Cadmium (Cd) Fact Sheet

What is cadmium?
Cd is a rare, but widely dispersed, element found naturally in the environment.

Are there commercial uses for cadmium?
Cd is used in metal plating, producing pigments, nickel cadmium batteries, as stabilizers in plastics and in nuclear reactors.

Is cadmium present in the environment?
Cd is mined and then released into the environment, mainly through the air during smelting. Once in the environment, Cd moves easily through the soil. Certain plants, such as tobacco, rice, cereal grains, potatoes, and some other vegetables take up Cd from the soil.

How are people exposed to cadmium?
Cigarette smokers are exposed to Cd through inhalation of tobacco smoke. A cigarette contains approximately 2.0 micrograms (μg) of Cd. Oral ingestion is the major route of exposure for non-smokers. The average person is exposed to low levels of about 30 micrograms per day (μg/day) of Cd in his/her diet. Inhalation can occur in workplace settings where Cd is present and proper industrial hygiene does not occur.

What happens to cadmium once in the body?
Half of the Cd inhaled by a smoker is absorbed from the lungs into the bloodstream. Most orally-ingested Cd passes through the gastrointestinal tract and only about 6 percent is absorbed. Cd absorption may increase in persons who are iron-deficient and during pregnancy. Cd in water is more easily absorbed than Cd in food. Negligible amounts (about 0.5 percent) of Cd are absorbed through the skin.

Once absorbed, Cd is transported throughout the body in blood, with the greatest concentration found in the liver and kidneys. Absorbed Cd is eliminated from the body, primarily in urine. It is slowly excreted and therefore, accumulation in the body can be significant. Due to its slow excretion, Cd accumulates in the body over a lifetime. In general, Cd concentration in blood reflects recent exposure, and Cd concentration in urine reflects the total body burden.

How harmful is exposure to cadmium?
Cd is primarily toxic to the lungs and kidneys, with secondary effects on the skeletal system. Chronic exposure through inhalation may result in impairment of lung function and acute liver and kidney damage. Chronic Cd exposure has been reported to cause mild anemia, to affect the sense of smell and yellow the teeth.
Background exposures in water and air, as well as background dietary exposures, are not a health concern. However, lifetime exposure to high levels of Cd in foods can lead to a serious kidney and bone disorder called "Itai-Itai" disease, which causes severe bone loss and kidney dysfunction.

**Can exposure to cadmium cause cancer?**
The Environmental Protection Agency, the International Agency for Research on Cancer, and the U.S. Department of Health and Human Services all classify Cd and Cd compounds as known human carcinogens.

**Are some people at greater risk of harm from cadmium than others?**
People who smoke cigarettes, who are malnourished (lacking adequate iron intake), and who are occupationally exposed to Cd (through jewelry making or paint manufacture) are at increased risk of harm.

**Are there medical tests to show whether I’ve been exposed to cadmium?**
Liver and kidney functions should be tested in the case of acute Cd ingestion. Chest X-rays should be performed if acute Cd inhalation exposure is suspected.

Evaluation of people with known or suspected chronic Cd exposure should focus on the kidneys. Initial tests should include kidney function, Cd in blood and urine, blood chemistry, urinary protein, and oxygen saturation. Evaluation may also include urinary metallothionein and β2–microglobin excretion.

The best screening and diagnostic test for chronic Cd exposure is a 24-hour urinary Cd level.

**Treatment and Preventive Measures**
There is no effective antidote or treatment for acute Cd exposure and toxicity. Supportive measures to treat symptoms include calcium and vitamin D supplements if bone disease is present. Prevention of further exposure is the most important step.

To prevent or minimize further exposures:
- Stop or reduce smoking;
- Maintain adequate iron intake in the diet; and
- Practice good occupational hygiene, if involved in work with Cd or in hobbies involving Cd exposure.

**How do I interpret the results of my clinical tests?**
Your physician is responsible to interpret the results of your clinical tests and make the appropriate diagnosis. However, in general, the following guidelines are useful:

- Non-smokers have very low levels of urinary Cd. The average Cd level is 0.08 μg/gm creatinine. Levels increase with age to 0.26 μg/gm creatinine.
Kidney dysfunction is unlikely when urinary Cd levels are less than 10 μg/gm creatinine.

Elevated blood Cd levels confirm recent acute exposure but do not correlate with body burden or clinical outcome, and should not be used to determine the need for treatment.

Blood Cd levels of healthy nonexposed nonsmokers is approximately 0.4 μg/L.

Blood Cd levels of occupationally exposed persons may be higher than the general population. OSHA considers a whole blood level of 5 μg/L or higher to be hazardous.

Hair Cd levels are not reliable either as predictors of toxicity or as indicators of occupational exposure.

Increased medical monitoring and exposure review is required if urine Cd is greater than 3 μg/gm creatinine, whole blood Cd is greater than 5 μg/L or urine β2 microglobulin is greater than 300 μg/gm creatinine.

Removal from exposure is required if the urine Cd is greater than 15 μg/gm creatinine, whole blood Cd is greater than 15 μg/L or urine β2 microglobulin is greater than 1,500 μg/gm creatinine.

**Has the federal government made recommendations to protect human health?**

- The U.S. Occupational Safety Health Administration (OSHA) and the National Institute of Occupational Safety and Health (NIOSH) have established workplace levels of Cd.

  - OSHA: The Permissible Exposure Limit – Time Weighted Average (PEL) is 5 micrograms per cubic meter (μg/m³) of air. OSHA requires medical examination and biological monitoring for workers exposed to Cd for 30 or more days a year at levels equal to 2.5 μg/m³ or greater in air to prevent Cd-induced disease.

  - NIOSH: The Immediately Dangerous to Life and Health level (IDLH) is 9 milligrams (9000 μg) per cubic meter (mg/m³) of air.

- The U.S. Federal Drug Administration (FDA) and the U.S. Environmental Protection Agency (EPA) have set exposure standards and the U.S Agency for Toxic Substance and Disease Registry (ATSDR) has established an exposure guideline to protect the general public from excess Cd exposure from various sources.

  - FDA: The maximum limit of Cd in bottled water allowed by law should not exceed 5 micrograms per liter (μg/L).

  - EPA: The Maximum Contaminant Level (MCL) in drinking water is 5 μg/L. The MCL is the maximum allowable amount of a contaminant in drinking water that is delivered to the consumer. The MCL is an enforceable standard.
• ATSDR: The chronic oral minimal risk level (MRL) is 0.0001 milligrams per kilogram per day (mg/kg/day) of Cd based on its kidney effects. The MRL is a guideline stating how much Cd can be taken in without risk of adverse health effects.

What methods are available to remove cadmium water?
Cation exchange units, reverse osmosis, or distillation all remove Cd from drinking water.

What methods do not remove cadmium in drinking water?
Boiling water does not remove Cd and is not a treatment alternative. As evaporation occurs during boiling, it increases Cd concentration in the remaining water. Chemical disinfection, such as chlorination, also does not remove Cd from water.

Additional information?
For emergency situations involving chemical exposures call the Philadelphia or Pittsburgh Poison Control Center at 800-222-1222.

For non–emergency situations requiring additional information contact the Pennsylvania Department of Health, Environmental Health Epidemiology.

References


Content last modified on 03/16/2017