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Lead by Example: New York's Effort to Protect Its Children from Exposure to Lead in Drinking Water in the Post-Flint Era

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URMIA

Take a course in good water and air; and in the eternal youth of Nature you may renew your own. Go quietly, alone; no harm will befall you.

—John Muir,

Scottish-American Naturalist, Author, and Wilderness Advocate

Lead by Example: New York's Effort to Protect Its Children from Exposure to Lead in Drinking Water in the Post-Flint Era

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Introduction

The entrance to the Van Cortland Park Valve Chamber was through a non-descript metal door set in stone block and built into a grass-covered rise in the North Bronx. We entered, signed our waivers, and donned our green New York City Department of Environmental Protection (DEP) hard hats. Then we proceeded through a damp tunnel to a construction elevator that descended 25 floors beneath the city streets to a valve chamber the size of several football fields. When we stepped out of the elevator, we had the sense of walking into some futuristic science fiction scene or onto the set of an old James Bond movie. After several beats, our guide brought us back to the present, reminding us that this valve chamber controls hundreds of millions of gallons of New York City drinking water, some of which was flowing through the cement-lined, 24-foot diameter Third Water Tunnel cut through bedrock hundreds of feet below where we stood.

Futuristic or not, this valve chamber is part of the latest phase of a water system that was started, ironically, as part of a joint venture between Alexander Hamilton and Aaron Burr in 1799.[1] That venture, which turned out to be a bit of legislative sleight of hand on Burr's part, never met its purported goal of transporting water from the Bronx River to lower Manhattan. Nevertheless, four-and-a-half decades and one very famous duel later, New Yorkers were drinking fresh water from the Croton watershed in Westchester County. Today, New York City consumes more than a billion gallons of water a day, much of which flows courtesy of gravity from mountain reservoirs more than a hundred miles to the north and west.[2]

The lessons learned from water systems in Flint, Michigan, and elsewhere over the past several years have illustrated how a relatively small amount of lead in the water—15 parts per billion, to be precise—can influence public policy.

Fascinating as the story of New York City's water system may be, this article is about a small segment of that story: protecting New York's children from elevated exposure to lead from drinking water. To be fair, exposure to lead in drinking water is significant, but only one of many municipal water quality challenges. Still, the lessons learned from water systems in Flint, Michigan, and elsewhere over the past several years have illustrated how a relatively small amount of lead in the water—15 parts per billion, to be precise—can influence public policy.

Regardless of the reader's familiarity with New York City's water system or the recent events leading to elevated lead levels in Flint's drinking water, this article will provide background on the sources of elevated blood lead levels in children—especially from lead in drinking water—and its health effects. It will then touch on some of the issues that Flint had to address and explore the practices that New York follows to help minimize those risks. In particular, it will include changes that New York adopted in sampling protocols to minimize potential exposure to children in its public schools.

Finally, because this is written with university risk managers in mind, it will touch on the risk implications for colleges, universities, and other institutions where young children may be exposed to lead in drinking water on a regular, occasional, or seasonal basis. These institutions may have childcare centers, specialized public schools, summer camps, after school programs, and other activities that host these vulnerable populations. Hopefully, this will contribute to the reduction of lead in drinking water in these settings and enhance our ability to protect children from lead exposure.

Lead and Public Health

Sources of Exposure

Lead is a naturally occurring heavy metal that has been in use for thousands of years. Because it melts at a relatively low temperature and is soft and malleable, it has many commercial and industrial uses. On the other hand, it is a known neurotoxin that bioaccumulates and causes damage to the brain and nervous system. It is especially harmful to young children. To protect children from the threat of exposure, the potential for elevated blood lead levels, and the resulting health and developmental impacts, three common sources of exposure were banned in the United States: leaded gasoline, house paint, and plumbing fixtures.[3]

By the late 1970s, with the initiation of the Environmental Protection Agency's (EPA) ultimate ban of leaded gasoline—one of the great American environmental success stories—exposure to lead in the air, or in the soil near heavily trafficked roads where lead particles were deposited, was significantly reduced.[4] In 1978, lead-based paint, another source of lead exposure, was banned, and subsequent regulations were promulgated to protect children—especially in older, poorly maintained buildings—from ingesting lead-based paint chips.[5] The 1986 requirement for "lead free" piping in public water systems and household plumbing installations, followed in 1991 by EPA's Lead and Copper in Drinking Water Rule, provided further protection from lead ingestion through potable water.[6] These requirements, however, do not obligate the removal of existing plumbing, and, therefore, many existing lead pipes and fixtures remain.

