An outbreak of leptospirosis in Orissa, India: the importance of surveillance

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Summary

OBJECTIVE To demonstrate the importance of surveillance systems in detecting emerging diseases and highlighting the strengths and weaknesses of an existing one.

METHODS The Orissa multi-disease surveillance system (OMDSS) was introduced in November 1999. Reporting units from the periphery send data to the district on a weekly basis. These reports are analysed regularly. A district task force (DTF) was available to intervene in the event of an outbreak. The OMDSS detected an increasing number of cases with fever and jaundice in June 2002. The DTF investigated this outbreak using clinical, epidemiological and laboratory tools to identify its cause.

RESULTS This outbreak, in a remote corner of India, was detected within 4 days by an existing surveillance system. Action was initiated within 24 h, but it took approximately two more weeks for the causative agent to be diagnosed. A total of 143 people were suspected to have leptospirosis between 23 June 2002 and 31 July 2002. The attack rate was 5.95% and the case fatality ratio (CFR) was 7.69%, both lower than outbreaks reported elsewhere in India. While males were infected more often than females, the CFR was higher among females and among the 6–15 year age groups. Exposure to infected water in a canal was the probable cause of the outbreak. IgM antibodies were positive in 33 of the patients and six patients tested positive for PCR and culture. *Leptospira interrogans* serovar canicola, *Leptospira interrogans* serovar pomona and *Leptospira interrogans* serovar hebdomadis were isolated.

CONCLUSIONS Leptospirosis is a new disease in this region of India. This outbreak was detected and diagnosed because of the surveillance system. The prompt response helped in containing the outbreak early enough. However, the morbidity and mortality could have been further mitigated if the delays in transmitting information had been minimized. An adequate laboratory support would have also helped considerably. We conclude stressing the importance of surveillance as a public health tool.

Keywords surveillance, leptospirosis, outbreak

Introduction

Leptospirosis, caused by spirochetes belonging to the genus *Leptospira interrogans*, is a common zoonosis with sporadic cases reported from most parts of the world. Rodents, especially rats, are the most important reservoir. Transmission of leptospires may follow direct contact with urine, blood or tissue from an infected animal or exposure to a contaminated environment during occupational or recreational use. The incubation period varies from 1–3 weeks. Fever, chills, headache and severe myalgias characterize the early phase of leptospirosis (American Public Health Association 2000). In the majority of patients the infection remains undetected or is misdiagnosed due to its protean and non-specific manifestations. However in 5–15% of clinical infections it can cause multi-organ involvement that may lead to death (Ko et al. 1999b).

In India, authors have documented outbreaks of leptospirosis from many parts of the country. Most of these reported outbreaks occurred along the coastline: Gujarat (Clerke et al. 2002), Mumbai (Karande et al. 2002), Kerala (National Institute of Communicable Diseases 2002), Chennai (Ratnam et al. 1993) and Andaman Islands (Sehgal et al. 1995). In Orissa, leptospirosis was first reported in Jajpur District, following the cyclone of 1999 (Sehgal et al. 2002).

We describe here an outbreak of leptospirosis in the forested hinterland of Orissa; how it was detected and
investigated on the outbreak investigation. This article is one of the few community-based reports of an outbreak of leptospirosis in India and provides data on attack rates (AR) and case fatality ratios (CFR). It also demonstrates how the presence of a good surveillance system and appropriate laboratory support is important to detect emerging diseases in a region.

Materials and methods

Mayurbhanj District

Orissa, on the eastern coast of India, is one of its poorest states. There are 30 districts in Orissa and Mayurbhanj is the largest. It is located in the densely forested belt of northern Orissa and home to 2.2 million people (Census 2001). Diarrhoeal diseases and malaria are endemic to this region. Badzore, one of the villages in Mayurbhanj District, has a population of 2404. Three-quarters (79%) are indigenous tribal people (adivasis) living below the poverty line. The nearest health facility, the subcentre manned by an auxiliary nurse midwife (ANM) is 1.5 km away. The primary health centre (PHC), a dispensary with a medical officer (MO), is approximately 5 km away while the 150-bed district hospital is 21 km away. There is a dam nearby with a network of canals and narrow streams crisscrossing the region. This article describes an outbreak of leptospirosis in Badzore.

Surveillance in Orissa

The Government of Orissa introduced a Multi-Disease Surveillance System (OMDSS) in November 1999. This surveillance system covers the entire state (population of 37 million). The reporting units are the existing government health units (ranging from the subcentre to the district hospital). It reports weekly on 12 syndromes. There is a fixed period for reporting at each level. Reports reach the PHC by Saturday, the community health centre by Monday, the district headquarters by Wednesday and the state capital by Friday. Timeliness of the reports varies from 95 to 100%. A District Task Force (DTF) consisting of a public health specialist, a doctor, a laboratory technician and the area health supervisor is available in most districts. The main function of the DTF is to investigate any outbreaks in the district. The DTF has access to a vehicle, a driver and fuel and is therefore able to investigate outbreaks at short notice.

