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An Acute Gastroenteritis Outbreak from Rice, Bangladesh, January 2021

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Abstract

On 7 Jan 2021, the health manager at Bheramara, Bangladesh, notified the Institute of Epidemiology, Disease Control, and Research that 18 people were hospitalized for acute gastrointestinal illness. We conducted a retrospective cohort study to describe the outbreak and identify its source and took actions to contain it. Cases ate lunch after a funeral service on 5 January in Bheramara and had three or more loose stools in 24 hours, and vomiting or abdominal cramps after 5 January. We interviewed attendees with a semi-structured questionnaire. A Food Safety Inspector examined the food preparation areas. Stool and water samples were tested for enteric pathogens. Food-specific-attack rates, risk ratios, and 95% confidence interval (CI) were calculated. Common symptoms were diarrhea (94%) and vomiting (42%). The median incubation period was 16 hours (range 7–23). The attack rate of lunch attendees was 62% (72/117) with one death. Attendees who ate the second serving of rice had significantly higher risk of having acute gastrointestinal illness than those who did not (risk ratio 2.59, 95% CI 1.06–6.34). No pathogenic organism was isolated from stool and water samples. We suspected inadequately stored cooked rice was the source of the outbreak. We recommend proper cooking and storage of rice in a clean environment to prevent future outbreaks.

Keywords: acute gastroenteritis, bacillus cereus, reheated rice, outbreak, Bangladesh

Introduction

A foodborne disease outbreak occurs when two or more people develop acute gastroenteritis symptoms such as diarrhea, vomiting, or abdominal cramps from eating a common food.[1] Every year thirty million people in Bangladesh develop foodborne illness.[2] The common risk factors are improper food processing, inappropriate food storage conditions, contamination of food with infective microorganisms, cross-contamination from the environment, and insufficient knowledge on food preservation.[3]

In Bangladesh, foodborne outbreaks are reported by the Event-Based Surveillance and other foodborne and waterborne disease surveillance systems.[4] When a foodborne outbreak is reported, Ministry of Health staffs investigate to determine the source of those outbreaks so that future outbreaks can be stopped or prevented. In those investigations, *Vibrio cholerae* (8%), *Enterotoxigenic Escherichia coli* (3%), *Shigella* (2%), and *Salmonella* (1%) were identified.[5] However, no etiologic organism was identified in 86% of the samples.[5] When the etiologic agent cannot be identified, environmental findings, clinical symptoms, incubation period, epidemiological studies, and biological plausibility help to identify the source of the outbreak.[2]

On 7 Jan 2021, the health manager of Bheramara Upazila of Kushtia District in Bangladesh reported to the Institute of Epidemiology, Disease Control and Research (IEDCR) that several people with acute gastroenteritis were admitted to Bheramara Upazila Health Complex after attending a funeral service on 5 Jan 2021. A national rapid response team from IEDCR investigated the event, as it is the focal institution for investigation and response to outbreaks on behalf of the Ministry of Health and Family Welfare.[6] The objectives of the investigation were to identify the source and risk factors and to suggest measures for preventing future outbreaks.

Material and Methods

Study Design

We used a retrospective cohort study and described the demographics of all people who attended the lunch and calculated risk ratios to identify the food item that caused the outbreak. We also collected stools and water samples for laboratory investigation and conducted assessment of food preparation. Our investigation team consisted of three field epidemiologists, one Food Safety Inspector (FSI), and a medical technologist. The field investigation occurred from 7–12 Jan 2021.

Location and Timeframe

The foodborne outbreak occurred in Bheramara, Kushtia, Bangladesh. The affected people attended a funeral service on 5 Jan 2021.

Study Population

We obtained the guest list of the funeral service and interviewed them. The list consisted of people from the rural community, neighboring villages, and districts. Of those, people who attended the funeral and ate the lunch on 5 Jan 2021 at the host house in Bheramara, Kushtia were included in the cohort study. A suspected case was someone who ate food served at the lunch and had three or more loose stools in 24 hours or vomiting from 5 January to the date of interview, 7–12 Jan 2021.

Data Collection

The team first visited the hospital and interviewed the patients to collect details on the event and the food items served. That information was used to finalize the food items on the questionnaire. For the decedent, we conducted a verbal autopsy with her family and medical providers using the International Standard Verbal Autopsy Questionnaire 3.[7] Record reviews at local and referral hospitals were done.

