

# Epidemiological impact of a nationwide measles immunization campaign in Viet Nam: a critical review

Hitoshi Murakami,<sup>a</sup> Nguyen Van Cuong,<sup>b</sup> Hong Van Tuan,<sup>b</sup> Katsuyuki Tsukamoto<sup>c</sup> & Do Si Hien<sup>b</sup>

**Objective** To study the impact on measles case incidence of a nationwide measles immunization campaign in Viet Nam, while considering differences in disease surveillance before and after the campaign.

**Methods** A nationwide mass immunization campaign was conducted in the north and south of Viet Nam in 2002 and 2003, respectively. During the campaign, a second vaccination dose was given to children aged 9 months to 9 years, and the reported coverage reached 99% in both zones. National measles case-based surveillance data collected during 2001–2006 were reviewed and analysed. Surveillance performance was assessed in terms of case investigation and specimen collection rates and reporting sensitivity for febrile rash cases. Fisher's exact test was used to test for differences in indicator values before and after the campaign at the national and regional levels; the Wilcoxon signed-rank test was used at the provincial level.

**Findings** Despite significant improvements in disease surveillance, a dramatic reduction in observed measles incidence was noted nationwide after the immunization campaign, with a drop in the national incidence of confirmed measles cases per 100 000 population from 5.44 in 2001 to 0.14 after the campaign (i.e. 2003 in the north and 2004 in the south;  $P < 0.001$ ). Rapid measles resurgence was observed in 2005 and 2006 only in the north-western mountainous region of the country. The north did not show a statistically significant age shift for new cases (median age: 9 years in 2001 versus 8 years in 2003;  $P = 0.113$ ), whereas the south did (median age: 7 years versus 12 years;  $P < 0.001$ ).

**Conclusion** A campaign approach for controlling measles in developing parts of Asia can prove effective. The swift re-emergence of disease in the north-western region was probably due to suboptimal coverage by the campaign and by the subsequent routine expanded programme on immunization in the north-western mountainous region.

Bulletin of the World Health Organization 2008;86:948–955.

Une traduction en français de ce résumé figure à la fin de l'article. Al final del artículo se facilita una traducción al español. الترجمة العربية لهذه الخلاصة في نهاية النص الكامل لهذه المقالة.

## Introduction

Measles is a childhood viral disease associated with a relatively high case-fatality rate, especially in malnourished populations in developing countries.<sup>1</sup> It also causes numerous complications.<sup>2–4</sup> The disease has been successfully controlled in the Americas, where the number of cases decreased dramatically from 2584 in 2002 to 105 in 2003. The incidence has been low ever since.<sup>5</sup> The turning point was the introduction of nationwide mass measles immunization campaigns, usually called catch-up or knockout campaigns, and periodic follow-up campaigns. This supplementary strategy enabled the maintenance of high coverage by childhood measles immunization and the establishment of case-based surveillance involving a serological laboratory network.<sup>6</sup>

Following success in the Americas, the drive for measles control in other parts of the world was accelerated.<sup>7</sup> In 2003, the World Health Assembly resolved to halve global measles mortality during 1999–2005 by fully implementing the joint strategic plan set forth by WHO and the United Nations Children's Fund. The strategy includes strengthening routine immunization, mass immunization campaigns, case-based surveillance with laboratory confirmation and optimal care of infected children, including the administration of vitamin A.<sup>8</sup> The goal set for 2005 was successfully achieved, with a 60% reduction in global mortality.<sup>9</sup> In 2005, the WHO Regional Office for the Western Pacific set a regional goal for the elimination of measles, which was defined as terminating the circulation of domestic strains in the region, by 2012.<sup>10</sup>

Viet Nam adopted this regional goal and is aiming to achieve it by 2010. Despite a measles immunization coverage rate that has surpassed 93% since 1993 with a one-dose schedule, measles outbreaks have occurred every 7–8 years. This clearly illustrates the limitation of the single-dose approach in interrupting domestic circulation of the measles virus.<sup>11</sup> A nationwide mass measles immunization campaign was conducted mainly to provide a second dose of vaccine to children aged 9 months to 9 years. It was carried out in two phases: the north of the country was covered between March and April 2002 and the south between March and April 2003. The campaign involved massive social mobilization and included the participation of entities such as the defence ministry, the Red Cross, local government at all levels

<sup>a</sup> Bureau of International Cooperation, International Medical Center of Japan, Ministry of Health, Labour and Welfare, 1-21-1 Toyama, Shinjuku, Tokyo 162-8655, Japan.

<sup>b</sup> National Institute of Hygiene and Epidemiology, Hanoi, Viet Nam.

