

**Elevated Blood Lead Levels among Children in Refugee Camps  
Mae La, Umpiem, and Nupo Refugee Camps, Tak Province, Thailand  
June 2–19, 2009**

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*The findings and conclusions of this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention or other organizations.*

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## TABLE OF CONTENTS

1. Table of definitions.....	p. 4
2. Background and introduction.....	p. 5
3. Methods.....	p. 6
4. Results.....	p. 8
Basic demographics.....	p. 8
Blood lead levels.....	p. 8
Anemia and nutritional status.....	p. 9
Interview (case-control) results.....	p. 9
Mapping.....	p. 10
Product samples.....	p. 10
5. Limitations.....	p. 11
6. Conclusions and discussion.....	p. 12
7. Recommendations.....	p. 15
8. Tables and figures.....	p. 18
9. Appendices.....	p. 26

## 1. TABLE OF ACRONYMS AND DEFINITIONS

AMI	Aide Médicale Internationale	Medical nonprofit NGO; main health agency in the three Tak camps
ARC	American Refugee Committee	Nonprofit NGO working with displaced populations; health agency in Umpiem and Nupo camps
CDC	Centers for Disease Control and Prevention	Main U.S. public health agency
CDC/TUC	U.S. CDC -Thailand MoPH	U.S. CDC -Thailand MoPH collaboration
DGMQ	Division of Global Migration and Quarantine, CDC	
IRMHB	Immigrant, Refugee, and Migrant Health Branch	CDC group responsible for monitoring medical exams of U.S.-bound refugees
IOM	International Organization for Migration	Leading intergovernmental organization in migration; handles resettlement for refugees on Thailand-Burma border
CCSDPT	Committee for the Coordination of Services to Displaced Persons in Thailand	Umbrella organization of agencies and NGOs serving refugees on the Thailand-Burma border
TBBC	Thailand-Burma Border Consortium	Camp agency responsible for nutrition and food security
WHO	World Health Organization	
BLL	Blood lead level	Measured in micrograms per deciliter (mcg/dL)
EBLL	Elevated blood lead level	Defined as venous BLL $\geq$ 10 mcg/dL
Hgb	Hemoglobin. Measured in grams per deciliter (g/dL).	
iQr	Interquartile range	
OR	Odds ratio	

## 2. BACKGROUND/INTRODUCTION

In spring 2008, the Immigrant, Refugee, and Migrant Health Branch (IRMHB) of DGMQ began receiving reports from state health departments of elevated blood lead levels (or EBLs, blood lead level  $\geq 10$  mcg/dL) among Burmese refugee children who had been resettled to the United States. Additional screening performed by the states showed that 13% of resettled Burmese refugee children had an EBL (most children tested were under 6 years of age). For comparison, the overall prevalence of EBLs among children under 6 years of age in the United States is now below 1%.<sup>2</sup> Since lead screening for these Burmese refugee children was conducted up to 3 months after their arrival in the United States, we could not determine whether exposure to lead occurred in the United States or in the refugee camps. EBLs among children tested within weeks of arrival in the United States indicated that their exposure had likely occurred in the refugee camps.

From 2007 to 2009, approximately 24,000 Burmese refugees were resettled to the United States. Most were from one of three camps in Tak province, Thailand: Mae La, Umpiem, or Nupo. Over the next 10 years, an estimated 100,000 Burmese refugees will be resettled to the United States from the nine camps along the Thailand-Burmese border.

Lead toxicity among refugees resettled to the United States has been previously reported.<sup>3</sup> In 2000, following the death of a U.S.-resettled Sudanese refugee child from lead poisoning, CDC recommended that state health departments perform BLL testing in refugee children up to the age of 16 years within 3 months of their arrival in the United States.<sup>45</sup> Currently, no routine BLL screening is conducted in refugee camps overseas.

An EBL can cause severe, permanent health problems in children (Figure 1). Early detection and management of EBLs can prevent further damage from occurring. Identification and control of environmental sources of lead are critical for all children with an EBL, as these measures can effectively interrupt continued exposure. The detection and treatment of anemia are also important, since iron deficiency is thought to potentiate lead absorption<sup>6</sup>. Anemia, which can be associated with poor nutrition and intestinal parasitism, is common among refugee children<sup>7</sup>. Other nutritional deficiencies (such as calcium deficiency) are also thought to result in enhanced lead absorption from the environment.<sup>8</sup> Current strategies for management of EBLs in children focus primarily on the elimination of environmental sources of lead, with adjunct measures for the improvement of iron and calcium sufficiency, and chelation therapy if warranted.<sup>9</sup>

Given the high prevalence of EBLs observed in Burmese refugee children resettled to the United States, CDC, IOM, and Mae La, Umpiem, and Nupo camp agencies planned an investigation of EBLs among refugee children still living in Thailand.

Objectives of the investigation were to:

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<sup>2</sup> CDC national surveillance data--unpublished.

<sup>3</sup> P. Geltman et al. Lead Poisoning among Refugee Children Resettled in Massachusetts, 1995-1999. *Pediatrics* 2001 Dec;108(6):1364-6.

<sup>4</sup> CDC. Elevated Blood Lead levels in Refugee Children—New Hampshire, 2003-2004. *MMWR* 2005;54(02):42-46.

<sup>5</sup> 2. CDC. *Lead Poisoning Prevention in Newly Arrived Refugee Children: Tool Kit*. 2006.

<sup>6</sup> AAP. Lead Exposure in Children: Prevention, Detection, and Management. *Pediatrics* 116 No. 4 October 2005, pp. 1036-1046

<sup>7</sup> CDC. Malnutrition and micronutrient deficiencies among Bhutanese refugee children—Nepal, 2007. *MMWR* 2008 Apr 11;57(14):370-3.

<sup>8</sup> C. Campbell et al. Prevention of Childhood Lead Poisoning. *Curr Opin Pediatr*. 2000 Oct;12(5):428-37.

<sup>9</sup> CDC. *Managing Elevated Blood Lead Levels Among Young Children*, 2002. [www.cdc.gov/nceh/lead/CaseManagement/](http://www.cdc.gov/nceh/lead/CaseManagement/)

1. Estimate the prevalence of EBLLs in Burmese refugee children living in Mae La, Umpiem, and Nupo camps.
2. Identify potential sources of lead exposure in the refugee camps.
3. Work with camp agencies and other partners to address this problem camp-wide.

### 3. METHODS

Information regarding the hazards of lead and describing the investigation was shared with camp health agencies, Camp Committee Leaders and Community Health Workers/Home Visitors. Results from previously tested items from the camps that had been found to contain lead (traditional infant remedy “Daw Tway Go Mo Dah”, an unlabeled red cooking spice, and cooking pot brand “Na Myein Pya/OK9”) were also shared with these partners. Educational flyers developed at CDC were translated into Karen and Burmese and distributed to families throughout the three camps by AMI and ARC. Local and regional offices of the Thai Ministry of Public Health were informed of the findings by CDC/TUC and by camp agencies.

During June 2–19, 2009, the team conducted a case-control investigation of refugee children in Mae La, Umpiem, and Nupo refugee camps, Tak province, Thailand.

#### 3.a. Study Participants

For convenience, cases and controls were identified through voluntary blood lead testing of U.S.-bound refugees. U.S.-bound refugees are required to have a medical evaluation prior to resettlement. The medical examination and lead testing were conducted by the International Organization for Migration (IOM) at Pawo Hospital in Maesot, Thailand.

All U.S.-bound refugee children ages 6 months through 14 years from Mae La, Umpiem, and Nupo camps who underwent the pre-resettlement medical evaluation during May 4 to June 12, 2009, were eligible for inclusion in the investigation. We chose to test children through age 14 years, because individuals through age 14 years are considered children for the purposes of the medical evaluation.

As a public health response, this investigation was accorded nonresearch status by the CDC Institutional Review Board. Participation in the investigation was voluntary, and lead testing results were released only to relevant individuals in refugee health agencies and at CDC. Oral consent was obtained from all parents or legal guardians before their minor children were enrolled (Appendix A).

#### 3.b. Testing for BLL and Hemoglobin

Testing for blood lead and hemoglobin levels was performed by trained IOM phlebotomists. Capillary blood was obtained by finger-prick and tested on the Lead Care II® machine. Due to the sensitivity of the machine to environmental lead, children’s hands were thoroughly washed prior to testing. The blood was collected in vials in a designated phlebotomy room and then analyzed in the laboratory.

Testing for anemia was performed on capillary blood from the same finger-prick. Blood was analyzed for hemoglobin (Hgb) concentration by using the Hemocue® machine. A child was classified as anemic according to Hgb for age and sex, as defined by UNHCR Health Information System.<sup>10</sup>

Children with an EBLL (BLL  $\geq$ 10 mcg/dL) on capillary testing underwent confirmatory venous blood testing, which was run on the Lead Care II®. Because small amounts of lead can be secreted in breast

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<sup>10</sup> The hemoglobin cutoff defining anemia in children under age 15 years is dependent upon age and sex and ranges from 11.0 g/dL in toddlers to 12.0 g/dL in children ages 5-14 years (HIS Case Definitions p. 11).

milk,<sup>11</sup> venous blood from mothers of breastfed children with an EBLL on confirmatory venous testing was also tested for lead.

Results for all blood tests were available within hours. Parents and guardians of children with EBLs or anemia or both were counseled on the same day by IOM physicians, and IOM provided follow-up testing and management by a predetermined protocol (Appendix B).

Data regarding height and weight were documented routinely during the pre-resettlement medical exam. WHO z-scores for body mass index (BMI; for children above age 2 years) and weight-for-height (for children ages 6 months to 2 years) were determined for cases and controls, as measures of acute nutritional status. WHO height-for-age z-scores were also determined, as measures of chronic nutritional status.<sup>12</sup>

Testing equipment and supplies were purchased by CDC at a cost of roughly \$15.00 per child tested. All personnel involved in phlebotomy, lab analysis, recording of results, and patient counseling were provided by IOM.

### **3.c. Case and Control Definitions**

#### ***Cases***

A case was defined as venous BLL of  $\geq 10.0$  mcg/dL in a child age 6 months through 14 years from Mae La, Umpiem, or Nupo camp during May 4 to June 12, 2009.

#### ***Controls***

A control was defined as a child age 6 months through 14 years from Mae La, Umpiem, or Nupo camp who had capillary BLL below the limits of detection ( $< 3.3$  mcg/dL for the Lead Care II®) during May 4 to June 12, 2009.

### **3.d. Home Interviews**

A 50-question survey regarding potential sources of lead exposure was administered to parents or guardians of cases and controls during June 5-19, 2009. Questions focused on possible environmental, dietary, and occupational sources of lead since January 1, 2009--approximately a 6-month period (Appendix C: English version of survey). The survey was translated into the Karen and Burmese languages and was administered by AMI Home Visitors (in Mae La camp) and ARC Community Health Workers (in Umpiem camp) following a 2-day training session conducted by CDC. Due to time and logistical constraints and because certain exposures were either rarely encountered or ubiquitous among both cases and controls in Mae La and Umpiem camps, an abridged version of the survey was administered to cases and controls in Nupo camp.

### **3.e. Environmental Sampling and Sample Analysis**

A small number of environmental samples associated with case households, such as cosmetics, spices, and soil, was collected. Soil samples were analyzed for lead content at the United Analyst and Engineering Consultant Co. labs in Bangkok, Thailand, in June 2009. The remaining samples were transported to the United States. Lead testing, which was limited to items identified as possible risk factors for an EBLL during home interviews, was conducted at the Applied Technical Services Labs (Marietta, GA) in August 2009.

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<sup>11</sup> S.A. Counter et al. Current Pediatric and Maternal Lead Levels in Blood and Breast Milk in Andean Inhabitants of a Lead-Glazing Enclave. *JOEM* 2004;46(9): 967-973.

<sup>12</sup> World Health Organization Child Growth Standards, 2007. <http://www.who.int/childgrowth/en/>

### **3.f. Statistical Analyses**

Bivariate and multivariate analyses of data from the case-control investigation were conducted in JMP 8 and SAS 9.1. Fisher's exact test was used to calculate p-values. Because children under the age of 2 years had the highest prevalence of EBLs (Table 1) and because the behaviors of children at this age are likely different from those of older children, the analysis was age-stratified to examine risk factors particular to the under-2 age group separately from those of older children.