Lead in drinking water can come from lead in the surface water or groundwater source. It can leach from the water provider's lead supply pipes, joints, pumps, or fixtures. And it can leach from a building's plumbing system—lead pipes, joints, solder, and fixtures. Lead cannot be detected in drinking water without sampling because it has no identifying taste, color, or smell.[7] All drinking water suppliers must sample for lead under the Safe Drinking Water Act,[8] and there are state and local sampling requirements for lead in drinking water at schools and childcare facilities. EPA provides guidelines for flushing and other measures to minimize potential exposure, but of course reducing the hazard at the source is preferable.[9] In the case of Flint, the water supply was corrosive and as a result the lead leaching was exacerbated.

Health Effects of Lead Exposure on Children

As noted, lead is a neurotoxin and, therefore, its primary effect is on the nervous system. Sustained exposure can result in additional health effects, including brain and kidney damage and ultimately death. For children, the impact of lead on the still-forming brain and nervous system can result in developmental issues that will affect the child for life. And while removing the source of exposure is always salutary, some impacts cannot be reversed. This is especially true for children whose bodies cannot reduce enough of the lead through the body's elimination processes to prevent permanent bioaccumulation in bone and tissue.[10]

The silver lining in this story is that lead blood levels in children have declined as a result of the aforementioned bans on leaded gasoline, lead-based paint, and lead plumbing fixtures. But again, the events in Flint remind us that the story is far from over.

Lead in the Flint, Michigan, Water System

Historians suggest that the citizens of ancient Rome may have had elevated blood lead levels because of the lead water pipes that were a symbol of Imperial engineering prowess.[11] Some even attribute the decline of the Roman Empire in part to lead poisoning.[12] Unfortunately, Flint has become a contemporary synecdoche. In spite of our scientific and regulatory advances, the Flint water crisis demonstrated that even in the 21st century, room for progress in this arena remains.

Like so many aging, economically stressed Rust-belt cities, Flint was under extraordinary pressure to cut costs. Among the "luxuries" that Flint provided to its citizens was Detroit Water and Sewerage Authority water, which was sourced from Lake Huron and the Detroit River. As one of many cost cutting initiatives, Flint decided that it could no longer afford to pay for Detroit water and would instead rely on Flint River water, beginning in April 2014. As everyone now knows, it appears to have been a penny wise and pound foolish decision. The Flint River water was more corrosive and was not adequately treated. This caused lead to leach from the city's many lead service lines and soldered joints. It exposed thousands of Flint

residents, many of them children, to elevated lead levels. The immediate threat has dissipated, but the events in Flint will have public policy ramifications throughout the United States for years to come.[13]

New York Water

New Yorkers (including this author) have been known to boast about the quality of New York City's drinking water. We cannot understand why people would waste energy and precious landfill space on bottled water when all they have to do is turn on any New York City tap. But New York City's water quality is a combination of heavenly blessing and two centuries of human enterprise dating back to before—and some say causing—the duel between Alexander Hamilton and Aaron Burr referred to above. In fact, some of the tap water coursing under Manhattan today flows through aqueducts built in the 19th century that are reminiscent of those providing water to Imperial Rome. What they did not have in Rome, though, is the 21st century quality assurance available to the New York City DEP, which collects and analyzes 630,000 samples a year from 1,000 sampling stations throughout the five boroughs.[14] These sample results, and a wide array of water quality information, are published in the DEP's annual Water Quality Reports.[15] As the *2016 Report* highlights:

> *New York City gets its drinking water from a surface supply system that comprises 19 reservoirs and three controlled lakes spread across a nearly 2,000-square-mile watershed. The watershed is roughly the size of the State of Delaware, extending 125 miles north and west of New York City. The New York City Water Supply System consists of three individual water supplies: the Catskill/Delaware supply, located in Delaware, Greene, Schoharie, Sullivan, and Ulster counties; the Croton supply, New York City's original upstate supply, in Putnam, Westchester, and Dutchess counties; and a groundwater supply in southeastern Queens. In 2016, New York City received a blend of drinking water from the Catskill/Delaware and Croton supplies. The Catskill/Delaware supply provided approximately 91 percent of the water, and approximately nine percent was supplied by Croton. Water from the groundwater supply was not fed into distribution in 2016.*[16]
>
> *Due to the very high quality of [the] Catskill/Delaware supply, New York City is one of only five large cities in the country with a surface drinking water supply that does not require filtration as a form of treatment. Rather, the Catskill/Delaware supply operates under a Filtration Avoidance Determination (FAD), and the water from the supply is treated using two forms of disinfection to reduce microbial risk. First, water is disinfected with chlorine before arriving at the Catskill/Delaware Ultraviolet (UV) Disinfection Facility. Chlorine is a common disinfectant added to kill germs and stop bacteria from growing on pipes. The UV Disinfection Facility, located in the towns of Mount Pleasant and Greenburgh in Westchester County, is the largest of its kind in the world. It consists of 56 UV disinfection units that contain a total of 11,760 large UV light bulbs. The facility is designed to disinfect more than two billion gallons of water per day.*[17]

