

Investigation of Diarrheal Outbreak in a Cantonment: Implementation of Epidemiological Triad to Reach Diagnosis

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DOI: <https://doi.org/10.3329/jafmc.v15i2.50822>

Abstract

Introduction: Acute diarrheal outbreak in Bangladesh prevails as an important cause of mortality and morbidity. In the month of April 2018, a diarrheal outbreak occurred in 'Formation Recruit Training Center (FRTC)' at 'Jashore Cantonment'. A total number of 262 cases were detected.

Objective: To find out the cause of outbreak.

Materials and Methods: In three dimensional aspect investigation was done. Namely case detection and hypothesis generation, laboratory investigation and environmental investigation.

Results: In 62% cases the sufferers were in the last half of second decade who were first exposed to the water of the Jsr cantonment. In stool culture no organism was found but mucus was seen in all (n=12) cases. In water bacteriological test water samples were highly contaminated with *E coli* and found unsatisfactory in 67% cases.

Discussion: Administration of antibiotic prior to taking stool sample caused 'false negative' result in 'antibiogram'. But the environmental investigation supported *E coli* mediated diarrhea outbreak strongly. Water was highly contaminated with bacteria. The host was immunologically sound due to stress. The agent was exposed for the first time.

Conclusion: The environment in which they used to live was very poor. This 'Epidemiological Triad' of agent, hosts and environment caused them victim in a large scale.

Key-words: Acute Diarrhea, Epidemiological Triad, Jashore Cantonment.

Introduction

Acute diarrheal outbreak in densely populated developing country like Bangladesh is very common¹. Every year it causes a high mortality rate² which is 9/1000. Among the most common causes of diarrheal outbreak the enterotoxigenic *Escherichia coli* and *V. cholerae* O1/O139 were the leading causes of hospitalizations³⁻⁵. In April 2018, at 'Formation Recruit Centre (FRTC), Jashore Cantonment an epidemic outbreak of diarrhea occurred, where a total number of 262 cases suffered from acute diarrhea within the period of 16 days and out of which 59(22.50%) cases were hospitalized. The case fatality rate was 'zero'. Sufferers' stools were investigated along with the source of water. The case definition of 'Diarrhea' is the passage of three or more loose or liquid stools per day (or more frequent passage than is normal for the individual)^{4,7}. Other symptoms are low-grade fever (61 cases, 23.28%), colicky

abdominal pain (165 cases, 62.97%), passing of mucus (47 cases, 18%). The water delivery system in a cantonment is centrally controlled and a deep tube well is used to draw the water. The water is then distributed through a spider web like connectivity made of aluminum pipes. The water has not been investigated for long time.

Materials and Methods

To identify patients, health officials interviewed ill persons in FRTC, as well as persons from outside FRTC who drunk the same source of water. Patients were routinely interviewed about a wide variety of potential exposures, and stool samples were collected for laboratory confirmation. Health officials assessed retail food distribution in FRTC as well as their living standard. This information was used to conduct the subsequent case-control studies. Selective stool samples as randomized basis was sent to department of Pathology, CMH Jashore. Where they were plated on MacConkey agar⁵ and also routine microscopic examination of the stool was done simultaneously. Representatives from the div medical branch, 55 infantry division inspected the FRTC's water supply system and reviewed testing and safety measures. Water samples were collected from the outlet of the storage tank and several points in the distribution line. Water samples were sent to department of pathology, CMH Jashore and analyzed for bacterial contamination within 24 hours of collection. Water samples were tested for total and fecal coliforms and *E. Coli* According to WHO criteria for drinking water⁸.

Results

Total 262 cases were investigated along with their living standard. The source of water was investigated and the distributed water investigated from different units. Patients' age range was 16-45 years. The highest numbers of the patients were in the second half of second decade and first half of the third decade. However, it is obvious that they were more victim of this epidemic (Figure-1). Symptoms of patients were commonly with diarrhea and colicky abdominal pain. A substantial number of patients also suffered from low-grade fever and passage of mucus that was obvious. These symptoms suggested that they were suffering from 'Acute Gastroenteritis' (Table-I). Stool culture sensitivity found no organism was found in any of the patient. In randomly selected 12 patients stool routine examination was done. In 1(8%) patients '+++ mucus was seen, in 2(25%) patients '++ mucus was seen and rest of the patients 8(67%) '+' mucus was seen (Figure-3). Water sample test of the different units of the Jashore cantonment was done based on presence of *E. Coli* in water which reflects fecal contamination. Based on WHO criteria none of the water sample was found satisfactory, 8(67%) samples were found unsatisfactory and 4(33%)

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samples were found suspicious. Nevertheless, the water sample of our place of diarrhea outbreak was found unsatisfactory and heavily contaminated with *E. Coli*. Figure-4 shows that the number of patients reported with diarrhea per day with associated symptoms. After getting the water test report the source of drinking water was changed on 24 April 2018. After that, the number of patients reduced in exponentially.