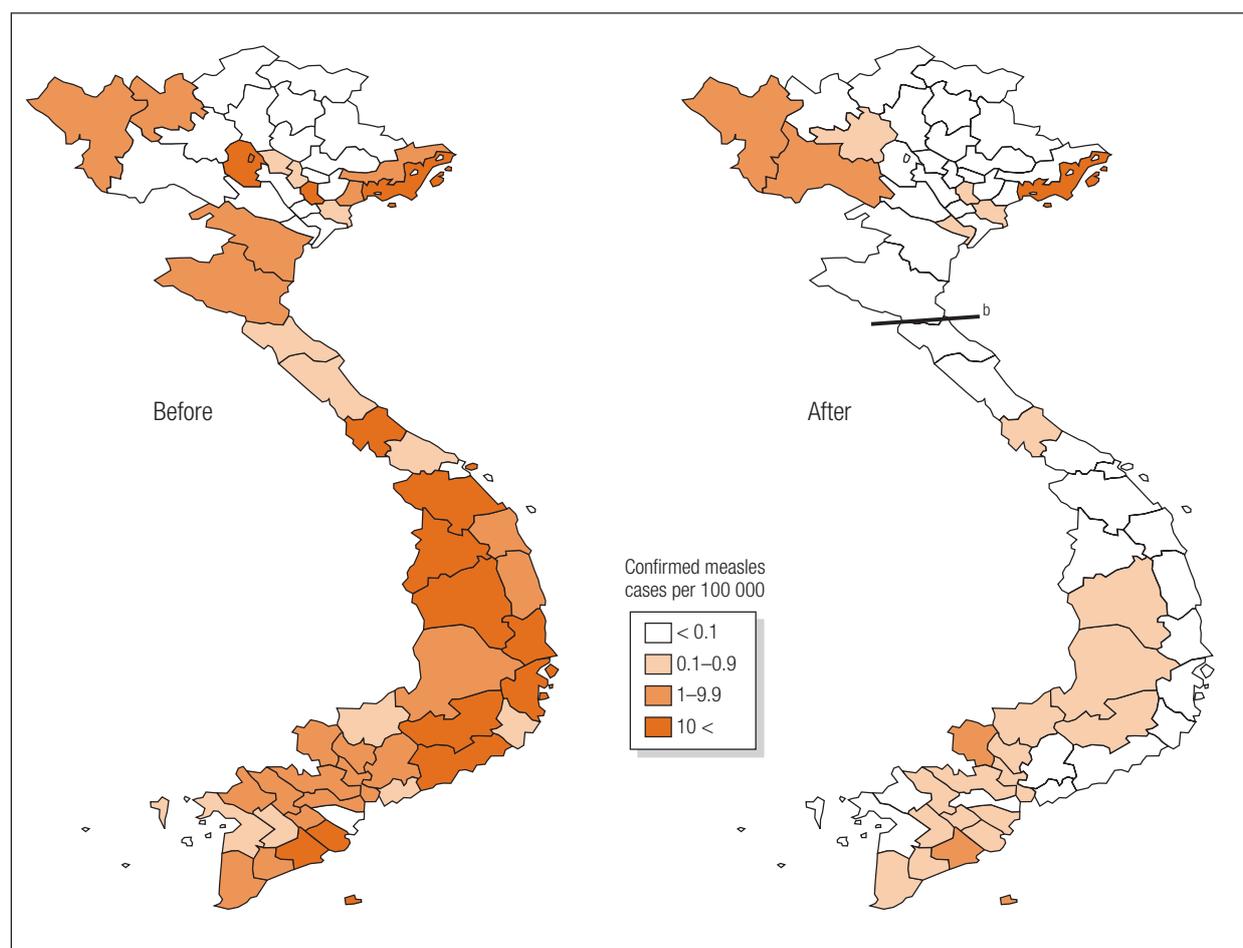
<sup>c</sup> World Health Organization, Hanoi, Viet Nam.

Correspondence to Hitoshi Murakami (e-mail: murakami@it.imcj.go.jp).

doi:10.2471/BLT.07.048579

(Submitted: 11 October 2007 – Revised version received: 6 March 2008 – Accepted: 14 April 2008 – Published online: 17 September 2008)

Fig. 1. Incidence of confirmed measles cases in Viet Nam by province, before (2001) and (2003 in the north, 2004 in the south) after the mass measles immunization campaign<sup>a</sup>



<sup>a</sup> The nationwide mass immunization campaign was conducted in the north of Viet Nam in 2002 and in the south in 2003. 2001 data were analysed for before the campaign.

<sup>b</sup> The horizontal line on the right-hand map indicates the division of the country into the north and south zones.

and the prime minister. Also, 169 906 health-care workers at all levels and 412 474 volunteers took part in this historic public health project. As a result, the reported coverage reached 6 684 980 out of 6 729 171 individuals (99.3%) in the north and 8 389 067 out of 8 466 868 (99.1%) in the south. This paper critically examines the epidemiological impact of this nationwide measles immunization campaign, while taking into account any changes in surveillance performance from before to after the campaign.

## Methodology

In Viet Nam, measles has been designated a notifiable infectious disease since the 1970s. In 2001, a WHO-recommended measles case-based surveillance system was introduced. Initially it focused on investigating and

reporting outbreaks of diseases associated with febrile rash; venous blood specimens were collected from a few early cases in order to confirm whether an outbreak was really due to measles. Since 2001, and especially after the immunization campaign, the system rapidly developed into a case-based system in which all suspected measles cases were reported and investigated and specimens were collected. A suspected measles case was defined in one of two ways: (a) any person with fever and a maculopapular (i.e. non-vesicular) rash accompanied by cough, coryza or conjunctivitis; (b) any person suspected by a clinician of having measles.

Blood specimens were usually centrifuged at a district hospital, and serum was sent to one of two national measles laboratories (the National Institute of Hygiene and Epidemiology in Hanoi

or the Ho Chi Minh City Pasteur Institute in Ho Chi Minh City). Cases of measles were confirmed in one of three ways: a laboratory-confirmed case was one in which the patient tested positive for measles-specific immunoglobulin-M (IgM) antibodies on the Enzygnost Anti-Measles Virus IgM enzyme immunoassay (Dade Behring, Marburg, Germany); an epidemiologically confirmed case was one in which there was documented evidence of exposure to a confirmed measles case within the incubation period; and a clinically confirmed case was one that met the clinical case definition despite the absence of a blood test and a history of exposure. Suspected cases in which laboratory test results were negative were discarded as non-measles. The WHO recommends testing all such cases for rubella in countries and areas in which

