Chapter 5

Screening and Diagnosis of Childhood Lead Poisoning

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## In Brief: A Public Health Blood Lead Screening Program

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<th>Activities</th>
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<tr>
<td>Describe high-risk populations in the community</td>
<td>• Identify characteristics of children in the community known to be lead-poisoned and the sources of exposure.</td>
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<td>• Identify locations of children who share these risks.</td>
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<td>• Map locations of children tested, lead poisonings, and age of housing.</td>
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<td>Assure blood lead testing is accessible and available</td>
<td>• Determine providers (e.g., WIC projects, HealthCheck providers, Federally Qualified Health Centers, local clinics, etc.) that provide lead services to identified at-risk populations.</td>
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<td>• Assess barriers to families in obtaining blood lead tests.</td>
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<td>• Establish collaborations to facilitate testing of at-risk children.</td>
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<td>• Identify resources for affordable venous blood lead tests for uninsured families.</td>
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<td>Monitor local blood lead testing practices</td>
<td>• Assess proportion of high risk population, e.g., Medicaid or WIC, who are tested.</td>
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<td>• Assess timeliness of venous confirmatory and follow-up tests.</td>
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<td>• Work with Wisconsin Childhood Lead Poisoning Prevention Program (WCLPPP) to obtain provider or site specific test data to determine lead testing trends.</td>
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<td>Provide information about blood lead testing to health care providers</td>
<td>• Assess knowledge of staff at local health care facilities about lead poisoning, blood lead testing recommendations, current protocols for follow-up testing and clinical management, and the health department role.</td>
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<td>and parents of young children</td>
<td>• Encourage health care providers in the community to utilize the Wisconsin Blood Lead Registry to ascertain the blood lead test histories of their pediatric patients.</td>
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<td>• Develop strategies to provide information on testing to health care staff and to establish effective communication about children with lead poisoning.</td>
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<td>• Develop strategies to effectively communicate to parents of children aged 0-5 about lead exposure and blood lead testing.</td>
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<td>• Identify a desired outcome for educational interventions.</td>
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Chapter 5.2
Introduction

Screening programs identify persons who have a particular health condition, e.g., lead poisoning, among a group of apparently well people. Without screening programs, persons with adverse health conditions may not be aware of the condition. Usually those with positive results from a screening program require additional diagnostic testing. The results of a screening program should benefit the individual being screened as well as the community because earlier detection and treatment of the disease may prevent severe and costly consequences from occurring.

Blood lead testing is the screening strategy used to identify children who are lead poisoned so that appropriate measures can be taken to identify and eliminate lead hazards, and minimize the length of time the child is exposed.

Glossary of Terms

The terminology used to discuss the process of identifying children at risk and providing diagnostic and treatment services can be confusing. Table 5.1 is a glossary of terms used by the Wisconsin Childhood Lead Poisoning Prevention Program (WCLPPP), adapted from the Centers for Disease Control and Prevention (CDC) and Wisconsin statute.

Wisconsin’s Blood Lead Screening Recommendations

The Wisconsin Blood Lead Screening Recommendations were developed in 1998 based on recommendations from a broad-based advisory committee and guidance from the Centers for Disease Control and Prevention (CDC, 1997). These guidelines recommend targeted screening of children who are at greatest risk for lead poisoning and incorporate the 1992 federal requirement that all Medicaid-enrolled children receive blood lead tests at age 12 months and 24 months, and through age 5 if not previously tested. The guidelines are summarized in Table 5.2 and Figure 5.1.

