MALARIA, INTESTINAL PARASITES, AND SCHISTOSOMIASIS AMONG BARAWAN SOMALI REFUGEES RESETTLING TO THE UNITED STATES: A STRATEGY TO REDUCE MORBIDITY AND DECREASE THE RISK OF IMPORTED INFECTIONS


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Abstract. In 1997, enhanced health assessments were performed for 390 (10%) of approximately 4,000 Barawan refugees resettling to the United States. Of the refugees who received enhanced assessments, 26 (7%) had malaria parasitemia and 128 (38%) had intestinal parasites, while only 2 (2%) had Schistosoma haematobium eggs in the urine. Mass therapy for malaria (a single oral dose of 25 mg/kg of sulfadoxine-pyrimethamine) was given to all Barawan refugees 1–2 days before resettlement. Refugees ≥2 years of age and nonpregnant women received a single oral dose of 600 mg albendazole for intestinal parasite therapy. If mass therapy had not been provided, upon arrival in the United States an estimated 280 (7%) refugees would have had malaria infections and 1,500 (38%) would have had intestinal parasites. We conclude that enhanced health assessments provided rapid on-site assessment of parasite prevalence and helped decrease morbidity among Barawan refugees, as well as, the risk of imported infections.

In 1997, approximately 6,200 African refugees migrated to the United States, including 4,000 refugees who resettled from Somalia.1 As part of the resettlement process, these refugees received mandatory health assessments that have traditionally been intended to identify inadmissible conditions among individual refugees. Inadmissible conditions include disorders associated with harmful behaviors, drug abuse, and communicable diseases of public health significance (i.e., infectious tuberculosis and Hansen’s disease, untreated sexually transmitted diseases, and, because of immigration law, human immunodeficiency virus [HIV] infection). Before resettlement, refugees with these conditions must receive treatment or apply for a medical waiver. The Centers for Disease Control and Prevention (CDC) monitors the mandatory health assessments, which are performed overseas by contract physicians.

To decrease morbidity among refugees and the risk of imported infections, CDC developed a strategy for enhanced health assessments.12 The strategy identifies geographically specific diseases of public health significance that may adversely affect the health of the individual refugee, the refugee population, or the resettlement community in the United States. In July 1997, CDC and the International Organization for Migration (IOM) performed enhanced health assessments for a group of Somali (Barawan) refugees resettling to the United States from camps near Mombasa, Kenya. Morbidity reports for these refugees indicated that malaria was their most common health problem.13 Additionally, a previous report demonstrated a 15% prevalence of malaria parasitemia among Somali refugees resettling from Kenya.14 Malaria, intestinal parasites, and urinary schistosomiasis were also prevalent among local residents of the Somali and Kenyan coastal regions.2,4

Because of these observations, the objectives of the enhanced health assessment strategy were to 1) estimate the prevalence of malaria, intestinal parasites, and schistosomiasis based on a subgroup of the population of Barawan refugees seeking resettlement to the United States during 1997; 2) evaluate the need for pre-embarkation therapies based on these prevalences; 3) perform a rapid assessment of the effectiveness of antimalarial therapy among this group of refugees; and 4) evaluate the diagnostic capability of the local laboratory.

MATERIALS AND METHODS

Population and camp characteristics. The Barawans are a minority, mostly Muslim, clan from southern Somalia with cultural and religious ties to Arabia and Persia.5 During the 1991–1992 factional warfare in Somalia, the Barawans fled to refugee camps near Mombasa, Kenya.6 The refugee camps, which were closed in December 1997, were privately maintained or were under the direction of the United Nations High Commissioner for Refugees. Despite crowded conditions, camp hygiene was good; pit latrines were regularly maintained and potable water was supplied by a central bore well. There were no surface freshwater sources nearby. Refugees were initially provided with permethrin-impregnated bed nets for mosquito control; however, the nets were not routinely retreated with insecticide or replaced when worn.