Table 1. Comparison of performance indicators for measles case-based surveillance in Viet Nam before and after the mass measles immunization campaign

| Performance indicator by zone  | Before the campaign <sup>a</sup> | After the campaign <sup>b</sup> | P-value from provincial analysis <sup>c</sup> | P-value from regional and nationwide analyses <sup>d</sup> |
|--|----------------------------------|---------------------------------|---|--|
| <b>Case investigation rate<sup>e</sup> (%)</b>   |                                  |                                 |   |  |
| North  | 686 of 9 365 (7)                 | 196 of 228 (86)                 | 0.002   | < 0.001  |
| South  | 1418 of 4 736 (30)               | 435 of 696 (63)                 | 0.036   | < 0.001  |
| Nationwide   | 2104 of 14 101 (15)              | 631 of 924 (68)                 | < 0.001                                       | < 0.001  |
| <b>Specimen collection rate<sup>f</sup> (%)</b>  |                                  |                                 |   |  |
| North  | 317 of 9 365 (3)                 | 157 of 228 (69)                 | < 0.001                                       | < 0.001  |
| South  | 746 of 4 736 (16)                | 392 of 696 (56)                 | < 0.001                                       | < 0.001  |
| Nationwide   | 1063 of 14 101 (8)               | 549 of 924 (59)                 | < 0.001                                       | < 0.001  |
| <b>Febrile rash cases reported but discarded as non-measles per 100 000 population<sup>g</sup></b> |                                  |                                 |   |  |
| North  | 0.20                             | 0.41                            | 0.112   | NA   |
| South  | 0.19                             | 1.01                            | < 0.001                                       | NA   |
| Nationwide   | 0.20                             | 0.74                            | < 0.001                                       | NA   |
| <b>Proportion of silent provinces<sup>h</sup> (%)</b>  |                                  |                                 |   |  |
| North  | 1 of 28 (4)                      | 9 of 28 (32)                    | NA  | 0.005  |
| South  | 4 of 33 (12)                     | 4 of 33 (12)                    | NA  | 1.000  |
| Nationwide   | 5 of 61 (8)                      | 13 of 61 (21)                   | NA  | 0.041  |

NA, not applicable.

<sup>a</sup> 2001 in the north of Viet Nam and 2002 in the south of Viet Nam.

<sup>b</sup> 2003 in the north of Viet Nam and 2004 in the south of Viet Nam.

<sup>c</sup> P-value derived using the Wilcoxon signed-rank test for the difference between the median values of the indicators before and after the campaign in each province.

<sup>d</sup> P-value derived using Fisher's exact test for the difference in indicator values recorded before and after the campaign.

<sup>e</sup> Proportion of cases investigated among the total number of suspected measles cases reported.

<sup>f</sup> Proportion of cases for which a serum specimen was collected among the total number of suspected measles cases reported.

<sup>g</sup> The figures do not include suspected cases that were reported but not classified because there was no case investigation.

<sup>h</sup> Proportion of provinces that did not report even one suspected measles case.

measles has almost been eliminated. The recommendation was slightly modified and followed in Viet Nam, as has been done in the Caribbean, and all suspected measles cases were tested for rubella-specific IgM.<sup>12</sup>

We analysed the 2001–2006 national measles surveillance data for Viet Nam. In assessing the campaign's epidemiological impact, only measles cases confirmed by laboratory results, epidemiological linkage or clinical compatibility were included. A descriptive epidemiological analysis of confirmed cases was carried out to reveal monthly incidence trends and geographical and age distributions. Pre-campaign cases in the north were defined as those that occurred during 2001, whereas post-campaign cases were those that occurred during 2003. Similarly, 2002 and 2004 were considered the pre- and post-campaign periods in the south. We thus excluded cases that occurred during the campaign phases to avoid possible misclassification and to reflect the same seasons and durations of pre- and post-

campaign periods in both north and south. In so doing, we circumvented distortions that could have been introduced into the analysis by underlying seasonal fluctuations in measles incidence. For the geographical distribution of confirmed measles cases (Fig. 1), the pre-campaign period was defined as 2001 for both north and south to illustrate the actual geographical variation in the annual incidence across the nation in a single pre-campaign year.

Surveillance performance indicators, namely the case investigation rate, the specimen collection rate, the proportion of silent provinces that reported no febrile rash cases in a year, and the number of reported cases discarded as non-measles per 100 000 population, were derived for before and after the campaign and compared. For each province, the Wilcoxon signed-rank test was used to test for differences between the medians of the indicators before and after the campaign; for the national and regional levels, Fisher's exact test was used (Table 1).

Pre- and post-campaign periods in the north and south were defined in the same way as in the epidemiological analysis. In analysing the change in reporting sensitivity from before to after the campaign, only reported suspected measles cases that were eventually discarded as non-measles were included. This was done to eliminate the effect of the reduction in measles incidence due to the campaign and to ensure that pre- and post-campaign performances were comparable. Even though measles was controlled after the campaign, it is unlikely that the incidence of similar diseases such as rubella would have been affected. The estimated mid-year population was used to calculate measles incidence and the number of cases discarded as non-measles that were reported per 100 000 population during each year. The surveillance data set was originally maintained using Microsoft Access software (Microsoft Corp., Redmond WA, United States of America (USA)) and was analysed using SPSS 10.0J (SPSS Inc., Chicago IL, USA).

## Results

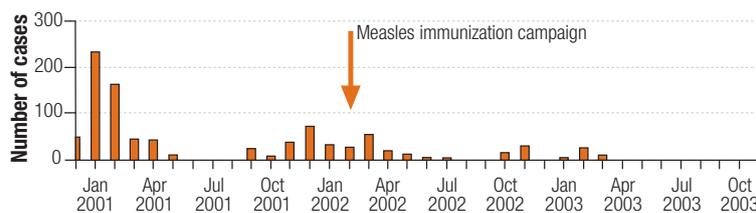
### Impact on monthly incidence

Fig. 2 and Fig. 3 depict the number of confirmed measles cases reported each month from 2001 to 2003 in the north and south of Viet Nam through the measles-case-based surveillance system before and after the immunization campaign. The seasonal peak in incidence occurred from January to May. The campaign targeted this period of high disease transmission and effectively reduced case incidence. In 2002 in the north, disease incidence was significantly reduced during and after the campaign, while in the south, the usual seasonal surge was noted but was reduced in 2003, and incidence remained low after the campaign. Nationally, confirmed measles cases dropped steadily and dramatically from 2001 to 2004: 3708, 1806, 855 and 95, respectively. Of the 95 confirmed measles cases observed in 2004, five were confirmed upon laboratory testing of 900 specimens, and 90 were confirmed on clinical grounds. Clearly, measles was very effectively suppressed in 2004.

