

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

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Authors' contributions

This work was carried out in collaboration between 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

ABSTRACT

Background: Gastroenteritis is an inflammation of the stomach and intestines. In Ghana the incidence is about 5.8 million annually. On the 28th 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, active case-search and a retrospective cohort-study. A case-patient was a student presenting with abdominal cramps, diarrhea and or vomiting from 28th of October to 2nd of November in the SHS. We interviewed students and reviewed medical records. Stool

from case-patients and water samples were taken 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 28th and case-patients peaked (16/101) 24hours later. The mean age of case-patients was 17 years (± 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, education on food safety and personal hygiene were initiated based on our recommendations and these contained the outbreak.

Keywords: Food-borne, gastroenteritis, outbreak, *Aeromonas spp.*, *Eschericia coli*, Akwapim North District, Ghana

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67 1. INTRODUCTION

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

71 It is estimated that three to five billion cases of gastroenteritis occur globally on an annual basis [Elliot,
72 2007]. Primarily, affecting children and those in the developing world [Webber, 2009]. It resulted in
73 about 1.3 million deaths in children less than five as of 2008, with most of these occurring in the world's
74 poorest nations [Mandell, 2010]. Gastroenteritis is an inflammation of the stomach and intestines. In
75 Ghana the incidence is about 5.8 million annually [GHS, 2010]

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

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86 2. MATERIALS AND METHODS

87 2.1 Descriptive Epidemiology

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

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2.2 Laboratory Investigations

Eighteen stool samples were taken from case-patients and sent to the Regional Hospital Laboratory, Koforidua, for a laboratory diagnosis. Similarly, water samples from the boreholes and storage tanks were sent to the Ghana Water Company, Kpong for analysis.

2.3 Environmental Survey

We inspected the school compound for different sources of water used for drinking, cooking and domestic purposes and 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 landmarks of the school were taken with a GPS Receiver to construct a spot map.

2.4 Analytical Epidemiology

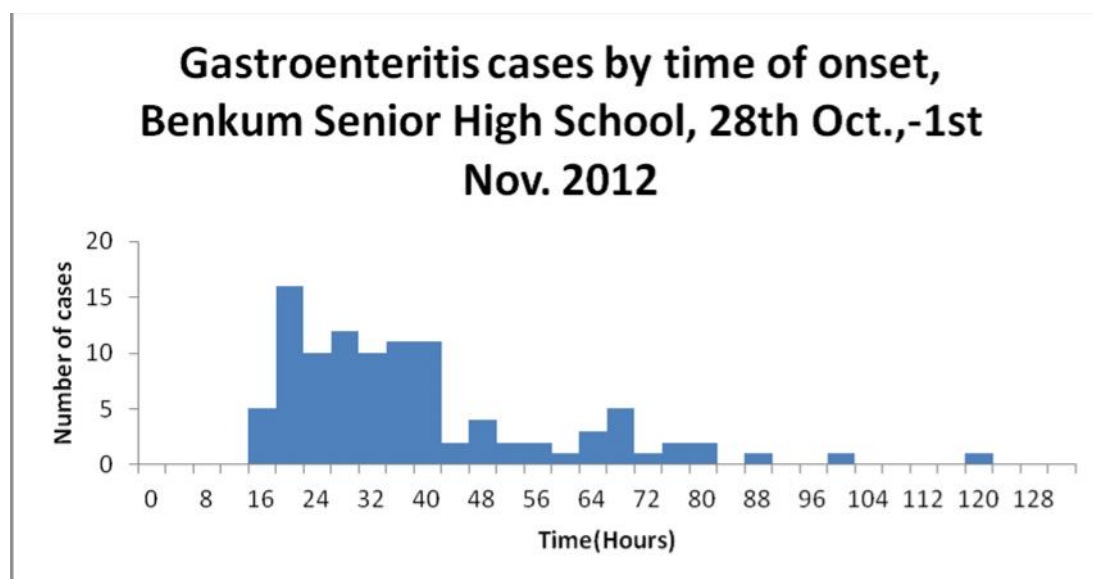
Review of the descriptive epidemiological findings led us to suspect that the illness was associated with a) Eating food either from the schools kitchen, canteen or the various food vendors at the dormitory. b) Drinking water from the bore-hole. To test these hypotheses, we conducted a retrospective 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 (± 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 28th and case-patients peaked (16/101) 24hours later.

135 **Figure: 1**



136
 137 The outbreak was a point source (Figure 1).The onset of the diarrhoea started around 16 hours of the 28th
 138 of October and peaked between 16 to 24 hours of the same day. It then plateaued on the second day.
 139 The number of cases reduced drastically from 40 hours of onset until 80 hours. Afterwards very few cases
 140 were seen between the third and fourth day ie 88 to 120 hours of onset.

141 **3.2 Laboratory Investigations**

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 143 Out of the 15 samples tested on the 2nd of November, 2012, only one showed growth for *Aeromonas spp.*
 144 All the others were free from pathogens. Preliminary results from the Ghana Water Company indicated
 145 faecal contamination of the school's bore-hole water. *Aeromonas spp* and *Eschericia coli* were isolated
 146 from stool and water samples. Most of the students shared a common place of convenience with their
 147 colleagues. The likely mode of transmission is faeco-oral.

148 **3.3 Environmental Investigations**

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

155 **3.4 Analytical Epidemiology**

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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
Dining Hall								
<i>White porridge and bread</i>	40	478	8.4	114	773	14.7	0.57	0.40-0.80
<i>Waakye, shito and fish</i>	72	698	10.3	82	553	14.8	0.67	0.50-9.0
<i>Kenkey and Pepper with fish</i>	87	605	14.4	67	646	10.4	1.39	1.03-1.87
Black Market								
<i>Waakye</i>	68	252	27.0	86	999	8.6	3.13	2.35-4.17
<i>Banku</i>	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
Girls' Dormitory								
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
Boys' Dormitory								
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								
<i>Borehole water</i>	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 (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 causing individual infections as well as outbreaks in the developed countries has been identified [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

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* (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 *Eschericia coli* contaminated-bore hole water was the most likely cause of this point-source outbreak. Chlorination of the boreholes water, education on food safety and personal hygiene were initiated based on our recommendations and these contained the outbreak.

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Conflict of interest: None declared

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