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Washing Hands Before Meals Becomes A Protective Factor In An Outbreak Of Typhoid Fever (ICD 10 Code: A01.0) In Village Darnu, Near Dharamsala, District Kangra, Himachal Pradesh, India

KEYWORDS: Typhoid outbreak, Hand pump contamination, open defecation

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ABSTRACT *Introduction: Each year 1.6 million children die from diarrhoea, more than malaria, measles and HIV/AIDS combined. The WHO estimates that 88%, or 1.4 million, of these deaths are caused by poor sanitation combined with unsafe drinking water . WHO estimates the annual incidence of typhoid at 21.6 million cases worldwide (2000). Typhoid fever occurs in all parts of the world where water supplies and sanitation are poor and incidence in south Asia is >100/100,000. In 2006, India reported 0.7 million cases of typhoid of which 26,327 (3.6%) were from the hill sate of Himachal Pradesh*

On 13/9/07 the local health workers informed the block Medical Officer and District Surveillance Officer about recent increase in fever cases in the Village Darnu, which is located 5 km from the district headquarter Dharmasala. The cases presented with fever, chills, sweating and headache and/or generalized pains. On 14/09/07 the District Surveillance Officer directed the author to look into and investigate the problem and suggest preventive measures.

Method: We collected Baseline fever data from outpatient reports of health sub centre Darnu since 2002 and analyzed for seasonal trends and seasonal averages. We looked into any recent change in case definition of enteric fever, surveillance system or population migration. We defined a case as occurrence of fever for more than one week in a resident of village Darnu from 20th Aug to 5th Oct 2007, and conducted a house to house search on 17/9/07 using a structured Performa and prepared line list of fever cases with date of onset, age, sex, address, clinical descriptions, number of household members, and serial number of households affected, laboratory investigation results and outcome and enumerated village population. During the active case search, we informed all people that cases should report at sub centre.

We sent blood samples for culture and serum samples for WIDAL, Weil Felix to Department of Microbiology, RPG Medical College, Kangra.

We studied the water supply and distribution system in the village. A map was prepared and correlated with spot map. We collected three water samples and sent to medical college and to lab of irrigation and public health department for coliform count to check for evidence of fecal contamination.

Results: We identified 124 cases from between 22/7/07 and 2/10/07. Baseline fever cases for the village were 8 for the month of September and standard deviation was 3. The reported 28 cases (and present 124 cases) are thus in excess of the expected frequency by more than 2 standard deviations. All cases had fever with chills, 96% had headache and 95% complained of generalized body aches and fatigue. The first case was on 22/7/7 and the number peaked in the week of 10-16 September and then declined. The geographic distribution shows that Marthan, Barthan Mogu, Batarha, Barsain 2 and Harijan localities in the village were more affected and there were negligible cases in colony/ sippy/ dhiman basti. The attack rate was 12 % overall, higher in females (15%) than males (10%). People of age 5-14 were most affected with attack rates of 17 %, followed by 15-29 (17%) and 0-4 yrs (15%).

The blood culture lab reports showed 7 samples positive for Salmonella typhi. CRI Kasuali lab confirmed 5 lab isolates as Serotype Salmonella typhi, antigenic structure 9,12,Vi:d:-. Phage type of 5 samples was Ei and one of phage type was DegVi. A total of 22 cases were positive by either blood culture or WIDAL titer of 1:160

There was no common meal. Eating outside- some cases had fast food / food from street vendor. –There was no household level purification of the water prior to the outbreak, though chlorine tablets were being used by many the outbreak

Report of water samples showed that the water was contaminated with coliforms and the coliform count in 2 samples was > 1800 and > 1600 respectively. The coliform count of the hand pump sample was 1000.

There were 2 sources- hand pump (underground) and stream. The water supply in the village is daily but intermittent, twice daily. Another water supply is from a natural source (untreated) for a part of the village. Case control study revealed that the hand pump B was associate with significant risk of outbreak and hand washing was protective against the disease.

Action taken : We prepared a spot map and with overlay technique of water supply pipe map, was able to identify the source of the contamination and did analytical analysis. The lab confirmed the hypothesis. We closed the shallow handpump which led to the containment of the outbreak.

Introduction

WHO estimates the annual incidence of typhoid at 21.6 million cases worldwide (2000). of which over 90% being in Asia[2]. In the age group of of 5-15 India had the highest annual incidence of typhoid with 493.5 per 100,000 person yr[3]. In 2007, India reported 0.7 million cases of typhoid

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of which 21,360 (3%) were from the hill state of Himachal Pradesh[4]. Typhoid fever occurs in all parts of the world where water supplies and sanitation are poor and **lack of investment in sanitation reveals a blind spot in development policy**, failure to recognize sanitation's integral role in reducing poverty is alarming as over 40% people globally [5] and 50 % people in India[6] lack access to basic sanitation predisposing people to recurrent episodes of waterborne diseases.

