ORIGINAL ARTICLE

Risk Factors for Typhoid Outbreak in Sungai Congkak Recreational Park, Selangor 2009

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SUMMARY

Typhoid fever continues to pose public health problems in Selangor where cases are found sporadically with occasional outbreaks reported. In February 2009, Hospital Tengku Ampuan Rahimah (HTAR) reported a cluster of typhoid fever among four children in the pediatric ward. We investigated the source of the outbreak, risk factors for the infection to propose control measures.

We conducted a case-control study to identify the risk factors for the outbreak. A case was defined as a person with *S. typhi* isolated from blood, urine or stool and had visited Sungai Congkak recreational park on 27th January 2010. Controls were healthy household members of cases who have similar exposure but no isolation of *S. typhi* in blood, urine or stool. Cases were identified from routine surveillance system, medical record searching from the nearest clinic and contact tracing other than family members including food handlers and construction workers in the recreational park. Immediate control measures were initiated and followed up.

Twelve (12) cases were identified from routine surveillance with 75 household controls. The Case-control study showed cases were 17 times more likely to be 12 years or younger (95% CI: 2.10, 137.86) and 13 times more likely to have ingested river water accidentally during swimming (95% CI: 3.07, 58.71). River water was found contaminated with sewage disposal from two public toilets which effluent grew *salmonella spp*.

The typhoid outbreak in Sungai Congkak recreational park resulted from contaminated river water due to poor sanitation. Children who accidentally ingested river water were highly susceptible. Immediate closure and upgrading of public toilet has stopped the outbreak.

INTRODUCTION

Typhoid fever continues to pose an important public health problem in many tropical parts of the world. In Malaysia, typhoid is a notifiable disease since 1986 under the Communicable Disease Control Act (CDC Act 1988)[1]. For the past 20 years, the incidence of typhoid in Malaysia has markedly declined from more than 10 per 100,000 populations in 1979 to less than two per 100,000 populations in 2009[2]. Currently the occurrence of typhoid fever in Malaysia is found to be sporadic with occasional outbreaks confined to a few areas where safe water supply and sanitation, food handling and personal hygiene practices are inadequate. The last big outbreak involving 128 cases was reported in 2003 in state of Kelantan where contaminated well water was the vehicle for transmission[3].

Typhoid fever is a systemic disease caused by human-specific pathogen, *Salmonella typhi*. Clinical syndrome is characterized by fever and abdominal symptoms, with incubation period most commonly 10 – 14 days (range 3 – 21 days)[3].

Sungai Congkak Recreational Park (SCRP) is located in the district of Hulu Langat, approximately 50 km from Kuala Lumpur and is within the Sungai Congkak Forest Reserve. One of the many freshwater tourism attractions in Selangor, this tourist spot offer a stretch of picnic, bathing and recreational area along the crystal clear stream water of Congkak River that flows downhill from Nuang Mountain. There were not less than 1000 visitors during weekend and public holidays. Basic amenities mainly lodging and toilets are provided by operators. There are choices of more than 20 chalets and sheds available for renting along the river.

On 26th February 2009 at 11.30 am, Communicable Disease Control (CDC) Unit of Selangor State Health Department received telephone notification from Paediatric ward of the HTAR informing about a cluster of four children with *S. typhi* isolated from their blood culture. Investigation was carried out immediately by State and District CDC team the same day notification was received. During case investigation, it was found that all of them shared one common history of having visited SCRP with their respective family members during public holiday (Chinese New Year) on 27th January 2009. Review of the communicable disease surveillance system (e-notis) did not show unusual increase of typhoid notification or clustering of typhoid in any of the nine districts of Selangor during this period.

An investigation was carried out to verify the outbreak, to Identify source of the outbreak, to identify risk factors for infection and to undertake immediate preventive and control measures.

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MATERIALS AND METHODS

A case-control study was conducted to identify the risk factors for the infection. A case is defined as a person with or without clinical features of typhoid infection (fever and abdominal symptoms), with isolation of *S. typhi* in blood or urine or stool and had visited SCRP from 26th to 27thJanuary 2009 prior to illness onset. Controls are healthy household members of a case who have visited SCRP during the same period with no isolation of S. typhi in blood or urine or stool.

