The ToxGuide™ is developed to be used as a pocket guide. Tear off at perforation and fold along lines.

Sources of Exposure

General Populations

- The general population may be exposed to arsenic in air, drinking water, and food. Of these, food is usually the largest source of arsenic.
- Some areas of the United States contain unusually high natural levels of arsenic in rock; this can lead to unusually high levels of arsenic in soil or water.
- Prior to 2003, arsenic was used in the production of wood preservatives, primarily copper chromated arsenate (CCA); arsenical wood preservatives have been phased out for certain wood products. Sawing or sanding wood treated with arsenical preservatives can generate arsenic contaminated sawdust. Similarly, burning arsenic-treated wood can result in elevated arsenic levels in smoke.
- Various organic arsenicals are used as herbicides and as antimicrobial additives for animal and poultry feed.

Occupational Populations

- Some occupations in which exposure to arsenic may occur include copper or lead smelting and wood treatment.
- Workers involved in the production or application of pesticides containing organic arsenicals may also be exposed to higher levels.

Toxicokinetics and Normal Human Levels

Toxicokinetics

- Both arsenate and arsenite are well absorbed by both the oral and inhalation routes. Absorption by the dermal route has not been well characterized, but is low compared to other routes.
- Once absorbed, arsenates are partially reduced to arsenites, yielding a mixture of As(III) and As(V) in the blood.
- As(III) undergoes methylation primarily in the liver to form monomethylarsonic acid (MMA) and dimethylarsinic acid (DMA). The rate and relative proportion of methylation production varies among species.
- Most inorganic arsenic is promptly excreted in the urine as a mixture of As(III), As(V), MMA, and DMA. Smaller amounts are excreted in feces.
- In most species, including humans, ingested organic arsenical compounds such as MMA and DMA, undergo limited metabolism, do not readily enter the cell, and are primarily excreted unchanged in the urine.

Normal Human Levels

Levels of arsenic in unexposed individuals:

< 1 µg/L in blood
<100 µg/L in urine
≤ 1 ppm in nails
≤ 1 ppm in hair

Biomarkers/Environmental Levels

Biomarkers

- Measurement of urinary arsenic levels is generally accepted as the most reliable indicator of recent arsenic exposure.

Environmental Levels

Air

- 1-3 ng/m^3 in remote locations.
- 20-100 ng/m^3 in urban areas.

Sediment and Soil

- Mean and range of arsenic in soil and other surficial materials in the U.S. are 7.2 and <0.1–97 µg/g, respectively.

Water

- Drinking water generally contains an average of 2 µg/L of arsenic, although higher levels have been measured in some parts of the U.S.
- Arsenic levels ranging from 0.138 to 1,700 µg/L have been measured in surface water in the U.S.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for Arsenic. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Services.

ToxGuide™ for Arsenic

As

CAS# 7440-38-2

October 2007

U.S. Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry
www.atsdr.cdc.gov

Contact Information:
Division of Toxicology
and Environmental Medicine
Applied Toxicology Branch

1600 Clifton Road NE, F-32
Atlanta, GA 30333
1-800-CDC-INFO
1-800-232-4636

www.atsdr.cdc.gov/toxpro2.html

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

The ToxGuide™ is developed to be used as a pocket guide. Tear off at perforation and fold along lines.

Chemical and Physical Information

Arsenic is a metalloid

- Arsenic is ordinarily a steel gray metal-like material that occurs naturally.
- Arsenic compounds can be categorized as inorganic or organic.
- Inorganic arsenic is primarily used as a preservative for wood to make it resistant to rotting and decay. In 2003, the use of arsenic-containing wood preservatives was phased out for certain residential uses such as play structures, picnic tables, decks, fencing, and boardwalks. Arsenic wood preservatives are still used in industrial applications.
- Inorganic arsenic occurs naturally in soil and in many kinds of rock, especially in minerals and ores that contain copper or lead.
- Elemental arsenic is used as an alloying element in ammunition and solders, as an anti-friction additive to metals used for bearings, and to strengthen lead-acid storage battery grids.
- In the past, inorganic arsenic compounds were used as pesticides; this use is no longer permitted.
- MMA is used for weed control on cotton, turf grass and lawns and under trees, vines, and shrubs. DMA, also referred to as cacodylic acid, is used for weed control under nonbearing citrus trees, around buildings and sidewalks, and for lawn renovation.

Routes of Exposure

- Inhalation – Minor route of exposure for the general population. Predominant route for occupational exposure.
- Oral – Predominant route of exposure for the general population; for most individuals diet is the largest source of arsenic exposure. Ingestion of arsenic in dirt through hand-to-mouth activity may be an important route of exposure for young children.
- Dermal – Minor route of exposure.

Arsenic in the Environment

- Arsenic cannot be destroyed in the environment. It can only change its form or become attached to or separated from particles.
- Arsenic attached to very small particles may stay in the air for many days and travel long distances.
- Arsenic in soil may be transported by wind or in runoff or may leach into the subsurface soil. Arsenic is largely immobile in agricultural soils, therefore, it tends to concentrate and remain in upper soil layers indefinitely.
- Transport and partitioning of arsenic in water depends upon the chemical form. Soluble forms move with the water and may be carried long distances. Arsenic may be adsorbed from water onto sediments or soils.

Relevance to Public Health (Health Effects)

Health effects are determined by the dose (how much), the duration (how long), and the route of exposure.

Minimal Risk Levels (MRLs)

Inhalation

- No acute-, intermediate- or chronic-duration inhalation MRLs were derived for inorganic arsenic or organic arsenic compounds.

Oral

- An MRL of 0.005 mg As/kg/day has been derived for acute-duration oral exposure (≤14 days) to inorganic arsenic.
- No intermediate-duration oral MRL was derived for inorganic arsenic.
- An MRL of 0.0003 mg As/kg/day has been derived for chronic-duration oral exposure (≥1 year) to inorganic arsenic.
- No acute-duration oral MRL was derived for monomethylarsonic acid (MMA).
- An MRL of 0.1 mg MMA/kg/day has been derived for intermediate-duration oral exposure (15-364 days) to MMA.
- An MRL of 0.01 mg MMA/kg/day has been derived for chronic-duration oral exposure (≥1 year) to MMA.
- No acute- or intermediate duration oral MRLs were derived for dimethylarsinic acid (DMA).
- An MRL of 0.02 mg DMA/kg/day has been derived for chronic-duration oral exposure (≥1 year) to DMA.

Health Effects

- Inhalation of inorganic arsenic may cause respiratory irritation, nausea, skin effects, and increased risk of lung cancer.
- Acute high dose oral exposure to inorganic arsenic may cause nausea, vomiting, diarrhea, cardiovascular effects and encephalopathy.
- Long term oral exposure to low levels of inorganic arsenic may cause dermal effects (such as hyperpigmentation and hyperkeratosis, corns and warts) and peripheral neuropathy characterized by a numbness in the hands and feet that may progress to a painful "pins and needles" sensation. There may also be an increased risk of skin cancer, bladder cancer, and lung cancer.
- Oral exposure to MMA may result in gastrointestinal damage. Kidney effects may be observed following chronic exposure.
- Chronic oral exposure to DMA may result in urinary bladder and kidney effects.

Children's Health

- Children who are exposed to high levels of arsenic exhibit symptoms similar to those seen in adults, including cardiovascular, dermal, and neurological effects, and vomiting following ingestion.
- There is some evidence that metabolism of inorganic arsenic in children is less efficient than in adults.