

Measles epidemic in Harare, Zimbabwe, despite high measles immunization coverage rates*

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Despite rapidly increasing measles immunization coverage in Harare city, measles remains endemic, and regular outbreaks occur. The most recent occurred in 1988, when the measles immunization coverage was 83%. We have carried out a retrospective study of the clinical and epidemiological features of this outbreak to assess whether the present immunization policy needs to be changed.

Of 4357 cases of measles seen at primary health care centres and hospitals in Harare during the outbreak, 1399 (32%) were severe or involved complications that required hospital admission. The peak incidence occurred among under-2-year-olds, followed by that among 5–7-year-olds. Poor nutritional status was significantly more frequent among children who were hospitalized and among those who died.

A total of 59% of all cases aged 9–59 months had documented evidence of measles immunization. The most frequent complications, which occurred most often among under-5-year-olds, were diarrhoea with dehydration, pneumonia, laryngotracheobronchitis, and convulsions, which together affected 56% of hospitalized cases. The hospital case fatality rate was low (1.43%).

In Harare, measles transmission remains a problem, despite high measles immunization coverage rates; the failure rate for the standard Schwarz measles vaccine also appears to be high. There is a need to reduce the number of measles cases among under-9-month-olds and young children. Further studies into alternative measles vaccines and schedules are required.

Introduction

In developed countries, measles immunization programmes have reduced the number of cases reported annually to negligible proportions (1). However, measles still remains a major health problem in sub-Saharan Africa, especially in urban areas with high population densities (2, 3). In Zimbabwe, measles is endemic with transmission peaks between August and December, despite the high levels of measles immunization coverage achieved in recent years.

The Zimbabwe Expanded Programme on Immunization (ZEPI) was implemented in 1981 on a national scale, and follows the policy of immunizing against measles at 9 months of age or at first contact with a health facility thereafter. As recommended by WHO, the standard Schwarz vaccine is used. The programme aimed to have fully immunized against measles all infants in the target age group by 1990.^a

As a result, by 1987 the national measles immunization coverage of 12–23-month-olds had risen to 65% (4). Since the advent of the programme, urban Harare has, however, continued to experience major measles outbreaks. Three such outbreaks have occurred since 1981—in 1983, 1986, and 1988.^b

A rapid increase in measles immunization coverage produces changes in the epidemiology of the disease (5), and strategies for measles control may therefore need to be reviewed. The 1988 outbreak presented an opportunity to study retrospectively its clinical and epidemiological features and to assess the need for possible change in the current immunization policy.

Patients and methods

Study area

Harare, the capital of Zimbabwe, had an estimated population of 914 780 in 1988, 15% of whom were below 5 years of age.^b The city has 28 comprehensive neighbourhood primary health care (PHC) clinics. These clinics are administered by the city health authority and staffed by state-registered and state-certified nurses. The clinics are used regularly, with 2.27 million attendances in 1988. Among other

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^a Ministry of Health, Zimbabwe. Revised ZEPI manual, 1986.

^b City Health Department, Harare, Zimbabwe. Annual reports, 1983, 1986, and 1988.

services, the clinics offer a programme for the under-5-year-olds that is mainly responsible for carrying out immunization, growth monitoring, and nutritional rehabilitation activities. The growth and immunization status of each child are recorded on a road-to-health (RTH) card, which is retained by the user. In 1988 measles immunization coverage of 12–23-month-olds in Harare was 83%.^c

The city has two major central referral hospitals and two municipal infectious diseases referral hospitals. Children diagnosed to have measles are assessed at the PHC level and the majority are treated as outpatients. However, patients who present with severe measles and/or have obvious complications are referred to hospitals. All cases of measles in Harare are reported monthly by the clinics and hospitals to the city's medical officer of health.

Study design

We reviewed the case notes of measles patients from all four referral hospitals and from the PHC clinics for 1988 and retrieved the data outlined below.

Age distribution of cases. The age of each child was calculated from the date of birth, which is normally recorded on the RTH card. For those who did not have this card, the age stated by the mother or guardian was accepted.

Nutritional status of cases. On admission or on presentation to a health centre, the patients were weighed. Weight-for-age on the Boston centile charts was used to assess the nutritional status of all measles cases aged ≤ 15 years.

