



LEAD

What Health Care Providers Should Know

DRINKING WATER FACT SHEET #8

What is Lead and Why Is There Concern about Its Presence in Drinking Water?

Lead is a toxic heavy metal used in batteries, ammunition, pipes and solder, and x-ray shielding devices. People are exposed to lead through air, drinking water, food, and ingesting dust or dirt that contains lead. For most Americans, lead exposure has been significantly reduced in recent decades through bans on leaded gasoline and lead-based paint. However, lead remains a serious public health threat for de-

EPA estimates that drinking water contributes 10 to 20% of children's lead exposure.

veloping fetuses, infants, and children, who are particularly sensitive to its toxic effects. Infants and children living in older housing are at greatest risk of lead exposure, through ingestion of chips and dust from deteriorating lead paint or soil contaminated by past emissions of leaded gasoline. The Centers for Disease Control and Prevention (CDC) has determined that nearly 900,000 children in the U.S. between the ages of 1 and 5 years still have elevated blood lead levels (1). [Note: The blood lead level is the most widely used measure of lead exposure. The CDC considers a blood lead level of 10 micrograms per deciliter ($\mu\text{g}/\text{dL}$) or higher to be a level of concern.]

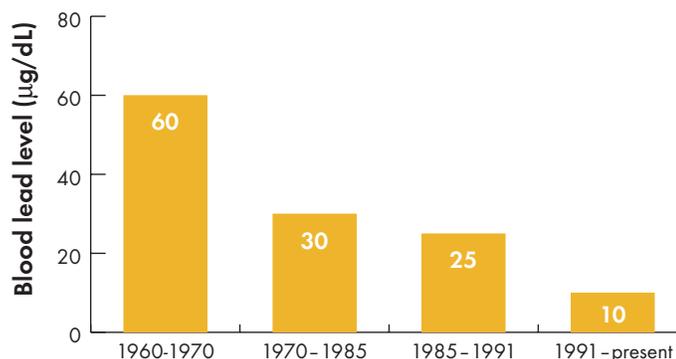
Lead in drinking water is rarely the lone cause of lead poisoning, but it can contribute to one's overall exposure and be a significant source of exposure for some people. EPA estimates that drinking water contributes 10 to 20% of children's lead exposure (2). Lead from sources such as metal smelting industries can pollute raw water sources, but most lead in drinking water results from corrosion of pipes and plumbing

materials in the water distribution system. Lead is leached from water service mains, lead service lines and interior household pipes, lead solders used to connect copper pipes, and fixtures made of brass or bronze. Approximately 20% of all public water distribution systems contain some lead components (3). Under the Safe Drinking Water Act, it is now illegal (as of August 6, 1998) for manufacturers or distributors to sell pipes, pipe fittings, or fixtures that are not "lead free." Consumers should be aware, however, that even so-called "lead free" plumbing products can legally contain up to 8% lead. Such devices can leach lead into the household water for a considerable period of time after installation (4). For information on the lead content of a particular plumbing product, individuals should contact the manufacturer or distributor.

What Are the Health Effects of Lead in Drinking Water?

Ingested lead enters the bloodstream and is immediately distributed to soft tissues such as the kidney, bone marrow, liver, and brain. Most absorbed lead is stored in the bones, and the stored fraction increases with age. In children, roughly 70% of body lead is found in the bones, whereas in

Lowering of the CDC Recommended Action Level for Blood Lead in Children



Source: ATSDR Case Studies in Environmental Medicine: Lead Toxicity (2000)

adults, more than 90% of lead in the body can be stored in bone (1). Lead in bone can serve as a continuing source of blood lead long after exposure has ceased, and can be released during pregnancy and lactation and in persons with

Young children can suffer significant and potentially permanent damage to their developing nervous systems, even with exposure to low to moderate levels of lead.

osteoporosis (5). Although lead can affect almost every system in the body, the nervous system is most sensitive to the adverse effects of chronic exposure. Young children can suf-

fer significant and potentially permanent damage to their developing nervous systems, even with exposure to low to moderate levels of lead. Adults can also experience neurological effects from lead, although these typically occur at higher exposure levels (above 40 µg/dL) (6). Several epidemiologic studies have shown an association between lead exposure and increases in blood pressure, although the evidence remains somewhat controversial (1,7,8). There is limited epidemiologic evidence that chronic lead exposure can cause renal damage in children with blood lead levels less than 40 µg/dL (9). Chronic lead exposure has also been associated with nephropathy in adults, although the strongest evidence is based on occupational exposures resulting in blood lead levels over 60 µg/dL (1).

