# SPECIAL FEATURE

## A SUSPECTED CLUSTER OF LEPTOSPIROSIS IN SINGAPORE

### Background

Leptospirosis is a common zoonotic disease worldwide, caused by Leptospira bacteria[1]. Transmission occurs through direct contact with infected animals or through contact with materials contaminated by the urine of these animals, usually rodents and other small mammals[2]. Other leptospirosis carriers include dogs, cows, pigs and other mammals[2]. The disease is usually associated with rural areas and urban slums of developing nations[3]. However, outbreaks and clusters have been reported, where risk factors include involvement in water-related recreational activities, travel to rural areas and floods[1,3,4].

Leptospirosis is not a notifiable disease in Singapore. However, medical practitioners do notify the Ministry of Health (MOH) of leptospirosis cases from time to time. Investigations will be carried out when a severe case is reported or a possible cluster of leptospirosis cases is suspected.

On 13 July 2011, MOH was notified by an infectious disease physician of a case of leptospirosis. The case had informed the physician that other members of his running group (RG) had also recently suffered from a febrile illness.

This report summarizes the epidemiological investigation into this possible cluster of leptospirosis cases.

### Methods

As preliminary information pointed towards a possible cluster of leptospirosis cases, MOH carried out an epidemiological investigation as soon as the notification was received. The cases were identified and their personal particulars such as age, gender and ethnicity were recorded. Clinical signs and symptoms, date of onset of illness, laboratory results, and information on their medical treatment were obtained. Information on workplaces, residences and risk factors for leptospirosis exposure such as involvement in water-related activities and contact with animals were also obtained. The lead runner and other members of the RG were also interviewed for more information about their runs.

A field investigation was conducted along the running route used by the RG for a major running event. Water and muddy water samples were taken, respectively, from a wide water body and muddy field located along the route.

A case was defined as a person who tested positive for leptospiral IgM antibody, with a recent onset of flu-like symptoms followed by severe renal symptoms, and had a recent history of participation in a run along a forest trail in Bukit Batok Estate (Figure 1).

### Epidemiological findings

Based on the case definition, two cases of leptospirosis were identified.

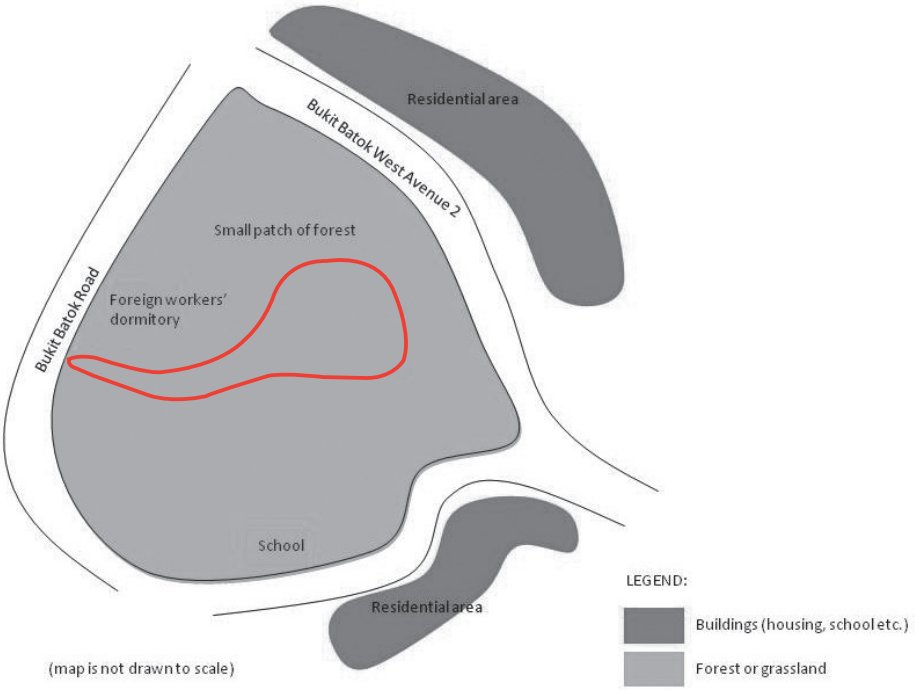
The index case (Case A) was a 48-year-old Caucasian male living in Singapore. He developed fever, chills, rigors, nausea and muscle ache on 27 June 2011 and subsequently visited a general practitioner (GP) for treatment. He was subsequently hospitalised on 3 July 2011 after his condition worsened, and was diagnosed with acute renal failure. Serological tests showed that he was positive for leptospiral IgM antibody. He was treated with doxycycline and ceftriaxone and subsequently recovered.