Anyone who has tried to keep the water in a swimming pool clear understands that the process is like a summer-long chemistry experiment with chlorine, algaecide, pH adjusters, and other chemicals. One of the underlying causes of the water issues in Flint was the failure to attain proper chemical balance.

It is nice to think that the best drinking water is chemical free, but that is often not the case. More important—and effective—is for suppliers to ensure that the chemicals are in balance. Anyone who has tried to keep the water in a swimming pool clear understands that the process is like a summer-long chemistry experiment with chlorine, algaecide, pH adjusters, and other chemicals. As noted, one of the underlying causes of the water issues in Flint was the failure to attain proper chemical balance. The lesson was not lost on other water suppliers.

New York does not rely solely on the quality of its water source.

> *[The] DEP also adds food grade phosphoric acid, sodium hydroxide, and fluoride to the water before sending it into distribution. Phosphoric acid creates a protective film on pipes that reduces the release of metals, such as lead, from service lines and household plumbing. Sodium hydroxide is added to raise the pH and reduce corrosivity, which also reduces the potential for lead to enter water from household plumbing. DEP is one of the many water suppliers in the United States that treat drinking water with a controlled, low level of fluoride for the protection of its consumers' dental health. New York City's drinking water has been treated with low levels of fluoride since 1966.*[18]

For lead in particular, the DEP has specific guidance. Unlike the water supply issues in Flint, New Yorkers have been fortunate that we only have to focus on the plumbing systems inside our buildings for lead contamination. For lead in the drinking water supply, the DEP has very extensive monitoring protocols.

> *New York City water is virtually lead-free when it is delivered from New York City's upstate reservoir system, but water can absorb lead from solder, fixtures, and pipes found in the plumbing of some buildings or homes. DEP has an active corrosion control program aimed at reducing lead absorption from service lines and internal plumbing. Under the federal Lead and Copper Rule, mandated at-the-tap lead monitoring is conducted at select households throughout New York City. In 2016, based on the results of this monitoring, the 90th percentile did not exceed 15 µg/L [15 parts per billion], the established standard or Action Level for lead.*[19]

And finally, the DEP seems to follow the universal risk management mantra of hoping for the best while preparing for the worst. After assuring New Yorkers that the water supply is safe, it closes with some practical and cautionary advice about the water in their homes.

> *It is possible that lead levels at your home may be higher than at other homes in the community as a result of materials used in your home's plumbing. DEP is responsible for providing high-quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your water, you may wish to have your water tested. DEP offers free testing to New York City residents. The Free Residential Testing Program is the largest of its kind in the nation: DEP has distributed over 113,000 sample collection kits since the start of the program in 1992 and saw an almost 400 percent increase in demand for testing in 2016 compared to the previous year.*[20]

New York's sophisticated sampling only checks the billion-plus gallons of water flowing daily through New York City's water mains; it does not address the water flowing from the main to private faucets, a trip that sometimes passes through lead service lines or lead-soldered joints.

Post-Flint Requirements in New York

Again, New York's sophisticated sampling only checks the billion-plus gallons of water flowing daily through New York City's water mains; it does not address the water flowing from the main to private faucets, a trip that sometimes passes through lead service lines or lead-soldered joints. Prompted in part by the Flint water crisis and a renewed nationwide awareness of the risk of lead exposure in our drinking water, New York felt that action was warranted. And while nobody should be exposed to any water contaminants above regulatory levels, young children are the most vulnerable to exposure and should receive priority attention. To that end, New York enacted legislation and promulgated regulations requiring its pub-

lic schools to sample for lead using specific methods and to develop remediation plans where elevated lead levels are found.[21] Unlike the EPA guidance cited above, which allows for flushing, the New York rules require that the samples be collected "from a cold water outlet where the water has been motionless in the pipes for a minimum of 8 hours but not more than 18 hours."[22]

