Corrosive Conditions—How This Common Issue Impacts Public Health

By Kelly A. Reynolds, MSPH, PhD

Recent events related to corrosive water and lead exposures in Flint, MI have highlighted national issues of water quality, infrastructure needs and public health risks. While the Flint event is devastating to the community, it provides a warning to others on the unpredictability of water quality and needs for improvement across the US.

What happened?

In April 2014, officials began sourcing water from the Flint River as opposed to Lake Huron, in order to save money by not purchasing their supply from Detroit water sources. The supply switch was always intended to be temporary and in fact, the city switched back to the Lake Huron source in October 2015, but not before significant exposures occurred to water consumers and some of the most vulnerable populations.[1]

Water managers frequently make decisions on how best to source water supplies to meet ever-changing community needs. When new water supplies are sourced, however, characteristics of the different water supplies must be considered and potentially treated. In Flint, residents immediately noted a change in the water aesthetics, claiming it looked, smelled and tasted different than before. The new water supply was reportedly more corrosive and, since many of the water distribution lines in Flint contain lead, increased amounts of the heavy metal leached into the drinking water supply.

Results from Virginia Tech studies showed 10 percent of homes in Flint had greater than or equal to 25 ppb of lead, exceeding the 15 ppb federal limit. The average amount of lead in Flint's water was 10 ppb, which is expected to result in a high health risk for infants drinking formula made from the tap water and significant health risks for estimated drinking water exposures in children aged one to two years.[2,3] Similarly, pregnant women are also at risk of increased miscarriages and fetal damage with even mild increases in blood lead levels. Higher levels can further result in developmental disorders in children.

Some of the effects of lead exposures manifest in ways that are difficult to trace. For example, an increase in learning disabilities or the decrease in intellectual development in children may occur following lead poisoning. Other effects include loss of appetite and weight loss, memory loss, irritability, anemia, weakness and organ damage. In children, neurological effects and mental retardation can also occur.[4]

The blame game

Various stakeholders in Flint and beyond are weighing in on the water quality problem, why it occurred and who is to blame. Celebrities, politicians and presidential hopefuls are leveraging this crisis to drive agendas ranging from environmental stewardship to social injustice to government malice. A federal investigation is reportedly underway to determine if city officials were aware of toxic lead levels in the water prior to positive results in the Virginia Tech studies from August 2015. Class-action law suits are being filed by Flint residents, naming the governor, the state Department of Environmental Quality and certain city managers as responsible for the tragedy.

While the federal investigation is ongoing, media reports continue to describe a scenario of negligence: lack of testing for lead in the finished water supply, failure to test and treat the corrosiveness of the water and ignorance of health department reports of increased blood lead levels in Michigan children, as well as scientists' reports of lead levels in the water exceeding federal action levels. Regardless of the factors specific to Flint, there remains a national problem of water supply sustainability and an aging water distribution infrastructure.

Fixing the problem

On January 15, President Obama declared a state of emergency in Flint authorizing the Federal Emergency Management Agency (FEMA) to provide federal aid and appropriating millions of dollars for provision of drinking water, filters and other items to local residents. The National Guard was also deployed to assist in dispersing cans of water to the city's population of 100,000 in response to high levels of lead contaminants in the municipal drinking water supply.

This is a temporary fix toward a much larger issue. Infrastructure improvements are needed in many US cities, particularly in the older Midwest regions where pipes may be more than 100 years old. Cracks and leaks in the water distribution system are broadly acknowledged. According to an article in *The Detroit News*, Flint's water infrastructure replacement needs will cost an estimated $767 million for replacement of public and private distribution lines.[5]

Prior to 1986, homes were commonly constructed with lead pipes and fixtures, but newer home construction may also result in lead exposures. Between 1986 and 2014, plumbing could be labeled as lead-free and still have up to eight-percent lead content. In 2014, however, amendments to US EPA's *Safe Drinking Water Act (SDWA)* mandated a maximum of 0.25-percent lead in plumbing fixtures. In 1991, US EPA's *Lead and Copper Rule (LCR)* identified techniques for reducing these contaminants in drinking water. Part of the rule required monitoring at consumer taps with an action level of 15 ppb of lead. Exceedances typically prompted

the action of corrosion control treatment.

