

# Gastroenteritis Outbreak in a Senior High School, Akwapim North District, Eastern Region-Ghana, 2012

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## ABSTRACT

**Background.** On the 28<sup>th</sup> of October, 12 students from a Senior-High-School (SHS) in the Akwapim North-District-Ghana, reported to the district hospital with abdominal cramps, diarrhea and vomiting. We investigated to identify the cause, the source of infection and to recommend control measures.

**Methods:** We conducted a descriptive investigation; with active case-search and a retrospective cohort-study. A case-patient was a student presenting with abdominal cramps, diarrhea and or vomiting from the 28<sup>th</sup> of October to the 2<sup>nd</sup> of November in the SHS. We interviewed students and reviewed medical records. Stool from case-patients and water samples were taken from known sources of drinking water and associated boreholes for laboratory diagnosis. We performed univariate analysis by person, place and time and assessed risk factors through relative risk 95% confidence level.

**Results:** *Aeromonas-spp* and *Eschericia-coli* were isolated from stool and water samples respectively. The overall attack rate was 8.0 (101/1254) /1000 with no fatalities. The index case, a 15 yr-old female student reported on october 28<sup>th</sup> and case-patients peaked (16/101) 24hours later. The mean age of case-patients was 17 years ( $\pm 1.2$ ) with females 77% (78/101) mostly affected. Eating waakye [RR=3.13(CI 2.35-4.17)], banku [(RR= 2.21(CI 1.33-3.69)], kenkey [RR=1.39 (CI 1.03- 1.87)] and drinking borehole water [( RR=7.60 (CI 6.26-9.25)] were associated with the gastroenteritis.

**Conclusions:** Drinking *Eschericia coli*-contaminated-bore hole water was the most likely cause of this point-source outbreak. Chlorination of the boreholes water coupled with education on food safety and personal hygiene were initiated based on our recommendations and these measures were temporally associated with containment of the outbreak.

**Keywords:** Food-borne, gastroenteritis, outbreak, Akwapim North District, Ghana

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## 1. INTRODUCTION

Gastroenteritis has been referred to as gastro, stomach bug, and stomach virus. Viruses (particularly rotavirus) and the bacteria *Escherichia coli* and *Campylobacter* species are the primary causes of gastroenteritis [Szajewska, 2010; Webber, 2009].

It is estimated that three to five billion cases of gastroenteritis occur globally on an annual basis [Elliot, 2007], primarily affecting children and those in the developing world [Webber, 2009]. It has resulted in about 1.3 million deaths in children less than five as of 2008, with most cases occurring in the world's poorest nations [Mandell, 2010]. Gastroenteritis is an inflammation of the stomach and intestines. In Ghana the incidence is about 5.8 million annually [GHS, 2010]

On the 30<sup>th</sup> of October, 2012, at 8:30am, the District Director of Health Services (DDHS) of the Akwapim North District (AKND) of the Eastern Region (ER) of Ghana received a phone call from the headmaster of a Senior High School in the AKND about an outbreak of diarrhoea in the school which started the night before and had prevailed until the time he was making the report. On further enquiry, we came to know that most of the case-patients were females and were admitted to nearby private and government hospitals with predominant clinical features of watery stool, lower-abdominal pain, and vomiting with or without dehydration. We initiated investigations on the same day to (a) assess the magnitude of the outbreak, (b) identify the etiologic agent and source of infection, and (c) initiate control and preventive measures.

## 2. MATERIALS AND METHODS

### 2.1 Descriptive Epidemiology

We defined a suspected case of gastroenteritis as any person with vomiting and diarrhoea between the 30<sup>th</sup> of October to the 2<sup>nd</sup> of November at Benkum Secondary School. The demographic and clinical details of the suspected case-patients were collected from the hospital-records and denominator data from the records from the school. Active case search and interview of the staff and students in the school were conducted to trace other cases and contacts to identify the possible common source of infection to generate a hypothesis. Data abstracted included age, sex, date of onset, date of presentation at health facility, signs and symptoms and outcomes. We drew a spot-map, constructed an epidemic curve (Fig.1), and calculated the attack rates by age-group.

