Blood Lead Testing – Indications and Interpretation: A guide for health care providers

This fact sheet is intended to inform health care practitioners on when to consider testing blood lead levels in asymptomatic individuals and on interventions for reducing blood lead. While not the focus of this fact sheet, references are also provided on the diagnosis and management of symptomatic patients for whom lead poisoning is or should be suspected.[1-3]

New epidemiological evidence shows an association between low blood lead levels and health effects. Through downward extrapolation, blood lead levels as low as 1 – 2 µg/dL have been linked with neurodevelopmental effects in children. A threshold for these effects has not been identified. Other health effects including reproductive, renal, and cardiovascular effects in adults have also been associated with blood lead levels below the current federal-provincial-territorial (F/P/T) blood lead intervention level of 10µg/dl.[4]

While these population-level effects cannot reliably be observed in individual patients, research supports the view that further measures to reduce lead exposures in the general population would benefit public health. There may also be benefit in identifying individuals with unusually high blood lead levels (BLL) to determine whether they and those around them are affected by a source of lead exposure that can be reduced.

How people are exposed to lead

Most people are exposed to lead through diet; drinking water may also contribute in areas where old lead service pipe is still present or water pH is such that lead leaches from old solder or other lead containing components of pipes or fixtures. Other sources of lead exposure include hobby or occupational exposure, local or neighbourhood sources such as active lead smelters or historical soil contamination from old industrial activity, traditional medications and cosmetic products. Occasionally toys or consumer products not meeting Canadian standards or paint removal as part of household renovations are also identified as a source of exposure. Secondary exposure within a family can occur if household members bring lead home on their clothes or in their vehicles. Children may be exposed to lead from hand-mouth activities involving contaminated dust and soils in and around older homes that contain lead-based paint or from eating paint chips that contain lead.

Interpreting a blood lead result

Once absorbed, lead is bound to red blood cells and distributes to soft tissues and bones. While turnover occurs over a period of weeks in blood and soft tissues, skeletal lead has a half life of 20 years or more. Skeletal lead slowly re-distributes into the blood, although during pregnancy, immobilization, or following certain fractures, skeletal lead redistribution to blood is more rapid. Age, pregnancy, injury, osteoporosis and illness should be considered in interpreting a patient's blood lead result. Testing within 48 hours of chelation therapy, as is sometimes ordered for assessment of the "body burden" of lead does not produce an interpretable result and is not recommended.[5]

While there is no good evidence to support the effectiveness of routine screening of asymptomatic individuals, the following risk factors in a patient's history may help identify patients who may have higher than normal lead exposure and warrant blood lead testing.[6,7]

- Lives in an older* home with recent or ongoing renovation or peeling or chipped paint
- Has been seen eating paint chips or other metallic non-food items
- Lives near a point source of lead contamination
- Consumes wild game killed with lead shot
- Works with lead, has a hobby that involves lead, such as shooting, or lives in a household with someone who does
- Has a sibling, housemate or playmate with prior history of lead poisoning
- Has evidence of poor nutrition, as low iron, calcium and Vitamin C stores contribute to raised lead uptake
- Has consumed Ayurvedic** and other traditional medications or privately imported medications or nutritional supplements from developing countries

* The Canadian Pediatric Society and the College of Family Physicians of Canada list any home that was built before 1978 as at risk based on the timing of the regulations to phase out lead paint. However, in practice, many houses used lead-free paint by 1960, so 1960 is a more useful cut-off for when to consider an older home at risk of having lead paint.[8]

** Ayurvedic medications are part of a traditional South Asian healing system.

How lead affects people's health

Most people with an elevated BLL are asymptomatic. However, occasionally cases of very high BLL leading to symptoms of poisoning still occur. A common clinical presentation of acute poisoning is colicky abdominal pain which may occur in individuals with BLL >60µg/dL.

