

Elevated Blood Lead Levels

Adverse health effects from exposure to lead remains an ongoing health concern. Though commonly thought of as a problem in toddlers from the ingestion of paint chips, lead toxicity is also an important health issue in adults. Each year in Michigan, 13,000-14,000 adults are tested for lead exposure. The appropriate test is a blood lead level; there is no reason to order a urine test. Approximately 1,300 (~10%) individuals in Michigan each year have an elevated blood lead level (BLL). Among the approximately 1,300 elevated BLLs reported each year in Michigan, about 54% have a BLL of 5-9 $\mu\text{g}/\text{dL}$, 38% have a BLL of 10-24 $\mu\text{g}/\text{dL}$ and 8% have a BLL of ≥ 25 $\mu\text{g}/\text{dL}$ (1). The average BLL in the US general population is 1.38 $\mu\text{g}/\text{dL}$.

Eighty percent of Michigan adults with an elevated BLL have their exposure to lead at work. The usual workplace sources for lead in Michigan are the removal of paint from outdoor metal structures (i.e. bridges or water towers) or during building remediation or renovation, the manufacture of brass and bronze, and work in indoor firing ranges. These workers are covered by a federal occupational health standard promulgated in 1978 that allows a worker's blood lead level to be as high as 50 $\mu\text{g}/\text{dL}$. Since 1978 there has been extensive research on the adverse health effects of lead at levels lower than 50 $\mu\text{g}/\text{dL}$. This literature is summarized in a 2012 publication from the National Institute of Health (NIH) (2) and a 2013 publication from the Environmental Protection Agency (3). A summary of the review of the medical literature from the NIH document is

shown in Table 1.

There is a clear consensus in the medical literature that adverse health effects begin even below blood lead levels of 5 $\mu\text{g}/\text{dL}$. The table shows the consensus opinion of NIH scientists and an external scientific review committee on whether there was sufficient or limited evidence of an adverse health effect in adults at blood lead levels below 5 and 10 $\mu\text{g}/\text{dL}$.

The awareness of adverse health effects at these low BLLs has fostered the development of new management guidelines for caring for adults with elevated blood lead levels. Table 2 shows a copy of the guidelines that have been developed by the California Department of Public Health and subsequently adopted by the Occupational Subcommittee of the Council of State and Territorial Epidemiologists and the Association of Occupational and Environmental Clinics.

On November 13, 2013 the California Department of Public Health held a symposium entitled Lead in the Workplace – the New Science. This is the first step in a process to adopt new occupational lead regulations in California. Prominent features proposed in the new regulations are for employers to aim to maintain worker blood lead levels at 5 to 10 $\mu\text{g}/\text{dL}$ and to require medical removal at 30 $\mu\text{g}/\text{dL}$ (4). To maintain blood lead levels of 5 to 10 $\mu\text{g}/\text{dL}$ as proposed, the allowable air standard would be reduced from 50 $\mu\text{g}/\text{m}^3$ to 0.5-2.1 $\mu\text{g}/\text{m}^3$.

TABLE 1. NATIONAL TOXICOLOGY PROGRAM (NTP) CONCLUSIONS ON HEALTH EFFECTS OF LOW-LEVEL LEAD (Pb) EXPOSURE ON ADULTS BY MAJOR HEALTH EFFECT AREAS

Health Area	NTP Conclusion	Principal Health Effects	Blood Pb Evidence	Bone Pb Evidence
Neurological	Sufficient	Increased incidence of essential tremor	Yes, <10µg/dL	No data
	Limited	Psychiatric effects, decreased hearing, decreased cognitive function, increased incidence of amyotrophic lateral sclerosis (ALS)	Yes, <10µg/dL	The association between bone Pb and cognitive decline is more consistent than blood Pb.
	Limited	Increased incidence of essential tremor	Yes, <5µg/dL	The association between bone Pb and cognitive decline is more consistent than blood Pb.
Immune	Inadequate	—	Unclear	No data
Cardiovascular	Sufficient	Increased blood pressure and increased risk of hypertension	Yes, <10µg/dL	The association between bone Pb and cardiovascular effects is more consistent than blood Pb.
	Limited	Increased cardiovascular-related mortality and ECG abnormalities	Yes, <10µg/dL	The association between bone Pb and cardiovascular effects is more consistent than blood Pb.
Renal	Sufficient	Decreased glomerular filtration rate	Yes, <5µg/dL	Yes, one study
Reproductive and Developmental				
Women	Sufficient	Reduced fetal growth	Yes, <5µg/dL	Maternal tibia Pb is associated
	Limited	Increase in spontaneous abortion and preterm birth	Yes, <10µg/dL	No data
Men	Sufficient	Adverse changes in sperm parameters and increased time to pregnancy	Yes, ≥15-20µg/dL	No data
	Limited	Decreased fertility	Yes, ≥10µg/dL	No data
	Limited	Increased spontaneous abortion	Yes, >31µg/dL	No data
Adults	Inadequate	Stillbirth, endocrine effects, birth defects	Unclear	No data