The screening recommendations include universal testing of all children living in the cities of Milwaukee and Racine. Because of the extremely high proportion of old housing in these communities, and therefore the high risk of lead poisoning, each child should have a blood lead test three times before age 3: around 12 months, 18 months and 24 months. When seeing children from all other areas of Wisconsin, health care providers are encouraged to use the Four Easy Questions to determine whether a child is at risk for lead poisoning and needs to be tested:

1. Does the child now live in or visit a house built before 1950, or have they ever lived in one in the past (including child care, homes of friends, grandparents, relatives)?
2. Does the child now live in or visit a house or building built before 1978 with recent or ongoing renovations or have they ever in the past (including child care, homes of friends, grandparents, relatives)?
3. Does the child have a brother, sister or playmate who has/had lead poisoning?
4. Is the child enrolled in Medicaid or WIC?
<table>
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<tr>
<th>TERM</th>
<th>DEFINITION</th>
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<tr>
<td><strong>Blood Lead Screening Test</strong></td>
<td>Any test, capillary (fingerstick) or venous, for a child who had no previous venous blood lead level ≥5 mcg/dL.</td>
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<tr>
<td><strong>Targeted Screening</strong></td>
<td>The blood lead testing of some, but not all, children in a defined geographic area based on assessment of the presence of a factor(s) that places them at increased risk for lead exposure.</td>
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<tr>
<td><strong>Universal Screening</strong></td>
<td>The blood lead testing of all children in a defined geographic area at recommended ages (minimally at ages 1 and 2 years, or at age 3-5 years if they have never had a test done before).</td>
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<tr>
<td><strong>Diagnostic Test</strong></td>
<td>A venous blood lead test. If the screening test is venous, it is also a diagnostic test.</td>
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<tr>
<td><strong>Confirmatory Test</strong></td>
<td>The first venous test following a capillary screening blood lead test results ≥5 mcg/dL. All capillary tests ≥5 mcg/dL should have a venous confirmation test. A second capillary test done within 12 weeks of the initial capillary screening test can also be considered a confirmatory test.</td>
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<tr>
<td><strong>A Follow-up Test</strong></td>
<td>A blood lead test (venous if possible) following a venous blood lead level ≥5 mcg/dL.</td>
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<tr>
<td><strong>Reference Value for Childhood Blood Lead Level</strong></td>
<td>A reference value of 5 mcg/dL was established by CDC in 2012 based on the 97.5th percentile of the population BLL in children aged 1-5. The reference value will be updated by CDC every four years based on the most recent U.S. population blood lead surveys (NHANES) among children in the U.S.</td>
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<tr>
<td><strong>Lead Poisoning or Lead Exposure (definition in Wisconsin Statute)</strong></td>
<td>A blood lead level ≥10 mcg/dL [Wis. Stat. 254.11(9)].</td>
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<tr>
<td><strong>Elevated Blood Lead Level (definition in Wisconsin Statute)</strong></td>
<td>One venous blood lead level ≥20 mcg/dL or 2 venous blood lead levels ≥15 mcg/dL at least 90 days apart [Wis. Stat. 254.11(5m)].</td>
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Table 5.2 Wisconsin blood lead screening recommendations

| Recommendations for Wisconsin outside the cities of Milwaukee and Racine |
|---|---|
| **Age** | **Recommendation** |
| 12 months *and* 24 months | Ask the Four Easy Questions (see below)  
Test if any one answer indicates a risk of exposure or the child is enrolled in Medicaid or WIC |
| 36 – 72 months | If no record of previous test, ask the 4 Easy Questions  
Test if any one answer indicates a risk of exposure or the child is enrolled in Medicaid or WIC |

**Four Easy Questions**
1. Does the child now live in or visit a house or building built before 1950 or have they ever in the past? (include places such as day care, home of friends, grandparents or other relatives)  
2. Does the child now live in or visit a house or building built before 1978 with recent or ongoing renovations or have they ever in the past? (include places such as day care, home of friends, grandparents or other relatives)  
3. Does the child have a brother, sister or playmate who has/had lead poisoning?  
4. Is the child enrolled in Medicaid or WIC?  

| Recommendations for the cities of Milwaukee and Racine |
|---|---|
| **Age** | **Recommendation** |
| Under 3 years | Test around 12 months  
Test around 18 months  
Test around 24 months |
| 3 – 5 years | Children enrolled in Medicaid, WIC or uninsured:  
Test around 36 months  
Test around 48 months  
Test around 60 months  
Any child:  
Test if no record of prior test  
Test if lives in house built prior to 1978 with recent or ongoing renovations  
Test if child has sibling or playmate with lead poisoning  
Test if lives in a house built before 1950 (Racine only)  

Chapter 5.5
Figure 5.1 Screening Wisconsin children for lead poisoning

Child lives outside the cities of Milwaukee and Racine:
Assess for lead exposure by asking the “Four Easy Questions” at every well-child check-up from age 6 months to 6 years:
1. Enrolled in Medicaid or WIC?
2. Live in a building built before 1950?
3. Live in a building built before 1978 with remodeling?
4. Has a sibling with lead poisoning?