To increase the statistical power of the analysis and to examine the total effects of similar variables, the following variables were also combined into categories:

1. Responses to questions 41-47 were combined into one variable representing all motor vehicle battery-related questions
2. Results for hemoglobin and weight-for-height/BMI z-scores, and questions 20a.3 (milk consumption) and 29 (related medical issues) were combined into one variable representing all physiologic risk factors
3. Results for Q32 (all questions about traditional remedies) were combined into one variable representing intake of any traditional remedy
4. Results for Q27 (mouthing various nonfood items) were combined into one variable representing all mouthing nonfood items. Pacifiers (see results) and betelnut (ubiquitous exposure to both cases and controls) were excluded.

### **3.g. Mapping**

Mapping of case and control homes was conducted in Umpiem and Mae La camps by using a Garmin GPS 76CSX (Kansas City, KS) handheld device. When possible, potential sources of lead exposure, such as businesses involving smelting activities (blacksmith, motorcycle repair, and electronic repair shops), were also mapped in these two camps to determine the proximity of cases to these locations. Mapping was not conducted in Nupo camp due to time constraints. Figures 3a&b show spot maps of Mae La and Umpiem camps.

Drs. Tarissa Mitchell and Emily Jentes, DGMQ, CDC Atlanta, were in Thailand from May 30 to June 25, 2009, to conduct the case-control investigation. They were joined in the field by Ms. Sutisa Rommaneyapet, DGMQ, CDC-TUC on June 17, 2009.

## **4. RESULTS**

### **4.a. Demographics**

Testing was performed on 645 eligible camp-resident children ages 6 months through 14 years (Table 1). Note that the ethnic designation 'Muslim' does not refer to religious affiliation, as camp residents who self-identify as ethnic Muslims may or may not indicate a religious affiliation with Islam. Eligible children came from 319 camp households; on average, two children were tested per household.

We interviewed 25 (75.8%) of the 33 cases, and 42 (64.7%) of the 65 controls, a ratio of 1.7 controls per case. The eight cases and 23 controls who were not interviewed either could not be located (for example, because some had already resettled to the United States) or did not have BLL testing until after the dates of the case-control investigation. These eight cases and 23 controls are included in the overall description of BLLs and hemoglobin levels, but were not included in the risk factor analyses.



## 4.b. Laboratory

### *i. Blood Lead Levels*

BLL of 10.0 mcg/dL or above on capillary testing were identified in 62 (9.6%) of the 645 eligible children. Of these, 33 (5.1% of the 645 eligible children) were confirmed as having an EBLL on venous testing and were classified as case-children. The median venous BLL for cases was 12.9 mcg/dL (range 10.0–34.1 mcg/dL, interquartile range [iQr] 11.2–15.2 mcg/dL).

BLL was undetectable for 65 (10.1%) of the 645 eligible children, who were classified as controls.

Of the 612 children without an EBLL, 547 (89.4%) had a detectable capillary BLL, with a median of 6.4 mcg/dL (range 3.3–14.5 mcg/dL, iQr 5.2–7.8 mcg/dL). This means that 580 out of the whole group of 645 eligible children (89.9%) had either a detectable BLL or an EBLL (Figure 2).

The highest prevalence of EBLLs was seen in children under 2 years of age (14.4%; Table 1). This prevalence was nearly five times the prevalence of EBLLs in children ages 2 and older (3.0%). More than half (51.5%, n=17) of all children with an EBLL were in the under-2 age group—including five of the six children with BLL above 20 mcg/dL.

Mothers of seven breastfed children under the age of 2 years with an EBLL also underwent venous BLL testing. (Not all mothers of breastfed children under age 2 with an EBLL were tested.) All seven mothers had detectable BLL (>3.3 mcg/dL), and two had a BLL  $\geq$  10 mcg/dL. There was no linear correlation between maternal BLL and child BLL ( $p=0.53$  on analysis of fit). Median venous BLL for the mothers was 5.1 mcg/dL (range 4.5–16.5 mcg/dL, iQr 4.8–11.3).

### *ii. Hemoglobin*

Hemoglobin testing was performed on all 645 eligible children. Over half (397 children, or 61.6%) had hemoglobin levels below 12.0 g/dL by Hemocue®, and 103 (16%) had hemoglobin levels below 10.0 g/dL. Among all cases (n=33), 33.3% or 11 children had hemoglobin levels below 10.0 g/dL, while only 10.7% or seven children with undetectable BLL (n=65) did (table 1). Mean hemoglobin among cases was 10.8 g/dL and among controls was 11.6 g/dL. This difference was statistically significant ( $p=0.029$  on Wilcoxon rank sum test; Table 2).

### *iii. Height and Weight*

Mean weight-for-height/BMI z-scores and mean height-for-age z-scores did not differ significantly between cases and controls (Table 3). Although a small number of case and control children had z-scores of  $\leq -2$ , mean z-scores for both cases and controls were well above the typical cutoffs for acute wasting or stunting.<sup>13</sup>

## 4.c. Risk Factors

The following risk factors for an EBLL were statistically significant on bivariate, age-stratified analysis of interview responses (Table 3). Since age stratification resulted in smaller numbers of children in each group, which limits power of statistical tests, results are also noted for some nonstatistically significant findings ( $p$ -value up to 0.2) with elevated exact odds ratios ( $OR \geq 3$ ). Highlights of the results are categorized here by:

1. Exposures (activities that potentially result in direct contact with items containing lead)
2. Physiologic risk factors (underlying health-related issues that may have put specific children at higher risk of developing an EBLL if exposed to items containing lead)

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<sup>13</sup> Acute malnutrition (wasting) is defined as a z-score of  $\leq 2$  on weight-for-height index (HIS Case Definitions p. 10). Chronic malnutrition (stunting) is defined as a height for age z-score of  $< -2$  (WHO, [www.who.int/entity/ceh/indicators/0\\_4stunting.pdf](http://www.who.int/entity/ceh/indicators/0_4stunting.pdf))

3. Demographic risk factors (associated factors such as gender, which might be markers for behaviors that increase the likelihood of contact with items containing lead).

***i. Children under age 2 (N=12 cases; N=18 controls):***

1. Exposures:

- a. Having any exposure to motor vehicle batteries, including
  - Playing with or touching motor vehicle batteries (n=5 [41.7% of cases]; OR infinite, p 0.006)
  - Any exposure to motor vehicle batteries (combined variable) (n=8 [66.7%]; OR 7.0, p 0.02).
- b. Mouthing (e.g., oral contact with) cosmetic products (n=8 [66.7%]; OR 23.0, p 0.001). Note that seven of the eight children who mouthed cosmetics also mouthed other nonfood items.
- c. Mouthing any nonfood item (excluding pacifiers and betelnut) (n=11 [91.7%]; OR 5.5, p 0.19).
- d. Taking traditional remedies, including
  - “Tum Shwe War” chest rub (n=4 [33.3%]; OR infinite, p 0.02)
  - Any traditional medicine (n=12 [100%]; OR infinite, p 0.07)
- e. Family member engaged in agricultural work (n=4 [33.3%]; OR infinite, p 0.02)

2. Physiologic risk factors:

- a. Hemoglobin less than 10.0 g/dL (n=8 [66.7%]; OR 10.0, p 0.009)
- b. Low milk consumption (excluding breastmilk). Drinking milk daily was protective against an EBLL (among cases, only n=1 [8.3%] drank milk daily; OR 0.1, p 0.04)
- c. Low weight-for-height or BMI (n=2 [16.7%]; OR infinite, p 0.15)
- d. Any physiologic risk factor (combined variable) (n=11 [91.7%]; OR 5.5, p 0.19)

3. Demographic risk factors

- a. Religion reported as non-Christian (e.g., reported either as practicing Islam or Buddhism; n=8 [66.7%]; OR 5.2, p 0.06)

In a multivariate model, the following were considered the most significant risk factors for children under 2 years (Table 4):

1. Having any exposure to motor vehicle batteries (combined variable) (n=8 [66.7%]; OR 44.7, p 0.03)
2. Hemoglobin less than 10 g/dL (n=8 [66.7%]; OR 43.6, p 0.02)
3. Mouthing any nonfood item (combined variable excluding pacifiers and betelnut) (n=11 [91.7%]; OR 18.6, p 0.1)
4. Male sex (n=9 [75.0%]; OR 6.9, p 0.15). Though p-value for male sex was not significant, the presence of ‘male sex’ in the model strengthened the association of the other risk factors.

***ii. Children ages 2 and over (N=13 cases; N=24 controls):***

1. Exposures:

- a. Mouthing metal objects (n=10 [76.9%]; OR 5.8, p 0.08)
- b. Taking Daw Kyin’s “Wonotsay” (n=3 [23.1%]; OR infinite, p 0.04)

2. Demographic risk factors:

- a. Male sex (n=10 [76.9%]; OR 10, p 0.005)

In a multivariate model with these three risk factors, only male sex was significant (Table 4).

Of note, items that were previously tested and found to contain lead (Daw Tway Go Mo Dah, red spice, cooking pot) were not significantly associated with an EBLL in either age group (Table 3).

#### **4.d. Geographic Distribution and Environmental Sampling**

Figures 3a&b indicate locations of case homes in Mae La and case and control homes in Umpiem.

##### ***i. Mae La Camp***

Seven case homes (53.8% of all Mae La cases; 70% of interviewed Mae La cases) were mapped. Some of the cases appeared to be clustered in zone C, particularly in and around section C4. The appearance of case clustering on the map may be artifactual, because over 50% of all tested children in Mae La camp were from zone C, which is known to have a high population density. One of the homes in section C4 had two cases, contributing to a cluster effect.

Soil samples were collected from motorcycle repair shops in sections B1, B2, C3, and C4, electronic repair shops in sections C2, C4 and C5, and a blacksmith shop in section C1B. Lead levels in the soil immediately outside the electronic repair shop in section C2 were 631 ppm, and levels in the soil from the C3 motorcycle repair shop were 1,433 ppm. These levels exceed U.S. standards for soil in play areas (400 ppm), but are close to U.S. standards for nonplay areas (1,200 ppm).<sup>14</sup> These levels do exceed set Thai soil standards, which are 750 ppm.<sup>15</sup>

##### ***ii. Umpiem Camp***

All case and control homes were mapped in Umpiem camp (n=27). There was no obvious clustering of cases or controls. Soil samples were collected from blacksmith shops in sections A2 and A3, as these shops were in locations where interviewed cases and controls had observed smelting activity (in response to survey Q48). Results were within acceptable limits (25.0 and 74.6 ppm of lead, respectively).

In summary, there was no obvious pattern to the geographic distribution of cases in Mae La or Umpiem camps. Cases were not obviously clustered around shops with possible lead contamination (e.g., blacksmith, motor vehicle repair, or electronics repair).

#### **4.e. Product Sampling**

Seven samples of cosmetic products that were reported to be mouthed by children with cases were purchased from shops in Mae La, Umpiem, and Nupo ('Arche' brand face cream, 'Arche' and 'Wen Yuan' brand hair dyes, 'Pineness' and 'Kiss Kiss' brand eyebrow pencils, and two samples of Thanakha 'Oo'). The only product with detectable levels of lead was the 'Pineness' brand of eyebrow pencil, which contained only 79 ppm. None of the samples contained levels of lead considered to be hazardous.

### **5. LIMITATIONS**

1. The group of U.S.-bound refugees may not be fully representative of the camp population.
2. Some parents of cases and controls were not interviewed, and there may have been important differences with those who were interviewed.
3. Statistical power of analyses was limited by relatively small sample size, especially when the data were stratified by age.
4. Some children with detectable BLL were not included in the case-control study, because their BLL was less than 10 mcg/dL.