### Impact on geographical and age distributions

Nationally, the incidence of confirmed measles cases per 100 000 population decreased from 5.44 in 2001 to 0.14 after the campaign ( $P < 0.001$ ). Fig. 1 shows the population-based incidence

Fig. 2. Change in the number of confirmed measles cases reported<sup>a</sup> in the north of Viet Nam before and after the mass measles immunization campaign<sup>b</sup>



<sup>a</sup> Cases reported through the measles case-based surveillance system.

<sup>b</sup> The arrow indicates the starting date for the immunization campaign.

of confirmed measles cases in each of the 61 provinces in Viet Nam both before the campaign (2001) and after (i.e. 2003 in the north and 2004 in the south). In 2001, the incidence was greater than 10 per 100 000 in 12 provinces. After the campaign, most had an incidence of less than 1 per 100 000, proof that effective suppression of measles had been attained in each province. However, the mountainous north-west and the central highlands continued to have a higher incidence than other parts of the country after the campaign.

Fig. 4 and Fig. 5 show that measles in children aged under 10 years of age was more successfully reduced in the south than the north. After the campaign, the median age for the entire country shifted from 8 to 11 years ( $P < 0.001$  by Mann-Whitney test). On analysing the north and south

separately, the former did not show a statistically significant age shift (median age: 9 years in 2001 versus 8 years in 2003;  $P = 0.113$ ), whereas the latter did (median age: 7 years versus 12 years;  $P < 0.001$ ). There was also an incidence peak in children aged under 1 year both before and after the campaign, probably due to the neutralizing effect of transferred maternal antibodies on vaccine-induced seroconversion.

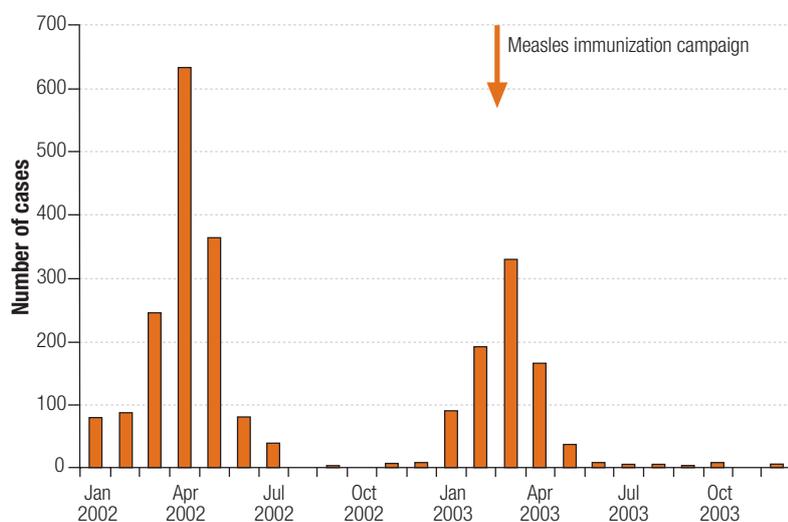
### Change in surveillance performance

Both the case investigation rate and the specimen collection rate were significantly better, at the 95% confidence level, after the campaign at the provincial, regional and national levels (Table 1). The reporting sensitivity of non-measles febrile rash cases also increased 3.5-fold after the campaign. Using the figures for each province, the change in reporting sensitivity was statistically significant both nationally and in the south ( $P < 0.001$  for both using the Wilcoxon signed-rank test). Of concern was the increased number of "silent" provinces seen in the north after the campaign. Eight of the 28 northern provinces became silent and, consequently, the proportion of silent provinces increased significantly ( $P = 0.041$  using the  $\chi^2$  test). Thus, the reporting sensitivity varied between provinces against a background of nationwide improvement. In summary, although the proportion of silent provinces increased, in general the capacity of case-based surveillance to detect and confirm measles cases was significantly better after the campaign.

### Long-term impact

Despite the success of the immunization campaign, local measles outbreaks were detected as early as 2005

Fig. 3. Change in the number of confirmed measles cases reported<sup>a</sup> in the south of Viet Nam before and after the mass measles immunization campaign<sup>b</sup>



<sup>a</sup> Cases reported through the measles case-based surveillance system.

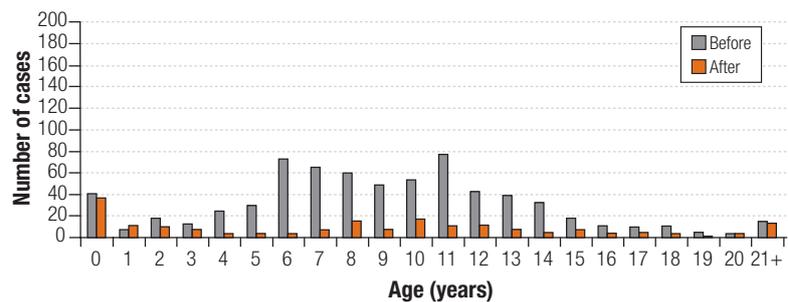
<sup>b</sup> The arrow indicates the starting date for the immunization campaign.

in Lai Chau province and in Lao Cai province, both in the north-western mountainous region. In total, 293 cases were reported in Lai Chau province, of which 136 were laboratory confirmed and 157 were epidemiologically confirmed. Of these 293 cases, 150 (51%) were in individuals aged over 15 years. In Lao Cai province, 91 cases were reported; 15 were laboratory confirmed and 76 were epidemiologically confirmed. Of these 91 cases, 42 (46%) were in individuals aged over 15 years.

In 2006, there was a larger resurgence of measles involving 1978 confirmed cases, of which 1607 were either laboratory or epidemiologically confirmed. Of these, 1883 cases occurred in Dien Bien province, which was part of the former Lai Chau province in the north-western corner of the country bordering China until 2004, when the latter province was divided into two smaller provinces: Dien Bien and Lai Chau. Of the cases that occurred in Dien Ben, 153 were laboratory confirmed and 1355 were epidemiologically confirmed. Only 248 (14%) of these confirmed cases were in individuals aged over 15 years, while 1289 (71%) were in children aged under 10 years. In the same year, a second routine immunization, given at school entry, was introduced into the province. Throughout 2005 and 2006, the main focus of the resurgence was in the territory comprised by the former Lai Chau province. As can be seen in Fig. 1, the incidence in this area did not decrease much after the campaign, which suggests that the campaign was compromised locally. There was no death due to measles in either the 2005 or 2006 outbreak.

