

An outbreak investigation of typhoid fever in Pondicherry, South India, 2013

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Abstract

Background: Preliminary investigation at Pediatric ward of Indira Gandhi Medical College revealed admission of a cluster of typhoid cases who were residents of one particular street in a nearby locality.

Objectives: This study was undertaken to estimate the magnitude of the outbreak, identify the source of infection, and, thereby, institute control measures.

Materials and Methods: An investigation team including 10 MBBS students carried out a sanitary survey, house-to-house survey, data collection using epidemiological case sheets, and spot mapping. Typhoid diagnosis was confirmed as per the IDSP guidelines, i.e., either a blood culture growth positive for *Salmonella typhi* or a fourfold rise in antibody titer. An age- and gender-matched case-control study was conducted to find the association of occurrence of typhoid with various possible sources of infection. Water samples were collected from the affected households and public taps for investigation.

Results: Rapid survey of all the 6 streets of Thilaspeth covered 1106 people living in 283 households. All nine confirmed cases were residents of one particular street. The attack rate calculated was 3.4% in this street. A significant association of occurrence of typhoid was found only with consumption of raw drinking water (OR = 12.6, $P = 0.01$). Water samples only from the affected street tested positive for the presence of coliforms. The sanitary survey documented water pipeline breakage at the junction of this street. Further spread of disease was stopped by advocating drinking of boiled water and repair of pipeline.

Conclusion: Strengthening of disease surveillance for early identification of localized outbreaks and instituting control measures can effectively control disease spread.

KEY WORDS: Outbreak investigation, Pondicherry, typhoid

Introduction

Typhoid fever is a bacterial disease caused by *Salmonella typhi*. It is transmitted through the ingestion of food or drink contaminated by the feces or urine of infected people. It is a public health problem in developing countries where it causes a lot of morbidity and mortality. In 2004, the World Health Organization (WHO) estimated an incidence of 21.6 million cases globally every year with 216,000 deaths; 90% of this morbidity and mortality occurs in Asia.^[1] A systematic review

in 2010 put this estimate as 26.9 million cases.^[2] Clean water, food hygiene, and good sanitation prevents the spread of typhoid fever. Typhoid is endemic in India with outbreaks having been reported from Rajasthan, Maharashtra, Bangalore, West Bengal, and Pondicherry.^[3-8] It is needless to say that investigation of a typhoid outbreak is of utmost importance. This study describes the steps that were followed in recognizing, estimating the magnitude, identifying the source of infection, and instituting control measures to stop the spread of a typhoid outbreak that occurred in the vicinity of a medical college in Pondicherry.

Materials and Methods

After receiving the information on admission of cluster of typhoid cases from Thilaspeth area at Pediatric ward, a team comprising faculty members, tutors, Medical Officer of the Primary Health Center (PHC), and medical undergraduate students was formed to carry out the outbreak investigation.

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Thilaspet is an urban locality opposite to this medical college and comprises six streets.

A sanitary survey of the area was conducted immediately. Water samples from the affected households and public taps were sent to the public health laboratory. A medical survey of all the 6 streets was done by 10 medical students using a predesigned pro forma. The purpose of this survey was to enumerate the population residing in this area and to rapidly search for new cases (diagnosed elsewhere) and identify probable cases (with fever for 1 week or more over last 1 month). Blood samples were drawn from all probable cases for further investigations at the medical college. All the cases diagnosed were confirmed with either blood culture growth for *Salmonella typhi* or a fourfold rise in the antibody titer by Widal test.^[9] A spot map of Thilaspet area was drawn to generate hypothesis regarding the source of infection. A case-control study was performed with age- and gender-matched controls selected from the affected and unaffected streets of Thilaspet.

Results

Investigation at the Medical College

Three children admitted on July 21 and 22, 2013, to the Pediatric ward of Indira Gandhi Medical College and Research Institute, Pondicherry, were diagnosed with typhoid fever. A preliminary investigation revealed that all these children were residents of one particular street in Thilaspet, a neighboring locality of this medical college. Registers maintained at Department of Microbiology revealed yet another adult case of typhoid from the same street. All these four cases were diagnosed within 4 days.