Typhoid is caused by the bacterium *Salmonella typhi* & presents with fever with chills and headache or malaise and anorexia. The average incubation period is 10 to 14 days (but can range from 3 to 53 days). It is transmitted via faeco-oral route or urine-oral route and humans are the sole reservoir of pathogens. Person to person transmission through soiled hands contaminated with faeces or urine, ingestion of contaminated water, milk, food can take place. It can survive at temperature of 7-45° C and in water for 2-3 weeks.

On 13th Sep 2007 the local health workers informed the Block Medical Officer and District Surveillance Officer about recent increase in fever cases in the Village Darnu. The cases presented with fever chills sweating and headache and or generalized pains. On 14th September, the Medical Officer of Health cum District Surveillance Officer asked the corresponding author to investigate the problem and suggest remedial measures. We conducted an investigation with the objectives of finding the cause and taking appropriate control and preventive measures.

Setting: Village Darnu is located 5 km from the district headquarter Dharmasala, at a located at a latitude of 76°19'23.1" E to 76°20'47.1" E and longitude 32°12'38.8" N to 32°12'57.6" N; at an altitude of 1225 - 1341 meters above mean sea level. The terrain is hilly and is located on the south slope of the mountain range. The village has a population of 1025 including migrant labour. The time of the year was the monsoon season when water borne diseases are common. Open defecation further contaminate the water sources in the villages especially during flooding in monsoon.

Methods :

Step 1 Determining the existence of an outbreak:
We collected Baseline fever data from outpatient records and reports of health sub centre Darnu since 2002 and analyzed for seasonal trends and seasonal averages. We looked into any recent change in case definition of enteric fever, surveillance system or population migration.

Step 2 Confirmation the diagnosis:
We examined the cases clinically for establishing diagnosis. We sent blood samples for culture to Department of Microbiology, RPG Medical College, Kangra on 14-15 September & serum samples for WIDAL.

Step 3 Define a case:
We defined a case as occurrence of fever for more than one week in a resident of village Darnu from 20th Aug to 5th Oct 2007.

Step 4 Search for cases:
We conducted a house to house search on 17th Sep using a structured Performa and prepared line list of fever cases with date of onset, age, sex, address, clinical descriptions, number of household members, and Serial number of household members affected, laboratory investigation results and outcome and enumerated village population. During the active case search, we informed all people were that cases should report at sub centre.

Step 5 Generate hypotheses using descriptive:
We described the outbreak by time place and person to generate the hypothesis. We administered a trawling questionnaire to a subset of the cases to identify possible exposures.

Step 6. Analytical study:
We confirmed the hypothesis regarding these exposures by a case control study. We conducted a case control study to confirm our hypothesis on exposures. We defined a case as all probable cases which were lab confirmed (with isolation of *S typhi* or serological evidence) [n=32]. We selected 2 age (±5years) and sex matched controls per case from the same village. We interviewed the cases and controls to elicit information about water source, washing hands, consumption of milk, meat, and eating out. We estimated the matched Odds Ratio and 95% confidence intervals. We administered a trawling questionnaire

Step 7, 8. Draw conclusions and comparison with established facts:
We mapped the water supply system and correlated it with spot map. We collected three water samples and sent to medical college and lab of irrigation and public health department for coliform count to check for evidence of fecal contamination.

Step 9. We made recommendations based on our conclusions derived, to implement control measures and prevent future outbreaks:

Step 10. We communicated the findings along with the recommendations to the district and state health authorities, who executed prevention measures.

Results:

Step 1 Determining the existence of an outbreak:
We identified 124 cases from between 22 July 07 and 2 Oct 07. Baseline fever cases for the village were 8 for the month of September and standard deviation was 3. The reported 28 cases (and total 124 cases) were thus in excess of the expected frequency by more than 2 standard deviations.

Step 2: Confirmation of diagnosis:
Symptoms: All cases had fever with chills, 96% had headache and 95% complained of generalized body aches and fatigue.

Lab results: The blood culture lab reports showed 7 samples of 21 positive for Salmonella typhi. 36 of 52 were samples positive for WIDAL (≥ 1/80) [of which 30 had titers of ≥1:160]. The CRI Kasuali lab confirmed 5 lab isolates as Serotype *Salmonella typhi*, antigenic structure 9,12,Vi:d:-.[1] Phage type of 5 samples was Ei and one of phage type Deg Vi.

