

Measles epidemiology and outbreak response immunization in a rural community in Peru

D.H. Sniadack,^{1, 2} B. Moscoso,^{2, 3} R. Aguilar,⁴ J. Heath,⁵ W. Bellini,⁵ & M. Chuy Chiu^{2, 3}

Only limited data are available on the impact of measles outbreak response immunization (ORI) in developing countries. We conducted a community survey in Espindola, a rural border community in northern Peru, following a measles outbreak and subsequent ORI to study the epidemiology and impact of the outbreak and to evaluate the costs and benefits of measles ORI.

During the outbreak, 150 of the 553 Espindola residents developed clinical cases of measles. Adults accounted for 44.0% of cases, and were frequently identified as primary cases. The attack rate among all susceptible people was 45.5% and was highest (61.2%) for the 16–20 year age group. Among adults, significant risk factors for developing measles included being aged 16–20 years (relative risk [RR]=3.06, 95% CI = 2.08, 4.49) and being male (RR= 1.73, 95% CI = 1.11, 2.71). Among serologically confirmed cases, 60.7% developed diarrhoea and 32.1% pneumonia. The overall case-fatality rate was 3.3%, but reached 19.1% in the 0–23-month age group. Failure to reach children through either routine immunization or national campaigns made this community vulnerable to the severe and extensive impact of measles virus importation.

The ORI campaign targeted non-measles case children aged 6 months to 15 years, regardless of their previous immunization status, and was effective in terminating this measles outbreak and in preventing morbidity, loss of livelihood and death despite the involvement of large numbers of adults in measles transmission. The last measles case occurred within 3 weeks of completing ORI. The ORI campaign, which would have cost approximately US\$ 3000 in 1998, saved as many as 1155 person-days of work among 77 adults, prevented an estimated 87 cases of diarrhoea and 46 cases of pneumonia, and averted 5 deaths.

Voir page 551 le résumé en français. En la página 551 figura un resumen en español.

Introduction

WHO considers that the priorities during measles outbreaks are to provide appropriate treatment and reduce mortality. Outbreak response immunization (ORI) often takes place too late to have an impact on measles morbidity and mortality. If implemented, however, ORI should be focused on unaffected areas into which measles virus transmission is likely to be introduced. Only in specific situations, such as in refugee camps, hospitals and military barracks or in

closed communities, should such vaccination activities be considered (1). The Pan American Health Organization advocates ORI under similar circumstances as part of its measles elimination strategy for the Americas (2). However, to date, only limited data are available on the impact of ORI activities in developing countries (3).

A measles outbreak occurred between 22 July and 21 September 1993 in Espindola, a rural community in the Peruvian Andes. More than a quarter of the population was affected, including many adults, and more than 3% of cases died. We conducted an investigation from 20 to 29 September 1993 to determine the characteristics of the outbreak as well as the costs and benefits of ORI in preventing measles morbidity and mortality.

Setting

The village of Espindola is located in Ayabaca District in the Subregion of Piura, Peru, on the border with Ecuador. Accessibility to routine vaccination services is poor because the nearest fixed health facility is several hours away on foot. At the time of the measles outbreak, the 553 inhabitants of

¹ International Branch, Division of Field Epidemiology, Epidemiology Program Office, Centers for Disease Control and Prevention, Atlanta, GA, USA. Currently at: Expanded Programme on Immunization, Global Programme on Vaccines, World Health Organization, Geneva, Switzerland. Requests for reprints should be sent to Dr Sniadack at the following address: American Embassy-Dhaka, Department of State, Washington DC 2051–6120, USA. (e-mail: sniadack@bangla.net).

² Field Epidemiology Training Programme, Lima, Peru.

³ General Office of Epidemiology, Ministry of Health, Peru.

⁴ Ayabaca District Health Centre, Piura Subregion, Ministry of Health, Peru.

⁵ Measles Section, Respiratory and Enteric Viruses Branch, Division of Viral and Rickettsial Diseases, Centers for Disease Control and Prevention, Atlanta, GA, USA.

Reprint No. 0016

Espindola, including 287 children aged ≤ 15 years, were living in 100 dwellings dispersed over an area of approximately 10 km².

In 1985, the Peruvian Ministry of Health began conducting annual, multi-antigen immunization campaigns for previously unvaccinated children aged under 5 years. One year before the 1993 Espindola outbreak, a national measles campaign targeting children aged under 15 years had been conducted in order to stop a pandemic that was sweeping across the continent. A local church was chosen as the vaccination site in Espindola. Vaccination registers were maintained and vaccination cards issued or updated. Although national coverage in the 1992 measles campaign was reported to be 78% for under-15-year-olds, only 4.2% of Espindola children aged 6 months to 10 years were vaccinated that year, as determined from vaccination records or following questioning during the investigation (data were not available for children aged 11–15 years). Only 8.7% of previously unvaccinated children aged 9 months to 4 years had been vaccinated during an annual campaign conducted in July 1993 just prior to the measles outbreak. Espindola residents could not recall an outbreak having occurred during the previous 20 years.

