

## An Outbreak of Diarrhoea Attributed to Consumption of Street-Foods- Bangladesh, March 2018

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### Abstract

**Background:** Diarrhoea outbreaks are common in Bangladesh and usually reported through event-based surveillance. Increased admission of diarrhoea cases was noticed in Upazila-health-center in early March, 2018 and reported to IEDCR on 11 March. The event was investigated to confirm outbreak, identify possible exposures and provide control measures.

**Methods:** We investigated outbreak since 12-14 March; conducted informal interviews, reviewed clinical records, created area-maps of case-patients, tested stool and water samples. For case-control study, we defined case-patients as “Any resident of that sub-district having  $\geq 3$  loose stools in 24 hours since 25th February’18 to date of investigation” and recruited 16 recently admitted case-patients mainly (most previous case-patients lacked contact information) and 32 neighborhood unmatched controls. Calculation of odds ratio and logistic regression were done to identify possible exposures with 95% confidence interval.

**Results:** Outbreak started since 3<sup>rd</sup> March; median age of line-listed case-patients (n=251) was 35 years (IQR 25-50) with male predominance (67%). Most case-patients were from municipality (53%, n=207). For case-patients versus controls, median age was 35 years (IQR 23-45.5) (versus 30 years (IQR 24-45)); 75% male (versus 31%); 60% (9/15) had occupations exposing them frequently to municipality (versus 19%). Odds ratios of consuming street-foods between 25 February-12 March (aOR 14.19, 95% CI 1.11-181.35) and similar illness among family members (aOR 35.4, 95% CI 2.71-461.98) were higher adjusting for sex and occupation. Interviews revealed that many people consumed available street foods in a fair occurred at this municipality from 2-10 March (prior to outbreak notification).

**Conclusion:** Duration of fair and outbreak showed that consumption of street foods from the fair was most likely source of this outbreak. Similar illness among family members might be due to person-to-person transmission or sharing same street food among family members. We suggested safety monitoring of street food sold in large gatherings (e.g., fair) to prevent similar outbreaks in future.

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## Introduction

Diarrhoea is an alteration in normal bowel movement characterized by passage of three or more loose stools in last twenty-four hours. Watery diarrhoea is usually associated with non-invasive entero-pathogens, is not usually associated with fever or blood in stool and may be large volume. In Low- and Middle-Income Countries, diarrhoea is most often a symptom of gastrointestinal infection caused by bacteria, viruses or parasites, commonly transmitted via fecal-oral route. In these countries, diarrhoea-related morbidity and mortality are directly linked with poor quality water, sanitation and hygiene system.<sup>1</sup> The diseases are highly sensitive to climate showing seasonal variations, as relative humidity and temperature influence the rate of replication of different types of pathogens.<sup>2</sup>

Globally, an estimated 1.17 million (95% uncertainty interval 0.793–1.62) diarrhoeal deaths occurred in 2021, with 59.0 million (47.2–73.2) disability-adjusted life-years attributable to it, among which 30.9 million (23.1–42.0) were children <5 years; sub-Saharan Africa had the highest mortality rates <5 years, whereas south Asia had the highest rates in those aged 70 years and older.<sup>3</sup> In Bangladesh, a total of 2,247,342 diarrhoeal cases were reported in 2024;<sup>4</sup> the prevalence being risen from 3.91% in 2012–13 to 8.78% in 2019 in children <5 years; and was found one of the leading causes of seeking hospital-level care is diarrhoea during 2008-2013.<sup>5-7</sup>

Acute watery diarrhoea outbreaks, often preventable, are common in this country, eight out of total 38 outbreaks investigated in the year 2024.<sup>8</sup> Outbreaks occur particularly in areas lacking in clean water for drinking, cooking, cleaning, as well as knowledge and practice of basic hygiene; and often caused by fecal contamination of water from municipal sewage, septic tanks, and latrines.<sup>6</sup> Foodborne outbreaks causing diarrhoea are

not an uncommon occurrence, also outside Bangladesh.<sup>9,10</sup> Therefore, investigating these outbreaks helps to explore cause, source, and at-risk people as well as the knowledge helps prevent spread or future recurrence.