<sup>14</sup> Agency for Toxic Disease Registry: [http://www.atsdr.cdc.gov/csem/lead/pb\\_standards2.html](http://www.atsdr.cdc.gov/csem/lead/pb_standards2.html)

<sup>15</sup> Thailand Pollution Control Department: [http://www.pcd.go.th/Info\\_serv/en\\_reg\\_std\\_soil01.html#s2](http://www.pcd.go.th/Info_serv/en_reg_std_soil01.html#s2)

5. Questions focused on exposures within the most recent 6-month time period. Misclassification may have resulted from respondents who did not accurately recall exposures or who had important lead exposures more than 6 months prior to testing. If recall was non-differential by case-control status, this would have biased the results towards showing no effect. If the misclassification did differ by case or control status, this would have biased the results in an unpredictable manner.
6. To increase sample size, we analyzed data from all three camps together. We made the assumption that practices and lifestyle are relatively similar in all three camps. However, it is possible that sources of lead were different for each camp and that combining results reduced the statistical power to detect an exposure that may have been limited to one camp.
7. Due to time limitations at one camp (Nupo), interviews were abbreviated by eliminating questions that, based on preliminary analyses of data from Umpiem and Mae La, were unlikely to yield a significant result.
8. Interviews may not have included questions about other important sources of lead. Questions were designed to include either specific items known to have been contaminated with or contain lead (e.g., the three products already tested; motor vehicle batteries) or categories of products that may potentially include lead (cosmetics, paint, etc). Some other traditional remedies may contain lead or other heavy metals. However, comprehensive testing of all available products was outside the scope of this investigation.
9. We did not conduct full mapping of cases and controls in Mae La camp and did not conduct mapping in Nupo camp. Thus we may have missed patterns in the geographic distribution of cases and controls in those camps.
10. Although mouthing cosmetic products was associated with an EBLL, the cosmetic products tested did not contain elevated lead levels. We may have missed the true cosmetic products of interest, that different batches from the same brand of cosmetics may vary in lead contamination, or mouthing cosmetics may simply have been a proxy for other practices.

## 6. CONCLUSIONS AND DISCUSSION

During our investigation, we observed EBLs in 5.1% of U.S.-bound Burmese refugee children ages 6 months to 14 years living in the three Tak Province camps, with a prevalence of 14.4% in children under the age of 2 years. Overall, the prevalence of EBLs in this group of Burmese refugee children was markedly higher than that of children in the United States. The fact that only 65 (10.1%) of 645 children had undetectable capillary BLLs indicates that most camp children have had some degree of exposure to lead. Though 10.0 mcg/dL is the current cutoff for an EBL, any detectable BLL is unsafe for children and could have subtle effects on their development.<sup>16,17</sup> The disproportionately high prevalence in children under age 2 years is especially problematic, since children of this age are at a critical stage in their development and therefore more likely to experience the adverse developmental effects of lead exposure.<sup>18</sup> Therefore, EBL-related health messaging and mitigation efforts in the camps should be targeted to children under the age of 2 years, and the ensuing discussion and recommendations will focus upon that age group.

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<sup>16</sup> CDC. Interpreting and Managing Blood Lead Levels < 10 mcg/dL in Children and Reducing Childhood Exposures to Lead. *MMWR* 2007 56(RR08); 1-14;16.

<sup>17</sup> R.L. Canfield et al. Intellectual Impairment in Children with BLL Concentrations Below 10 mcg/dL. *New England Journal of Medicine*. 2003 Apr;348(16): 1517-26.

<sup>18</sup> Robert M. Kliegman et al, ed, Nelson textbook of Pediatrics (Philadelphia: Saunders, 2007) ch. 709.

Because practices and exposures are likely similar in all nine Thailand-Burma border camps, these recommendations are not limited to the three Tak province camps, but rather are meant to assist agencies in all nine camps.

A major risk factor significantly associated with an EBLL in this investigation was exposure to the motor vehicle batteries frequently used to power electrical equipment inside camp homes. Of those with an EBLL, 66.7% had some form of exposure to motor vehicle batteries (Table 3). Such batteries are known to contain lead—and in fact are commonly referred to as ‘lead-acid’ batteries. They have been directly linked to lead poisoning in numerous settings around the world, including Thailand,<sup>19</sup> and even to recent deaths in children in Senegal.<sup>20</sup> These batteries, which are often encased in brightly colored plastic (Figure 4), can be tempting playthings for young children, who enjoy exploring their environments. We also learned from camp HVs/CHEs and other residents that motor vehicle batteries are opened inside homes for adjustment, cleaning, or acid replacement, and that camp residents sometimes smelt the lead inside the batteries to make other objects. These dangerous practices release lead into the surrounding environment, which can then be inhaled or orally ingested by camp residents.

Since children under age 2 also have significant mouthing behaviors, it is especially important to keep these children away from items containing lead, such as motor vehicle batteries.

Of note, fewer motor vehicle batteries were observed in Mae La camp homes, perhaps because sections of that camp have recently been connected to electricity. The lowest prevalence of EBLLs in our groups of tested children was among residents of Mae La camp (Table 1).

Several other camp-purchased products were either shown to be contaminated with lead on past laboratory testing (Appendix D) or had some degree of association with an EBLL in the case-control investigation (such as the combined category for traditional medicines, Table 3). In a refugee camp setting, traditional medicines, cosmetics, spices, and other supplies may be obtained from sources that do not consistently test product safety and their production may not be regulated by local authorities. It would be difficult if not impossible to test every item or toy that enters the camp. However, a continuation of the community education that camp agencies and committees have begun regarding certain products or categories of products (such as traditional medicines) is important under these circumstances. Of note, it is unclear why Gripe Water and pacifiers were protective against EBLLs in our results, but we cannot recommend use of these items to prevent an EBLL, since they may simply be proxies for other protective measures (for example, children who suck on pacifiers may not mouth other objects as frequently) and may themselves present certain risks (Gripe Water may also contain alcohol or other compounds that are unsafe for young children).<sup>21</sup>

Cosmetic products have been associated with lead poisoning in other studies.<sup>22</sup> However, this risk factor may simply be a marker for child mouthing behavior in general and the associated increased risk for ingestion of lead-contaminated objects, since most children who mouthed cosmetics were also mouthing other objects. Note also that an EBLL in a child may be the result of a combination of exposures (e.g., exposure to car batteries and ingestion of Daw Tway, etc).

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<sup>19</sup> V. Wiwanitkit et al. Lead Intoxication: A Summary of the Clinical Presentation Among Thai Patients. *Biometals*. 2006 Aug; 19(4): 345-348.

<sup>20</sup> Vogt, Heidi. Lead Poisoning Kills Children in Senegalese Town. *NYTimes* online [www.nytimes.com/2009/01/04/world/africa/04iht-batteries.1.19064480.html](http://www.nytimes.com/2009/01/04/world/africa/04iht-batteries.1.19064480.html)

<sup>21</sup> Blumenthal, I. The Gripe Water Story. *J.R. Soc Med* 2000;93:172-174.

<sup>22</sup> I. Al-Saleh et al. Assessment of Lead in Cosmetic Products. *Regul Toxicol Pharmacol*. 2009 Jul;54(2): 105-13.

This study did not find a strong association of EBLL with use of traditional remedies. However, the sample size is too small to determine the safety of traditional remedies. As noted, samples of Daw Tway have contained lead; Wonotsay, a children's remedy for constipation, and other remedies, such as chest rubs (e.g., Tum Shwe War) have contained arsenic on previous testing.<sup>23</sup> Lead and arsenic are known to exist together in nature, and therefore some of these remedies may be contaminated with both metals.

The connection between an EBLL and agricultural work in this investigation warrants further examination, since we did not probe into the nature of the work or collect environmental samples from surrounding fields. Of note, lead arsenate has been used in pesticides in various agricultural settings, and although it has reportedly been banned in Thailand since 2001,<sup>24</sup> it is known to persist in the environment.

Anemia, as measured by low hemoglobin, was significantly associated with an EBLL in this investigation. Iron deficiency anemia is commonly seen in children with an EBLL.<sup>25</sup> At very high levels, EBLs can cause a type of anemia; however, BLLs observed in this group of Burmese refugee children are unlikely to have caused anemia. Anemia therefore likely preceded EBLs in these children. Note that anemia itself can negatively affect development and intelligence.<sup>26</sup> Moderate to severe anemia (Hgb below 10) was seen in 16% of the total tested group of children. Refugee camps should have programs in place for ensuring adequate micronutrients and for systematic treatment against intestinal parasites. Given the relatively high prevalence of anemia seen in this population, increased attention should be given to evaluating anemia prevention programs. Of note, anemia can also be associated with pica and therefore can contribute to mouthing behaviors.<sup>27</sup>

Children without regular dietary intake of milk were also more likely to have an EBLL. Dietary calcium is thought to inhibit intestinal transport of ingested lead,<sup>28</sup> and dietary sources of calcium should be evaluated.

Demographic risk factors associated with an EBLL included male sex and non-Christian religion, although their importance is not clear. Male sex has been identified as a risk factor for an EBLL in other studies.<sup>29</sup> There is no specific physiologic explanation for this elevated risk in males, which may simply reflect boys' higher levels of activity and mouthing behaviors at young ages. In our investigation, for example, 67% (8/12) of all children with reported physical contact with motor vehicle batteries were boys. Non-Christian religion might be a marker for some other exposure or behavior that could not be further elucidated in our investigation (such as cooking practices, dietary habits, higher likelihood of contact with motor vehicle batteries, socioeconomic status, or others). Other studies around the world have also shown an association of EBLs with minority ethnicities (African Americans and Latinos in the United States; blacks in Cuba; etc), thought to be due to differences in socioeconomic status and cultural practices.<sup>30</sup>

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<sup>23</sup> Unpublished data from testing done by Refugee Health Coordinators in MN and IN. The effects of arsenic on children are not as well understood as those of lead.

<sup>24</sup> [http://thailand.ipm-info.org/pesticides/pesticides\\_banned.htm](http://thailand.ipm-info.org/pesticides/pesticides_banned.htm)

<sup>25</sup> W.T. Kwong et al. Interactions Between Iron Deficiency and Lead Poisoning: Epidemiology and Pathogenesis. *Sci Total Environ*. 2004 Sep 1;330(1-3): 21-37.

<sup>26</sup> WHO. Micronutrient Deficiencies. [www.who.int/nutrition/topics/ida/en/index.html](http://www.who.int/nutrition/topics/ida/en/index.html)

<sup>27</sup> P. Schnuelle et al. An Unusual Case of Severe iron Deficiency Anemia. *Gut* 2006 Jul;55(7):1060

<sup>28</sup> C. Campbell et al. Prevention of Childhood Lead Poisoning. *Curr Opin Pediatr*. 2000 Oct;12(5):428-37.

<sup>29</sup> J.S. Raymond et al. Risk for Elevated Blood Lead Levels in 3- and 4-year-old Children. *Matern Child Health J*. 2009 Jan; 13(1):40-7.

One question that may arise after reviewing these findings is whether it would be advisable to implement a camp-wide BLL screening program. Our impression is that this would be of limited usefulness. Some reasons are as follows:

- a. The main purpose of this investigation was to identify risk factors and environmental sources associated with EBLLs. Results of this investigation may be generalized to all Thailand-Burma border camps, and findings from the three camps in this study could be applied to all camps.
- b. The levels of BLL seen among this group of children do not generally require hospitalization or chelation therapy, but do call for a remediation of risk factors. None of those tested had BLL requiring clinical intervention. Therefore, testing for BLL alone, without the identification and control or elimination of specific sources of lead, is of limited value.
- c. Testing can be costly and logistically difficult (though not impossible) to perform in the field. The machines are sensitive to environmental lead; therefore, a clean, lead-free environment would have to be prepared for testing, and special training would have to be given to lab technicians and phlebotomists.
- d. Targeted testing of BLLs in high-risk children, including refugees, is routine in the United States. When shared with refugee health officials, results of BLLs in the United States (or other resettlement country) may be used to monitor prevalence and trends of EBLLs among refugee children, without utilizing the limited resources for health in the refugee camps.

## **7. RECOMMENDATIONS**

Recommendations are focused on children under the age of 2 years. The section is divided into recommendations for camp agencies and recommendations for U.S. Refugee Health Coordinators. For camp agencies, the recommendations may be useful for all nine Thai-Burmese border refugee camps, as risk factors at all camps may be very similar to those in the three camps in this study. We look forward to continued collaboration with camp agencies, state Refugee Health Coordinators, and other international and domestic partners regarding the prevention of lead poisoning in Burmese refugee children.

### **7.a. Recommendations for camp agencies**

#### **1. Environmental**

- i. Eliminate children's contact with and exposure to motor vehicle batteries.
  - o If at all possible, families should be discouraged from using, keeping, or manipulating motor vehicle batteries inside or around their homes.
  - o Consider conducting household surveys regarding the prevalence and use of motor vehicle batteries in the various camps, and use as opportunities for community education
  - o Identify potential alternatives to motor vehicle batteries if possible.
  - o At minimum, families should be educated regarding safer practices:
    - Place motor vehicle batteries out of the reach of children.
    - Do not place motor vehicle batteries in rooms where children regularly sleep, eat, or play.
    - Do not allow young children to have physical contact with motor vehicle batteries.
    - Do not tamper with or open motor vehicle batteries, especially not inside or near the home.
    - Any family member who touches a motor vehicle battery should immediately wash their hands with water and soap.
    - The metal materials inside motor vehicle batteries should not be touched, burned, smelted, or used to make other items (such as fishing weights or pellets for hunting, for example).

