

# Measles prevention and control in emergency settings\*

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*Outbreaks of measles continue to be a common occurrence among refugee and famine-affected children in emergency relief camps. Extremely high measles-associated mortality rates have been reported from refugee camps—where undernutrition is common—in several countries over the past 10 years. Mortality from measles is, however, preventable, and immunization against the disease is a high priority in emergency relief programmes, second only in importance to the provision of adequate food rations. All children aged 6 months to 5 years should be immunized with measles vaccine as soon as they enter an organized camp or settlement. Should supplies of measles vaccine be inadequate, children in feeding centres, or those otherwise identified as undernourished, are the top priority for immunization.*

*The occurrence of measles in a camp is not a contraindication to conducting an immunization campaign. Strong coordination by a designated lead agency is needed if such campaigns are to be successful; however, cooperation with the local expanded programme on immunization is essential to ensure that existing cold chain equipment, training protocols, and management manuals are used. If additional equipment is necessary, a complete immunization kit developed by the Office of the United Nations High Commissioner for Refugees, the World Health Organization, and Oxfam can be procured from Oxfam headquarters in the United Kingdom. Vitamin A supplements should be given routinely at the time of measles immunization in situations where malnutrition is severe. Mortality and morbidity in children with clinical measles can be reduced by administering high doses of vitamin A.*

## Background

Measles is a severe, highly infectious disease; in developing countries it is primarily a disease of children aged less than 5 years. In unimmunized populations, most children will have acquired measles by 5 years of age, and almost all infections will result in a well-recognized clinical illness (1). Newborn infants are protected from measles infection by maternal antibodies, but in developing countries this protection is often rapidly lost, and clinical measles is seen in children aged as young as 5–6 months (2).

In developing countries, measles-associated death—predominantly from respiratory, gastrointestinal, nutritional, and neurological complications—is common. In stable populations the case fatality rates range from 1% to 21% (1, 3–7) during

the acute phase of the illness. Early age of infection is associated with the risk of serious complications (8). Although the relationship between measles and undernutrition has not yet been fully clarified, it has been suggested that severe measles with high mortality rates is more common in populations where the prevalence of undernutrition among children is high (9). Also, in one study the risk of death from measles in undernourished children was reported to be more than twice that of well-nourished children (10). Other community studies suggest that overcrowding, rather than undernutrition, may be more strongly associated both with increased risk of measles infection at an early age and with greater severity of the disease (11). Furthermore, measles has been strongly associated with post-illness undernutrition and subsequent nutritional complications, including death (12). In addition to protein–energy undernutrition, measles rapidly depletes the stores of vitamin A in young children, leading to sequelae such as xerophthalmia (eye signs of vitamin A deficiency) and blindness (13).

Emergency relief operations involving displaced famine victims or refugees are characterized by large populations in overcrowded settings, where serious problems of acute and chronic undernutrition prevail, particularly among children under 5 years of age (14). Under such circumstances, immunization programmes have sometimes been implemented too