In the first week of March 2018, there were increased numbers of admitted acute watery diarrhoea (AWD) cases at Muktagacha Upazila Health Complex (UHC), Mymensingh affecting mostly adults with no deaths and confined to the municipality area. An official letter from the Upazila Health and Family Planning Officer (UHFPO) of Muktagacha UHC was sent to Director IEDCR on the 11th instance regarding this and a team from IEDCR investigated the outbreak to confirm its existence, to identify the possible source/causative organisms and risk factors to control the current one and prevent such outbreaks in future.

## Methods

The outbreak was investigated following the 'steps of outbreak investigation'. After confirming the existence of the outbreak, we developed a case definition, identified cases systematically to prepare a line list. Afterwards, a descriptive study concerning time, place, and person was conducted to develop the hypothesis, and a case-control study was done to evaluate the hypothesis. Appropriate samples were collected and tested.

The investigation was conducted among the people of Muktagacha Upazila during 12-14 March, 2018. Muktagacha Upazila, located in Mymensingh district, comprises a central municipality area and adjacent rural unions.

To understand the scenario better, in-depth discussions were conducted with UHFPO, Sanitary Inspector, Health Assistants, Assistant Health Inspectors and Health Inspectors of different areas of Muktagacha

UHC as well as several of the case-patients at the beginning.

To confirm the existence of the outbreak, clinical records of acute watery diarrhoea cases admitted at Muktagacha UHC for last 3 years (2015-2017) were reviewed.

We defined cases for line listing and descriptive analysis as:

**Suspected case:** Any resident of Muktagacha Upazila having 3 or more loose stools in 24 hours since 25th February to 14 March, 2018.

**Confirmed case:** Any suspected case with laboratory confirmation of the causative organism.

For the case control study, we developed the hypothesis “Ingestion of street-food at Muktagacha Municipality between 25 February to 12 March 2018 resulted in increased number of acute watery diarrhoea cases among residents of Muktagacha Upazila.”

Street food was defined as “wide range of ready-to-eat foods and beverages or prepared at home and consumed on the streets without further preparation”.<sup>11</sup> A case was defined as “any resident of Muktagacha Upazila having 3 or more loose stools in 24 hours since 25th February 2018 to the date of investigation” and a control as “any resident of Muktagacha Upazila who did not have 3 or more loose stools in 24 hours since 25th February 2018 to the date of investigation”.

The case-control study was unmatched, with a case:control ratio of 1:2. It was assumed that 40% of controls were exposed to the risk factor and sample size was calculated with 80% power and a confidence interval of 95%. In total, 16 cases were enrolled in the study of which 10 were from Municipality (3 from Nandibari, 3 from Para tongi, 2 from Poyar kandi, 2 from Ishwar gram, 2 from Tarati

union, 2 from Basati union and 2 from Mankon union). The 32 controls were enrolled conveniently from the neighbourhood.

Face-to-face interview was conducted using standardized questionnaire with questions regarding demographics and risk factors (e.g., water, sanitation, hygiene, street food ingestion)

#### *Collection of samples (Stool and water sample)*

A total of 8 stool samples were collected from cases and tested for RDT for V. Cholerae in field. Stool Culture was done in the Microbiology laboratory (IEDCR). Polymerase Chain Reaction (PCR) for Rota and Norovirus was done in Virology lab, IEDCR.

Water samples were collected from 4 points; 2 samples of tube-well water from two different most affected unions, and 2 samples of submersible water from Municipality (1 household user point, 1 hotel user point); and microbiological tests were done in Institute of Public Health (IPH) Laboratory.

#### *Data Analysis*

Data from record review and line list were used to create line graphs to understand trends of diarrhoea cases in the UHC, spot map to identify most affected areas, and an epidemic curve. Descriptive analysis using frequency, percentage, mean (SD), and median (IQR) was conducted as appropriate for data from line listing and environmental investigations. Chi square test, Fisher’s exact test, Wilcoxon rank sum tests were performed to see associations between variables. Odds ratio and logistic regression were calculated to identify degree of association and to adjust for confounding with 95% confidence interval. We used MS Excel 2016 and Stata version 14.2 for analysis.

### Ethical Considerations

Informed verbal consent was obtained from all respondents and assent from diarrhoeal cases less than 18 years of age. Respondents were informed that there was minimal risk for participants if they were interviewed and stool samples were collected from them. They were also informed about data confidentiality.