Using a semi-structured questionnaire, we collected data on age, gender, signs and symptoms, time of the meal, onset of illness, hospitalization, time of recovery, specific food items, and about recovery or death for the cohort study.

Stools from patients and water that was used for drinking and cooking at the lunch were collected for laboratory testing.

We interviewed the cooks regarding the food ingredients and preparation. The FSI inspected the cooking and preparation areas for any breach in the food processing chain.

Data Analysis

The distributions of the demographics, clinical symptoms, incubation period, hospitalization, and outcomes of the study participants were summarized using frequencies and proportions. Attack rates (AR) were calculated by age, gender, food items, type of lunch attendees, and food servings. To measure the association between different food items and illness among the exposed and non-exposed groups, risk ratios (RR) were calculated. The statistical significance was set at a 95% confidence interval (CI) and the *p*-value was set at <0.05. Analysis was done using the statistical software STATA (version 14.2, Texas, USA).

Ethical Approval

The investigation was an emergency public health response and was not considered research subject to institutional review board approval. However, before interview and sample collection, verbal informed consent was requested and obtained from participants and guardians of the minors. Data security and confidentiality were ensured by a password-protected device.

Results

Demographic Information

There were 117 people who attended a funeral service in Bheramara, Bangladesh on 5 Jan 2021 (Figure 1). All those attendees ate food from the lunch were interviewed. Of them, 63% (74/117) were older than 18 years and 55% (64/117) were male (Table 1).

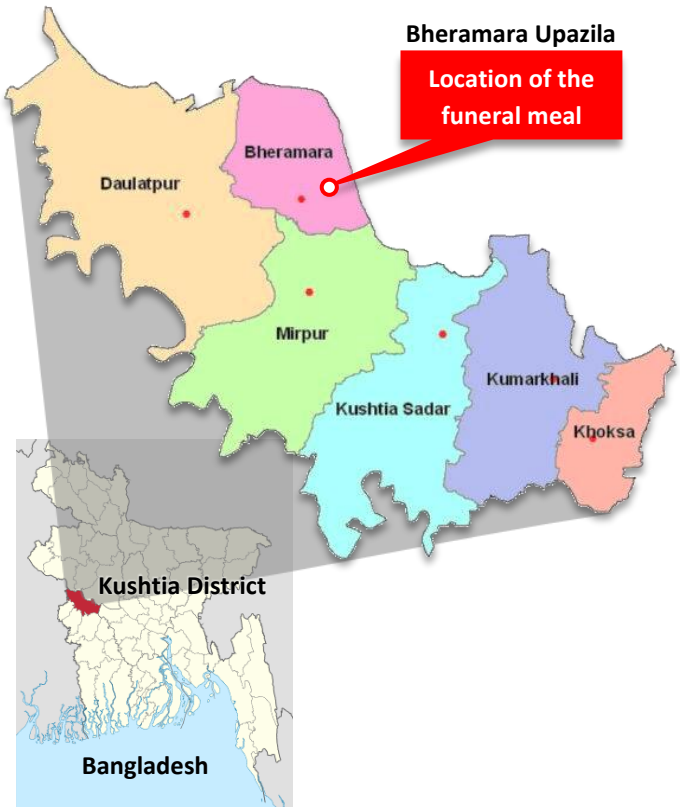

Figure 1. Upazilas of Kushtia District and location of the funeral service on 5 Jan 2021, Bheramara Upazila, Bangladesh

Epidemic Curve

The lunch started at 12:30 PM and ended at 5:00 PM on 5 Jan 2021. The median time from eating lunch to symptom onset was 16 hours (range 7–24 hours). The number of cases peaked in 10 hours after the first reported case. The epidemic curve suggested a point-source outbreak (Figure 2).

