# The challenges to public health of arsenic in well water

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**How to site this article?** Dummer JDT. The challenges to public health of arsenic in well water. BC Toxicology News Monthly Bulletin 2019; 2(4): 433-434.

## Introduction

Arsenic is a naturally occurring toxic metalloid classified by the International Agency for Research on Cancer (IARC) as a class I carcinogen that causes bladder, kidney, lung, and skin cancer.[1] Human exposure to arsenic is through a range of occupational and environmental pathways, including: consumption of arsenic contaminated food and water, cigarette smoking, exposure to smelting by-products and to fossil fuel smoke, and inhalation and ingestion of arsenic contaminated mine tailings, dusts and soils.[2] Despite the multiple exposure pathways, the primary human exposure is via drinking water that is contaminated with inorganic arsenic naturally present in some types of bedrock.[3]

Arsenic in well water is a worldwide public health hazard.[4-6] Evidence of a dose-response relationship between drinking water arsenic and cancers of the skin, lung, liver, bladder and kidney in areas with high levels of arsenic greater than 100 µg/L in groundwater is well established.[7,8] Chronic exposure to arsenic in drinking water is also associated with increased risk for hypertension, diabetes, coronary artery disease and poor cognition and neuropsychological functioning, even at lower arsenic concentration levels.[9–12]

Although the magnitude of the health risk at low to moderate levels of arsenic has been contested due to mixed epidemiological data, a consistent body of evidence is now accumulating highlighting the increased cancer risk associated with drinking water arsenic concentrations around the current World Health Organization (WHO) maximum acceptable concentration (MAC) of 10 µg/L.[13-16] For example, a recent meta-analysis of studies world-wide reported a doubling of bladder cancer risk at arsenic levels around the current WHO MAC.[17]

Data from Canada also indicate increased cancer risk at lower arsenic concentrations—an analysis in Nova Scotia reported a 16% increased risk of bladder cancer at arsenic concentrations between 2 to 5 µg/L;[18] a finding consistent with a recent case-control study of bladder cancer in New England which also found increased cancer risk at low to moderate arsenic concentrations.[19] Thus, given the wealth of epidemiological evidence there is a strong argument for lowering the current arsenic drinking water MAC. Indeed, Health Canada acknowledges that the current 10 µg/L MAC is an operational guideline that was set based on municipal and residential treatment achievability and not only health risk.[20]

Health Canada emphasize that for health purposes efforts should be made to reduce arsenic levels to as low as reasonably achievable.Around 30% of Canadians draw drinking water from groundwater sources which, depending on the local geological conditions, have potential to be contaminated with naturally occurring arsenic.[21] 12% of Canadians overall and around 7% of British Columbians obtain drinking water from a private well, which source groundwater.[22] Elevated levels of arsenic have been found in well water in most provinces and territories, with noted hotspots of elevated arsenic in parts of British Columbia (BC).[21] The BC Ministry of Environment Water Quality Check Program reported that 4.2% of groundwater samples obtained between 1977 and 1990 had arsenic levels greater than 10 µg/L.[23]

Arsenic concentrations above the current MAC were found in drinking water wells on the Sunshine Coast and the Gulf Islands, 100 Mile House, Bowen Island, Burns Lake, Chase, Kamloops, Quesnel, Vernon, Chilliwack, Langley and Williams Lake.[23]

Some wells on Saltspring Island, parts of the Lower Mainland, and near Nukko Lake have also reported high levels of arsenic and it has been noted that arsenic concentrations above the drinking water guideline may also occur locally in other parts of BC.[23] A more recent study conducted in the Surrey-Langley area found that 43% of the 98 private wells sampled had arsenic concentrations greater than 10 µg/L and a further 40% had arsenic concentrations between 3-10 µg/L.[24]

## The public health challenge

The public health challenge of arsenic in drinking water is compounded in Canada because private wells are unregulated and private well users are responsible for testing and treating their drinking water.[25] Public awareness of the health risks posed by drinking water contaminants in Canada is low and compliance with testing guidelines is poor.[26,27]

A study conducted in Nova Scotia found that few people test or treat their well water in line with Health Canada guidelines.[28] Reasons for this lack of compliance were complex, but included convenience to testing facilities, cost, awareness and access to appropriate treatment technologies and lack of risk awareness.[28] Even in areas where there has been widespread publicity about arsenic in drinking water, not all well users adhere to guidelines.[29]

Evidence suggests many barriers to effective well user remediation of arsenic, including constraints related to community knowledge of arsenic risk and treatment options, and challenges associated with identifying appropriate treatment technologies.[25,28]

Over a tenth of Canadians source drinking water from a private well and, due to geology, exposure to naturally occurring arsenic is widespread and represents an important public health issue. There exist major challenges related to reducing the health risk associated with arsenic in private well water.

## Conclusion

As noted, there is a strong argument for lowering the arsenic MAC to protect public health. However, although this is an important regulatory option, for private well users adherence to safe drinking water guidelines is at the well owner's discretion, which means the resource is essentially unregulated and the guideline limit is advisory and not enforced. Therefore, it is important that community-based interventions and educational and risk awareness campaigns are combined with a guideline limit that adequately reflects health risk.

To reduce the health impact of arsenic in well water there is an urgent need for more comprehensive risk management and public health interventions, combined with regulatory reform and appropriate, effective and affordable treatment options.

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