Corrosion control may include adding chemicals to create a barrier between the water and pipes (i.e., orthophosphates) or to modify water pH and hardness. Managing any corrosion-control intervention is complicated by the variable nature of drinking water and interactive water chemistry parameters.

Protecting your family

A number of factors can impact lead levels in water, including the amount of lead in the pipes and residence time, but also the chemistry of the water. Changes in water chemistry related to increased acidity and alkalinity can cause pipe corrosion and leaching of lead and other contaminants into the water. Treatment plants balance corrosion by diluting or treating the water with additives to reduce the corrosiveness but such actions and their potential risks are usually not known by the consumer in real time.

Residents can test for lead in their own drinking water via an inexpensive kit, purchased at home improvement or hardware stores. If your water tests positive, flushing pipes before drinking the water can reduce levels. (Researchers evaluating Flint lead exposure risks found that after three minutes of flushing, the average lead levels were reduced to four ppb, reducing potential risks. They were, however, careful to point out that no level of lead is safe in drinking water and residents of Flint should not be drinking their tap water without additional treatment to remove lead.) Controlling for lead also involves elimination of the metal in plumbing materials. Drinking water pipes, fixtures and fittings should be lead-free with levels below the 0.25-percent *SDWA* limit. Plumbing products certified by NSF International to meet *NSF/ANSI Standard 61* are already in compliance with the federal mandate.[6]

Ultimately, to ensure a lead-free water supply consumers can seek an alternative water source besides tap water or invest in lead treatment filters at the point of use. POU treatments may include reverse osmosis, distillation or specific adsorption filters.

Ultimately, to ensure a lead-free water supply consumers can seek an alternative water source besides tap water or invest in lead treatment filters at the point of use. POU treatments may include reverse osmosis, distillation or specific adsorption filters.

Tens of thousands of water filters rated for lead removal have been distributed in Flint, MI. For a list of certified lead-reduction POU devices, search NSF International (www.nsf.org) or the Water Quality Association (www.wqa.org) websites.

References

1. McLaughlin, E.C. "5 things to know about Flint's water crisis." *CNN.com*. 2016. www.cnn.com/2016/01/18/us/flint-michigan-water-crisis-five-things/. Accessed January 20, 2016.

2. Roy S. *Lead in Drinking Water–Health Risks to Flint Residents/Flint Water Study Updates*. http://flintwaterstudy.org/2015/09/lead-in-drinking-water-health-risks-to-flint-residents/. Accessed January 21, 2016.

3. Triantafyllidou, S.; Gallagher, D. and Edwards M. "Assessing risk with increasingly stringent public health goals: the case of water lead and blood lead in children." *J Water Health*. 2014;12(1):57-68. doi:10.2166/wh.2013.067.

4. *Lead: Health Problems Caused by Lead–NIOSH Workplace Safety and Health Topic*. 2013. www.cdc.gov/niosh/topics/lead/health.html#4. Accessed January 21, 2016.

5. "White House to decide soon on $96M Flint aid request." *Detroit News*. 2016. www.detroitnews.com/story/news/politics/2016/01/14/snyder-asks-obama-declare-federal-emergency-flint/78831312/. Accessed January 21, 2016.

6. *NSF International Supports New Lead-Free Definition and Regulations for Plumbing Products. 2016*. www.nsf.org/newsroom/nsf-international-supports-new-lead-free-definition-regulations-plumbing. Accessed January 21, 2016.

About the author

♦ *Dr. Kelly A. Reynolds is an Associate Professor at the University of Arizona College of Public Health. She holds a Master of Science Degree in public health (MSPH) from the University of South Florida and a doctorate in microbiology from the University of Arizona. Reynolds is WC&P's Public Health Editor and a former member of the Technical Review Committee. She can be reached via email at reynolds@u.rizona.edu*