

Implications of the New Lead Screening Recommendations in North Carolina

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In June of 2012, the Centers for Disease Control and Prevention updated their recommendations regarding the prevention of childhood lead poisoning. This commentary provides an overview of the new recommendations for blood lead screening and follow up.

Healthy People 2010 objectives included a call for the elimination of elevated blood lead levels (BLLs) in children, and this remains an objective of Healthy People 2020 [1]. Although fatal lead encephalopathy is nearly nonexistent today as a result of vigorous public health interventions, many children are still at risk of experiencing adverse cognitive effects caused by exposure to lead [2]. In North Carolina in 2010, 132,014 children underwent blood lead screening at well-child visits at the ages of 12 or 24 months [3]. Of those, 519 children had screening BLLs equal to or greater than 10 $\mu\text{g}/\text{dL}$, which at the time was the threshold at which repeat screening and investigation were required. Of note, 81% of the Medicaid population aged 9-35 months underwent blood lead screening in 2010, a significant increase from 2005, when 56% of that population underwent screening [4]. There is no way to know for certain whether the prevalence of elevated BLLs decreased between 2005 and 2010, because in 2005 nearly half of the Medicaid population was not screened. In all, 162,060 children between the ages of 6 months and 6 years were screened in 2010, with 146 confirmed cases of BLL elevation in which levels were at least 10 $\mu\text{g}/\text{dL}$ but lower than 20 $\mu\text{g}/\text{dL}$, and 24 cases of elevation in which levels were equal to or greater than 20 $\mu\text{g}/\text{dL}$ [3].

Currently 804,000 children—40.6% of the state's pediatric population—are enrolled in North Carolina Medicaid [5]. That number is likely to grow with anticipated changes in health care coverage under the Affordable Care Act, as an increased number of children will have Medicaid and will meet requirements for lead screening. In addition, the Centers for Disease Control and Prevention (CDC) recently changed its recommendations with regard to repeat blood lead screening [6, 7], which is now indicated for children with BLLs equal to or greater than 5 $\mu\text{g}/\text{dL}$. So the number of children for whom repeat blood lead screening is indicated will increase. Practitioners therefore need to be well-versed in the reasoning underlying blood lead screening recom-

mendations and to be aware of the appropriate course of action called for by various test results [8].

CDC Screening Recommendations

Recommendations regarding who should receive blood lead screening have not changed. All Medicaid-enrolled children must undergo BLL screening at 12 and 24 months of age, and Medicaid-enrolled children between 36 and 72 months of age who have never been previously tested must also be tested [9]. All refugee children should be tested within 90 days of arrival in the United States, with repeat testing 3-6 months after placement in a permanent residence, regardless of the initial test results. Neonates or infants born to women with lead exposure during pregnancy or lactation should also receive blood lead screening. It is strongly recommended that all North Carolina children, regardless of their insurance coverage or risk factors, have BLL levels checked at 12 months of age and again at 24 months of age. In addition, the CDC recommends universal lead screening for communities in which 27% or more of the housing stock was built before 1950 [10]. In North Carolina, the proportion of housing that falls into that category is assessed at the county level [3].

Blood for lead screening is often obtained by capillary fingerstick, because that method is efficient and low in cost. However, all fingerstick results with a BLL equal to or greater than 5 $\mu\text{g}/\text{dL}$ require confirmation through repeat testing by venous sampling in order to avoid possible contamination from residual lead ingrained in children's fingers [6, 11]. Decisions about any action to be taken (such as chelation) should be based on venous results.

When considering which children may be at risk, consult the Web site of the Environmental Health Section of the North Carolina Division of Public Health [12]. Their list of all of the North Carolina zip codes in which universal testing is required is reproduced in Table 1, and their list of questions to ask parents can be found in Table 2 [10]. However, keep in mind that recent research [13] indicates that questionnaires

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such as the one in Table 2 do not accurately predict elevated BLLs in all populations. The most accurate route for detection is universal screening.