Step 3: Define a case:
We defined a case as occurrence of fever one week in a resident of Darnu during 20 Aug to 5 Oct 2007

Step 4: Search for cases:
The house to house search yielded 124 cases which confirmed to the case definition among the 1025 enumerated population and thus an attack rate of 12.1%.

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Step 5 .Generate hypotheses using descriptive:
Time: The first case was on 22nd July 2007 and the number peaked in the week of 10-16 September and then declined.

Place: The geographic distribution shows that Marthan, Barthan Mogu, Batarha, Barsain 2 and Harijan localities in the village were more affected than average attack rate of 12 % and there were negligible cases in colony/ sippy/ dhiman basti. The overall attack rate was 12 %, higher in females (15%) than males (10%).

Person: People of age 5-14 were most affected with attack rates of 17 %, followed by 15-29 (17%) and 0-4 yrs (15%).

Trawling questionnaire revealed that there was no common meal. Eating outside- some cases had fast food / food from street vendor. –There was no household level purification of the water prior to the outbreak. Report of water samples showed that the water was contaminated with coliforms and the coliform count in 2 samples was > 1800 and > 1600 respectively. The coliform count of the hand pump sample was 1000.

Step 6 & 7 Analytical Study & Drawing conclusions:
Trawling questionnaire suggested that villagers did not consume water from Bauri (traditional water sources). They used tap water. There was no feast /common meal consumed. Persons living in the areas were supplied water from Hand pumps A & C were unaffected, whereas those supplied from hand pump B were affected. Therefore, water from hand pump B was suspected as potential source of contamination. To test this hypothesis we conducted a case control study.

The matched analysis of case control study showed that the odds of getting typhoid among those who drank water from handpump B were 18.6 times compared to those who did not [CI=3.4-388.9]. Washing hands was protective [Adjusted OR MLE =0.23 CI=0.06- 0.65] (**those who washed hands before meals were 80% less likely to have typhoid than those who did not**). Water from one hand pump was significantly associated whereas eating out, consumption of raw salad, milk, meat were not significantly associated with the disease (Table II).

Step 8 Compare the hypothesis with established facts:
Water from the shallow hand pump was the only risk factor that was significantly associated with the outbreak. Food items were not associated with the outbreak. Outbreak of S typhi was confirmed in village Darnu and was due to consumption of contaminated water from hand pump B. Environmental investigations revealed that open air defecation is common and the toilet ownership is to the tune of 50%.. High contamination of water in hand-pump B was probably due to fecal contamination of ground water table due to open defecation practices.

The clinical features and lab reports were consistent with typhoid. The high attack rates in 5-15 years age group is also consistent with the disease. However, the attack rates in under-5 was high and is common in developing countries

Step 9. We communicated our findings to the local health authorities and they made medicines available and contaminated hand pump was closed.

Step 10 Execute prevention measures:
We managed the cases with antibiotics. The isolates were sensitive to cotrimoxazole, quinolones, and cephaloshporins. We made medicines available in local health centre in the village and health worker did follow up visits of all cases. The cases were managed with cotrimoxazole and paracetamol and none were drug resistant.

The water from the suspected hand pump was tested, found to be contaminated. We shared the feedback with the water supply engineer and he confirmed the contamination of water in his own lab. The suspected shallow handpump was closed immediately.

We also educated the people to wash hands before preparing meals and after defecation. Local health and rural development authorities carried out campaigns to educate villagers to avoid open air defecation and to construct toilets. People were also told about various schemes of government to construct toilets and subsidies available.

Discussion
We came to know about the outbreak late which indicates a surveillance failure. Though the Integrated Disease Surveillance Project was operational since only one year and reports were coming from the health sub centre Darnu, the system was not sensitive enough to capture cases and data was not being analyzed, to enable detection at trigger level 1.

High attack rates in under-5 are high and are common in developing countries. The age specific incidence is similar to that in recent Asian studies[2]. However, low attacker rates in under-5 may be due to the reason that some cases did not present with fever because of treatment sought for children that reduced the fever duration (as fever more than 7 days was used as the standard case definition for suspected typhoid under Integrated Disease Surveillance Project (IDSP).

The outbreak curve suggested a persistent common source outbreak. The spatial distribution along with gradient and water supply flow suggested that a hand pump was the source of the contaminated water. There was no common meal, Environmental investigation that open air defecation was common and was consistent with contamination of the water source.

Analytic investigation confirmed the hypothesis of water borne transmission. This is consistent with other reported outbreaks in the country.