Mandatory health assessment protocol. In 1997, 3,958 Barawan refugees resettling to the United States received mandatory health assessments as part of the resettlement process. Assessments were performed by the IOM and scheduled by family unit as assigned by the United States Immigration and Naturalization Service (INS). Family units frequently did not reflect actual living arrangements. A couple (or single parent) and any minor children were considered a family unit, while a single adult ≥18 years of age frequently was considered a separate family unit, even if this individual resided with other family members.

During February–June (mandatory group 1, n = 2,648) and August–October (mandatory group 2, n = 920), refugees received only the mandatory health assessments. The assessment included a general physical examination, a brief mental health assessment, and medical screening to identify inadmissible conditions. Refugees ≥15 years of age were screened for infectious tuberculosis (abnormal chest radio-
graph confirmed by sputum smear), syphilis (VDRL), and HIV infection (enzyme immunoassay and Western blot confirmation of positive individuals). Refugees <15 years of age were screened for these same communicable diseases only if symptomatic or if they were a household contact of an individual with infectious tuberculosis, syphilis, or HIV infection.

Enhanced health assessment protocol. During July 1997, refugees received both mandatory and enhanced health assessments (n = 390). Because enhanced health assessments were performed according to the existing INS interview schedule, we were unable to randomly select participants. However, enhanced health assessment were performed on approximately 10% of the 3,958 Barawans resettling to the United States and there was no reason to believe that the refugees receiving health assessments in July differed from those receiving health assessments in February–June or August–October. Therefore, we estimated that screening approximately 10% of the refugees was sufficient to determine prevalence of malaria with 95% confidence limits 5%, based on at least 15% prevalence of malaria parasitemia. Since 50–100 Barawan refugees per week resettled to the United States starting in May 1997, rapid on-site screening of the enhanced health assessment group was an important factor in evaluating the need for intervention(s) before most of the Barawan refugees had migrated.

Informed consent was obtained from all participants in the enhanced refugee health assessment group. The 1980 United States Refugee Act mandates routine medical screening of refugees seeking resettlement to the United States, with authority delegated to CDC. This paper represents an evaluation of an ongoing U.S. Government program designed to determine eligibility of refugees entering the United States, to improve health of refugees, and to minimize the risk of imported diseases. Refugees were informed of the purpose of the screening and that refusal to participate in the enhanced screening would not adversely affect their immigration status.

To collect data on demographics, amount of time spent in the camp, symptoms of parasitic infections, and history of parasitic diseases, the IOM administered an initial questionnaire at the time of the medical screening. To further examine behaviors related to treatment of self-reported malaria, CDC administered a follow-up questionnaire several days after the medical screening. Both questionnaires were administered in the Barawan language with the help of interpreters. Enhanced health assessment included tests for parasitic behaviors related to treatment of self-reported malaria.

Malaria screening. Whole blood specimens were screened for malaria by using a quantitative buffy coat test (the QBC® system; Becton Dickinson Company, Rutherford, NJ) according to manufacturer’s recommendations. Thick and thin blood smears were prepared for all refugees; smears from all QBC test-positive specimens were stained with Field’s stain and examined (200 fields at 1,000× magnification for parasites) for confirmation of malaria parasites and species diagnosis.12 Stained and unstained thick and thin smears and remaining sera were stored (~20°C for sera) and transported to CDC.

Refugees with uncomplicated malaria (not requiring hospitalization or demonstrating severe anemia) received sulfadoxine-pyrimethamine as a single oral dose (25 mg/kg based on the sulfa component). Parasitemia was assessed by microscopic examination of blood smears 3 and 7 days following therapy. Sulfadoxine-pyrimethamine therapy was considered effective if parasites were cleared by day 7.13 CDC assessed the diagnostic capabilities of the local laboratory by reviewing either the original smears or duplicate smears stained by CDC with Giemsa. Blood smears were reviewed from all the refugees who demonstrated malaria parasites and a 10% random sample of the negative blood smears. Smears were examined at 1,000× magnification for 200 fields.