The requirements are very specific in spite of the enormity of the task. Because of the vast number of schools that have to be tested, a phased approach was developed so that schools with the most vulnerable (i.e., youngest) students would be sampled first. The following summary of the new requirements was issued in a press release from the Governor's Office.[23]

> *Previously, schools in New York were not required to test their drinking water for lead, or notify parents or government officials of results. Testing was voluntary and administered by the federal Environmental Protection Agency. This method of voluntary testing without enforceable standards has demonstrated the clear need for direction by the state to New York schools on when, what and how to sample drinking water for lead.[24]*
>
> *By September 30, 2016, all school buildings serving children in pre-kindergarten through grade five must collect a sample from each identified sampling location for testing. Any schools serving children in grades six through 12 that are not also serving children in younger grades must complete collection of samples by October 31, 2016. For new schools, which begin operations after the effective date of this regulation, initial samples must be performed prior to occupancy.[25]*
>
> *Under the regulations, schools are required to report all lead test results to the state Department of Health via a designated statewide electronic reporting system. If lead levels are detected above 15 parts per billion at any potable water outlet, the school must discontinue use of that outlet, implement a lead remediation plan to mitigate the lead level, and provide building occupants with an adequate [alternative] supply of water for cooking and drinking.[26]*
>
> *Schools must report the exceedance to the local health department within one business day. Test results must also be provided in writing to all staff and parents no more than 10 business days after receiving the report. Schools must post the results of all lead testing and any remediation plans on its website as soon as possible but no more than six weeks after the school received the laboratory reports. Once test results indicate that lead levels are below the action level, schools may resume use of the water outlet.[27]*
>
> *For schools that performed testing and remediation at buildings after January 1, 2015, and that complies with these regulations, those buildings do not need to be retested. Schools may also be eligible for a waiver for testing school buildings, if the school can demonstrate that they performed testing and remediation that substantially complies with the regulations, and that lead levels in the building's potable water are below the action level.[28]*
>
> *Schools will be required to collect samples every five years, at a minimum, after the initial testing or at a time determined by the Commissioner of Health. All samples will be analyzed by a lab approved by the Department's Environmental Laboratory Approval Program.[29]*
>
> *Although laws now limit the amount of lead in new plumbing equipment, materials installed before 1986 may contain significant amounts of lead. Federal laws in 1986 required that only "lead-free" materials be used in new plumbing and plumbing fixtures but still allowed certain fixtures with up to 8 percent lead to be labeled "lead free." Amendments to the Safe Drinking Water Act in 2011 appropriately redefined the meaning of "lead free." Even so, it's possible that older plumbing may leach lead into the drinking water.[30]*
>
> *Facilities such as schools, which typically have intermittent water use patterns, are more likely to have elevated levels of lead due to prolonged water contact with plumbing materials. This source is increasingly being recognized across the nation as a contribution to a child's overall lead exposure.[31]*

The fact that New York requires sampling in all public schools, including high schools with students who are older, shows how seriously the state is treating this health threat. At this time, colleges, universities, libraries, hospitals, and other institutions have not been included in the requirements, presumably because they do not cater primarily to vulnerable populations.

Drinking Water at Universities and Other Institutions

Although students, faculty, and staff are almost all 18 and older, there are still many occasions where we find minors and even small children on campus. Many campuses have childcare centers for children while their parents are in class. Because of the unique vulnerability of these very young children, the New York City Department of Health and Mental Hygiene and the New York City Department of Education regulate and enforce lead testing in the centers. In fact, childcare centers in New York cannot obtain the necessary licensure without demonstrating that test results proved negative for lead in drinking water.

It is not uncommon, especially at public universities, to have public schools—generally high schools—collocated on college campuses. In New York, any collocated schools must comply with the new lead testing protocols and standards. Because of this more stringent sampling methodology, there have been additional detections, and universities must work with the public schools on their campuses to minimize these risks. Additionally, children use campus cafeterias, libraries, gyms, pools, and other facilities for after school programs and summer camps, which raises additional concerns.

