Measles in Rural West Bengal, India, 2005–6: Low Recourse to the Public Sector Limits the Use of Vitamin A and the Sensitivity of Surveillance

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Background. Measles is often underreported. We evaluated the sensitivity of the measles surveillance in 2 districts of West Bengal in 2005–2006.

Methods. We sampled households with children aged <5 years in village clusters selected with probability proportional to size. We searched households door to door to identify World Health Organization–defined suspected measles cases that had occurred during 12 months in 2004–2005 in Howrah and in 2006 in Purulia. We interviewed mothers about use of health care services during episodes and calculated the proportion of patients seen in the public sector. We reviewed surveillance records at all levels to estimate the proportion of cases seen in public health care facilities that had been reported to the district. We calculated the overall sensitivity of measles surveillance by multiplying these 2 proportions.

Results. In Howrah, we identified 240 cases of measles. Of these, 8 (3.3% [95% confidence interval {CI}, 1.5%–6.5%]) had been seen in public facilities and recorded. Of 980 cases identified in 448 public facilities in the periphery, 962 (98%) had been transmitted to the district (overall sensitivity of surveillance, 3.2%). In Purulia, we identified 167 measles cases. Of these, 39 (23.4% [95% CI, 17.2%–30.5%]) had been seen in public facilities and recorded. Of 418 cases identified in public facilities in the periphery, 414 (99%) had been transmitted to the district (overall sensitivity of surveillance, 23.1%).

Conclusions. Measles surveillance captured a minority of measles cases, but cases captured were transmitted well to the district. Surveillance must engage the private sector. Health education focusing on vitamin A treatment for measles might provide an incentive to seek care, which could increase the sensitivity of surveillance.

In the year 2000, measles was a leading cause of childhood morbidity and mortality worldwide, accounting for 50%–60% of childhood vaccine-preventable deaths globally [1]. Hence, in 2001, the World Health Organization (WHO) and UNICEF launched a global initiative toward reduction of measles mortality and regional elimination of the disease [1]. In accordance with this initiative, some regions had a goal of eliminating measles, while others, including the WHO Southeast Asia region (SEAR), had to focus first on reducing mortality. Surveillance efforts need to be adapted to the goal in place. At the earlier, mortality reduction stage, when measles virus freely circulates within poorly immunized communities, surveillance focuses on detecting larger outbreaks to trigger investigations, if warranted. At a later, measles elimination stage, once routine coverage has been improved with the introduction of a second opportunity for measles immunization, surveillance can be upgraded to a case-based system that is sensitive (ie, captures a large proportion of cases) and ensures laboratory confirmation. This allows the estimation
of the proportion of suspected measles cases that are in fact due to rubella or other diseases.

Between 2001 and 2005, the global measles initiative achieved substantial progress and reached its goals [2]. However, challenges persisted, including in the WHO SEAR and in India. In 2005, the WHO estimated that globally 345,000 deaths due to measles occurred, with 174,000 in the WHO SEAR. Hence, following this 2005 review, India was one of the 47 high-priority countries identified for measles mortality reduction, with a focus on outbreak detection and management [2, 3, 4]. Measles vaccine was introduced in a Universal Immunization Programme in the country in 1985. Although the reported 1-dose measles vaccine coverage was 90% in 2005, the evaluated coverage was only 59% [5]. Coverage also varied across states and within states [5]. In 2009, data available from 6 Indian states indicate that nearly 45% of measles cases in the country were reported in children aged <5 years [6]. In 2005, the Government of India developed a multiyear strategic plan with the objectives of (1) reducing measles mortality rates by two-thirds by 2010 (compared with the 2000 estimates), (2) achieving at least 90% coverage with measles vaccine in 80% of the districts by 2009, and (3) collecting high-quality epidemiological data to use to guide further action [7]. This strategy also recommended the use of Vitamin A for case management. The primary purpose of measles surveillance is to detect, in a timely manner, all areas in which the measles virus is circulating. However, case-based surveillance has not yet been initiated and measles cases remained underreported in the country. In 1996, in the state of Uttar Pradesh, cases were recorded in only 20% of the districts [8]. In 2005, the Government of India developed a multiyear strategic plan with the objectives of (1) reducing measles mortality rates by two-thirds by 2010 (compared with the 2000 estimates), (2) achieving at least 90% coverage with measles vaccine in 80% of the districts by 2009, and (3) collecting high-quality epidemiological data to use to guide further action [7]. This strategy also recommended the use of Vitamin A for case management. The primary purpose of measles surveillance is to detect, in a timely manner, all areas in which the measles virus is circulating. However, case-based surveillance has not yet been initiated and measles cases remained underreported in the country. In 1996, in the state of Uttar Pradesh, <1% of the estimated measles cases were captured by the surveillance system [8]. In fact, states with lower rates of immunization coverage report the fewest cases, and overall, the number of reported cases in the country (52,546 in 2005) was far from what could be expected on the basis of the vaccination coverage rates [6].

