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Research Article

SURVEILLANCE SYSTEM ELICITING AN OUTBREAK OF GASTROENTERITIS DUE TO BACILLUS CEREUS ASSOCIATED WITH CONSUMPTION OF CONTAMINATED FOOD

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ABSTRACT

Background: The 53rd World Health Assembly had emphasized on effective surveillance systems to bring down the burden of Food borne diseases. Functionaries of Integrated Disease Surveillance Programme (IDSP) of Solan, a mid hill district of India, on the basis of a feedback from peripheral hospital in April 2017, promptly swung into action.
Objectives: (1) confirming the existence of the outbreak, (2) identifying the source and mode of transmission and (3) initiating mitigation measures.
Materials and methods: A case- control study was initiated. Case definition was formulated and 70 cases admitted in two hospitals were selected. 70 Controls were recruited from Hostel Mess register by convenience sampling. A semi structured questionnaire was used to collect information. 11 food samples and water samples from two sites were sent for laboratory examination. Epidemiological survey was undertaken for assessing environmental sanitation of the area.
Results: The median incubation period of illness was 6 hours. Carrot, Radish and fried rice with respective Crude Odds Ratios of 97.92, 32.76 and 33.98 were associated with illness (P = <0.0001). *Bacillus cereus* was identified in Carrot, Radish and Fried rice and water samples had nil Coliform count. The rice boiler was cleaned and the rotten vegetables were discarded. Thereafter no fresh case was reported.
Conclusion: Existence of a robust integrated surveillance system led to the control the outbreak within one day. Trained personnel, feedback mechanisms, integrated Laboratory network were the strengths of IDSP not only confirming but also timely and efficiently managing this Food borne outbreak.

INTRODUCTION

Food borne illness is a serious public health problem. Centers for Disease control estimates that worldwide 76 million people get sick, more than 300,000 are hospitalized and 5000 die as a result of food borne illnesses[1]. The 53rd World Health Assembly called for the reduction of the burden of food borne diseases through effective surveillance systems [2].

Gastrointestinal symptoms are the most common clinical manifestations of the food borne illnesses. A strong Public Health department must have a robust integrated surveillance system to report any such illness in time so as not only to take mitigation steps to prevent any suspected impending outbreak in such settings but also integrate health curative services in the case of an outbreak. Worldwide the Outbreak surveillance systems provide thorough and prompt information about the causative foods, involved pathogens and type of settings in food borne gastrointestinal outbreaks[3]. Surveillance data also identifies specific food pathogen pairs repeatedly linked to outbreaks and illnesses[4]. The highest burden of food borne diarrheal disease is found in African and South East Asian countries especially due to E coli and non typhoid Salmonella species[5]. Outbreak reports and research studies are an integral part of the feedback source of the Food borne disease surveillance system in Malaysia[6]. Surveillance for twenty odd years here, led to various recommendations which evolved into

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rules and regulations resulting in that no outbreaks were reported between 1992 and 1997 [7]. In these middle income developing countries many disease surveillance activities have been fragmented under the disease specific vertical programmes. This has, although proved efficient in terms of short term outcomes such as containment of outbreaks, but at the same time have consumed lots of resources [8-12]. However integrated approach in a programmatic way not only improves disease surveillance but also provides impetus in outbreak mitigation and control measures. In India, the Integrated Disease Surveillance Programme (IDSP) reported about 1964 outbreaks in 2013, 1562 in 2014 and 1935 in 2015. Majority of these outbreaks were of food borne diarrheal diseases [13]. The IDSP at the state, district and the sub district level plays pivotal role through its mechanism of the action by Rapid Response Teams, the laboratory framework and feedbacks. A food borne outbreak was investigated in the hostel of an Engineering University by using the strengths of the IDSP.

MATERIALS AND METHODS

The Casuality Medical Officer of a sub district hospital on 21st April, 2017, telephonically reported to the Chief Medical Officer about the sudden hospital admission of about 12 students of an adjoining Engineering college, suffering with gastrointestinal symptoms. The First Hand information was lodged with the district Public Health Authorities under IDSP and within 2 hours the district Rapid Response Team members led by an Epidemiologist reached this hospital and started the investigations. Meanwhile the State IDSP also reported about another 40 plus students from the same college being admitted in the nearby State Medical College Hospital, again suffering from the same sign and symptoms. Thereafter the state and district Rapid Response teams conducted the outbreak investigations with the objectives of: (1) confirming the existence of the outbreak, (2) identifying the source and mode of transmission and (3) initiating mitigation measures.

Study area: The study was conducted in the two hospitals i.e. one Sub district Hospital and the other, the State hospital where the Cases had been admitted. The selection of Controls and the epidemiological survey of the Mess/ kitchen environment was conducted in the hostel area of the college.

Study period: The study was conducted w.e.f. 21- 24th April, 2017.

Study Design: A case- control study was initiated to test the hypothesis that the gastrointestinal illness was associated with a particular food item consumed in meals in the hostel mess.