- Children should not play in electronics or motor vehicle repair shops, since activities can involve motor vehicle battery repair or recharging, and soil in the immediate area of such shops may be contaminated with lead.
- ii. Families should be educated about practices that reduce the risk of inadvertent ingestion of lead.
- Children’s hands and toys should be regularly washed. Hands should be washed especially after playing outside and before eating.
  - Parents should attempt to limit the variety of items that children can access and put in their mouths (for example, to avoid ingestion of dirt, cosmetics, and metal objects).
  - Potentially dangerous items in the home, such as chemicals, cosmetics, paints, batteries, electrical and electronic equipment, should be kept away from small children. The floor should be kept clear of such items.
- iii. Parents should be made aware of the potential risk of heavy metal contamination in traditional Burmese remedies.
- iv. Items such as Daw Tway ‘Go Mo Dah’, Daw Kyin ‘Wonotsay’, unlabeled red spice (only the unlabeled type of ‘Asay Mo’ shown in Appendix D), and the pots of brand ‘Na Myein Pya’ or ‘OK8/OK9’ have been shown to contain lead and/or other heavy metals in a previous lab analysis, and should be avoided by camp residents.
- v. To explore the connection between EBLLs and agricultural work, the following approach may be considered:
- Camp agencies could check pesticide cans/bottles typically used in the fields to determine whether these pesticides contain lead arsenate
  - Consider collecting and testing soil samples from nearby farms/fields frequented by camp residents
  - Camp residents who are engaged in agricultural work should be advised to wash their hands thoroughly, and—if possible—change clothes, before they come in contact with family members. This recommendation also extends to camp residents engaged in other types of work, such as (but not limited to) smelting metal or burning other items (such as wood, garbage, etc.), working in motor repair or electronic shops, and daily wage work.

## 2. Nutritional:

Measures to address iron and calcium deficiency in camp children under the age of 2 years should be discussed with the appropriate camp agencies, such as TBBC. The method of intervention should be left to the discretion of camp health agencies, but might include:

- Multivitamin with iron or micronutrient powder (‘sprinkles’) supplementation.<sup>30</sup>
- Routine screening for anemia during the second year of life if feasible.
- Campaigns for prevention and treatment of intestinal parasites in children, such as routine de-worming treatment twice a year beginning at age 1.
- Inclusion of a good source of calcium in the camp food basket or in a micronutrient powder, if not already provided.
- Community education regarding the benefits of calcium and iron-rich foods in children, and appropriate intake amounts for each age group. Note that it is not recommended that infants under the age of 1 year drink cow’s milk due to its low iron content.<sup>31</sup>

<sup>30</sup> Caution should be taken when providing iron supplementation to children diagnosed with thalassemia major, since they can be at risk of iron overload

<sup>31</sup> I.J. Griffin and S.A. Abrams. Iron and Breastfeeding. *Pediatric Clinics of North America*. 2001 April; 48(2): 401-13.



3. Engagement of other resettlement countries:

Engage other resettlement countries in the discussion of EBLLs in Burmese refugee children, and suggest BLL testing after resettlement, if not already conducted. As an example, CDC guidelines for testing all refugee children after U.S. resettlement include:<sup>32</sup>

- a. Screening BLL for all refugee children ages 6 months to 16 years within 90 days of arrival in the United States, followed by—
- b. Repeat BLL testing for refugee children ages 6 months to 6 years within 3-6 months of placement in permanent residences.

4. If resources are available in the future, a follow-up survey in coordination with CDC and IOM could assess the impact of these recommendations on camp children's blood lead levels.

**7.b. Recommendations for U.S. Refugee Health Coordinators**

1. Continue to follow CDC guidelines for BLL screening and management in all arriving refugee children ages 6 months to 16 years (as above); ensure that physicians caring for refugee children are aware of these guidelines.
2. Monitor BLLs among newly arrived refugee children to identify at-risk groups and to monitor whether interventions implemented in the camps have had an impact on the prevalence of EBLLs.
  - Work with state and local Lead Poisoning Prevention programs to collect BLL on arriving refugee children.
  - When possible, link results with information regarding camp of origin.
  - Share findings with CDC DGMQ (in turn, DGMQ should keep IOM and camp agencies informed of trends in EBLLs in this group of refugees)
3. Consider educational efforts to raise awareness of EBLLs and potential causes among resettled refugee populations, including but not limited to the Burmese refugee population.
4. Work with state and local Lead Poisoning Prevention programs to coordinate state screening and management efforts, and to ensure that resettled refugee children are placed in lead-safe housing.

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<sup>32</sup> [http://www.cdc.gov/nceh/lead/Publications/RefugeeToolkit/Refugee\\_Tool\\_Kit.htm](http://www.cdc.gov/nceh/lead/Publications/RefugeeToolkit/Refugee_Tool_Kit.htm)

## TABLES AND FIGURES

**Table 1: Demographics and other characteristics of all cases and controls**

Characteristic	EBLL n (row % of total tested)	Undetectable n (row % of total tested)	Total tested n (% of 645 tested)
<b>Age (years)</b>			
< 2.0	17 (14.4)	22 (18.6)	118 (18.3)
2.0-4.9	6 (3.7)	9 (5.6)	162 (25.1)
5.0-12.9	7 (2.3)	24 (7.9)	302 (46.8)
≥13.0	3 (4.8)	10 (15.9)	63 (9.8)
<b>2.0 and older</b>	<b>16 (3.0)</b>	<b>43 (8.2)</b>	<b>527 (81.7)</b>
<b>Sex</b>			
Male	20 (10.7)	26 (13.9)	187 (29.0)
Female	8 (4.5)	37 (21.0)	176 (27.8)
Unknown	5 (1.8)	2 (0.71)	282 (43.7)
<b>Ethnic Group</b>			
Sqaw Karen	16 (4.4)	42 (11.5)	366 (56.7)
Muslim (ethnic)	14 (6.9)	17 (8.1)	209 (32.4)
Other/unknown	3 (4.3)	6 (8.6)	70 (10.9)
<b>Camp</b>			
Mae La	13 (3.6)	42 (11.7)	360 (55.8)
Umpiem	11 (6.1)	16 (8.9)	180 (27.9)
Nupo	9 (8.6)	7 (6.7)	105 (16.3)
<b>Hemoglobin (g/dL)</b>			
≥12.0	8 (3.2)	23 (9.3)	248 (38.4)
10.0-11.9	14 (4.8)	35 (11.9)	294 (45.6)
7.0-9.9	11 (11.0)	6 (6.0)	100 (15.5)
<7.0	0 (0.0)	1 (33.3)	3 (0.5)
<b>TOTAL</b>	<b>33 (5.1)</b>	<b>65 (10.1)</b>	<b>645</b>

**Table 2: Nutritional parameters for all cases and controls**

Parameter	Cases (n = 33)		Controls (n = 65)		Wilcoxon p-value
	Mean (std dev)	Median (range)	Mean (std dev)	Median (range)	
Hemoglobin (g/dL)	10.8 (1.8)	10.8 (7.0-14.2)	11.6 (1.5)	11.6 (6.0-16.5)	<b>0.029</b>
Weight for Height or BMI (z-score)	-0.3 (1.2)	0.0 (-3.0-3.0)	-0.1 (0.8)	0.0 (-3.0-2.0)	0.46
Height for Age (z-score)	-0.9 (1.3)	-1.0 (-3.0-3.0)	-1.0 (1.0)	(-3.0-1.0)	0.90

**Table 3: Findings on age-stratified bivariate analysis of interview results**

**Table 3a: Exposures Associated with EBLL**

Risk Factor	Age (yrs)	Interviewed Cases (<2 yrs: n = 12 ≥2 yrs: n = 13)				Interviewed Controls (<2 yrs: n = 18 ≥2 yrs: n = 24)				P exact	OR	95% CI
		Yes	%	No	N missing	Yes	%	No	N missing			
Plays with or touches motor vehicle batteries	<2	5	41.7	7	0	0	0	18	0	0.006	inf	--
	2&up	4	30.8	9	0	3	12.5	20	1	0.2	3.0	0.6-16.1
Any exposure to motor vehicle batteries <sup>a</sup>	<2	8	66.7	4	0	4	22.2	14	0	0.02	7.0	1.4-35.9
	2&up	7	53.8	6	0	10	41.7	14	0	0.52	1.6	0.4-6.4
Puts cosmetics in mouth	<2	8	66.7	3	1	2	11.1	16	0	0.001	21.3	2.9-154.6
	2&up	2	15.4	11	0	5	20.8	19	0	1	0.7	0.1-4.2
Sucks on pacifier <sup>b</sup>	<2	1	8.3	9	2	9	50.0	7	2	0.04	0.09	0.009-0.9
	2&up	1	7.7	9	3	2	8.3	17	5	1.0	0.9	0.08-11.9
Puts metal objects in mouth	<2	3	25.0	7	2	4	22.2	12	2	1	1.3	0.2-7.5
	2&up	5	38.5	4	4	3	12.5	14	7	0.08	5.8	1.0-35.7
Mouths any nonfood item (except pacifier) <sup>c</sup>	<2	11	91.7	1	0	12	66.7	6	0	0.19	5.5	0.6-53.2
	2&up	9	69.2	4	0	16	66.7	8	0	1	1.1	0.3-4.8
Takes 'Wonotsay'	<2	2	16.7	10	0	0	0	18	0	0.15	inf	--
	2&up	3	23.1	10	0	0	0	24	0	0.04	inf	--
Takes 'Tum Shwe War'	<2	4	33.3	8	0	0	0	18	0	0.02	inf	--
	2&up	2	15.4	11	0	7	29.2	17	0	0.5	0.4	0.08-2.5
Takes 'Gripe Water'	<2	4	33.3	8	0	15	83.3	3	0	0.009	0.1	0.02-0.6
	2&up	0	0	13	0	1	4.2	23	0	1.0	0	--
Takes any traditional remedy (except gripe water) <sup>d</sup>	<2	12	100	0	0	13	72.2	5	0	0.07	inf	--
	2&up	8	61.5	5	0	15	62.5	9	0	1.0	0.96	0.2-3.9
Family member does agricultural work	<2	4	33.3	8	0	0	0	16	2	0.02	Inf	--
	2&up	4	30.8	8	1	2	8.3	19	5	0.2	4.8	0.7-31.3

a. Exposure to motor vehicle batteries defined as 'yes' response to any or all of questions 41 to 47 on survey

b. Protective effect may be because child does not mouth other items while pacifier is in mouth.

c. Combined variable for question 27.

d. Combined variable for question 32.

**Table 3b: Physiologic Risk Factors for EBLL**

Risk Factor	Age (yrs)	Interviewed Cases (<2 yrs: n = 12 ≥2 yrs: n = 13)				Interviewed Controls (<2 yrs: n = 18 ≥2 yrs: n = 24)				P exact	OR	95% CI
		Yes	%	No	N missing	Yes	%	No	N missing			
Hemoglobin < 10.0 g/dL	<2	8	66.7	4	0	3	16.7	15	0	0.009	10	1.8-56.2
	2&up	0	0	13	0	2	8.3	22	0	0.53	0	--
Drinks milk daily (excluding breast milk)	<2	1	8.3	10	1	9	50.0	9	0	0.04	0.1	0.01-0.1
	2&up	0	0	13	0	4	16.7	20	0	0.28	0	--
Weight for Height or BMI of -2 z scores or less	<2	2	16.7	10	0	0	0	18	0	0.15	inf	--
	2&up	1	7.7	12	0	0	0	24	0	0.35	inf	--
Has other health condition (Q 29)	<2	4	0.3	8	0	4	0.22	12	2	0.69	1.5	0.3-7.8
	2&up	5	0.4	7	1	4	16.7	18	2	0.2	3.2	0.7-15.6
Has physiologic risk factors <sup>e</sup>	<2	11	91.7	1	0	12	66.7	6	0	0.19	5.5	0.6-53.2
	2&up	13	100	0	0	20	83.3	4	0	0.3	inf	--

e. 'Physiologic risk factors' defined as any combination of anemia, low weight for height or BMI (z-score -2 or below), medical condition as indicated in Q29 of survey, or infrequent milk consumption.