Intestinal parasite screening. Stool specimens collected within 24 hr of the medical examination were screened by the local laboratory for intestinal parasites by using a direct wet mount of unconcentrated feces and a wet mount examination of the same stool specimen after concentration by the formol-ether concentration technique.14 Any specimen remaining was stored in polyvinyl alcohol and 10% formalin containers (Para-Pak Stool Systems; Meridian Diagnostics, Inc., Cincinnati, OH). CDC reviewed a 10% random sample of preserved stool specimens. Permanent slides of specimens fixed in polyvinyl alcohol were stained with trichrome15 and examined by light microscopy for protozoa. Specimens fixed in 10% formalin were concentrated by the formalin-ethyl acetate sedimentation technique16 and were examined by wet mount for helminths and protozoa (22 × 22 mm coverslip area) and by the Kinyoun carbol-fuchsin modified acid-fast stain17 for Cryptosporidium parvum and Cyclospora sp. All stained slides were reviewed at 1,000× magnification for 200 fields.

Schistosomiasis screening. Stool specimens were examined for Schistosoma mansoni eggs by using the techniques listed above. Free-catch urine specimens were collected from refugees in 2 age groups (7–20 and ≥40 years of age). More young refugees were tested because young age is associated with active S. haematobium infection (i.e., persons <20 years old are more likely to have blood and Schistosoma eggs in the urine).17 Urine specimens were tested for the presence of hemoglobin (1–4+) by using a urine dipstick (Chemstrips; Boehringer Mannheim Diagnostics, Indianapolis, IN). Positive specimens were examined for S. haematobium eggs by using standard techniques.18

As follow-up to schistosomal screening performed in the field, CDC performed schistosomal antibody serology by using enzyme immunotransfer blot (EITB) strips of S. haematobium and S. mansoni adult microsomal antigen, as previously described.19

Pre-embarkation therapy. A single oral dose of sulfadoxine-pyrimethamine (25 mg/kg body weight based on the sulfa component) was administered for antimalarial therapy. Refugees ≥2 years of age and nonpregnant women received a single oral dose of 600 mg of albendazole for intestinal parasite therapy. Medications were administered by directly observed therapy 1–2 days before travel (pre-embarkation).

Statistical analysis. Categorical variables were analyzed by using frequency distributions, and differences among groups were assessed by chi-square or Fisher’s exact tests. Prevalence ratios (PRs) and 95% confidence intervals (95% CIs) were calculated by using Epi-Info computer software.19
RESULTS

Enhanced health assessment participation rates. All 390 refugees in the enhanced health assessment group or their guardians participated in the initial questionnaire and 388 (98%) provided specimens for at least 1 of the parasite screening tests. Whole blood specimens for malaria screening were obtained from 385 (99%) of the refugees; the parents of 5 refugees <1 year of age did not give permission for their child’s participation in malaria screening. Stool specimens for intestinal parasite and 
S. mansoni screening were provided by 331 (85%) refugees. Free-catch urine specimens for S. haematobium screening tests were collected from 95 (60%) of 159 refugees 7–20 years of age and 23 (62%) of 37 refugees ≥40 years of age. Sera for schistosomal antibody screening were collected from 305 (78%) refugees (all ages).

Enhanced and mandatory health assessment group characteristics. The enhanced and mandatory health assessment groups were similar with regard to sex, age, and the percentage of refugees diagnosed with active tuberculosis, a measure of general health status (Table 1). Among the enhanced health assessment group, 334 (86%) were born in Somalia, and 315 (95%) refugees ≥5 years of age had lived in the Kenyan refugee camps for ≥5 years.

Malaria screening results. Of respondents to the initial questionnaire, 77 (20%) reported a recent history of febrile illness (within the past 2 weeks); 54 (70%) of refugees with recent fevers reported taking antimalarial medication (Table 2). Fever-related health-care seeking behaviors were examined in a follow-up questionnaire (CDC, unpublished data).

