Implementation of CDC Refugee Blood Lead Testing Guidelines in Minnesota

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SYNOPSIS

The state of Minnesota undertook a trial of the 2005 recommendations for blood lead testing in refugees developed by the Centers for Disease Control and Prevention. New refugee children younger than 16 years of age receiving health screening at an urban clinic were tested for elevated blood lead levels (EBLLs) and nutritional status. Follow-up lead tests were obtained three to six months after the first test. During the course of the project, 150 refugee children received an initial blood lead test and nutritional blood tests, and 140 (93%) received a second blood lead test. Five children (3.3%) had EBLLs at the initial blood lead test and one child (0.7%) had an EBLL at the second test after a nonelevated first test result. In contrast to findings from New Hampshire, this project did not observe a high number of refugees who developed EBLLs after moving to the U.S.

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The rate of lead poisoning in U.S. children is declining, but it is still a problem for high-risk populations of children,¹ including refugees.^{2,3} Refugees may have been exposed to lead in their countries of origin from a variety of sources, such as continued use of leaded gasoline; herbal remedies, cosmetics, or spices that contain lead; cottage industries that use lead in an unsafe manner; and limited regulation of emissions from larger industries.⁴ Once these refugees are in the U.S., they frequently move into older, inner-city housing, with potential for exposure to lead-based paint.^{5,6} They may also continue activities such as backyard car repair³ and use of lead-contaminated herbal remedies, cosmetics, or spices that contribute to elevated blood lead levels (EBLLs). In addition, refugees may have poor nutritional status⁷ that leads to greater absorption of any lead to which they are exposed.

Blood lead testing data from Minnesota and other states have shown refugees to be at higher risk for EBLLs than the general population. In Minnesota from 1997 through 2003, 16% to 28% of refugee children had EBLLs—defined as 10 micrograms of lead per deciliter of whole blood ($\mu\text{g}/\text{dL}$) or greater—compared with a steady decline during that same period of 8.1% to 2.7% in the general population of Minnesota children.⁸ The rate of EBLLs in Minnesota refugees was 4% in 2004 and 6% in 2005 compared with 2.1% and 1.8% in the general population of children.

New Hampshire has dealt with EBLLs in refugees for several years. In 2000, a Sudanese refugee child died from lead poisoning after she was observed eating plaster chips with adhering lead paint. The home was found to contain other lead hazards as well. This case helped prompt the New Hampshire Department of Health to issue state guidelines for testing.⁵ These guidelines include testing all refugee children aged six months through 15 years upon entry into the U.S., and follow-up testing after three to six months in the U.S. In 2005, New Hampshire published refugee data for 2003–2004 describing test results from these guidelines.⁶ These data showed that of children with two tests, 29% had nonelevated initial blood lead results but elevated follow-up results after spending time in the U.S. All children with elevated follow-up tests were from Africa. Lead risks were identified in their U.S. homes. The children also suffered from chronic and acute malnutrition.

Because New Hampshire refugee children were developing EBLLs after living in the U.S., the Centers for Disease Control and Prevention (CDC) developed new recommendations for blood lead testing in refugees in 2005, resulting in an education tool kit.⁹ CDC's recommendations are similar to the New Hampshire

recommendations, including lead testing within 90 days of arrival for children aged six months through 15 years, blood tests for nutritional assessment, follow-up blood lead tests three to six months after placement in a permanent residence, daily pediatric multivitamins with iron, and educational efforts for families. The Minnesota Department of Health (MDH) Refugee Health Program adopted these new guidelines as standard clinical practice and recommended their use by refugee health-screening clinics in Minnesota.

Refugee children in Minnesota come from various countries of origin. Refugee families come to established refugee clinics for a domestic health screening (primarily for infectious diseases); however, lead testing is included for all children younger than 6 years of age. As a result, most refugee children younger than age 6 (79% in 2005) are tested for lead upon arrival in Minnesota. The new CDC recommendations are stricter than current MDH recommendations for blood lead testing in refugees. MDH recommends testing for all refugee children younger than 6 years of age, but has not recommended routine testing of all refugee children through age 15, and has not recommended retesting of refugee children with low initial lead levels.¹⁰

The goal of the project was to evaluate the new CDC recommendations in Minnesota; i.e., to assess the practicality and fiscal feasibility for refugee health-screening clinics to implement CDC's recommendations and determine whether elevated follow-up lead levels would be found, especially among African refugees. The main efforts of the project were blood lead tests in refugee children aged six months through 15 years, comprehensive blood analyses for nutritional status, and follow-up lead tests three to six months after the initial blood draw.