**Table 3c: Demographic Risk Factors Associated with EBLL**

Risk Factor	Age (yrs)	Interviewed Cases (<2 yrs: n = 12 ≥2 yrs: n = 13)				Interviewed Controls (<2 yrs: n = 18 ≥2 yrs: n = 24)				P exact	OR	95% CI
		Yes	%	No	N missing	Yes	%	No	N missing			
Male sex	<2	9	75.0	3	0	9	50.0	9	0	0.3	3.0	0.6-14.9
	2&up	10	76.9	3	0	6	25.0	18	0	0.005	10	2.1-48.9
Non-Christian religion	<2	8	66.7	4	0	5	27.8	13	0	0.06	5.2	1.1-25.3
	2&up	8	61.5	5	0	12	50.0	12	0	0.7	1.6	0.4-6.3

**Table 3d: Other Exposures of Interest (not statistically associated with EBLL)**

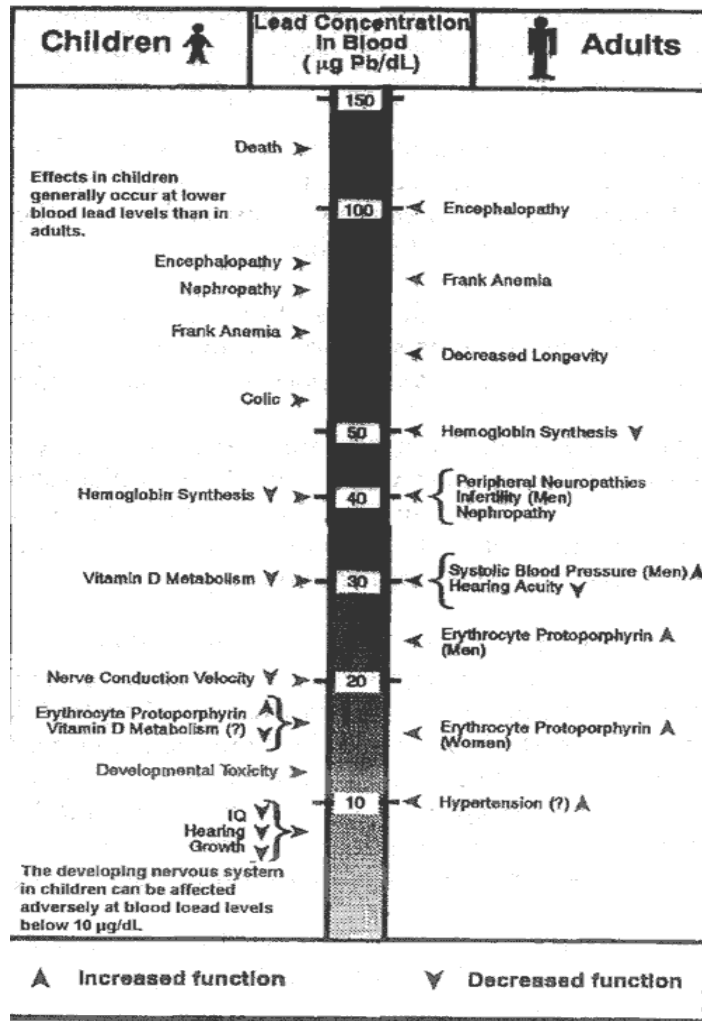
Risk Factor	Age (yrs)	Interviewed Cases (<2 yrs: n = 12    ≥2 yrs: n = 13)				Interviewed Controls (<2 yrs: n = 18    ≥2 yrs: n = 24)				P exact	OR	95% CI
		Yes	%	No	N missing	Yes	%	No	N missing			
Takes 'Daw Tway Go Mo Dah'	<2	2	16.7	10	0	1	5.6	17	0	0.55	3.4	0.3-42.4
	2&up	0	0	13	0	0	0	22	2	0	n/a	
Use of cooking pot resembling 'Na Myein Pya' pot	<2	10	83.3	2	0	16	88.9	2	0	0.2	0.6	0.08-5.2
	2&up	10	76.9	3	0	18	75.0	6	0	1	1.1	0.2-5.4
Use of red spice in cooking ('Asay Mo')	<2	9	75.0	3	0	10	55.6	8	0	0.4	2.4	0.5-11.9
	2&up	9	69.2	4	0	14	58.3	10	0	0.7	1.6	0.4-6.7

**Table 4: Findings on multivariate modeling**

Variable	p-value	OR (95% CI)
<b>Children under age 2 (n = 30)</b>		
Any exposure to motor vehicle batteries	0.03	44.7 (1.7-57.2)
Hemoglobin < 10.0 g/dL	0.02	43.6 (1.8-49.4)
Mouths any nonfood item (except pacifier)	0.1	18.6 (0.95-36.2)
Male gender	0.15	6.9 (0.81-13.7)
<b>Children ages 2 and above (n = 37)</b>		
Male sex	0.005	10.0 (1.5-7.6)

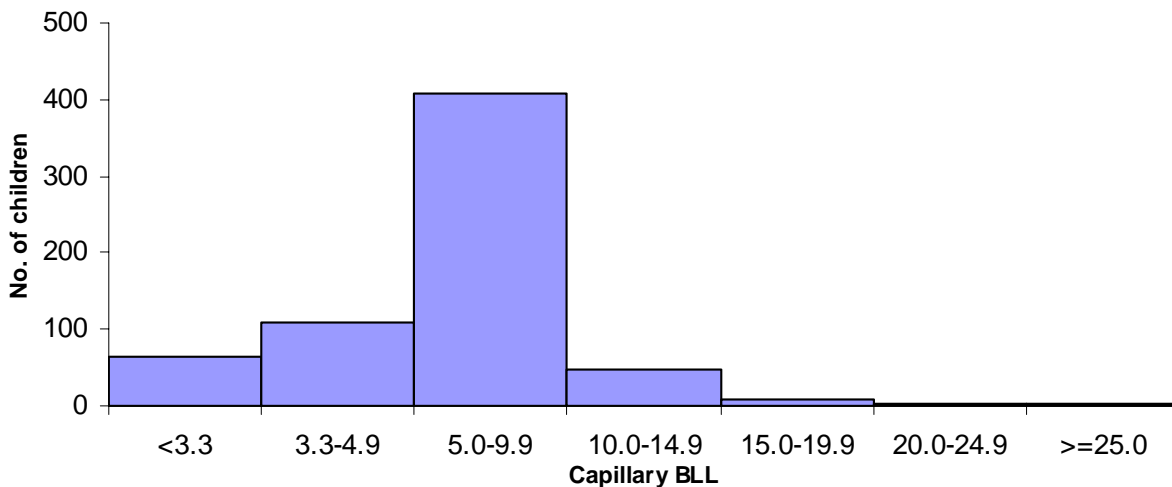
Figure 1. Effects of EBLL

Figure 9. Effects of lead on children and adults—  
Lowest-observed-adverse-effect levels\*

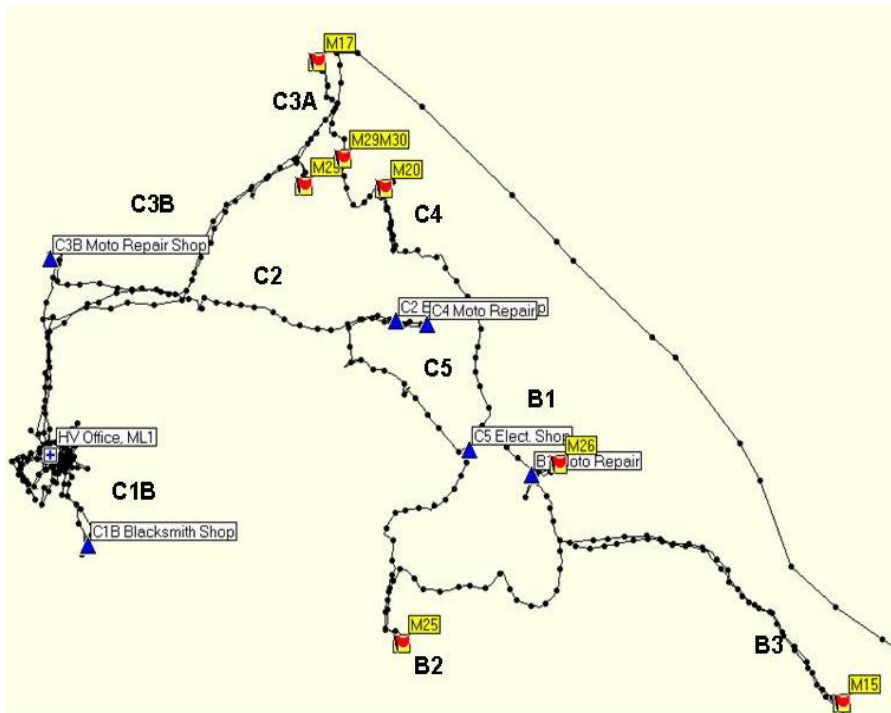


\* (Adapted from case studies in Environmental Medicine: Lead Toxicity, 1990, ATSDR)

Figure 2: Capillary blood lead levels in all tested children (N=645)

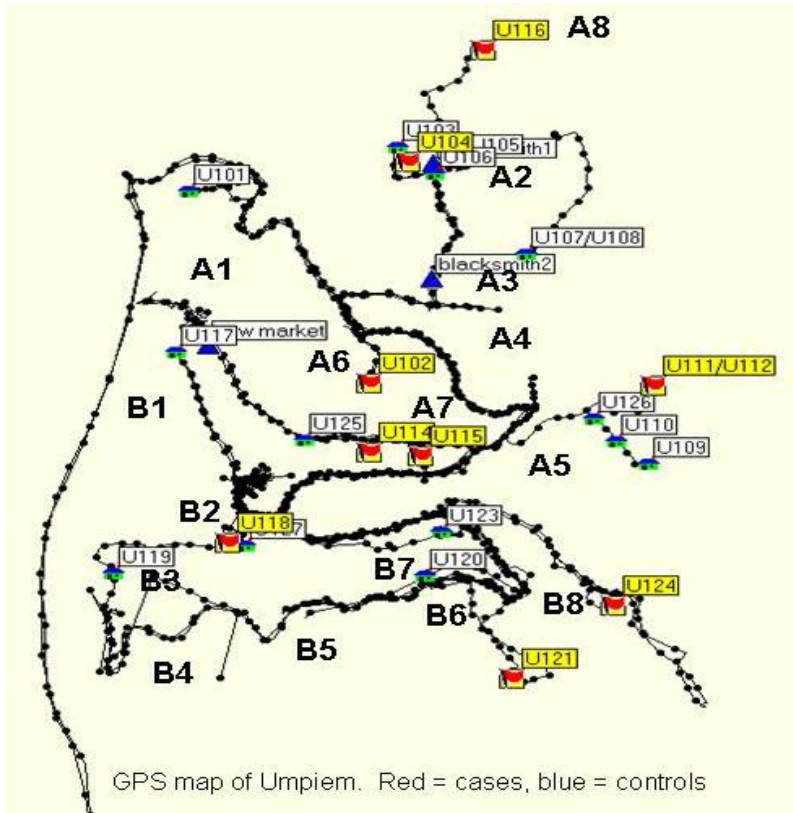


**Figure 3a: Spot map of Cases in Mae La\***



\* Red flag = case home; blue triangle = shop of interest. Of note, only seven case homes were mapped.

**Figure 3b: Spot Map of Cases and Controls in Umpiem\*\***



\*\* Red flag = case home; green house = control home; blue triangle = shop of interest.

Figure 4: Motor Vehicle Batteries in Camp Homes





## Appendix A: Oral Consent for Blood Lead and Anemia Screening

### ORAL CONSENT SCRIPT – Blood Lead Level and Anemia Tests

---

*Before a blood test for lead and anemia is performed, the child's parent/legal guardian should be told the following:*

Lead is a metal found in the environment. It can have bad effects on nearly every part of the body, especially for children. It can cause problems with learning and behavior. At very high levels, lead can cause seizures, coma, and death. Anemia, a condition of low iron in the blood, can be caused by many different things, including poor nutrition or parasites. Children with anemia are more likely to have high blood lead levels.

During your child's exam today, we are offering a blood test for lead. This is to see if your child has been exposed to harmful levels of lead. This test is not required for your health exam. Your application for resettlement will not be affected by whether or not your child is tested.

If you agree to the blood test, a small amount of blood the size of 5 rice grains will be taken from your child's finger. If the test shows high levels of lead, some blood will be drawn from your child's arm to check the level more accurately. If your child has high blood lead levels, a follow-up blood test will be offered later to make sure that the level is not getting higher.