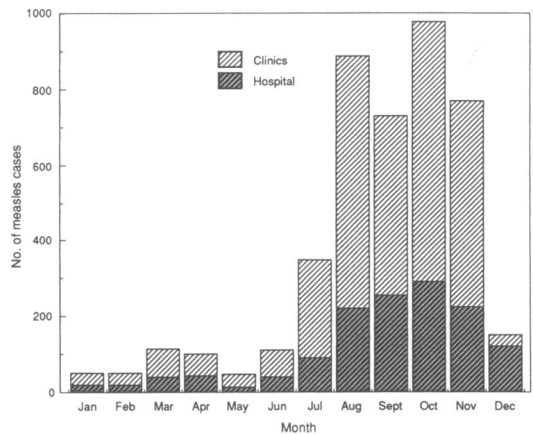
Immunization status of cases. The immunization status of measles cases was confirmed by the information on the RTH card presented at the health centre. A verbal history of immunization with no card for confirmation was categorized as a "history" of immunization. "Unknown" was used to designate patients with no knowledge of their immunization status.

Measles complications. All information about complications, other medical problems, and outcome was abstracted from the hospital case notes.

Results

A total of 4357 clinic reports and hospital case notes were reviewed for the period January–December

Fig. 1. Distribution of the number of measles cases per month in hospitals and primary health care clinics, Harare, Zimbabwe, 1988.



1988. Of these patients, 1399 (32%) had severe or complicated measles that required hospital admission, while the rest were treated as outpatients.

Measles transmission occurred throughout the year, with outbreak levels between August and December, coinciding with the hot dry and early rainy seasons (Fig. 1). The outbreak subsided to background levels after December 1988.

Age distribution of cases

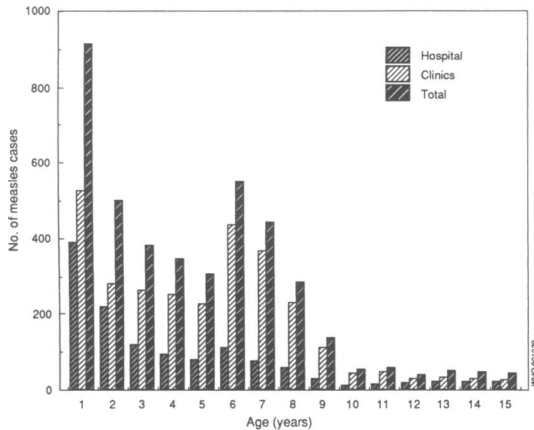
Fig. 2 shows the age distribution of the total number of measles cases, according to whether they were dealt with in the clinics or referred to hospital. The age range of cases was 6 weeks to 30 years. Measles occurred most frequently (32% of cases) in children below 2 years of age: 910 (21%) cases were aged less than 1 year, and 485 (11%) less than 9 months. The age group 9–24 months accounted for 921 (21%) cases. Of the measles cases that presented to the clinics, 27% were below 2 years of age. In contrast, 44% of patients admitted to hospital with severe measles were less than 2 years of age. Children aged 5–10 years accounted for 31% of cases.

Of the 1399 hospital admissions, 388 (28%) were aged < 1 year, and 199 (14%) were < 9 months of age. In the PHC clinics 522 (17%) of the cases that were treated as outpatients were aged < 1 year, and 286 (9.7%) were < 9 months of age. Altogether, 210 of the cases were > 15 years of age, of whom 133 (63%) required admission to hospital. Among 5–7-year-olds 19% needed hospitalization.

Two peak ages for measles were observed for the study population (Fig. 2), whose immunization coverage was high. The first and much larger peak

^c See footnote b, p. 213.

Fig. 2. Distribution of the number of measles cases, by age, in hospitals and primary health care clinics, Harare, Zimbabwe, 1988.



occurred among children aged < 2 years, while the second involved those aged 5–7 years. The latter peak was less pronounced for hospital cases with severe or complicated measles.

Nutritional status of cases

The weights of 3306 cases (80%) aged < 15 years were determined on admission to hospital or on first presentation to the PHC clinic. Of these, 959 (29%) corresponded to the third centile or below for weight-for-age on the Boston centile charts. In turn, 1245 hospital cases were < 15 years of age, 1158 of whom (93%) were weighed on admission; the remaining 87 cases were not weighed because of the severity of the disease. A total of 542 (47%) of the hospital cases who were weighed corresponded to

the third centile or below for weight-for-age on the Boston charts.