Answers are all “No”

Any answer is “Yes” or unknown

Obtain a blood lead test at about age 12 and 24 months
Test any child aged 3-5 years who has never been tested

Screening test result is ≥5 mcg/dL

Yes

Initiate Intervention

No

Further additional testing is not needed; continue to screen for increased risk of exposure according to the protocol.

Child lives in city of Milwaukee or Racine:
Test all children at 12, 18, and 24 months.
Test any child age 3-5 who has never been tested.
If enrolled in Medicaid or WIC, continue to test annually until age 6.

Obtain venous BLL within recommended time

Venous BLL ≥5 mcg/dL

Yes
Strategies Behind the Wisconsin Screening Recommendations

Lead poisoning is the major environmental health threat to young children. Early detection and follow-up of lead poisoning remains a priority in Wisconsin. The Wisconsin Blood Lead Screening Recommendations are based on the high risk of lead exposure to Wisconsin children due to the extent of old housing throughout the state. The screening recommendations reflect four strategies to achieve early detection and intervention:

1. **Assessing risk for lead exposure and age-appropriate blood lead testing becomes a standard for pediatric preventive health care.**
   Assessing a child’s risk for lead exposure and testing children based on risk are essential components of routine well-child care. This practice is a nationally recognized standard of the American Academy of Pediatrics (AAP) and is included in the Recommendations for Pediatric Preventive Health Care for all children aged 6 months to 6 years.

2. **The child’s environment is considered the primary risk factor for lead exposure.**
   The child’s environment poses the greatest risk for lead poisoning. Blood lead screening tests are targeted for those children living in high-risk environments.

3. **Children receiving publicly funded health care services are at high risk for lead exposure because they are low income and likely to live in older homes.**
   In many Wisconsin communities, access to safe affordable housing may be limited for low-income families. As a result, these families tend to live in housing that is older, poorly maintained and more likely to have lead-paint hazards. These children should be a focus of lead screening programs.

   The Wisconsin Medicaid Program and Wisconsin WIC Program have collaborated with the WCLPPP in linking program data to determine blood lead testing and lead poisoning among Medicaid-enrolled and WIC-enrolled children. This linking has demonstrated that children who are enrolled in either of these programs are at much higher risk of lead poisoning than children who are not enrolled in either program. From 2006 to 2010, 89% of Wisconsin children with a blood lead level (BLL) >10 mcg/dL and 77% of children with a BLL >5 mcg/dL were enrolled in one or both of these programs. In 2010, the prevalence rate of lead poisoning among children enrolled in Medicaid or WIC was three times higher than among children who were not enrolled in either of these programs. This has led to ongoing efforts within Wisconsin to assure compliance with the Medicaid testing requirement, and to support blood lead testing at WIC project sites.

4. **Children aged 1 and 2 are most vulnerable to lead toxicity.**
   Blood lead levels tend to be highest among children between the ages of 12 and 36 months. Children aged 1 and 2 are at greatest risk for lead poisoning because of:
   - increasing mobility during the second year of life, resulting in greater access to lead hazards that exist within their environment.
   - frequent hand-to-mouth activity.

   The reasons for increased susceptibility of young children to lead toxicity are described in this excerpt from Lead Poisoning in Childhood (Pueschel, S., Linakis, J, Anderson, A; p. 50):

   First, at this age, children master ambulation and become capable of exploring all corners of their environment, finding lead sources previously unavailable to them. Second, toddlers receive relatively less parental attention than infants, providing greater opportunity for unsupervised hazardous behaviors. Third, young children, in
exploring their environment, often spend a considerable amount of time at the window, a site that tends to have high concentrations of lead, usually in the form of easily absorbed dust. Fourth, toddlers have not only developmentally appropriate hand-to-mouth activity but also a high rate of pica (i.e., the repeated ingestion of non-food substances). Fifth, toddlers have a high prevalence of iron deficiency, which increases gastrointestinal absorption of ingested lead. Finally, gastrointestinal absorption of ingested lead is inversely related to age. Although adults absorb only 10 to 20 percent of lead, young children absorb 30 to 50 percent.