## 2.2 Laboratory Investigations

A total of 18 stool samples from affected students were collected into sterile containers and transported on ice packs to the microbiology department of the Regional Hospital in Koforidua within 24 hours of collection. The stool samples were inoculated on thiosulfate citrate bile salts sucrose agar (TCBS) plates and incubated at 37°C overnight. On the next day, isolated sucrose-fermenting colonies on the TCBS plate were carefully selected to inoculate a heart infusion agar (HIA), a non-selective medium and also incubated at 37°C for up to 6 hours. Standard bacteriological procedures for oxidase test and serological slide agglutination tests with polyvalent O1 and O139 was then conducted on a fresh isolated colonies from the HIA for a presumptive identification of *V. cholera* O1 (serotypes: Inaba, Ogawa and Hikojima) and/or O139 (Cheesbrough, 1993). The string test for a presumptive identification of *Aeromonas* spp. was also done.

Similarly, water samples from the boreholes and storage tanks were sent to the Ghana Water Company, Kpong for laboratory analysis.

## 2.3 Environmental Survey

We inspected the school compound for different sources of water used for drinking, cooking and domestic purposes to identify the possible sources of drinking-water contamination. We also inspected all conditions for food preparation and handling and interviewed the kitchen and canteen staff, and other food vendors about the storage of drinking water and clinically examine the food-handlers. An environmental survey of the school compound was undertaken to inspect and interview the students on the sanitary conditions of the school. Geographical co-ordinates of landmarks of the school were taken with a GPS Receiver to construct a spot map.

## 2.4 Analytical Epidemiology

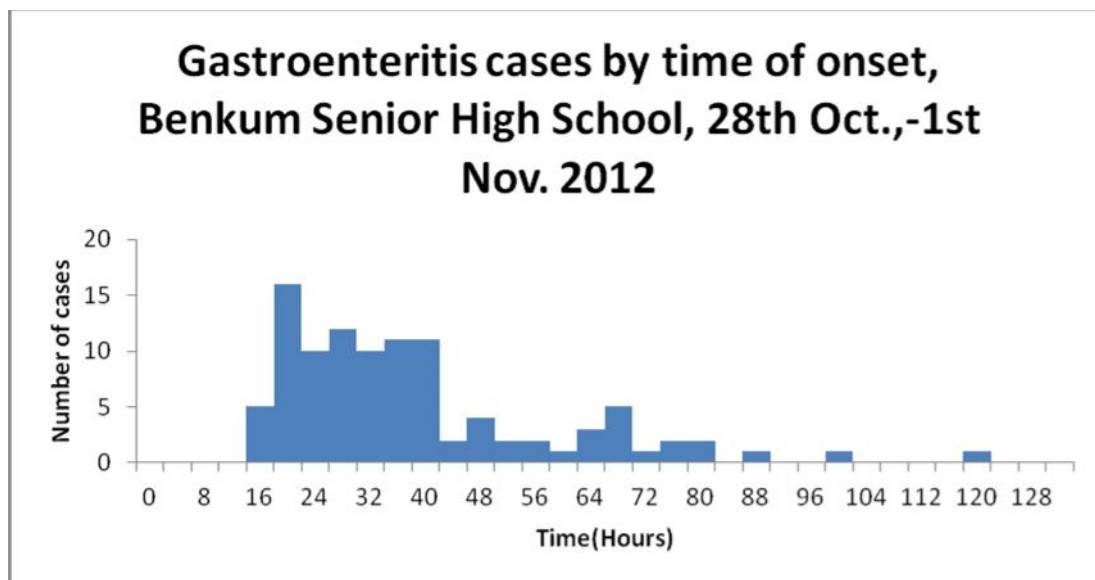
Review of the descriptive epidemiological findings led us to suspect that the diarrhoea illness was associated with a) Eating food either from the schools kitchen, canteen or the various food vendors at the dormitory, or b) Drinking water from the bore-holes. To test these hypotheses, we conducted a retrospective cohort study among the students of the school. The students were interviewed to collect information about their source of food and drinking water.