Twenty-six (6.8%) of the refugees tested had blood smears demonstrating malaria parasites. According to the local laboratory results, 25 (96%) of these refugees had Plasmodium falciparum and 1 (4%) had P. ovale. Refugees with malaria parasitemia were twice as likely to be male than female and twice as likely to be children <15 years of age than adults (Table 3). Among children, males were nearly 5 times more likely to be parasitemic than females.

Of the 26 parasitemic refugees, 20 (77%) received sulfadoxine-pyrimethamine therapy. One refugee on therapy was lost to follow-up. Five of the remaining 19 refugees were parasitemic on day 3 of follow-up, but all were asexual by day 7. Because of the severity of their anemia, the local hospital treated 6 (23%) of the parasitemic refugees with alternative antimalarial therapy (halofantrine or artemether).

CDC review of the findings for 37 blood smears that were reported as parasite-negative by the local hospital confirmed that all were truly negative. However, of 26 smears reported as demonstrating malaria parasites, CDC could not confirm 2 cases of P. falciparum infection. The specimen diagnosed by the local hospital as P. ovale parasitemia was identified by CDC as P. falciparum.

Intestinal parasite screening results. Twelve (3%) of respondents to the initial questionnaire indicated they had a history of intestinal parasites. Only one (<1%) refugee had a recent history of diarrhea (3 or more loose stools in any 24-hr period over the past 2 weeks). However, 54 (16%) of stools examined by laboratory personnel were noted to be loose or watery. Among the 331 refugees who provided stool specimens, 128 (38%) had 1 or more pathogenic intestinal parasites, as determined by the local laboratory (Table 4). Twenty-eight (22%) of the refugees with intestinal parasites had multiple infections. The 1 refugee who had a recent

### Table 1
Age, sex, and percent of Barawan Somali refugees with active tuberculosis, 1997

<table>
<thead>
<tr>
<th>Enhanced health assessment group* (n = 390)</th>
<th>Mandatory health assessment group† (n = 2,648)</th>
<th>( P^| )</th>
<th>Mandatory health assessment group‡ (n = 920)</th>
<th>( P^| )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age, years (range)</td>
<td>19.6 (&lt;1–70)</td>
<td>20.5 (&lt;1–80)</td>
<td>0.23</td>
<td>20.9 (&lt;1–78)</td>
</tr>
<tr>
<td>Female sex (%)</td>
<td>194 (49.7)</td>
<td>1,251 (47.3)</td>
<td>0.37</td>
<td>440 (47.8)</td>
</tr>
<tr>
<td>Tuberculosis‡ (%)</td>
<td>8 (2.0)</td>
<td>74 (2.8)</td>
<td>0.40</td>
<td>26 (2.8)</td>
</tr>
</tbody>
</table>

* During July, these refugees received both mandatory and enhanced health assessments.
† During February through June (group 1) and August through October (group 2), refugees received only mandatory health assessments.
‡ Comparison of enhanced health assessment group with mandatory health assessment groups.
§ Active tuberculosis (abnormal chest radiograph consistent with tuberculosis).

### Table 2
Number of affirmative answers about malaria symptoms and therapies among Barawan Somali refugees, 1997

<table>
<thead>
<tr>
<th>Affirmative responses</th>
<th>No. (%)</th>
<th>Total responses*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever in past 2 weeks</td>
<td>77 (20)</td>
<td>390</td>
</tr>
<tr>
<td>Received no therapy or other medication</td>
<td>23 (30)</td>
<td>77</td>
</tr>
<tr>
<td>Received antimalarial therapy</td>
<td>54 (70)</td>
<td>77</td>
</tr>
<tr>
<td>Chloroquine</td>
<td>27 (50)</td>
<td>54</td>
</tr>
<tr>
<td>Halofantrine</td>
<td>9 (17)</td>
<td>54</td>
</tr>
<tr>
<td>Quinine</td>
<td>6 (11)</td>
<td>54</td>
</tr>
<tr>
<td>Sulfadoxine-pyrimethamine</td>
<td>3 (6)</td>
<td>54</td>
</tr>
<tr>
<td>Medication not specified</td>
<td>9 (17)</td>
<td>54</td>
</tr>
</tbody>
</table>

* Presence of fever in the past 2 weeks was unknown for one respondent.