METHODS

Target population

The project was conducted at the St. Paul-Ramsey County Department of Public Health (SPRCDPH) Refugee Health Clinic. This clinic performs a battery of screening tests recommended by MDH on new refugees arriving in Ramsey County. Local public health agencies in Minnesota are contacted by MDH after the department receives notice from CDC of new refugees entering the state. The local public health agencies, in cooperation with voluntary resettlement agencies, then contact refugee families for health screening. The target population for this project consisted of all newly arrived refugee children referred to the SPRCDPH screening clinic. All children younger

than 16 years of age were tested for EBLs. Initial screening tests were performed over a four-month period from October 10, 2005, to February 10, 2006. At the initial health-screening appointment, a brochure about lead-poisoning prevention was included in information packets given to the family. Clinic staff also verbally provided basic lead-poisoning prevention information during the visit, in each family's appropriate language.

Efforts to obtain follow-up lead tests were conducted until June 30, 2006. The MDH Refugee Health Program, resettlement agencies, sponsoring families, and local physicians were contacted and informed of the project. These resources were also used to assist with follow-up contacts. Because this project consisted of an evaluation of new standard clinical practice, MDH Internal Review Board approval was not sought.

Blood lead testing and follow-up

Venous specimens were obtained for blood lead analysis and a panel of nutritional blood tests. Every effort was made to conduct the initial health screening within one month of arrival in Ramsey County. Follow-up lead tests were obtained three to six months after the first test for each child. Both initial and follow-up blood lead specimens were drawn and analyzed at the SPRCDPH laboratory. This laboratory is Clinical Laboratory Improvement Amendments (CLIA) certified and uses the graphite furnace atomic absorption method. This is one of four currently used methods for analysis of lead in blood specimens. Children with EBLs were referred to the SPRCDPH Lead Program for case management. Home environmental assessments were conducted for all children with EBLs.

Nutritional blood testing

Venous blood specimens for nutritional blood analyses were obtained at the same time as initial lead specimens. The following blood analyses were conducted:

hemoglobin (Hgb), hematocrit (Hct), mean corpuscular volume (MCV), red cell distribution width (RDW), ferritin, transferrin saturation (% Sat), serum iron (Iron), and total iron binding capacity (TIBC). Lead, Hgb, Hct, MCV, and RDW analyses were done at the SPRCDPH laboratory. Iron, TIBC, % Sat, and ferritin were analyzed by LabOne, Lenexa, Kansas. Cutoff values for abnormal findings were specific by age and gender as provided by the respective laboratories. When a child's nutritional blood test results were substantially abnormal, the family and sponsor were contacted as soon as possible to encourage families to commence a relationship with a primary care provider and to stress the need for follow-up care. Additionally, during the contact to schedule the second blood lead test, families were asked whether they had obtained a medical home and whether they were being treated for nutritional deficiencies.

Data tracking and analysis

Data analysis was conducted in SAS.¹¹ Blood lead test results for children in this project were tracked using MDH's statewide Minnesota Blood Lead Information System. Fisher's Exact Test was used to detect differences in rates of abnormal blood test results. A level of $p < 0.05$ was used to indicate statistical significance.

RESULTS

Number tested, countries of origin, and ages

During the course of the project, 150 refugee children were seen for routine health screening at the SPRCDPH clinic and received an initial blood lead test and nutritional blood tests. Of these children, 140 (93%) received a second blood lead test three to six months after the original lead test. Children arrived from various countries of origin (Table 1), with a mean age of 9.1 years and a range of 6.5 months to 15 years on the date of health screening (Table 2).

Number of EBLs and potential lead sources

Five of the children tested (3.3%) had EBLs at the initial blood lead test. Upon follow-up testing, two of

Table 1. Countries of origin and languages spoken (n=150)

Language	Country of origin	Departure country	Number of children
Somali	Somalia	Kenya/Syria/Ethiopia/Egypt	45
Oromo	Ethiopia	Kenya/Ethiopia	4
Amharic	Ethiopia	Kenya	1
English	Liberia	Guinea	7
English	Sierra Leone	Guinea	1
Hmong	Laos	Thailand	65
Karen	Burma	Thailand	27

Table 2. Ages of children at time of first test (n=150)

Age range	Number	Percent
<1 year	7	5
1–5 years	38	25
6–10 years	44	29
11–15 years	61	41

Table 3. Children with elevated blood lead levels

Age	Origin	Year home built	First lead result	Second lead result
15 years	Somalia	1906	13 µg/dL	<5 µg/dL
13 years	Somalia	1981	15 µg/dL	13 µg/dL
10 years	Sierra Leone	1948	10 µg/dL	7 µg/dL
9 years	Somalia	1951	10 µg/dL	<5 µg/dL
6 years	Thailand (Hmong) ^a	1890	14 µg/dL	12 µg/dL
6 months	Liberia	1973	7 µg/dL	10 µg/dL

^aThailand was the departure country for the Hmong child. Because many Hmong children may have lived most if not all of their lives in a refugee camp in Thailand, the country of departure is more relevant for this study than the initial country of origin, Laos.

