

Private Well Water Arsenic Screening Validates the Need for POU/POE Water Treatment

By Kelly A. Reynolds, MSPH, PhD

Information obtained from screening private drinking-water wells for hazardous contaminants promotes health beneficial reaction. The understanding and commitment to consistently maintain POU/POE systems, however, remains a challenge. The POU/POE industry can help by partnering with local and federal agencies aimed at educating consumers on the benefits of water testing, interventions and long-term maintenance planning.

Arsenic impacts

The presence of arsenic in water is typically unnoticed given the contaminant cannot be seen, tasted or smelled. Any level of arsenic exposure can lead to adverse health effects. While water may be contaminated with arsenic from anthropogenic sources (i.e., pesticides, mining, coal combustion), naturally occurring sources are commonly identified in the US and worldwide.

According to the National Research Council (NRC), exposure to inorganic arsenic at the regulatory limit of 10 ppm results in up to 23 cases of bladder and lung cancer per 10,000 people.¹ Risk goals related to waterborne carcinogens are typically set at one excess cancer case per million persons, making the case that even low-level arsenic exposures result in unacceptable health burdens. Other health risks have also been identified from chronic arsenic exposures, including cardiovascular disease, diabetes, respiratory effects, adverse pregnancy outcomes and impaired intellectual development in children.²

Given the high rate of arsenic related adverse health outcomes, some states reduced the regulatory limit of total arsenic in drinking water to five ppm, a level determined to be too costly for small-system compliance nationwide. Areas with high levels of naturally occurring arsenic in soil or rock formations have documented frequent exposures in the local population. In Maine, for example, arsenic was found in 40 percent of groundwater samples and 99 percent of blood samples collected from young children.³ Those consuming well water with >5 ppm were found to have significantly lower IQ scores.

Vulnerability of private well water sources

There is an estimated excess of 13 million private wells in the United States, serving 45 million people, primarily in rural and often underserved environments. Unlike municipal water supplies regulated by the federal *Safe Drinking Water Act (SDWA)*, private well water is not subject to routine monitoring for harmful contaminants, including naturally occurring arsenic.

Studies have shown a high level and frequency of arsenic contaminated domestic wells in the US. During a 15-year (1986-2001) survey of over 7,000 private wells, more than half tested positive for arsenic (with nearly 11 percent exceeding the federal limit of 10 ppm), serving approximately 1.7 million people.⁴

Populations consuming water from wells with arsenic above the five-ppm level number at 3.8 million. Areas in New England and the western and south-central regions of the US were most at risk. Although regional trends can help to predict more vulnerable areas, high spatial variability of the contaminant-spread dictates the need for monitoring every well system.

Monitoring drives treatment compliance

Recently, researchers have explored the benefits of universal screening and approaches needed to ensure consumer compliance with monitoring and control of arsenic exposures.⁴ Zheng *et al.* (2017) found that persistent arsenic exposure is a result of households, 1) who are unaware of arsenic in their water because they have not tested; 2) who have tested for arsenic but not taking action to reduce exposure and 3) who have taken action to test and reduce exposure but remain exposed due to inconsistent behavior or failing treatment systems.⁴

In a survey of 2,000 private well residents, researchers found that up to 50 percent of households have never tested their water for arsenic. While some states have implemented policies to enforce private water-supply testing, for most states, evaluation of the quality and safety of the household water is a personal effort and choice. Income and education are clear predictors of the likelihood a homeowner will ever test their well.

Addressing the financial burden of water treatment, Florida and New Jersey have provided interest-free loans or other financial assistance to support household treatment of naturally occurring waterborne contaminants. Regulated testing can help to overcome disparities among different populations. With market costs for arsenic testing averaging around \$40, the provision of free testing has been shown triple the response rate (42 percent versus 12 percent).⁶

Education and support are also needed post-testing. A study of 256 private-well households that received high-arsenic test results found that 74 percent took some kind of corrective action (i.e., installed POU/POE treatment or drank bottled water) to control arsenic exposures. The remaining ~26 percent, however, took no protective action, where costs and a lack of concern where main drivers for inaction.^{5,3} Researchers commonly documented perception biases where homeowners trusted their private-well supplies over municipal supplies, despite a lack of any testing.

Even when consumers opted for in-house treatment, a 15-percent failure rate has been documented at the point of use. While some homes utilized effective reverse osmosis or iron oxide adsorbent media treatments, others implemented treatments not designed for removal of high levels of arsenic, such as a common sediment filter or water softener.

Lessons learned

In order to reduce arsenic exposures at a population level, universal water screening and greater community engagement are needed. Additionally, identifying and targeting groups with the highest levels of exposure potentials and vulnerability (i.e., children, neonates, the immunocompromised or socio-economically challenged) will have a larger impact on public health. A number of professions could be better utilized to raise awareness of arsenic risks and treatment benefits. Obstetricians and pediatricians are needed to educate parents on arsenic concerns in children. Water treatment professionals are essential to inform communities of the need and potential problems with POU/POE treatment, including the selection of effective systems, proper equipment maintenance and safe hazardous (spent) material disposal.

Public health researchers are advocating for the regulation of private-well water testing, minimally during real estate transactions or new construction, in order to promote a broader culture of awareness. Provision of subsidies for testing and treatment will help to ensure effective compliance, particularly in low-income communities. While some may be concerned about costs or privacy invasion, the current model that relies on individual knowledge and action has been shown to leave a substantial number of people, and especially children, at high levels of risk.

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