Of the 2867 cases dealt with at PHC clinics who were < 15 years of age, 2148 (75%) were weighed, and of these, 417 (19%) were on the third centile or below for weight-for-age. Poor nutritional status was significantly more prevalent among the hospital cases compared with those treated as outpatients ($P < 0.05$).

Measles immunization status of cases

The immunization status of all cases, stratified by age and according to whether they were treated as clinic or hospital cases, is shown in Table 1. Overall, 1876 (48%) cases aged ≥ 9 months had received prior measles immunization. Of those aged 9–59 months, 1075 (59%) were immunized. Within the same age range, 387 (60%) hospital cases and 688 (58%) clinic cases had been immunized.

A total of 485 (11%) cases were below 9 months of age and hence could not be immunized on the basis of current antimeasles policy. In the target age group for measles immunization (9–23 months), 506 (55%) had been immunized, while 335 (36%) had not; a further 39 reported a history of immunization, while the measles immunization status of 41 was unknown. In the 24–59-month group, 569 (63%) had been immunized.

The measles immunization status of all patients above 16 years of age was unknown since none had RTH cards.

Measles complications

Table 2 shows the frequency of the major complications, according to age. Of the 1399 hospital admissions, 804 (57%) were admitted with clearly identifiable measles-associated complications. The

Table 1: Immunization status of cases of measles in the 1988 outbreak, stratified by age and whether they were treated in a primary health care clinic or hospital

Age group	No. of cases (by immunization status):								Total
	Immunized		Not immunized		Unknown		"History"		
	Clinic	Hospital	Clinic	Hospital	Clinic	Hospital	Clinic	Hospital	
1–8 months	—	—	286	199	—	—	—	—	485 (11)*
9–23 months	297	209	173	162	9	32	38	1	921 (21)
24–59 months	391	178	103	33	24	28	140	2	899 (21)
5–10 years	546	212	161	36	143	79	442	2	1621 (37)
11–15 years	21	19	23	3	57	71	29	—	223 (5)
16–30 years	3	—	9	—	54	133	9	—	208 (5)
Total	1258	618	755	433	287	343	658	5	4357 (100)

* Figures in parentheses are percentages.

Table 2: Distribution of the major complications of measles among hospital patients in the 1988 outbreak by age

Age group	No. of cases (by complication):				
	Pneumonia	LTB ^a	Diarrhoea with dehydration	Convulsions	Total
< 11 months	125	16	124	2	267
12–23 months	74	5	79	0	158
24–59 months	66	13	85	8	172
5–10 years	41	6	71	1	119
11–15 years	6	0	16	1	23
> 15 years	10	0	32	0	42
Total	322	40	407	12	781

^a LTB = acute laryngotracheobronchitis.

remaining 595 had no obvious complications but were sufficiently ill to warrant admission to hospital.

The most frequent complications were diarrhoea with dehydration, pneumonia, acute laryngotracheobronchitis, and convulsions. The following complications were also observed: cutaneous abscesses (4 cases), otitis media (3), cellulitis (3), epistaxis (3), ocular complications (1), and others (9). Higher rates of complications occurred among the younger age groups: 32% among those aged < 1 year, and 26% among those aged < 5 years had complications.

Three patients were known to be seropositive for human immunodeficiency virus (HIV) and symptomatic before the onset of measles. None of them died during the acute phase of measles, and one was immunized, while the other two were not. There may well have been other HIV-infected children in the study group who were not identified. Such infected children may partly account for the low vaccine efficacy and high complication rates.

An attempt was made to relate the complication rate to immunization status in patients < 10 years of age who were hospitalized. Of 974 children aged 9 months to 10 years, 599 (62%) were immunized and 356 (51%) of them developed major complications. Of the 375 children not immunized, 172 (46%) developed major complications. The rate of complications among those who were immunized was greater than that among those who were not, and was significant ($P < 0.05$).

Case fatality

Of the 1399 cases admitted to hospital, 20 died, corresponding to a hospital case fatality rate of 1.43%. Those who died ranged in age from 8 months to 18 years, and 19 of these deaths involved children aged ≤ 6 years. The case fatality rate was highest

(3.25%) among children aged 9–23 months (13 cases). Two of the deaths involved children < 9 months of age. Fifteen of the 19 deaths among under-10-year-olds involved children who were weighed on admission, and 11 (73%) were below the third Boston centile for weight-for-age. Seven (41%) of 17 deaths involved patients who were aged > 9 months when they were immunized, three were not, and six had an unknown measles immunization status. A history of immunization was given for one patient.