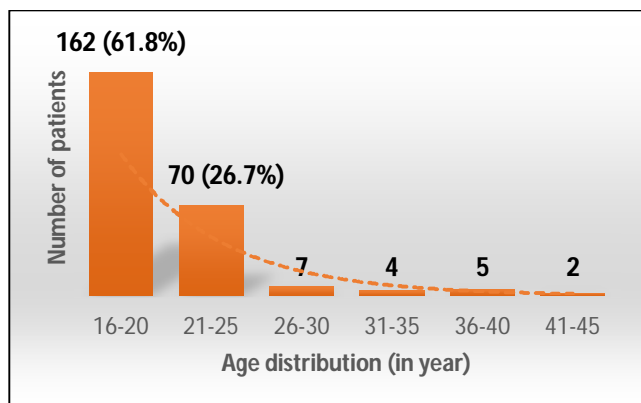


Figure-1: Distribution of patients by age group (n=262)

Table-I: Distribution of symptom (n=262)

Symptoms	Frequency	Percentage
Diarrhea	262	100.0
Colicky Abdominal Pain	165	62.9
Passing of mucus	47	17.9
Low grade fever	61	23.3

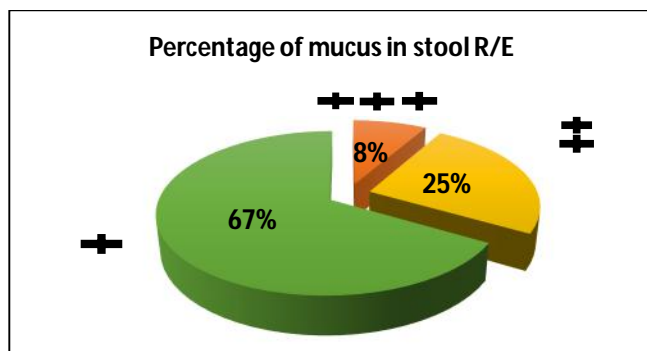


Figure-2: Stool R/E reports (n=12)

Table-II: Water test result based on presence of *E. Coli* in drinkable water (n=12).

Name of Unit	Result
FRTC (c/o 9EB)	Unsatisfactory
12 Lancer	Suspicious
26 Fd Regt Arty	Unsatisfactory
8 Engr Bn	Suspicious
Stn HQ	Unsatisfactory
21 BIR	Unsatisfactory
17 BIR	Unsatisfactory
14 EB	Suspicious
30 EB	Suspicious
BSD	Unsatisfactory
Mil Farm	Unsatisfactory
Static Sig Coy	Unsatisfactory

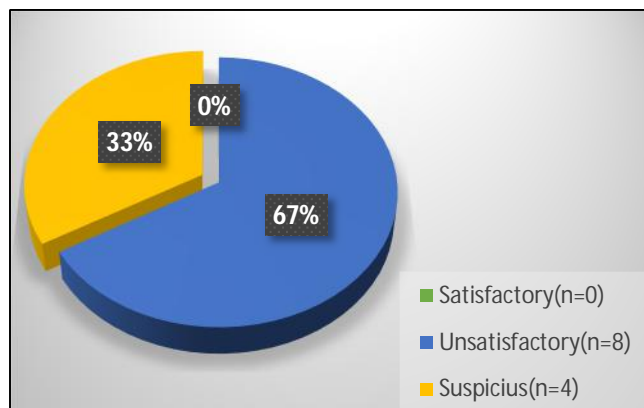


Figure-3: Status of drinkable water in Jashore cantonment (n=12)