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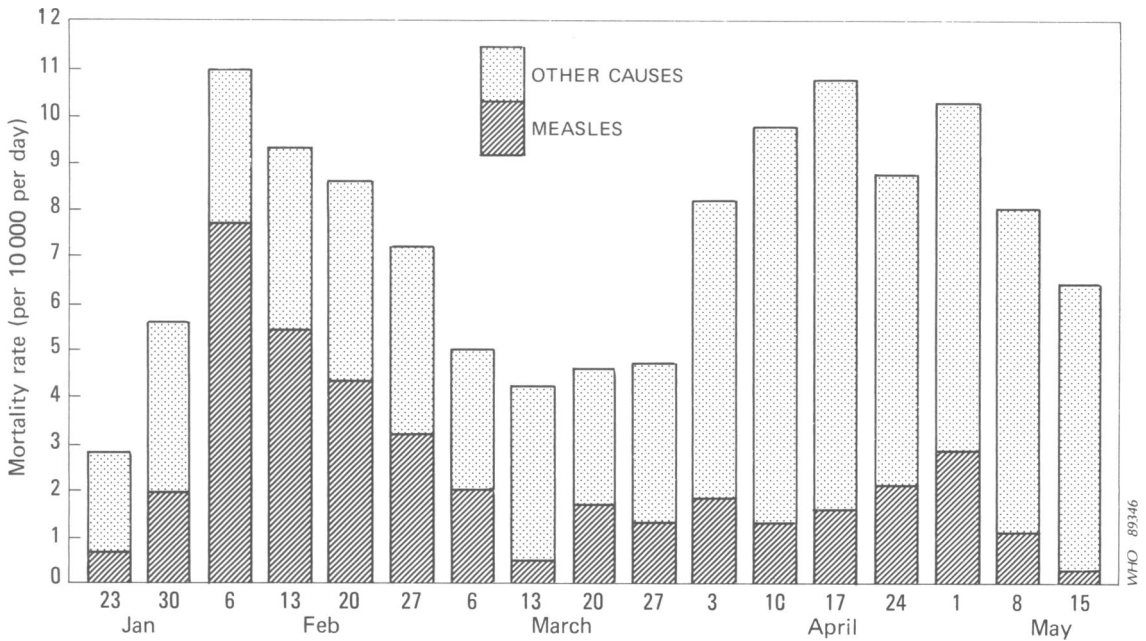
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Fig. 1. Average mortality rates (all ages) for measles and other causes, by 7-day period, Wad Kowli camp, Sudan, 23 January–14 May 1985.



slowly or not at all; thus, preventable outbreaks of measles have commonly occurred in refugee camps (15–17). Case fatality rates for measles as high as 33% have been reported in refugee camps in the eastern Sudan (18), and measles has been reported to be the leading cause of mortality in children under 5 years of age during the initial phase of several emergencies, each involving hundreds of thousands of refugees (15). The measles-specific mortality rates from the end of January to mid-May 1985 in Wad Kowli camp in eastern Sudan are shown in Fig. 1 and represent an estimated total of 2000 deaths.

## Emergency control programmes

Measles control programmes in emergency settings have two major components: measles prevention, through routine immunization, and measles outbreak control. If preventive measures are established early enough and conducted efficiently, outbreaks will not occur.

### Immunization programme management

A measles immunization programme should be an early priority of emergency relief programmes, and trained personnel, vaccine, cold chain equipment,

and other supplies, e.g., needles, syringes, and record cards, should be available as soon as at-risk persons begin to gather at a camp. Strong support and coordination is required from the agency assigned overall responsibility for this aspect of the relief operation; also, responsibilities for each component of the immunization programme need to be explicitly assigned to agencies and individuals, both at the national and local levels.

The national expanded programme on immunization (EPI) in the country where the emergency has taken place should be involved from the outset. Measles vaccine may initially be provided by the national EPI and be replaced later by the lead relief agency, which, in refugee situations, is usually the Office of the United Nations High Commissioner for Refugees (UNHCR).

In camps where accurate population figures do not exist, a pre-immunization count should be conducted to estimate the number of children eligible to receive the vaccine; however, it must be carried out quickly and should not be allowed to delay the commencement of the programme. Such a count facilitates both the planning and evaluation of the programme, and is often a useful time to promote the idea of immunization in the community; however, reassurances should be given that the children are not being counted for political purposes.

**Personnel.** All emergency health personnel, regardless of their qualifications or experience, can be trained to participate in measles immunization programmes. For this purpose, basic training manuals—appropriate for use at every level of the immunization management chain—are available from the national EPI or WHO. Involvement of community leaders is essential in order to achieve maximum cooperation and motivation among the population. Also, community health workers recruited from within the camp or settlement can be invaluable in educating and mobilizing the population for an immunization campaign. Health workers (including expatriates) should receive measles vaccine if they are unsure of their immunization status.

**Measles vaccine.** Measles vaccine produces a mild, noncommunicable form of the disease, and, for use in emergency situations in developing countries, single-antigen measles vaccine is recommended. In controlled field settings in developing countries, vaccine efficacy is over 85% for children aged 9 months and approaches 95% among those aged 12 months (19); protection is long-lasting and there is no need for a booster dose (20).