### Blood Lead Tests

Testing of whole blood for lead is the screening and diagnostic test of choice for lead poisoning and is the most widely accepted and commonly used measure of lead exposure. A blood lead test is a direct measurement of the concentration of lead in blood. It reflects the dynamic equilibrium between absorption, excretion, and deposition in soft tissue, blood, and bone, and is usually reflective of recent environmental exposure.

Since blood collected by venipuncture has a low likelihood of contamination compared to blood collected by fingerstick, venous blood is the preferred specimen for analysis and should be used for lead measurement whenever practicable. In addition, venous specimens provide a larger volume for analysis and are less prone to clotting and other problems that can be encountered with capillary specimens. However, collection of venous blood from children is sometimes difficult; thus, capillary blood from a fingerstick is acceptable for blood lead screening, provided that special collection procedures are followed to minimize the risk of contamination. Personnel should be thoroughly trained in proper collection procedures. The recommended procedure for the collection of blood lead specimens by fingerstick is available from the Wisconsin State Laboratory of Hygiene. An abbreviated fingerstick collection procedure is also available. Supplies for obtaining capillary blood specimens can be obtained from the Wisconsin State Laboratory of Hygiene (WSLH) by calling 800-442-4618.

Elevated blood lead results obtained on capillary specimens should be considered presumptive and should be confirmed using venous blood. See Table 5.3 for the recommended schedule for obtaining a confirmatory venous sample (CDC, 2012). In general, the higher the blood lead level (BLL), the sooner the confirmatory test should be done. The CDC recommends that BLLs of 10 – 44 mcg/dL be confirmed within one week to one month, noting that the higher the BLL on the screening test, the more urgent the need for confirmatory testing. Children whose BLL is at the upper end of this range should receive a confirmatory test in approximately one week if possible.

In the event that it is not possible to obtain a confirmatory venous sample from the child, a second capillary sample drawn within 12 weeks of the initial screening test can be considered a confirmatory test. This is consistent with the standard surveillance definitions used by the CDC to classify confirmed and unconfirmed elevated BLLs. If the second capillary test result is elevated, all follow-up tests should be performed on venous samples.

Chapter 5.8
Recommended schedule for obtaining a confirmatory venous sample

<table>
<thead>
<tr>
<th>Blood lead level (mcg/dL)</th>
<th>Time to confirmation testing</th>
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<tbody>
<tr>
<td>≥ 5 – 9</td>
<td>1 – 3 months</td>
</tr>
<tr>
<td>10 – 44</td>
<td>1 week – 1 month*</td>
</tr>
<tr>
<td>45 – 59</td>
<td>48 hours</td>
</tr>
<tr>
<td>60 – 69</td>
<td>24 hours</td>
</tr>
<tr>
<td>≥ 70</td>
<td>Urgently as emergency test</td>
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</table>

* The higher the BLL on the screening test, the more urgent the need for confirmatory testing.

Source: Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention, Centers for Disease Control and Prevention, January 4, 2012.

Other Tests

There is no medical foundation for relying on the following methods to diagnose overexposure to lead: gingival lead lines; testing of neurophysiologic function; evaluation of renal function (except during chelation with Calcium Disodium Versenate (CaNa₂ EDTA); testing of hair, teeth, packed red cells, saliva or fingernails for lead; and radiographic imaging of long bones, nor is provocative chelation prior to measurement of lead in urine testing recommended (CDC, 2012).