The outbreak

The first reported patient developed symptoms of fever and jaundice on 23 June 2002. The local ANM detected it on the 27 June. By this date there were 11 more cases including one death. She reported it to the MO of the PHC as a potential epidemic of ‘acute jaundice syndrome’. He immediately deployed staff to the village. They instituted control measures on the initial assumption that the outbreak was caused by either malaria or viral hepatitis A. These measures included active surveillance of all fever cases, presumptive radical treatment with chloroquine and primaquine for all reported cases of fever, disinfection of water with bleaching powder and health education activities in the community. The health education message was focussed on boiling drinking water and using bed nets at nights. All patients with fever had their blood tested for the malarial parasite. However, in spite of these measures, the cases and deaths continued to rise. There was no clinical response to the treatment and most of the blood smears tested negative for malaria. All these factors induced the MO of the PHC to alert the district authorities on 2 July. Alarmed by the findings, the district health authorities requested the DTF to investigate this outbreak.

The DTF conducted an epidemiological investigation. Using the case definition ‘a case of fever from Badzore village and occurring in June through August 2002’, the DTF identified and listed all possible suspect cases both at the village and the health institutions (public and private). MOs were mobilized from the neighbouring PHCs to operate an emergency medical camp at Badzore. The staff at the camp screened patients and referred those with fever and jaundice to the district hospital. All patients with fever only were monitored right in the village by the camp staff. They also sent clinical samples for testing to the district laboratory, to the Sriram Chandra Bhanj Medical College, Cuttack, and to the Regional Medical Research Centre (RMRC) Laboratory, Bhubaneswar. Although the initial diagnosis was restricted to malaria, other differentials like typhoid, dengue and viral hepatitis A and E were also considered.

As leptospirosis had not been documented in this region, the DTF did not consider it a possibility until 7 July, i.e. 10 days after the outbreak was reported. Following discussions with their colleagues in UNICEF (Bhubaneswar) and WHO (New Delhi), the DTF sent three clinical samples to the RMRC for testing for leptospirosis. One of them tested positive on 10 July ( Dipstick ELISA). Control measures against leptospirosis were immediately instituted. All patients were treated with injectable penicillin (i.m.) and all inhabitants in Badzore were given chemoprophylaxis with doxycycline 200 mg p.o. on a weekly basis for four consecutive weeks. At the same time, public education about the cause of the fever and about the signs and symptoms of leptospirosis was undertaken in the community. The DTF trained the other MOs in the district about early diagnosis of leptospirosis and its management. These
measures contained the outbreak. A team from the Defence Research Development Organisation (DRDO), Gwalior, confirmed the diagnosis later. As many of the samples collected earlier were inappropriate or contaminated, the team visited the village on 24 July and collected 88 blood samples from treated patients.

Data on the outbreak was collated from the listing of cases, the records from the medical camp, the hospitals and the laboratory. Interviews with relatives of patients who had died because of leptospirosis were also conducted. The data thus obtained was later analysed with the use of a statistical package (SPSS). The results are given below.

**Results**

The epidemic curve (Figure 1) shows a typical single source outbreak with a sharp initial rise in cases followed by a more gradual fall. The first case developed fever and jaundice on 23 June. By 27 June, there were 11 more cases in the village as well as one death. In spite of interventions, the cases and deaths continued to rise and by 1 July, there were 31 cases, four of whom had died. By the time a probable diagnosis of leptospirosis was made on 10 July, 78 cases and nine deaths had occurred. However, once appropriate control measures were instituted, the number of cases and deaths dropped. The last case was detected on 31 July 2002, by which time a total of 143 people had been affected of whom 11 had died. The spot map of the village indicates that most of the cases and deaths occurred along the canal running along one corner of the village.

There were a total of 143 suspect cases. The distribution of cases and deaths, by gender and age is shown in Table 1. The overall AR was 5.93% (143/2404), and was significantly higher among males ($\chi^2 = 4.64, P < 0.05$). Similarly the age group of 6–15 years had higher ARs than other age groups. Of the 143 suspects, 65 patients (45.5%) were

![Figure 1](image-url) **Figure 1** Distribution of cases and deaths by date of onset of symptoms in the leptospirosis outbreak at Orissa, India.