The case worked in an office despatching engineers to service cranes on board ships. He reported that he did not go on board the ships.

The case lived with his family in a private apartment. The family did not rear any pets at home, nor were they aware of any recent complaints of rodent infestation around their residence. A pest control company carried out regular checks and pest control on a weekly basis at his residential area. None of his family members or any other residents in the area had been reported to be ill with similar symptoms. Furthermore, environmental survey of the vicinity around his residence had revealed no signs of a rodent infestation.

Case A stated that he often travelled to Senai Airport in Johor, Malaysia during the weekends to fly his private jet. He usually spent 3 hours at the airport and then returned to Singapore on the same day. On 25 June 2011, he had travelled to Senai Airport to fly his jet in the morning from 1000hrs to 1300hrs before returning to Singapore. The case actively participated in runs organised by RG, which were conducted every week at various locations. On the afternoon of 25 June 2011, Case A participated in a run along a forest trail in Bukit Batok Estate. The run involved 60 local members of RG and 100 foreign guest runners. Figure 1 shows the approximate running location and surrounding vicinity.

**Figure 1:**
**Map of the running location (demarcated by the red line) and its surrounding vicinity**




Active case finding through interviews with the lead runner and other runners in the RG revealed that three local participants (including Case A) had become ill with a febrile illness between 25 June 2011 and 13 July 2011. None of the foreign participants were reported to be ill.

One of the other 2 local participants who were ill was identified to be a case of leptospirosis (Case B). He was a 58-year-old Caucasian male Singapore permanent resident. He developed fever, cough and loose stools on 14 June 2011 but did not seek medical attention at that time as he thought he had flu. He was later admitted to Changi General Hospital on 9 July 2011 as his symptoms persisted, and he was eventually diagnosed with sepsis secondary to left lower limb cellulitis and urinary tract infection, as well as acute kidney impairment. He was tested positive for leptospiral IgM antibody although his urine culture results were negative for *Leptospira*. He was treated with ciprofloxacin and clindamycin and discharged well on 13 July 2011.

The case was a retiree who lived with his family in a private apartment. He did not keep any pets at home and was not aware of any recent rodent infestation in the vicinity. The case also had no recent history of travel overseas.

The other local participant reported feeling unwell on the day of the 25 June 2011 run, and thus only assisted on the sidelines. He subsequently developed fever on 28 June 2011 and sought treatment from a GP as well as outpatient treatment at a hospital. The GP's diagnosis was that of a bacterial upper respiratory tract infection. No laboratory tests were done to identify the causative organism. As such, we were unable to confirm if this was a case of leptospirosis.