### Result

#### Findings from In-Depth Interviews

There was sudden increase in number of diarrhoeal cases in the outpatient and inpatient departments of the Hospital for last 6-7 days. Regarding water use, rural community people mostly used tube-well water for drinking and household purposes. The hygienic condition of the Municipality supply water was poor; there were often leakages in the water supply lines; and hence most residents of the Municipality used tube-

well or submersible water for drinking and household uses. Additionally, construction of roads of Upazila had been going on for last few months, which might have further damaged the Municipality water supply lines. A 'keerton mela' took place in the Upazila premises during 2-10 March 2018; where plenty of people consumed street food. Municipality water supply was also disconnected from 10 March due to strike.

#### From Review of Clinical Records

Total number of admitted diarrhoeal cases from 1-12 March 2018 was 211 (76% of total number of admitted diarrhoeal cases in May 2017, an earlier outbreak), which confirmed the existence of an outbreak of acute watery diarrhoea at Muktagacha Upazila (Figure 1). The diagnosis was verified with Rapid Diagnostic Test of 2 stool samples on the first day of investigation-, one of which tested positive for *Vibrio Cholerae*.

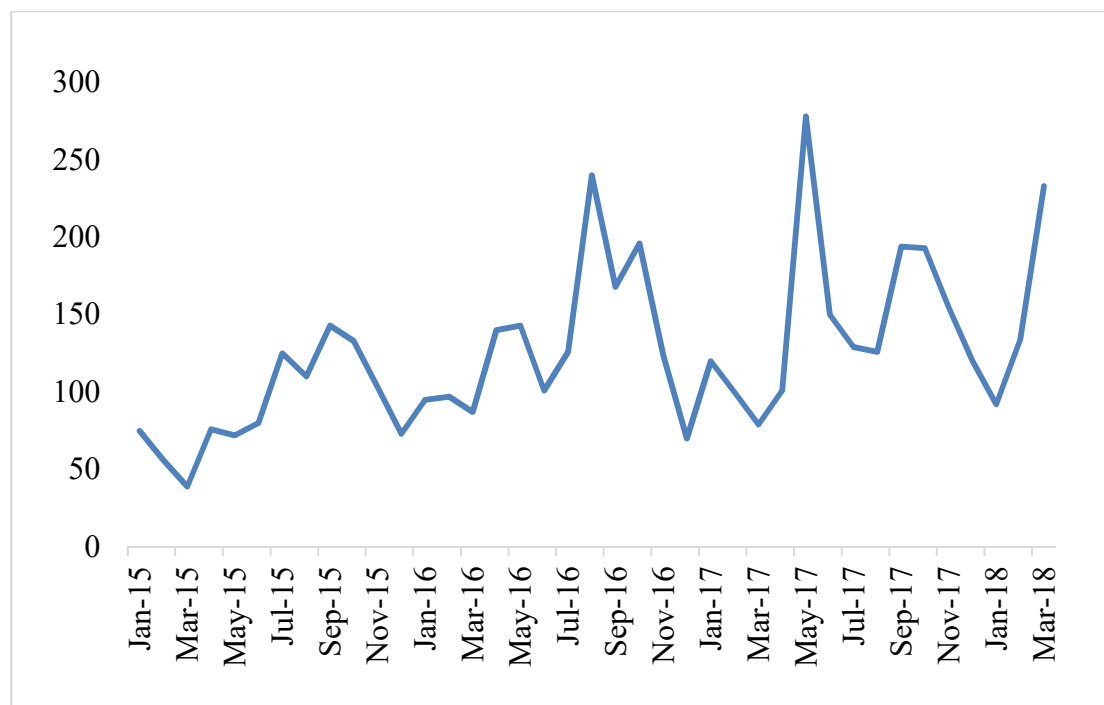


Figure 1. Distribution of admitted acute watery diarrhoeal cases at Muktagacha Upazila Health Complex for last 3 years (January 2015-Mid March 2018)

### Findings of the line listed cases: Descriptive epi

The epidemic curve showed an increase in number of diarrhoeal cases in March 2018 (since 3rd March) in comparison to previous few days and a gradual decrease after 17 March (Figure 2). The period of increased number of cases roughly matched with incubation period of exposure to AWD causing organisms in the 'keerton mela' and also with stoppage in provision of municipality supply water.