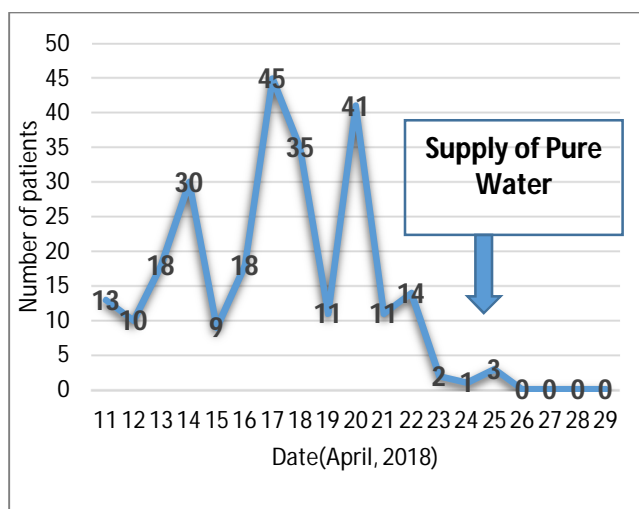


Figure-4: State of diarrhea patients by date (April, 2018).

Discussion

Diarrheal disease is very common in Bangladesh¹. In most of the cases of diarrheal outbreak occurs in the mid of April⁹. The outbreak in April is usually associated with *Vibrio cholera* infection⁹. But the symptoms like passing of rice watery stool, severe dehydration and nausea and vomiting in the last stage of the disease were not present in any of the cases¹⁰. Again in the stool culture no organism was found. In all cases the antibiotics, namely 'Ciprofloxacin' and 'Metronidazole' was prescribed along with oral rehydration salt. Due to use of antibiotics prior to culture and sensitivity report, no organism was found¹¹. But the symptoms of diarrhea found in 262(100%) cases. Colicky abdominal pain in 165(62.97%) cases, passing of mucus in 47(18%) cases, low grade fever in 61(23.28%) cases were consistent with bacterial gastroenteritis¹².

Later onward an environmental test was carried out to reach in diagnosis. The laboratory test of water was done and special attention was given to bacteriological contamination. The water supply of the FRTC, Jsr cantonment was found unsatisfactory according to the WHO drinkable water criteria⁸. The water was highly contaminated with *E. coli*. The water source of different units of the Jsr cantonment was tested simultaneously and found unsatisfactory in 8(67%) units, suspicious in 4(33%) units and none of the unit's water supply was found satisfactory. To prove this retrospective data, the water supply of FRTC, Jashore was changed on 24 April 2018 and safe water was supplied by 8-engineer battalion. Following that the number of diarrhea patient reduced

drastically and none of the recruit reported sick with diarrhea after 27 April 2018.

This *E. coli* contaminated 'unsatisfactory' water was supplied in other units also. But they did not complain of diarrhea or any other symptoms of gastroenteritis. This explains the implementation of 'Epidemiological Triad'¹³. As environmental investigation was carried out it revealed the poor standard of living of the recruits of the FRTC, Jsr compare to the other units. The recruits of the FRTC used to live in very poor condition. They used to live even on floor in congested condition. The numbers of toilets were not satisfactory and those were not maintained properly. The water for drinking was not boiled or treated with chlorine initially. The recruits were not aware of personal hygiene properly. They were poorly interested in bathing after hardship of training. The 'host' condition was also deteriorated in terms of their immunity. They were never experienced with the hardship of military training, physical exertion and mental training, which is associated with raised cortisol level and subsequently decreased immunity¹⁴.

Finally, the 'agent' *E. coli* of that particular strain, which was not exposed to those recruits, previously caused more reaction. Due to the lack of memory cell of previous infection, their immunity could not fight. On contrary to the recruits, in other units the soldiers were infected due to their living standard, not living in stress and chronic low exposure of *E. coli*, which boosted their immunity¹⁵. Finally, the hypothesis was proved by changing of the water source on 24 April 2018. After supply of pure drinking water, the number of diarrhea patient reduced drastically and no further report of diarrhea occurred later of 27 April 2018.

Conclusion

The epidemic outbreak of diarrhea in FRTC, Jashore cantonment that occurred in the month of April 2018 was the classical implementation of 'Epidemiological Triad'. The triangular factors of agent, host and the environment caused the recruits to be suffered from 'Diarrhea' into a large scale. The combined effort of laboratory and environmental investigation brought the fact in limelight. Later on, the effective measurement on water supply controlled the situation promptly, effectively and completely.

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