### Table 3
Number and percentage of malaria infections and prevalence ratios for parasitemia among Barawan Somali refugees, by sex and age, 1997

<table>
<thead>
<tr>
<th>Sex</th>
<th>No.*</th>
<th>Total (%)</th>
<th>PR (95% CI)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>8</td>
<td>191 (4.2)</td>
<td>1.00</td>
</tr>
<tr>
<td>Male</td>
<td>18</td>
<td>194 (9.3)</td>
<td>2.22 (0.99, 4.97)</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥15</td>
<td>10</td>
<td>225 (4.4)</td>
<td>1.00</td>
</tr>
<tr>
<td>&lt;15</td>
<td>16</td>
<td>160 (10.0)</td>
<td>2.25 (1.05, 4.83)</td>
</tr>
<tr>
<td>&lt;15 years old</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>3</td>
<td>83 (3.6)</td>
<td>1.00</td>
</tr>
<tr>
<td>Male</td>
<td>13</td>
<td>77 (16.9)</td>
<td>4.67 (1.38, 15.77)</td>
</tr>
</tbody>
</table>

* Malaria parasitemia by quantitative buffy coat (QBC®) test with thick and thin blood smear confirmation of QBC®-positive test results.
† Prevalence ratio (95% confidence interval).
Number and percentage distribution of intestinal parasite infections among Barawan Somali refugees and comparison of results of stool specimen screening performed by a local hospital laboratory and reviewed by CDC, by parasite, 1997

<table>
<thead>
<tr>
<th>Pathogens</th>
<th>Enhanced health assessment group(^a) (n = 331)</th>
<th>Local laboratory† (n = 41)</th>
<th>CDC‡ (n = 41)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. (% )</td>
<td>No. (% )</td>
<td>No. (% )</td>
</tr>
<tr>
<td><strong>Pathogens</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trichuris trichiuria</td>
<td>92 (28)</td>
<td>13 (32)</td>
<td>18 (44)</td>
</tr>
<tr>
<td>Ascaris lumbricoides</td>
<td>29 (9)</td>
<td>7 (17)</td>
<td>7 (17)</td>
</tr>
<tr>
<td>Giardia lamblia</td>
<td>25 (8)</td>
<td>5 (12)</td>
<td>7 (17)</td>
</tr>
<tr>
<td>Entamoeba histolytica/dispar</td>
<td>7 (2)</td>
<td>2 (5)</td>
<td>4 (10)</td>
</tr>
<tr>
<td>Hookworm sp.</td>
<td>3 (1)</td>
<td>1 (2)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Strongyloides stercoralis</td>
<td>3 (1)</td>
<td>1 (2)</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Hymenolepis nana</td>
<td>3 (1)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td><strong>Non-pathogens</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entamoeba coli</td>
<td>64 (19)</td>
<td>5 (12)</td>
<td>6 (15)</td>
</tr>
<tr>
<td>Blastocystis hominis</td>
<td>39 (12)</td>
<td>9 (23)</td>
<td>6 (15)</td>
</tr>
<tr>
<td>Iodamoeba buetschili</td>
<td>4 (1)</td>
<td>1 (2)</td>
<td>2 (5)</td>
</tr>
</tbody>
</table>

\(^a\) Stool specimens from enhanced health assessment group tested at a local hospital laboratory.

\(^\dagger\) A subset of the 331 specimens received quality review.

\(^\ddagger\) Quality review by the Centers for Disease Control and Prevention (CDC).

History of diarrhea was a 2-year-old boy who had *Giardia lamblia* cysts in his stool.

CDC review of stool specimens found that in 11 (27%) of 41 specimens reviewed, the local hospital did not identify pathogens that were present in sufficient numbers to detect (>1 specimen per slide). The most frequently missed pathogens were *Trichuris trichiura* and *Entamoeba histolytica/dispar* (Table 4). All of the 41 specimens reviewed by CDC were negative for *Cryptosporidium parvum* and *Cyclospora* sp.