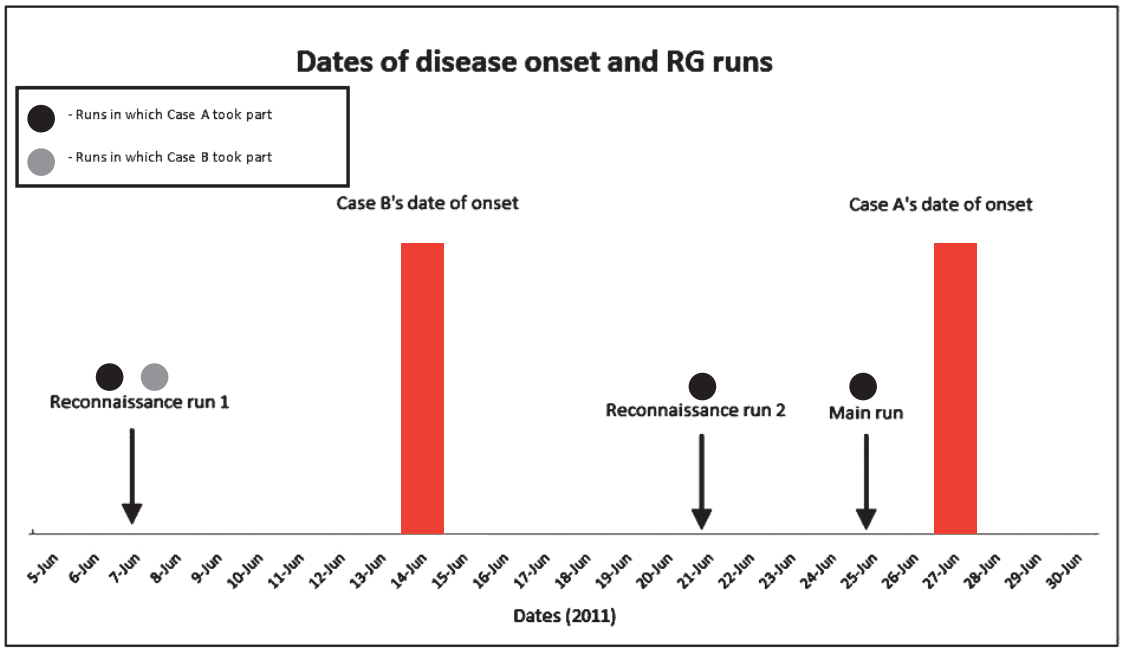
Description of RG's running activities

The lead runner of RG stated that two 'reconnaissance' runs through the same forest trail in Bukit Batok estate were conducted on 7 June 2011 and 21 June 2011, involving about 60 local RG members each time. These were followed by the main event run on 25 June 2011.

Case A participated in all three runs on 7, 21 and 25 June 2011. Case B had assisted on 7 June 2011 to set up the river crossing ropes across a wide body of water for the reconnaissance run, spending at least 2 hours in the water. He did not participate directly in the runs held on 21 June 2011 and 25 June 2011, but only assisted on the sidelines.

The dates of onset of illness of Cases A and B in relation to these 3 runs are shown in Figure 2.

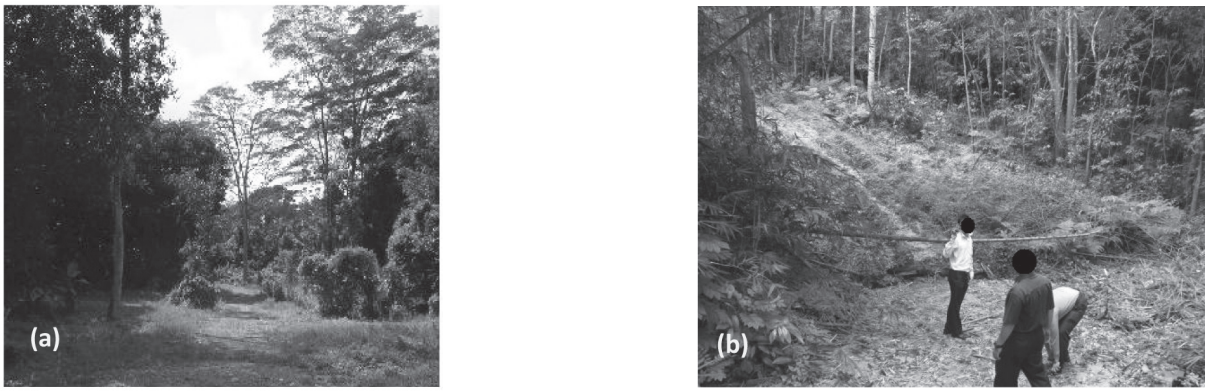
**Figure 2:**
**Timeline showing dates of the RG runs (black arrows) and onset of illness of Case A and Case B (blue bars)**




Field inspection findings

A field inspection of the forest trail was carried out on 21 July 2011. The forest trail used for the run consisted of a series of dirt trails. These trails were surrounded by moderately dense vegetation on both sides. The trail was intercepted by several small streams along the way (Figure 3). Along the trail, the runners had to cross a wide body of water measuring approximately 15 metres wide and 1.2 metres deep. This was done using ropes secured on trees across the water body, which was set up by several members of RG prior to the run.