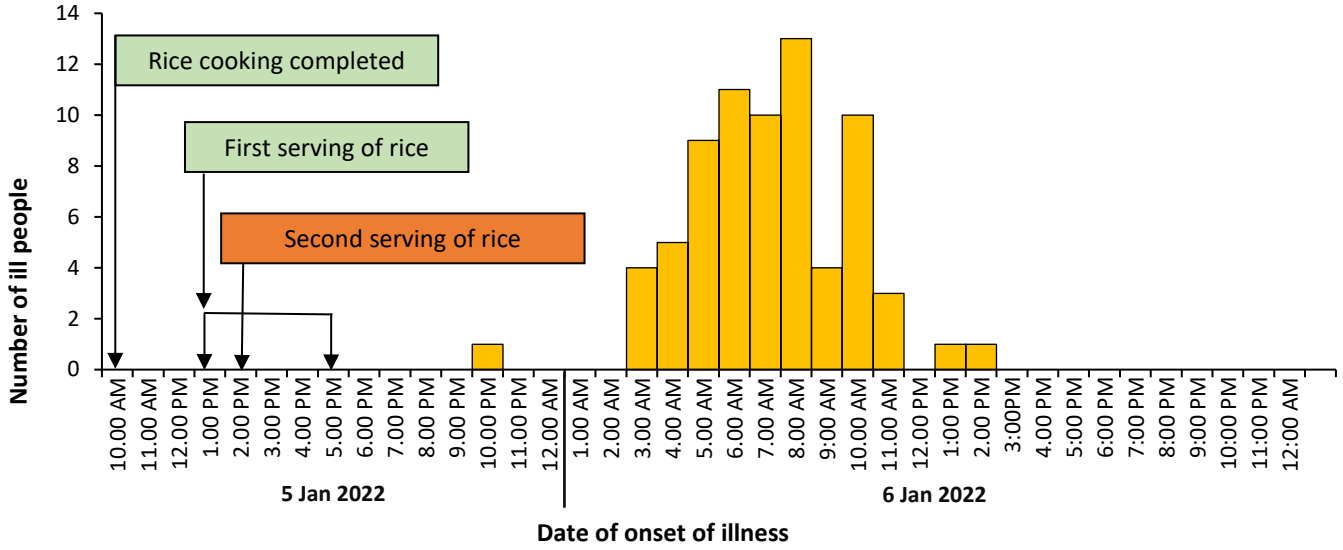

Figure 2. Epidemic curve showing total number of ill people who attended the funeral on 5 Jan 2021 by time of onset in Bheramara, Bangladesh (n=72)

Characteristics of Cases from the Lunch Cohort

Of the 117 people who ate lunch, 62% (72/117) presented with GI illness. The common symptoms were diarrhea 94% (68/72) and vomiting 42% (30/72). Among them, 38% (27/72) needed hospitalization and 85% (61/72) recovered within 24 hours of illness (Table 2). One elderly, co-morbid woman died from hypovolemic shock following uncorrected fluid loss and delayed hospitalization. The highest attack rates occurred among people aged 5–34 years (AR 72%, 41/57), females (AR 74%, 39/53) and people who ate the second serving of rice (AR 91%, 71/78) (Table 1–2).

Table 1. General characteristics and attack rate of the people who attended the lunch after the funeral service, Bheramara, Bangladesh, 5 Jan 2021 (n=117)

General characteristics	Total cohort (n=117)		Ill (n=72)		Attack rate (%)
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)	
Age range					
<5	7	6.0	4	5.6	57.1
5-14	28	23.9	23	31.9	82.1
15-24	16	13.7	9	12.5	56.3
25-34	13	11.1	9	12.5	69.2
35-44	17	14.5	10	13.9	58.8
45-54	16	13.7	9	12.5	56.3
55-64	11	9.4	4	5.6	36.4
>64	9	7.7	4	5.6	44.4
Gender					
Male	64	54.7	33	45.8	51.6
Female	53	45.3	39	54.2	73.6
Types of funeral service attendees					
Relative	70	59.8	43	59.7	61.4
Neighbor	42	35.9	24	33.3	57.1
Host family	5	4.3	5	6.9	100.0
People attended lunch during two servings of rice					
First serving	39	33.3	1	1.4	2.6
Second serving	78	66.7	71	98.6	91.0

Table 2. Clinical profile of the funeral service attendees who developed illness after taking food at lunch, Bheramara, Bangladesh, 5 Jan 2021 (n=72)