Study Population: The RRT easily confirmed the existence of a suspected food borne gastrointestinal outbreak. The Suspect Cases were defined as the ones having eaten meals in the hostel mess w.e.f 20- 21st April, 2017 and suffering from three or more episodes of any one of the symptoms of loose motions, vomiting, abdominal cramps or fever > 100^0 F. The Controls were the persons who ate the meals in the hostel mess between 20th and 21st April but did not develop any of the above mentioned gastrointestinal symptoms. Controls were recruited from the hostel mess attendance register and via a convenience sampling process in which the Cases were asked about whom they had dined with during the meals during the selected time period. All the cases, admitted in the two hospitals and controls from the hostel were line listed.

A semi structured questionnaire was prepared from the list of food items served in the hostel mess. The questionnaire also collected information on illness symptoms, onset date and time, consumption of specific food and beverage items in the Mess.

Environmental investigations: Epidemiological survey was conducted to have thorough knowledge about the sanitation aspects of the Mess and the surrounding area. Interviews were also conducted with the food handlers of the Mess and with the Director of the school to ascertain the movements of the students in and out of the hostel. A trace back investigation led to the identification of an unwashed semi rotten stock of carrots and radish lying among the other food items, stored in a room adjoining the kitchen. Also it was found that one of the boilers used for cooking rice was used without proper cleaning on the day of the reported illness.

Laboratory investigations: 11 food items used in the Mess for last two days were sampled and sent for microbiological analysis. The tap water from the Mess and from the exit point of the water store tanks of the institute was sent for testing of coliforms.

Human subject protection: The verbal informed consent was obtained from all the cases and the controls. Voluntary participation was ensured. This investigation was undertaken as a public health response to an outbreak. Therefore an ethical committee review was not indicated.

Data statistics and Statistical Analysis: An unmatched analysis was conducted as there were often whole tables of the Hostel Mess affected by illness and the cases varied by age and gender. The data was analyzed in IBM SPSS Statistics version 21, MEDCALC software and Microsoft Excel 2010 software. Pearson's Chi-Square ($\chi 2$) test was done to ascertain the statistical significance. The p- values of lesser than 0.05 were considered significant. Univariate analysis was conducted to calculate the crude odds ratio (OR) with 95% confidence intervals (CI).

RESULTS

Epidemiological findings: The outbreak investigations by the IDSP team identified 70 cases suffering from gastrointestinal symptoms following the dinner in the hostel mess on 20th April, 2017. About 18 cases had meals between 8 pm and 9 pm and 52 cases took meals between 9 pm and 10 pm. The median incubation period was 6 hours (Figure). Symptom prevalence for the 70 cases was: watery diarrhea 96%, chills with rigors 92%, stomachache 53%, vomiting 40%, fever 39% and altered sensorium in about 3% of the cases (Table 1).

Table 1 Frequency of symptoms among cases, Engineering University Hostel, Solan, Himachal Pradesh, India, 2017

Symptoms	Cases (N= 70)	Percentage
Watery diarrhea	67	96
Bloody diarrhea	0	0
Chills with rigors	64	92
Stomachache	37	53
Vomiting	28	40
Fever	27	39
Altered sensorium	2	3

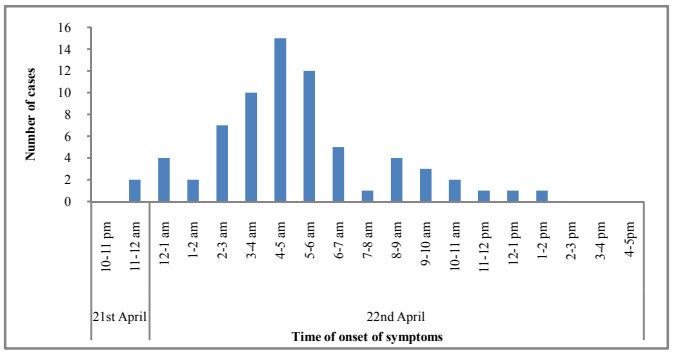

Figure Cases of a gastrointestinal illness of Engineering University Hostel Solan, 21 to 22 April 2017, by symptom onset time.

None of the cases reported bloody diarrhea. 12 cases got admitted in a nearby sub district level public hospital on the night of illness and other 58 were admitted in a state level hospital. No fatality was reported.

The mean age of the Cases was 22 years (median: 20 years, range: 15- 46 years) whereas the mean age of the Control group was 22 years (median: 21 years, range: 15- 46 years). There was no significant difference found in the sex distribution among cases and controls (P = 0.550) and there was no significant difference in the mean ages between the groups (P = 0.977).

Using a questionnaire based upon the food items served in the mess during the day before and on the day of illness, the exposure of the cases and controls to about 11 food and beverage items, including pickle and salad vegetables like carrot and radish, was assessed. Table 2 shows that the salad items carrot, having Crude OR of 97.92 (95% CI 26.57-360.79) and radish with the Crude OR of 32.76 (95% CI 12.84) had elevated Odds Ratios and there was statistically significant association of these two food items with the illness (respective P values < 0.0001). Fried rice with Crude OR of 33.98 was also significantly associated with illness (P= <0.0001).

Environmental observations: Investigation of the Mess kitchen and adjoining store rooms by the RRT members revealed an overall good standard of cleanliness and general food hygiene.