Schistosomiasis screening results. Eighty-seven (22%) of the respondents to the initial questionnaire reported ever having had exposures to fresh surface water (i.e., living near a lake, pond, or slow-moving river). Only five (1%) reported ever having had hematuria (not due to menstruation). All stool specimens were negative for *S. mansoni* eggs. Six (6%) of the urine specimens from the 7–20-year-old age group and five (22%) of the specimens from the ≥40-year-old age group were positive for hemoglobin on urine dipstick. Among refugees who had hemoglobinuria, only 2 had *S. haematobium* eggs identified by urine microscopy (an 8-year-old boy and a 56-year-old woman). Both came from an urban environment in Somalia and reported no known history of exposures to fresh surface water.

Of the refugees tested for schistosomal antibodies, only 2 (<1%) were EITB-positive for antibodies to *S. mansoni* (a 9-year-old boy and a 22-year-old man). However, 51 (17%) refugees were EITB-positive for antibodies to *S. haematobium*. Figure 1 presents the age-specific antibody prevalence among Barawan Somali refugees. Refugees <15 years of age were less likely to have antibodies to *S. haematobium* than refugees ≥15 years of age (4/86 versus 47/217, PR = 0.21, 95% CI = 0.08–0.58).

**DISCUSSION**

The enhanced refugee health assessment strategy presented in this report examined the prevalences of malaria, intestinal parasite, and schistosomal infections among 390 (10%) of approximately 4,000 Barawan refugees resettling to the United States from camps near Mombasa, Kenya. Initial estimates of the parasitic disease burden among the refugees were based on regional prevalences among the local Kenyan population. Although the regional prevalence estimates proved useful in establishing the need for screening, the enhanced health assessment strategy demonstrated that population-specific screening helped focus pre-embarkation interventions to provide therapy for parasitic infections affecting the current population of Barawan refugees.

Malaria infections were of particular concern among the refugee population because of the severe morbidity from malaria reported in the region. A previous report demonstrated 15% prevalence of malaria parasitemia among Somali refugees resettling from Kenya and estimates of malaria incidence in Kenya were high. In 1994, Kenya reported 208 malaria infections per 1,000 residents. Malaria was also the most common diagnosis among the Barawan refugees who presented to the clinic at the refugee camp. During May 1997, 6 refugees reportedly died of complications of malaria infection.

Accurate assessment of malaria parasitemia among the refugees was complicated by the fact that individuals with febrile symptoms were often treated presumptively for ma-
Sulfadoxine-pyrimethamine remains an effective drug in therapy of refugee populations resettling to the United States in a single dose. Choice of antimalarial medication for mass pyrimethamine was chosen for malaria therapy because it is dose 1–2 days before travel (pre-embarkation). Sulfadoxine (on the sulfa component) was administered as a single oral Sulfadoxine-pyrimethamine (25 mg/kg body weight based on the patient’s preference for parenteral antimalarial therapy. Additionally, refugees commonly self-medicated with antimalarial therapy purchased without prescription from an unregistered pharmacy in the camp and from pharmacies in the surrounding communities. Chloroquine was the most frequent choice of first-line antimalarial therapy to treat fever attributed to malaria for all age groups, regardless of whether the refugee received medication from the camp clinic or if they self-medicated (CDC, unpublished data). The common use of chloroquine occurred despite reports of its diminished effectiveness in Kenya and a Ministry of Health recommendation that sulfadoxine-pyrimethamine be used for first-line treatment of uncomplicated malaria.

Among the refugees in the enhanced health assessment group, the risk of having malaria parasitemia was twice as high among children than adults, probably due to acquired immunity to malaria infection among adults. The enhanced health assessments also demonstrated that males were twice as likely to be parasitemic as were females, a difference that may have reflected sex differences in behavior during the evening hours (i.e., males tend to be outside more) or in the amount of clothing worn. During our visits to the refugee camps, we observed that women and girls often wore long dresses and headdresses that covered most of the body, while males frequently wore less clothing.