Background to the measles outbreak

The July 1993 outbreak began following the arrival of a family from Ecuador. During this family's 2-day journey to Espindola, their two children became ill, developing a fever, rash and cough. The children were confined to bed after their arrival on 14 July. The following evening, a welcome party was held at the home of the Peruvian host family. Between 7 and 14 days later, 10 people, including children and adults who had attended the welcome party, also became ill, with a fever and rash. Several of these people also attended either a baptism or a funeral at the local church on 24 July. During the subsequent 12 days, 11 more people who had attended the baptism and/or funeral developed similar symptoms.

In late August, Espindola authorities notified their district health office of the measles outbreak that had begun in July. Health officials arrived in Espindola on 26 August, identified the likely etiology of the outbreak by examining patients with acute disease, and administered single doses of measles vaccine to non-measles case children aged 6 months to 15 years, regardless of their previous immunization status, from 26 August to 3 September in a house-to-house campaign. No additional cases occurred after 21 September.

Methods

Definition of terms

A clinical case of measles was defined as any resident of Espindola with fever and rash of any duration

between 1 July and 28 September 1993. A primary case of measles was defined as a clinical case who developed fever and rash 8–14 days before any other case in the same household. A confirmed case of measles was defined as a clinical case who had not been vaccinated against measles during the outbreak and who had anti-measles virus nucleoprotein immunoglobulin M (IgM) antibodies.

People were considered as susceptible if they were unvaccinated and without a history of measles before the outbreak. Clinical cases were considered previously vaccinated if either parental response or vaccination cards indicated that they had received measles vaccine at least 30 days before the onset of fever and rash. Non-measles cases were considered vaccinated if they had received measles vaccine before 1 July 1993.

Pneumonia was defined as a cough and either pleuritic chest pain or cyanosis; diarrhoea was defined as three or more watery bowel movements per day. People aged over 15 years were considered adults.

Data sources and analysis

Serological analysis

To verify the etiology of the outbreak, blood specimens were obtained from the 29 clinical cases with symptom onset 5 weeks or less prior to the dates of specimen collection (24–28 September). Sera from these blood samples were separated in the field, stored on ice in containers and brought to Lima within 7 days of sample collection. Sera were then frozen at approximately -20°C for 3–4 weeks until they were evaluated for anti-measles virus nucleoprotein antibody by IgM-capture enzyme immunoassay at the Centers for Disease Control and Prevention, Atlanta, GA, USA. Anti-measles virus nucleoprotein IgM antibody levels were determined by measuring their optical density (OD₅₅₀) in clinical case sera and comparing with standard control sera. A positive anti-measles nucleoprotein IgM antibody level was defined as a case-control OD value >0.01 (5, 6).

Community survey

We conducted a survey in Espindola to identify clinical cases and determine vaccination coverage. Questionnaires were given to heads of all households and demographic data were obtained for all occupants. Household heads were asked if anyone had been ill with fever and rash since 1 July, and if and when anyone had had measles before the outbreak. They were also asked about the vaccination status of any children aged ≤ 10 years, and whether anyone had died since 1 July. The 29 clinical cases from whom blood specimens were collected were given a second questionnaire to identify clinical symptoms and disease outcomes.

Calculation of attack rates, vaccine effectiveness, and predictive value positive

Attack rates and vaccine effectiveness were calculated for various age groups, using ages as of 22 July 1993 (the date the outbreak began). Attack rates were determined by dividing the number of clinical cases by the number of all or susceptible individuals. Vaccine effectiveness was calculated by dividing the percentage of clinical measles cases among all vaccinated children by the percentage of clinical measles cases among all unvaccinated children, and then subtracting from one. The usefulness of the case definition in correctly identifying suspected measles cases was determined by dividing the number of IgM-positive clinical cases by the total number of serologically tested clinical cases, expressed as a percentage (the predictive value positive, PVP).

Statistical methods

Epi Info 6.03 software was used. The 95% confidence intervals (CI) for proportions were determined assuming a binomial distribution (7) and the 95% CIs were calculated for relative risks (RRs) using Taylor Series expansion. Exact confidence limits or Fisher's exact test was used with an expected cell value of less than 5 (8). Student's *t*-test was used to determine significance of differences of means and Kruskal-Wallis *H*-test was used for non-parametric significance testing. All *P*-values were two-tailed.