(Adapted from Reference #2)

Practitioners should also be aware of the potential for lead exposure in non-work settings. The most common non-work source of lead for adults in Michigan is the regular use of indoor firing ranges, particularly if individuals reload or cast bullets so as to reduce the cost of ammunition. The next most common non-work-related setting where lead exposure occurs in Michigan is home remodeling, which involves disturbing/removing paint from homes built before 1978. There are many less common non-work-related sources of lead such as previous gunshot wounds with retained bullets and hobbies making stained glass windows or fish sinkers. Contamination of food, particularly spices, has occurred on multiple occasions in Michigan. Lead is an ideal adulterant of spices, since spices are generally sold by weight, and lead tastes sweet, is relatively inexpensive and is heavy. A recent contamination episode occurred in Michigan households of individuals importing spices from Iraq.

Chelation therapy in adults is generally not indicated unless blood lead levels are above 50 µg/dL. There is no evidence that chelation is useful to treat or prevent the chronic neurological, cardiovascular or renal effects of lead. Primary prevention to eliminate or minimize exposure is the only “treatment” shown to be effective to prevent the chronic effects described in Table 1.

TABLE 2. MANAGEMENT GUIDELINES FOR BLOOD LEAD LEVELS IN ADULTS

The following categories represent general guidelines. Blood lead level (BLL) monitoring should be done on a schedule based on an individual's risk of exposure to lead. **Primary management of lead poisoning is source identification and the elimination or reduction of further exposure.** A single BLL does not reflect cumulative body burden, nor predicts long-term effects. Recent evidence suggests that chronic low-level lead exposure has adverse health effects in adults and no blood lead threshold level for these effects has been identified. Treatment decisions, including chelation, should be made in consultation with a physician knowledgeable about lead poisoning medical management. Centers for Disease Control and Prevention (CDC, 2012) report that the mean BLL for US adults age 20 years and older is 1.38ug/dL.

Blood Lead Level (ug/dL)	Management Recommendations
<5	No action needed Monitor BLL if ongoing exposure
5-9	Discuss health risks Minimize exposure Consider removal for pregnancy and certain medical conditions Monitor BLL
10-19	Decrease exposure Remove from exposure for pregnancy Consider removal for certain medical conditions or BLL \geq 10 for an extended period of time Monitor BLL
20-29	Remove from exposure for pregnancy Remove from exposure if repeat BLL in 4 weeks remains \geq 20 Annual lead medical exam recommended
30-49	Remove from exposure Prompt medical evaluation
50-79	Remove from exposure Prompt medical evaluation Consider chelation with significant symptoms
\geq 80	Remove from exposure Urgent medical evaluation Chelation may be indicated

Note: The above management guidelines recommend removal from lead exposure at blood lead levels that are lower than those at which Medical Removal Protection is required under current OSHA lead standards. However, OSHA job protections also apply whenever a licensed health care provider removes an individual from lead exposure, whatever the patient's blood lead level, if the individual has a lead related problem or has a medical condition that places the worker at greater risk from lead exposure. Because of the complexity in recommending medical removal below levels required by OSHA, a physician making such a recommendation may want to review the OSHA regulations, consult with a physician familiar with the regulatory process and discuss with their patient how this may affect their employment. For further information on this topic, please see the medical removal protection provisions of the OSHA lead standards. (<http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/OccupationalHealth/ManagementGuidelinesforAdult.pdf>)

References

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4. Recommendations for improving the Cal/OSHA Lead Standards. California Department of Public Health. <http://www.cdph.ca.gov/programs/olppp/Pages/LeadStdRecs.aspx>

IF YOU HAVE QUESTIONS REGARDING THE DIAGNOSIS OR MANAGEMENT OF LEAD TOXICITY, PLEASE CALL KENNETH ROSENMAN, MD AT 1-800-446-7805.

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News

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In this issue: v25n1 Elevated Blood Lead Levels

***S** Remember to report all cases of occupational disease!

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