

## OREGON PUBLIC HEALTH DIVISION • OREGON HEALTH AUTHORITY

### ELEVATED BLOOD LEAD IN OREGON ADULTS

Lead and humans have a long history together. Lead is thought to have been discovered around 6500 BC. As early as the 2nd century BC, the Greek botanist Nicander described the lead poisoning symptoms of colic and paralysis. Discorides, a Greek physician who lived in the 1st century, reported that lead poisoning causes the mind “give way”.\*

While it is impossible to estimate the number of people who have suffered disability and/or early mortality as a result of lead poisoning there is evidence that it adversely affected several prominent historical figures. Queen Elizabeth I used lead-based cosmetics that probably hastened her death; U.S. President Andrew Jackson suffered from a form of lead poisoning called plumbism (from Latin); and a 2000 study found Ludwig Von Beethoven’s hair had lead levels 100 times normal, supporting the theory that lead poisoning contributed to his deafness and early his demise.<sup>1</sup>

Because of health concerns, lead has either been removed or greatly reduced in many product including: gasoline, paints, ceramics, caulking, cosmetics and pipe solder. While this has dramatically reduced exposures, lead in the environment continues to be a health concern because it is still used by a number of industries and is present in legacy sources, such as lead-based paint in older housing. This *CD Summary* reviews the health effects and potential sources of exposure, and examines trends in lead testing and elevated blood lead levels (EBLLs) in Oregon adults.

#### HEALTH EFFECTS OF LEAD

The presence of lead in the human body can lead to toxic effects and is known to adversely affect every organ system. Proposed mechanisms for toxicity include lead’s ability to inhibit or mimic the actions of calcium (which can affect calcium-dependent or related processes) and to interact with

proteins (including those with sulfhydryl, amine, phosphate and carboxyl groups).<sup>2</sup> Lead in the body can be absorbed and stored in bones, blood, and tissues; it can be remobilized and serve a source of ongoing internal exposure, such as when bones demineralize during the aging process, a particular concern for menopausal women.<sup>3</sup>

Exposure to high levels of lead over a short period can lead to: abdominal pain, constipation, confusion, headache, anemia, kidney failure, irritability, weakness, neuropathy, and in severe cases seizures, coma, and death. Longer-term exposures to lower levels of lead can produce similar problems, and have been shown to increase the risk of high blood pressure, heart disease, kidney disease, infertility, miscarriages, and cognitive dysfunction.<sup>2</sup> Lead is particularly toxic to children because of the relatively rapid development of the nervous system during early childhood and may cause permanent learning and behavior disorders.<sup>4</sup> And if this is not enough, the International Agency for Research on Cancer has determined that lead is probably a human carcinogen.<sup>2</sup>

#### CURRENT SOURCES OF LEAD

Despite ongoing efforts to reduce exposure to lead, significant sources still exist. Older buildings with degrading lead-based paint pose a threat to inhabitants and renovation workers. Lead is still found in some commercial products, particularly imported home remedies, cosmetics and toys. High concentrations of lead in soil, air, and water can be found near the sites of historic or ongoing mining and smelting operations. Recent research suggests smaller municipal airports frequently used by piston-driven propeller aircraft can be a source of airborne lead.<sup>4</sup>

Lead-related occupations and hobby activities are also significant pathways to lead exposure. Industries involved in the smelting, refining, and manufacturing of lead have workers

with the highest and most prolonged occupational exposure to lead.<sup>2</sup> Other occupations with an increased risk for lead exposure include: renovation of older buildings; production of rubber products and plastics; soldering and welding; bridge maintenance; municipal waste incineration; radiator repair; and pottery/ceramics production. Hobbies such as target shooting, automotive repair and restoration, and the manufacture of ammunition and fishing tackle can expose people to lead.

#### BLOOD LEAD TESTING

With a continued risk of exposure, surveillance is an important component in safeguarding the public’s health. Since 1991, Oregon has received funding through the CDC’s Adult Blood Lead Epidemiology and Surveillance (ABLES) program to conduct surveillance for elevated blood lead levels (EBLLs) among Oregon adults.

Venous blood lead level testing is the most useful screening and diagnostic test for recent (within the past 4 months) exposure. In 1991, when lead poisoning became a reportable condition in Oregon, only test results  $\geq 25$   $\mu\text{g}/\text{dl}$  were required to be reported for adults. As of November 2011, all blood lead tests regardless of result level or age of patient are required to be reported.<sup>‡</sup>

The program currently receives BLLs for 3,000 new adults annually. Of the 52,000 individuals tested from 1990 through April 2013, 60% were in men and 35% in women (5% unknown). The average age at first test was slightly younger for men (44.5 years) than for women (47.7 years).

#### ELEVATED BLLs

The Good News: over the past 30 years, the prevalence of EBLL among workers in Oregon and nationally has markedly declined. Oregon’s prevalence is substantially lower than the national level (Figure, *verso*).

‡ Oregon Administrative Rule 333-018-0015(d).  
[http://arcweb.sos.state.or.us/pages/rules/oars\\_300/oar\\_333/333\\_018.html](http://arcweb.sos.state.or.us/pages/rules/oars_300/oar_333/333_018.html)

\* [http://en.wikipedia.org/wiki/Lead\\_poisoning#History](http://en.wikipedia.org/wiki/Lead_poisoning#History). Where else?