We reviewed all typhoid notification in the e-notis from 27th January 2009 until 27th February in which the investigation report was subsequently examined for history of visiting SCRP. Medical records at the nearby Health Clinic situated about two km from SCRP were examined, where patients attended the clinic from 26th January to 27th February 2009 and presented with fever and abdominal symptoms were contacted for history of visiting SCRP. Active case searching was carried out by the District Health Office to identify possible carrier among contacts of cases, food handlers at the SCRP and food premises visited by the patient-case, the administrative staffs and construction workers in SCRP. All hospitals in the state and the bordering state were alerted to report suspicious cases.

Data was collected through face-to-face interview, telephone interview and observation. Information collected includes socio-demographic characteristics, clinical history, activities in SCRP and food history. Information collected was line-listed and analyzed using SPSS v15. Descriptive statistics were used to describe the distribution of cases and OR is used to express risk factor of infection with 95% confidence interval (CI).

An environmental investigation was carried out by District Health Office in collaboration with State CDC team for general sanitation of the recreational park, public toilets, food premises and the activities at SCRP. Dye test was used to ascertain leakages of the sewage system. Food handlers were inspected and interviewed for hygiene practices and their movements if any.

Stool specimens were obtained from all 68 household contacts, 14 suspected cases from medical record search, four food handlers at SCRP, 26 construction workers at SCRP, 14 local people and 170 other food handlers visited by cases. Stool samples were cultured at National Public Health Laboratory (NPHL). All isolates of *S. typhi* were further analyzed for epidemiological finger-printing using PFGE at Institute of Medical Research (IMR).

Several environmental samples were taken for microbiological analysis and these include 11 water samples at various points of the riverbank and five samples from the sewage effluent, inspection chamber of the public toilet in the recreational area and from the surrounding drain were sent for microbiology. Food samples from food handlers at SCRP were also sent for microbiology.

RESULTS

The investigation started with the first four cases reported by the hospital on 26th February 2009. Two of the cases are cousins and the rest are not related but all were treated in the same ward. During the interview with their mothers or care taker in the ward, it was revealed that all of them had visited SCRP during the same period which happened to be Chinese New Year (CNY) holiday on 27th January 2009. Another eight cases were identified from e-notis subsequently giving a total of 12 typhoid cases altogether in this outbreak. All 68 household contacts were asymptomatic and stool cultures were negative for *s. typhi*.

Forty five (45) suspected cases with fever and abdominal symptoms were identified from medical records at the nearest health clinic but 39 were contactable. Of 39 patients whom the district contacted, only 14 had history of visiting SCRP. However their stool culture did not grow *s. typhi*. No other cases were detected from active searching.

There were equal number of cases by gender (six males and six females) and all were of Malay ethnic. Majority of cases (83.3%) were from other districts and neighboring state while only two cases (16.7%) were from local district.

After fever, most common signs and symptoms were nausea/vomiting (66.7%), diarrhea (53.8%), abdominal cramp (53.8%), lethargy (46.2%), headache (46.2%) and loss of appetite (38.5%).

The earliest onset in this outbreak was on 31stJanuary 2009 and the last onset was on 18th February 2009 after the exposure on 27th January 2009. Median incubation period was 18 ± 5 days (range 4 - 20 days) (figure 1).

Sixty eight (68) healthy family members were identified as control group from the 12 patient-case. None of the adults in the control group work as food handler. Case and controls did not differ significantly by gender. This study found out that cases were significantly aged 12 years or younger (92%) as compared to controls (40%); cases were 17 times more likely to fall into this age group (95% CI: 2.04, 136.95) (table I).

Further analysis of risk factors revealed that all cases and majority of controls (73.5%) had swam or bathed in the river during their visit, and there is no significant difference between these groups. There was also no significant difference in the duration and place of swimming between the two groups (table I).

Accidental water ingestion during swimming or bathing in the river was found to be significantly associated with typhoid infection in this outbreak where cases were 14 times more likely to have ingested river water accidentally (95% CI: 3.07, 58.71) during swimming or bathing in the river.

With regards to possible exposure from food item, less than half of cases (44%) and controls (43%) had bought any food item from food handlers in the park (table I). Food items bought at the recreational were mostly canned drinks.