ORI cost estimation

Direct costs of ORI included per diem allowances and salaries for two nurses and four technicians for 9 days and for one driver for 2 days, fuel for two round-trips of 200 km each, 20 vials of measles vaccine, 200 syringes, alcohol and cotton wool. Per diem allowances and salaries were based on standard 1998 Peruvian Government rates for nurses, technicians and drivers. Costs of fuel, alcohol and cotton wool were determined using 1998 market prices. Standard UNICEF rates for 1998 were used to calculate the costs of the vaccine and syringes.

Results

Among the 553 residents of Espindola, 150 clinical cases of measles occurred between 22 July and 21 September 1993 (Fig.1), giving an overall attack rate of 27.1% (95% CI = 23.5, 31.0). The attack rate among all susceptible persons was 45.5% (95% CI = 39.7, 51.5). Clinical cases lived in 48 of the 86 households in Espindola.

Twenty-nine clinical cases were serologically tested, and of these, 28 were confirmed as having measles, a predictive value positive (PVP) of 96.6% for the clinical case definition. Among the 28 people whose illness was serologically confirmed, additional symptoms included cough (25), conjunctivitis (24), headache (24), sore throat (23), runny nose (19), loss of consciousness (4), and seizure (1). None of the cases

became blind. Seventeen (60.7%) confirmed cases developed diarrhoea for a median of 3 days. Nine (32.1%) confirmed cases developed pneumonia.

Case-fatality rates

Five (3.3%) clinical cases died between 16 August and 14 September 1993. Case fatalities included four children aged 2 months, 8 months, 10 months and 22 months and one woman aged 24 years. The case-fatality rate (CFR) was 19.1% for children aged 0–23 months and 1.5% for adults aged 16–40 years. Case-fatality rates were virtually the same for children aged 0–11 months and 12–23 months old (18.8% and 20.0%, respectively).

Attack rates

Of 150 clinical cases, 83 were male. Among children, the attack rate for males was similar to that for females (40/141 [28.4%] vs 44/146 [30.1%], RR = 0.94, 95% CI = 0.66, 1.35), whereas among adults, the attack rate for males was significantly higher than that for females (43/138 [31.2%] vs 23/128 [18.0%], RR = 1.73, 95% CI = 1.11, 2.71), and remained so when restricting the analysis to susceptible adults only (43/83 [51.8%] vs 23/69 [33.3%], RR = 1.55, 95% CI = 1.05, 2.30). There was no significant difference between the total number of males and females in any age group.

Among the 150 clinical cases, 13 were under 9 months old, 71 were aged 9 months to 15 years, and 66 were aged >15 years. The attack rate was highest (46.4%) for infants aged 0–8 months. Three of the 6 children born during the outbreak period were clinical cases. In decreasing order, attack rates for other age groups were: 42.6% for adults aged 16–30 years; 33.3% for children aged 9–23 months; 31.6% for children aged 2–4 years; 27.7% for children aged 5–10 years, 22.1% for children aged 11–15 years, and 16.7% for adults aged 31–40 years (χ^2 test = 19.35, df = 6, *P* = 0.004) (Table 1).

Among susceptible people, the attack rate was highest for children aged 2–4 years (56.3%), followed by adults aged 16–30 years (54.2%) (Table 1). However, the attack rate among susceptible people was highest of all for young adults aged 16–20 years (61.2%); 20 (40.8%) of 49 susceptibles in this age group had already developed measles before ORI was conducted compared to 40 (28.6%) of 140 susceptible children \leq 10 years old (RR = 1.43, 95% CI = 0.93, 2.19).

Among adults, the age group 16–20 years was a significant risk factor for developing measles (30/57 [52.6%] vs 36/209 [17.2%], RR = 3.06, 95% CI = 2.08, 4.49), and remained so when the analysis was restricted to susceptible adults only (30/49 [61.2%] vs 36/103 [35.0%], RR = 1.75, 95% CI = 1.24, 2.47).

Among clinical cases, there was no significant correlation between age group and the development of pneumonia or the duration of diarrhoea. However, adults required a median of 15 days (inter-quartile

