
RESEARCH ARTICLES

An outbreak of gastroenteritis among students of a religious boarding school, district Islamabad: A retrospective cohort study

Khurram S Akram¹, Mirza Amir Baig¹, Zakir Hussain¹, Abid Saeed¹, Mirza Zeeshan Iqbal Baig¹, Ambreen Chaudhry¹, Fawad K Khan¹ & Aamir Badar¹

¹ Field Epidemiology and Laboratory Training Program, Pakistan

Abstract

Background: On 1 March, 2018, 15 students of a religious boarding school presented to a tertiary care hospital in Islamabad with complaints of nausea, vomiting, abdominal pain and diarrhea. A team of FELTP fellows were tasked to investigate the suspected outbreak to confirm diagnosis, determine magnitude, evaluate possible risk factors, identify the source and implement control measures.

Methods: A retrospective cohort study was conducted from 25 February to 5 March, 2018. Medical records were reviewed at the hospital. All the students and staff of the boarding school were interviewed using a structured questionnaire. A case was defined as any student of the religious school reported with nausea, abdominal discomfort and one of the following symptoms of vomiting, diarrhea, and chills on 1 March, 2018. Information on demographics, history of food intake and clinical features was collected. Suspected food items and drinking water samples were sent to the National Institute of Health for microbiological analysis. Frequencies and attack rates were calculated and risk ratios computed at 95% confidence interval at the margin of error $P < 0.05$.

Results: Out of a total of 120 students, 39.1% (n=47) developed symptoms with an overall attack rate (AR) of 39%. All the students were male with a mean age of 11 years (range 8-14 years). The most affected age group was 10-11 years (AR 62%). The highest food specific attack rate (82%) was calculated for rice. Among all food items served at breakfast, rice was found statistically significant. Out of 57 students who ate rice, 47 developed illness (RR=17.31, 95% CI 5.70-52.58). During interviews with staff it was found that the food was cooked a day before and stored before being donated to the school by a local restaurant. *Staphylococcus aureus* was isolated from rice samples.

Conclusion: Consumption of contaminated rice was the most probable cause of the outbreak. Unhygienic storage and handling lead to contamination of the rice. Proper training of food handlers can prevent the transmission of food borne disease. It is strongly recommended that extreme care should be taken while accepting food items from the locals as donation and it should be ascertained that food is not old or smelly. Food must also be accepted with the identity of the person who donates food and this was adopted as a policy later on. In addition to the internal food safety checks, implementation of frequent hand washing and hygiene promotion operating procedures were recommended for the restaurant. Further, an awareness session was conducted on spot among the students and staff.

Keywords: Religious boarding school, Foodborne illness, Food storage and handling, Outbreak

Background

Foodborne diseases are considered a major public health problem because individuals of all ages and socioeconomic statuses are affected by them. Foodborne diseases (FBDs) are defined by the World Health Organization (WHO) as “diseases of infectious or toxic nature caused by, or thought to be caused by the consumption of food or water” (1). Most outbreaks of acute gastroenteritis occur in places of mass feeding such as institutions, schools, restaurants and military units (2). The main microorganisms responsible for FBDs

are *Salmonella*, *Staphylococcus aureus*, *Clostridium perfringens*, *Bacillus cereus*, and *Campylobacter* (3).

Gastroenteritis (GE) is also known by another name, “stomach flu”. It is mostly known by the two most common symptoms it is presented with, which are vomiting and diarrhea (4). Among the 15 developing countries, Pakistan ranks 5th where 73% of all under-five deaths occur due to diarrheal diseases (water-borne and food-borne diseases). Diarrhea accounts for 10.8% of under-five mortality in Pakistan, making it a leading cause of death in this age group (5).

In Pakistan, the current therapeutic and management guidelines for the treatment of acute GE is not adhered to properly, resulting in partially treated cases and increased numbers of hospital admissions due to recurrent GE attacks or episodes (6). It is the second most common cause of death among adults. In children under 5 years, there are more than 700 million cases of gastroenteritis every year. The annual mortality associated with gastroenteritis has been estimated to be 3.5 to 5 million, with the majority of deaths occurring in developing countries (7).