Fig. 6 shows the annual number of measles cases between 1986 and 2006. Two measles surveillance systems

Fig. 4. Age distribution of measles cases before and after the mass measles immunization campaign in the north of Viet Nam



co-existed during 2001–2002: notifiable diseases surveillance and measles case-based surveillance. The former system confirmed more cases based on physicians’ diagnosis than the latter, which primarily confirmed cases either by laboratory tests or epidemiologically. Consequently, the former system may be considered less specific than the latter because of possible overdiagnosis by physicians. The peak incidence in 2006 was low. In 2007, there were only 17 confirmed measles cases. Cases mainly occurred in the north-western mountainous provinces and did not lead to a long-term increase in incidence.

Discussion

Findings and limitations

The incidence of measles in Viet Nam was significantly reduced after the 2002–2003 nationwide immunization campaign, particularly in 2004. Comparison of the performance of the surveillance system before and after the campaign clearly indicates that the system’s ability to detect and confirm measles cases improved. The reduced measles incidence observed is, therefore, genuine. However, without the swift introduction of a follow-up second im-

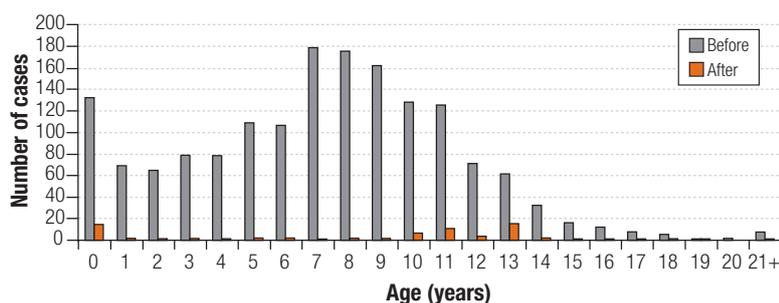
munization, the reduction in incidence was followed by the rapid resurgence of measles, even though routine second-dose immunization at school entry commenced after 2006.

A notable limitation of the study is the underrepresentation of measles cases that were not investigated and laboratory tested before the campaign. It is difficult to determine whether the numerous uninvestigated and untested cases were measles or not. These cases were clinically diagnosed by physicians and reported through the notifiable infectious disease surveillance system rather than the measles case-based surveillance system. Although the reporting sensitivity of non-measles febrile rash cases increased at the national, regional and provincial levels after the campaign, the analysis did not include those uninvestigated and untested cases, and this may have compromised the validity of both the sensitivity estimate and the epidemiological analysis for the pre-campaign period, especially in the north.

A global context

Between 2000 and 2003, 23 of the 45 countries with the highest measles mortality, including Viet Nam, implemented nationwide measles immunization campaigns. This undoubtedly contributed to the dramatic fall in measles mortality worldwide by 2005.<sup>9,13</sup> The campaigns in three west African nations (Burkina Faso, Mali and Togo) have been documented<sup>14</sup> and the annual number of cases after the campaigns ranged from 333 in Togo to 1712 in Burkina Faso. A reduction in incidence also occurred after the 2002 campaign in Afghanistan<sup>15</sup> but was smaller than reductions obtained in the Americas and Viet Nam.

Fig. 5. Age distribution of measles cases before and after the mass measles immunization campaign in the south of Viet Nam



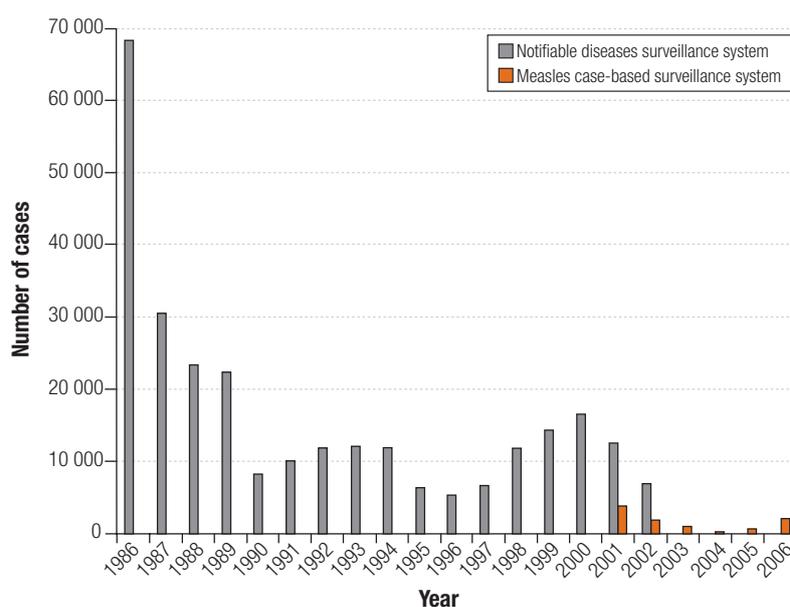
The reduced incidence of measles following a campaign offers an opportunity to introduce a case-based surveillance system involving case investigation and specimen testing. The WHO Regional Office for the Western Pacific<sup>16</sup> and the global consensus meeting on monitoring measles elimination<sup>17</sup> both have as a criterion for elimination that the surveillance system should be sensitive enough to report at least one suspected measles case per 100 000 population per year in at least 80% of all districts. In Viet Nam, the reporting sensitivity was 0.74 per 100 000 after the campaign (Table 1), just below the level required to certify elimination.

Discussions with preventive medicine staff indicate that the increase in silent provinces in the north after the campaign was probably caused by bias and complacency. Bias was due to preventive medicine staff not reporting suspected measles cases because of a fear it would be interpreted as a failure of the immunization campaign and thus damage their reputation. Complacency was due to the belief that there would not be many febrile rash cases after the campaign because of the reduced measles incidence.