Pneumonia was the most frequent complication associated with death (11 patients), followed by diarrhoea with dehydration (6 patients). Laryngotracheobronchitis was associated with five deaths, and convulsions with four.

Discussion

Harare metropolitan area has one of the highest measles immunization coverage rates in sub-Saharan Africa. In 1987 and 1988 these rates (determined in annual immunization coverage surveys conducted by the Harare City Health Department) were 82% and 83%, respectively, for children aged 9–23 months. Nevertheless, measles remains endemic in the city, with major periodic outbreaks.

Since the implementation of ZEPi in 1981, three measles outbreaks have occurred in Harare—in 1983, 1986, and 1988, when 11 265, 4522, and 4424 cases, respectively, were reported. Measles immunization coverage rates have steadily increased in the city from 62% in 1982 to 83% in 1988. This confirms emerging experience from sub-Saharan Africa and other developing countries that despite moderately high immunization coverage, significant transmission of measles, particularly in urban areas, still occurs with periodic epidemics

(2, 6). The reasons for this are not entirely clear; however, analysis of the data for the 1988 outbreak indicates that the infected susceptibles consisted of infants aged < 9 months, vaccination failures, and nonimmunized individuals.

Serious overcrowding, a feature of population migration from rural to urban areas in developing countries, may also be responsible not only for the spread of measles but also for its severity among infants and young children (7).

In sub-Saharan Africa measles has been characterized by its occurrence among younger children (6, 8–10).^d However, the 1988 Harare outbreak exhibited a bimodal age distribution, with peaks for children aged ≤ 2 years and among 5–7-year-olds and a general upward shift in the age of the children affected. This upward shift in the age-specific incidence of measles with increasing immunization coverage has also been observed in Yaoundé (5), Lesotho, and Swaziland.^d The accumulation of nonimmunized children and vaccination failures may result in a pool of susceptible older children large enough to result in an outbreak of measles.

The ideal age for immunization with the standard Schwarz vaccine is 15 months (11). Administration of this vaccine at the recommended age of 9 months in developing countries with high childhood measles morbidity and mortality is a compromise between the presence of interfering persistent maternal antibodies and the intensity of measles transmission in the community. Invariably, the cost of this is a lower vaccine efficacy. Since 53% of all cases of measles aged 9 months to 10 years in the study were immunized, this suggests a relatively high rate of measles vaccination failure in Harare. Although faults in maintaining the cold chain are a possible cause of this, there was no evidence of improper vaccine storage. Based on a coverage rate of 82% in 1987, we estimate that the vaccine efficacy rate among 9–24-month-olds was 73%, which is not satisfactory.

Infants aged < 9 months, who could not be immunized against measles under the current national policy, formed 11% of cases in the study. In other African countries even higher proportions of measles among under-9-month-olds have been reported. For example, in Kinshasa, with a measles immunization coverage of 50–60%, 27% of the reported cases were aged < 9 months (3). Also, Loening & Coovadia, who found a positive associ-

ation between population density and the proportion of measles cases aged ≤ 8 months, reported that 20–45% of their urban and 6–12% of their rural patients with measles were < 8 months of age (7). The high proportion of infants with measles in Africa is of concern because of the greater risk of complications and death in this age group.

Even though the current global measles immunization policy and programmes have shown some impact, there is a need to consider alternative vaccines and schedules if the trend of measles endemicity and epidemics is to be controlled, especially in sub-Saharan Africa.

In general, in most developing countries, there is a need to reduce measles morbidity among under-9-month-olds and in early childhood. High potency Edmonston–Zagreb (E–Z) vaccine administered to 4–6-month-olds is highly immunogenic and safe (12, 13), and may offer an opportunity for effective early measles immunization in countries with high early childhood morbidity and mortality from the disease. In this respect it should be noted that the 12th Meeting of the WHO/EPI Global Advisory Group, Tokyo, 16–20 October 1989, stated that “high titre” E–Z vaccine be administered at 6 months of age or as soon thereafter as possible in countries in which measles before the age of 9 months is a significant cause of death.^d An alternative would be to use a two-dose measles immunization schedule, e.g., at 6 months and 12–18 months, to reduce the risk of exposure and infection before 9 months of age and to minimize the number of vaccination failures in order to prevent transmission in older children. Such an approach may be less attractive because of potential operational and compliance problems. The impact of such a two-dose schedule in urban and rural settings will require further studies.