**Figure 3:**
**(a) The running trail ran through moderately dense vegetation and (b) a small stream along the trail**




A survey of the trail revealed no obvious signs of any rodent infestation in the vicinity. Water and muddy water samples that were taken on 27 July 2011 from the wide water body and a muddy field along the trail yielded negative results when cultured for *Leptospira.*

## Discussion

Our investigation revealed two cases of leptospirosis who were both members of the same running group, and who had participated in a run on a forest trail in Bukit Batok estate in a 3-week period between 7 and 25 June 2011. Both tested positive for leptospiral IgM antibody and had presented with symptoms and a biphasic pattern consistent with a leptospirosis (i.e. a mild initial phase characterized by flu-like symptoms followed by a second, more serious phase which included severe renal symptoms)

Interviews with Cases A and B did not identify any other potential risk factors in their occupation, residential environments, or travel history, which could have exposed them to animals or contaminated soil, vegetation or water. Given that the only common link between the two cases was their run on the forest trail and their exposure to the water body on the trail, this activity was considered to be the most likely source of infection. The date of onset of illness for Cases A and B were consistent with the incubation period for leptospirosis (usually 5-14 days, with a range of 2-30 days). Both cases mentioned that they had suffered cuts during the course of the run(s). This increased their risk of acquiring an infection when wading through the water body along the route.

Environmental sampling did not reveal the presence of *Leptospira*, and there were no obvious signs of rodent or animal presence in the area. However, this does not exclude the possibility that the water might have been previously contaminated by urine of infected animals, as the sampling was only done 4-6 weeks after the cases were exposed to the water. Furthermore, the samples were only taken from the sides of the water body, whereas the cases had waded through the middle of the water body.

Recent reviews have reported an emerging trend of leptospirosis acquired through recreational activities in rural areas such as hiking, fresh water swimming and rafting[1,3,4]. Recent outbreaks have been reported worldwide associated with such activities[3]. These rural areas are home to small mammals such as bats, rats and other rodents, which are all potential carriers of *Leptospira* [4].

In rural, forested areas, the best way to avoid an infection would be to avoid high-risk activities, such as traversing through bodies of water or muddy areas with dense vegetation, especially when a person has cuts or similar injuries which may increase the risk of exposure to contaminated animal urine in the environment. Vaccination against leptospirosis is a developing area, and may be a viable option for the prevention of leptospirosis infection in the future[4].

The number of reported cases of leptospirosis in Singapore are low annually (approximately 10-60 cases per year)[5]. However, recent trends observed in other developed and urban settings worldwide show that the

possible emergence of leptospirosis as an important disease should not be dismissed[3,4]. Measures such as chemoprophylaxis can be considered for groups with a higher risk of exposure, such as military personnel or regular outdoor activity enthusiasts. Public education to raise awareness on leptospirosis and other diseases associated with outdoor activities could also be considered.

## References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2. Adler B, de la Peña Moctezuma A. *Leptospira* and leptospirosis. Vet Microbiol 2010; 140:287-96
3. Pappas G, Papadimitriou P, Siozopoulou V et al. The globalization of leptospirosis – worldwide incidence trends. Int J Infect Dis 2008; 12:351-7.
4. Lau CL, Smythe L, Craig SB et al. Climate change, flooding, urbanisation and leptospirosis – fuelling the fire? Trans R Soc Trop Med Hyg 2010; 104:631-8.
5. Ministry of Health, Singapore. Communicable Disease Surveillance in Singapore 2006-2008.