Fig. 1. Cases of measles, by date of symptom onset, Espindola, Peru, 1993

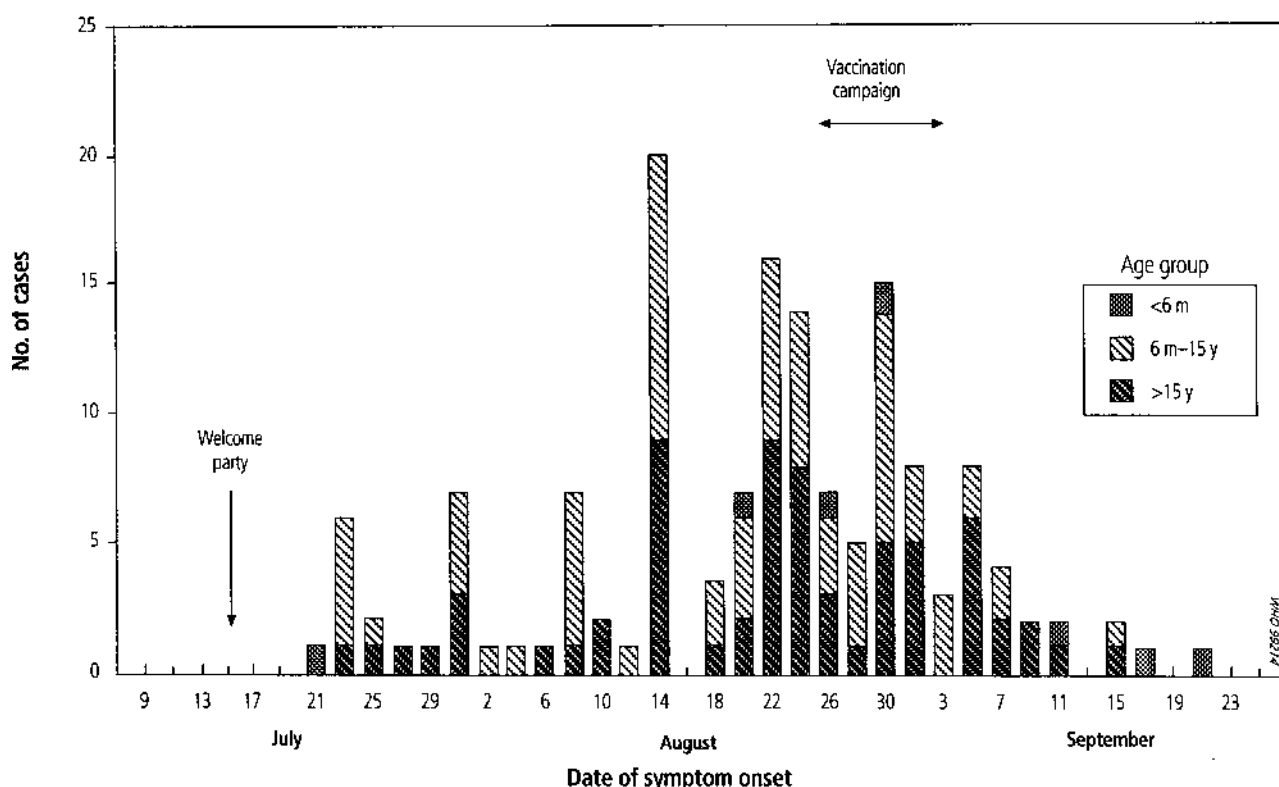


Table 1. Attack rates of measles cases and protection rates of susceptible people following ORI in Espindola, Peru, 1993

Age group	Total number in age group	No. of measles cases	Attack rate (%)	No. previously vaccinated	No. with measles history	No. susceptible ^a	Attack rate among susceptible people (%)	No. protected by ORI	Susceptible people protected by ORI (%)
0-8 months	28	13	46.4	0	0	28	46.4	15	53.6
9-23 months	24	8	33.3	9 (37.5%)	0	17 ^b	47.1	9	52.9
2-4 years	57	18	31.6	28 (49.1%)	0	32 ^b	56.3	14	43.7
5-10 years	101	28	27.7	40 (39.6%)	1 (1.0%)	63 ^b	44.4	35	55.6
11-15 years	77	17	22.1	Unknown	3 (3.9%)	Unknown	Unknown	Unknown	Unknown
16-30 years	136	58	42.6	0	29 (21.3%)	107	54.2	49	45.8
31-40 years	48	8	16.7	0	23 (47.9%)	25	32.0	17	68.0
41-60 years	66	0	0	0	48 (72.7%)	18	0	18	100.0
> 60 years	16	0	0	0	14 (87.5%)	2	0	2	100.0
Total	553	150	27.1	77	118 (21.3%)	292^c	45.5%^c	159^c	54.5%^c

^a A susceptible person was defined as a person without a history of measles or measles vaccination prior to the outbreak, or a child who was vaccinated ≤ 30 days before symptom onset during the outbreak.

^b Seven children were vaccine failures and were therefore considered as susceptible (two children aged 9-11 months, three children aged 2-4 years, and two children aged 5-10 years).

^c Does not include children aged 11-15 years.

range [IQR] = 11.0-21.0 days) before returning to work or normal daily activities, whereas children required a median of 8 days (IQR = 7.5-11.5 days, $P = 0.04$).