Sanitary Survey at Thilaspet

The overall level of sanitation in the affected street was far from satisfactory in comparison with other streets in Thilaspet. Water pipeline leakage following recent road work was noticed at the junction of this particular street.

Medical Survey

The medical survey covered 1106 individuals residing in the 283 households located in 6 streets of Thilaspet. Taking this opportunity, the students in the survey team created awareness among the residents to boil water for drinking purposes and distributed health education pamphlets received from the PHC. The survey revealed three more typhoid cases in the same street, who had been diagnosed and treated elsewhere (in addition to the four cases who were admitted at the medical college). Thus, seven cases were reported in this street alone. Apart from these, four probable cases (fever for 1 week or more over last 1 month) were also identified from this street, of which two were confirmed to have typhoid. Surprisingly, no new case or probable case was identified from the other streets in this area.

Laboratory Diagnosis of Typhoid

A blood culture growth positive for *S. typhi* or a fourfold rise in antibody titer was taken as confirmation of typhoid in all cases.^[9] A total of nine cases were confirmed in this investigation, including four admitted at the medical college, three initially diagnosed elsewhere, and two newly identified from the probable cases during the medical survey. Of the nine cases, two had growth in blood culture and the rest seven had fourfold increase in antibody titers [Table 1].

Table 1: Laboratory diagnosis of typhoid cases at Thilaspet, Pondicherry

Name	Age/sex	Address	Diagnostic test	Result	Initial widal		Repeat widal	
					Date	Titer	Date	Titer
Case 1	9 y/M	30, Drowpathi Amman Koil Street	Blood culture	Growth positive for <i>S. typhi</i>	—	—	—	—
Case 2	7 y/F	1, Drowpathi Amman Koil Street	Widal test	Fourfold rise in antibody	July 18	TO: 1:320; TH: 1:160	August 3	TO: 1:1280; TH: 1:1280
Case 3	23 y/F	5, Drowpathi Amman Koil Street	Blood culture	Growth positive for <i>S. typhi</i>	—	—	—	—
Case 4	7 y/F	6, Drowpathi Amman Koil Street	Widal test	Fourfold rise in antibody	July 19	TO: 1:320; TH: 1:160	August 2	TO: 1:640; TH: 1:640
Case 5	19 y/F	20, Drowpathi Amman Koil Street	Widal test	Fourfold rise in antibody	July 9	TO: 1:160; TH: 1:160	August 8	TO: 1:640; TH: 1:640
Case 6	35 y/F	16, Drowpathi Amman Koil street	Widal test	Fourfold rise in antibody	July 14	TO: 1:160; TH: 1:160	August 6	TO: 1:1280; TH: 1:640
Case 7	25 y/M	21, Drowpathi Amman Koil Street	Widal test	Fourfold rise in antibody	July 14	TO: 1:160; TH: 1:160	August 6	TO: 1:640; TH: 1:640
Case 8	1 y 6 mo/M	38, Drowpathi Amman Koil Street	Widal test	Fourfold rise in antibody	July 26	TO: 1:320; TH: 1:320	August 6	TO: 1:2560; TH: 1:2560
Case 9	19 y/M	21, Drowpathi Amman Koil Street	Widal test	Fourfold rise in antibody	July 6	TO: 1:320; TH: 1:160	August 17	TO: 1:640; TH: 1:640