Drawing blood from the finger or the arm is usually very safe and only causes discomfort for a short time. Other less common risks from the procedure are bruising and swelling around the puncture site, infection, or fainting.

You will be told the results of this test. Since lead can be anywhere in the environment, someone may also visit you at home within the next few months to ask questions about your child's diet and activities and to check things in the environment of your home (such as soil or toys) for lead.

You do not have to agree to have your child tested. If you do not want your child to be tested, your child's status in the U.S. refugee resettlement program will not be affected. The results of this test will not be shared with any other families at the camp.

## **Appendix A: Oral Consent for Blood Lead Screening in Mothers of Exclusively Breastfed Infants with Elevated Blood Lead Levels**

### **ORAL CONSENT SCRIPT – Blood Lead Level Test for Mothers of Breastfed Infants Ages 6 months to 1 year with Elevated Blood Lead Levels**

---

*Before a blood test for lead is performed on the mother of a breastfed infant with high lead levels, the mother should be told the following:*

Your infant's blood lead result was high. This may mean that your blood lead level is high also. We would like to offer you a blood test for lead.

If you agree to the blood test, a small amount of blood the size of 5 rice grains will be taken from your finger. If the test shows high levels of lead, some blood will be drawn from your arm to check the level more accurately. If you have high blood lead levels, a follow-up blood test will be offered later to make sure that the level is not getting higher.

Drawing blood from the finger or the arm is usually very safe and only causes discomfort for a short time. Other less common risks from the procedure are bruising and swelling around the puncture site, infection, or fainting.

You will be told the results of this test.

You do not have to agree to be tested. If you do not want to be tested, your status in the U.S. refugee resettlement program will not be affected. The results of this test will not be shared with any other families at the camp.

## Appendix A: Oral Consent for Home Visiting

### ORAL CONSENT SCRIPT – Home Interviews and Environmental Sampling

---

*Before interviewing the parent/ primary caregiver, say the following:*

My name is \_\_\_\_\_ and I am with the \_\_\_\_\_ team.

Today we are working with the camp agencies, CDC, and IOM to see if there is lead in the camp

Lead is a metal found in the environment. It can have bad effects on nearly every part of the body, especially for children. It can cause problems with learning and behavior. At very high levels, lead can cause seizures, coma, and death.

Your child was tested for blood lead levels during the health exam, and we are asking questions of some families who do have children with high blood lead levels, and some families who do not have children with high blood lead levels. We would like to take about 1 hour to ask you some questions about your child's diet, home, and activities. This will be important for finding out whether your child could be exposed to lead. Your answers to these questions will not affect your or your family's food rations in any way

You do not have to answer the questions. If you do not want to answer some or all of them, your child's status in the U.S. refugee resettlement program and in the camp will not be affected. Your answers will not be shared with any other families in the camp.

Lead can be anywhere in the environment. We may also ask to collect small amounts of soil, water, and other things (such as medicines, cosmetics) from your home to check them for lead. This is not required for your resettlement. Your application for resettlement will not be affected by whether or not you allow us to collect samples.

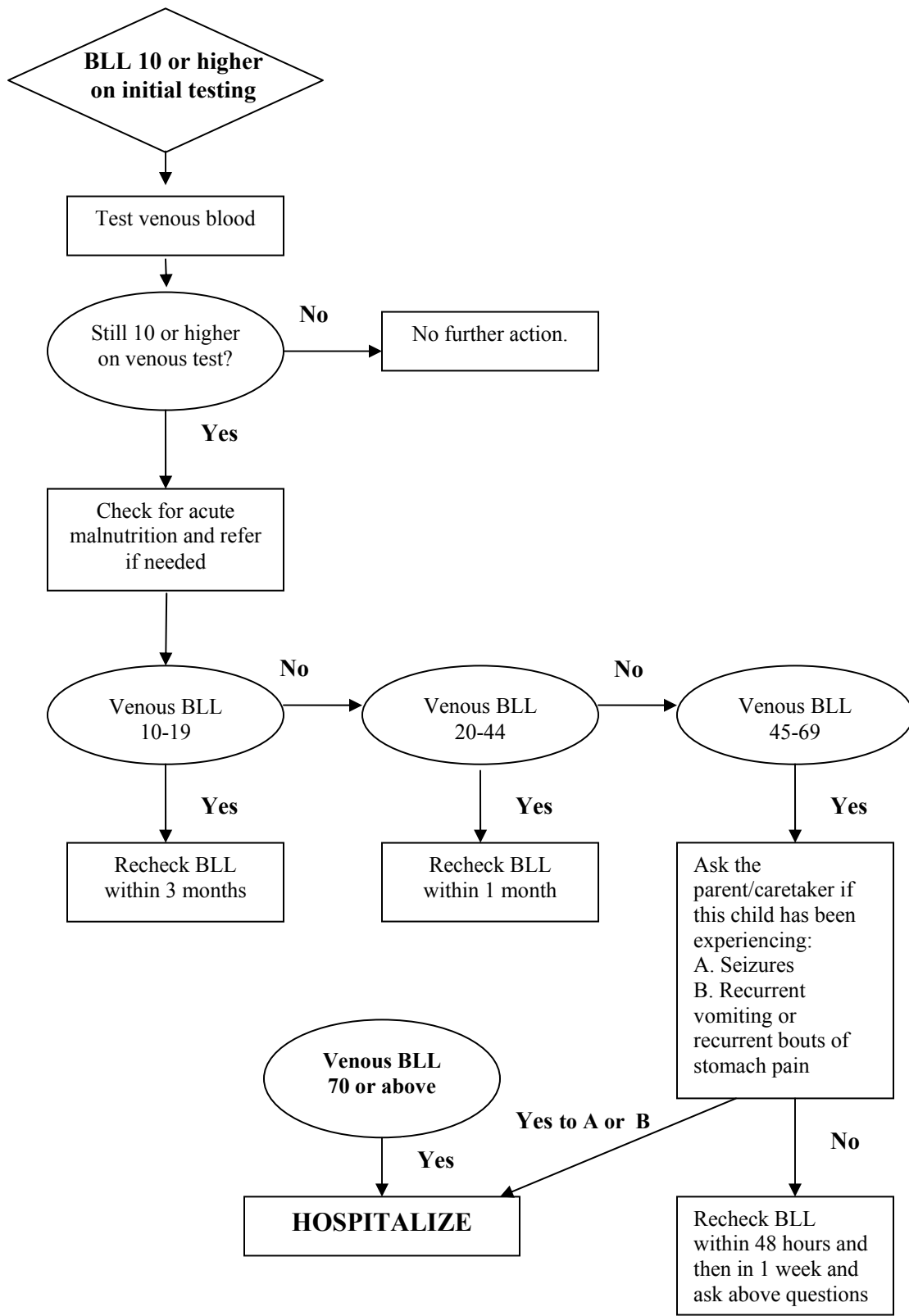
Do you agree to participate?

*[Interviewer: If the person says "no":*

- 1. Ask the reason for refusal*
- 2. Note the reason on the sheet*
- 3. Thank the person and leave]*

Do you have any questions?

**Appendix B: Algorithm for Testing and Treatment of Children with Blood Lead Level (BLL) of 10 or Higher**



## Appendix C: Survey

<b>PART I: GENERAL INFORMATION</b>	
<b>1*. Child's Alien Number:</b> <i>[interviewer: do not fill out #1]</i>	<b>2*. Number (starts with M for Mae La, U for Umpiem, and N for Nupo)</b> _____
<b>3. Date:</b> day ___ month ___	<b>4. Interviewer:</b> _____
<b>5*. Name of person being interviewed (primary caregiver of child):</b> _____	
<b>6*. Relationship to child (choose one only):</b> 1. Mother      2. Father      3. Sibling      4. Aunt/uncle      5. Grandparent  6. Other (please note): _____	

<b>PART II: DEMOGRAPHIC INFORMATION for CHILD</b>
<b>7*. Name of child:</b> _____
<b>8*. Age of child:</b> ___ years, ___ months
<b>9*. Place of birth:</b> _____ <b>10*. Sex:</b> 1. Male      2. Female
<b>11. Address</b> <i>[interviewer: please make sure address is correct]</i> <b>Zone:</b> <b>Section:</b> <b>Household:</b>
<b>12. Ethnic Group:</b> 1. Sgaw Karen      2. Pyo Karen      3. Karenni (Kayah)      4. Mon 5. Chin      6. Kachin      7. Shan      8. Rakhine (Arakhan) 9. Muslim      10. Chinese      11. Other (please note): _____
<b>13. Religion:</b> 1. Christian      2. Muslim      3. Buddhist      4. Animist 5. Other (please note) _____
<b>14. Burma province where family is originally from:</b> 1. Karen      2. Karenni      3. Mon      4. Tenasserim      5. Shan      6. Kachin 7. Pegu      8. Chin      9. Other (please note): _____
<b>15*. What language do you speak with your child at home?</b> 1. Karen      2. Burmese      3. Chinese      4. Other (please note) _____
<b>16*. How long has the child lived in this camp?</b> 1. All his/her life <i>[skip to question 18]</i> 2. ___ years      3. Less than one year [4. Don't know]
<b>17*. If your child has NOT lived in this camp all his/her life, where was your child living before?</b> 1. Another refugee camp on the Thailand-Burma border (please note): _____ 2. Burma      3. Thailand (please note which city or town): _____ [4. Don't know]
<b>18. How many people live in this household?</b> _____
<b>19. Please give the age of each child under the age of 15 years living in the household</b> _____ _____

**PART III: DIET**

**20\*. Now I would like to ask questions about some of the foods the child has eaten since the new year (January 1<sup>st</sup>) [interviewer: please show cup or spoon when appropriate]**

20a. Type of food	20b. Where was it from? (choose all that apply)	20c. How often has your child eaten this since the new year? (choose only one)	20d. How much did/does your child eat every time?	20e. When did your child eat this? (choose only one)
Since the new year: 1. Fish paste 1. Yes 2. No [3. Don't know]  Name of fish paste: _____	1. A shop in the camp 2. Camp agencies (food rations) 3. Friends or family 4. From outside the camp 5. Other (please note): _____ [6. Don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Child has eaten this every day since the new year [6. Don't know]	1. More than five spoons 2. 4-5 spoons 3. 2-3 spoons 4. Less than 2 spoons [5. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]
Since the new year: 2. Candy 1. Yes 2. No [3. Don't know]  Name of candy: 1. _____ 2. _____ 3. _____	1. A shop in the camp 2. Camp agencies (food rations) 3. Friends or family 4. From outside the camp 5. Other (please note): _____ [6. Don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Child has eaten this every day since the new year [6. Don't know]	1. More than 3 pieces 2. 2-3 pieces 3. 1 piece [4. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]

<p>Since the new year: 3. Milk 1. Yes 2. No [3. Don't know]</p> <p>Kind of milk: 1. Cow milk 2. Goat milk 3. Powdered milk 4. Condensed milk 5. Milk in box 6. Other (please note): _____</p>	<p>1. A shop in the camp 2. Camp agencies (food rations) 3. Friends or family 4. From outside the camp 5. Milking the animal 6. Other (please note): _____ [7. Don't know]</p>	<p>1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Child has drunk this every day since the new year [6. Don't know]</p>	<p>1. More than one cup 2. One cup 3. Half a cup 4. Less than half a cup [5. Don't know]</p>	<p>1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]</p>
<p>Since the new year: 4. Breast milk 1. Yes 2. No [3. Don't know]</p> <p>Does the woman who breastfeeds the child put any cream or powder on her breasts? 1. Yes (please note what): _____ 2. No [3. Don't know]</p>	<p>1. Child's mother 2. Another person (who _____)</p>	<p>1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Child has drunk this every day since the new year [6. Don't know]</p>	<p>1. More than one cup 2. One cup 3. Half a cup 4. Less than half a cup [5. Don't know]</p>	<p>1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]</p>
<p>Since the new year: 5. Wrapping food directly in newspaper or in a plastic bag before eating 1. Yes 2. No [3. Don't know]</p>		<p>1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Child has taken this every day since the new year [6. Don't know]</p>		<p>1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]</p>

**21\*. How often does the child wash his/her hands before eating meals (please choose only one)?**

1. Always    2. Most of the time    3. Some of the time    4. Not usually    5. Never  
6. Not applicable (for example, because the child is an infant)    [7. Don't know]