Primary and secondary cases

Adults were the only primary cases of measles in 11 of 48 case households. In another four households,

adults were co-primary cases with children. The 11 exclusive primary-case adults fell into the following age groups: seven aged 16-20 years; two aged 21-25 years; one aged 26-30 years; and one aged 31-35 years. Ten of the 11 primary cases were male. Among the 24 secondary cases living in the same households as the 11 primary case adults, 13 were children and 11 were adults.

Vaccination coverage and effectiveness

Measles vaccination coverage before the July 1993 outbreak was only 37.5% among children aged 9–23 months, 49.1% among children aged 2–4 years, and 39.6% among children aged 5–10 years (χ^2 test = 1.61, $df = 2$, $P = 0.45$).

Vaccine effectiveness was 80% (95% CI = 58.0, 90.0) for children aged 9 months to 10 years. The 95% CI for vaccine effectiveness overlapped substantially for the 9–11 months, 12–23 months, 2–4 years and 5–10 years age groups. No particular vaccination date was associated with seven vaccination failures.

Impact of ORI

ORI, which was conducted from 26 August through 3 September, began 35 days after the first Espindola case became ill on September 22, and after 97 people, including 42 (27.6%) of 152 susceptible adults, became clinical cases. Only two cases occurred 2 weeks or more after the end of the ORI campaign and both of these cases were children aged under 6 months.

Of 140 children aged ≤ 10 years who were susceptible to measles before the outbreak, 73 (52.1%) remained asymptomatic following ORI; 86 (56.6%) of 152 susceptible adults also remained asymptomatic (Table 1). Given the disease outcome and fatality rates during this outbreak, ORI prevented an estimated 40 cases of diarrhoea and 21 cases of pneumonia among children aged ≤ 10 years, and 47 cases of diarrhoea and 25 cases of pneumonia among adults. ORI also prevented four deaths among children in the 0–23-month age group, and one death among adults (Table 2).

Cost effectiveness of ORI

Costs for ORI, based on 1998 prices, totalled approximately US\$ 3000 and included US\$ 2880 for

per diem allowances and salaries, US\$ 50 for fuel and US\$ 50 for vaccine, syringes, alcohol and cotton wool. Assuming that 77 additional cases of adult measles would have occurred without ORI (Table 2) and that adult cases were unable to work for a median of 15 days, ORI saved as many as 1155 person-days of work at a cost of US\$ 2.60 per day of work saved. The cost of averting each of the estimated 5 deaths among children aged under 24 months and adults was US\$ 600.

Discussion

ORI successfully interrupted measles transmission and prevented substantial morbidity and mortality among residents of Espindola in the July 1993 outbreak. The cost for each death averted by ORI (US\$ 600) was only slightly higher than the expected cost of routine measles immunization to avert death. In rural areas of other developing countries, achieving routine measles vaccination coverage of 80% has cost US\$ 561 per death averted (9). More sensitive and timely surveillance in the Peru outbreak could have resulted in earlier intervention, fewer cases of measles, fewer deaths and greater cost-effectiveness of ORI.

WHO does not recommend measles ORI in most circumstances because the immunization response is often too late to affect the impact of the outbreak (1, 2). At least two factors may explain why ORI was effective in the Peru outbreak. First, a very large proportion of the population was susceptible to measles before the outbreak. Adults were susceptible because the geographical characteristics of the village made previous exposure to measles virus unlikely; children were especially susceptible because of low measles vaccination coverage. Second, large inter-household distances

Table 2. Expected number of additional cases of measles, diarrhoea, pneumonia, and of additional deaths without ORI

Age group	No. protected by ORI	Expected no. of measles cases ^a	Expected no. of diarrhoea cases (95% CIs) ^b	Expected no. of pneumonia cases (95% CIs) ^c	Expected no. of deaths (95% CIs) ^d
0–23 months	24	21.6	13.1 (8.8–17.0)	6.9 (3.4–11.3)	4.1 (1.2–9.1)
2–4 years	14	12.6	7.6 (5.1–9.9)	4.0 (2.0–6.6)	0
5–10 years	35	31.5	19.1 (12.8–24.8)	10.1 (5.0–16.5)	0
Total children	73	65.7	39.8 (26.7–51.6)	21.0 (10.4–34.4)	4.1 (1.2–9.1)
16–30 years	49	44.1	26.8 (17.9–34.7)	14.2 (7.0–23.1)	0.7 (0.1–3.7)
31–40 years	17	15.3	9.3 (6.2–12.0)	4.9 (2.4–8.0)	0.2 (0.0–1.3)
41–60 years	18	16.2	9.8 (6.6–12.7)	5.2 (2.6–8.5)	0.2 (0.0–1.3)
> 60 years	2	1.8	1.1 (0.7–1.4)	0.6 (0.3–0.9)	0.0 (0.0–0.2)
Total adults	86	77.4	47.0 (31.4–60.8)	24.9 (12.3–40.5)	1.1 (0.1–6.5)
Grand Total	159	143.1	86.8 (58.1–112.4)	45.9 (22.7–74.9)	5.2 (1.3–15.6)

^a Assumes a secondary attack rate of 90%.

