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An Outbreak of Leptospirosis in Davao City of Philippines, 2013: An Investigation of the Risky Behaviors that Led to the Resurgence

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Abstract

On 7 Feb 2013, the National Epidemiology Center in the Philippines Department of Health received a report on increasing number of leptospirosis cases in Davao City after the monsoon flooding. Leptospirosis has been endemic in Davao City and a leptospirosis outbreak occurred in 2011 after a flashflood in the city. Objectives of our investigation were to determine existence of the outbreak, identify source and mode of transmission, and find out risk factors. We reviewed medical records of local hospitals and conducted active case finding in the affected communities. A suspect leptospirosis case was a resident in one of nine flooded districts of Davao City who had fever for two days or more and any of the following: myalgia, conjunctival suffusion, jaundice, anuria/oliguria, hematuria or calf pain from 6 Jan to 15 Feb 2013. Serum samples were collected for laboratory confirmation by microscopic agglutination test and polymerase chain reaction. Key informants were also interviewed. Total 64 suspect leptospirosis cases with six deaths (CFR = 9.4%) were identified. Ages ranged from 14-73 years (median = 33 years), with 86% as males. Among 42 cases, 64% were positive for *leptospira spp*. Majority of the cases (82%) waded in the flood without any post-exposure prophylaxis and 63% had open wounds on lower extremities when exposed to floodwater. The most affected age group was 21-30 years old (33%). The case-control study showed that wading in floodwater (OR = 11, 95% CI = 1.45-458.37), swimming in floodwater (OR = 3, 95% CI = 1.31-8.00), having contact with moist soil (OR = 3, 95% CI = 1.13-6.49) and having open wounds (OR = 11, 95% CI = 3.61-36.63) were risk factors. Therefore, it was confirmed that there was a resurgence of leptospirosis in Davao City. Intensive health education activities, emphasizing protective clothing and prophylactic treatment might reduce risk for leptospirosis and future outbreaks.

Keywords: leptospirosis, case-control, risk factors, flooding, Philippines

Introduction

Leptospirosis is a zoonotic disease that affects both humans and animals, and a re-emerging public health problem.[1] Early-phase illness is characterized by abrupt onset of high fever, muscle pain in calves and lumbar region, and retro-orbital and frontal headaches. Other manifestations such as nausea, vomiting, abdominal pain, diarrhea, cough, photophobia and rash may present in the early phase as well. Conjunctival suffusion, redness of conjunctiva, is a pathognomonic finding of leptospirosis.[2]

Feral and domestic animals are reservoirs of pathogenic leptospires. Infected animals may shed spirochete in urine or amniotic fluid. People become infected when their mucous membrane or broken skin comes in contact with water (swimming or immersion), moist soil or vegetation that is contaminated with urine of infected animals. Incidence is significantly higher in countries with warm climate than those in temperate regions, which is mainly due to longer survival of leptospires in warm and humid environment.[3]

With the estimated 350,000-500,000 cases reported annually around the world, leptospirosis is an emerging important public health problem in many developing countries.[4] In the Philippines, it is an endemic zoonotic disease, with average 680 cases and 40 deaths reported every year and prevalence of 10 per 100,000 population.[5] Risk of infection can be increased by poor sanitation and growing number of urban slums, along with frequent typhoons and expansion of flood areas. Health education campaigns directed at household occupants as well as promotion on social determinants of health and concrete actions to decrease health inequity are several approaches to reduce risk of acquiring leptospirosis in these situations.[6]

On 28 Jun 2011, heavy rainfall caused flash floods in Davao City, Mindanao, Philippines. Matina Pangi, Matina Crossing, Matina Aplaya and Talomo Villages were greatly affected. The flash flood contributed to upsurge of leptospirosis cases during 26-27th weeks of 2011, with two reported deaths. On 7 Feb 2013, the Event-based Surveillance and Response (ESR) Unit of

the National Epidemiology Center (NEC) observed an increase of leptospirosis cases in Davao City. Thus, we conducted an outbreak investigation to determine existence of an outbreak, identify source and mode of transmission, find out risk factors, and recommend control and prevention measures.

Method

To construct a line-list of leptospirosis cases, we reviewed medical records of admitted cases in Southern Philippines Medical Center, Brokenshire Hospital, Community Health and Development Cooperative Hospital, and the City Health Office (CHO). In addition, the investigation team travelled to the flooded communities in order to conduct active and retrospective case finding. The team also reviewed data from NEC-Philippine Integrated Disease Surveillance and Response (NEC-PIDSR), Regional Epidemiology Surveillance Unit and City Epidemiology Surveillance Unit.