µg/dL = micrograms per deciliter

these remained elevated (Table 3). All of the children with initial EBLs were between 6 and 15 years of age. One child aged six months had an EBL at the second test after a nonelevated first test result. This child's level rose from 7 µg/dL to 10 µg/dL. Nine other children had lead levels that rose during the project, but remained below 10 µg/dL. Only two of the nine manifested a rise of more than 1 µg/dL. All other children's lead levels either dropped or remained the same.

Assessment of the home occurred for all children with EBLs. Half of the children with EBLs were living in homes built after 1950 (Table 3), which are likely to have lower lead risk than homes built before 1950, due to a lower concentration of lead in house paint after 1950. Of the five children with initial EBLs, three were from Somalia. Refugees reported that vendors work with metals on the streets in Somalia. This could be a source of lead exposure for children. One of the children with an initial EBL was Hmong (an ethnic group with its own language and culture, originally from Laos) and had departed for the U.S. from Thailand. The child had been given a cultural medication compound (*shung-fa* plus *paylooh*) in the refugee camp for fever. *Paylooh* has been known to contain lead in some cases. However, the exact source of lead for the children in their countries of origin is unknown. For the Liberian infant who experienced a rise in lead levels in the U.S., the lead source was not identified. The family's apartment was constructed in 1973 and its windows were high off the floor and composed of metal. The child had not yet fully engaged in exploratory activities. However, the child's home was observed to have very dirty carpets. In combination with nutritional deficiency, dirt containing lead-contaminated soil may have increased the child's blood lead level. Environmental samples of carpet dust were not analyzed for lead as the child's lead level dropped below 10 µg/dL upon further follow-up testing.

Nutritional lab results and correlation with EBLs

Of the six children with EBLs, two (33%) had an abnormal result for at least one of their nutritional blood tests. This included the infant who had a follow-up EBL after a lower first blood lead result. This was similar to the percentage for all tested children (39%). For the population of all tested children, no association was found between having at least one abnormal nutritional test result and an initial EBL, according to Fisher's Exact Test ($p=0.65$). There was also no association between having at least one abnormal nutritional test result and language spoken (Table 4). However, statistically significant differences were found according to languages spoken for RDW, Iron, and ferritin levels. Somali children and Liberian children had higher rates of abnormal test results, and Hmong children had lower rates. Children from Burma and children from other parts of Africa had rates of abnormal test results that were between these extremes.

Practical issues during implementation

The cost for implementing this nine-month project in which 150 refugee children were screened was approximately \$20,000. Most of this cost (approximately \$14,000) can be attributed to 0.2 full-time equivalent additional staff time for a public health nurse to track laboratory results, make family contacts for discussing abnormal nutritional tests and follow-up blood lead tests, perform home visits, and make transportation arrangements. Significant additional costs were incurred for language interpreting and translation services. Some of the costs, such as developing a Microsoft® Access database to track test results, were one-time set-up expenses; however, most of the project's cost would be ongoing if the full CDC guidelines were implemented.

Table 4. Number of refugee children with abnormal nutritional blood tests

Language (origin)	Number	Hgb (percent)	Hct (percent)	MCV (percent)	RDW (percent)	Iron (percent)	TIBC (percent)	% Sat (percent)	Ferritin (percent)
Hmong	65	3 (4.6)	3 (4.6)	7 (1.0)	8 (12.0)	3 (4.6)	3 (4.6)	4 (6.1)	7 (11.0)
Somali	45	6 (13.0)	3 (6.7)	7 (16.0)	16 (36.0)	10 (2.2)	5 (11.0)	9 (20.0)	18 (40.0)
Karen	27	3 (11.1)	1 (3.7)	7 (26.0)	6 (22.0)	2 (7.4)	2 (7.4)	3 (11.0)	3 (11.0)
English (Liberia)	7	2 (29.0)	1 (14.0)	3 (43.0)	4 (57.0)	1 (14.0)	0 (0.0)	1 (14.0)	1 (14.0)
Oromo	4	0 (0.0)	0 (0.0)	0 (0.0)	1 (25.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Amharic	1	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
English (Sierra Leone)	1	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Total	150	14 (9.3)	8 (5.3)	24 (16.0)	35 (23.0)	16 (11.0)	10 (6.7)	17 (11.0)	29 (19.0)