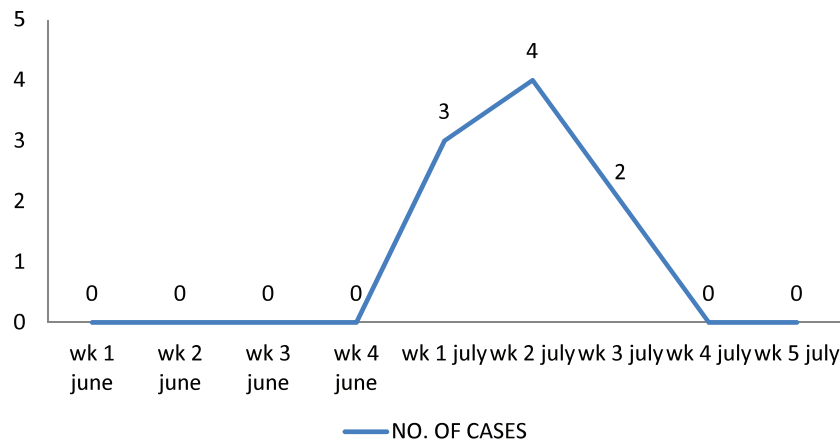


Figure 1: Epidemic curve of typhoid outbreak at Thilaspeth, Pondicherry (July 2013).

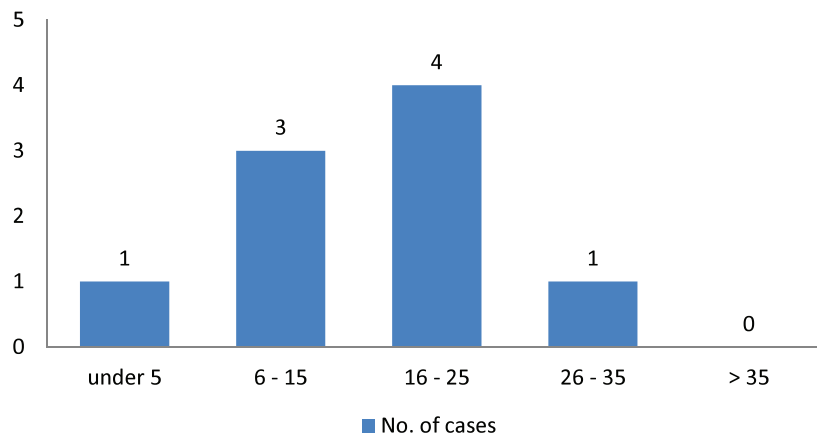


Figure 2: Age distribution of cases in typhoid outbreak at Thilaspeth, Pondicherry.

Water Sampling

Water samples were collected from five sites including two houses of confirmed cases and all the six streets and sent to the Public Health Laboratory. Of these, the three samples from the affected street had coliform presence with counts ranging from 6 to 9 coliform/100 mL indicating a fecal contamination.

Data Analysis

Time Distribution. The outbreak occurred during the first 3 weeks of July 2013 with peak at the second week [Figure 1]. Considering an incubation period of 10–14 days, these cases could have been exposed to *S. typhi* bacilli around the last 2 weeks of June 2013. The outbreak was controlled, and no further cases were reported from this area.

Most affected were in the younger age groups of 16–25 and 6–15 years with attack rates of 103/1,000 and 100/1,000, respectively [Figure 2]. The overall attack rate was 34/1,000 for this street [Table 2]. There were no cases diagnosed in the other streets.

Place Distribution. Spot mapping [Figure 3] clearly shows that all the nine confirmed cases resided in Drowpathi Amman Street. No cases were identified in the other five streets of

Table 2: Attack rates among residents of Drowpathi Amman Koil street, Thilaspeth (population = 226)

Characteristic	No. cases	Population	Attack rate/ 1000 population
Sex			
Male	4	115	35
Female	5	111	45
Age group (y)			
0–5	1	20	50
6–15	3	100	103
16–25	4	39	103
26–35	1	36	28
≥36	0	101	0
Total	9	226	34