Lead exposure has also been linked to a number of other serious health consequences, including blood disorders, particularly anemia; reproductive effects, including reduced sperm counts in men and increased frequency of miscarriages and spontaneous abortion in pregnant women; and developmental effects, including premature births, reduced birth weight, and effects on growth and neurologic devel-

Continuum of Signs and Symptoms Associated With Toxicity of Ongoing Lead Exposure

Impaired Abilities (Patient May Appear Asymptomatic)

- Decreased learning and memory
- Decreased verbal ability
- Early signs of hyperactivity or ADHD
- Lowered IQ
- Impaired speech and hearing functions

Mild Toxicity

- Myalgia or paresthesia
- Irritability
- Occasional abdominal discomfort
- Mild fatigue
- Lethargy

Moderate Toxicity

- Arthralgia
- Difficulty concentrating/muscular exhaustibility
- Headache
- Vomiting
- Constipation
- General fatigue
- Tremor
- Diffuse abdominal pain
- Weight loss

Severe Toxicity

- Paresis or paralysis
- Lead line (blue-black) on gingival tissue
- Encephalopathy—may abruptly lead to seizures, changes in consciousness, coma, and death
- Colic (intermittent, severe abdominal cramps)

Source: ATSDR Case Studies in Environmental Medicine: Lead Toxicity (2000)

opment after birth. EPA has classified lead as a “probable human carcinogen”.

Which Populations Are Most Susceptible to the Health Effects of Lead?

The health effects of lead exposure in the developing fetus, infants, and young children are more severe than in any other group. Lead readily crosses the placenta, exposing the fetus. Because the blood/brain barrier is not fully developed until the age of three, young children’s nervous systems are particularly susceptible to lead penetration. Children also absorb a greater percentage of ingested lead than do adults (1). Children’s behaviors, such as hand-to-mouth activity and crawling and playing on the ground or other contaminated surfaces can also increase their risk of lead exposure from paint and dust.

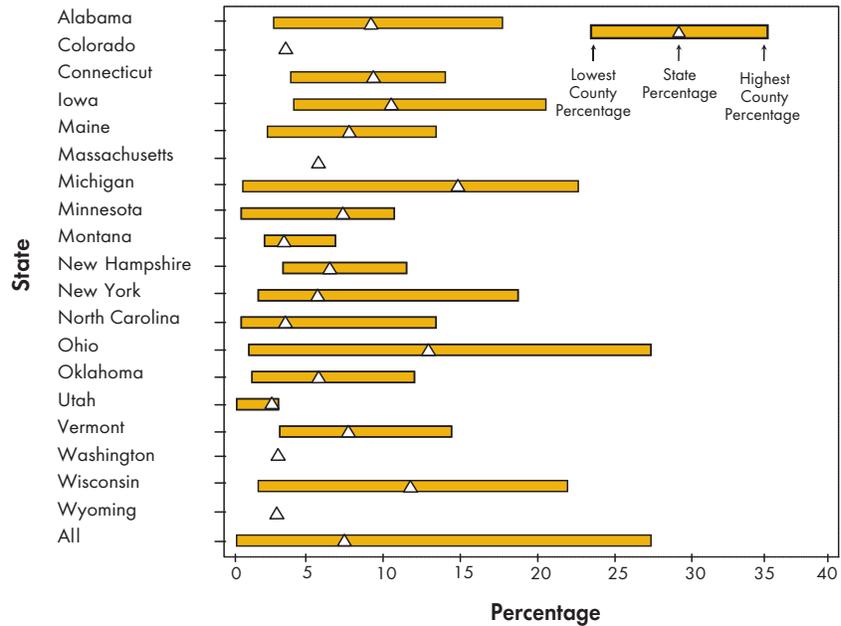
Fetal exposure to lead can result in premature birth and reduced birth weight. Chronic exposure to lead during early childhood development can also cause slow mental development, lower intelligence, and cause other neuro-psychologic and neurobehavioral deficits that may persist into adulthood (1,10). Recent studies suggest that some neurological deficits could occur at blood lead concentrations at or below the current CDC level of concern (10 µg/dL) (1,11). Children ingesting large amounts of lead may also develop anemia, kidney damage, colic, muscle weakness, and developmental delay. Severe lead poisoning may cause seizures, increased intracranial pressure, and, in rare cases, death (1).