**22. Where do you get the food that you and your family eat (please choose all that apply):**

1. The camp agencies    2. Shops/market inside the camp    3. Shops/market outside the camp  
4. Hunting    5. Fishing    6. Looking for vegetables and other food in the forest  
7. Digging roots from the ground (please note where): \_\_\_\_\_  
8. Other (please note): \_\_\_\_\_

**23. a. Does anyone in your home ever cook food in ceramic (clay glazed) pots like the ones in this picture? [interviewer: show picture #2]**

1. Yes    2. No [skip to question 24]    [3. Don't know] [skip to question 24]

**b. How often is food cooked in these pots?**

1. Every day    2. Three or more times in a week    3. One or two times a week  
4. Less than one time a week    5. Never    [6. Don't know]

**24. a. Does anyone in your home ever cook food in metal pots like the one in this picture? [interviewer: show picture #1]**

1. Yes    2. No    [3. Don't know]

**b. How often is food cooked in these pots?**

1. Every day    2. Three or more times in a week    3. One or two times a week  
4. Less than one time a week    5. Never    [6. Don't know]

**25. Do you or anyone in your household ever put foods (like fish or chili peppers) outside to dry before eating them?**

1. Yes    2. No [skip to question 27]    [3. Don't know] [skip to question 27]

**26. If you answered "yes", what is the food dried on?**

1. In the soil  
2. On a piece of bamboo  
3. On a grill  
4. On something made of metal, like a car hood or piece of metal (please note):  
\_\_\_\_\_

5. Other (please note): \_\_\_\_\_

[6. Don't know]



<b>27*. Since the new year (January 1<sup>st</sup>), have you ever seen your child put any of the following things into their mouths (all things that are not food)?</b> <i>[interviewer: ask about each of the items below]</i>		
<b>27a. Item child puts in mouth</b>	<b>27b. How often did your child put this in their mouth since the new year? (choose only one)</b>	<b>27c. When was the last time your child put this in their mouth? (choose only one)</b>
Since the new year:  1. Dirt/soil 1. Yes 2. no [3. don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]
Since the new year:  2. Paints/paint chips 1. Yes 2. no [3. don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]
Since the new year:  3. Make-up (cosmetics) 1. Yes 2. no [3. don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]
Which ones		
Since the new year:  4. Toys 1. Yes 2. no [3. don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]
Which ones		
Since the new year:  5. Stones 1. Yes 2. no [3. don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]
Since the new year:  6. Pacifier 1. Yes 2. no [3. don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]
Since the new year:  7. [Blank]	1. 1 to 5 times 2. 6 to 10 times	1. In the past week 2. In the past month

7. Sticks 1. Yes 2. no [3. don't know]	3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	3. More than one month ago 4. [Don't know]
Since the new year: 8. Betelnut 1. Yes 2. no [3. don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]
Since the new year: 9. Insects 1. Yes 2. no [3. don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]
Since the new year: 10. Batteries 1. Yes 2. no [3. don't know]  Which ones (big or small, etc)	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]
Since the new year: 11. Metal things 1. Yes 2. no [3. don't know]  What things	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]
Since the new year: 12. Other things that are not food (please note):	1. 1 to 5 times 2. 6 to 10 times 3. 10 to 15 times 4. More than 15 times [5. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]

**28. Do you or anyone in your household ever cook with any spices like the ones shown in these pictures, or with any other spices since the new year (January 1<sup>st</sup>):- [interviewer: ask about every one of the spices in picture #37 and fill in the table below]**

28a. Type of Spice	28b. Where did you get it from? (choose all that apply)	28c. How many times did you use this spice since the new year? (choose only one)	28d*. When was the last time your <b>child</b> ate any of this spice? (choose only one)
Since the new year:  1. Red spice 1. Yes  2. No [3. Don't know]  Name of spice: _____	1. A shop in the camp 2. Delivery to home 3. Friends or family 4. From outside the camp 5. Other (please note): _____ [6. Don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. Never 5. [Don't know]
Since the new year:  2. Chili powder 1. Yes  2. No [3. Don't know]  Name of spice: _____	1. A shop in the camp 2. Delivery to home 3. Friends or family 4. From outside the camp 5. Other (please note): _____ [6. Don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. Never 5. [Don't know]
Since the new year:  3. Yellow spice 1. Yes  2. No [3. Don't know]  Name of spice: _____	1. A shop in the camp 2. Delivery to home 3. Friends or family 4. From outside the camp 5. Other (please note): _____ [6. Don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. Never 5. [Don't know]
Since the new year:  4. Other spice 1  Name of spice: _____	1. A shop in the camp 2. Delivery to home 3. Friends or family 4. From outside the camp 5. Other (please note): _____ [6. Don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. Never 5. [Don't know]
Since the new year:  5. Other spice 2  Name of spice: _____	1. A shop in the camp 2. Delivery to home 3. Friends or family 4. From outside the camp 5. Other (please note): _____ [6. Don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. Never 5. [Don't know]
Since the new year:  6. Other spice 3  Name of spice: _____	1. A shop in the camp 2. Delivery to home 3. Friends or family 4. From outside the camp 5. Other (please note): _____ [6. Don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. Never 5. [Don't know]

**PART IV: YOUR CHILD'S HEALTH**

Now I would like to ask some questions about your child's health.

**29\*. Has your child ever had any of these problems with health (choose all that apply):**

1. Poor nutrition/malnutrition
2. Anemia (low blood or low iron in the blood)
3. Thalassemia
4. Malaria
5. Parasites
6. Poor growth
7. Another chronic health problem (please note) \_\_\_\_\_
8. No, none of these problems [*skip to question 31*] [9. Don't know] [*skip to question 31*]

**30\*. Is the child being treated for any of those health problems right now?**

1. Yes (please note which one/s): \_\_\_\_\_
2. No [3. Don't know]

**31\*. Was the child ever enrolled in a feeding program (choose all that apply)?**

1. Yes, had to stay in the hospital (when? Month \_\_\_\_ Year \_\_\_\_\_)
2. Yes, the child was not in the hospital but came to a clinic to get extra food  
(When? Month \_\_\_\_ Year \_\_\_\_\_)
3. No
- [4. Don't know]

**32\*. Since the new year (January 1<sup>st</sup>), has your child taken any of the medicines in the pictures, or any other medicines like them? We know that you may have heard that the Daw Tway medicine has lead in it, but we still would like to know if your child ever took it in the past. [Interviewer: Please show pictures 4 to 30 and list the medicines that the child takes. Ask everyone about picture #11, Daw Tway ‘Go Mo Dah’]**

32a. # of picture	32b. Name of Medicine	32c. Where did you get it from? (choose all that apply)	32d. How many times did your child take this medicine since the new year? (choose only one)	32e. How much did the child take? (choose only one)	32f. When was the last time the child took this medicine? (choose only one)
11	<p><b>Daw Tway ‘Go Mo Dah’</b></p> <p>1. Yes 2. No [3. Don’t know]</p> <p>How did the child take this medicine (choose all that apply)?</p> <p>1. By mouth 2. On the skin 3. Other: _____</p>	<p>1. A shop in the camp 2. Delivery to home 3. Friends or family 4. From outside the camp 5. Other, such as traditional healer (please note): _____</p> <p>[6. Don’t know]</p>	<p>1. 1 to 5 times 2. 6 to 10 times 3. 10 to 15 times 4. More than 15 times [5. Don’t know]</p>	<p>1. More than one spoon 2. One spoon 3. Half a spoon 4. Less than half a spoon [5. Don’t know]</p>	<p>1. In the past week 2. In the past month 3. More than one month ago 4. [Don’t know] <b>5. If the child is not taking Daw Tway any more, why not? (please note)</b> _____</p>
_____	<p>_____</p> <p>How did the child take this medicine (choose all that apply)?</p> <p>1. By mouth 2. On the skin 3. Other: _____</p>	<p>1. A shop in the camp 2. Delivery to home 3. Friends or family 4. From outside the camp 5. Other, such as traditional healer (please note): _____</p> <p>[6. Don’t know]</p>	<p>1. 1 to 5 times 2. 6 to 10 times 3. 10 to 15 times 4. More than 15 times [5. Don’t know]</p>	<p>1. More than one spoon 2. One spoon 3. Half a spoon 4. Less than half a spoon [5. Don’t know]</p>	<p>1. In the past week 2. In the past month 3. More than one month ago 4. [Don’t know]</p>

_____	<p>_____</p> <p>How did the child take this medicine (choose all that apply)?</p> <p>1. By mouth</p> <p>2. On the skin</p> <p>3. Other: _____</p>	<p>1. A shop in the camp</p> <p>2. Delivery to home</p> <p>3. Friends or family</p> <p>4. From outside the camp</p> <p>5. Other, such as traditional healer (please note):</p> <p>_____</p> <p>[6. Don't know]</p>	<p>1. 1 to 5 times</p> <p>2. 6 to 10 times</p> <p>3. 10 to 15 times</p> <p>4. More than 15 times</p> <p>[5. Don't know]</p>	<p>1. More than one spoon</p> <p>2. One spoon</p> <p>3. Half a spoon</p> <p>4. Less than half a spoon</p> <p>[5. Don't know]</p>	<p>1. In the past week</p> <p>2. In the past month</p> <p>3. More than one month ago</p> <p>4. [Don't know]</p>
_____	<p>_____</p> <p>How did the child take this medicine (choose all that apply)?</p> <p>1. By mouth</p> <p>2. On the skin</p> <p>3. Other: _____</p>	<p>1. A shop in the camp</p> <p>2. Delivery to home</p> <p>3. Friends or family</p> <p>4. From outside the camp</p> <p>5. Other, such as traditional healer (please note):</p> <p>_____</p> <p>[6. Don't know]</p>	<p>1. 1 to 5 times</p> <p>2. 6 to 10 times</p> <p>3. 10 to 15 times</p> <p>4. More than 15 times</p> <p>[5. Don't know]</p>	<p>1. More than one spoon</p> <p>2. One spoon</p> <p>3. Half a spoon</p> <p>4. Less than half a spoon</p> <p>[5. Don't know]</p>	<p>1. In the past week</p> <p>2. In the past month</p> <p>3. More than one month ago</p> <p>4. [Don't know]</p>
_____	<p>_____</p> <p>How did the child take this medicine (choose all that apply)?</p> <p>1. By mouth</p> <p>2. On the skin</p> <p>3. Other: _____</p>	<p>1. A shop in the camp</p> <p>2. Delivery to home</p> <p>3. Friends or family</p> <p>4. From outside the camp</p> <p>5. Other, such as traditional healer (please note):</p> <p>_____</p> <p>[6. Don't know]</p>	<p>1. 1 to 5 times</p> <p>2. 6 to 10 times</p> <p>3. 10 to 15 times</p> <p>4. More than 15 times</p> <p>[5. Don't know]</p>	<p>1. More than one spoon</p> <p>2. One spoon</p> <p>3. Half a spoon</p> <p>4. Less than half a spoon</p> <p>[5. Don't know]</p>	<p>1. In the past week</p> <p>2. In the past month</p> <p>3. More than one month ago</p> <p>4. [Don't know]</p>

<p>_____</p>	<p>_____</p> <p>How did the child take this medicine (choose all that apply)?</p> <p>1. By mouth 2. On the skin 3. Other: _____</p>	<p>1. A shop in the camp 2. Delivery to home 3. Friends or family 4. From outside the camp 5. Other, such as traditional healer (please note): _____ [6. Don't know]</p>	<p>1. 1 to 5 times 2. 6 to 10 times 3. 10 to 15 times 4. More than 15 times [5. Don't know]</p>	<p>1. More than one spoon 2. One spoon 3. Half a spoon 4. Less than half a spoon [5. Don't know]</p>	<p>1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]</p>
<p>_____</p>	<p>_____</p> <p>How did the child take this medicine (choose all that apply)?</p> <p>1. By mouth 2. On the skin 3. Other: _____</p>	<p>1. A shop in the camp 2. Delivery to home 3. Friends or family 4. From outside the camp 5. Other, such as traditional healer (please note): _____ [6. Don't know]</p>	<p>1. 1 to 5 times 2. 6 to 10 times 3. 10 to 15 times 4. More than 15 times [5. Don't know]</p>	<p>1. More than one spoon 2. One spoon 3. Half a spoon 4. Less than half a spoon [5. Don't know]</p>	<p>1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]</p>

**PART V: CHILD'S ACTIVITIES**

**Interviewer: Now I would like to ask questions about things that your child has done since the new year**

**33\*. During the day, is your child anywhere outside the house (choose all that apply)?**

1. No, only or just outside the house    2. Yes, outside, not close to the house  
 3. Yes, at school    4. Yes, somewhere else in the camp (please note where): \_\_\_\_\_  
 \_\_\_\_\_ 5. Yes, outside the camp (please note where): \_\_\_\_\_  
 [6. Don't know]