Religious boarding schools are very common in Pakistan. Here, children are admitted for getting religious education of the Quran and other Basics of Islam, and they thrive and survive mostly on donations from philanthropists.

On 1 March 2018, 15 students of a religious boarding school presented to the emergency ward of a tertiary care hospital, Pakistan Institute of Medical Sciences (PIMS), with complaints of abdominal pain, vomiting and diarrhea. The Federal Disease Surveillance and Response Unit (FDSRU), National Institute of Health (NIH), Islamabad, was notified on the same day. A team comprising of two members was deputed to investigate the suspected outbreak with the objectives to verify the outbreak, determine its magnitude, evaluate risk factors, identify the source and implement control measures.

Methods

A retrospective cohort study was conducted from 25 February to 5 March, 2018 at the religious boarding school in Islamabad. A case was defined as any student of the religious school reported with nausea, abdominal discomfort and one of the following symptoms of vomiting, diarrhea, and chills on 1 March, 2018. Interviews were conducted using a structured questionnaire. Information was collected on demographics, time of onset of illness, signs/symptoms, source of drinking water, food served during breakfast and other relevant possible risk factors. A line list was developed and maintained. During interviews, 32 cases were compatible with the cases definition. Interviews were also conducted from food handlers in line to environmental epidemiology. Samples of drinking water and food items served in the breakfast were collected from the religious boarding school and sent to the Public Health Laboratory Division, NIH, Islamabad, for further microbiological and chemical analyses.

Data was analyzed using software epi info version 7 and both descriptive and inferential analysis was done, frequencies of different risk factors were calculated, and risk ratios were determined. Attack rates of different age groups and food specific attack rates were also calculated with a 95% confidence interval and a p value of <0.05.

Results

A total of 47 cases of acute GE were identified. The mean age was 11 ± 1.332 SD (range:8-14 years). All the cases, 100% (n=47), were men and had primary level education. Most of the cases belonged to the age group

10-11 years 61.70% (n=29), followed by the age group 12 to 13 years 23.40% (n=11), and 8 to 9 years 8.51% (n=4). The overall attack rate calculated was 39% (Table 1).

The most frequent signs/symptoms were nausea 100% (n=47), abdominal cramps 100% (n=47), and vomiting 85% (n=40). This was followed by diarrhea 64% (n=30) and chills 59% (n=28) (Table 2).

Students in the 10-11 year age group had higher attack rates (AR=53%), followed by the 12-13 year age group (AR=31%) (Table 3).

A total of 57 students consumed suspected food during breakfast and out of them 47 became ill. The food specific attack rate was 82% (Table 4).

A point source outbreak was indicated by the epidemic curve. The Epi curve shows that the first case had a time and date of onset of illness between 9-9:59 am on 1 March, 2018. The cases started rising between 10:00-10:59 am (n=7) and most of the cases developed signs/symptoms between 11:00-11:59 am on 1 March, 2018 (n=18) (Figure 1).

Laboratory Analysis

Food and water samples were sent for microbiological analysis. *Staphylococcus aureus* was isolated from food samples. Clinical features of the cases were compatible with the organism isolated from the food sample.

Food was stored inappropriately and the hygiene of the staff handling the food was poor. It was found that the food was cooked one day before and served at an evening function. The leftover food was donated to the religious school. The food was handled by multiple persons and was most likely contaminated during transportation to the religious school, and the storage of the food was not proper.

Discussion

The short incubation period was also suggestive of an enterotoxin producing bacterium, such as *Staphylococcus aureus* whose incubation period is 2–36 h (8). The results deduced from the statistics collected from the microbiological analyses and questionnaires showed that *S. aureus*, which was found in the rice, was the main etiological cause of the presented outbreak.

The question related to the utmost reason of the contamination is concerned. The source can be the food-handler who packed the food in the bags, since the pathogen was found in leftover food (rice). According to the findings of epidemiological studies, sources of staphylococci food poisoning can be the extensive range of food products that results from enterotoxins which is primarily produced by *S. aureus* (9). According to many studies, there is an association between the packed food products and *S. aureus* because it grows well in packed food products in the course of its production and packaging processes (10)(11). In our study, it was also found that food was packed before delivery at the religious school. Generally, the growth of *S. aureus* is highly favorable in the foods that contain higher levels of salt, like fried items (chicken, meat etc.), in comparison

to other bacteria. Staphylococcal enterotoxins are considered the most common reason for food-borne diseases as the wide range of toxins are produced by *S. aureus*, which results in an extensive array of illness symptoms (12)(10). Since the Staphylococcal toxin cannot be destroyed by heat during cooking, it is considered as the endured cause of gastroenteritis throughout the world.