A suspect leptospirosis case was defined as a previously well individual who lived in one of nine flooded districts of Davao City (Talomo North, Talomo South, District A, District B, District C, Agdao, Buhangin, Toril and Calinan) and had fever for two days or more and one of the following: myalgia, conjunctival suffusion, jaundice, anuria or oliguria, hematuria, or calf pain, with onset of symptoms between 6 Jan to 15 Feb 2013. A confirmed case was a suspect case or any individual who was a resident in one of the nine flooded districts of Davao City and tested positive for *Leptospira spp.* by microscopic agglutination test (MAT) or polymerase chain reaction (PCR) during the same time period.

A case-control study was conducted to determine risk factors associated with leptospirosis. A standard questionnaire was used in the interviews. Controls were healthy and symptom-free individuals randomly selected from neighborhood of the cases and tested negative for *Leptospira spp.* by MAT or PCR. Odds ratios with 95% confidence interval (CI) and chi-square test were calculated by Epi Info version 3.5.1.[7]

Blood samples from cases and controls were collected, sent to the Research Institute for Tropical Medicine and tested for leptospira antibodies by MAT and for leptospira DNA by PCR. MAT was considered as the "gold standard" of serodiagnosis and interpreted as positive when there was 4-fold rise in titer from acute to convalescent sera. The serogroups that could be identified by MAT were Andaman, Australis, Autumnalis, Ballum, Bataviae, Canicola, Cellidoni, Cynopteri, Djasiman, Grippotyphosa, Hebdomadis, Icterohaemorrhagiae, Javanica, Louisiana, Manhao, Mini, Pomona, Pyrogenes, Ranarum, Sarmin, Sejroe, Shermani, Tarassovi and serogroup Semaranga serovar patoc. PCR has an advantage for early confirmation of diagnosis, especially during acute leptospiremic phase (first week of illness) before appearance of antibodies.[5]

We also interviewed key informants from CHO and district health office and village health workers. An environmental survey of the affected villages was also conducted during investigation from 20-26 Feb 2013.

Results

We identified 64 cases (Figure 1) and of which, six died (Table 1), with case fatality rate (CFR) of 9.4%. Majority (86%) were males. Age of the cases ranged from 14-73 years, with median 33 years and highest proportion in age group was 21-30 years (33%) (Figure 2). Aside from fever, other common clinical manifestations were myalgia (82%), conjunctival suffusion (62%), hematuria (49%) and oliguria (40%).

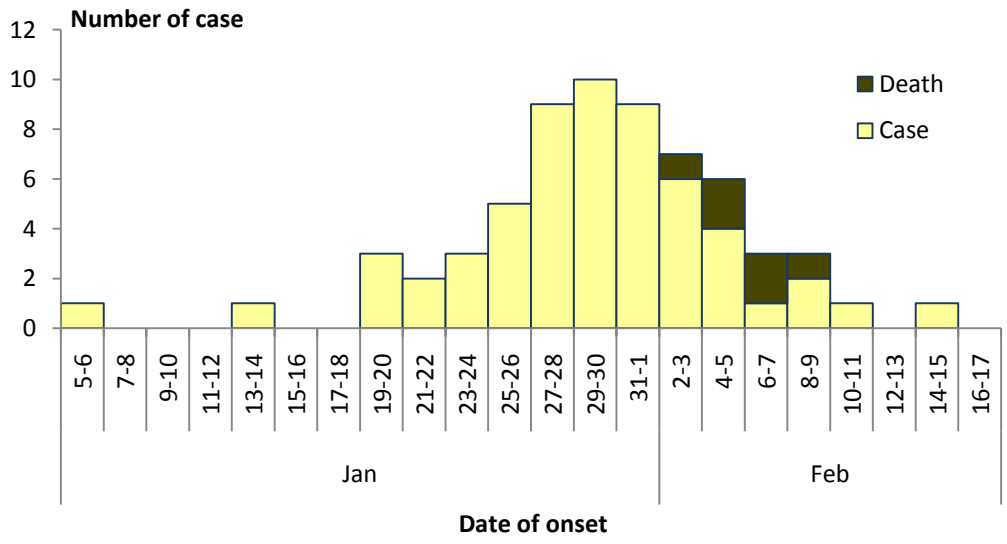

Figure 1. Leptospirosis cases (n=58) and deaths (n=6) by onset of illness in Davao City, Philippines, Jan to 15 Feb 2013