<table>
<thead>
<tr>
<th>Age group</th>
<th>Population</th>
<th>Cases* ($n = 143$)</th>
<th>Hospitalized ($n = 65$)</th>
<th>Deaths ($n = 11$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>F</td>
<td>Total</td>
<td>M</td>
</tr>
<tr>
<td>0–5</td>
<td>118</td>
<td>108</td>
<td>226</td>
<td>7</td>
</tr>
<tr>
<td>6–15</td>
<td>220</td>
<td>200</td>
<td>420</td>
<td>15</td>
</tr>
<tr>
<td>16–45</td>
<td>510</td>
<td>500</td>
<td>1010</td>
<td>44</td>
</tr>
<tr>
<td>45–60</td>
<td>270</td>
<td>260</td>
<td>530</td>
<td>15</td>
</tr>
<tr>
<td>&gt;60</td>
<td>101</td>
<td>117</td>
<td>218</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>1219</td>
<td>1185</td>
<td>2404</td>
<td>83</td>
</tr>
</tbody>
</table>

* Age of two male cases not known.
hospitalized. There was no significant age or gender variation among those hospitalized. Most of the patients (69%) were admitted to the district hospital, followed by 28% in the private hospitals.

Of the 143 suspected cases 11 died. The overall CFR was 7.69% and was much higher among females than males. The age-specific CFR was highest in the oldest and youngest age groups (11.1% for <15 years and 10.7% for >45 years) (Figure 2). The least CFR (4.41%) was in the age group 16–45 years. CFR was higher among those admitted in the private sector (16%) than those admitted in the public sector (8.5%). Four of those who died did not receive any treatment in the formal sector. The median duration between onset of symptoms and death was 24 h, with a minimum of <12 h and a maximum of more than 7 days.

Five of 69 records of those who had been hospitalized or had died could not be located. Of the remaining 64, the main symptoms were biphasic fever and headache (Table 2). Vomiting (OR = 115, 95% CI 11–205), jaundice (OR = 13, 95% CI 2.4–79.3) and loss of consciousness (OR = 10.2, 95% CI 1.7–66) were symptoms predominant among those who died subsequently. They therefore appear to be good predictors of fatality. The main cause of death was ‘respiratory failure’.

Being an outbreak situation, only some of the suspected patients’ clinical samples were tested. This sample showed leucocytosis with raised ESR. All tested patients ($n = 3$) had thrombocytopenia. The liver function tests were deranged with high direct bilirubinaemia and raised enzymes. Tests for viral markers (A, B and E) were negative. Serological tests for typhoid and dengue were negative. The initial diagnosis of leptospirosis was made through the Dipstick test and one of the three samples was positive. Subsequently the DRDO team collected 88 samples from the probable cases and of these 32 were positive for IgM antibodies using the ELISA Dot test (Cochin Diagnostics). Six samples taken from patients recently admitted to the District Hospital were positive when tested by PCR (RAPD PCR) (Gerritson et al. 1995) and culture using EMJH Media Supplements with 10% Rabbit Pool Serum. The serovars identified were Leptospirosis interrogans serovar pomona, Leptospirosis interrogans serovar hebdomadis and Leptospirosis interrogans serovar canicola.

### Discussion

In an era of emerging and re-emerging communicable diseases, it is imperative that the health services remain alert to all possible outbreaks. Hence it is important to have a good public health surveillance system, which is able to pick up any unusual events early enough and alert decision makers enabling them to act swiftly and effectively.

Orissa is one of the states in India which has a strong surveillance system (WHO 2003). It was this OMDSS that detected the outbreak quickly (within 4 days of the first case) and responded immediately (within 24 h). This same OMDSS also mobilized the DTF at short notice and conducted an epidemiological investigation, arrived at a probable diagnosis and used all available resources to confirm this diagnosis (the district hospital laboratory, the RMRC laboratory, the medical college laboratory and even a national laboratory). The OMDSS also helped coordinate adequate responses, which ranged from public education of the community to conducting training workshops for the MOs on early diagnosis and management of leptospirosis – a disease unheard of in the hills of Mayurbhanj. Two steps that were noteworthy were the inclusion of the private health services in the investigation and control measures; and the initiation of mass chemoprophylaxis with doxycycline. To date, there has been only one reported instance of such chemoprophylaxis in India (Kakkilaya et al. 2000a).

But a detailed analysis reveals weaknesses in the surveillance system. There was a delay of about 9 days
between the onset of the outbreak and its notification to the district health authorities because of a delay of about 4 days in detecting the outbreak. One of the reasons for this is the fact that the ANM is responsible for a large population (more than 6000, spread over three to four villages). This means that she visits a village only once in a week. And as she is constantly mobile, the community finds it difficult to locate and contact her. The lack of modern communication systems in this area compounds the problem. Another delay of five more days was caused by the information percolating to the district. One of the reasons for this was the fact that the MO of the PHC assumed that the outbreak was caused by malaria (an endemic disease in these parts). The other reason is the lack of clear guidelines for alerting the next level. A third possible reason is the human factor of trying to control a crisis at one’s own level. Any crisis is seen as a personal failure and usually reflects on the performance of the MO. So the MO attempts to manage the crisis at the local level in order to prove his/her efficiency.