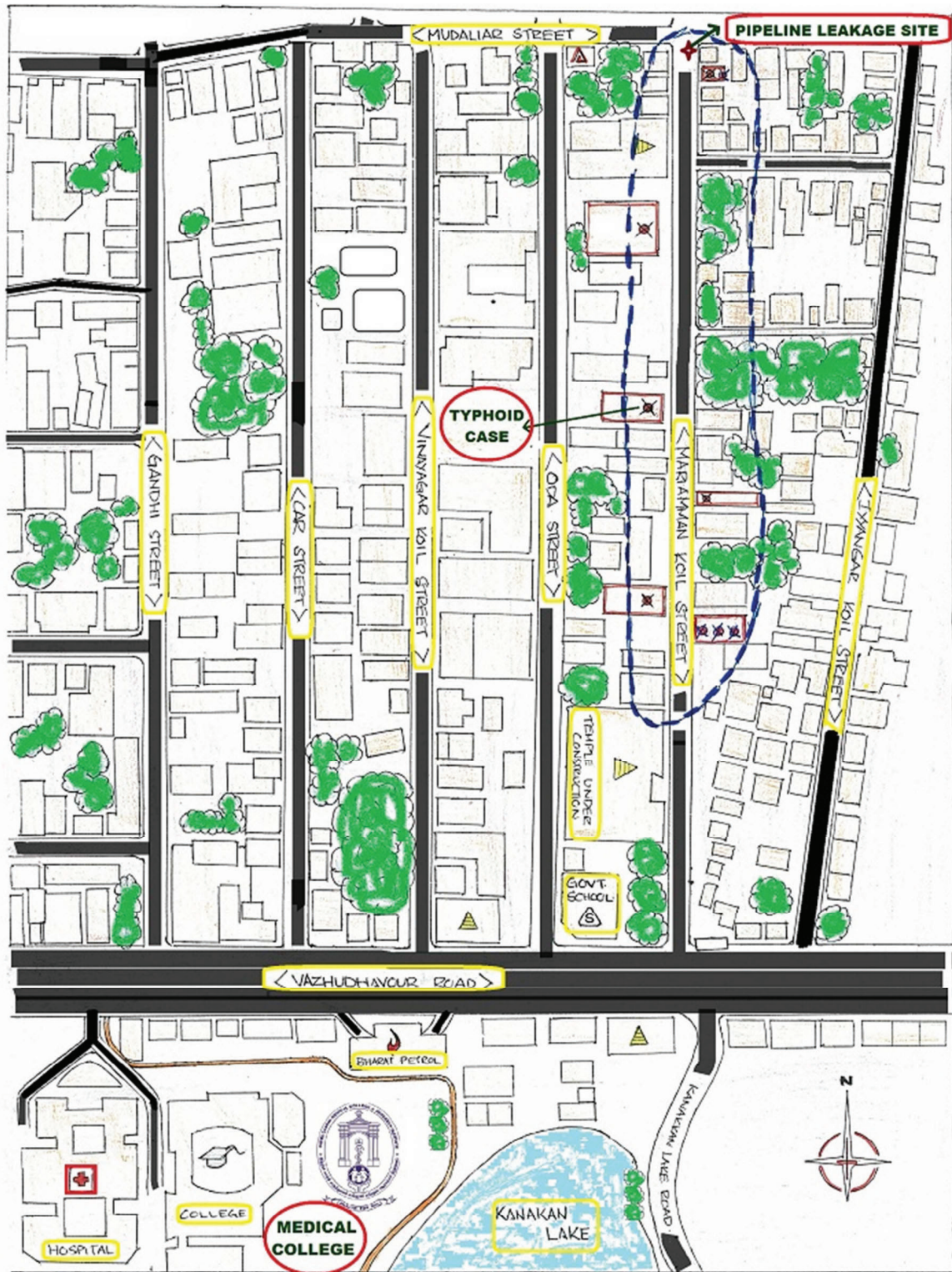


Figure 3: Spot map of the typhoid cases in Thilaspeth area of Pondicherry.