In the Region of the Americas, estimated reporting rates of suspected measles cases between 2003 and 2006 ranged from 3.55 to 4.34 per 100 000.<sup>18–21</sup> During the same period, confirmed measles cases in the region ranged from 75 to 187 per year (incidence rate per 100 000 population from 0.01 to 0.02), indicating near elimination. Compared to the America's sensitive system, Viet Nam's measles surveillance system was still suboptimal at the time of the study. However, the reporting rate reached 5.19 per 100 000 in 2006, by far the highest among Western Pacific countries.

In the Western Pacific, the Republic of Korea was the first country to declare measles elimination in 2006, with only 25 new cases (an incidence of 0.52 per 1 million population).<sup>22</sup> However, the reporting rate of non-measles febrile-rash cases in the country was 0.18 per 100 000 population, indicating still suboptimal reporting sensitivity.<sup>23</sup> Some Pacific island countries have demonstrated limited measles virus transmission since national campaigns in 1997 and 1998, although sporadic outbreaks have been reported,<sup>11</sup> and the reporting

Fig. 6. Annual number of measles cases reported in Viet Nam between 1986 and 2006<sup>a</sup>



<sup>a</sup> In 2001, only the north of Viet Nam had implemented the measles case-based surveillance system.

rate of non-measles febrile-rash cases was 0.20 per 100 000 population.<sup>23</sup> In the Hong Kong Special Administrative Region of China, the incidence of measles was reduced to 0.9 per 100 000 population in 1998.<sup>24</sup> In 2006, it was 1.49 per 100 000 population.<sup>23</sup>

### Challenges faced after the campaign

A possible explanation of the rapid resurgence of measles in north-western Viet Nam during 2005–2006 is that older children remained vulnerable because the age group targeted for vaccination was narrower (i.e. 9 months to 9 years) than recommended (i.e. up to 14 years).<sup>25</sup> The change in age distribution after the campaign observed in the south (Fig. 5) and in outbreaks in Lai Chau province and Lao Cai province in 2005 suggest that the virus may continue to circulate among teenagers. Conversely, children aged under 10 years were mainly affected in the larger 2006 outbreak focused on Dien Bien province, which instead indicates suboptimal immunization coverage. Also, 474 of the 1508 confirmed cases (31%) in the Dien Bien outbreak occurred in children aged under 1 year, pointing to suboptimal coverage by the expanded programme on immunization since 2003. Accordingly, the resurgence was probably due to suboptimal coverage of both the immunization campaign and,

thereafter, the expanded programme on immunization. This implies that increasing the upper age limit from 10 to 15 years would not necessarily be effective and would certainly not be cost-effective.

An important strategic question is how to maintain the population immunity attained in 2004 given the variation in immunity across the country. Viet Nam has the advantage that coverage of the routine first dose of measles vaccination is generally high: 98% and 94% in the north and the south, respectively, before the campaign, and 97% and 96%, respectively, after. This background no doubt contributed to the very effective suppression of measles after the campaign. In 2006, the country introduced the second routine immunization dose at school entry in 43 out of 64 provinces, with a coverage exceeding 98%.

The county is reluctant to implement nationwide follow-up campaigns mainly because of concern about the cost. In the nationwide catch-up campaign described here, US\$ 2.0 million was spent on operational costs in addition to the cost of the necessary vaccines, syringes and safety boxes provided by Japan. This expenditure was unprecedented for a mass public health intervention in the country. A follow-up campaign targeting 1- to 4-year-olds will require nearly half the money

spent on the catch-up campaign. In November and December 2007, an immunization campaign was carried out in 17 mountainous provinces in the north targeting 6- to 20-year olds (1- to 20-year-olds in four provinces with the highest risk) in response to the 2005 and 2006 outbreaks.

Viet Nam is aiming to achieve the level of immunity required to eliminate measles by maintaining a high coverage of routine first vaccinations in infants, routine second vaccinations at school entry

and supplementary local campaigns in high-risk districts. The effectiveness of this strategy should be closely monitored since the country is a rare example of a tropical developing country outside the Americas that is pursuing measles elimination following a catch-up campaign, which this critical epidemiological review found to be very effective. ■

#### Acknowledgements

The authors thank the regional, provincial, district and subdistrict preventive

medicine staff in Viet Nam for establishing and implementing the measles case-based surveillance programme during the study period.

**Funding:** This review was carried out while some of the authors were assigned to the WHO Viet Nam Office. Therefore, part of the data collection and analysis was indirectly funded from that Office's budget.

**Competing interests:** None declared.

## Résumé

### Impact épidémiologique d'une campagne nationale de vaccination antirougeoleuse au Viet Nam : revue critique

**Objectif** Etudier l'impact d'une campagne nationale de vaccination antirougeoleuse de masse au Viet Nam sur l'incidence des cas de rougeole, en considérant les variations des résultats de la surveillance de cette maladie avant et après la campagne.

**Méthodes** Une campagne nationale de vaccination de masse a été menée dans le Nord, puis dans le Sud du pays, en 2002 et 2003 respectivement. Dans le cadre de cette campagne, une deuxième dose de vaccin a été administrée aux enfants de 9 mois à 9 ans et le taux de couverture rapporté a atteint 99 % dans les deux zones. Les données de surveillance nationale de la rougeole à partir des cas recensés, recueillies sur la période 2001-2006, ont été examinées et analysées. Les résultats de la surveillance ont été évalués en termes de taux d'investigation des cas et de collecte d'échantillon, et d'après la sensibilité de la notification pour les cas d'éruption fébrile. On a utilisé le test exact de Fisher pour rechercher des différences entre les valeurs indicatrices avant et après la campagne, au niveau du pays et des régions et on a fait appel au test de Wilcoxon (test des rangs signés) au niveau provincial.