## 3.0 RESULTS

### 3.1 Descriptive Epidemiology

Among the 1800 students, 101 were affected. The overall attack rate was 5.6 (101/1800) /1000 with no fatalities. The mean age of case-patients was 17 years ( $\pm 1.2$ ) with females 77% (78/101) mostly affected. Sex specific attack rates were 3.8% (23/600) and 6.5 % (78/ 1200) for males and females respectively. The index case, a 15 yr-old female student reported on october 28<sup>th</sup> and case-patients peaked (16/101) 24hours later.

Figure: 1



The outbreak was a point source (Figure 1). The onset of the diarrhoea started around 16 hours of the 28<sup>th</sup> of October and peaked between 16 to 24 hours of the same day. It then plateaued on the second day. The number of cases reduced drastically within 40 hours to 80 hours of onset. Afterwards very few cases were seen between the third and fourth day ie 88 to 120 hours of onset.

### 3.2 Laboratory Investigations

Out of the 15 samples tested on the 2<sup>nd</sup> of November, 2012, only one showed growth for *Aeromonas spp.* All the others were free from pathogens. Preliminary results from the Ghana Water Company indicated faecal contamination of the school's bore-hole water. *Aeromonas spp* and *Eschericia coli* were isolated

from stool and water samples. Most of the students shared a common place of convenience with their colleagues. The likely mode of transmission is faeco-oral.

### 3.3 Environmental Investigations

There were three bore-holes located on the school compound. These had been cited together in a closed area. About 20 meters from this area is a pit latrine being used by the students of the school. Filthy drains, both in and outside the school kitchen, an open refuse dump and dirty urinals (near the sick bay) were identified. The area around the water storage tanks was weedy, poorly kept and few places littered with human fecal by the students. The site of the school canteen was filthy with an open refuse dump. It was observe that the 'waakye' and 'banku' sellers handled food with their bare fingers.

### 3.4 Analytical Epidemiology

We included 1254 (70%) of the 1800 students available in the cohort study. 412(40%) were males. Compared with students who ate banku and jollof rice from the school canteen, white porridge and waakye (rice shito and fish) from the school's kitchen and those who used other sources of water, students who reported to have eaten waakye and banku from the school canteen, ate kenkey and fish from the school kitchen and used borehole water for drinking were more likely to develop the acute diarrhoea and vomiting (RR=3.13(CI 2.35-4.17), RR= 2.21(CI 1.33-3.69), RR=1.39 (CI 1.03-1.87), RR=7.60 (CI 6.26-9.25). However, students who ate white porridge and waakye from the school's kitchen were protected from the ailment. (Refer Table 1)

Table 1: Attack of Gastroenteritis in Bunkum Senior High School according to selected factors, Akwapim North District, 2012

| Number of persons who ate food item |     |       |               | Number of persons who did not eat food item |       |               |      |           |
|-------------------------------------|-----|-------|---------------|---------------------------------------------|-------|---------------|------|-----------|
|                                     | Ill | Total | Attack Rate % | Ill                                         | Total | Attack Rate % | RR   | CI        |
| <b>Dining Hall</b>                  |     |       |               |                                             |       |               |      |           |
| White porridge and bread            | 40  | 478   | 8.4           | 114                                         | 773   | 14.7          | 0.57 | 0.40-0.80 |
| Waakye, shito and fish              | 72  | 698   | 10.3          | 82                                          | 553   | 14.8          | 0.67 | 0.50-9.0  |
| Kenkey and Pepper with fish         | 87  | 605   | 14.4          | 67                                          | 646   | 10.4          | 1.39 | 1.03-1.87 |
| <b>Black Market</b>                 |     |       |               |                                             |       |               |      |           |
| Waakye                              | 68  | 252   | 27.0          | 86                                          | 999   | 8.6           | 3.13 | 2.35-4.17 |
| Banku                               | 12  | 46    | 26.1          | 142                                         | 1205  | 11.8          | 2.21 | 1.33-3.69 |
| Jollof rice                         | 2   | 18    | 11.1          | 152                                         | 1233  | 12.3          | 0.90 | 0.24-3.36 |
| <b>Girls' Dormitory</b>             |     |       |               |                                             |       |               |      |           |
| Macaroni                            | 12  | 106   | 11.3          | 142                                         | 1145  | 12.4          | 0.91 | 0.52-1.59 |
| Egg                                 | 28  | 167   | 16.8          | 126                                         | 1084  | 11.6          | 1.44 | 0.99-2.10 |