# NOROVIRUS OUTBREAK AT A PRIMARY SCHOOL IN SINGAPORE

## Introduction

On 3 Oct 2011, the Ministry of Health (MOH) was notified of a possible gastroenteritis outbreak at a primary school, involving 148 students who had developed fever, diarrhoea and vomiting between 1 and 3 Oct 2011.

The school has a total of 1,836 students (1,297 students in the morning session and 539 students in the afternoon session), with 135 teaching and non-teaching staff. The school's canteen has six food stalls and two drinks stalls.

Field investigations were carried out immediately at the school. This report summarizes the findings of the outbreak investigation.

## Methods

A case was defined as any student or staff of the primary school who developed one or more symptoms of gastroenteritis (vomiting, watery diarrhea, abdominal pain, fever and nausea) between 29 Sep and 4 Oct 2011. Cases from the school were identified and their personal particulars such as age, gender and ethnicity were recorded. Signs and symptoms of those who were ill and the types of medical treatment sought were obtained. A case-control study was conducted using a standard questionnaire to determine the vehicle of transmission by comparing the food histories of well and unwell students two days prior to the onset of symptoms.

Food and environmental samples were collected from the school canteen and sent for microbial analysis. Environmental samples from the wash basins in the school toilets and mops used for general cleaning were taken from various locations within the school premises. Food handlers from the school canteen were screened for enteropathogens (*Shigella, Campylobacter, Vibrio, Salmonella,* rotavirus and norovirus). A total of nine food samples, four environmental swabs and 15 food handlers from the school canteen were tested. In addition, four stool samples were collected from the affected cases and sent for laboratory testing.

Differences in attack rates between cases and controls using the chi-square or Fisher's exact test were examined first by day and then by food stalls. Differences in food stall-specific attack rates were subsequently examined using bivariate analyses, with crude odds ratio (OR) and 95% confidence intervals (CI) computed. Statistical analyses were performed using PASW Statistics Version 18.0 (SPSS Chicago, IL). A p value of $<0.05$ was considered statistically significant.

## Findings

Using the case definition, a total of 121 cases, which consisted of 119 students and 2 staff, were identified, giving an overall attack rate of 6.2%. The attack rate for students was 6.5% (8.2% for morning session and 2.4% for afternoon session) compared to 1.5% for staff only. The age range for the cases was between 6 and 11 years for students and 21 and 24 for staff. The male to female ratio of the cases was 1.25:1 for students and 1:1 for staff. Their clinical features comprised vomiting (86.0%), abdominal pain (71.9%), fever (65.3%), nausea (44.6%) and watery diarrhoea (31.4%). 88 cases sought outpatient treatment (72.7%) while the rest self-medicated (19.0%). One (0.8%) was hospitalized for observation. All recovered uneventfully. The epidemic curve is shown in Figure 1.

A total of 60 cases responded to the questionnaire and respondents who were asymptomatic throughout served as controls. Case-control analysis revealed no significant association between illness and consumption of food from any of the eight canteen stalls from 28-30 September 2011.

Three of the four stool samples obtained from the cases were tested positive for norovirus genogroup II. Of the 15 food handlers screened, two were tested positive for norovirus genogroup II.