The results of the lab analysis were quite similar to the findings of the study by Bangure et al. on food poisoning among census enumerators in the Gokwe South District in 2012 (13). It was concluded that staphylococcus was isolated from food handlers, despite the fact that no

microbial analysis was undertaken for food leftovers. The lab analysis is also alike to the study performed in 2004 on bacteriological assessment of the disinfection effectiveness and cleaning by Moyo et al. (14) at Midlands State University, where they figured out that staphylococcus aureus had contaminated the hands of around 40% of tested food handlers. Staphylococcus aureus is related to many outbreaks. The food may become contaminated if food handlers carry the enterotoxin produced by staphylococcus aureus, which can result in staphylococcus aureus food poisoning. The risk of diarrheal illness can be reduced by frequently washing hands with water and soap.

Table 1. Demographic characteristics of the G E cases identified at religious school X Islamabad March 2018

Characteristics	No of cases	Percent(%)
Male	47	100
Age groups		
8-9 years	4	8.51
10-11 years	29	61.70
12-13 years	11	23.40
≥14 years	3	6.38
Total	47	100

Table 2. Frequency of signs and symptoms among the cases identified at religious school X Islamabad March 2018

Signs and symptoms	No of cases	Percentage(%)
Nausea	47	100
Abdominal cramps	47	100
Vomiting	40	85
Diarrhea	30	64
Chills	28	59

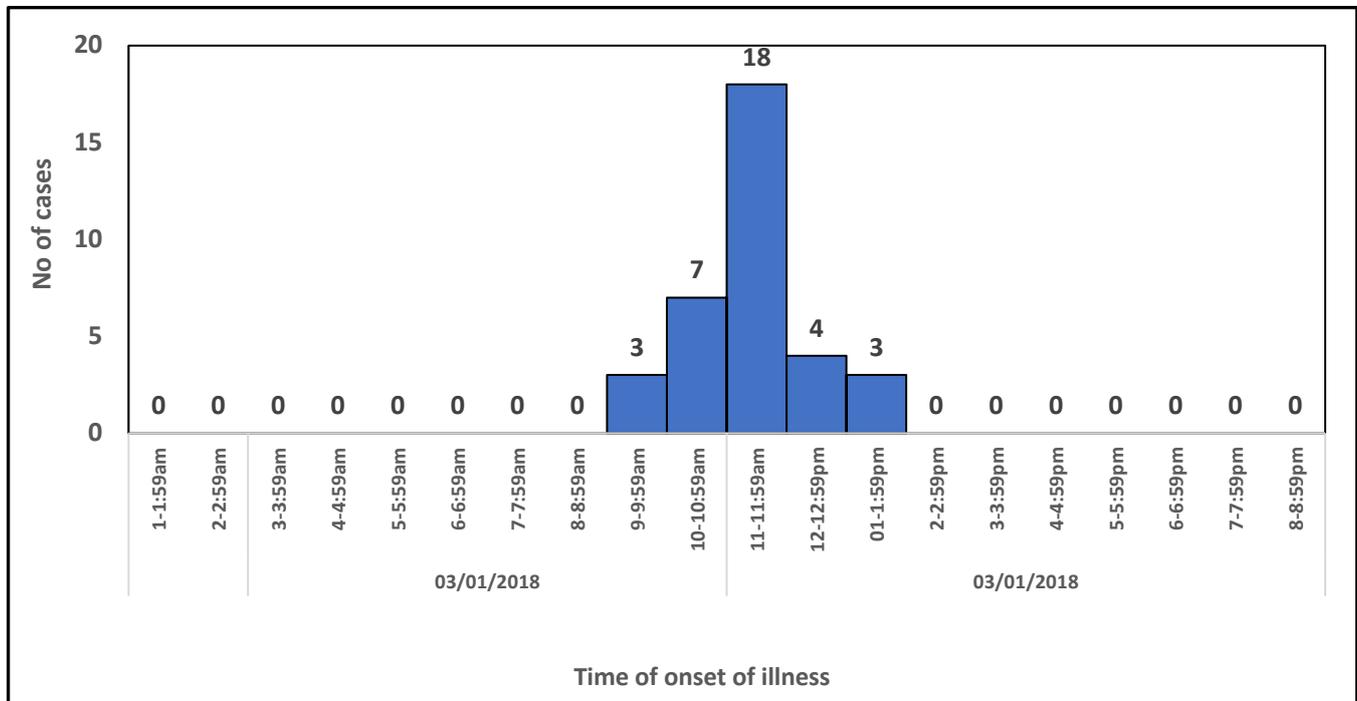
Table 3. Age specific Attack rates of the GE cases identified at religious school X Islamabad March 2018

