Arsenic in Drinking Water:

ISSUES ASSOCIATED WITH REVISING THE STANDARD

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Arsenic is a naturally occurring element that has been recognized and used as poison for centuries. The first standards for drinking water were set in 1942, primarily to guard against accidental poisoning. Levels of arsenic in drinking water are set by the US Environmental Protection Agency, which administers the federal Safe Drinking Water Act for the United States. In Nevada, the Nevada Bureau of Health Protection Services oversees compliance with Federal and State standards for community drinking water supplies.

The debate about new standards in drinking water arose from concerns about the effects of consuming small amounts of arsenic in water over long periods of time. The United States Environmental Protection Agency is considering lowering the standard (also called the Maximum Contaminant Level (MCL)) for arsenic in drinking water from the current level of 50 parts per billion (ppb). The proposed change is based on studies summarized in a recent publication issued by the National Research Council (see For Further Reading). These studies examined health effects in populations in many locations in the world. Deliberations about changing the standard also consider the costs of compliance relative to expected benefits of public health protection nationwide.

Any changes will apply to all 54,000 community water systems and all non-transient non-community water systems in the United States. Non-transient non-community water systems regularly serve at least 25 of the same nonresident people per day for more than 6 months per year. For example, schools, offices, and factories are considered to be non-transient, non-community water systems.

Sources of arsenic in drinking water

Arsenic occurs naturally in rock and soil. It is also used by some industries in the United States, especially the wood treatment industry. When water comes in contact with arsenic-bearing rock, it can dissolve and carry it as it flows, even below the land surface. Arsenic concentrations in water can vary tremendously—even between wells that are very close together. Because arsenic is usually found in soil and rock underground, surface water supplies (such as rivers and lakes) generally have much lower concentrations than ground water sources. In the US concentrations in ground water are generally highest in the Western states, especially in areas with geothermal activity. Concentrations of arsenic in ground water vary tremendously throughout the world. In some countries arsenic levels in wells have been found to be greater than 200 ppb.

There are numerous forms of arsenic in water. The most common are As(III) (arsenite) and As(V) (arsenate) in anaerobic waters. As (III) exists in most natural water as arsenous acid (As(OH)3). As(III) is more mobile in underground environments than As(V), which is negatively charged. This characteristic of arsenic compounds is important for understanding treatment options. Removal efficiencies for As(III) are poor compared to removal of As(V). Treatment takes advantage of the charge to extract As (V). For this reason, some techniques convert As(III) to As(V) before treatment, to take advantage of the effects of negative charge.

Other types of exposure to arsenic

Worldwide, human arsenic intake is most associated with food. Approximately 93% of the average person’s intake of arsenic is associated with food, especially seafood. However, arsenic in food sources is overwhelmingly organic arsenic, which is less toxic than inorganic arsenic. Drinking water represents the route of most hazardous exposure, because arsenic in groundwater is predominantly in the inorganic form.

(continued inside)
When developing and seeking comments for the new drinking water standard, the USEPA considered the potential effects of contact with skin and inhalation of arsenic from air. Proposed new standards consider food and water to be the most important types of arsenic exposure. This means that the risk of drinking water is more significant than the risk of bathing in water that contains low concentrations of arsenic.

**Potential health effects**

A dose of more than 60 mg of arsenic (which is slightly more than 1/5 the weight of a common aspirin tablet) can be lethal. This is called an acute effect. By comparison the amount of arsenic in nearly all drinking water sources is very small and health effects are the result of many years of consuming water that contains arsenic. The current standard specifies that no more than 1/1200 of the acute dose can be present in a liter of water. A liter of water is slightly more than a quart. Experts who have studied populations that consume water that contains arsenic differ in their conclusions about the levels that lead to adverse health effects. More research is needed to determine all the connections between observed illnesses, concentrations in water and factors such as duration of exposure, age, sex and lifestyle effects, such as nutritional status.

Studies summarized in a recent publication about arsenic in drinking water (by the National Research Council (NRC), see “Further Reading” p. 4) suggest that long-term, low-concentration exposure to inorganic arsenic leads to cancers of the skin, bladder, lung, kidney, nasal passages, liver and prostate. It may also affect the nervous and circulatory system and may be associated with cardiovascular diseases. Skin disorders (such as hyperpigmentation, depigmentation and keratosis), and peripheral vascular disorders are also suspected to be caused by chronic consumption of water containing arsenic. Some studies suggest that malnutrition, pre-existing health conditions, and Hepatitis B accentuate the effects of arsenic.