Because of the predominance of *P. falciparum* infections detected among the enhanced health assessment group and the severe morbidity from malaria in the region, and because prior treatment with chloroquine may not have effectively cleared parasitemia, CDC considered the 7% prevalence of malaria parasitemia as a conservative estimate of prevalence and sufficient to recommend mass antimalarial therapy for all resettling Barawan refugees. If untreated, 280 (7%) of the 4,000 Barawan refugees seeking resettlement may have had malaria infections at the time of arrival in the United States. Sulfadoxine-pyrimethamine (25 mg/kg body weight based on the sulfa component) was administered as a single oral dose 1–2 days before travel (pre-embarkation). Sulfadoxine-pyrimethamine was chosen for malaria therapy because it is generally well tolerated and offered ease of administration in a single dose. Choice of antimalarial medication for mass therapy of refugee populations resettling to the United States should also consider regional parasite resistance patterns. Sulfadoxine-pyrimethamine remains an effective drug in most areas in sub-Saharan Africa, though there is evidence that resistance is increasing and this should be monitored. Although only 19 of 26 parasitemic Barawans in the enhanced health assessment group were followed up after sulfadoxine-pyrimethamine treatment, the therapy appeared to adequately clear malaria parasitemia among this population of refugees. Additionally, serious reactions to sulfadoxine-pyrimethamine have rarely been reported, and they occur less frequently when the treatment is given as a single dose than when it is used for weekly chemoprophylaxis.

High prevalences of intestinal parasites among local residents of East Africa have been documented by previous studies. *Ascaris lumbricoides* (26–35%), *T. trichiura* (79–92%), and hookworm (85–93%) infections are especially common among schoolchildren in the region, and are known to contribute to malnutrition and developmental disabilities among infected children. Based on the regional prevalence of helminths and prior to the enhanced health assessments, CDC recommended mass therapy for intestinal parasites with mebendazole (100 mg twice a day for 3 days). Mebendazole therapy was provided prior to embarkation for refugees departing for the United States before July 1997. Although reports of diarrhea among refugees were low (<1%), laboratory personnel noted that 16% of refugees had loose or watery stools. In the context of Barawan culture and diet, loose stools may not be considered abnormal and therefore, diarrhea may have been under-reported. During the enhanced health assessment we determined that of those refugees who provided stool specimens, 128 (38%) had intestinal parasites. Without pre-embarkation therapy for intestinal parasites, approximately 1,500 (38%) of the 4,000 Barawan refugees seeking resettlement would have been infected at the time of arrival in the United States.

The most common infections among the enhanced health assessment group were due to *Trichuris* (28%), *Ascaris* (9%), and *Giardia* (8%), and about one-quarter of the refugees had multiple infections. CDC laboratory examination of 10% of the stool specimens indicated that the actual prevalence of intestinal parasites, and of multiple or mixed infections in particular, may have been considerably higher. Mebendazole has been reported to reduce the prevalence of a broad range of intestinal helminths, including *Ascaris*, *Trichuris*, hookworm, and *Giardia* infections and to improve the weight gain, appetite, and physical fitness of schoolchildren. As a population of mostly young adults and children living under adverse conditions, we anticipated that pre-embarkation albendazole therapy would substantially reduce parasite load and improve fitness of the Barawan refugees. Albendazole also offers the convenience of single-dose therapy. Therefore, CDC revised the pre-embarkation therapy recommendation to include mass therapy with a single dose of 600 mg albendazole for all refugees >2 years of age, with the exception of pregnant women. Pre-embarkation albendazole therapy was provided for refugees departing for the United States from July to November 1997. Presumptive administration of albendazole to immigrants at risk for intestinal helminthic infections has been shown to be cost-effective compared with no therapy (watchful waiting). However, trials are needed to determine the optimal choice of agent(s) and the duration of therapy for mass treatment of intestinal parasite infections among refugees seeking resettlement. To improve the future identification of intestinal pathogens, CDC recommended that the local laboratory incorporate a newer formalin-ethyl acetate concentration procedure and permanent staining of slides.