|                        |    |     |      |  |     |      |      |      |           |           |
|------------------------|----|-----|------|--|-----|------|------|------|-----------|-----------|
|                        |    |     |      |  |     |      |      |      |           |           |
| Jollof rice            | 17 | 144 | 11.8 |  |     | 137  | 1107 | 12.4 | 0.90      | 0.56-1.44 |
| <b>Boys' Dormitory</b> |    |     |      |  |     |      |      |      |           |           |
| Jollof rice            | 9  | 85  | 10.6 |  |     | 145  | 1166 | 12.4 | 0.85      | 0.45-1.61 |
| Rice                   | 11 | 92  | 12.0 |  |     | 143  | 1159 | 12.3 | 0.97      | 0.55-1.72 |
| Banku                  | 7  | 38  | 18.4 |  | 147 | 1213 | 12.1 | 1.52 | 0.77-3.02 |           |
| Water Source           |    |     |      |  |     |      |      |      |           |           |
| Borehole water         | 50 | 60  | 83.3 |  | 135 | 1232 | 11.0 | 7.60 | 6.26-9.25 |           |

## 4.0 DISCUSSIONS

A point source outbreak of gastroenteritis occurred among the students of the Senior High School. The outbreak was associated with drinking water from the schools bore-holes. The points supporting our findings included: (a) absence of any cases among the populace in the district residing outside the school using other borehole water for drinking purposes; (b) presence of *E.Coli* in the bore-hole water. The presence of *Aeromonas spp* in the stool specimen probably exacerbated the condition and **was** (c) a significant risk associated with drinking water from bore-hole, with more than 95% of the cases attributable to this exposure. Although, the depth of the latrine was not assessed, they are generally very deep since they are designed to serve many people for many years. The possibility exists that the bottom of the latrines are very close to the water-table. It has been recommended that latrines should be at a lower level than the nearest wells, the bottom of latrines must be at least 1-5 m above the ground-water table and the distance between latrine and any water source should be as large as possible, but never less than 30 m [De Araoz & Subrahmanyam, 1970].

E.Coli transmission from fresh water source has been documented but not common, however it **has been a cause** of individual infections as well as outbreaks in developed countries. [Armstrong, 1996] while reports from developing countries like India and Bangladesh are sparse [Albert, 1995]. The detection of E. Coli in water is an indication that the water source has been contaminated with human faeces [http://www.epa.gov/].

It was also realized from the environmental assessment that the area surrounding the water storage tanks was poorly kept and contaminated with human faeces. Poor hygiene is considered a main risk factor for acquiring E.coli **infection** (Huang *et al.*, 2006).

Our study found out that some of the food vendors at the school canteen handled food (waakye & banku) in unacceptable conditions. Inappropriate food handling as a risk factor for a disease outbreak has been documented by Smith *et al.* [1997]

It was a challenge to collect information on the entire student population since about 10 of them had gone home to see their family physicians. This reduced the denominator for the retrospective cohort study.

Despite the exclusion of these individuals from analysis, our study had sufficient power to detect the association between the illness and the risk factors (power 98%). We were unable to get some food samples for further laboratory diagnosis since the team was invited to investigate the outbreak a few days after the onset.

In Conclusions, drinking *Escherichia coli* contaminated-bore hole water was the most likely cause of this point-source outbreak. Chlorination of the boreholes water, coupled with education on food safety and personal hygiene were initiated based on our recommendations and these measures were temporally associated with containment of the outbreak.

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**Conflict of interest:** *None declared*

## Authors' contributions

This work was carried out in collaboration with all authors. Author JKLO wrote the study protocol helped in study, design, data analysis and drafted the manuscript. Authors EA, FW, CO, SS directed the work, and reviewed the manuscript. Authors GKD, DA, JA, DKA,KT, PB, OSO and JA helped in data collection, analysis, interpretation. All authors read and approved the final manuscript

## Ethical Issues

Informed consent and permission was sought from the Headmaster, the staff and students of the school before the interviews. We protected the confidentiality of participants through use of codes. However, ethical committee review did not apply as this was a public health response to an outbreak. Preliminary report of the outbreak was discussed with the Headmaster and the staff of the school.

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