How does arsenic affect your Health?

Many factors determine harmful effects and the type and degree of those health effects:

Dose

How much arsenic you are exposed to?

Duration:

How long you have been exposed to arsenic?

Genetic susceptibility:

Family traits

Route:

Drinking/eating (ingestion), breathing (inhalation), or skin (dermal) contact

Individual characteristics:

Age, general health and lifestyle

Most of the toxic effects arise from exposure to inorganic arsenic and affects nearly all organ systems of the body. Arsenic is known to cause cancer in humans (human carcinogen). Ingested inorganic arsenic increases a person's risk to develop lung, skin, bladder, breast, prostate, kidney and liver cancer. Other toxic effects include cancers of the bone marrow, blood and lymphatic system. Arsenic is known to cause weakness, numbness, burning, and tingling in the hands and feet, as well as skin lesions.

Arsenic is a solid substance (metalloid) naturally existing in the Earth’s crust and in crushed rock.

Arsenic exposure is natural but can be aggravated by human activities. We are exposed to arsenic in two chemical forms:

• Inorganic – Varying amounts of this poisonous (toxic) form can be found in:
  - Naturally in geologic materials (soils, rocks, aquifer materials)
  - Sources of arsenic in groundwater
  - Mining wastes
  - Industrial wastes: Arsenical Pesticides
  - Superfund Basic Research Program
  - Arsenic in groundwater
  - Mining wastes
  - Drums
  - Dusts

• Organic – (arsenic compounds that contain carbon) – Varying amounts of this non-poisonous (low-toxicity) form are found in:
  - Animals
  - Plants
  - Fish and Seafood

Naturally in geologic materials (soils, rocks, aquifer materials)

Water (ground & surface)

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How can I be exposed to arsenic?

Most people take in (ingest/inhale) small amounts of arsenic from:

- Drinking water
- Air dust (particulates)
- Food

Too much arsenic taken in may result in harmful side effects. In the general environment, the ingestion is the main route of absorption of arsenic. In occupational environments, arsenic is absorbed mainly through the lungs. The chart below illustrates how a person can be exposed to arsenic.

Routes of Exposure

Why is arsenic present?

Ask yourself - Where does your drinking water come from? Due to natural geologic contamination (remember arsenic exists naturally in the Earth’s crust and some forms dissolve in water) communities that get their drinking water from underground (groundwater), can potentially be exposed to excessive amounts of arsenic.

Arsenic attached to very small particles may stay in the air for many days and travel long distances. Expose to dust with elevated arsenic levels may come from agricultural (use of pesticides and fungicides and farming), mining (mine tailings, smelters, particles high in arsenic), inhaling smoke (burning of oil, gasoline, wood, coal), and lifestyle activities such as tobacco smoking (tobacco products have small amounts of arsenic, because of past application of arsenic-containing pesticides).

Surface water can be contaminated by contact with soils, sediments and mine tailings (large piles of crushed rock left over after minerals have been extracted from the rocks which contained them) that contain arsenic, runoff and wastewaters contaminated with arsenic, arsenic-containing pesticides and industrial wastes.

Wastes

Most foods contain low levels of arsenic. Fish, seafood, algae and rice can contain elevated levels of organic forms of arsenic, however these forms of arsenic have much lower toxicities than inorganic forms.

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The development of health problems depends on how much arsenic got into their bodies and how much was absorbed. Either high concentrations or short exposures or low concentrations and long-term exposures can cause the above health effects. Most arsenic is rapidly discharged in urine and does not accumulate in the body.

In most cases, it is safe to use water that contains arsenic for bathing, laundering, showering, and washing dishes, because arsenic does not easily get into your skin. It is not safe to cook with or drink water with levels of arsenic above the Maximum Contamination Level (MCL), please see table or below.

### What are the government policies concerning arsenic?

#### Drinking water standards

In comparison, the levels of arsenic in water within the southwestern US and northern Mexico typically range from 2 - 100 ppb. Together, the US Environmental Protection Agency (US EPA) and state government agencies are responsible for monitoring arsenic in public water systems. Privately owned wells are not monitored by government agencies, though MCL information is available for private well owners. If you are not using your local drinking water company or community water supply, you should test your well water.