Requirements for Reporting Blood Lead Test Results

State law (Wis. Stat. 254.13) requires that all blood lead test results on Wisconsin residents be reported to the Department of Health Services (DHS). The specific requirements for reporting blood lead results, such as timetable, content, form, etc., are described in Wis. Admin. Code 181. The WCLPPP implements the reporting rule through a laboratory-based reporting system and works directly with laboratories to assure all blood lead results are reported. Health care providers are responsible for sending complete demographic information as required by Wis. Admin. Code 181 to the analytical laboratory with each blood lead sample. This allows the laboratory to include the demographics in the blood lead report.

Health care providers that conduct on-site blood lead testing using the LeadCare II are responsible for reporting these test results to the WCLPPP. These sites should use the DHS Blood Lead Lab Reporting (F-00017) (see Appendix A) or a comparable form for reporting blood lead results.

A WIC project that uses the LeadCare II must assure the results are reported to the WCLPPP on a timely basis. To do this, WIC staff should notify the WCLPPP when they begin using the LeadCare II. WIC staff should enter all LeadCare II results into the ROSIE database. The WCLPPP will then obtain the results through a weekly electronic report from the ROSIE data system. If WIC or the local health department uses the LeadCare II to test children who are not enrolled in WIC, the agency must report the results to the WCLPPP using the DHS Blood Lead Lab Reporting (F-00017) (see Appendix A) or a comparable form.

The timetable for reporting is specified in Wis. Admin. Code 181:

- BLLs <10 mcg/dL within 30 days
- BLLs 10 – 44 mcg/dL within 48 hours
- BLLs ≥45 mcg/dL within 24 hours

Chapter 5.9
Blood lead reports can be mailed or faxed to the WCLPPP. The mailing address is:
Wisconsin Department of Health Services
Division of Public Health
WCLPPP, Rm. 145
P.O. Box 2659
Madison, WI 53701-2659

The WCLPPP fax number is 608-267-0402. For questions about reporting blood lead results, contact the WCLPPP at 608-266-5817.

**Evaluating a Screening Program**

The local health department (LHD) contracting with DHS for childhood lead poisoning prevention funds should assess the availability and accessibility of blood lead testing for high-risk children in their jurisdiction. The LHD may or may not directly collect blood lead samples, but should evaluate whether children at high risk for lead exposure are being tested, and determine the barriers to testing and how these barriers can be addressed. The LHD can review blood lead data for their jurisdiction to determine the adequacy of testing among target populations, incidence and prevalence of lead poisoning, and timeliness of confirmatory and follow-up blood lead tests.

To evaluate the effectiveness of a blood lead screening program, the following outcome measures can be monitored:

- Number of children tested by age cohort
- Percent of children enrolled in Medicaid and/or WIC who were tested
- Positive screening rate (percent of those tested who have a BLL ≥5 mcg/dL) by age cohort
- Timeliness of confirmatory tests for children with elevated capillary screening tests
- Timeliness of follow-up tests for children with venous BLLs ≥5 mcg/dL

Blood lead data can be collected in various data systems. The STELLAR system is used by WCLPPP and some LHDs for blood lead surveillance and tracking public health services provided to children with lead poisoning. Blood lead results for WIC participants can be recorded in the WIC ROSIE system. The SPHERE system can be used to record blood lead results and public health services. The LHD can use the data system that best suits their needs, computerized or paper, to monitor and evaluate their lead screening program.

Beginning in 2011, access to the Wisconsin Blood Lead Registry (WBLR) is available upon request to health care providers who have direct authority for a child’s medical and testing care. These providers include primary care providers, managed care organizations, public health workers, and Wisconsin school systems. The WBLR is a web-based data system that is accessed through the Wisconsin Immunization Registry (WIR) secure network and contains all blood lead test results for Wisconsin children, regardless of where they were tested. Once granted access privileges, providers are able to check whether a child is due for a blood lead test or has a history of lead poisoning at the same time that they check the child’s immunization history. The WCLPPP staff uploads new blood lead test results to the WBLR on a weekly basis. For more information about the WBLR and how to gain access privileges, contact the WCLPPP at 608-266-5817.
References

http://www.cdc.gov/nceh/lead/publications/screening.htm


Stanton, Noel V. (2000). Erythrocyte protoporphyrin, Therapeutic Drug Monitoring and Toxicology, American Association for Clinical Chemistry, Inc.