In the 1988 Harare measles outbreak, approximately a third of patients (32%) required hospitalization, of whom 56% had clinically demonstrable major measles-associated complications—diarrhoea with dehydration, pneumonia, laryngotracheobronchitis, and convulsions being the most frequent. No attempt was made to define the measles encephalitis syndrome in those cases that experienced convulsions. Younger age groups most frequently experienced complications. These major complications are consistent with local experience (I. Chitsike, unpublished report, 1983) and studies from other African countries (10, 14).

The case fatality rate among hospitalized patients in the 1988 outbreak was low (1.36%) compared with the 1983 outbreak, when 26% of children admitted died, and also with reports from other sub-Saharan African countries (3, 6, 8–10,

^d Report of the Expanded Programme on Immunization Global Advisory Group Meeting, 16–20 October 1989, Tokyo, Japan. Unpublished document WHO/EPI/GEN/90.1.

15). The high proportion of older children and the increasing measles immunization coverage rate, with its parallel rise in herd immunity, may have significantly contributed to the reduction in the mortality rate. Almost all the deaths in this epidemic occurred in infants and young children, stressing again the vulnerability and much higher risk of measles-associated deaths in this age group.

A high prevalence of undernutrition (47%) occurred among hospitalized cases aged below 15 years. Severe measles and the presence of complications may have contributed further to the weight loss. Recently Aaby et al. (16, 17), found that pre-morbid nutritional status (weight-for-age) did not affect the outcome of measles infection, but that intensity of exposure and overcrowding were more potent predictors of this. However, whether pre-morbid nutritional status *per se* significantly contributes to the severity of measles has yet to be confirmed.

ZEPi has achieved remarkably high measles immunization coverage levels in Harare, and in recent years the observed low mortality from the disease among children may be a result of this. However, the problems of measles transmission and of recurrent outbreaks persist. While there is a need to administer measles vaccine at 9 months of age (or perhaps earlier), the standard Schwarz vaccine is not the appropriate one to use at that age because its efficacy is unacceptably low. Whether this efficacy can be improved by giving high-dose Schwarz vaccine is uncertain. Present strategies need to be intensified in terms of national coverage and improvement of vaccine efficacy in order to reduce further the number of cases of measles in urban areas and in the country as a whole. Also, since measles below the age of 9 months remains an important problem in African urban centres, studies should be carried out to examine the feasibility of using alternative immunization strategies; for example, use of E-Z vaccine at 6 months to reduce measles transmission among this age group.

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Résumé

Epidémie de rougeole à Harare, Zimbabwe, malgré des taux élevés de vaccination

Malgré une couverture vaccinale rapidement crois-

sante, la rougeole reste endémique et, régulièrement, des flambées épidémiques se déclarent à Harare. La flambée la plus récente a eu lieu en 1988, alors que la couverture vaccinale antirougeoleuse avait atteint 83%. Nous avons effectué une étude rétrospective des caractères cliniques et épidémiologiques de cette épidémie pour savoir si la politique actuelle de vaccination au Zimbabwe demande à être modifiée.

Des 4358 cas de rougeole vus à Harare, 1397 (32%) étaient graves et comportaient des complications qui nécessitaient une hospitalisation. Le maximum d'incidence a eu lieu chez les enfants âgés de moins de deux ans, suivis par ceux de 5 à 7 ans. Un état nutritionnel médiocre était nettement plus fréquent chez les enfants qui avaient été hospitalisés et chez ceux qui sont décédés.

Dans 59% de tous les cas âgés de 9 à 59 mois, une vaccination contre la rougeole était attestée. Les complications les plus fréquentes, qui sont apparues surtout chez les enfants de moins de cinq ans, étaient une diarrhée avec déshydratation, des pneumonies, des laryngotrachéobronchites et des convulsions qui, au total, ont affecté 56% des cas hospitalisés. Le taux de létalité chez les cas hospitalisés était faible (1,36%).

Cette étude montre que la transmission de la rougeole reste un problème, malgré les taux élevés de couverture vaccinale contre cette maladie. Les résultats montrent également un taux élevé d'échecs du vaccin antirougeoleux standard de souche Schwarz. Il est nécessaire de réduire le nombre de cas de rougeole chez les nourrissons de moins de 9 mois et chez les jeunes enfants. Des études sur les possibilités d'autres calendriers vaccinaux devront être entreprises.

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