New Thresholds for Counseling, Abatement Services, and Chelation Therapy

The North Carolina Division of Public Health's new follow-up schedule for children under the age of 6 years

who have BLLs that are equal to or greater than 5 µg/dL is reproduced in Table 3 [7]. This schedule highlights that, regardless of level, all blood lead test results must be reported to parents and documented. It also stresses that all parents must be educated about lead sources, environmental assessment, and prevention of lead exposure. For 1-year-olds with lead levels lower than 5 µg/dL, a repeat BLL should be performed at 2 years of age, or sooner if risk of

TABLE 1.
North Carolina Zip Codes in Which All Children Should Undergo Blood Lead Screening Because the Risk for Lead Exposure There Is High

27011	27405	27810	27871	27954	28137	28365	28463	28581	28752
27013	27406	27812	27872	27956	28139	28367	28464	28585	28753
27014		27813	27873	27957	28144	28368	28466	28586	28755
27016	27504	27814	27874	27960	28150	28369	28469		28756
27024	27508	27816	27875	27962	28159	28371	28470	28604	28757
27028	27510	27818	27876	27964	28160	28372	28471	28611	28761
27030	27521	27819	27877	27965	28169	28373	28472	28615	28762
27042	27530	27820	27878	27967	28170	28376	28478	28616	28771
27046	27534	27821	27882	27970		28377	28479	28621	28772
27047	27536	27822	27883	27973	28208	28379		28622	28777
27052	27542	27823	27884	27974		28382	28501	28623	28779
27053	27544	27824	27885	27979	28301	28383	28504	28624	28781
	27546	27826	27886	27980	28303	28384	28510	28627	28782
27101	27549	27827	27888	27982	28305	28385	28511	28635	28789
27105	27551	27828	27889	27983	28306	28386	28513	28637	28792
27107	27553	27829	27890	27985	28315	28390	28515	28640	
	27555	27830	27891	27986	28318	28393	28516	28642	28801
27202	27557	27831	27892		28323	28394	28518	28644	
27212	27559	27832	27893	28001	28325	28395	28519	28657	28909
27217	27563	27839	27897	28007	28326	28396	28521	28659	
27239	27565	27840		28009	28328	28398	28523	28662	
27242	27568	27841	27909	28018	28330	28399	28525	28663	
27252	27569	27843	27910	28019	28332		28526	28666	
27260	27570	27844	27915	28020	28333	28401	28528	28669	
27262	27573	27845	27919	28032	28334	28422	28529	28670	
27263	27576	27846	27922	28034	28338	28430	28530	28675	
27288	27577	27847	27923	28040	28339	28431	28531	28679	
27291	27582	27849	27924	28043	28340	28432	28537	28681	
	27584	27850	27925	28072	28342	28434	28538	28685	
27305	27589	27851	27926	28073	28343	28435	28551		
27306		27852	27928	28076	28345	28438	28552	28702	
27311	27601	27853	27932	28077	28349	28439	28553	28705	
27314		27855	27935	28083	28350	28441	28554	28708	
27341	27701	27856	27937	28089	28351	28444	28555	28710	
27342		27857	27938		28352	28447	28556	28714	
27343	27801	27860	27941	28101	28356	28448	28557	28725	
27360	27803	27862	27942	28102	28357	28450	28560	28726	
27371	27804	27863	27944	28114	28358	28452	28570	28733	
27379	27805	27864	27946	28119	28360	28456	28572	28734	
	27806	27866	27947	28127	28362	28457	28573	28735	
27401	27807	27869	27950	28128	28363	28458	28577	28743	
27403	27809	27870	27953	28135	28364	28462	28580	28746	

Source: Reproduced with permission of the Environmental Health Section, Division of Public Health, North Carolina Department of Health and Human Resources.

TABLE 2.
Lead Risk Assessment Questions for the Parents of Children
Who Do Not Live in a Zip Code in Which Risk is High

If the answer to any of these questions is "yes" or "I don't know," the child should undergo blood lead screening
Do you receive Women, Infants, and Children (WIC) Program services, or is your child enrolled in Medicaid (Health Check) or Health Choice?
Does your child live in or regularly visit a house that was built before 1950, including home child care centers or homes of relatives?
Does your child live in or regularly visit a house that was built before 1978, with recent or ongoing renovations or remodeling (within the last 6 months)?
Does your child live in or regularly visit a house that contains vinyl miniblinds?
Does your child have a brother, sister, other relative, housemate, or playmate who has or has had a high blood lead level?
Is your child a refugee or an immigrant, or was your child adopted from another country?