Photo of Contaminated Source:
Contaminated shallow Hand Pump that was identified as the cause of outbreak of Typhoid outbreak in the village and was later closed.

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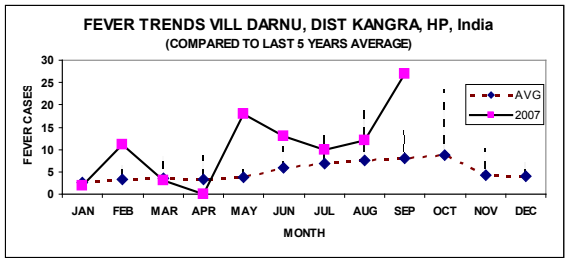

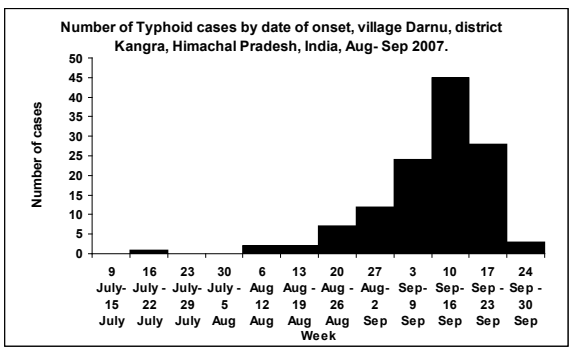

Fig III: Map of village Darnu showing area wise attack rates and relation to water supply

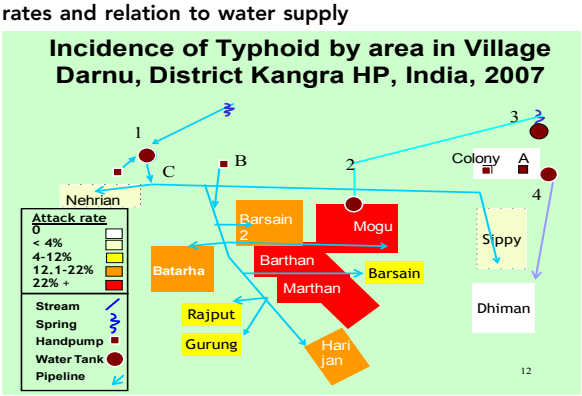

Table-I: Age Sex distribution of cases and attack rates, typhoid outbreak village Darnu, district Kangra, Himachal Pradesh, India June July 2007.

	Cases	Popln at risk	Attack rates
	n=124	n= 1025	%
Age			
< 4	11	74	14.86
5-14	28	163	17.18
15-29	54	326	16.56
30-44	18	229	7.86
45-59	6	158	3.80
>60	7	75	9.33
Sex			
Male	55	548	10.04
Female	69	477	14.47
TOTAL	124	1025	12.10

Table II: Risk of typhoid according to selected exposures, village Darnu, district Kangra, Himachal Pradesh, India June July 2007.

Possible Factor Responsible	Adjusted OR MLE (Maximum Likelihood Estimate)	CI (lower)	CI (Upper)	p
Water from shallow hand pump B	18.6	3.4	388.9	<0.05
Washing hands before meals	0.23	0.06	0.65	<0.05
Eating outside	0.93	0.38	2.28	>0.05
Consumption of raw salad	1.15	0.32	4.71	>0.05
Consumption of Milk	1.44	0.51	4.43	>0.05
Consumption of Meat	1.33	0.33	4.87	>0.05

REFERENCE Safer water, better health, WHO Report; | http://www.who.int/water_sanitation_health/publications/safer_water/en/ | | Crump JA, Luby SP, Mintz ED. The Global burden of typhoid fever. Bulletin of the World Health Organisation 2004; 82: 346-353. | Ochiai RL, Acosta CJ, Danovaro-Holliday MC et al. A study of typhoid fever in five Asian countries: disease burden and implications for control. Bull World Health Organ 2008. 86(4):260-68 | Central Bureau of Health Intelligence. National Health profile India 2007 | Water Aid. Tackling the silent killer- The case for sanitation 2008. file:///C:/Users/a/Downloads/case-for-sanitation%20(1).pdf | Nurturing the rural sanitation revolution in India. Rajiv Gandhi National Drinking Water Mission. Ministry of Rural Development, Department of Drinking Water Supply, Paryavarn Bhawan, B-1 Wing, 8th Floor, CGO Complex, Lodhi Road, New Delhi 110 003, India | | | The normal serotype of serovar Typhi is 9,12,[Vi]:d:-, i.e., 9, 12 for LPS (O) antigen, Vi | (Capsular/ virulence) positive, flagellar antigen (H) d in phase 1 and negative in phase 2 |