Table I: Characteristic of respondents and risk factors for typhoid infection in SCRP

Exposure	Cases (n=12)		Controls (n=68)		OR	95% CI / p value
	n	%	n	%		
Gender						
Male	6	50.0	39	57.4		0.636
Female	6	50.0	29	42.6		
Age 12 years or younger	11	91.7	27	39.7	16.70	2.04 – 136.95
Swim or bath in the river	12	100	50	73.5	0.81	0.059
Swim/bath for 4 hours or longer	10	76.9	59	78.7	0.90	0.22 – 3.68
Swim/bath at middle stream	5	62.5	43	86.0	0.27	0.05 – 1.40
Accidental ingestion of river water	10	83.3	9	25.7	14.44	2.65 – 78.82
Bought food/drink at recreational park	4	44.4	29	42.6	1.08	0.26 – 4.36

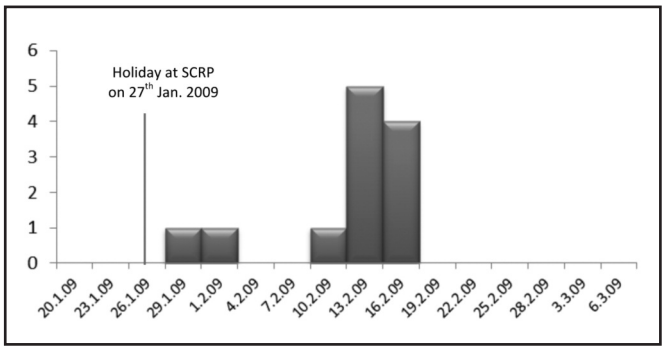

Fig. 1: Epidemic curve of typhoid cases in SCRP by date of onset.

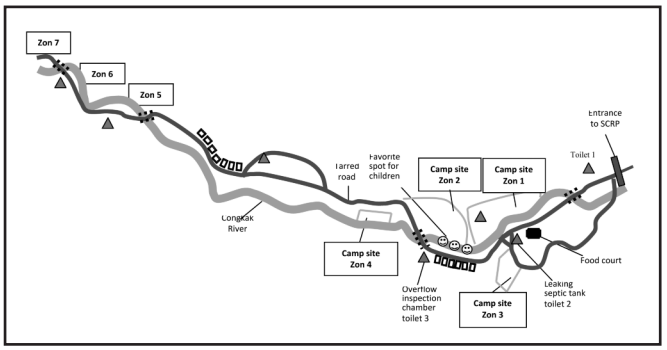

Fig. 2: The layout plan of SCRP.

Fig. 3: One of the pit latrines (in red circle) built few meters away from river bank.

During our environmental investigation, we observed several workers were doing construction works in the park. The upgrading and renovation of drainage system and the chalets had started since early December 2009. The main contractor had employed more than 20 foreign workers since then. At present there were 26 workers but their turnover was quite fast. Some of the workers had camped inside SCRP (near the second toilet) while some staying in nearby rented house. Those camping inside SCRP claimed they used the public toilets or the river for bathing and washing.

Food premises are provided by SCRP in a food court located at the lower ground from the leaking septic tank (figure 2), while mobile peddlers are available outside SCRP during weekends or public holiday.

The main water supply to the park was untreated and coming directly from the river via gravity feed system. There are seven flush type public toilets managed by SCRP at the upper stream, but all were poorly maintained and two were grossly malfunctioned with leaking septic tank in the second toilet and overflowing inspection chamber in the third toilet. Dye test used in the third toilet showed that sewage from the overflowing chamber finally drained into the river just 50 meters away. This is the favorite spot for family with children as the water turbulent is very minimal.

At the lower stream of Congkak river, as many as 18 chalets or sheds were erected by public operators; all come with pit latrine toilets built just several meters away from the river bank (figure 3).

All stool samples collected during the investigation other than the cases did not grow *s. typhi*. These include samples from 68 household contacts, 26 construction workers at SCRP, four food handlers at SCRP, 39 suspected patients from record search in the health clinic, 14 local people and 60 food handlers outside the park that were patronized by cases prior to illness. The DNA profiles were analyzed using the PFGE test and found that 5 (35.7%) from 14 isolates were of similar sources.

