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NH Comprehensive Cancer Collaboration in partnership with Dartmouth-Hitchcock Norris Cotton Cancer Center and its NCI National Outreach Network Community Health Educator Site.

New Hampshire Comprehensive Cancer Collaboration
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Dartmouth-Hitchcock Norris Cotton Cancer Center

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New Hampshire Comprehensive Cancer Collaboration
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EMERGING ISSUES BRIEF

Arsenic in Water and Food: Implications for New Hampshire

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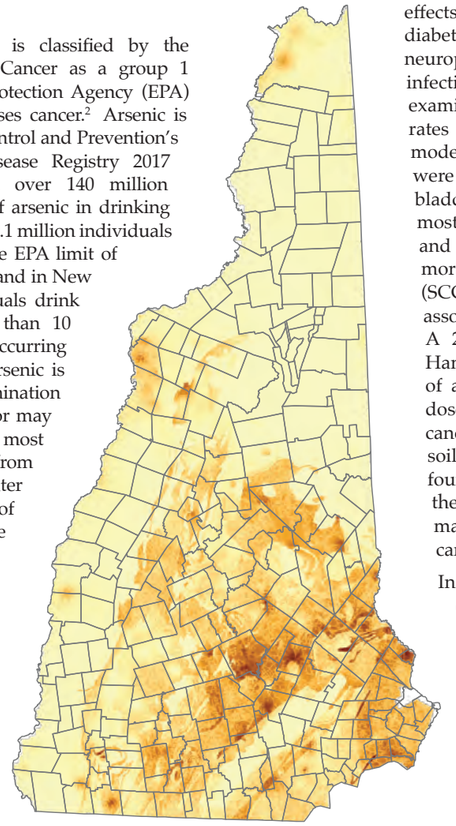
Introduction

Arsenic, specifically inorganic arsenic, is classified by the International Agency for Research on Cancer as a group 1 carcinogen.[1] The U.S. Environmental Protection Agency (EPA) also has acknowledged that arsenic causes cancer.[2] Arsenic is number one on the Center for Disease Control and Prevention's Agency for Toxic Substances and Disease Registry 2017 Substance Priority List.[3] World-wide, over 140 million individuals are exposed to toxic levels of arsenic in drinking water.[4] In the United States an estimated 2.1 million individuals drink private well water that exceeds the EPA limit of 10 parts per billion (ppb, or or 10 µg/L), and in New Hampshire an estimated 61,000 individuals drink private well water containing greater than 10 ppb of arsenic.[5] Arsenic is a naturally occurring metalloid found in the earth's crust. Arsenic is also in the air, water and soil. Contamination from arsenic can be naturally occurring or may come from manmade sources. By far the most widespread arsenic exposures have been from natural sources. Exposure through water and food are the most common routes of exposure. Other paths of exposure include smoking, use of legacy pressure-treated wood products (pre-2003), occupational exposures and proximity to an arsenic polluted site. Because arsenic is tasteless, colorless, and odorless, and because most exposure in the U.S. does not cause immediate adverse health effects, many people are not aware of their arsenic exposure. A major goal of the Dartmouth Toxic Metals Superfund Research Program is to increase awareness of adverse health risks related to arsenic and to provide solutions to reduce arsenic exposure in water and food.



Arsenic ≥ 10 µg/L model

Model-predicted probability of arsenic in groundwater from bedrock aquifers with >10 ppb (10 mg/L). Data and Map, U.S. Geological Survey.

Arsenic and Health

Arsenic has been linked to cancers of the bladder, skin, kidney, liver, prostate, and lung.[6] Arsenic has also been linked to other negative health effects, including vascular and cardiovascular disease, reproductive and developmental effects, cognitive and neurological effects, diabetes and other metabolic disorders, neuropathy, and bacterial and viral lung infections.[7] [8] A recent population-based study examined historically-elevated bladder cancer rates in Northern New England. Low-to-moderate levels of arsenic in drinking water were associated with an increased risk of bladder cancer.[9] Bladder cancer is the third most diagnosed cancer in New Hampshire and ranks 8th in New Hampshire's cancer mortality.[10] Squamous Cell Carcinoma (SCC), a type of skin cancer, has long been associated with high-dose arsenic exposure. A 2013 population-based study in New Hampshire found that low-dose exposure of arsenic also is linked to SCC.[11] High dose arsenic exposure is also linked to lung cancer.[12] A 2011 study in the U.S., looking at soil arsenic concentrations and lung cancer, found a significant association between the two, and it was estimated that arsenic may contribute to up to 5,297 cases of lung cancer per year.[13]

In 2000, the U.S. EPA's maximum contaminant level (MCL) for arsenic in public water systems was 50 ppb. At the time, the U.S. EPA estimated that the excess population risk of lung and bladder cancer at water concentrations of 50 ppb was 1 in 100 to 1 in 300.[14] In 2003, the U.S. EPA lowered the MCL to 10 ppb, giving public water system operators until 2006 to meet the change. Researchers at Columbia University recently completed a review of National Health and Nutrition Examination Survey data looking at trends of urinary arsenic concentrations in public water users vs. private well users after the US EPA's lowering of the MCL. They found a reduction in urinary arsenic among public water users, estimating a reduction of 200–900 lung and bladder cases annually depending on the

method used. They saw no reduction in urinary arsenic among private well users.[15]