**Résultats** Malgré de grandes améliorations dans la surveillance de la maladie, on a observé une forte chute de l'incidence de la rougeole à l'issue de la campagne de vaccination, avec une baisse de l'incidence nationale des cas confirmés pour 100 000 habitants de 5,44 en 2001 à 0,14 après la campagne (c'est-à-dire en 2003 dans le Nord et en 2004 dans le Sud,  $p < 0,001$ ). Une résurgence rapide de la rougeole a été observée en 2005 et 2006, mais seulement dans la région montagneuse du Nord-Ouest. On n'a pas observé dans le Nord de décalage statistiquement significatif de l'âge médian des nouveaux cas (âge médian : 9 ans en 2001 contre 8 ans en 2003,  $p = 0,113$ ), en revanche ce fut le cas dans le Sud (âge médian passant de 7 ans en 2001 à 12 ans en 2003,  $p < 0,001$ ).

**Conclusion** Une démarche de type campagne vaccinale peut s'avérer efficace pour endiguer la rougeole dans les régions en développement d'Asie. La réémergence de cette maladie dans la région du Nord-Ouest était probablement due à une couverture sous-optimale de cette région par la campagne et par le programme étendu de vaccination systématique ultérieurement mis en place.

## Resumen

### Impacto epidemiológico de una campaña nacional de inmunización antisarampión en Viet Nam: reseña crítica

**Objetivo** Estudiar el impacto en la incidencia de casos de sarampión de una campaña nacional de inmunización antisarampión en Viet Nam, teniendo en cuenta la diferente eficacia de la vigilancia de la enfermedad antes y después de la campaña.

**Métodos** Se llevó a cabo una campaña nacional de inmunización masiva en el norte y el sur de Viet Nam en 2002 y en 2003, respectivamente. Durante la campaña, se administró una segunda dosis a los niños de 9 meses a 9 años de edad, con una cobertura notificada que alcanzó el 99% en las dos zonas. Se analizaron los datos nacionales de vigilancia de los casos de sarampión reunidos durante el periodo 2001-2006. La eficacia de la vigilancia se determinó en función de las tasas de investigación de casos y de recogida de muestras, así como de la sensibilidad de la notificación de los casos de exantema febril. Se empleó la prueba exacta de Fisher para analizar las diferencias entre los indicadores antes y después de la campaña a nivel nacional y regional; con los datos de nivel provincial se aplicó la prueba de rangos con signo de Wilcoxon.

**Resultados** Pese a mejorar considerablemente la vigilancia de la enfermedad, tras la campaña de inmunización se registró una muy marcada reducción de la incidencia observada de sarampión a nivel nacional, con una caída de la incidencia nacional de casos confirmados por 100 000 habitantes de 5,44 en 2001 a 0,14 después de la campaña (esto es, en 2003 en el norte y en 2004 en el sur;  $p < 0,001$ ). El rápido resurgimiento de casos de sarampión observado en 2005 y 2006 se limitó a la región montañosa noroccidental del país. En el norte no se observó un desplazamiento estadísticamente significativo de la edad en los nuevos casos (mediana de la edad: 9 años en 2001, frente a 8 años en 2003;  $p = 0,113$ ), mientras que en el sur sí se dio tal desplazamiento (mediana: 7 años, frente a 12 años;  $p < 0,001$ ).

**Conclusión** La realización de campañas puede ser un arma eficaz para controlar el sarampión en las zonas en desarrollo de Asia. La súbita reaparición de la enfermedad en la región montañosa noroccidental se debió probablemente a una cobertura subóptima tanto de la campaña como del posterior programa ampliado de inmunización sistemática en dicha región.

## ملخص

## الأثر الإبيديميولوجي لحملة شاملة للبلاد للتطعيم ضد الحصبة في فيت نام

حدوث انخفاض في معدل الوقوع الوطني الملاحظ لحالات الحصبة المؤكدة لكل 100 000 من السكان، من 5.44 في عام 2001 إلى 0.14 بعد الحملة (أي في عام 2003 في شمال البلاد، وفي عام 2004 في جنوب البلاد)؛ عند قيمة احتمال  $P > 0.001$ ). كما لوحظ انبعاث سريع للحصبة في عامي 2005 و2006 في المنطقة الجبلية بشمال غربي فيت نام. ولم يُلاحظ في شمال البلاد اختلاف يُعتد به إحصائياً في عمر الحالات الحديثة (العمر الوسيط: 9 سنوات في عام 2001 مقابل 8 سنوات في عام 2003؛ عند قيمة احتمال  $P = 0.113$ )، ولكن لوحظ اختلاف في جنوب البلاد (العمر الوسيط: 7 سنوات مقابل 12 سنة؛ عند قيمة احتمال  $P > 0.001$ ).

الاستنتاج: يمكن لأسلوب الحملات في مكافحة الحصبة في المناطق النامية في آسيا أن يثبت فعاليته. وقد يُعزى الانبعاث السريع للمرض في شمال غربي البلاد إلى معدل التغطية دون الأمثل بأنشطة الحملة وبأنشطة التطعيم الروتيني اللاحقة المنفذة من قبل البرنامج الموسع للتمنيع في المنطقة الجبلية بشمال غربي البلاد.

الغرض: استهدفت هذه الدراسة معرفة تأثير حملة تطعيم شاملة للبلاد ضد الحصبة في فيت نام على معدل وقوع حالات الحصبة في البلد، مع الأخذ في الاعتبار الفروق في ترصد المرض قبل الحملة وبعدها.

الطريقة: أجريت حملة تطعيم شاملة في شمال فيت نام في عام 2002 وفي جنوب البلاد في عام 2003. وتم في هذه الحملة إعطاء جرعة تلقيح ثانية للأطفال الذين هم في عمر 9 شهور إلى 9 سنوات، ووصل معدل التغطية المبلغ إلى 99% في المنطقتين. وتمت مراجعة وتحليل بيانات ترصد حالات الحصبة الوطنية التي جمعت خلال المدة 2001 - 2006. كما تم تقييم أداء عملية التردد من حيث تقصي الحالات ومعدلات جمع العينات وحساسية التبليغ عن حالات الطح الحُموي. واستُخدم اختبار الدقة لفيشر Fisher Exact Test واختبار الفروق في القيم للمؤشر قبل الحملة وبعدها على الصعيد الوطني وصعيد المناطق؛ كما استُخدم اختبار ولوكوكسون Wilcoxon signed-rank test على صعيد الولايات.

