An Outbreak of Measles in Tanzanian Refugee Camps

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From March 2000 to May 2001, four camps in Kibondo District, Tanzania, hosting refugees from Burundi reported 1062 cases of measles, a highly infectious and potentially lethal disease. Of 1062 case-patients, 225 (21%) were <9 months old, 286 (27%) were 9 months to 5 years, 324 (31%) were 6–15 years, and 227 (21%) were ≥16 years old. No deaths were reported. Although, in accordance with Sphere Project guidelines for humanitarian emergencies, camp policy was to vaccinate all new arrivals aged 6 months to 15 years against measles, 152 (72%) of 210 newly arrived refugees in this age group were unvaccinated; 143 (94%) of the 152 had lived in the camp ≥1 month before rash onset. This investigation supports Sphere Project recommendations for wide age group vaccination and suggests that in some circumstances vaccination of refugees ≥15 years old may be beneficial.

Measles, a highly infectious and potentially lethal disease, is particularly deadly in refugee emergencies. Population movement and density facilitate measles transmission and poor nutritional status, also common in these settings, has been associated with increased risk of death [1]. In Tanzania, the World Health Organization (WHO) estimates the measles-specific case-fatality ratio (CFR) to be 2% [2], but CFRs as high as 33% have been reported in humanitarian emergencies [3].

The importance of measles prevention in emergency settings was highlighted by a landmark publication by Toole et al. [4] that set out guidelines for vaccination and disease control. Guidelines for disaster response formulated by the Sphere Project’s Minimum Standards in Disaster Response now recognize measles vaccination of children aged 6 months to 12 years as one of the highest priorities in the acute phase of humanitarian emergencies and advise systematic vaccination of all newcomers in this age range to displaced settlements. The upper age limit may be increased to ≥15 years if there is evidence of high susceptibility to measles in this age group. Because of the increased likelihood of primary vaccine failure in young infants [5], those vaccinated before age 9 months should be revaccinated at 9 months. Sphere Project guidelines also recommend that target age group coverage exceed 95% [6].

Kibondo, a border district in Tanzania, has camps that by late 2001 hosted 170,500 refugees from civil unrest in Burundi. Despite control measures and after 5 measles-free years, between March 2000 and May 2001 four of these camps (Nduta, Karago, Mtendeli, and Kanembwa) reported 1124 measles cases, 1062 in camp residents. Here we report on the investigation into this outbreak and its implications for measles control in refugee settings.

BACKGROUND

The camps of Nduta, Mtendeli, and Kanembwa were established in the mid-1990s; in early 2000 Nduta again welcomed new refugees. In December 1999 Karago was established and refugees began arriving in mid-2000.
Newcomers to these four camps initially present to the camp’s reception center where they are screened by the Tanzanian Ministry of Home Affairs and the United Nations High Commission for Refugees (UNHCR) prior to being registered as refugees. After registration, all children aged 6 months to 15 years receive measles vaccine, regardless of vaccination or disease status; children without country-of-origin vaccination records are issued immunization cards. Screening and registration may take up to 2 weeks and during this time the newcomers often leave the reception center and move within the camp. Some refugees do not register in camps but stay with relatives in nearby border communities. Camp residents may visit neighboring villages or other camps. Each camp has a central health facility that is used by residents of the camp and surrounding villages. Vitamin A supplementation is given every 6 months to children aged 6 to 59 months but is not given at the time of initial immunization. Children born in camps receive measles vaccine at age 9 months.

In 2000, Mtendeli, Nduta, and Karago (data for Kanembwa are unavailable) reported measles vaccine coverage in the 9 month to 5 year age group exceeding 95% based on administrative data (unpublished data; International Rescue Committee [IRC], annual health camp report, 2000). However, a July 2000 nutritional survey of children aged <5 years, which included verification of vaccination status, showed that in Nduta 24% of those vaccinated against measles had received their sole vaccination before the recommended age of 9 months (unpublished data; IRC, annual health camp report, 2000); administrative data included these children as vaccinated.

On 5 March 2000, a case of illness meeting the WHO clinical case definition for measles [7] (fever, rash, and cough, coryza, or conjunctivitis) presented to the Nduta health facility; this case-patient was not a camp resident. Three days later, a similar case in a non-camp resident was reported from Karago’s health center. On 8 April the first case of measles-like illness was reported in a Nduta camp resident, a person who had arrived in the camp 6 days earlier.

**METHODS**

**Surveillance.** In March 2000, a facility-based outbreak line list was established in all camps. A case-patient was defined as any person presenting to the health facility meeting the WHO clinical case definition for measles. Information collected included case-patient name, place of residence, age, sex, date first seen at the health facility, vaccination status, and outcome of illness (i.e., death). Vaccination status was determined by history and review of the immunization card. Case-patients were considered to be vaccinated if this was recorded on the immunization card and had occurred at age ≥9 months; case-patients who claimed without supporting documents to be vaccinated were considered to have unknown vaccination status; all other persons were considered to be unvaccinated. In Karago, information was also collected on refugees’ date of arrival in camp, defined as the date of presentation to the reception center.