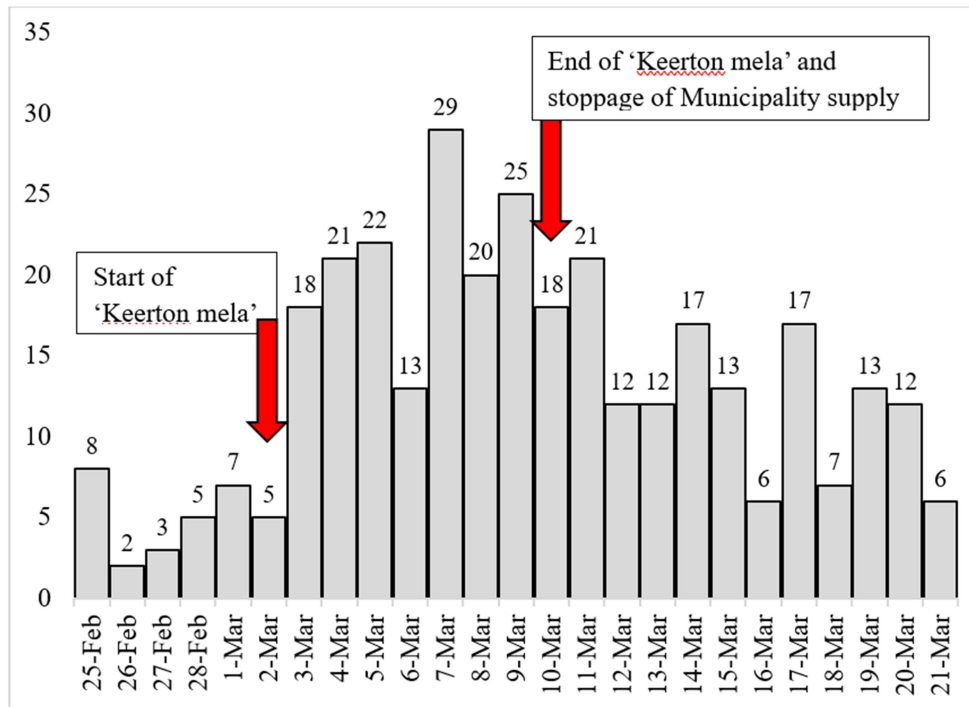


Figure 2. An epidemic curve showing distribution of admitted acute watery diarrheal cases at Muktagacha UHC from 25 February to 21 March 2018

Median age of line-listed 251 cases (with IQR) was 35 years (25-50) and male cases were 67% (167/250) among them. Most (53%, 109/207) cases were from Municipality, 11% (22/207) were from Tarati union, 10% (19/207) from Basati union, 9% (18/207) from Mankon union, and 19% (39/207) from other 7 unions (Figure 3). In further exploration, from cases of Municipality, 23% (25/109) cases were from Nondibari area, 15% (16/109) cases were from Para tongi area, 11% (12/109) cases were from Poyar kandi area, 10% (11/109) cases were from Ishwar gram area and 41% (45/109) cases were from other areas.



Figure 3. Muktagacha upazila map showing mostly affected areas with diarrhea in March 2018

Mean duration of illness in cases was 3.06 days. Average number of purging in 24 hours was 15.07. Of 16 cases, 69% reported to have rice watery stool. Abdominal pain was present in 38% of cases, vomiting in 31%, both fever and vomiting in 25% of cases, and 38% had no other symptoms (Table not given).

#### *Findings from the Case-Control Study*

Median ages of cases and controls were 35 (IQR 23-45.5) and 30 (IQR 24-45) years respectively and this difference was not statistically significant ( $p > 0.05$ ). Males were significantly more affected than females ( $p < 0.01$ ). Among cases, 27% were businessman, 20% were service holders, 20%

were housewives. Among controls, 50% were housewives and 19% were students. On further categorization of occupations based on exposure to Municipality, occupations with more exposure to Municipality were found more likely to have diarrhoea compared to those without ( $p < 0.01$ ). Analysis of behavioural risk factors showed that use of submersible water for household use and drinking, consumption of street food between 25 Feb-12 March, and presence of similar illness among family members were significantly more associated with getting infected with acute watery diarrhoea compared to those who did not ( $p < 0.05$  for all) (Table I).