Clinical status	Frequency (n)	Percentage (%)
Symptoms[a]		
Diarrhea[b]	68	94.4
Vomit	30	41.7
Abdominal cramp	29	40.3
Feverishness	27	37.5
Dehydration	25	34.7
Weakness	19	26.4
Fever with rigor	5	6.9
Headache	5	6.9
limb cramp	2	2.8
Incubation period (in hours)		
<8	1	1.4
8-16	42	58.3
>16	29	40.3
Hospitalization		
Yes	27	37.5
No	45	62.5
Recovery (within hours)		
<24	61	84.7
>24	11	15.3

Note: [a]Multiple responses. [b]Three or more loose stools within 24 hours

Source of the Foodborne Illness

Eating rice had the highest risk (RR 2.15, 95% CI 0.83–5.60) among the seven food items at the lunch (Table 3). Between 12:30 and 2:00 PM, 37 people ate the first serving of rice and 2.7% (1/37) got ill (Table 4). The 70 people who ate the second serving of rice had significantly higher risk of developing illness (RR 2.59, 95% CI 1.06–6.34). All members of the host family (5/5) ate the second serving of rice and got ill (Table 1). The cooks took rice home from the first serving for family and neighbors. None of the cooks or family members (0/28) developed illness. All three people who did not eat rice at lunch and ate the second serving of rice at home were ill. No commercial foods were served at the lunch.

Table 3. Food specific attack rate among the funeral service attendees, Bheramara, Bangladesh, 5 Jan 2021 (n= 117)

Food items consumed	Among exposed[a]				Among unexposed[b]				Relative risk	95% CI	*P*-value
	Ill	Not ill	Total	Attack rate (%)	Ill	Not ill	Total	Attack rate (%)			
Rice	69	38	107	64.5	3	7	10	30.0	2.15	0.83–5.60	0.03
Lentils	61	40	101	60.4	11	5	16	68.8	0.87	0.61–1.27	0.52
Water	64	40	104	61.5	8	5	13	61.5	1.00	0.63–1.58	1.00
Chicken	2	2	4	50.0	70	43	113	61.5	0.81	0.30–2.17	0.63
Beef	67	42	109	61.5	5	3	8	62.5	0.98	0.56–1.72	0.95
Vegetables	54	39	93	58.1	18	6	24	75.0	0.77	0.58–1.03	0.13
Rice pudding	50	37	87	57.5	22	8	30	73.3	0.78	0.59–1.04	0.12

Note: CI: confidence interval. [a]Exposed refers to an individual who consumed specific food items during the lunch. [b]Unexposed refers to individual who did not consume specific food items during the lunch

Table 4. Rice specific attack rate by time of intake among the funeral service attendees, Bheramara, 5 Jan 2021 (n=117)

Rice servings[a]	People who ate rice				People who did not eat rice				Relative risk	95% CI	*P*-value
	Ill	Not ill	Total	Attack rate (%)	Ill	Not ill	Total	Attack rate (%)			
Second serving (n=78)	68	2	70	97.1	3	5	8	37.5	2.59	1.06–6.34	<0.001
First serving (n=39)	1	36	37	2.7	0	2	2	0.0	-	-	0.81

Note: CI: confidence interval. [a]None among the people who attended the funeral and ate lunch took rice from both servings during the lunch

Laboratory Investigation

Bacteriological tests on eight stool samples and three water samples did not isolate any pathogens after 48 hours of culture. Food samples were not tested because leftover food was discarded on soil and was unsuitable for laboratory testing due to the possibility of contamination.

Assessment of Rice Preparation

None of the three cooks who prepared rice reported gastrointestinal symptoms before or after cooking the rice. The raw rice was stored in a cool, humid place. Thirty-eight kilograms of rice was washed in a large pan (Figure 3) beside a cowshed (Figure 4) and then cooked on a temporary wood-burning-stove outside the kitchen (Figure 5). The FSI inspected the area and noted that there was a possibility of environmental and soil contamination of the rice. Cooking of the rice ended at 10:00 AM and was separated into two non-equal parts and stored at room temperature. The first serving was stored inside the house and served at 12:30 PM. At 2:00 PM, the remaining rice which was kept beside the cowshed with half-open lid was reheated for 1–2 minutes and served to lunch attendees.