**Vaccine storage and transport.** Stabilizers that are present in measles vaccine make it more resistant to inactivation by heat; however, it is recommended that all measles vaccine should be stored at 0–8°C or colder, prior to reconstitution. Freezing at –20°C is recommended for long-term storage, but the diluent should not be frozen to prevent the ampoule from breaking. The dried vaccine is reconstituted by mixing it with cold diluent just prior to administration, and dissolved vaccine can be used for up to 3 hours, provided it is stored cold, for example on an ice-pack. The vaccine must be protected from direct sunlight, both before and after reconstitution, to avoid inactivation.

WHO recommends that measles vaccine be transported on ice at temperatures of 0–8°C. Equipment and procedures necessary to maintain this temperature range have been described by the WHO Expanded Programme on Immunization.<sup>a</sup> During an emergency relief operation, provision should be made with the appropriate authorities for use of the national vaccine storage facilities. If camps or emergency settlements are located in regions that lack cold chain stores, such facilities will have to be installed. Emergency immunization kits, including cold chain equipment, have been assembled by

WHO, UNHCR, and Oxfam and are available at short notice.<sup>b</sup>

Ideally, each camp should have a vaccine storage facility that includes an ice-lining refrigerator/freezer powered by bottled gas or electricity (with a back-up generator); in most situations, however, this is not feasible. In an area where several camps are within relatively easy driving distance of a central location, a regional cold store should be established. Should this be the case, each camp can store vaccines in a 7-day cold box with weekly replacement of icepacks, with temperatures being monitored daily using a cold chain monitor card (time–temperature card).

It is preferable not to rely on kerosene refrigerators for storage of vaccines because it is often difficult to obtain pure kerosene and very difficult to maintain the minimum temperatures required, especially in hot desert climates.

**Target population.** WHO currently recommends that in developing countries measles vaccine be administered to children as soon as possible after the age of 9 months (21).<sup>c</sup> Data from some high-density populations in Africa, however, indicate that a substantial proportion of measles cases occur among children aged less than 9 months (22, 23). During epidemics, measles appears to attack younger infants, and mortality rates among those aged less than 9 months are particularly high (2). In emergency situations when the risk of both epidemics and high case fatality rates is high, routine immunization of children aged 6–9 months against measles is advisable. However, since some infants do not respond to the vaccine because of interference by maternal antibodies, infants aged less than 9 months at first vaccination should be revaccinated as soon after 9 months of age as possible—or 1 month after this, if the child was 8 months old at first vaccination. Most infants less than 6 months of age will be protected by maternal antibodies.

In late 1988, field trials of the Edmonston–Zagreb strain of measles vaccine were undertaken in several countries to determine its clinical efficacy and optimal dose. Initial results indicate that this strain may prove to be effective in most infants even when given as early as 4–6 months, despite the presence of maternal antibodies (24).

The groups shown below, in order of priority, should be immunized against measles in an emergency setting. The decision on how many groups to immunize should be based on vaccine availability,

<sup>b</sup> Requests should be made to: Oxfam, 274 Banbury Road, Oxford, England.

<sup>c</sup> Expanded Programme on Immunization. *Immunization policy*. Unpublished document WHO/EPI/GEN/86/7.

<sup>a</sup> See, for example: *Manage the cold chain system*. Unpublished WHO document EPI/MLM/CC/Rev. 2.

the age groups at risk of measles, and the prevalence of undernutrition:

- undernourished or sick children aged 6 months to 12 years, in feeding centres and inpatient wards;
- all other children aged 6–23 months; and
- all other children aged 24–59 months.

If the exact age of the infant is uncertain, it is advisable in any case to immunize with measles vaccine.

Based on the analysis of recent experience during outbreaks in Ethiopia (25), and in refugee camps in Thailand (17) and eastern Sudan,<sup>d</sup> older children, adolescents, and adults may also need to be immunized if these age groups are affected during an outbreak. Because of the high probability of death from measles in young children, all children in high-risk groups should be immunized against the disease.