New Yorkers rely on the DEP's testing of the water supply, the results of sampling at our child care facilities, and the results of public school sampling by the Department of Education to provide a water quality baseline. Nevertheless, colleges, universities, and other institutions have become more sensitive to drinking water quality as students, faculty, and staff are becoming better acquainted with the risks. Regardless of the actual threat, which has to be addressed on a case by case basis, student and faculty leaders have been raising concerns, and administrators must be prepared to respond to reports of potential drinking water quality issues. Combined with the recent outbreaks of Legionella, which have placed cooling towers and other water system components in higher relief, water quality will likely remain a high-profile campus concern for the foreseeable future.[32]

Conclusion

This story began deep below the hustle and bustle of the Bronx, at the user end of one of the best and most sophisticated water systems in the world. It closes at one of the water system's bucolic sources, the Ashokan Reservoir in the Catskill Mountains, about a two-hour drive north of the Van Cortland Valve Chamber. It was built in the early 20th century, holds more than 120 billion gallons of water, and is 180 feet deep at its deepest point. It is fed by the Esopus Creek and the Schoharie Reservoir to the north. Together, these reservoirs supply 40 percent of New York City's drinking water.[33]

This story began deep below the hustle and bustle of the Bronx, at the user end of one of the best and most sophisticated water systems in the world. It closes at one of the water system's bucolic sources, the Ashokan Reservoir in the Catskill Mountains.

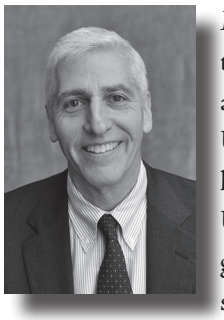
The trip that the water takes includes the 92-mile Catskill Aqueduct, a stop at the Kensico Reservoir in the Croton system, where the Delaware and Catskill waters are combined, and a final stop at the Hillview Reservoir in Yonkers, just north of the Van Cortland Valve Chamber.[34]

Unless you are familiar with the area and have hiked or biked around the reservoir—which I recommend—or are a water system buff, the Ashokan is little more than a cultural reference. "Ashokan Farewell" is a haunting lament written in 1982 by Jay Ungar and Molly Mason that is best known as the theme for "The Civil War," the Ken Burns television documentary aired in 1990. And the original Woodstock, New York—after which the renowned arts colony and the iconic 1969 music festival[35] are named—rests at the bottom of the reservoir.[36]

But if you are a water system buff, or just a concerned citizen worried about the quality of your drinking water in the post-Flint era, the Ashokan is more than the scenic starting point of what Dr. Mary Bassett, New York City's

Health Commissioner, refers to as the "best beverage for your health."[37] It is a symbol of the creativity and commitment of New York's leaders and builders, from 1799 through today, to provide our children with clean, plentiful water. So if you are lucky enough to get tickets to "Hamilton,"[38] the Broadway musical, pass on the bottled water during intermission and take a long swig at the water fountain in his honor. Cheers!

About the Author



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Earlier in his career, he served for several years in New York City government at the Mayor's Office, the Board of Education, and the Sanitation Department. He left municipal government to pursue a career in environmental and risk management consulting, which included eight years as a principal, and ultimately national director, of a nationwide consulting firm, which led to the founding of Apsan Consulting. He has served industrial, commercial, real estate, government, and not-for-profit clients throughout the United States and has extensive international experience.

In addition to his management and consulting activities, he has been a member of the faculty at Columbia University's School of International and Public Affairs since 1986 and also teaches in Columbia's Sustainability Management program. He is a LEED Accredited Professional and has served on the United States Technical Advisory Group (US TAG) for ISO 14000, the American Society for Testing and Materials (ASTM) Environmental Committee (E-50), and the Environmental Commission in Springfield (New Jersey), where he is also a lieutenant in the police reserve. He chaired the New York Chamber of Commerce Environment and Energy Committee and the New York Chapter of the Environmental Auditing Roundtable, and he was the president of a community-based non-profit corporation. He is a member of the Editorial Board of *Environmental Quality Management* and writes and lectures regularly.

He earned his B.A. and M.A. from Brooklyn College and his M.Phil. and Ph.D. from Columbia University.

Endnotes

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[34] NYC DEP, "Ashokan."

[35] The Woodstock Music and Art Fair, "An Aquarian Exposition: 3 Days of Peace & Music," lasted four days, August 15-18, 1969, and was actually held in Bethel, New York, about a 60-mile drive from the town of Woodstock.

[36] The approximate location is noted on a road sign along New York State Route 28 on the northern edge of the reservoir.

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Water is life's mater and matrix, mother and medium.

There is no life without water.

—Albert Szent-Györgyi,

Hungarian Biochemist and

Winner of the Nobel Prize in Physiology or Medicine in 1937

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