In 2004–2005, the Indian state of West Bengal reported 85% measles vaccine coverage and 15,217 cases of measles (Government of West Bengal, Department of Health, unpublished data). A national survey conducted during 2002–2004 provided additional information, suggesting that the measles vaccination coverage was in fact lower, at 65% [9]. From 2004, the appointment of a number of scholars from the Indian Field Epidemiology Training Programme (FETP) of the National Institute of Epidemiology led to a number of measles outbreak investigations that pointed to low rates of vaccine coverage as a key factor in the persistence of measles virus circulation in the state [10]. The state of West Bengal has a measles surveillance system that focuses exclusively on children aged <5 years [11]. It is based on (1) active case search through fortnightly house visits by community health workers and (2) passive detection in health care facilities. Cases are then compiled in block primary health centers (at the level of the community development block) before being forwarded to the district headquarters.

However, little information was available to understand the use of health care facilities for measles-affected children and the characteristics of the surveillance system. Hence, in 2005 and 2006, we conducted a project in the Howrah and Purulia districts of West Bengal (1) to understand the use of health care facilities among children affected by measles and (2) to estimate the sensitivity of the surveillance system.

METHODS

Populations
We evaluated the surveillance system in place for measles among children aged <5 years in 2 districts in the state of West Bengal. First, we worked in 14 rural block primary health centers of Howrah (close to the city of Kolkata) in 2005. During that year, the district had a population of children aged <5 years of 461,242 and reported a 58% rate of measles vaccine coverage and 1190 cases of measles. Second, we worked in Purulia district (with 20 block primary health centers, in a rural environment, and farther away from Kolkata city) in 2006. During that year, the district had a population of children aged <5 years of 339,530 and reported 75% measles vaccine coverage and 422 cases of measles.

Evaluation Design
In both districts, we estimated the overall sensitivity of measles surveillance in terms of the proportion of cases occurring in the community that were captured by the district headquarters. To obtain that measure, we proceeded in 2 steps, so that we could measure the case attrition secondary to (1) the failure to identify cases at the periphery and (2) the failure to transmit the information regarding cases from the periphery to the district. First, we estimated the proportion of the cases occurring in the community that were captured by the peripheral health system (including the fortnightly house visits), through validation community surveys in each of the 2 districts. Second, we estimated the proportion of cases captured by the peripheral health system that were transmitted to headquarters by means of a comparison of records at these 2 levels.

Sampling for Community Surveys
In each of the 2 districts, we used 2-stage cluster sampling to survey the children aged 0–60 months (measles surveillance was conducted only among children <5 years of age). First, we selected 16 villages with a probability proportional to size. Second, in each the 16 village-clusters, we selected households at random to search for measles cases door-to-door. In Howra district, assuming the annual incidence of measles among children aged <5 years as 5%, a rate of homogeneity of 0.3, a relative precision of 6%, and a cluster size of 160, we aimed at a sample size of 2560 children aged <5 years to identify cases of measles that occurred during the period October 2004 through September
2005 (12 months). In Purulia district, assuming 9% incidence, a 0.3 rate of homogeneity, 6% precision, and a cluster size of 70, we aimed at a sample size of 2800 children to identify cases that had occurred during the period from April 2006 through March 2007 (12 months).