**34\*. What is the one thing or toy that your child plays with the most? (please describe)**

\_\_\_\_\_

\_\_\_\_\_

**35\*. How often does your child play near or ride in cars, motorcycles, trucks, or other vehicles? (choose only one)**

1. More than one time a day    2. One time a day    3. More than once a week  
 4. Less than once a week but more than once a month    5. Less than once a month  
 6. Never    [7. Don't know]

**36\*. Did your child use any of the eyeliners/face paints/powders shown in the pictures, or any other face paints or cosmetics since the new year (January 1<sup>st</sup>).-**

*[Interviewer: Please show pictures 31-33 and ask about each of the paints or cosmetics]*

36a. Name of cosmetic	36b. Where did you get it from? (choose all that apply)	36c. How many times did the child use this since the new year? (choose only one)	36d. When was the last time your child used this? (choose only one)
Since the new year:  1. Surma (picture 31) 1. Yes    2. No [3. Don't know] If yes, which one: #31A #31B #31C #31D Other	1. A shop in the camp 2. Friends or family 3. From outside the camp 4. Other (please note): _____ _____ [5. Don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]
Since the new year:  2. Thanakha (picture 32) 1. Yes    2. No [3. Don't know] If yes, which one? #32A #32B Other	1. A shop in the camp 2. Friends or family 3. From outside the camp 4. Other (please note): _____ _____ [5. Don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]
Since the new year:  3. Hair dye _____ _____	1. A shop in the camp 2. Friends or family 3. From outside the camp 4. Other (please note): _____ _____ [5. Don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]



Since the new year:  4. Other cosmetic or face paint 33A <hr/>	1. A shop in the camp 2. Friends or family 3. From outside the camp 4. Other (please note): <hr/> [5. Don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]
Since the new year:  5. Other cosmetic or face paint 33 <hr/>	1. A shop in the camp 2. Friends or family 3. From outside the camp 4. Other (please note): <hr/> [5. Don't know]	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]

<b>PART VI: HOUSEHOLD WORK AND ACTIVITIES</b>				
<b>37. Now I would like to ask questions about work and other activities that people in your household have done since the new year (January 1<sup>st</sup>).</b>				
<b>37a. Type of work or activity</b>	<b>37b. Who does this work? (choose all that apply)</b>	<b>37c. How many times have they done this work since the new year? (choose only one)</b>	<b>37d. When was the last time they did this work? (choose only one)</b>	<b>37e. Where is this work done?</b>
Since the new year:  1. Factory work 1. Yes 2. No [3. Don't know]  What factory: <hr/>	1. Child's mother 2. Child's father 3. Child's brother/sister 4. Child's aunt/uncle 5. Child's grandparent 6. The child 7. Other (please note): <hr/>	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times [5. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]	1. Inside the camp 2. Outside the camp (where?) Town _____ Province _____ Country _____
Since the new year:  2. Mining work 1. Yes 2. No [3. Don't know]  Type of mine: <hr/>	1. Child's mother 2. Child's father 3. Child's brother/sister 4. Child's aunt/uncle 5. Child's grandparent 6. The child 7. Other (please note): <hr/>	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times [5. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]	1. Inside the camp 2. Outside the camp (where?) Town _____ Province _____ Country _____
Since the new year:  3. Home business 1. Yes 2. No [3. Don't know]  Type of business: <hr/>	1. Child's mother 2. Child's father 3. Child's brother/sister 4. Child's aunt/uncle 5. Child's grandparent 6. The child 7. Other (please note): <hr/>	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times [5. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]	1. Inside the camp 2. Outside the camp (where?) Town _____ Province _____ Country _____

<p>Since the new year:</p> <p>4. Art/crafts (like painting or working with wood)</p> <p>1. Yes 2. No [3. Don't know]</p> <p>Type of work:</p>	<p>1. Child's mother 2. Child's father 3. Child's brother/sister 4. Child's aunt/uncle 5. Child's grandparent 6. The child 7. Other (please note): _____</p>	<p>1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times [5. Don't know]</p>	<p>1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]</p>	<p>1. Inside the camp 2. Outside the camp (where?) Town _____ Province _____ Country _____</p>
<p>Since the new year:</p> <p>5. Making jewelry</p> <p>1. Yes 2. No [3. Don't know]</p> <p>Type of jewelry:</p>	<p>1. Child's mother 2. Child's father 3. Child's brother/sister 4. Child's aunt/uncle 5. Child's grandparent 6. The child 7. Other (please note): _____</p>	<p>1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times [5. Don't know]</p>	<p>1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]</p>	<p>1. Inside the camp 2. Outside the camp (where?) Town _____ Province _____ Country _____</p>
<p>Since the new year:</p> <p>6. Working with car batteries or cars</p> <p>1. Yes 2. No [3. Don't know]</p>	<p>1. Child's mother 2. Child's father 3. Child's brother/sister 4. Child's aunt/uncle 5. Child's grandparent 6. The child 7. Other (please note): _____</p>	<p>1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times [5. Don't know]</p>	<p>1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]</p>	<p>1. Inside the camp 2. Outside the camp (where?) Town _____ Province _____ Country _____</p>
<p>Since the new year:</p> <p>7. Hunting, or other job with bullets, gunpowder, or guns</p> <p>1. Yes 2. No [3. Don't know]</p>	<p>1. Child's mother 2. Child's father 3. Child's brother/sister 4. Child's aunt/uncle 5. Child's grandparent 6. The child 7. Other (please note): _____</p>	<p>1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times [5. Don't know]</p>	<p>1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]</p>	<p>1. Inside the camp 2. Outside the camp (where?) Town _____ Province _____ Country _____</p>
<p>Since the new year:</p> <p>8. Fishing</p> <p>1. Yes 2. No [3. Don't know]</p> <p>where:</p>	<p>1. Child's mother 2. Child's father 3. Child's brother/sister 4. Child's aunt/uncle 5. Child's grandparent 6. The child 7. Other (please note): _____</p>	<p>1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times [5. Don't know]</p>	<p>1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]</p>	<p>1. Inside the camp 2. Outside the camp (where?) Town _____ Province _____ Country _____</p>
<p>Since the new year:</p> <p>9. Other (please note): _____</p> <p>1. Yes 2. No [3. Don't know]</p> <p>Type:</p>	<p>1. Child's mother 2. Child's father 3. Child's brother/sister 4. Child's aunt/uncle 5. Child's grandparent 6. The child 7. Other (please note): _____</p>	<p>1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times [5. Don't know]</p>	<p>1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]</p>	<p>1. Inside the camp 2. Outside the camp (where?) Town _____ Province _____ Country _____</p>

**38. Since the new year, have you burned incense? (since January 1<sup>st</sup>).**

1. Yes 2. No [3. Don't know]	Where was it from? (choose all that apply)	How many times? (choose only one)	When was the last time? (choose only one)
Name of incense: _____	1. A shop in the camp 2. Delivery to home 3. Friends or family 4. From outside the camp 5. Other (please note): _____	1. 1 to 5 times 2. 6 to 10 times 3. 11 to 15 times 4. More than 15 times 5. Every day since the new year [6. Don't know]	1. In the past week 2. In the past month 3. More than one month ago 4. [Don't know]
	[6. Don't know]	[6. Don't know]	

**39. What types of containers does your family use to store water? (choose all that apply)**

1. Metal drum      2. Plastic      3. Ceramics (clay)      4. Glass      5. Rubber  
6. Other (please describe) \_\_\_\_\_

**PART VII: ELECTRONIC EQUIPMENT and METALS**

Now I would like to ask about any electronic equipment that people in your household have used since the new year (January 1<sup>st</sup>).

**40. Have you noticed any burned electronic things near your house (e.g., batteries, computers, televisions, radios, etc)?**

1. Yes (where did you see these) \_\_\_\_\_  
2. No      3. Don't know

**41. Has anyone in your household used car batteries to power anything in and around your house,? [interviewer—show picture 34]**

1. Yes      2. No [skip to question 43]      [3. Don't know] [skip to question 43]

**42. When was the last time anyone in your household used car batteries to power anything in and around your house?**

1. In the past week      2. In the past month      3. More than one month ago      4. [Don't know]

**43. How many car batteries do you have? \_\_\_\_\_**

**44. Does anyone in your house ever open car batteries? For example, to clean them, change them, or use their parts?**

1. Yes      2. No      [3. Don't know]

**45. What do you or others in your household usually do when car batteries are finished? (choose all that apply)**

1. Try to use their parts for other things      2. Sell them      3. Give them to someone else  
4. Throw them in the trash      5. Recycle them      6. Other: \_\_\_\_\_  
7. Does not apply (do not have car batteries)      [8. Don't know]

**46a. Do people in your household or your neighbors use the inside of batteries to make things (for example, to make metal things, hooks for fishing, bullets for hunting, or other things)?**

1. Yes      2. No      [3. Don't know]

**b. If yes how often? (choose only one)**

- 1 Every day      2. More than once a week      3. Less than once a week but more than once a month  
4. Less than once a month      [5. Don't know]

**47\*. a. How often have you seen your child playing with car batteries like the ones in the picture? (choose only one)**

- 1 Every day      2. More than once a week      3. Less than once a week but more than once a month  
4. Less than once a month      5. Never      [6. Don't know]

**b. Does the child ever visit or play in homes where there are car batteries?**

1. Yes (where) \_\_\_\_\_      2. No      [3. Don't know]

**48. a. Have you ever seen anyone burning and melting any kind of metal to make things? (for example, to make knives, or other things)**

1. Yes      2. No [skip to question 54]      [3. Don't know] [skip to question 54]

b. If yes, where? \_\_\_\_\_

**49. a. Does anyone in your household burn and melt metal to make things?**

1. Yes      2. No [skip to question 50]      [3. Don't know] [skip to question 50]

**b. If yes, how often? (choose only one)**

- 1 Every day      2. More than once a week      3. Less than once a week but more than once a month  
4. Less than once a month      [5. Don't know]

**50. a. Have you heard anything about lead and problems it can cause?**

1. Yes      2. No [finished with survey]      3. Don't know [finished with survey]

**b. If yes, where did you get this information? [interviewer: let the person answer the question without asking the choices below, then circle any choices that apply]**

1. Camp agencies      2. IOM, during the resettlement exam      3. Newsletter  
4. Flyers      5. other (please note): \_\_\_\_\_

**c. If yes, when did you get this information? \_\_\_\_\_**

**(May we see the cooking pots you have?)**

**Thank you very much for answering these questions!**

**Appendix D: Camp product samples containing heavy metals**

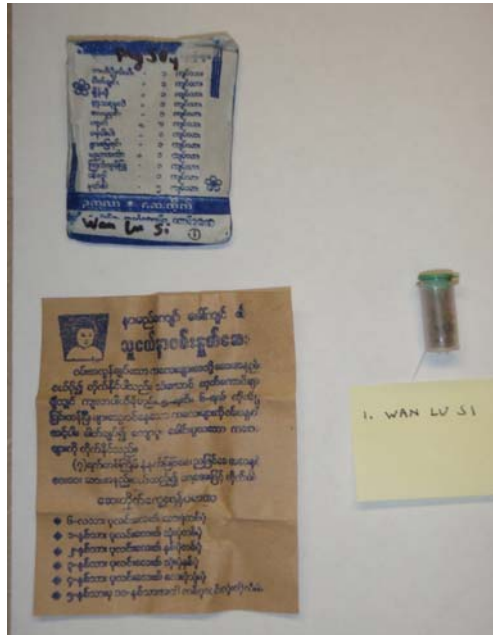
1. Daw Tway's 'Go Mo Dah' infant remedy (front and back of package shown): Used in first 6 months of life for a variety of issues. Taken orally or topically.

Samples tested in March 2009 contained 525 ppm lead and 24,500 ppm arsenic.



2. Daw Kyin's 'Wonotsay' (front and back of package shown): Used for constipation in children.

Samples tested in March 2009 contained 26,500 ppm arsenic.



3. Red cooking powder: Unlabeled, but likely same as 'Asay Mo' (Burmese) or 'Mo He Gamoo' (Karen).

Sample tested in March 2009 contained 395 ppm lead.





4. Cooking pot purchased at a market in Nupo camp, brand “Na Myein Pya”.

Sample tested in March 2009 contained 801 ppm lead.

