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## **Arsenic: Comprehensive Health Information Summary**

Arsenic is a naturally occurring metal-like element common in the earth's crust. It is produced commercially as a byproduct of refining other metals and is used to tan animal hide. Arsenic was used extensively in pesticides and herbicides until the late 1960s; most agricultural uses have now been banned. Arsenic was also a major component of the preservative solution chromated copper arsenate (CCA) used in "pressure-treated" lumber. Use of this preservative essentially ended as of 2004. Arsenic is also found as a contaminant in coal ash.

Arsenic in drinking water may be due to either man's past activities or the leaching of arsenic from certain types of rock. In most cases of arsenic contamination of drinking water, it is difficult to distinguish whether it is man-made or natural. Although arsenic levels in water are generally low, drinking water obtained from wells drilled in arsenic-containing bedrock may have relatively high concentrations from arsenic leaching from the rock. Random well testing conducted in New Hampshire showed that only one percent of surficial (in sand or gravel) wells had arsenic levels exceeding two parts per billion (ppb) compared to 35 percent of bedrock wells.

Arsenic is found in organic and inorganic forms. Most of the arsenic in drinking water is inorganic arsenic that may be present as a combination of arsenic species called arsenate (As V) and arsenite (As III). The percentages of each form in water are important to know if you wish to remove arsenic from drinking water, as some treatment methods require an additional treatment process to change As III to As V so it can be removed. Both forms of arsenic have similar toxicity except at very high doses, in which case the body excretes As III more slowly than As V. Arsenic has no taste or odor at the concentrations found in drinking water, therefore testing is the only reliable way to determine if it is present.

For the general population, food is the most significant source of arsenic exposure. Most foods contain low levels of arsenic taken up from the soil. Some fish and shellfish build up arsenic in their tissues, but most of it is in an organic form that is not toxic. The total adult daily dietary intake of the inorganic forms of arsenic in the typical U.S. diet averages in the range of about 8 to 14 micrograms (ug).

### **Health Effects**

#### **Absorption**

After absorption, arsenic distributes throughout the body and some may accumulate in the nails, hair, bone and skin. Most of the arsenic taken into the body is excreted within one week of exposure. Although there are only a few studies on absorption through the skin, they indicate that only a small percentage is absorbed by this route.

Some studies of occupational exposure to arsenic dust have reported increased levels of contact dermatitis. Similar effects on the skin from bathing with arsenic contaminated water have not been observed. Bathing with contaminated drinking water exposes skin to very dilute levels of arsenic compared to concentrated arsenic-dust in the work place. Skin effects are often the first observable sign of

arsenic toxicity. Researchers have generally considered skin effects to result from ingested arsenic rather than exposure and absorption through the skin.

### **Short Term (acute) Effects**

Oral exposure to arsenic at levels much higher than those typically found in the environment may result in symptoms soon after ingestion. Symptoms include abdominal pain, vomiting, and diarrhea. Eventually shock, coma, and death may follow. It is estimated that 70,000 ug of arsenic can be a fatal dose, indicating that arsenic is considered extremely toxic from acute exposure.

### **Long Term (chronic) Effects**

The most sensitive observable signs of chronic arsenic poisoning involve the skin. First, a freckling of small dark spots may appear on the trunk, neck, face, arms and legs. Next, skin-thickening and small corn-like growths can develop, especially on the palms of the hand and soles of the feet. With higher exposures, other effects may include numbness, tingling or burning sensations in the arms and legs, fluid accumulation causing swelling in the face and ankles, diarrhea, stomach cramps, and anemia. Eventually, liver, kidney, and central nervous system damage may occur. Recent evidence indicates that arsenic may increase the risk of several other diseases including diabetes, lung, and cardiovascular disease. Basic research suggests that arsenic may cause some of these diseases by interfering with chemical messengers such as hormones that act as signals in the body to regulate many processes.

### **Carcinogenic (Cancer-causing) Effects**

Corns resulting from arsenic exposure may ultimately develop into non-melanoma forms of skin cancer. Researchers have also observed a relationship between higher levels of arsenic in drinking water and an increased risk of bladder, lung, kidney, liver, and prostate cancer. The evidence for skin, bladder, and lung cancer are the strongest. Data from occupational studies demonstrates a strong association between inhalation of inorganic arsenic and lung cancer. Arsenic was a Group A (known human carcinogen) under the old Environmental Protection Agency (EPA) classification system and would fit into the “human carcinogen” classification group under the current cancer guidelines.

### **Teratogenic/Reproductive Effects**

No conclusions can be drawn from the few studies investigating arsenic’s effect on human development or reproduction. However, birth defects and other toxic effects to embryos have been observed in rats, mice, and hamsters at levels much higher than typically found in drinking water. In a two-generation study more closely approximating chronic human exposure from drinking water than any other study examining developmental toxicity, mice fed arsenic acid in their diet showed no effects at 20 parts per million (ppm) and reversible effects on growth at 100 ppm.

