinking water outlets in schools, the experience in New Jersey demonstrates that such a requirement is an important public health strategy for protecting children from the harmful effects of lead. If New Jersey had not mandated testing of all drinking water outlets in each district in the state, hundreds of drinking water outlets in New Jersey schools would not have been identified as harmful exposure points for lead—and action would not have been taken to end use or remediate these outlets.

New Jersey's regulation is a good first step toward protecting children's health from lead exposure in drinking water in schools. Of note, almost all districts that reported results found lead in drinking water at detectable levels. This information, combined with the recognition that the current U.S. EPA action level of 15 ppb was not set as a health-based standard (Jonas, 2015), New Jersey should consider lowering its action level at which drinking water outlets should be remediated. Because there is no safe level of lead exposure, the American Academy of Pediatrics (2016) recommends that "state and local governments should take steps to ensure that water fountains in schools do not exceed water lead concentrations of 1 ppb." Parks and coauthors (2018) argue, however, that "meeting this goal with current plumbing and fixtures will be challenging because current 'lead-free' standards did not anticipate targets this low." Therefore, even schools with new plumbing and fixtures would be required to use lead filters to meet this standard (Roy & Edwards, 2019).

Finally, in the absence of strong U.S. EPA leadership at a national level, states are left to determine how and if they will ensure that drinking water in schools does not exceed action levels for lead. New Jersey should study the implementation of its mandated lead-in-water testing program, along with the outcomes of its remediation, in order to provide best practice recommendations that would be useful to other states.

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