Table 3: Exposures to selected risk factors for infection with *Salmonella typhi*, case-control study, Thilaspeth, Pondicherry, July 2013

Exposure	Cases (%) (N = 9)	Controls (%) (N = 18)	Odds ratio	95% Confidence interval	P value
Drinking raw water directly from pipeline	8 (88.9)	7 (38.9)	12.6	1.2–123.4	0.01
Eating food from local junk food stall	6 (66.7)	11 (61.1)	1.3	0.2–6.8	0.78
Contact with known typhoid case	6 (66.7)	5 (27.8)	5.2	0.9–29.2	0.053
Buying vegetables from the local market	8 (88.9)	14 (77.8)	2.3	0.2–24.1	0.48

Thilaspeth. This spatial distribution with the results of the water sampling suggests that water supply to this street alone has been contaminated with fecal matter, resulting in this outbreak.

Hypothesis Generated

It is an outbreak of typhoid fever, caused by *S. typhi* organisms, transmitted through contaminated water supply to this particular street.

Hypothesis Testing—Case-Control Study

A case-control study was carried out with age- and gender-matched neighborhood controls selected from the affected and unaffected streets of Thilaspeth. Two controls for each case were identified during the medical survey. The case-control study tested the hypothesis that “cases were more likely to have consumed raw water from the public water supply than controls.” Other possible sources of infection such as consumption of food from local eateries, vegetables from local market, and contact with confirmed case were also noted. Consumption of raw water was reported by 88.9% of the cases, as opposed to 38.9% of the controls, and this association was found to be significant ($P = 0.01$). Subjects who had drunk water without purifying had a 12.6-fold risk of contracting typhoid fever. In contrast, no risk was found to be significantly associated with consumption of junk food from local stalls, vegetables from the local market, and contact with confirmed case [Table 3]. The data were analyzed with SPSS version 17.

Control of Outbreak

All the nine cases recovered after antibiotic treatment. There was no case fatality. The medical students, during the medical survey, gave health education in each household for proper water and food sanitation to prevent further spread. Chlorination of water supply was ensured. The pipeline at the junction of the street was repaired. No further occurrence of cases was documented in this area.

Discussion

It was evident that there was a localized outbreak of typhoid with the occurrence of four cases in the same street. This occurrence conforms to Trigger 1 level (more than two cases from same ward/village with population of 1000) for declaring an outbreak as per the Integrated Disease Surveillance Project (IDSP) guidelines for disease surveillance in India.^[10] Further

systematic investigations confirmed another five cases. All these cases were confirmed with either a blood culture growth positive for *S. typhi* or a fourfold rise in antibody titer.

Spot mapping revealed that all cases were confined to one particular street in the locality, with other five streets of Thilaspeth unaffected. Transmission of infection is known to occur with ingestion of food or water contaminated with feces. Other risks include contact with known case or carriers, consuming ice creams or iced drinks, food from street vendors, and vegetables grown in fields fertilized by sewage.^[11] In our case, it was evident that the water supply to this street alone had fecal contamination, as found by the presence of coliform in water samples. A case-control study taking into account the other probable sources of infection such as food from local eatery, vegetables from local market, and contact with known case was conducted. A significant association of occurrence of typhoid with consumption of raw drinking water (OR = 12.6, $P = 0.01$) was seen.

The evidence is more pointing toward the contamination of water by sewage in this street because of the presence of coliform in water samples collected from this street. The samples from other streets were free from the coliform. Sanitary survey at the start of the investigation found water pipeline leakage at the junction of the street. However, we could not test for the presence of *S. typhi* in the water samples.

Conclusion

This study describes how a localized outbreak was recognized, investigated, and controlled to prevent further spread. This investigation presents the link of contaminated water supply with the outbreak of typhoid fever in Drowpathi Amman Koil Street of Thilaspeth, which has resulted in nine confirmed cases within a span of 2 weeks. The early recognition of this handful cases and repairing of pipeline along with consumption of boiled water by the people in the locality prevented this outbreak from infecting large number of people. In order to avoid such incidences in future, we recommend that proper precautions be taken when water pipelines are repaired, replacement of water pipelines in this street with underground pipes to avoid contamination, and proper chlorination to be followed. Awareness among the residents on importance of use of household water purification methods and environmental sanitation needs to be created. Most importantly, medical colleges can effectively function to recognize these outbreaks very early and institute control measures before it spreads to a larger extent.

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