Age Groups	Total residents	No of cases	Attack rate (%)
8-9 years	20	4	20
10-11 years	55	29	53
12-13 years	35	11	31
≥ 14years	20	3	15
Total Students	120	47	39.1

Table 4. Food specific Attack rate among cases identified at religious school X Islamabad March 2018

Food	Ate		Didn't Eat		Ate		Didn't Eat		95% CI	P-Value
	Ill	Total	Ill	Total	AR	AR	RR			
Rice	47	57	3	63	82%	5%	17.31	5.7-52.5	0.000	
Chicken Quorma	1	57	3	6	2%	50%	0.035	0.00-0.28	0.001	
Lentil	2	55	3	6	4%	50%	0.070	0.01-0.34	0.004	

Figure 1. Epi Curve shows the number of cases by the time and date of onset of illness at Religious School X



Nausea (100%), abdominal cramps (100%), loose motions (63.8%) and vomiting (85.1%) were the important signs and symptoms found in this study. No complaints of bloody diarrhea were reported. The results were also similar to the findings of a gastroenteritis outbreak study done in 2006 by Jelastopulu et al. (2) in an air force base in Western Greece, where they concluded that abdominal pain (73%) and watery diarrhea (96%) were the prominent symptoms. Other studies also found similar symptoms of staphylococcus aureus food poisoning, which we found in this investigation. Contamination of food with staphylococcus causes sudden gastrointestinal illness because the organism was found to be capable of producing an enterotoxin. Meat and its products are the

foods that are usually the carrier of staphylococcus food poisoning (15)(14).

This study also revealed that most (80%) of the food handlers were untrained and non-qualified in the food handling process. The same finding was found in a study done in 2012 by Chihava et al. (15). In that study, the sample was taken from Bulawayo City restaurants and the factors that contribute to biological diversity and load were considered. They figured out that the main reason for the outbreak was the lack of training and essential qualifications in Bulawayo restaurants. Food handlers play a vital role in the food chain in bringing food from farms and providing it to the fork, so in order to improve their practices, it is necessary to give them proper training in food preparation and handling processes.

According to this study, none of the food handlers had medical examination certificates. A survey was conducted in 2012, by Dagneu et al. (16), among the food handlers in Gondar University, Northwest Ethiopia. The purpose of their survey was to investigate the intestinal parasites and nasal carriage of *Staphylococcus aureus* in the above-mentioned sample. The results of the survey were similar to the findings of this study, in which the food handlers had not undergone the medical checkup.

Conclusions and Recommendations

This outbreak was most likely caused by eating contaminated rice (Biryani) on 1 March, 2018, which was actually a leftover food from a wedding function and was served to the students during breakfast. Inappropriate storage and cross-contamination during cooking and handling of the food were likely to have been the main contributing factors leading to this outbreak. Hygienic conditions of the staff handling the food were poor. No food security checks were done while accepting donated food items. Freezers where the staff used to store the food were in obsolete condition.

Limitations

One of the important limitations of this study was the fact that for microbiological diagnosis, stool samples were not collected. Though the stool sample collection is important in suspected foodborne outbreaks, here, the short duration of symptoms and lack in overall coordination was the main reason of this limitation (17).

Conflict of Interest

Authors declare no conflict of interest.

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