Note: Adapted with permission from the lead risk assessment questionnaire on the Web site of the Environmental Health Section, Division of Public Health, North Carolina Department of Health and Human Services. http://www.deh.enr.state.nc.us/Children_Health/Lead/Lead_Forms/Lead%20Risk%20Assessment%20Questionnaire%202011-05-13%20FINAL.pdf. Accessed November 14, 2012.

exposure increases. For all BLLs of 5 µg/dL or above, further investigation and retesting is required. If this elevated level is confirmed on venous sampling, laboratory assessment of a child's iron status as well as hemoglobin or hematocrit should be considered. When ingestion of lead particulate matter or a foreign body is a concern, an abdominal radiograph should be obtained and examined for the presence of radiopaque material [7].

Treatment for children with extremely elevated BLLs has not changed. Chelation directed by a toxicologist or a practitioner experienced in chelation therapy should be initiated only in children whose BLL is 45 µg/dL or higher. Chelation is not recommended for asymptomatic children with BLLs below 45 µg/dL, because multiple studies have shown that there is no cognitive benefit from treatment in this group [14]. Rather, these children should have developmental and medical follow-up, with removal of the cause of lead. It may take months to years for the BLL to drop below 5 µg/dL. A careful environmental investigation, led by the patient's local health department (see Table 3), is the key to locating the source of the lead and ending the patient's exposure [8].

Health Effects and Sources of Lead Poisoning

Deleterious effects of lead poisoning are more subtle in children than in adults. Children are at a higher risk of experiencing effects from low levels of lead exposure because the developing nervous system is so vulnerable. Children's hand-to-mouth exploratory behaviors expose them to more contamination, and their increased fractional gastrointestinal absorption of lead makes them less likely to excrete what they do ingest. In addition, absorption of lead is increased in the presence of dietary deficiencies of calcium, iron, and

vitamin C, all of which are more common in the pediatric population than in adults [15].

Now that lead in gasoline is nonexistent, the most common source of lead is dust or chipped paint from contaminated surfaces, and the highest concentration of this is in old houses or houses that are being renovated. Other well-known sources include antique furniture or toys, contaminated foodstuffs grown in lead-rich soil, cosmetics such as kohl, ceramic glazes, stained glass-making materials, folk remedies, herbal products, imported products (ceramics, pewter, toys, candy), and contaminated drinking water [16]. Cases of ingestion of foreign bodies containing lead, leading to rapidly increasing and severe lead poisoning and even death, have recently been reported in children [17, 18].

Acute lead poisoning, with BLLs generally greater than 60 µg/dL, is increasingly rare, but must be considered an emergency when it does occur. Children may complain of headaches, abdominal pain, loss of appetite, and constipation, and on examination they may display clumsiness, agitation, and decreased activity. These symptoms can rapidly deteriorate to vomiting, stupor, and convulsions [19]. Chronic symptoms seen in adults, such as peripheral neuropathy and chronic renal disease, are rare in children.

New clinical evidence obtained over the past 10 years has shown that even very low levels of lead exposure in asymptomatic children can cause irreversible developmental and behavioral effects [20]. The changes in the CDC's recommendations reflect the findings of multiple studies that have shown that there is no safe blood lead level in children; even very low levels may harm cognitive function [20]. Although it has long been known that high BLLs are poisonous to the developing nervous system, it has also been shown that in children whose lead levels were never greater than 10 µg/dL, IQ decreased 7.4 points as lifetime average BLL increased from 1 µg/dL to 10 µg/dL [21].

Practical Advice

Pediatric primary care practitioners embrace well-child interventions and are entrusted with the role of carrying out many different screening protocols. The CDC's new recommendations are aimed at minimizing the effects of lead on children, but they will also likely increase the number of blood draws and office visits, thereby increasing costs to the state's health care system. As family-centered patient advocates, we must recognize that these recommendations are the surest method of managing elevated BLLs; however, each pediatric practitioner is responsible for making a well-informed decision about how to proceed with lead screening and follow-up. It is the primary care provider's role to provide anticipatory guidance with regard to in-home exposures, unsafe renovation practices, and potential lead exposures associated with parental occupations or hobbies.