† *CD Summary*, Vol 62, No. 13, June 18, 2013



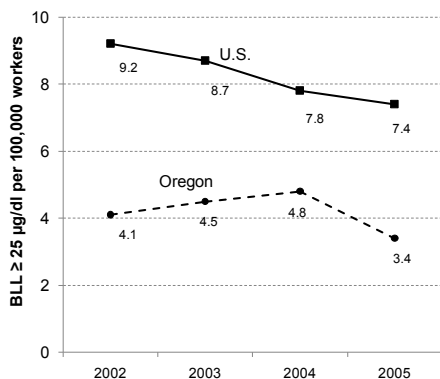
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**CUMULATIVE LEAD DOSE**

While the decline in EBLL is promising, recent research suggests that the cumulative lead dose may have significant health impacts.<sup>5-7</sup> Cumulative blood lead dose was estimated for 798 Oregon adults with more than

**Figure. Prevalence of BLL ≥25 µg/dl in adults per 100,000 employed**



Source: [www.cdc.gov/niosh/topics/ABLES/pdfs/2002-2005lead\\_data.pdf](http://www.cdc.gov/niosh/topics/ABLES/pdfs/2002-2005lead_data.pdf)

2 years between their first and last elevated test result by multiplying the average of all the individual's blood lead tests by the time range in years (Table). The average cumulative dose for the 328 individuals whose maximum blood lead test result was 10–24 µg/dl was 87.4 µg/dl. For the 470 individuals whose maximum blood lead test was ≥25 µg/dl was 219.8 µg/dl. Of note: a higher percent of workers with elevated blood lead levels ≥10 years apart had maximum levels ≥25 µg/dl. These are the folks at particular risk for adverse health effects due to lead.

**WHAT'S A DOC TO DO?**

- Because the symptoms of lead poisoning are non-specific, ask your

**Table. Cumulative lead dose: Oregon workers with EBLL by maximum level**

Time between first elevated and last elevated test result	Number with Max Level 10–24 µg/dl	Number with Max Level ≥25 µg/dl	Total
2–4 years	155	134	289
5–9 years	120	156	276
≥10 years	53	180	233

patients about activities that may be sources of lead exposure, including those related to occupation or hobbies.

- Because Oregon's adult blood lead test results are not tied to any health outcomes, medical researchers who are interested in accessing these data for research projects should contact the Oregon Lead Poisoning Prevention Program. (<http://public.health.oregon.gov/PHD/Directory/Pages/program.aspx?pid=73>)

**FOR MORE INFORMATION**

The Oregon Public Health Division has resources for providers and patients.

- Lead in the home: <http://public.health.oregon.gov/HealthyEnvironments/HealthyNeighborhoods/HealthyHomes/LeadPoisoning/Pages/index.aspx>
  - Lead in the workplace: <http://public.health.oregon.gov/HealthyEnvironments/WorkplaceHealth/Work-RelatedLeadPoisoning/Pages/index.aspx>
- The CDC provides a variety of resources.
- General information about childhood lead poisoning, lead in the workplace, and lead in the environment. See [www.cdc.gov/lead](http://www.cdc.gov/lead)
  - CDC Adult Blood Lead Epidemiology and Surveillance program (ABLES) has national data on adult lead testing. See [www.cdc.gov/niosh/topics/ABLES/ables.html](http://www.cdc.gov/niosh/topics/ABLES/ables.html)

- CDC Agency for Toxic Substances and Disease Registry has extensive information about the health effects of lead available at [www.atsdr.cdc.gov/toxfaqs/TF.asp?id=93&tid=22](http://www.atsdr.cdc.gov/toxfaqs/TF.asp?id=93&tid=22)

**REFERENCES**

1. San Jose State University, Beethoven Research Center. Press release: Lead Poisoning Probable Cause of Beethoven Illnesses, 2000. [www.sjsu.edu/beethoven/collections\\_exhibit/beethoven\\_hair/scientific\\_testing/testno2/press\\_release/](http://www.sjsu.edu/beethoven/collections_exhibit/beethoven_hair/scientific_testing/testno2/press_release/)
2. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry. Toxicological Profile for Lead, August 2007. Available at [www.atsdr.cdc.gov/toxprofiles/tp13.pdf](http://www.atsdr.cdc.gov/toxprofiles/tp13.pdf)
3. Navas-Acien A, Guallar E, Silbergeld EK, Rothenberg SJ. Lead exposure and cardiovascular disease: A systematic review. *Environ Health Perspect.* 2007;115:472–82.
4. Miranda ML, Anthopolos R, Hastings D. A geo-spatial analysis of the effects of aviation gasoline on childhood blood lead levels. *Environ Health Perspect.* 2011;119:1513–16.
5. Hu H, Shih RA, Rothenberg S, Schwartz BS. The epidemiology of lead toxicity in adults: Measuring dose and consideration of other methodologic issues. *Environ Health Perspect.* 2007;115:455–62.
6. Shih RA, Hu H, Weisskopf MG, Schwartz BS. Cumulative lead dose and cognitive function in adults: A review of studies that measured both blood lead and bone lead. *Environ Health Perspect.* 2007;115:483–92.
7. Bandeen-Roche K, Glass TA, Bolla KI, Todd AC, Schwartz BS. Cumulative lead dose and cognitive function in older adults. *Epidemiology* 2009;20:831–9. Available at: [http://hero.epa.gov/index.cfm?action=reference.details&reference\\_id=451066](http://hero.epa.gov/index.cfm?action=reference.details&reference_id=451066).