**Vaccine administration, side-effects, and precautions.**

These aspects of measles immunization have been adequately described elsewhere (20), and only issues specific to the refugee situations are mentioned here. A sterile needle and syringe should be used for each injection (UNHCR, UNICEF, and WHO all recommend the use of non-disposable equipment). Although steam sterilization between each use is recommended, should steam sterilizers not be available, it is sufficient to boil needles and syringes for 20 minutes, after appropriate cleaning. If no other method is possible, jet injectors can be used to immunize large numbers of children in emergency camps.<sup>e</sup> Where possible, 50-dose vials of vaccine should be used, particularly when jet injectors are employed. To date, the transmission of a viral disease by jet injector has been reported only once, and this involved a model of injector that is not in general use outside the USA (26).

Fever, respiratory-tract infection, diarrhoea, and undernutrition—all common in refugee camps—are not contraindications to measles immunization. Because measles is so severe in undernourished children, this condition should be considered a strong indication for immunization. Also, immunization of hospitalized children is safe, effective, and extremely important because of the threat of nosocomial infection with the disease (27, 28). Measles immunization does not adversely affect the course of the child's illness in hospitals, but does effectively reduce the risk of cross-infection (27). In terms of its potential to transmit measles, a camp feeding centre is equivalent to a paediatric ward; immediate immu-

nization of children attending such centres is therefore essential. It is safe to immunize children who either may previously have received measles vaccine or may have had clinical measles infection. Acquired immunodeficiency syndrome (AIDS) and tuberculosis are not contraindications to measles immunization, as described below.

● **AIDS.** Movements of refugees from or into countries where the prevalence of human immunodeficiency virus (HIV) is high may not be unusual in the future. Unimmunized individuals who are infected with HIV (whether symptomatic or not) should receive measles vaccine (29, 30), although it may not be as effective as that administered to uninfected children. There is no evidence of increased adverse effects of immunization among such children; on the other hand, measles is a severe illness in children with AIDS (30) and they should be protected.

● **Tuberculosis.** Tuberculosis may be exacerbated by natural measles infection; however, there is no evidence that live measles vaccine has such an effect. It is therefore not necessary to perform tuberculin skin testing before measles immunization (20).

**Timing of immunization.** Ideally, eligible children should be immunized as they arrive in refugee camps as part of a screening process. In most cases, however, measles immunization programmes are implemented when the affected persons have already been settled in a camp. Because of the high risk of measles infection, immunization should be carried out as soon as the vaccine, equipment, and personnel are available and should not be delayed pending the arrival of other vaccines, e.g., diphtheria-pertussis-tetanus (DPT), poliomyelitis, BCG, and meningitis. Should these vaccines be available and indicated, they can be administered simultaneously with measles vaccine. In contrast, if measles vaccine is given alone, the other vaccines should be given as soon as they are available, according to the standard EPI schedule (BCG and poliomyelitis at birth or first contact, and DPT and poliomyelitis at 6, 10, and 14 weeks of age).

Once the population has been adequately covered in an initial mass measles immunization campaign, an ongoing immunization programme should aim at immunizing new arrivals in the camp and infants aged 6 months or older who have not previously been immunized, as well as revaccinating children who were less than 9 months of age when they first received the vaccine. Ongoing immunization can be carried out at a fixed facility (such as a maternal and child health clinic) on a daily or weekly basis if there are adequate vaccine storage facilities in the camp. Immunization should not be refused on the grounds of avoiding wastage, since

<sup>d</sup> Murphy, R. Report on measles outbreak in Wad Kowli camp, eastern Sudan, January–April 1985. International Rescue Committee, Gedaref, May 1985.

<sup>e</sup> See footnote c, p. 383.

opening a 10-dose vial of measles vaccine to immunize only one child is still cost-effective. If vaccine stores are remote from the camp and its population is stable in size, it is best to organize regular "immunization days" at convenient intervals, e.g., every month, when measles vaccine may be given together with other EPI antigens. If, however, there is a continual influx of large numbers of new arrivals, daily immunization sessions are recommended. After the initial emergency phase, a register of children who are eligible for immunization can be organized and updated by trained community health workers.