^b 60.7% (95% CI: 40.6, 78.6) of clinical measles cases developed diarrhoea.

^c 32.1% (95% CI: 15.9, 52.4) of clinical measles cases developed pneumonia.

^d 19.1% (95% CI: 5.4, 41.9) case-fatality rate among children aged <2 years; 1.5% (95% CI: 0.2, 8.3) case-fatality rate among adults (aged >15 years).

in the village may have slowed transmission of measles virus, allowing time for ORI to interrupt virus transmission. It is interesting to note that specific social events, e.g. a baptism and funeral, appeared to play a key role in measles transmission at the onset of this outbreak. Had it not been for these events, transmission would have been slower and the benefit of ORI could have been greater.

ORI for children aged 6 months to 15 years was effective in rapidly terminating the outbreak in Espindola even though adults (i.e., those aged >15 years) accounted for 44.0% of measles cases and were involved in measles transmission. A similar phenomenon was seen during a measles outbreak in São Paulo, Brazil, which occurred with peak intensity from May to November 1997, and in which adults aged 20–29 years accounted for over half of all cases (10). In the São Paulo outbreak, indiscriminate vaccination of children aged 6 months to 4 years in August 1997 appeared to have little immediate impact on measles transmission, whereas the addition of selective immunization of 5–14-year-olds from September to November 1997 was associated with a substantial decrease in the weekly number of measles cases. The results of both the São Paulo and Espindola ORI suggest that targeting adults for supplementary immunization to interrupt measles transmission may not be necessary even when adults represent a substantial proportion of the susceptible population and are involved in measles transmission.

Risk factors for adults in the Peru outbreak

Male sex and being 16–20 years old were significant risk factors for measles among adults. Moreover, adult primary cases of measles were almost exclusively male, most of whom were aged 16–20 years. One explanation for the predominance of young adult males among cases in this community may be that members of this group are more mobile or socially active than their female counterparts or elders. Risk factors may differ in other societies.

Consequences of adult infection and susceptibility

Measles infection or susceptibility in adults had serious consequences for children. First, infected adults were unable to work and could not adequately care for their children for a median of 15 days. Second, infected adults transmitted measles virus to susceptible children. Third, susceptible mothers could not confer protective anti-measles virus antibodies to newborn children, leaving them vulnerable to measles infection from their parents, siblings or other close contacts.

Implications for vaccination policies

Although vaccination of adults was not necessary to interrupt measles transmission in the Peru outbreak, ORI did not begin until after more than 25% of all susceptible adults and 41% of susceptible young adults aged 16–20 years developed measles. The large number of young adult primary cases and the consequences of adult infection and susceptibility on children suggest that vaccinating potentially susceptible adults under specific circumstances could help reduce the burden of disease on children. The Pan American Health Organization recommends vaccination of young adults at highest risk of measles virus exposure, including health workers, military personnel, university students and construction workers, as well as young adults that migrate from rural to urban areas (11). The results of this outbreak investigation support the recommendation for the last-mentioned group, and suggest the possibility that an additional group, i.e., young adults living in remote areas, be considered for measles vaccination when feasible. Additional studies would be helpful to more clearly identify circumstances in which measles immunization of adults would be useful.

Implications for border areas

In both routine and campaign vaccinations, low coverage rates among children made this community vulnerable to the severe and extensive impact of measles virus importation. Border areas may be particularly vulnerable to importation of measles or other diseases due to increased migration of people from neighbouring countries and inaccessibility to health services. Preventing the introduction of vaccine-preventable diseases into countries by ensuring high levels of immunological protection among residents of border areas, and by establishing sensitive and timely disease surveillance, should be a public health priority for all countries. Outbreak investigations, such as that conducted in Espindola, provide opportunities to understand potential changes in the epidemiology of disease and to evaluate and modify existing disease prevention strategies. ■

Acknowledgements

We thank Miriam Strull and Maria Carmen Reyna of the Peruvian Expanded Programme on Immunization for their valuable contributions. We also thank Dr Daniel Fishbein, Dr Stephen Redd, Dr Stanley O. Foster and Dr Jean-Marc Olivé for reviewing the manuscript.