Figure 1 highlights some of the important health effects and clinical presentations related to lead poisoning, either in individuals or which have been identified through population studies. The tube level indicates the levels at which health effects may begin to occur. The higher the blood lead level the greater the likelihood of health effects.

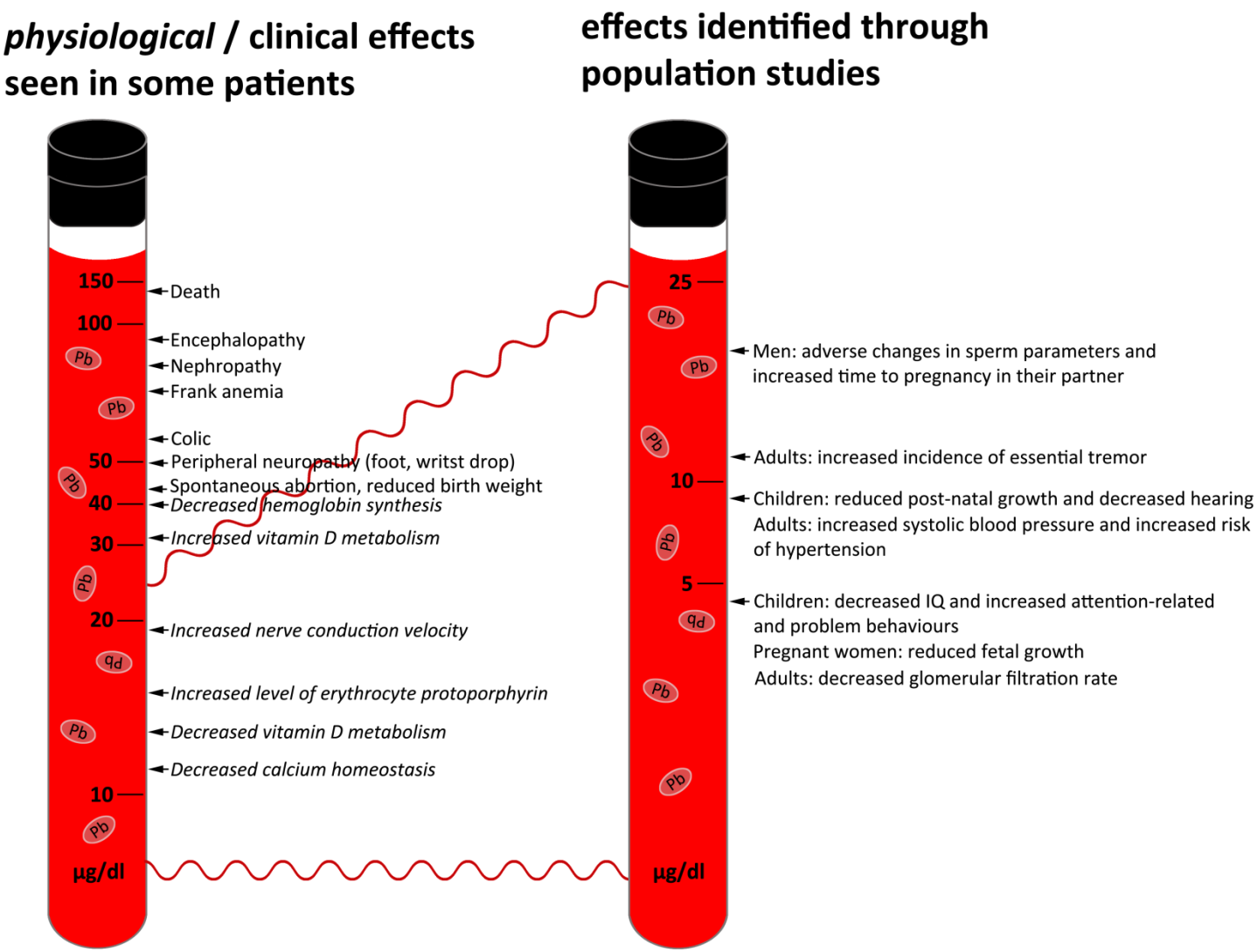

Figure 1: Health effects at varying blood lead levels.
(Modified from WHO 2010, US Dept of Health and Human Services 2012, Health Canada 2013, National Toxicology Program 2012)

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Blood lead levels in the Canadian population

The 2009-2011 Canadian Health Measures Survey, found that the mean blood lead level for children and adults together was 1.2µg/dL (0.06µmol/L).[12] Age-specific results are provided in **Figure 2**.