Although blood lead levels have declined dramatically since leaded gasoline was banned, and recent surveillance shows that average levels are still declining, some children remain at high risk. Low-income children, urban children, and those living in older housing are more likely to have blood lead levels above the CDC action level than other children (12).

How is Lead Regulated in Drinking Water?

Whereas EPA has established legally enforceable maximum contaminant levels (MCLs) for many drinking water contaminants, it has not done so for lead. Instead, the agency has adopted an “action level” of 15 µg/L for lead. Water systems are required to control the corrosiveness of their water to ensure that tap water does not exceed this level in more than 10% of homes sampled, and they must notify citizens of any violations of the action level (3). In addition,

State-specific percentage of children aged <6 years tested with blood lead levels (BLLs) 10 µg/dL and highest and lowest percentage of elevated BLLs, by county— selected states, 1998*



* Only counties with 200 children tested for BLL are included. Colorado, Washington, and Wyoming had <2 counties with 200 children tested, and Massachusetts did not report county of residence.

Source: CDC. Blood lead levels in young children—United States and selected states 1996–1999. MMWR Morbidity and Mortality Weekly Report 49:1133–1137 (2000)

the Safe Drinking Water Act requires utilities to use lead-free pipes, solder, and flux in the installation or repair of any public water system or plumbing equipment.

What Can Health Professionals Do to Reduce the Public Health Threat from Lead in Drinking Water?

- If lead exposure is suspected, talk with patients to identify possible sources of exposure. (Refer to ATSDR’s *Case Studies in Environmental Medicine: Lead Toxicity* for suggested lines of inquiry). Individuals with potentially high lead exposure should be screened using a blood lead test. Early detection and intervention can prevent serious long-term health consequences of lead exposure.
- Educate patients, particularly high-risk populations such as pregnant women and low-income families, about the risks of lead exposure for infants and children. Research has shown that health professionals can have a direct impact on how people perceive the risk from lead in tap water by motivating people to take action to reduce their exposure (13).
- The American Academy of Pediatrics recommends that pediatricians provide anticipatory guidance to parents about sources of lead exposure and prevention strategies

and increase their efforts to screen children at risk for lead exposure. (See *Sources* below.)

- Encourage patients to ask their public water supplier if its supply system contains lead piping and what steps the supplier is taking to deal with lead contamination.
- Because prolonged contact with lead pipes, solder, or fixtures increases the lead content of tap water, advise patients to “flush” pipes by running water down the drain for 30 to 60 seconds before drinking it or using it for cooking. People living in high-rise buildings may need to allow water to run for a longer time to adequately flush pipes. Hot water also tends to leach more lead from pipes, so encourage patients to use only cold tap water for cooking, drinking, and mixing infant formula.
- Advise parents of children who may already be exposed to high levels of lead from deteriorating paint or other sources to have their water tested for lead. Testing, which costs between \$20 and \$100, is especially important for residents of large apartment buildings, where flushing may not be as effective. EPA’s Safe Drinking Water Hotline at (800) 426-4791 can direct individuals to state laboratory that can assist with testing.
- If patients have high lead levels in their water, urge them to install a home water filter capable of removing lead. Contact NSF International at (313) 769-8010 or <http://www.nsf.com>, or the Water Quality Association at (630) 505-0161, for assistance in selection of a filter or water treatment system.

Sources of Additional Information and Guidance

- Physicians for Social Responsibility: (202) 667-4260 or <http://www.psr.org>
- PSR/ACPM online CME course, “Drinking Water and Disease”: http://www.acpm.org/ehealth/sdw_intro.htm
- American Academy of Pediatrics, policy statement on screening for elevated blood lead levels: <http://www.aap.org/policy/re9815.html>
- Alliance to End Childhood Lead Poisoning: (202) 543-1147 or <http://www.aeclp.org>
- *Case Studies in Environmental Medicine: Lead Toxicity*, Agency for Toxic Substances and Disease Registry (ATSDR): <http://www.atsdr.cdc.gov/HEC/CSEM/lead/index.html>

- CDC Childhood Lead Poisoning Prevention Program: <http://www.cdc.gov/nceh/lead/lead.htm>
- National Lead Information Center: (800) LEAD-FYI or <http://www.epa.gov/lead/nlicdocs.htm>

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This document is one in a series of Drinking Water Fact Sheets developed specifically for health care providers by Physicians for Social Responsibility. These fact sheets provide practical and concise information to assist health care providers in recognition and prevention of disease caused by exposure to drinking water contaminants.



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