Facility-based surveillance was supplemented by house-to-house active case finding and follow-up conducted within refugee camps by community-based health workers. This active surveillance system reported routinely on five diseases of epidemic potential. From March 2000 until the end of the outbreak, all persons with rash and fever identified by community-based health workers were referred to health facilities for evaluation and admission. Case-patients were supplemented with vitamin A and treated according to Integrated Management of Childhood Illness (IMCI) [8] guidelines. In addition, each camp had two surveillance focal persons who routinely reviewed health facility registers for cases of eight infectious diseases (including measles) and received surveillance reports from community-based health workers. During this outbreak, the surveillance focal persons compiled an independent line-list of clinically defined measles cases that included the same variables as the facility-based line-list. These two lists were compared and reconciled.

**Laboratory confirmation.** The first 15 clinically confirmed measles cases presenting to Nduta health facility had blood specimens collected for laboratory confirmation: 5 mL of whole blood was collected and centrifuged at 1000 g for 10 min to separate serum. Serum was stored at 4–8°C and transported to Muhimbili National Referral Laboratory within 3 days of collection for ELISA testing (Enzygnost; Behring) for measles IgM.

**Data analysis.** Data were entered and analyzed by Epi Info 6 [9] software. The statistical difference in distribution of age between groups was calculated by the χ² test.

**RESULTS**

From March 2000 to May 2001, 1124 clinically confirmed cases of measles were reported from the health facilities at Nduta, Karago, Mtendeli, and Kanembwa camps. Of these, the first 15 case-patients (all with serologic samples taken) tested positive for measles IgM. Of the 1124 cases, 1062 (94%) were in camp residents. Therefore, the rest of this analysis will focus on the camp case-patients. Karago reported 739 (69%) of the 1062 cases, Nduta 220 (21%), Mtendeli 93 (9%), and Kanembwa 10 (1%). Nduta initially showed the highest monthly measles incidence (0.98/1000 in May 2000) but was surpassed by Karago (see figure 1). In response to the outbreak, campaigns targeting children not previously vaccinated who were aged 6 months to
5 years were held in Nduta 17–19 April 2000, in Karago 5–7 June 2000, and in Mtendeli 13–15 August 2000.

Ages of the cases were as follows: 225 (21%) were <9 months; 286 (27%) were 9 months to 5 years; 324 (31%) were 6–15 years; and 227 (21%) were >15 years (table 1 lists the camp-specific age distributions). Detailed data on case-patients >15 years were only available for Karago residents; 65% of the 147 in this category were 16–20 years and 29% were 21–25 years.

During this period, Burundi reported a large outbreak in which 18% of case-patients were <1 year old and 13% were ≥15 years (unpublished data; WHO, East African Regional Conference for Expanded Programmes on Implementation, Entebbe, Uganda, October 2001). The percentage of all cases represented by each age group differed significantly (P < .05) between Burundi and Karago.

Vaccination status of refugee case-patients varied by age group (figure 2). Among those aged 9 months to 15 years, 82% (234/286) of those aged 9 months to 5 years were vaccinated, whereas only 27% (87/324) of those aged 6–15 years were known to be vaccinated. Because of the guidelines used to determine vaccination status in this investigation, children <9 months old were considered unvaccinated.

Information on time since arrival in camp was available for 710 of 739 Karago case-patients. Of these, 706 (99%) case-patients had arrived <1 year before rash onset; 637 (90%) had arrived <1 month before rash onset. Vaccination status of cases varied by group and time since arrival in camp. In general, the percentage of vaccinated case-patients aged 9 months to 15 years decreased as time in camp increased. However, regardless of time in camp, most case-patients aged 9 months to 5 years were vaccinated, whereas most case-patients aged 6–15 years were not (figure 3). Of the cases, 32 occurred in persons staying at the reception center while awaiting registration. Despite the large number of measles cases, of which 225 were in infants <9 months old, no associated deaths were reported.

**DISCUSSION**

This outbreak was the extension of an epidemic in Burundi that began in November 1999 and eventually resulted in more than 27,000 reported cases (unpublished data; WHO, East African Regional Conference for Expanded Programmes on Implementation, Entebbe, Uganda, October 2001). In September 1999, the contiguous Tanzanian district of Kibondo had a supplemental measles immunization program that targeted children aged 9–59 months and achieved coverage of 92% (unpublished data; Kibondo District Medical Office, 1999 Measles Mass Campaign and Subnational Immunization Days report); in 2000, the district reported 82% coverage of measles vaccine delivered through routine health services (unpublished data; Kibondo District Medical Office annual report, 2000). This strategy offered relative protection to Kibondo: Between March and December 2000 only 579 cases (excluding those in refugee camps) were reported in a population of 279,455 (unpublished data; Kibondo District Medical Office annual report, 2000). Only 2 cases were reported from this district in 2001 (unpublished data; Kibondo District Medical Office annual report, 2001).