النتائج: برغم التحسن الملموس في ترصد المرض، لوحظ انخفاض جذري في معدل الوقوع الملاحظ للحصبة على النطاق القطري بعد حملة التطعيم، مع

## References

- Halsey NA. Measles in developing countries. *BMJ* 2006;333:1234. PMID:17170396 doi:10.1136/bmj.39058.361620.BE
- Fetuga MB, Jekanma OF, Ogunfowora OB, Abiodun R. A ten-year study of measles admissions in a Nigerian teaching hospital. *Niger J Clin Pract* 2007;10:41-6. PMID:17668714
- Filia A, Brenna A, Pana A, Moggio Cavallaro G, Massari M, Ciofi Degli Atti ML. Health burden and economic impact of measles-related hospitalizations in Italy in 2002-2003. *BMC Public Health* 2007;7:169. PMID:17650298 doi:10.1186/1471-2458-7-169
- Bellini WJ, Rota JS, Lowe LE, Katz RS, Dyken PR, Zaki SR, et al. Subacute sclerosing panencephalitis: more cases of this fatal disease are prevented by measles immunization than was previously recognized. *J Infect Dis* 2005;192:1686-93. PMID:16235165 doi:10.1086/497169
- Centers for Disease Control and Prevention (CDC). Progress toward measles elimination — region of the Americas, 2002-2003. *MMWR Morb Mortal Wkly Rep* 2004;53:304-6. PMID:15085074
- De Quadros CA, Olive JM, Hersh BS, Strassburg MA, Henderson DA, Brandling-Bennett D, et al. Measles elimination in the Americas. Evolving strategies. *JAMA* 1996;275:224-9. PMID:8604176 doi:10.1001/jama.275.3.224
- Hoekstra EJ, McFarland JW, Shaw C, Salama P. Reducing measles mortality, reducing child mortality. *Lancet* 2006;368:1050-2. PMID:16997650 doi:10.1016/S0140-6736(06)69335-5
- Measles mortality reduction and regional elimination: strategic plan 2001-2005. Geneva: WHO & United Nations Children's Fund (UNICEF); 2001. pp. 6-15.
- Wolfson LJ, Strebel PM, Gacic-Dobo M, Hoekstra EJ, McFarland JW, Hersh BS. Has the 2005 measles mortality reduction goal been achieved? A natural history modeling study. *Lancet* 2007;369:191-200. PMID:17240285 doi:10.1016/S0140-6736(07)60107-X
- The World Health Organization Regional Committee for the Western Pacific. Resolution no. WPR/RC54.R3 (Expanded Programme on Immunization: measles and hepatitis B). Manila: WHO Regional Office for the Western Pacific; 2003.
- McFarland JW, Mansoor OD, Yang B. Accelerated measles control in the Western Pacific region. *J Infect Dis* 2003;187 Suppl 1;s246-51. PMID:12721921 doi:10.1086/368039
- Irons B, Carrasco P, Morris-Glasgow V, Castillo-Solórzano C, de Quadros CA. Integrating measles and rubella surveillance: the experience in the Caribbean. *J Infect Dis* 2003;187 Suppl 1;s153-7. PMID:12721907 doi:10.1086/368031
- Centers for Disease Control and Prevention (CDC). Progress in reducing measles mortality-worldwide, 1999-2003. *MMWR Morb Mortal Wkly Rep* 2005;54:200-3. PMID:15744229
- Centers for Disease Control and Prevention (CDC). Measles mortality reduction-West Africa, 1996-2002. *MMWR Morb Mortal Wkly Rep* 2004;53:28-30.
- Centers for Disease Control and Prevention (CDC), Nationwide measles vaccination campaign for children aged 6 months-12 years. Afghanistan, 2002. *MMWR Morb Mortal Wkly Rep* 2003;52:363-6.
- Field guidelines for measles elimination. Manila: WHO Regional Office for the Western Pacific; 2004. p. 5.
- Monitoring the interruption of indigenous measles transmission, Cape Town meeting, 14 October 2003. *Wkly Epidemiol Rec* 2004;7:70-2.
- Measles Weekly Bulletin. Vol. 9, no. 53. Washington, DC: Pan American Health Organization; 2003. Available from: <http://www.paho.org/english/AD/FCH/IM/MeaslesWeeklyBulletin.htm> [accessed on 1 September 2008].
- Measles Weekly Bulletin. Vol. 10, no. 52. Washington, DC: Pan American Health Organization; 2004.
- Measles Weekly Bulletin. Vol. 11, no. 52. Washington, DC: Pan American Health Organization; 2005.
- Measles Weekly Bulletin. Vol. 12, no. 52. Washington, DC: Pan American Health Organization; 2006. Available from: <http://www.paho.org/english/AD/FCH/IM/MeaslesWeeklyBulletin.htm> [accessed on 1 September 2008].
- Measles Bulletin. Vol. 1, issue 11. Manila: WHO Regional Office for the Western Pacific; 2006. Available from: <http://www.wpro.who.int/sites/epi/documents/MeaslesBulletin.htm> [accessed on 1 September 2008].
- Measles Bulletin. Vol. 1, issue 12. Manila: WHO Regional Office for the Western Pacific; 2007. Available from: <http://www.wpro.who.int/sites/epi/documents/MeaslesBulletin.htm> [accessed on 1 September 2008].
- Chuang SK, Lau YL, Lim WL, Chow CB, Tsang T, Tse LY. Mass measles immunization campaign: experience in the Hong Kong Special Administrative Region of China. *Bull World Health Organ* 2002;80:585-91. PMID:12163924
- Measles eradication field guide [Technical paper no. 41]. Washington, DC: Pan American Health Organization; 2003. pp. 23-30.