#### Air Standards

Arsenic is listed as a hazardous air pollutant (HAP); meaning arsenic is a substance that may increase mortality or serious illness in humans after significant exposure. These standards must be met the workplace. EPA limits emission of inorganic arsenic from primary copper smelters, glass-manufacturing and arsenic plants. However, there is no federal air standard for arsenic, like the water standards above.

#### Food Standards

The US Department of Agriculture has prohibited the use of arsenic in organic crop production. Currently, the US Food and Drug Administration (US FDA) has not established tolerance levels for arsenic in food, except for bottled water and the byproducts of animals treated with veterinary drugs.

### Arsenic (As) Standards Table

<table>
<thead>
<tr>
<th>Source</th>
<th>Federal Agency</th>
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<tr>
<td>Public drinking water</td>
<td>US EPA</td>
<td>MCL = 10 parts per billion (ppb), or 10 µg/L</td>
</tr>
<tr>
<td>Bottled drinking water</td>
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</tr>
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Air

US Department of Labor, Occupational Safety & Health Administration

- 8-hour total weight average (TWA) permissible exposure limit (PEL) for general industry of:
  - Inorganic = 10 µg/m³ (micrograms of As per cubic meter of air)
  - Organic < 5 mg/m³ (milligrams of As per cubic meter of air)

- Tolerance level for an organic form of arsenic residue in fruits and citrus at .035 ppb.

Food

US FDA

- Regulation applies only to the byproducts of animals treated with veterinary drugs. 0.05 ppb in eggs and uncooked edible tissues of chickens and turkeys to 0.2 ppb in certain uncooked edible by-products of pigs and others.

### How can I find out if my drinking water is safe?

The best way to prevent health problems related to arsenic exposure is with knowledge. The only way to know if your drinking water contains arsenic is to have it tested. By Federal law public water utilities must test the drinking water they deliver and provide an annual quality report to their customers known as a Consumer Confidence Report (CCR). This report is a general overview of the water quality of that system and will show which regulated contaminants such as arsenic were found in the drinking water and quantities identified from the previous year.

If you own a water source or have a private well, you can take a water sample to a state certified laboratory. In Arizona call 602-364-0728 for a list of state certified laboratories.

Lastly, be aware of the historical uses of the area in and around your home. Find out if an old industrial site, mine or smelter or a Hazardous Waste or Municipal Solid Waste Landfill is or was located near your home. In addition, look into whether the land you live upon was once a farm-land, and test your soil. Note that all soils contain natural levels of arsenic. These range from 1-50 mg/kg worldwide, but some soils in Arizona may have even higher natural levels of arsenic. Therefore, it is normal for plants to take up some arsenic. But arsenic plant uptake is also dependent on other factors such as soil pH, texture, organic matter, soil arsenic chemical forms, and plant types and varieties. Edible plants should not be cultivated in soils containing Arsenic levels above the mid range (~20-25 mg/kg) stated above, but no “unsafe” arsenic soil standards are available. Concerned homeowners may have their garden soil tested and compared to natural background arsenic levels in their area.

### How is arsenic removed (reduced) from drinking water?

Arsenic levels can be reduced to drinking water safe levels using two different technologies:

- **Adsorption process:** water passes through a filter where the arsenic sticks to a filter (media column) made of another metal like iron, alumina zirconium or titanium.
- **Reverse Osmosis process (RO):** water passes through a layer (membrane) that filters out the arsenic.

These technologies can be installed at different places like public water utilities or residences. These implementation points are categorized and described below.

### Before water reaches your residence

- **Centralized Treatment Plant:** ground-water from the well goes directly to a treatment plant reducing the arsenic level before it is distributed to residences.
- **Well Head:** ground-water from the well is treated to reduce arsenic levels right after it is removed from the well.

### At your residence

- **Point of Entry:** arsenic levels are reduced before it enters the home.
- **Point of Use:** arsenic levels are reduced within the home. For example, a device would be installed under a kitchen or bathroom sink.