Résumé

Epidémiologie de la rougeole et vaccination en réponse à une poussée épidémique dans une communauté rurale du Pérou

L'OMS recommande de n'envisager la vaccination antirougeoleuse en réponse à une poussée épidémique (ORI) que dans des circonstances exceptionnelles, par exemple dans le cas de communautés vivant en vase clos (1, 2). Toutefois, on ne possède que des données limitées sur l'impact de la vaccination antirougeoleuse en réponse à une poussée épidémique dans les pays en développement (3). Une étude communautaire a été réalisée à Espindola, une communauté rurale de la région frontalière au nord des Andes péruviennes, pour analyser l'évolution d'une poussée épidémique de rougeole survenue en 1993 et les coûts et avantages de l'ORI.

Les chefs de tous les ménages de la communauté ont été interrogés et des échantillons ont été prélevés pour examen sérologique sur tous les cas cliniques dont les symptômes sont apparus dans les 5 semaines ayant précédé le prélèvement des échantillons. A été considéré comme cas clinique de rougeole tout membre de la communauté présentant une fièvre et une éruption de quelque durée que ce soit pendant la poussée épidémique; comme cas primaire tout cas clinique dont les symptômes sont apparus 8 à 14 jours avant tout autre cas dans le même foyer; et comme cas confirmé tout cas présumé pour lequel des anticorps dirigés contre la nucléoprotéine du virus rougeoleux avaient été retrouvés dans le prélèvement sanguin (par capture d'IgM). L'état vaccinal a été déterminé verbalement ou en consultant les carnets de vaccination. La pneumonie a été définie par la présence d'une toux accompagnée d'une douleur thoracique de type pleurétique ou d'une cyanose; la diarrhée par l'émission de 3 selles liquides ou davantage par jour.

Sur les 553 résidents de la communauté, on a dénombré 150 (27,1%) cas cliniques de rougeole. Les adultes représentaient 44% de l'ensemble des cas. La

valeur prédictive positive (VPP) de la définition du cas présumé de rougeole recommandée par l'OMS était de 96,7%. Parmi toutes les personnes susceptibles de contracter la maladie, le taux d'atteinte était de 45,5% et de 61,2% pour la tranche d'âge 16-20 ans. Chez les adultes, la durée médiane de l'incapacité professionnelle a été de 15 jours (intervalle interquartile = 11,0-21,0). Dans la population adulte, les facteurs de risque étaient la tranche d'âge 16-20 ans (RR = 3,06, IC 95% = 2,08-4,49) et l'appartenance au sexe masculin (RR = 1,73, IC 95% = 1,11-2,71). Parmi les cas confirmés, 60,7% des sujets ont présenté une diarrhée et 32,1% une pneumonie. Le taux de létalité a été de 3,3% au total, mais a atteint 19,1% dans la tranche d'âge 0 à 23 mois. Le dernier cas s'est déclaré dans les 3 semaines suivant l'achèvement de la vaccination après poussée épidémique, vaccination qui a visé les enfants âgés de 6 mois à 15 ans quel que soit leur état vaccinal antérieur. La vaccination, qui aurait coûté environ US \$3000 en 1998, a permis d'économiser jusqu'à 1155 jours de travail/personne chez 77 adultes pour un coût de US \$2,60 par jour économisé, de prévenir quelque 87 cas de diarrhée et 46 cas de pneumonie et d'éviter 5 décès pour un coût de US \$600 par décès évité.

La non-vaccination des enfants par les services de vaccination habituels ou lors des campagnes nationales de vaccination précédentes a rendu cette communauté vulnérable aux conséquences graves de l'importation du virus rougeoleux. L'ORI pratiquée sur les enfants âgés de 6 mois à 15 ans a permis de mettre un terme à cette poussée épidémique de rougeole et de prévenir la morbidité, les pertes de salaire et les décès, en dépit du nombre important d'adultes impliqués dans la transmission de la maladie.

Resumen

Epidemiología del sarampión e inmunización de respuesta a brotes en una comunidad rural del Perú

La OMS recomienda que la opción de la inmunización de respuesta a brotes (IRB) de sarampión se reserve sólo para circunstancias excepcionales, como es el caso de las comunidades cerradas (1, 2). Sin embargo, se dispone de muy pocos datos sobre las repercusiones de la IRB contra el sarampión en los países en desarrollo (3). Realizamos una encuesta en una comunidad rural fronteriza de los Andes septentrionales peruanos, Espindola, para evaluar las consecuencias de un brote de sarampión ocurrido en 1993 y los costos y beneficios de la IRB.