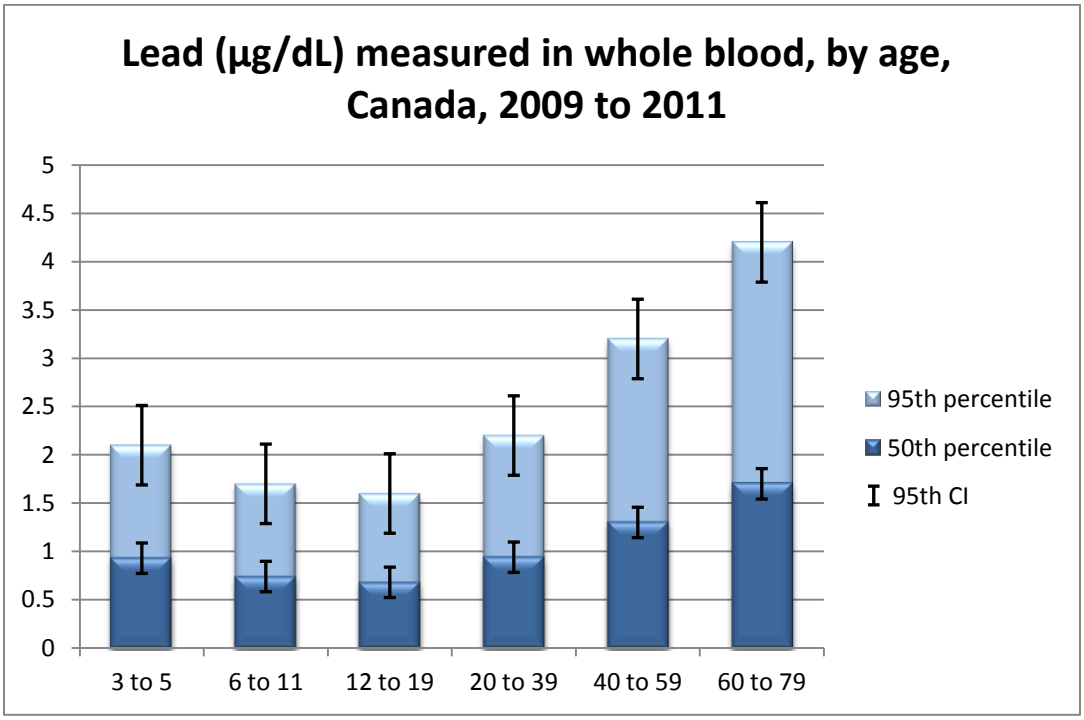

Figure 2: Lead (µg/dL) measured in whole blood, by age, Canada, 2009 to 2011 – 50th percentile and 95th percentile[12]

There has been a significant decline in blood lead levels over the last 30 years. In 1978-1979, the mean BLL for Canadians aged 5 to 69 was 6.8µg/dL, compared with 1.2µg/dL for Canadians from 3-79 in 2009-2011. Further, in 1978-1979, 25% of the population had a BLL above 10µg/dL, compared to less than 1% in 2009-2011.[8,13] This demonstrates that public health efforts to reduce lead exposure in the general population continue to be successful.

People with risk factors listed in the box above may have BLLs higher than the general population. It is these patients who should be targeted for testing. As lead has a half-life of one to two months in the blood, it is recommended that individuals with high BLLs have repeat blood testing done at six months to see whether levels have declined.