**In the nation**

The US Geological Survey (USGS) carried out a survey of wells across the nation to assess levels of arsenic. The study examined 18,850 wells used for public and private water supplies, irrigation, industrial purposes and research. Approximately 10 percent of the samples exceeded 10 ppb. The findings do not represent every well or drinking water supply system in the areas sampled. However, the results suggest that many Western states, including Nevada, are likely to have water supplies with levels that exceed 10 ppb.

**In Nevada**

In Nevada, many wells used for community drinking water supplies have detectable amounts of arsenic. The Nevada Bureau of Health Protection Services has records of samples taken from 551 water sources used by 266 Community Water Systems (CWS). Figure 1 summarizes sampling results compiled by the Nevada Bureau of Health Protection Services. Not every community water supply is represented in the record and among those sampled not every source was examined. Also, the data do not contain information about private home drinking water wells or non-transient non-community water systems. The chart shows that most of Nevada’s community water supply systems comply with the current standard of 50 ppb. However, if the standard is changed, some systems may have to install treatment systems to remove arsenic from at least once source of water used by their systems. Community water supplies may pump, blend, treat and deliver water from several wells at once.

**Cost**

Decreasing the public’s exposure will result in decreased health risks but will also lead to greater cost. The Nevada State Health Division, Bureau of Health Protection Services, estimated that Nevada might face up to $400 million for capital costs alone to bring community and non-transient, non-community water systems into compliance with the recently withdrawn standard of 10 ppb. The costs of compliance increase substantially as the permissible concentrations decrease.

**Your water**

If you receive your water from a community water system you can find out if there is arsenic in your drinking water by consulting the “Consumer Confidence Report” produced each year by your water system. The report is issued by July 1” of each year and summarizes results of all testing from the previous year. The report lists water sources used and any detectable contaminants in tap water that have standards set by federal and state authorities. You may also call your water utility to ask about the level of arsenic in your drinking water.

If you have a private well, it is recommended that you have your water tested. Public water systems are required to test for arsenic every three years. If you wish to have a private well tested, you may want to do so on the same schedule. Use a laboratory certified by the Nevada Bureau of Licensure and Certification. Call the Nevada State Health
Division at (775) 688-2888 for the names of certified laboratories in your area. You may also find a list of certified laboratories at http://health2k.state.nv.us/environmental/certified. Usually, the cost of analysis for arsenic alone is less than $30. Before collecting a sample, contact a certified laboratory to obtain appropriate sample containers and to find out about correct sampling procedures. Be sure that the certified laboratory has experience with arsenic analysis before you submit samples. If you would like help interpreting the results of your water test, contact any of the Drinking Water Assistance Programs listed on the back of this bulletin.

Is bottled water the answer?
The chemical quality of bottled water is not necessarily different than tap water. In fact, bottled water may be tap water produced by a community water system that has undergone additional treatment, such as filtration with activated carbon. Bottled water that is distributed across state lines is regulated in the same way that food is regulated by the US Food and Drug Administration and the Nevada Bureau of Health Protection Services. In Nevada, the Bureau of Health Protection Services requires bottled water producers to provide copies of permits issued by local health authorities that demonstrate that sources and the bottling plant have been approved. The producer must also provide the Bureau with copies of all chemical and bacteriological analyses performed. Prior to selecting a brand of bottled water for cooking and drinking purposes, check with the Bureau to be sure that the product is a good substitute for tap water.

In contrast, community drinking water supplies that deliver water to your tap are regulated by standards set by the USEPA and enforced by the Nevada Bureau of Health Protection Services. Tap water must conform to rigorous testing requirements that specify the type and frequency of tests that must be performed on samples. If tap water does not conform to standards community water suppliers are required to notify the public.

**Sampling for Arsenic**
A sample is meant to represent the entire volume of water from which it is drawn. It is important to collect, store and transport a sample properly to avoid changing the contents in a way that alters the outcome of analysis. Before collecting a sample, be sure to contact a laboratory that is certified to analyze drinking water samples and that has experience with carrying out the analysis. It is best to obtain a sample container and instructions for how to collect the sample from the laboratory prior to submitting a sample. The laboratory can offer guidance about the best place to collect the sample in your home and should give instructions about how much water is needed and how to store the sample until it can be delivered to the laboratory. Be sure to follow instructions carefully, because a sample that is collected, stored or delivered incorrectly could lead to misinformation about the quality of your water supply.