Table 1: Distribution of demographic characteristics and behavioural risk factors among cases and controls and their association with having diarrhoea at Muktagacha upazila in March 2018\*

Characteristics	Case (n=16) f (%)	Control (n=32) f (%)	p value
Age (years) Median (IQR)	35 (23-45.5)	30 (24-45)	>0.05
Sex	Male 12 (75) Female 4 (25)	Male 10 (31) Female 22 (69)	0.004
Occupation	More exposure 9 (60) Less exposure 6 (40)	More exposure 6 (19) Less exposure 26 (81)	0.005
Submersible water source for household use	Submersible water 3 (19) Others 13 (81)	Submersible water 0 (0) Others 32 (100)	0.03
Submersible water for drinking	Submersible water 5 (31) Others 11(69)	Submersible water 2 (6) Others 30 (94)	0.03
Sanitation (Kacha latrine) facilities	Kacha 5 (31) Sanitary 11 (69)	Kacha 17 (53) Sanitary 15 (47)	0.15
Consumed Street food between 25 Feb-12 March	No 6 (37.5) Yes 10 (62.5)	No 26 (81) Yes 6 (19)	0.002
Presence of similar illness of family members	No 8 (50) Yes 8 (50)	No 27 (84) Yes 5 (16)	0.02

\*Figures are rounded

The degree of association of different socio-demographic characteristics and behavioural risk factors with being diarrhoea-infected was calculated. It was found that the odds of getting infected with diarrhoea continued to be higher among those who took street food between 25 February-12 March (aOR 14.19, 95% CI 1.11-181.35) and presence of similar illness in other family members (aOR 35.4, 95% CI 2.71-461.98) compared to those who did not take street food in that time period and absence of similar illness in other family members after adjusting for remaining risk factors (Table II).

Table II: Risk factors of having acute watery diarrhoea among residents of Muktagacha Upazila in March 2018

Risk factors	Crude Odds ratio (95% CI)	Adjusted Odds ratio (95% CI)
Similar illness of other family members (compared to no illness in fam. mem.)	5.4 (1.13-26.7)	35.4 (2.71- 461.98)
Street food intake between 25 Feb-12 March (compared to non-intake)	7.22 (1.57-34.43)	14.19 (1.11-181.35)
Male (compared to female)	6.6 (1.46-33.93)	4.68 (0.63-34.53)
Occupations with more exposure to Municipality (compared to occupation with less exposure)	6.5 (1.38-31.55)	2.5 (0.22-28.01)
Tube-well or OHT source of drinking water (compared to submersible water)	0.15 (0.01-1.1)	-
Other water sources for household use (compared to submersible water)	0 (0-0.57)	-

*Laboratory tests for stool and water samples*

Collected stool samples (n=8) were tested. Only 25% of the samples were RDT positive for *V. Cholerae* in the field. None of the samples showed growth of *Vibrio*, *Salmonella* and *Shigella*, when culture of samples was done. All samples were negative in PCR when tested for Rota and Norwalk virus. Water samples were tested in the laboratory to identify presence of bacteria in the samples. None of the samples showed presence of any bacteria and all samples were bacteriologically satisfactory (No table given).

*Control measures taken and follow-up activities*

A health message suggesting avoidance of open prepared food available in bazars/hotels and rotten/food left for over-night, emphasizing drinking pure water, washing hands properly after using toilets and before eating, and on seeking treatment from nearby health facility after having symptoms of diarrhoea, was developed. The UHFPO of Muktagacha UHC facilitated its circulation in the community. The total number of diarrhoeal cases admitted in the UHC was followed up every day for a week after completion of field investigation. An overall decrease in total number of admitted diarrhoeal cases for that week was noticed.

