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

Sources of Exposure

General Populations

- Aluminum is ubiquitous in the environment. For the general population, exposure to aluminum most likely occurs through the consumption of food (mainly processed foods), water, and aluminum containing medicinals, such as antacids, buffered analgesics, antidiarrheal agents, or antiulcerative medication.
- The intake of aluminum from food and water is low, especially compared with that consumed by people taking aluminum-containing medicinals.
- Inhalation exposure and dermal contact may also contribute a small amount to an individual's daily aluminum exposure.

Occupational Populations

- Potential for exposure during the refining of the primary metal and in secondary industries that fabricate aluminum products (such as aircraft, automotive, and metal products) and aluminum welding.

Toxicokinetics and Normal Human Levels

Toxicokinetics

- Aluminum is poorly absorbed following either oral or inhalation exposure and is essentially not absorbed dermally. Approximately 1.5–2% of inhaled and 0.01–5% of ingested aluminum is absorbed. The absorption efficiency is dependent on chemical form, particle size (inhalation), and concurrent dietary exposure to chelators such as citric acid or lactic acid (oral).
- Aluminum binds to various ligands in the blood and distributes to every organ, with highest concentrations ultimately found in bone and lung tissues.
- Absorbed aluminum is excreted principally in the urine and, to a lesser extent, in the bile.

Normal Human Levels

- The total body burden of aluminum in healthy individuals is 30–50 mg.
- Approximately 50% of the body burden is in the skeleton and 25% is in the lungs.
- Aluminum levels in lungs increase with age.
- Aluminum levels in bone tissue of healthy individuals range from 5 to 10 mg/kg.
- Serum levels in healthy individuals range from 1 to 3 µg/L.

Biomarkers/Environmental Levels

Biomarkers

- Aluminum can be measured in the blood, bone, urine, and feces. There are insufficient data to relate aluminum exposure levels with blood or urine levels. Aluminum measured in feces cannot be used to estimate absorption.
- No biochemical or histological changes specific for aluminum exposure were identified.

Environmental Levels

Air

- Average range: 0.005–0.18 µg/m^3.
- 0.4–8.0 µg/m^3 in urban and industrial areas.

Sediment and Soil

- Concentration in soil varies widely ranging from 7 to over 100 g/kg.

Water

- Generally below 0.1 mg/L in surface water.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2008. Toxicological Profile for Aluminum. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Services.

ToxGuide™ for Aluminum

Al

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

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ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Chemical and Physical Information

Aluminum is a Metal

- Aluminum is a silvery-white metal. In nature it is found in soil, rocks (particularly igneous rocks), and clays as aluminosilicate minerals.
- Due to high reactivity, aluminum does not exist as the metal in the environment; it exists in a combined state with other elements.
- Aluminum metal is used to make a variety of products including beverage cans, pots and pans, automotive components, siding and roofing, and foil.
- Aluminum compounds are used in diverse industrial applications including water treatment, abrasives, and furnace linings. Powdered aluminum metal is used in explosives and fireworks.
- Aluminum compounds are also used in consumer products such as foil and antiperspirants, over the counter and prescription drugs such as antacids, buffered aspirin, and antiulceratives, and in food additives.

Routes of Exposure

- Inhalation – generally limited to occupational exposure.
- Oral – primary route of exposure for the general population. Aluminum is found in food, drinking water, and medicinal products such as antacids and buffered aspirin.
- Dermal (skin) contact – minor route of exposure; aluminum is found in some topically applied consumer products such as antiperspirants, first aid antibiotics, and sunscreen and suntan products.

Aluminum in the Environment

- Aluminum is the most abundant metal in the earth's crust.
- High levels in the environment can be part of the natural deposits in the earth or caused by the mining and processing of its ores and by production of aluminum metal, alloys, and compounds.
- Aluminum cannot be destroyed in the environment. It can only change its form or become attached to or separated from particles.
- Aluminum is only sparingly soluble in water between pH 6 and 8; thus aluminum concentration in most natural waters is extremely low.
- Aluminum is not bioaccumulated to a significant extent.

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 aluminum.

Oral

- An acute-duration oral MRL was not derived for aluminum.
- An MRL of 1 mg aluminum/kg/day has been derived for intermediate-duration oral exposure (15–364 days).
- An MRL of 1 mg aluminum/kg/day has been derived for chronic-duration oral exposure (≥365 days).

Health Effects

- The most sensitive target of aluminum toxicity is the nervous system. Impaired performance on neurobehavioral tests of motor function, sensory function, and cognitive function have been observed in animals. Neurobehavioral alterations have been observed following exposure of adult or weanling animals and in animals exposed during gestation and/or lactation.
- Respiratory effects, such as impaired lung function and fibrosis have been observed in aluminum workers.
- Aluminum-containing over the counter medications such as antacids and buffered aspirin are assumed to be safe in healthy people at recommended doses based on historical use. There is some indication that skeletal effects (e.g., osteomalacia) can result from long-term use in some individuals.

Children's Health

- Children who are exposed to high levels of aluminum exhibit symptoms similar to those seen in adults, including neurological effects and skeletal effects.
- We do not know if children are more susceptible than adults to aluminum toxicity.