Table 1. Epidemiological characteristics and clinical course of fatal leptospirosis cases (n=6) in Davao City, Philippines, 6 Jan to 15 Feb 2013

No.	Age (year)	Gender	District	Date of onset	Date of admission	Date of death	Exposed to floodwater or mud	Cause of death
1	34	Male	District A	24 Jan 2013	5 Feb 2013	6 Feb 2013	Yes	Acute respiratory distress syndrome
2	35	Male	District A	27 Jan 2013	4 Feb 2013	4 Feb 2013	Yes	Sepsis
3	52	Male	Talomo North	29 Jan 2013	31 Jan 2013	2 Feb 2013	Yes	Acute kidney injury secondary to sepsis
4	28	Male	Talomo North	31 Jan 2013	4 Feb 2013	5 Feb 2013	Yes	Acute renal failure
5	68	Female	District A	3 Feb 2013	6 Feb 2013	6 Feb 2013	Yes	Sepsis
6	70	Male	District A	4 Feb 2013	Missing	8 Feb 2013	Yes	Weil's Syndrome

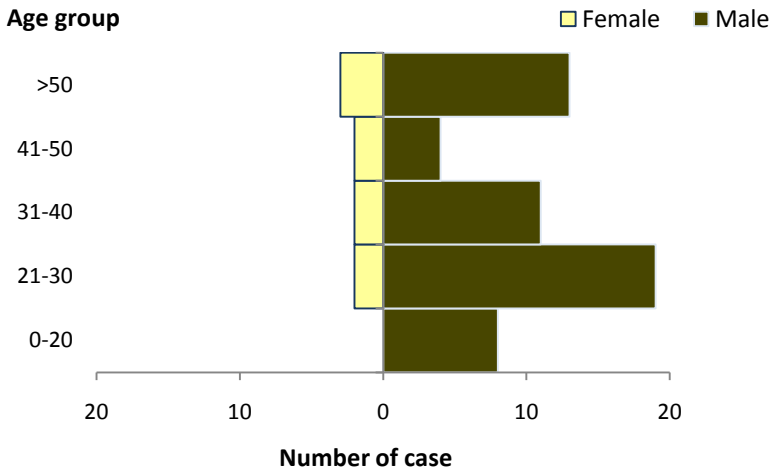

Figure 2. Leptospirosis cases by age groups and gender in Davao City, Philippines, 6 Jan to 15 Feb 2013 (n=64)

Among total 64 cases, 56 (87.5%) were exposed to floodwater, including 46 cases (82.1%) who had history of wading without any post-exposure prophylaxis and four cases (7.1%) who had post-exposure prophylaxis (Doxycycline) but not able to complete the treatment. Total 35 cases (62.5%) had history of open wounds on lower extremities at the time of exposure to floodwater, including three cases (8.6%) who received the prophylaxis.

For analytic study, 44 cases and 66 controls were interviewed using a standard questionnaire. On bivariate analysis, results showed that cases were 11 times more likely to have open wounds, 11 times more likely to wade, three times more likely to have contact with moist soil and three times more likely to swim in floodwater than controls, and these were all statistically. Moreover, wearing boots was a strong protective factor for leptospirosis.

A total of 42 serum samples were collected from the cases. Of these, 27 (64.3%) and 16 (38.1%) specimens were positive for *Leptospira spp.* and L*eptospira biflexa* serovar Patoc by MAT respectively, and 11 (26.2%) were positive for pathogenic *Leptospira spp.* by PCR.

During interviews with the key informants, the village health workers mentioned that for the period of flooding, the local people had to wade in floodwater for evacuation without protective clothing and were not able to take prophylaxis. In addition, the CHO staff mentioned that there was a leptospirosis outbreak in 2011 after a flashflood.

On environmental survey, we observed mud, moist soil and pools in the communities. Several rodents were seen, especially in open canals. Many households owned dogs and some had pigs and goats. Poor sanitation and improperly maintained sewage system were detected in the affected villages. Submerged pipes in open canals and muddy roads were also noticed.