Note: Photo taken on 8 Jan 2021

Figure 3. The utensils in which rice were processed. These were kept beside the cowshed when the FSI inspected the area, Bheramara, Bangladesh

Note: Picture taken on 8 Jan 2021 and represents typical situation

Figure 4. The cowshed beside which rice was washed and cooked at the funeral service, Bheramara, Bangladesh

Note: Photo taken on the fourth day of the event during inspection of the cooking area by the FSI, Bheramara, 8 Jan 2021, which may not represent the situation on 5 Jan 2021

Figure 5. Parts of temporary stove where cooking of the main rice meal was done after the funeral-service, Bheramara, Bangladesh

Discussion

A foodborne outbreak occurred in Bheramara, Bangladesh due to eating rice. Laboratory testing could not identify any enteric pathogen. However, we suspected that an enterotoxin-producing organism caused the outbreak based on environmental findings, incubation period, and clinical symptoms.

Among the pathogens could cause this outbreak, *Bacillus cereus* seems the most likely cause. *B. cereus* produces a toxin mediated emetic or diarrheal gastro-intestinal illness.[8] The incubation period, symptoms and outcome of this outbreak are compatible to the form of toxin producing *B. cereus* which causes diarrheal form of illness.[9] Of the two rice servings, the second batch stored beside the cowshed and served two hours after the first batch was the probable source. The second batch had the highest attack rate and the later serving may allow *B. cereus* to multiply and contamination may have occurred after cooking and during storage beside the shed. Several studies in Bangladesh have shown the presence of *B. cereus* in contaminated food items and the environment.[10,11]

The outbreak may have been avoided if the rice was stored properly. Outbreaks in Canada, Netherland, Finland, United Kingdom, United States of America, China, Belgium, Japan and Malta have been associated with consumption of rice.[12–20]

In most instances, foodborne outbreaks are under-reported and fail to identify an etiologic agent in developing countries like Bangladesh. The reasons may be due to mild signs-symptoms, misdiagnosis, initiation of antibiotic intake before collection of samples and a lack of laboratory capacity to identify the organisms.[21] Most outbreaks that are reported occur in institutions such as schools and after large gatherings such as weddings. However, this outbreak was reported by the health manager of Bheramara who attended a training on public health rapid response that encouraged reporting of foodborne illnesses.

Death can occur following acute gastrointestinal illness due to ingestion of a high dose of exotoxin or complications of dehydration.[22,23] Moreover, people with compromised immune systems are likely to suffer serious consequences after consuming food containing enterotoxin.[24] The fatality in this outbreak was left alone at home after she ate the rice. She was a diabetic patient on insulin. As her family members were at work, she was unattended and taken to the hospital after more than 24 hours of fluid loss due to diarrhea and vomiting which caused hypovolemic shock and death.

Limitations

The etiology of the outbreak could not be confirmed due to limited laboratory capacity to detect enteric pathogens or measure enterotoxin in stools, vomitus, or contaminated food samples. The environmental assessment of the cooking area was done on the third day of the exposure event, which might not represent the actual conditions available during the food storage and preparation.

Public Health Actions and Recommendations

The leftover food items were discarded on 7 January. Local health authorities distributed leaflets on safe food processing and proper behavioral practices regarding food safety. Community members were encouraged to seek early hospitalization and proper intake of oral rehydration fluid in case of diarrhea. The local health authority at Bheramara Upazila was advised during a meeting to strengthen the emergency hotline services for acute cases.

We recommended proper storage and processing of food from preparation to consumption. Raw food should be stored in a clean and dry environment to avoid contamination. Food like rice should be boiled in small quantities in several pots and kept at 140°F (60°C) or above and served hot.[25] If reheating is required, the rice should be heated for at least 5 minutes at 133°F (56.1°C).[26]

Increasing food safety education in the community would encourage health-related behavioral practices such as proper handling, processing, and storage of food. Moreover, people should be encouraged to seek physicians' advice following any rapid onset gastrointestinal illness after eating meals at a social event. Laboratory capacity needs to be strengthened to identify suspected pathogens with biochemical and serological characteristics, toxin gene profiling and toxin quantification, which will assist in investigating the cause of future outbreaks.

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Disclaimer

The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the U.S. Centers for Disease Control and Prevention.

Suggested Citation

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