Hgb = hemoglobin

Hct = hematocrit

MCV = mean corpuscular volume

RDW = red cell distribution width

Iron = serum iron

TIBC = total iron binding capacity

% Sat = transferrin saturation

DISCUSSION

The rate of initial EBLs in the refugee population tested during this project (3.3%) was higher than the rate for the statewide children tested for lead (1.8%) during the same time frame. It appears that refugees continue to be a group at risk for coming into Minnesota with lead poisoning. The emphasis of CDC's guidelines on testing older children in addition to those younger than age 6 appears justified in Minnesota as all initial EBLs occurred in children aged 6 years or older. Because children in this age range with EBLs may have had a continuous EBL since early childhood, they may be at risk for developmental effects of lead. Providers should consider educational assessment for these children.

The one child who experienced an increase in blood lead level was approximately six months of age, which is younger than the age range routinely recommended for blood lead testing. According to CDC and state guidelines, 1- and 2-year-old children are considered to be at highest risk, due to hand-to-mouth activities and crawling on the floor. However, children as young as six months may engage in exploratory behavior, which may result in exposure to lead-containing dust.

Results of blood analysis for nutritional status did not appear to be related to EBLs in this population of refugee children. The percentages of refugee children who had abnormal blood test results for nutritional deficiency were generally similar to rates in a 2004 United Nations report.⁷

Although refugees appear to be a high-risk population for initial lead poisoning in Minnesota, significant increases in lead levels after moving to the U.S. were not observed during this project. Of those retested, 89% had a lead level of 5 µg/dL or less; 99% had a level less than 10 µg/dL. In the group of 140 retested children, only 10 demonstrated any rise in lead level. Most had only a 1 µg/dL rise. In this project, refugee children with EBLs most likely acquired lead in their country of origin or departure country. Although direct evidence is not available, the difference between these results and New Hampshire's findings⁶ may be due to differences in housing-related lead risk between the two areas, and different countries of origin with different levels of nutritional deficiency. Supplemental education about lead poisoning, provided in the refugee health-screening clinic, and increased collaboration with family sponsors resulting from follow-up efforts may have helped families find more suitable lead-safe housing. However, it is unknown whether this may be true for refugees across the state.

Limitations

Because this was a pilot study intended to document the implementation of new standard practice recommendations for blood lead testing in refugees, there are several limitations to generalizing the findings. First, the project spanned a short time period and encompassed a small group of children seen in one refugee health-screening clinic. Clinics in other areas of Minnesota and the nation are likely to experience

a different set of risk factors for lead poisoning. Also, this project did not follow the nutritional status of children beyond the initial health screening and did not document the housing-related lead risk for individual children. Information on these factors would provide clues as to why a low percentage of children in this pilot study developed EBLs when compared with findings from New Hampshire. Finally, there is potential for misclassification of EBL status due to imprecision of laboratory tests. Under national quality assurance programs, the allowable margin of error is $\pm 4 \mu\text{g/dL}$; however, most laboratories are routinely able to achieve a smaller margin of error of $\pm 2 \mu\text{g/dL}$.

Challenges

The extra effort needed to follow the new CDC refugee lead-screening guidelines posed several challenges, many of which were due to language and cultural barriers. While doing the initial lead screen during the routine diagnostic or screening exam takes a small effort, case management follow-up of the abnormal lead and nutritional blood test results, including assuring that each new refugee family was connected to a new assigned medical clinic in a timely manner, was very time-consuming. Even for children with normal laboratory results, coordination with the screening clinic, family, interpreter, transportation providers, and sponsor required much effort. Significant additional demands would be placed on local refugee screening clinics for statewide implementation of these CDC recommendations. The cost for implementing the guidelines in one clinic in St. Paul for nine months was approximately \$20,000. This amount may vary in other locations depending on differences in the cost of staff time and refugee health-screening capacity.

CONCLUSION

This project suggests that there may be differences in lead-poisoning risk in geographically different areas, based on the condition of housing stock in those areas and refugees' countries of origin. The MDH childhood lead-poisoning prevention program will reevaluate its blood lead screening guidelines in light of these findings. Local lead-poisoning prevention and refugee health agencies should assess the risk of lead poisoning in their area, evaluate their need and

capacity for full implementation of CDC recommendations for blood lead testing in refugees, and strive to obtain lead-safe housing for all children, both refugees and nonrefugees. Due to the increased risk of initial EBLs in refugee children and potential for nutritional deficiency, state and local health departments should continue to encourage medical providers to be aware of the risk of lead poisoning and other health issues in refugee populations.

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