Data Collection
We defined measles as the occurrence of fever and maculopapular rash (ie, nonvesicular) and cough, coryza (ie, runny nose), or conjunctivitis (ie, red eyes) [12]. For each case identified during the community survey, we collected information about age, sex, treatment received, and reported health care-seeking behavior. We reviewed registers of health centers to determine whether cases were registered. We reviewed available documents or prescriptions available from measles case patients. We also counted the number of cases of measles registered in the registers of the health care facilities of the community development blocks. Finally, we counted the number of cases registered in the records of the district headquarters.

Data Analysis
First, we estimated the capacity of the peripheral health system to identify cases in the community (including the identification of cases during community health workers’ fortnightly visits) by dividing the number of cases identified in the peripheral health care facilities by the total number of cases identified through the community survey. Second, we estimated the proportion of cases transmitted from the peripheral health system to the district headquarters by dividing the number of cases registered at district headquarters by the number of cases available in the records of the health care facilities of the community development block. Finally, we estimated the overall sensitivity of the surveillance system by multiplying (1) the proportion of cases identified in the community by (2) the proportion of cases transmitted to the district. We analyzed the data and calculated 95% confidence intervals (CIs) using Epi Info (Centers for Disease Control and Prevention). We also estimated the incidence of measles in the 2 districts and compared it with the published data from India.

RESULTS

Howrah District

Validation community survey. Among the 2560 children aged <5 years surveyed, we identified 240 (9.4%) cases of measles that met the WHO case definition (Table 1). The median age of measles patients was 27 months (range, 9–59 months), and 126 (52%) were boys (Table 1). Eight (3%) of the 240 patients received treatment from the nearby subcenter or primary health center. Thus, these cases were registered in these health facilities. A total of 123 patients (51%) consulted private doctors, whereas the remaining 109 patients (45%) did not receive any treatment (Table 2). Twenty-nine (12%) of the 240 patients received vitamin A (Table 2). The fact that 8 of the 240 cases had been captured indicated that the peripheral health system (including fortnightly home visits by community health workers) had the capacity to identify 3.3% of measles cases in the community (95% CI, 1.5%–6.5%).

Surveillance data. Review of the records indicated that 980 cases of measles were present in the registers of health care facilities in 8 blocks of the district. No cases were available from the remaining 6 blocks. Of these 980 cases, 962 (98%) had been transmitted to the district. Hence, 2% of the cases identified by health care workers were lost during the reporting process between the peripheral health system and the district.

Overall sensitivity of the surveillance system. Taking into account the capacity of the peripheral system to identify cases in the community (3.3%) and the proportion of cases transmitted from the peripheral system to the district (98%), the overall sensitivity of measles surveillance in the district was 3.2%.

Purulia District

Validation community survey. Among the 2800 children aged <5 years surveyed, we identified 167 (6%) cases of measles that met the WHO case definition (Table 1). The median age of measles patients was 30 months (range, 6–60 months), and 81 (49%) were boys (Table 1). Thirty-nine (23%) of the 167 patients received treatment from the nearby subcenter or primary health center. Thus, these cases were registered in these health facilities. Of the remaining 128 patients, 90 (34%) were seen by faith healers, whereas for 38 (23%), some offerings (“pooja”) were performed at home and no treatment was received (Figure 1). The peripheral health system (including fortnightly home visits by community health workers) had the capacity to identify 23.4% of cases in the community (95% CI, 17%–30%). The survey in Purulia did not investigate Vitamin A use.

Surveillance data. There were 418 cases of measles registered in 14 blocks of the district. No cases were recorded from the remaining 6 blocks. Of these 418 cases, 414 (99%) had been transmitted to the district.

Overall sensitivity of the surveillance system. Taking into account the capacity of the peripheral system to identify cases in the community (23.4%) and the proportion of cases transmitted from the peripheral system to the district (99%), the overall sensitivity of measles surveillance in the district was 23.1%.

