Can We Rid Our Drinking Water Supply of Lead?

By Kelly A. Reynolds, MSPH, PhD

As evidenced by national media headlines, congressional hearings and town hall meetings, concern over lead contamination in the US continues to rise. Since the lead drinking water exposure disaster in Flint, MI, there has been an increased focus on drinking water supplies and safety. Cities other than Flint are known to be vulnerable and stakeholders want lead out of their drinking water and distribution pipes. Keeping water lead-free, however, requires a significant investment in monitoring, treatment and infrastructure replacement.

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More cities at risk

A recent review in *The New York Times* reports that lead crises similar to the one in Flint have occurred with some regularity in numerous US cities (Sebring, OH in 2015; Jackson, MS in 2015; Durham and Greenville, NC in 2006; Columbia, SC in 2005 and Washington, DC in 2001).[1] In multiple instances, changes in water treatment practices resulted in increased corrosion of pipes, resulting in unsafe levels of lead leaching from the distribution channels. Another common theme in drinking water lead exposures is that residents were often not immediately informed of the problem and continued consuming the harmful water for months or even years.

A *USA Today Network* investigation surveyed US EPA's Safe Drinking Water information system and found 2,000 water systems with lead exceedances over the last four years.[2] The article further detailed that six million people were exposed to these high lead levels and at least 180 of the water systems in violation of the US EPA action level (15 ppb) did not notify consumers about the risks. Samples were collected at schools and daycare centers, where the most sensitive populations were found to be exposed at lead levels 14 to 42 times higher than the action level. Texas, Pennsylvania, New York and California reported the greatest number of exceedances (see www.usatoday.com/longform/news/2016/03/11/nearly-2000-water-systems-fail-lead-tests/81220466/ for a complete listing of state and county test results).

Homes built prior to 1986 likely have lead pipes, fixtures or solder. Solders commonly contained about 50-percent lead until 1986. Even if these items were labeled lead-free, small amounts of lead (up to eight percent until 2013 and now 0.2 percent since 2014) are still allowed. Lead concentrations in drinking water range from five to 30 ppb, with the majority testing below 15 ppb.[3]

Subtle but severe health effects

When ingested via contaminated drinking water, approximately 20 percent of the lead is absorbed into the body. Short-term exposures can be measured in the urine (excreted levels) and blood (absorbed levels), while long-term exposures are monitored in bones. There are no safe levels of lead exposure, but the most adverse outcomes occur following chronic, cumulative exposures. Intellectual impairment has been documented in children with less than 7.5 ug/dL of body blood levels.

Drinking water lead levels above 15 ppb are associated with a 14-percent increase in the percentage of children with blood lead levels above 10 ug/dL.[4] At these levels and lower, children begin to lose IQ points and have a greater than four-fold increase in the risk of ADHD (attention-deficit hyperactivity disorder).[5] Even small decreases in intellectual development are associated with behavioral problems and increased criminal activity. Children under the age of six are most at risk for developmental disorders. Adults are not as susceptible to developmental disorders but exposure to lead has also been associated with cancer, stroke, heart disease, hypertension, mental retardation and IQ (intellectual quotient) loss.

Challenges in control

US EPA has set a non-enforceable action level of 15 ppb of lead in water that has sat stagnant in pipes for at least six hours. This is known as the *Lead Control Rule (LCR)* and requires water utilities to monitor for lead at consumer taps in homes. If >10 percent of the samples collected from a water utility serving <50,000 residents exceeds the action level, the utility must identify and install optimal corrosion control treatment. Utilities serving ≥50,000 residents are required to have optimal corrosion control treatment regardless of the level of lead in drinking water. Any size water utility exceeding the lead action level and covered by *LCR* is required to educate the public about lead in drinking water until water levels are below the action level. Most US drinking water systems are in compliance with *LCR*. During a 2000-2003 survey by US EPA, <3.6 percent of municipalities exceeded the action level.[6]

The *LCR* is currently under revision and a national call to eliminate lead risks by removing all lead service lines is gaining momentum. Although Congress banned lead pipes 30 years ago, millions of lead lines are still in use. In a recent report by the American Water Works Association, researchers estimated there are 6.1 million lead service lines in the US, down from 10.2 million in 1991.[7] About seven percent of homes served by municipal supplies (or up to 22 million people) remain at risk. The greatest concentration of lead service lines is in the Midwest but more than 11,000 utilities (approximately 30 percent of the total number) nationwide are affected. Cost for removal of the remaining pipes is estimated at $30 billion (USD). This value is in addition to the $1-trillion-dollar price tag to repair the water distribution network more broadly.

One of the difficulties in getting the lead out of our water supply is that premise plumbing (i.e., residential pipes) is a significant contributor. Leaded plumbing, fixtures and solder in household pipes add to the contamination and as water sits in the premise plumbing during extended periods of non-use, contaminants effectively leach into the water. Lead levels can be dramatically reduced in tap water by first flushing the system before using. Letting the water run for at least 30 seconds before using to drink, cook or prepare baby formula can prevent harmful exposures.

Conclusion

Although replacing water distribution infrastructure will help to reduce lead exposures it will not fully prevent them due to lead sources in the premise plumbing. Thus, POU/POE treatment is preferred for maximum lead removal. The most common POU devices for lead removal are reverse osmosis, distillation and activated carbon filtration and adsorption; removal rates are often greater than 95 percent. A precautionary approach is warranted as history indicates another Flint is bound to occur and that yet another contaminant will eventually be in the spotlight.

References

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