Action levels for elevated blood lead levels are outlined in **Table 1**.

Table 1: Action by clinicians for blood lead levels

Blood Lead Level	Action for Children	Action for Adults
5-10µg/dL (0.24 – 0.48 µmol/L)	• Repeat BLL testing in 6 months. • Consider whether iron deficiency or other nutritional factors might be contributing to increased lead absorption and work up if indicated. • Provide information on preventing lead exposures, but advise on limited likelihood of success in reducing BLLs at this low level.	• No action • (for pregnant women) Consider whether iron deficiency or other nutritional factors might be contributing to increased lead absorption and work up if indicated.
10-20µg/dL (0.48 –0.97 µmol/L)	• Action as above. • Environmental evaluation may help in identifying the source that is contributing to the increased blood lead level. Contact local public health for advice on how this can be done in your area.	• Repeat BLL testing in 6-12 months. Environmental evaluation may help in identifying the source that is contributing to the increased blood lead level. Contact local public health for advice on how this can be done in your area • Provide information on preventing lead exposures.
≥20µg/dL (0.97 µmol/L)	• Action as above. • Refer to specialist for assessment of possible lead related effects and/or need for therapy.	• Action as above. • Refer to specialist for assessment of possible lead related effects and/or need for therapy.

Interventions that may reduce lead exposure

The most successful primary prevention interventions to date have been those that reduce exposures to the entire population such as the removal of lead from gasoline and paint. Emission control measures on local sources such as lead smelters are also effective in reducing community lead exposure. It is less clear whether interventions directed towards individuals or families are effective. A 2012 Cochrane review failed to demonstrate the effectiveness of household interventions for BLL below 15µg/dL.[14] Until additional evidence is available to support interventions that may further reduce BLL, clinicians should be aware of the limited evidence for the effectiveness of the interventions presented below:

- Older homes (pre-1960) may have lead-containing paint that is in poor condition and can be a source of lead exposure to occupants, particularly young children. Old paint on high friction surfaces such as windows and door sills may produce fine leaded dust. Wet wiping down of surfaces weekly to minimize dust can be effective.[14,15] Remind parents of the risks of lead exposure during renovations. Refer to the Health Canada documents listed under Further Information below.
- Some toys and jewellery contain lead or lead-based paints: see Further Information below for a link to Health Canada's recall list on products that should not be used.
- Lead in house dust and on soil is also a potential exposure source and parents could be encouraged to wash their children's hands frequently. However, there are no data to support that hand washing will reduce exposure, although it does have an intuitive appeal.[16,17] Removing shoes at the door may also decrease contaminated soil that is tracked in.
- Lead in drinking water can contribute to blood lead levels. Homes with lead service connections or lead solder in the pipes may have water levels that exceed the Canadian Drinking Water guidelines for lead and contribute to increased BLLs. Your patients can contact their water services provider to determine the potential for lead in their water system. Flushing the water, water treatment devices, replacing the service connection and other measures can help reduce the lead in the water.
- Clinicians should consider correcting nutritional deficiencies in children with elevated lead levels. Although there is no trial data to support this strategy, there is laboratory evidence that adequate dietary intake of iron and calcium may decrease lead absorption and that adequate dietary intake of vitamin C may increase renal excretion of lead.[18]
- Where a worker is found to have a blood lead level of concern, workplace health and safety authorities in your province/territory should be informed.
- While chelation therapy has been recommended for pregnant women and for children with BLLs above 45µg/dL, healthcare providers should consult with an expert in the management of lead chemotherapy prior to using chelation agents.[17,19]

Further Information

Healthy Canadians: Reduce Your Exposure to Lead
http://healthycanadians.gc.ca/environment-environnement/home-maison/lead-plomb-eng.php

Health Canada: Lead-based Paint
http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/prod/paint-peinture-eng.php

Health Canada's Product Recall List
http://www.hc-sc.gc.ca/ahc-asc/media/advisories-avis/index-eng.php

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