DISCUSSION

Most of the measles patients detected during the survey were managed by private practitioners in the village or stayed at home. In India, as in many countries, beliefs that measles is just a normal phase of the development of a child are common. Some of these beliefs refer to supernatural causes [13] and promote home care with various ritual practices [14], including dietary
restriction and herbal treatments [15]. Use of formal health care is seen as a second-line solution in case of absence of improvement [16]. As a consequence of these beliefs, parents do not seek medical attention up front for their children who stay home. Thus, children are not seen by the formal public sector health care system. This leads to 2 types of consequences. First, they do not receive vitamin A therapy that could improve the case-fatality ratio [17]. Second, they are not captured by the surveillance system. Use of the formal private sector was substantial among measles patients; however, these providers underuse vitamin A and do not report cases. In theory, according to the terms of operation of the Indian public health system, community health workers are supposed to visit households every 2 weeks and enquire about a limited list of important ailments, including measles. Thus, the low proportion of cases captured suggests that fortnightly visits by community health workers are an ineffective method of measles case detection in the scenario of the districts investigated. A number of reasons could explain this lack of effectiveness. First, health care workers could fail to ask specifically about measles cases. Second, community members could fail to report measles cases when prompted, maybe because they perceive this to be an unimportant event. Our surveys did not provide the kind of information that would have allowed us to differentiate between these 2 hypotheses.

The sensitivity of measles surveillance was higher in Purulia district (23.1%) than in Howrah district (3.2%). No information was available to explain the lower sensitivity in Howrah district. However, measles outbreak investigations may have stimulated the surveillance system in Purulia district. In Purulia district, 2 scholars of the Indian FETP were assigned, 1 in 2004–2005 and 1 in 2006–2008 (2 additional scholars also conducted part-time work there). These scholars investigated a total of 3 outbreaks, generating interest among health care workers. In 2006, 37 (57%) of 65 community health workers sampled in Purulia district reported that they would report only measles cases associated with an outbreak, not sporadic cases (West Bengal Department of Public Health, unpublished data). This specific interest in outbreak-related cases may be a consequence of the recent local outbreak investigations. It is relevant to the measles

### Table 1. Age and Sex Distribution of Measles Cases Captured by the Surveillance System and Identified by the Validation Community Survey, Howrah (2005) and Purulia (2006) Districts, West Bengal, India

<table>
<thead>
<tr>
<th>Variable</th>
<th>Howrah district</th>
<th>Purulia district</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surveillance</td>
<td>Community survey</td>
</tr>
<tr>
<td></td>
<td>Proportion captured by surveillance, %</td>
<td>Proportion captured by surveillance, %</td>
</tr>
<tr>
<td>Age, months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9–12</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>13–24</td>
<td>0</td>
<td>78</td>
</tr>
<tr>
<td>25–36</td>
<td>4</td>
<td>76</td>
</tr>
<tr>
<td>37–48</td>
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<td>47</td>
</tr>
<tr>
<td>49–60</td>
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<tr>
<td>Male</td>
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<td>126</td>
</tr>
<tr>
<td>Female</td>
<td>3</td>
<td>114</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>240</td>
</tr>
</tbody>
</table>

### Table 2. Distribution of Measles Cases Identified Through the Community Survey According to Health Care–seeking Behaviors and Vitamin A Treatment, Howrah District, West Bengal, India, 2005

<table>
<thead>
<tr>
<th>Health care–seeking behavior</th>
<th>Received vitamin A, proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home</td>
<td>0109 (0)</td>
</tr>
<tr>
<td>Public sector</td>
<td>6/8 (75)</td>
</tr>
<tr>
<td>Private sector</td>
<td>23/123 (19)</td>
</tr>
<tr>
<td>Total</td>
<td>29/240 (12)</td>
</tr>
</tbody>
</table>

**Figure 1.** Proportion of measles patients seeking health care from different sources, Purulia District, West Bengal, India, 2006.
mortality reduction strategy in which India is engaged and might explain the difference in sensitivity between the Purulia and Howrah districts.