Furthermore, it is important to assess each child's nutritional status. Although there is currently no evidence that routine supplementation with iron, calcium, or vitamin C

TABLE 3.
Follow-Up Schedule for Blood Lead Levels in Children Under the Age of 6 Years: Recommendations from the North Carolina Division of Public Health

Blood Lead Level	Recommended Response
<5 µg/dL	- Report blood lead test result to parent and document the notification. - Educate family about lead sources, environmental assessment, and prevention of lead exposure. - Perform another blood lead test at 2 years of age, or earlier if risk of exposure increases.
<i>All diagnostic (ie, confirmation) tests should be performed as soon as possible within the time periods listed below.</i> If diagnostic test result falls into a lower category than the initial test result, follow response for that risk category. If diagnostic or follow-up test result falls in a higher category, conduct another diagnostic test based on the higher risk category and follow the recommended response for that risk category.	
5-9 µg/dL	- Report blood lead test result to parent and document the notification. - Educate family about lead sources, environmental assessment, and prevention of lead exposure. Conduct diagnostic test for confirmation within 3 months. If diagnostic test result is 5-9 µg/dL: - Conduct nutritional assessment. - Take environmental history to identify lead sources and emphasize the importance of environmental assessment to identify and mitigate lead hazards. - Continue follow-up testing every 3 months until 2 consecutive test results are <5 µg/dL. - Test other children under the age of 6 years in same household.
10-19 µg/dL	- Report blood lead test result to parent and document the notification. - Educate family about lead sources and prevention of lead exposure. Conduct diagnostic test for confirmation within 1 month. If diagnostic test result is 10-19 µg/dL: - Conduct nutritional assessment and refer to WIC Program. - Take environmental history to identify sources of lead exposure. - Refer to local health department for environmental investigation. - Continue follow-up testing every 1-3 months until 2 consecutive test results are <5 µg/dL. - Test other children under the age of 6 years in same household.
20-69 µg/dL	- Report blood lead test result to parent and document the notification. - Educate family about lead sources and prevention of lead exposure. Conduct diagnostic test for confirmation within 1 week for results of 20-44 µg/dL, within 48 hours for results of 45-59 µg/dL, or within 24 hours for results of 60-69 µg/dL. If diagnostic test result is 20-69 µg/dL: - Conduct nutritional assessment and refer to WIC Program. - Take environmental history to identify sources of lead exposure. - Refer to local health department for required environmental investigation. - Provide clinical management. - Refer children to CDSA Early Intervention or CC4C as appropriate. - Refer to Division of Social Services as needed for housing or additional medical assistance. - Continue follow-up testing every 1 month until 2 consecutive test results are <5 µg/dL. - Test other children under the age of 6 years in same household.
≥70 µg/dL	- Report blood lead test result to parent and document the notification. - Educate family about lead sources and prevention of lead exposure. Conduct diagnostic test for confirmation immediately as an emergency laboratory test. If diagnostic test result is ≥70 µg/dL: - Hospitalize child and begin medical treatment immediately. - Conduct nutritional assessment and refer to WIC Program. - Take environmental history to identify sources of lead exposure. - Refer to local health department for required environmental investigation. - Refer children to CDSA Early Intervention or CC4C as appropriate. - Refer to Division of Social Services as needed for housing or additional medical assistance. - Continue follow-up testing every 1 month until 2 consecutive test results are <5 µg/dL. - Test other children under the age of 6 years in same household.

Note. WIC, Special Supplemental Nutrition Program for Women, Infants, and Children; CDSA, Children's Developmental Service Agency; CC4C, Care Coordination for Children. Adapted with permission from the North Carolina Division of Public Health.

above the level of the recommended daily requirement provides any prevention of lead toxicity, assuring that a child's diet contains recommended amounts of these critical nutritional elements is essential.

Recognizing that the vast majority of children in North Carolina who have elevated BLLs are impoverished, we must combine screening efforts with a concentration on primary prevention of lead exposure with the goal of ensuring safe housing and good nutrition for all children. A multidisciplinary effort is required to provide the best care. When appropriate, referral to the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) should be considered. Collaboration with local health departments is the key to patient management, for they conduct environmental investigation, with the goal of ending the lead exposure as the primary intervention. Development and school performance should be carefully scrutinized. Further testing for recognized delays or concerns about learning disabilities should be performed when needed. Appropriate therapies and interventions can then be initiated depending on each child's needs. Considering recent clinical evidence regarding lead's insidious neurodevelopmental effects, careful follow-up and support is crucial to the success of these children over the long term. NCMJ

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