And finally it took the DTF about a week to diagnose the outbreak. This was because the outbreak was caused by a new disease. So the index of suspicion for leptospirosis was low. Secondly, the laboratory facilities were not available at the district level and all specimens had to be transported to the state capital, which is a half-day journey from Mayurbhanj.

These delays, if avoided could have contained the outbreak at an earlier stage and saved unnecessary suffering. One possible way is to have community members reporting in these remote areas. A community representative could be trained to identify specific thresholds, e.g. unnatural deaths, clustering of cases, etc. and report immediately to the PHC. Similarly one could develop threshold levels for each level of the surveillance system so that the staff are clear about what has to be done.

Apart from the delays, the district staff were not sufficiently informed about the collection and transportation of specimens. Many of the specimens collected during the outbreak had to be rejected because of contamination. This is one area where the district could have benefited with technical help from the state and the national level. This also highlights an issue, which is common in most low-income countries. Transportation and storage of clinical specimens poses a real problem leading to undiagnosed and hence unreported outbreaks. Finally the response appeared to be very non-specific. This could be because the DTF was not sure of the aetiology and was using a ‘shotgun’ therapy. In addition, there was tremendous pressure on the DTF to ‘act’. So any amount of analysis and scientific response is influenced by extrinsic considerations.

Comparison of the results with previously published studies shows some similarities as well as differences. Most of the studies of outbreaks have been institution-based ones and so calculation of ARs has not been possible. In Jajpur District of Orissa, following a natural disaster, the AR was 21%, while in the Mayurbhanj outbreak it was only 5.95%, indicating that the outbreak was recognised and controlled early.

In Badzore, the age group most affected was between 6 and 15 years, unlike other outbreaks. One of the reasons could be that these children had higher exposure to the risk factor, as they tended to swim in the canals. Males were more affected than females probably because they were more active outdoors and hence were exposed more to risk factors. The CFR of 7.69% is much lower than the reports from other Indian outbreaks – 18.4% in Gujarat (Clerke et al. 2002) and 11.1% in Mumbai (Dept. of Health and Family Welfare, Maharashtra 2001). In Italy, the CFR in 1994 was 22.6% (Ciceroni et al. 2000).

However, unlike the Kerala outbreak where males were more affected (Kuriakose et al. 1997), in the Mayurbhanj outbreak, there was a significantly higher mortality among females, which should be investigated further. While in the Brazilian study, altered mental status was a strong predictor of death (Ko et al. 1999a), in Mayurbhanj, it was vomiting.

Like in the north Andamans (Murhekar et al. 1998), Kerala and Karnataka (Kakkilaya et al. 2000b) using contaminated stream water for domestic purposes, including bathing, appeared to be an important risk factor for developing the disease. This was also seen in Illinois among athletes (Morgan et al. 2002).

While *Leptospirosis interrogans* serovar *autumnalis* and *Leptospirosis interrogans* serovar *icterohaemorrhagiae* are the common serovars isolated in India, *Leptospirosis interrogans* serovar *canicola* has been identified earlier in Orissa (Weekly Epidemic Report 2000). We report the involvement of *Leptospirosis interrogans* serovar *pomona*, *Leptospirosis interrogans* serovar *hebdomadis* in an outbreak in India for the first time.

Leptospirosis is an important zoonosis, which is not commonly recognized by medical professionals. This is all the more important, as it has protein manifestations and can progress to multi-system failure and death very rapidly. Unlike many other diseases, an effective cure is available.

* The attack rate is an aggregate attack rate. As some of the patients tested with the IgM kit were negative, we may surmise that the 143 suspects, all did not suffer from leptospirosis. However, as there is no way of differentiating between them, we conclude that there were 143 cases (six confirmed cases and 137 suspect).
and hence it becomes imperative that physicians have a high index of suspicion when confronted with syndromes like fever and jaundice. Along with sensitization of clinicians, laboratory support should be strengthened so that the disease can be diagnosed accurately and early enough. There is a need for validation of the currently available rapid diagnostic kits so that they may be made available to the clinician.

To conclude, we emphasize the importance of an effective surveillance system in detecting and responding to outbreaks, be it of known or unknown aetiology. In this context, strong laboratory support is important to give direction to the epidemiological investigation. This is usually lacking and neglected in low-income countries and needs further strengthening (Sehgal 2000), if an effective Global Surveillance system is to be developed as advocated by the WHO.

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