**Immunization records.** A permanent record of a child's immunization status should be made both on a card retained by the family and at a central register. "Road-to-health" cards, which are commonly available during relief programmes, can be used for this purpose and ideally should be issued with a protective plastic cover. Other, smaller record cards are usually also available from the national EPI office or Ministry of Health.

**Surveillance.** An aggressive surveillance system to detect cases of measles should be set up irrespective of whether all the children are believed to have been immunized. All suspected cases of measles should be investigated immediately by an individual familiar with diagnosing the disease, and immediate action (as described under *Outbreak control*, see below) should be taken locally. All confirmed cases should be reported immediately along the "surveillance chain", i.e., from the camp medical officer, to the regional health coordinator, to the national coordinating agency. It is particularly important to screen newcomers to a relief camp or centre for evidence of clinical measles, bearing in mind that measles immunization is an essential part of the screening process. Health workers at every level need to be trained in the recognition of clinical measles.

Measles immunization coverage should also be monitored in camps by maintaining registers of all newborn and newly arrived children aged less than 6 months. Such registers should be checked regularly to ensure that children who reach the age of risk for measles infection (>6 months) are all promptly immunized. Also, the coordinating agency should periodically conduct immunization coverage surveys under the supervision of persons experienced in the appropriate sampling techniques. Reports from some developing countries (22) indicate that immunization coverage rates as high as 70% may not be sufficient to prevent transmission of measles; careful surveillance, therefore, is required to ensure that the highest coverage possible is attained. The number of persons routinely immunized against measles should

be reported to the main coordinating agency on a monthly basis.

### **Outbreak control**

Outbreaks of measles represent a major failure in the health care system. In the event of such an outbreak, the main control strategy is to immunize the population at risk with live measles vaccine as quickly as possible to prevent further transmission.

The presence of several cases of measles in an emergency settlement does not contraindicate a measles immunization campaign. Even among individuals who have already been exposed and are incubating the natural virus, measles vaccine, if given within 3 days of infection, may provide protection or modify the clinical severity of the illness (20). Furthermore, transmission of the disease is not usually rapid enough to infect all susceptibles before vaccine can be administered. Nevertheless, during an outbreak, it is inevitable that some immunized children will develop clinical measles, having been incubating the virus at the time of immunization. Thus, it is important to warn the community of such outcomes in order that the campaign does not lose credibility. If there is insufficient vaccine for all susceptibles, immunization should be targeted at those areas, such as feeding centres and hospital wards, where transmission is facilitated by close contact, and where the population is most likely to suffer complications.

Isolation of patients with measles from the rest of the population is not indicated in an emergency camp setting, where prompt immunization of all children at risk is the first priority. Also, withdrawal of children with clinical measles from feeding programmes is not advised, since such children are most in need of nutritional supplements. Instead, all children should be properly immunized in this and other settings.

Children with measles complications should be given standard treatment, e.g., oral rehydration therapy for diarrhoea, and antibacterials such as penicillin or co-trimoxazole for possible superinfection manifesting as pneumonia and middle-ear infections. Increased intake of oral fluids and continued feeding should be routine in all cases of measles.

All children who develop clinical measles in refugee camps should be enrolled in a feeding programme and their nutritional status carefully monitored.

### **Vitamin A and measles**

The link between measles and vitamin A deficiency is complex, but in camps it can be expected that many children who develop measles will also exhibit signs of vitamin A deficiency, especially xerophthalmia. A

high dose of vitamin A will nevertheless protect a young child for a variable period, at least 3 months and probably 6 months, against such serious consequences of deficiency, even if their diet remains very inadequate. Whenever possible, relief provisions should be fortified with vitamin A and use made of local vitamin-A-rich foods.