Table 2. Bivariate analysis of factors associated with leptospirosis in Davao City, Philippines, 6 Jan to 15 Feb 2013

Factor	Case (n=44)		Control (n=66)		Crude odds ratio (95% CI)
	Number	Percent	Number	Percent	
Gender (male)	40	90.9	56	84.8	1.78 (0.47-8.32)
Age group (year)					
<21	9	20.5	17	25.8	Reference
21-30	12	27.3	17	25.8	1.33 (0.39-4.61)
31-40	9	20.5	11	16.7	1.55 (0.40-6.00)
41-50	4	9.1	8	12.1	0.94 (0.16-4.85)
>50	10	22.7	13	19.7	1.45 (0.39-5.29)
Waded in floodwater	43	97.7	53	80.3	10.55 (1.45-458.37)
Swam in floodwater	32	72.7	30	45.5	3.20 (1.31-8.00)
Contacted with moist soil	23	52.3	19	28.8	2.71 (1.13-6.49)
Walked barefoot	24	54.5	27	40.9	1.73 (0.75-4.02)
Had open wounds	23	52.3	6	9.1	10.95 (3.61-36.63)
Wore boots	0	0	22	33.3	0 (0-0.18)*
Took prophylaxis	2	4.5	11	16.7	0.24 (0.02-1.19)

*P-value < 0.001

Discussion

There was a leptospirosis outbreak in Davao City, Philippines from 13 Jan to 9 Feb 2013. Majority of the cases were males and the most affected age group was 21-30 years. There were a significant number of deaths (CFR = 9.4%) and causes of death were acute renal failure and sepsis. This was consistent with a previous study in the Philippines which stated that mortality rates of patients admitted to hospitals were high (12-14%) in Philippine General Hospital and San Lazaro Hospital, with major cause of death as renal failure.[4]

Poor sanitation, muddy roads and improper sewage system were observed in the flooded villages. Thus, health teaching on usage of protective clothing and prophylactic treatment were helpful in controlling for this outbreak. As leptospirosis is a preventable disease, control measures at household level and in community are critical for success of prevention and control of leptospirosis. Poverty, environmental sources of transmission such as open refuse deposits, animal reservoirs, open sewers, and flooding in and around the household had shown to be associated with exposure to and infection of leptospirosis.[6] In the Philippines, leptospirosis is endemic and number of cases peak during the rainy months from June to August.[5] While the occurrence of serovars among humans in the country dated back to the late 1960s and 1970s, the first leptospirosis outbreaks in the country were reported from Sablayan Prison and penal farms in Mindoro in 1976, followed by outbreaks in Manila City Jail from September to October 1999.[4]

In October 2009, two weeks after heavy rainfall from the typhoon Ketsana, the Department of Health declared a leptospirosis outbreak in Metro Manila.[5] In 2011, there was a leptospirosis outbreak in Davao City due to flooding caused by heavy rainfall. Therefore, leptospirosis was likely to continue to re-emerge in the Philippines as a result of rapid urbanization, deforestation, poor sanitation and increase incidence of typhoons brought about by the climate change.[5] The Philippines is directly hit by typhoons and cyclones at an average of 20 times a year. It was also observed that since 1960s, the flooded areas in the Philippines have been expanding. Yanagihara et al. demonstrated that leptospirosis cases occurred when rainfall level exceeded 50-100 mm per month.[4]

In our case-control study, cases were randomly selected from the obtained line list of suspect cases rather than choosing only confirmed cases, given that laboratory results were not available at the time of study. This was likely to reduce the power of our study. Nevertheless, the measurement of association remained significant. In spite of this limitation, our study demonstrated that majority of the patients' clinical features were fever, myalgia and conjunctiva suffusion, which was consistent with other studies where majority of patients presented with non-specific clinical signs such as fever (98.5%), myalgia (78.1%), malaise (74.9%) and conjunctiva suffusion (59.3%).[8] Another limitation of our investigation was that due to delayed notification, the investigation team arrived at the end of the outbreak and missed an opportunity to institute control measures in a timely manner.

Majority of the residents did not use any protective clothing such as boots and walked barefoot when they waded in floodwater and had contact with moist soil. Most of the residents were also not aware of the need for post-exposure prophylaxis or availability of prophylaxis distributed by the CHO. Although some cases took post-exposure prophylaxis, they were not able to follow the recommended duration and timing of prophylaxis treatment. The World Health Organization recommended antimicrobial therapy to start before the fifth day of disease onset.[1] Intensive and well-directed health education activities on prevention and control of leptospirosis, emphasizing on usage of protective clothing, prophylactic treatment and advocacy of seeking early consultation, decrease garbage and rodent population, for long term plan, the government should plan for a fast floodwater irrigation that might reduce risk factors for leptospirosis.

In conclusion, Davao City had experienced another outbreak of leptospiroris after flooding. Our study highlighted the challenges in improving community awareness and practice in prevention of future outbreaks.

Suggested Citation

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