Se entrevistó a los jefes de todas las familias de la comunidad, obteniéndose muestras serológicas de todos los casos clínicos ocurridos en las 5 semanas anteriores a la obtención de muestras. Se consideró caso clínico de sarampión el de todo miembro de la comunidad que hubiera presentado fiebre y exantema, cualquiera que hubiese sido su duración, durante el periodo de brote; se

consideró caso primario todo caso clínico cuyos síntomas hubiesen comenzado entre 8 y 14 días antes que otro surgido en la misma unidad familiar; y se consideró caso confirmado todo caso sospechoso que hubiera mostrado anticuerpos contra la nucleoproteína del virus del sarampión en una muestra de sangre, según la prueba de captura de IgM. El estado de vacunación se determinó verbalmente o a partir de los registros de las fichas de vacunación. La existencia de neumonía se infería de la presencia simultánea de tos y ya fuera dolor torácico pleurítico o cianosis; y la diarrea se definía por la emisión de tres o más deposiciones acuosas al día.

Entre los 553 residentes se registraron 150 casos clínicos de sarampión. Los adultos representaban un 44% de todos los casos. El valor predictivo positivo de la definición de caso sospechoso de sarampión recomendada por la OMS fue del 96,7%. La tasa de ataque entre

la población susceptible fue del 45,5% y alcanzó el 61,2% para el grupo de edad de 16-20 años. Los adultos afectados no pudieron trabajar durante 15 días como mediana (intervalo intercuartiles = 11,0-21,0). Los factores de riesgo de sarampión entre los adultos incluían el hecho de ser varón (riesgo relativo = 1,73, IC 95% = 1,11-2,71) y la pertenencia a la franja de edad de 16 a 20 años (riesgo relativo = 3,06, IC 95% = 2,08-4,49). Entre los casos confirmados, un 60,7% había sufrido diarrea, y un 32,1% neumonía. La tasa de letalidad fue de un 3,3% globalmente, pero del 19,1% en el grupo de edad de 0 a 23 meses. El último caso se produjo a las 3 semanas de concluida la IRB, dirigida a niños de entre 6 meses y 15 años con independencia de su estado de inmunización anterior. La IRB, que habría costado aproximadamente US\$ 3000 en 1998, evitó la

pérdida nada menos que de 1155 días-persona de trabajo entre 77 adultos a un costo de US\$ 2,60 por día economizado, previno según las estimaciones unos 87 casos de diarrea y 46 de neumonía, y evitó 5 defunciones a un costo de \$ 600 por muerte evitada.

La no cobertura de los niños, mediante vacunación sistemática o mediante campañas nacionales anteriores, hizo a esta comunidad vulnerable a las graves y extensas repercusiones de la importación del virus del sarampión. La IRB aplicada a los niños de 6 meses a 15 años de edad permitió atajar eficazmente ese brote de sarampión y prevenir gran parte de la morbilidad, las pérdidas de horas de trabajo y las defunciones asociadas, pese a la implicación de un gran número de adultos en la transmisión del sarampión.

References

1. *Using surveillance data and outbreak investigations to strengthen measles immunization programmes*. Geneva, World Health Organization, 1996 (unpublished document WHO/EPI/GEN/96.02; available upon request from Vaccines and other Biologicals, World Health Organization, 1211 Geneva 27, Switzerland).
2. **de Quadros CA et al.** Measles elimination in the Americas. Evolving strategies. *Journal of the American Medical Association*, 1996, 275: 224-229.
3. **Aylward RB, Clements J, Olivé JM.** The impact of immunization control activities on measles outbreaks in middle and low income countries. *International journal of epidemiology*, 1997, 26: 662-669.
4. Progress toward elimination of measles from the Americas. *Morbidity and mortality weekly report*, 1998, 47(10): 189-193.
5. **Erdman DD et al.** Evaluation of monoclonal antibody-based capture enzyme immunoassays for detection of specific antibodies to measles virus. *Journal of clinical microbiology*, 1991, 29: 1466-1471.
6. **Hummel KB et al.** Baculovirus expression of the nucleoprotein gene of measles virus and utility of the recombinant protein in diagnostic enzyme immunoassays. *Journal of clinical microbiology*, 1992, 30: 2874-2880.
7. **Armitage P, Berry G.** *Statistical methods in medical research*, 2nd ed. Oxford, Blackwell Scientific Publications, 1987.
8. **Mehta CR, Patel NR, Gray R.** Computing an exact confidence interval for the common odds ratio in several 2 x 2 contingency tables. *Journal of the American Statistics Association*, 1985, 80: 969-973.
9. **World Bank.** *World development report 1993: investing in health*. New York, Oxford University Press, 1993: 63.
10. **Pan American Health Organization.** Update: São Paulo measles outbreak. *Expanded Program on Immunization newsletter*, 1998, 20(February): 5-6.
11. **Pan American Health Organization.** Measles outbreak in Nuble Province, Chile. *Expanded Program on Immunization newsletter*, 1998, 20 (June): 2-3.
12. **Pan American Health Organization.** The Americas play to win the fight against measles! *Expanded Program on Immunization newsletter*, 1998, 20 (June): 8.