## **Health Standards and Criteria**

The federal drinking water standard, a Maximum Contaminant Level (MCL), for arsenic was 50 ppb for many years. MCLs are enforceable drinking water standards for public water supplies, determined by balancing the adverse health effects of a particular chemical against the feasibility and costs of treating contaminated water, and a consideration of the lowest level at which a chemical can be detected in water.

Studies conducted in recent years in several countries found strong associations between arsenic exposure from drinking water and an increased risk of cancer of the lung and bladder. Therefore, the EPA reduced the MCL for arsenic to the current level of 10 ppb. The regulations also revised the Maximum Contaminant Level Goal (MCLG) from 50 ppb to zero. MCLGs are health-based non-enforceable guidelines. Exposure assumptions used to calculate MCLs and MCLGs include consuming two liters (0.53 gallons) of water per day by a 70 kilogram (154 lb) adult for a 70-year exposure duration.

## **Arsenic-Containing Pressure Treated Wood**

As previously mentioned, pressure-treated wood, commonly used to build decks, playground equipment and other outdoor structures was preserved with arsenic-containing CCA until its use was voluntarily cancelled. Although pressure-treated wood sold no longer contains CCA, exposure may occur from

existing structures built with CCA-treated lumber. People who work on CCA-treated wood structures should take certain precautions to limit exposure to sawdust, which may be breathed in or incidentally ingested. Whenever possible, work outdoors to avoid indoor accumulation of sawdust from CCA-treated wood. Never dispose of CCA-treated wood by burning it.

Some of the arsenic in pressure-treated wood can leach out and contaminate the soil beneath structures. A small percentage of the arsenic on the surface of the wood can be wiped off and absorbed through the skin or ingested by young children, who tend to have frequent hand-to-mouth activity. Precautions to reduce exposure include not growing edible plants below and in the immediate vicinity of CCA-treated decks or allowing children to play in those same areas. *Preliminary results of research conducted by the EPA and the Consumer Product Safety Commission (CPSC) demonstrated that using a non-toxic non-slippery sealant such as an oil-based stain every year on CCA-treated wood structures, such as decks and playground equipment, can minimize leaching of arsenic, reducing exposure.*

For more detailed information on safe practices at work and home when using CCA-treated wood, please refer to this EPA web site: [www.epa.gov/oppad001/reregistration/cca/](http://www.epa.gov/oppad001/reregistration/cca/).

### **Medical Testing for Arsenic Exposure**

Because arsenic is cleared from the blood in only a few hours, blood arsenic is generally not a useful measurement of exposure. Measurement of arsenic in urine is considered the most reliable indicator of recent arsenic exposure if testing is done no more than a few days after exposure ceases. Consumption of fish or shellfish within two days before a urine test occurs can influence the results because of the largely non-toxic organic arsenic present in these foods. Therefore, they should be avoided before you are evaluated for exposure to inorganic arsenic.

Some arsenic is stored in parts of the body rich in the protein keratin such as hair, finger- and toe-nails. Levels in these tissues can be a useful indicator of past exposure, but results can be misleading because arsenic tends to strongly bind externally to hair and nails. Arsenic bound externally to hair and nails is not absorbed.

### **Testing for Arsenic in Water**

*Since private wells are not subject to regular testing as are public water supplies, the DES Environmental Health Program recommends that all private well owners have their water tested for arsenic if they have not done so previously.* In testing of bedrock wells serving residences in New Hampshire, approximately 13 percent exceeded 10 ppb of arsenic, indicating that a substantial percentage of the public may be exposed to arsenic from private water supply wells above the new MCL. Although bedrock wells appear to be at greater risk due to naturally occurring arsenic leaching from rock, dug or shallow wells are more likely to be impacted by man-made contamination. Dug wells located in former agricultural land, particularly fruit orchards or potato fields, crops for which arsenic-containing pesticides were often heavily used, are more likely to be at risk.

The DES Laboratory's "Standard Analysis" for drinking water includes analysis for arsenic. A list of New Hampshire certified commercial water testing laboratories is available at <http://www4.egov.nh.gov/DES/NHELAP/>. Additional information on water testing and treatment options can be obtained by contacting the DES Drinking Water and Groundwater Bureau (603-271-2513) or fact sheet WD-WSEB 3-2 "Arsenic in Drinking Water," <http://des.nh.gov/organization/commissioner/pip/factsheets/dwgb/documents/dwgb-3-2.pdf>. For health questions, please contact the DES Environmental Health Program, 29 Hazen Drive, PO Box 95, Concord, NH 03302-0095; (603) 271-4608.

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