

CADMIUM POISONING

1. The Disease Definition

Cadmium and its compounds are highly toxic and exposure to this metal is known to cause cancer and targets the body's cardiovascular, renal, gastrointestinal, neurological, reproductive, and respiratory systems.

A. Clinical Description

Acute inhalation exposure causes pulmonary edema, which may result in death. The most serious long-term exposure risk is cancer (lung and prostate). The first observed chronic effect is generally kidney damage. Cadmium also is believed to cause pulmonary emphysema and bone disease (osteomalacia and osteoporosis). The latter has been observed in Japan ("itai-itai" disease) where residents were exposed to cadmium in rice crops irrigated with cadmium-contaminated water. Cadmium may also cause anemia.

Metal fume fever may result from acute exposure. It includes flu-like symptoms of weakness, fever, headache, chills, sweating and muscular pain. Acute pulmonary edema usually develops within 24 hours and reaches a maximum by three days. If death does not occur, symptoms may resolve within a week. Excretion of excessive low molecular weight protein in the urine is usually the first symptom of chronic kidney damage.

B. Sources of Exposure

Cadmium (Cd) is a soft, malleable, bluish white metal found in zinc ores, and to a much lesser extent, in the cadmium mineral greenockite. It is used in numerous products and industrial applications. Most of the cadmium produced today is obtained from zinc byproducts and recovered from spent nickel-cadmium batteries. First discovered in Germany in 1817, cadmium found early use as a pigment because of its ability to produce brilliant yellow, orange, and red colors. Cadmium became an important metal in the production of nickel-cadmium (Ni-Cd) rechargeable batteries and as a sacrificial corrosion-protection coating for iron and steel. Common industrial uses for cadmium today are in batteries, alloys, coatings (electroplating), solar cells, plastic stabilizers, and pigments. Cadmium is also used in nuclear reactors where it acts as a neutron absorber. New market opportunities for industrial applications of Ni-Cd batteries will continue to fuel cadmium use. Increased investment in solar power will also drive cadmium use in the future.

Workers can be exposed to cadmium by breathing in dusts, fumes, or mists containing cadmium. Cadmium or cadmium compounds can also get on clothing or the skin where it can be transferred out of the workplace to expose other family members. Skin exposure can transfer to food eaten in the workplace causing cadmium to be ingested. Due to its low Permissible Exposure Limit (PEL), overexposures may occur even in situations where trace quantities of cadmium are found in the parent ore or smelter dust. Several deaths from acute exposure have occurred among welders who have unsuspectingly welded on cadmium-containing alloys or worked with silver solders. Cadmium is also found in industrial paints and may represent a hazard when sprayed. Operations involving removal of cadmium paints by scraping or blasting may similarly pose a significant hazard. Cadmium is also present in the manufacture of some types of batteries. Cadmium emits a characteristic brown fume (CdO) upon heating, which is relatively non-irritating, and thus does not alarm the exposed person.

C. Population at Risk

OSHA estimates that 300,000 workers are exposed to cadmium in the United States. Worker exposure to cadmium can occur in all industry sectors but mostly in manufacturing and construction. Workers may be exposed during smelting and refining of metals, and manufacturing batteries, plastics, coatings, and solar panels. The expanding Ni-Cd battery recycling industry is a concern for cadmium exposure. Electroplating, metal machining, welding and painting are operations associated with cadmium exposure.

Workers involved in landfill operations, the recycling of electronic parts, or the recycling of plastics may be exposed to cadmium. Compost workers and waste collectors are also potentially exposed to dust which may contain cadmium. The incineration of municipal waste is another source of cadmium exposure.

According to the American Association of Poison Control Centers' (AAPCC) National Poison Data System (NPDS), 70 cadmium exposures with 1 fatality were reported in the United States during 2011. Five hundred sixty seven metal fume fever exposures with no fatalities were reported in the United States during 2011.

D. Diagnosis, Treatment, and Prognosis

Requirements to protect workers from cadmium exposure are addressed in specific OSHA (Occupational Safety and Health Administration) cadmium standards covering general industry ([1910.1027](#)), shipyards ([1915.1027](#)), construction ([1926.1127](#)) and agriculture ([1928.1027](#)) with additional information available at www.osha.gov/SLTC/cadmium/. A blood test is used to determine recent exposure to cadmium. The amount of cadmium in the urine shows both recent and past exposure.

There are no effective chelating agents for cadmium poisoning. Vitamin D has been used to treat "itai-itai" disease.

The mortality rate for acute cadmium poisoning is about 15 percent. Death usually occurs within four to seven days. If the patient survives, respiratory problems may persist.

E. Prevention of Exposure

Controlling occupational cadmium exposure is best accomplished through substituting it with a non-toxic chemical, depending on the application. If this cannot be done, engineering, administrative, and personal protective equipment (PPE) including protective clothing and respirators should be used.

Primary control should focus on inhalation. Inhaled cadmium is more readily absorbed into the body than is ingested cadmium. Intake of cadmium by ingestion and skin absorption are considered to be of relatively less importance in occupational settings, but steps should be taken to prevent the transfer of cadmium on skin or clothing to outside of the workplace (take-home exposure).

2. Reporting Criteria

A. Disease Reporting

Cadmium poisoning is reportable if:

- Blood cadmium values are equal to or greater than the equivalent of 5 micrograms per liter ($\mu\text{g/l}$ or mcg/l).
- Urine cadmium values are equal to or greater than the equivalent of 10 micrograms per liter ($\mu\text{g/l}$ or mcg/l).

Cadmium poisoning must be reported to the Iowa Department of Public Health by the physician or other health practitioner attending the patient and by laboratories performing tests identifying the disease. Cadmium poisonings must be reported within a week to the Iowa Department of Public Health by the physician or health practitioner attending any person having a reportable disease and by laboratories performing tests identifying reportable diseases. Reporting can be through the Iowa Disease Surveillance System (IDSS), phone, fax, or mail. The preferred reporting method is through IDSS. To report via phone, fax or mail, please use the contact information and the Cadmium Case Report Form available in the Epi Manual and online at www.idph.state.ia.us/eh/reportable_diseases.asp.