A surprising finding of the enhanced health assessment was that the overall prevalence of schistosomal infections was much lower than expected. Schistosomal infections cause substantial morbidity in endemic populations in East
Africa. Previous studies have demonstrated high prevalences of *S. haematobium* among local residents of Somalia (25–89%) and Kenya (30–60%). Additionally, schistosomal infections may pose a significant health threat to short-term sojourners in endemic areas; immuno-naive populations with light schistosome infections can develop severe neurologic sequelae.

Among the enhanced health assessment group who were tested, low levels of hematuria and schistosomal eggs in urine (or stool) likely indicate that the prevalences of active and high-intensity schistosomiasis infections were low. Additionally, only 51 (17%) of 305 refugees screened had antibodies to *S. haematobium*, and the prevalence of antibodies varied significantly by age. Of those tested, none of the refugees born in Kenya (<6 years of age) had antibodies to *S. haematobium*. Adequate camp hygiene, including a piped water supply, and minimal exposures to freshwater sources likely account for the low prevalence of *S. haematobium* infections among children. Infections with *S. haematobium* among adults were probably acquired in Somalia, before migration to Kenya. Since the average lifespan of adult *S. haematobium* worms is 3 years, low prevalence of *S. haematobium* eggs and low seropositivity among recent camp residents suggest that very few refugees were harboring adult worms. Consequently, the value of mass therapy with praziquantel in this population would have been limited. Use of praziquantel to prevent future sequelae among asymptomatic seropositive refugees, as is currently recommended for immuno-naive travelers to endemic areas who seroconvert following exposure, deserves further study.

One of the major strengths of the enhanced health assessment is rapid on-site appraisal of the need for overseas intervention(s) for diseases of public health significance based on the prevalence among a specific population of refugees. However, the approach does have some limitations. First, we were unable to randomly select enhanced health assessment participants because refugees were scheduled for health assessments following immigration interviews. However, we did find that the enhanced health assessment group was similar to the overall population of refugees seeking resettlement with respect to age, sex, and percentage of refugees with tuberculosis (a measure of general health status). Additionally, the way the refugees were scheduled for health assessments was unrelated to risk factors for being parasite-positive. Second, the enhanced health assessment strategy assumed that the point prevalence detected during the screening examination reflected the actual prevalence of infection at the time of migration, often several months later. This assumption does not take into account potential seasonal variation, which may be especially important with diseases such as malaria. However, in the case of this enhanced health assessment, screening was conducted during the rainy season, when peak malaria transmission would be expected. Finally, refugees may have perceived that participation in the enhanced health assessment would affect their immigration status. Although the refugees were informed that participation was voluntary, the enhanced health assessment was performed under potentially stressful circumstances common during the mandatory health assessments required for immigration purposes. We attempted to minimize these potential biases by conducting group question-and-answer sessions during the enhanced screening and by administering the follow-up questionnaire after the medical examination was completed and under more relaxed conditions at the camp community center.

Despite these limitations, enhanced health assessments performed before the refugees resettled likely reduced morbidity among the refugees and diminished introduction of parasitic infections into the United States, thereby protecting the health of the resettlement communities and reducing the impact of these infections on the local health-care system. Because many parasitic infections such as malaria are not endemic in North America, health centers may not be proficient in the diagnosis and treatment of these infections. Additionally, large numbers of untreated malaria infections may adversely impact the health-care system, as was demonstrated during a recent outbreak of malaria among refugees detected after resettlement to the United States. Because the enhanced health assessment group received screening tests before migration, we were able to provide interventions for the entire population of refugees while they were grouped together in one central area and before they resettled to more than 35 states. Since the number of refugees resettling from sub-Saharan Africa is expected to increase in the future (12,000 expected to settle in the United States during 1999), we strongly recommend providing enhanced health assessments for a subgroup of refugees to evaluate the need for mass pre-embarkation therapy for parasitic infections.

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