**Home treatment units**
There are many types of home filtration units. If you are considering purchasing a home water filtration or treatment unit be sure that it has arsenic removal capabilities. The National Sanitation Foundation (NSF) tests and publishes lists of products that they certify for home use. These include products that meet testing specifications listed in standards 58 and 62, which deal with reverse osmosis and distillation. For a complete and current list of brands and products that meet these standards use the NSF web site at http://www.nsf.org and search for products that have proven to remove arsenic effectively.

Home treatment units fall into two general classes, point of entry (POE) treatment units and point of use (POU) units. Point of entry treatment units generally treat all or much of the water that enters a building. One example of a point of entry device is a home water softener. Some homeowners prefer to soften all water before using it inside the home. Point of use treatment devices treat much smaller volumes of water and treat water that comes from a specific fixture in the home. An example is a filtration unit for a faucet in the kitchen.
Not all water treatment devices serve all purposes. Water softeners, activated carbon filters, and chlorinators will not remove arsenic, nor will boiling your water. It is important to know what results you want before selecting a treatment system. University of Nevada's Cooperative Extension's publication “Matching Drinking Water Quality Problems to Treatment Methods” (SP-00-19) provides information about appropriate treatment methods for home use for many kinds of water quality problems. Remember that any system must be maintained according to the manufacturer's specifications. A poorly maintained treatment unit may provide little or no treatment and may give no signs that it is not functioning as designed.

For community systems, most technologies under review perform most effectively when treating arsenic in the form of As (V) (arsenate – which has a negative charge). To ensure that arsenic is present in this form, water is often pretreated with an oxidant such as chlorine, ferric chloride, or potassium permanganate. This converts As (III) to As (V). Table 1 contains brief descriptions of some technologies available for arsenic removal. Note that most of the technologies in Table 1 are primarily useful for municipal treatment. Only a few can be used practically by homeowners.

### Table 1: Arsenic Removal Techniques Available

<table>
<thead>
<tr>
<th>Technique</th>
<th>Typical Applications</th>
<th>Maintenance and Operation Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distillation</td>
<td>Home treatment</td>
<td>Very slow, requires extensive maintenance, energy costs of treatment are likely to be very high</td>
</tr>
<tr>
<td>Ion Exchange</td>
<td>Municipal or home treatment</td>
<td>The presence of other substances in water may affect performance and amount of required maintenance</td>
</tr>
<tr>
<td>Reverse Osmosis (RO)</td>
<td>Municipal or home treatment</td>
<td>The amount of water needed for the home may increase because reject water can be 20-25% of the total volume that enters the treatment system</td>
</tr>
<tr>
<td>Nanofiltration (NF)</td>
<td>Municipal treatment</td>
<td>Efficient arsenic removal but requires high water use</td>
</tr>
<tr>
<td>Coagulation/Filtration</td>
<td>Municipal treatment</td>
<td>Skilled, well-trained operators are needed to oversee the process</td>
</tr>
<tr>
<td>Lime Softening</td>
<td>Municipal treatment</td>
<td>Skilled, well-trained operators are needed to oversee the process</td>
</tr>
<tr>
<td>Activated Alumina</td>
<td>Municipal treatment</td>
<td>Chemical handling requirements make the process complex for small systems</td>
</tr>
</tbody>
</table>

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### More Information

- **The Nevada Bureau of Health Protection Services**
  [http://www.state.nv.us/health/bhps](http://www.state.nv.us/health/bhps) (Call: 775-687-4750)
- **Rural Community Assistance Association**
  [http://www.rcac.org](http://www.rcac.org) (Call: 775-884-2055)
- **University of Nevada, Reno and Cooperative Extension**
  [http://www.nce.unr.edu/swp](http://www.nce.unr.edu/swp) (Call: 775-784-1938)
- **USEPA, Office of Ground Water and Drinking Water**
  [http://www.epa.gov/ogwdw000/ars arsenic.html](http://www.epa.gov/ogwdw000/ars arsenic.html)
- **Nevada Division of Environmental Protection/Bureau of Water Quality Planning**
  [http://www.state.nv.us/ndep/bwqp](http://www.state.nv.us/ndep/bwqp) (Call: 775-687-4670)
- **The National Sanitation Foundation International**

### Further Reading


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