Several studies have attempted to estimate the incidence of measles in India. In a 13-year prospective study from 1974 to 1986 in a rural community in Varanasi, Uttar Pradesh, the mean annual incidence of measles was 4.47% among children aged 0–14 years [18]. In another study in rural Uttar Pradesh, the 6-month incidence among children aged 9 months to 5 years during 1999 was 4.7%, whereas the vaccine coverage in this age group was 32% [8]. In Alwar, Rajasthan, the incidence of measles among children aged <5 years in 1996 was 6.3%, whereas the 1-dose measles vaccine coverage was 70% [19]. In West Bengal, the incidence among children aged <5 years residing in slum areas of Kolkata was 5.75% in 2004, whereas the mean incidence in the West Bengal districts of Purulia, Bankura, Midnapur, and Haldia-Tamluk was 4.8% in 2008 [20, 21]. Hence, the incidences of 6% in Purulia and 9.4% in Howrah that we report are comparable to those reported elsewhere in India [8, 18–21].

Appropriate management, including administration of Vitamin A, is one of the key elements of the strategy for measles mortality reduction [1]. Several studies reported that the administration of vitamin A during a measles episode reduces case fatality and the severity of measles [17]. However, the proportion of measles patients who received therapeutic vitamin A administration in our evaluation was low. Low vitamin A coverage of 8% and 16%, respectively, was also reported among measles cases in slum areas of Kolkata and Madhya Pradesh where informal private providers are common [22, 23]. It is therefore necessary to educate community members, community health workers, and health care providers about the need for administration of vitamin A to all measles patients. If parents were aware of the availability of an effective treatment, they might consider visiting community health workers with children with measles. This would decrease measles case-fatality and improve measles surveillance.

Our evaluation had 3 main limitations. First, we carried out the surveys to identify cases only among children aged <5 years. Until 2007, the measles surveillance system in West Bengal focused exclusively on children aged <5 years, among whom most cases occur. Hence, we were unable to assess what happens in other age groups. Second, we included measles cases that occurred in the community during the previous year on the sole basis of the mother’s or the guardian’s history. To reduce recall bias, we interviewed other family members to confirm the occurrence of the case, reviewed available prescriptions, and included only cases that were consistent with the WHO case definition. Third, we focused only on rural areas. The urban areas that are particularly at risk for measles have a different health care and surveillance system that we did not address through this project.

Measles surveillance in West Bengal had a low sensitivity. Hence, it is necessary (1) to expand the age groups to target individuals >5 years of age, (2) to strengthen supervision of community health workers so that they are better able to identify measles in the community during their house visits, and (3) to educate health care workers and community members about the need to take children affected by measles to health workers for treatment with life-saving vitamin A. In addition, private health care providers must be engaged in the use of vitamin A for measles case management. Investigation of outbreaks may also constitute an opportunity to underline the importance of measles surveillance for outbreak detection with community health workers. To address some of the limitations of the routine surveillance system, in 2007, the Government of West Bengal initiated collaboration with the World Health Organization–National Polio Surveillance Project (WHO-NPSP) to integrate measles and acute flaccid paralysis surveillance. This system, mostly focused on outbreak detection, in line with the current measles control issues, collects case information for suspected measles cases of all age groups, investigates selected outbreaks through a house-to-house search, and includes a component of serological testing for both measles and rubella. Collaboration with WHO-NPSP resulted in more systematic reporting of suspected measles cases and in data that can be acted upon, including the age distribution of case patients and their vaccination status. For instance, recent data indicated that 80%–90% of the laboratory-confirmed measles cases occurred among children aged <10 years (WHO/NPSP, unpublished data). In the future, India may embark on more active measles control activities, with supplemental measles vaccinations and second opportunities for immunization. Thus, there will be a need to switch from outbreak reporting to case-based reporting. At this stage, all measles cases will have to be reported, whether they occur sporadically or in the context of an outbreak. Our data will then remind public health professionals that unlike for children with acute flaccid paralysis who may be assessed in tertiary care facilities because of the severity of symptoms, most measles patients stay at home and need to be identified there for the purpose of management and surveillance.

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References