When arsenic exposure via drinking water at levels over 10 ppb is not a concern, dietary arsenic is the most common form of arsenic exposure.[16] Both inorganic and organic arsenic are found in food, including rice, rice products, juice, and seafood.[17] There are at least six different chemical forms of arsenic in food, and they vary widely in their effects on human health. Some are considered completely safe and some are highly toxic. Rice and food made from rice can be major sources of dietary arsenic exposure. Rice is a staple food eaten by half of the global population, and rice can have a 10-fold higher inorganic arsenic level than other grains.[19]

In the United States there are currently no regulations for dietary arsenic. In 2013, the Food and Drug Administration (FDA) proposed an 'action level' for arsenic in apple juice of 10 ppb: the same level for public water systems.[20] In 2016 the FDA proposed a limit of 100 ppb for inorganic arsenic in infant rice cereal.[21] While the FDA's risk assessment found lung and bladder cancer risk from lifetime exposure to rice and rice products to be relatively small, they also suggested that the risk increases almost proportionally with increases in exposure.[22] These limits were proposed for a variety of reasons, including enforcement considerations and the ability of producers to meet the limits. Health is not the sole consideration when limits or action levels are set. The European Union has set a maximum inorganic arsenic level for rice specifically destined for production of food for infants and young children at 100 ppb – matching the FDA's proposed limit. Studies on human exposures following this legislation indicate that it has been ineffective to date.[23]

Arsenic and Private Wells in New Hampshire

In the U.S. 2.1 million people are exposed to well water containing greater than 10 ppb of arsenic. Approximately 46% of New Hampshire residents (more than 500,000 people) depend on private wells for their water at home.[24] As many as 61,000 drink well water exceeding 10 ppb of arsenic. Public water supplies are regulated, tested, and treated to meet maximum contaminant levels, but private wells have no such requirements. It is the responsibility of the well owner to test, treat, and maintain the quality of their private water supply. While some residents prioritize the monitoring of their well water, many do so inconsistently or not at all. A 2014 survey found only 44.2% of private well owners in New Hampshire reported having their wells tested for arsenic within the last 3 years.[25] In a random sampling of bedrock wells in southeastern New Hampshire, nearly one-fifth tested contained arsenic levels that exceed the EPA's MCL of 10 ppb.[26] In Rockingham, Strafford, and Hillsborough counties, it is estimated that private drinking water supplies for more than 41,000 people may have arsenic above 10 ppb.[27]

Ideally, private well owners should test their wells every 3–5 years. The New Hampshire Public Health Lab, housed within the New Hampshire Department of Health and Human Services, offers water testing, as do eight private, certified laboratories located across the state. Despite how intimidating and complex analysis of chemicals in water seems to many people, testing is still the only way to know what is in well water.

Encouraging New Hampshire residents to test their well water is the responsibility of clinical and public health professionals. If well water requires treatment for elevated arsenic, there are a variety of options for New Hampshire residents. The New Hampshire Department of Environmental Services has an online application, called Be *Well* Informed, to help individuals understand their water test results and identify what treatment technologies may work best for them. Other short-term options, like switching to bottled water, using an alternative water source, or using a pitcher filter certified for arsenic removal, can also help until a more permanent solution has been found.

Arsenic in food, with a focus on rice and rice products in New Hampshire

Understanding dietary arsenic exposure is a complicated, ever-changing undertaking. Although consumption of arsenic-containing food, such as rice, is low in the U.S., there are populations who consume more foods that are higher in inorganic arsenic. Individuals with dietary restrictions (e.g., following a gluten-free diet), weaning infants, or people following traditional Asian or Hispanic diets may consume rice multiple times a day. A 2016 study of New Hampshire Birth Cohort participants found that the intake of rice and rice products was associated with inorganic arsenic exposure in infants and suggested that every effort should be made to reduce arsenic exposure during this important phase of development.[28] Given the prevalence of arsenic in well water in New Hampshire, some members of these groups will also be exposed to arsenic via drinking water. To reduce arsenic exposure via food, the Dartmouth Toxic Metals Superfund Research Program suggests including a variety of grains in the diet; cooking rice in large amounts of water; eating basmati rice from India, Pakistan, or California; or eating sushi rice. Since rice is a very common ingredient in many foods, especially gluten-free foods, people should also check their processed foods for rice as a main ingredient and limit consumption accordingly.

In New Hampshire, arsenic exposure via contaminated drinking water or food happens every day. Clinical and public health professionals are vital to reducing exposure. Simple steps, like testing well water or eating a varied diet, can make a real difference. Working together, we can lower New Hampshire residents' risk of arsenic exposure and the negative health effects associated with exposure over time.

WHAT CAN HEALTH PROFESSIONALS DO TO ADDRESS THIS ISSUE?

- Ask patients where their water comes from and if they have recently (within the last 3 years) tested their well for arsenic. If they have not tested, encourage them to do so, and, if the water exceeds 10 ppb, encourage them to initiate strategies to remove arsenic from the water. Let them know about the Be Well Informed application available at http://www4.des.state.nh.us/DWITool/ so they can learn more about their water treatment options.
- Encourage patients who have rice-heavy diets to eat a variety of grains, prepare their rice in large amounts of water, learn where their rice is grown, and check product labels for rice as a main ingredient.
- Provide patients with current resources (available through the Dartmouth Toxic Metals Superfund Research Program) on arsenic in water and food.
- Learn more. Researchers at the Dartmouth Toxic Metals Superfund Research Program are available to present at grand rounds or other meetings. More information is available on our websites: www.arsenicandyou.org or www.dartmouth.edu/~toxmetal/

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