**Discussion**

The investigation confirmed the existence of an outbreak of diarrhoea at Muktagacha Upazila of Mymensingh in March 2018. Possible source of infection and the causative organism of the outbreak could not be identified. However, intake of street food from vendors at Muktagacha Municipality between 25 February-12 March and presence of similar illness among family members were found to be risk factors. Along with the information of a recently occurring fair 'keerton mela' since 2-10 March, 2018 there

led to an observation that street foods sold in the 'keerton mela' might have association with this outbreak; however, there was lack of enough data to establish a direct relationship.

Street food vending is a common feature of most cities and towns in developing countries. Street vended foods, bearing the cultural and social heritage of societies, are well recognized for their unique flavors and convenience, and play an important role in maintaining the nutritional status of the population, particularly for those from low socio-economy.<sup>12</sup> These foods can get contaminated through raw materials, processing, utensils for cooking and serving, place of preparation, and personal hygiene of the personnel involved.<sup>11,13</sup> The most common micro-organism belonging to the genus *Bacillus*, *Staphylococcus*, *Clostridium*, *Vibrio*, *Campylobacter*, *Listeria*, *Salmonella*.<sup>11</sup> Therefore, these foods are perceived to be a major public health risk, making children more vulnerable, as their consumption was related to outbreaks of foodborne illnesses, particularly cholera and typhoid.<sup>14-18</sup> Different studies from Bangladesh report presence of microbes, of drug resistant on many occasions, in the street-vended food items, some of which, like Fuchka, are very popular among general people.<sup>19-21</sup> Hence, for the current outbreak, street foods sold in the fair could be contaminated at any of the stages, from preparation to storage, or even by using Municipality supply water to prepare them. However, as we investigated retrospectively and could not test food sample, confirming the specific food source and causative organism were not possible.

Nevertheless, investigation revealed occurrence of a 'keerton mela' in the municipality since 2-10 March of that year, where plenty of people from different parts of the upazila came to visit and enjoyed street

foods sold over there. The number of admitted AWD cases in the UHC increased since 3<sup>rd</sup> March (i.e., just after the beginning of the fair) and the number of admitted AWD cases started to decrease after 17 March. This peak of AWD cases roughly matched with incubation period of diarrhoea after probable exposure to related micro-organisms in the foods sold in the fair. Previous literature supported similar findings of food contamination in mass gatherings and subsequent gastrointestinal problems in the community and suggested strict surveillance and compliance to the food safety regulation.<sup>10,22</sup>

Presence of similar illnesses among family members was another identified risk factor of this outbreak, a finding alike results in other studies done among hospitalized diarrhoea cases.<sup>23</sup> Street food sharing among the family members at home or at the fair or household transmission might result in this observation.

As cases and controls were selected conveniently, there might be presence of selection bias. Besides, dependency on recall about the food consumption in last few days might result in information bias. Additionally, laboratory results of stool and water samples were inconclusive. Failure to collect and test stool samples before taking antibiotics resulted in 'no growth', as well as water samples supplied by the Municipality, due to employees' strike, resulted in absence of documented evidence of contamination.

This outbreak of acute watery diarrhoea most likely resulted from consumption of street foods sold in a fair. A health message demonstrating avoidance of ingesting openly prepared food in bazar/hotels for controlling current situation and preventing future outbreaks was provided. We also recommended strict monitoring of street food sold in large gatherings (i.e., fair) to ensure

food safety and to prevent similar outbreaks in future.

### *Conclusion*

Diarrhoeal outbreaks continue to pose a substantial public health challenge in Bangladesh and are frequently detected through event-based surveillance. This investigation confirmed an outbreak of acute watery diarrhoea at Muktagacha Upazila, Mymensingh in March 2018, with the highest burden among adult male residents of the municipality area. Descriptive epidemiology and the epidemic curve indicated a sharp rise and decline in cases, temporally associated with a local fair. The case-control study identified consumption of street foods during the exposure period and the presence of similar illness among family members to be strongly associated with diarrhoea. Although laboratory investigations did not conclusively identify a causative pathogen, the epidemiological evidence strongly suggested foodborne transmission of this outbreak from street foods vended at the fair, with possible secondary household spread. We circulated health messages to increase community awareness regarding hygienic food consumption practices and recommended strengthening safety monitoring of street foods sold during large public gatherings to reduce the risk of similar outbreaks in the future.

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### *Conflict of interest*

The authors declare that they have no conflict of interests.

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