Should they not have received vitamin A during the previous month, all children diagnosed as having clinical measles should be administered 200 000 IU of vitamin A orally—those aged less than 12 months should receive 100 000 IU (31, 32). This should be repeated every 3 months. If any eye signs of vitamin A deficiency are observed (xerosis, Bitot's spots, keratomalacia, or corneal ulceration) the following full treatment schedule should be given: 200 000 IU of vitamin A on the first day, 200 000 IU the next day, and a further 200 000 IU 1–4 weeks later (infants <1 year of age should receive half these doses) (31).

Since use of vitamin A supplements is advised during food shortages, these could also be routinely distributed at the same time as measles vaccine is given to children in refugee camps.

## Conclusions

The major conclusions drawn from the results of the study are summarized below.

- Measles infection has traditionally been, and continues to be, one of the major causes of mortality among famine-affected or refugee children in relief camps. The risk of mortality is particularly high when there is undernutrition and severe overcrowding. Undernourished children are most at risk of measles mortality. However, measles-related mortality is preventable.
- Measles immunization has a high priority in an emergency relief programme. All children aged 6 months to 5 years should be immunized with measles vaccine at the time they enter an organized camp or settlement. Children vaccinated prior to 9 months of age should be revaccinated as soon as possible after 9 months.
- A measles immunization programme in emergency relief camps needs to be coordinated by a lead agency and to cooperate with the national EPI office, and should use existing training and management manuals, introducing new cold chain equipment only if this is not available in the affected region. A complete immunization kit, including cold chain equipment for emergency use, is available from WHO, UNHCR or Oxfam. The responsibilities of the agencies and individuals involved should be precisely defined by the lead agency at each step in the immunization management chain.

- Careful surveillance of measles cases is necessary, especially among new arrivals at a camp. A measles outbreak represents a failure in the health system, and in such an event immediate immunization should target all at-risk age groups, starting with children in feeding centres and inpatient facilities, should they exist. The occurrence of measles in a camp is not a contraindication to conducting an immunization campaign.

- The adequacy of measles immunization coverage should be regularly assessed by checking registers of children in the at-risk age groups. Coverage surveys should be conducted if the registers are not accurately maintained.

- Children with clinical measles should be treated promptly for complications, enrolled in a supplementary feeding programme, and given the appropriate dosage of vitamin A.

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## Résumé

### Prévention de la rougeole et lutte antirougeoleuse dans les situations d'urgence

Les épidémies de rougeole continuent de frapper les enfants dans les camps de réfugiés touchés par la famine. Dans ces camps, où la sous-alimentation est fréquente, on a observé des taux de mortalité associés à la rougeole extrêmement élevés dans plusieurs pays, et ce depuis 10 ans. La mortalité rougeoleuse est toutefois évitable, et la vaccination contre cette maladie est une priorité des programmes d'urgence, qui ne le cède en importance qu'à la fourniture de rations alimentaires suffisantes. Tous les enfants âgés de 6 mois à 5 ans devraient être vaccinés contre la rougeole dès qu'ils arrivent dans un camp, qu'il soit provisoire ou organisé. Si l'approvisionnement en vaccins antirougeoleux est insuffisant, la priorité pour la vaccination devra être donnée aux enfants séjournant dans les centres de réalimentation ou

reconnus de toute autre manière comme sous-alimentés.

La présence d'une épidémie de rougeole dans un camp n'est pas une contre-indication à la campagne de vaccination. Pour que ces campagnes soient couronnées de succès, il faut une forte coordination par un organisme désigné à cet effet; toutefois, la coopération avec le programme élargi de vaccination local est indispensable pour assurer que la chaîne du froid existante, les modalités de formation et les manuels de gestion sont bien utilisés. Si l'on manque de matériel, on peut se procurer un nécessaire complet de vaccination mis au point par le Haut Commissariat des Nations Unies pour les Réfugiés, l'Organisation mondiale de la Santé et Oxfam en s'adressant au Siège d'Oxfam au Royaume-Uni. Des suppléments de vitamine A devront être donnés systématiquement au moment de la vaccination anti-rougeoleuse lorsque les enfants sont gravement dénutris. L'administration de doses élevées de vitamine A permet en effet de réduire la mortalité et la morbidité chez les enfants atteints de rougeole.

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