As for environmental samples, two of five environmental samples from the sewage at the overflowing inspection chamber of the third toilet and leaking septic tank of the first toilet grew *Salmonella spp* while 11 water samples from various points of the river bank did not grow *S. typhi* or other enteric microorganisms.

DISCUSSION

We were able to identify only 12 cases through routine surveillance system despite alert signal sent to all hospitals and active searching of cases from nearby clinic. Massive stool collection in effort to detect more patients through contact tracing also did not yield positive result. The low attack rate in this outbreak was probably due to the uneven distribution of the bacteria as a result of dilution from the flowing stream of water. Hence, only certain group of people who had enough infecting dose through ingestion of contaminated water will become infected. In this outbreak, the median incubation period was considerably long, about 18 days. These findings are supported by a study among volunteers challenged with typhoid where larger inocula produced higher attack rates and shorter incubation period,[4,5].

There is possibility that the infection may have originated from a carrier who happen to be there during the holiday and have used one of the faulty toilet. The carrier could also be among the guests who swam or bathed at the same spot and had passed urine or faeces direct into the river water intentionally. However, we did not ask the respondents habit of urinating or defecating in river water. With respect to spot of activity, some of our respondents were not able to recall their location of activities in SCRP.

A striking feature in this outbreak is that cases were predominantly children. Similar observation was also reported in West Bengal6and Karachi[7] where young age group was reportedly more susceptible. In any food and water borne outbreaks, children are indeed more vulnerable as the dose needed to infect is much lower compared to adults. Beside fever, diarrhea and abdominal cramps were next common symptoms reported and no cases had reported constipation. As reported in many papers earlier, diarrhea has always been a common presenting symptom in children while constipation is more in adults[8,9,10].

Although *s. typhi* was not isolated from the water samples in this outbreak, there was evidence of contamination of the river with human waste as supported with insanitary condition of public toilets and isolation of *salmonella spp* from the samples. There was no or limited documented typhoid outbreak with contaminated water source as vehicle for transmission in local context, but there are enough evidence pointing to sewage contamination elsewhere. Review of typhoid cases in the United States from 1960 to 1999 has found out that among outbreaks in which contaminated water was the most likely vehicle, half had apparent sewage contamination[11]. In Indonesia, cases were 11 times more likely to have consumed water from untreated sources such as river, pond, well or vendor1[2] which again suggested possible contamination as majority of cases were seven times likely to use open sewer.

Phage typing though not a routine has facilitated the tracing of the route of transmission and detection of the infectious source[13]. It is obvious that this current outbreak came from same source as shown by the same phage type of the *S. typhi* isolated from five cases.

CONCLUSION

A common source outbreak of typhoid has occurred in Sungai Congkak recreational park during public holiday on 27th January 2009 where children were most susceptible. The index case or carrier was not known in this outbreak. The source of infection was most likely from the leaking septic tank or overflowing inspection chamber of the toilets and the river acted as vehicle for transmission. The outbreak stopped after closure of the park commenced immediately for repair works and upgrading of the faulty toilets.

ACTIONS AND RECOMMENDATIONS

Immediate control measures to halt the outbreak and prevent spread of typhoid fever were undertaken successfully as below.

1. Immediate closure of the recreational park for eight weeks under the Communicable Disease Control (CDC) Act from 19th March 2009 for repair works of the affected toilets by the relevant management.
2. A new septic tank was built to replace the malfunction toilet by the management after consultation with the State Public Health Engineer and periodic maintenance has been exercised since then.
3. Typhoid vaccination for all food handlers in the recreational park and food handlers patronized by the cases.
4. Houses of all cases were inspected and disinfected immediately.
5. Cases and household contacts were given specific education on personal hygiene and drinking safe or boiled water.

To prevent recurrent outbreak in the future, we have put forward two recommendations to the Selangor State Government. These recommendations need higher authority decision as it involve other agencies and special budget.

1. Develop a standard regulation for resort and recreational park build near a river that cover safe water supply and proper sewage system to safeguard the water body from contamination, subsequently preventing water borne diseases in the future. This recommendation has finally being taken up by the State Government representative where a field visit to the affected recreational park and nearby park was carried out with all related agencies involving the District Officer, District Health Officer, the community head, Forestry Department, Department of Irrigation and Drainage, State and Parliamentary representatives of the local community.
2. Regular monitoring and evaluation through enforcement activity.

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