The refugee camp epidemic was primarily due to inadequate immunization of new arrivals rather than to spread of virus in poorly vaccinated settled refugees. Of the cases, 69% were from Karago and virtually all had arrived from Burundi in the preceding 12 months. Some 21% of all cases were from Nduta, the only other camp designated to receive new visitors. Only 10% of cases were from the settled camps of Mtendeli and Kanembwa.

Although the age group 9 months to 5 years appears to have

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**Figure 1.** Monthly measles incidence in four Kibondo, Tanzania, refugee camps, February 2000–May 2001.

**Table 1.** Age distribution of measles cases, Kibondo refugee camps, Tanzania, March 2000–May 2001 (n = 1062).

<table>
<thead>
<tr>
<th>Camp</th>
<th>&lt;9 months</th>
<th>9 months–5 years</th>
<th>6–15 years</th>
<th>&gt;15 years</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kanembwa</td>
<td>3 (30)</td>
<td>3 (30)</td>
<td>1 (10)</td>
<td>3 (30)</td>
<td>10 (1)</td>
</tr>
<tr>
<td>Karago</td>
<td>161 (22)</td>
<td>215 (29)</td>
<td>216 (29)</td>
<td>147 (20)</td>
<td>739 (69)</td>
</tr>
<tr>
<td>Mtendeli</td>
<td>24 (26)</td>
<td>22 (24)</td>
<td>26 (28)</td>
<td>21 (23)</td>
<td>93 (9)</td>
</tr>
<tr>
<td>Nduta</td>
<td>37 (17)</td>
<td>46 (21)</td>
<td>81 (37)</td>
<td>56 (25)</td>
<td>220 (21)</td>
</tr>
<tr>
<td>Total</td>
<td>225 (21)</td>
<td>286 (27)</td>
<td>324 (31)</td>
<td>227 (21)</td>
<td>1062 (100)</td>
</tr>
</tbody>
</table>
had very high vaccination coverage, coverage was lower in children 6–15 years old. This discrepancy may be due at least in part to the vaccination campaigns in Nduta, Karago, and Mtendeli, which targeted the lower age group. Assuming vaccine efficacy of 90% in both groups, the percentage of vaccinated cases indicates coverage exceeding 95% in the younger group but near 80% in the older group [10], below coverage targets recommended in Sphere Project guidelines. In Karago, refugees in these age groups should have been vaccinated upon arrival, but many remained unvaccinated and developed measles months after becoming camp residents. Campaigns seeking to increase vaccination coverage in children aged 6 months to 5 years may have decreased the total number of measles cases and helped to prevent deaths. However, in order to halt transmission, campaigns targeting a wider age group may have been more effective.

At present, in contrast to Sphere Project guidelines, the WHO only recommends vaccinating children aged 9 months to 5 years in refugee settings [11]. In Karago, 49% of measles cases were in persons ≥6 years old, suggesting that implementation of WHO recommendations would have left many persons in the camp susceptible to measles. Many African countries now report ≥30% of all measles cases in those ≥5 years old (unpublished data; 2001 Task Force on Immunization, Addis Ababa, December 2001). Some 20% of Karago case-patients were ≥15 years old. These persons were born about 1985, the year Burundi introduced measles vaccine (unpublished data; WHO, East African Regional Conference for Expanded Programmes on Implementation, Entebbe, Uganda, October 2001) and may have been protected from infection by their position between an older group with disease-derived immunity and a younger, vaccinated population.

In all, 22% of cases were <9 months old. Vaccination at 6 months of age offers some protection from infection until revaccination at 9 months; however, protection for infants can best be offered by reducing virus circulation through community immunity. Lack of 9-month revaccination as occurred in Nduta permits infants with primary vaccine failure at 6 months to remain susceptible to measles infection. Susceptibility to measles persisted in newly arriving refugees for several reasons: primary vaccine failures in those aged 9 months to 4 years, lack of vaccination in those aged 5–14 years, and lack of inclusion in the target population of those ≥15 years old. Although most cases in Karago were recent arrivals from Burundi, the age distribution of Burundi’s cases was significantly different from those in Karago. This difference may reflect the impact of the camp’s vaccination policy or the greater mobility of those young enough to be carried or old enough to travel independently and demonstrates that distribution of susceptible persons, even in newly arrived refugees, may differ from that of the populations of origin.

This epidemic was remarkable for its lack of reported measles-associated deaths despite rigorous community-based surveillance. Early case detection, vitamin A supplementation, and use of IMCI guidelines may all have contributed to this success.

CONCLUSIONS AND RECOMMENDATIONS

This outbreak occurred primarily in refugees who had recently fled Burundi, the site of a large measles epidemic. Although Sphere Project guidelines for measles vaccination in emergencies were followed in Tanzanian camps, more stringent implementation of guidelines is necessary to prevent outbreaks. WHO guidelines for refugees should be reviewed in light of changing measles epidemiology. In some emergency settings, achieving population immunity adequate to prevent virus transmission may require vaccinating persons older than 15 years. When possible, selection of target age groups for vaccination should consider measles epidemiology in source and
refugee populations. Children vaccinated when <9 months old must be revaccinated at age 9 months.

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References