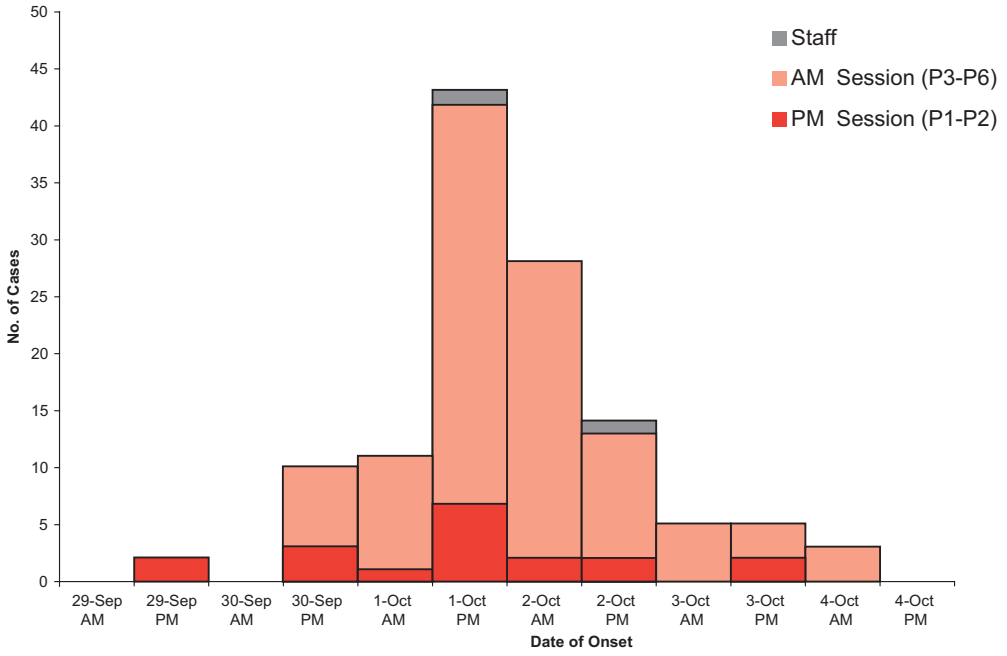
One food sample taken from one of the canteen stalls was positive for *Escherichia coli* (210 MPN/g). Another food handler was found to be positive for rotavirus and *Vibrio fluvialis* (likely an incidental finding). All three food handlers who were found to be positive during screening were asymptomatic prior to this incident.

## Discussion

The epidemiological features of this gastroenteritis outbreak, with vomiting as the predominant symptom, evidence of person-to-person transmission, and absence of a food-borne vehicle, were consistent with an outbreak caused by norovirus. Noroviruses are highly contagious and are usually transmitted directly from person to person by faecal-oral spread, and indirectly through

**Figure 1**

**Onset of illness 121 gastroenteritis cases at a school in Singapore, 29 September - 4 October 2011**




contaminated food and water, or environmental contact. The incubation period is 12-48 hours and symptoms may last 24-72 hours[1].

Our investigations revealed that a student (from a primary 2 class) had vomited in class in the afternoon of 30 Sep 2011. We believe this to be the most likely source of the outbreak, as we identified several lapses in the school's cleaning and disinfection procedures which could have directly or indirectly facilitated the rapid transmission of norovirus in the school. These lapses included not using household bleach to clean and disinfect areas contaminated by vomitus, inappropriate disinfection and storage of cleaning equipment used to clean the vomitus, and inappropriate disposal of waste materials contaminated by vomitus.

Most of the affected students were from primary 3 and 5 classes. These students had afternoon remedial or enrichment lessons on 30 Sep 2011. We hypothesized that while waiting for their afternoon lessons, the students played around the area where the vomitus was disposed of. Their close proximity to the infected vomitus may have facilitated transmission. Only a few of the primary 1 and 2 students were affected. This was because most of their classes already started before the student vomited in the afternoon of 30 Sep 2011.

The following factors could have also contributed to the explosive nature of the outbreak:

1. There was a high proportion of cases (86%) with vomiting and some of them vomited in their classrooms. Vomiting can give rise to infectious droplet aerosols and widespread contamination[1].
2. The virus has a low infectious dose of 10-100 particles and could remain viable in the environment for up to five days as a consequence of inadequate environmental cleaning[1].
3. The densely populated school environments and sharing of classes and facilities could facilitate transmission of the infection to susceptible population (i.e. young school children).

To prevent the recurrence of similar outbreaks, MOH has advised the school on measures to improve environmental, food and personal hygiene.

## References

1. US Centers for Disease Control and Prevention. National Center for Immunization and Respiratory Diseases (NCIRD). Last reviewed on May 20, 2011. Available at : http://www.cdc.gov/ncidod/dvrd/revb/gastro/norovirus.htm (accessed 3 November 2011)