Table 2 Odds ratios for food items and beverages consumed by Cases and Controls

Food/ beverage consumed	Cases		Controls		Crude OR	95% CI	*P* value
	n	%n		%			
Carrot	67	96	13	19	97.92	26.57-360.79	< 0 .0001*
Raddish	61	87	12	17	32.76	12.84-83.53	< 0.0001*
Cauliflower	60	86	58	83	1.24	0.49- 3.09	0.642
Pao	43	61	37	53	1.42	0.72- 2.78	0.306
Bhaji (vegetable)	41	59	34	49	1.49	0.76- 2.91	0.236
Channa (pulse)	38	54	31	44	1.49	0.76- 2.90	0.237
Gulab Jamun (desert)	28	40	18	26	1.92	0.93- 3.95	0.073
Water	70	100	70	100	1.00	0.01-51.00	1.000
Milk	34	49	28	40	1.41	0.72- 2.76	0.307
Fried Rice	62	89	13	19	33.98	13.12- 87.98	< 0.0001*
Pickle	32	46	27	39	1.34	0.68- 2.62	0.392

Cases = 70 and Controls= 70
OR - odds ratio
* Statistically significant (P < 0.05)

The medical checkup of the Mess workers including the food handlers ruled out any person having any illness. The Mess had semi automatic cooking machines which were also found to be hygienically clean. Further tracing to the store room inspection revealed an old stock of radish and carrots lying along with other fresh vegetable items. Detailed verbal autopsy further revealed that one of the rice boiler was accidently not cleaned in the morning and was used for cooking the fried rice, served at dinner.

The remaining stock of these food items was preliminarily withdrawn from being cooked and the boiler was thoroughly cleaned. Surveillance further reported no cases w.e.f. 22- 24th April.

Laboratory findings: Out of 11 food items sent for microbial assay radish, carrot, cauliflower and fried rice were found to be contaminated with *Bacillus cereus*, a Gram positive Bacillus. Laboratory examination of water samples, three samples each from two sites i.e. the kitchen and the store tank sites, revealed zero coliform count (Table 3). However the samples of Gulab jamun and pickle could not be sent for examination.

Table 3 Laboratory examination findings of the food and beverage items tested

Food/ Beverage item	Quantity	Weight (approximate)	Results (organism growth obtained)
Unwashed and raw Carrot	1	100 grams	*Bacillus cereus*
Unwashed and raw Cauliflower	1	500 grams	*Bacillus cereus*
Unwashed and raw Radish	1	250 grams	*Bacillus cereus*
Cooked fried rice	1	500 grams	*Bacillus cereus*
Uncooked rice	1	100 grams	Nil
Paw	1	100 grams	Nil
Cooked Bhaji	1	100 grams	Nil
White Channa	1	100 grams	Nil
Cooked white Channa	1	100 grams	Nil
Water	2	From Mess and From water tanks source	Nil coliforms in 100 ml of water
Milk	1	One litre	Nil

DISUCSSION

The prompt and integrated approach by trained personnel of IDSP was successful in not only confirming the outbreak in time but also curtailing it within a day. Feedback to IDSP from already sensitized and trained field staff was the initial trigger point for action by the system in place. Lynch *et al.*(2006) had similarly documented in their study, the utility and ease of enhanced reporting of food borne outbreaks by effective surveillance systems[14]. Murphree *et al.*(2012) also documented the advantages of Foodborne disease active surveillance network in USA [15]. A study by Lukwago *et al.* in Uganda in 2007 also showed the utility of strengthened disease surveillance system in increasing the reporting and timeliness of suspected outbreaks and thereafter their prompt management[16]. The present Case- Control study promptly documenting *Bacillus cereus*, being identified by laboratory network, shows the efficiency of the system in place. Tewari *et al.* (2014)[17], Velusamy *et al.* (2010)[18], Wijnands *et al.* (2006)[19] and Yadav (2004) [20] have also documented in their respective studies about the *Bacillus cereus* borne gastrointestinal outbreaks. *Bacillus cereus* is a ubiquitous saprophytic Gram positive bacillus found widely in soil, water, dust and air.

The surveillance system functioning has the basis on feedback mechanisms and trigger points, as documented by the present study. Similar results, documenting utility of these supplementary tools in managing public health threats, have been reported by Sharma *et al.* in 2009 [21].

CONCLUSION AND RECOMMENDATIONS

This study revealed that the old rotten radish and carrot were infected with *Bacillus cereus*. These items were also used in cooking of fried rice. These were the cause for this point source outbreak. Moreover the uncooked rice sample did not reveal the presence of *Bacillus cereus*. Also the boiler used for cooking of the fried rice was not cleaned on the day of illness though unknowingly on the part of the Mess workers. The Mess handlers were advised about thorough washing and cleaning of vegetables, especially taking care of the salad vegetables and those which are semi cooked, as were used in the case of fried rice. The IDSP team concluded in its report to the district health authorities about the contaminated vegetables (probably through soil) being the culprit for the present outbreak. Thereafter the health advisory regarding food safety and handling was issued to all educational institutes of the district.

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