Epidemiology of Acute Watery Diarrhea Outbreak and Challenges of Control—Afar, Ethiopia, 2009

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Abstract

Acute watery diarrhea (AWD) is becoming a big problem in Ethiopia. The aim was to rapidly investigate the outbreak epidemiologically and guiding response activities in the affected districts of Afar from April-June 2009. A line list and case register of districts were reviewed as per the world health organization case definition. 31 cases and 23 controls were interviewed with a structured questionnaire. Observation of case treatment centers and investor camps was made using checklist. Stool and drinking water samples were also collected, transported and examined as per standard microbiologic procedures. Then analysis was done using EPI Info version 3.5.1. A total of 1,076 cases and 48 deaths were reviewed with an attack rate of 0.9% and case fatality rates of 4.4%. The majority [87.8% (945)] of cases were males. Hand washing after latrine usage (OR = 0.13, p= 0.03), unsanitary latrine (OR = 10.5, P-value= 0.001), contact with a case (OR = 200, P-value= 0.001) and visiting a place which has similar illness (OR=33.6, P=0.001) shown statistically significant association. Vibrio cholera 01 serotype Inaba and Escherichia coli were isolated from 89 % (9) of stool and 100 % (4) of drinking water samples respectively. V. cholera 01 serotype Inaba was confirmed as etiologic agent in all districts. Therefore, provision of safe drinking water supply and raising community awareness about hygienic practices to control diarrhoeal disease is necessary.

Key words: Acute watery diarrhea, Vibrio cholera, Afar, Ethiopia.

INTRODUCTION

Cholera is a diarrheal disease caused by infection of the intestine with the bacterium Vibrio cholerae, either type O1 or O139; usually transmitted through faecally contaminated water or food and remains an ever-present risk in many countries (WHO, 2004). It becomes also a global threat to public health and a key indicator of lack of social development. In 2008 alone, a total of 190, 130 cases were notified from 56 countries, including 5143 deaths. Many more cases were unaccounted for due to limitations in surveillance systems and fear of trade and travel sanctions. The true burden of the disease is estimated to be 3–5 million cases and 100 000–120 000 deaths annually (http://www.who.int/mediacentre/factsheets/fs107/en/-accessed on 18-08-2010). In 2007, 62% (110,837) of the global burden of cholera cases notified to WHO were from African Region which resulted in huge economic loss with millions of US$ in different life expectancies (Kirigia et al., 2009).

In Ethiopia it was indicated that, there was acute watery diarrhea (AWD) epidemic in 1990 which persisted with recrudescence of cases till 1998 (Scrascia et al., 2008). Moreover, from July 2008 to June 2009 in Ethiopia, there were a total of 9485 cases and 193 deaths (with case-fatality rate 2.0%) of acute watery diarrhea in six regions including Addis Ababa. Afar region took the country’s highest share of cases [2,988(31.5%)] and deaths [99(51.25%)] of AWD with a case fatality rate of 3.3% (FDRE-MOH, 2009).

Afar National Regional State is one of the nine regional states of Ethiopia, according to the report of 2007 population and housing census the total population of the region was 1,411,092 out of which 55.7% were males and 44.3% were females (FDRE-MOH, 2009), with 92.2% of population living in rural and 7.8% living...
in urban areas (MOH-PPS, 2003).

During 2006-2009, 8109 cases and 194 deaths of AWD were reported from three districts of Afar with a total case fatality rate of 2.4%. From these districts Burimedayto and Gewane reported cases of AWD only in 2007, but Amibara reported AWD in every four consecutive years.

On last week of May the Afar Regional health bureau requested the Federal Ministry of Health’s Public Health Emergency Management (FMOH-PHEM) for assistance with investigation of an increased number of AWD cases. On June 06, 2009 a team from FMOH-PHEM which includes field epidemiology residents, prepared for field visit and deployed to Afar. The aim of this investigation was to determine the cause for the increased number of cases, characterize the epidemiology of the disease that occurred from April – June 2009 and guide the intervention measures in three districts of Afar.

MATERIALS AND METHODS

Study area and population

The outbreak investigation was conducted in three districts of Zone 3, Afar Regional State. The population was 63280, 31786 and 31313 in Amibara, Burimedayto and Gewane respectively. Many migrant laborers (around ten thousand; specific list couldn’t be discovered) were working for 11 companies (number of companies in Amibara were also not included) which engaged in cotton production. There were also charcoal producers who came from other regions of the country especially from Wolyta Zone of Southern Nations, Nationalities and Peoples Region (SNNPR).

Study design and Sampling

We reviewed case register log books and morbidity and mortality report forms from May 7 to June 16 2009 in district health offices and health facilities. An unmatched case-control study was also conducted on 31 cases and 23 controls. Sampling for the case control group was proportional to the intensity of occurrence of disease within the three districts. Choosing unmatched type of study and reaching to the indicated size of controls and cases is just for simplicity issue. However defined criteria were used for including controls and cases in to the study (see case-control group).

Data collection

Secondary data: Line-lists of acute watery diarrhea cases were collected from all three district health offices. We also reviewed health facilities’ case log book and checked with district health offices’ data to verify whether recorded AWD cases were consistent with the WHO case definition. Line lists contain variables such as date of onset of illness, age, sex, district and kebele (village) name, disease outcome.

Case-control group: We developed a structured questionnaire to interview cases and controls. Cases were identified using the WHO case definition and controls were recruited among neighbors or family member of cases who did not report clinical symptoms consistent with AWD in the previous two weeks.

Case definition: The working case definition, “a patient aged 5 years or more which develops acute watery diarrhea, with or without vomiting”, was used to identify cases of AWD. This definition bases the WHO standard case definition of cholera in epidemics (WHO, 2004).

Observation and intervention methods

The national assessment tool (checklist) for AWD, which is based the WHO guideline (WHO, 2004), was used to collect data during observation of case treatment centers in health facilities, investor camps, and discussion with districts’ epidemic teams.

After conducting brief discussion with respected districts administrative and health officials, the team engaged in activating the districts epidemic response task force to participate in active case detection and educating the community to control the epidemic. The team also accomplished activities like reporting daily cases and deaths, supportive supervision in case treatment centers (CTCs) on case management, communicated with Afar Regional Health Bureau and UNICEF in order to transmit messages of prevention methods through media by Afar language and gave advice for farm owners on how to control the epidemics and take care of their daily laborers.

Water and Stool sample collection

We collected nine stool samples from cases (which is enough for epidemic situations (WHO, 2004)) and four drinking water samples from river source which served for the community. The cold chain was maintained during transportation of samples to the Ethiopian Health and Nutrition Research Institute microbiology laboratory for analysis. We also used Cary-Blair transport medium for stool samples (CDCP, 1990; WHO, 2003).

Culture and identification

All samples were initially cultured on Thiosulphate Citrate Bile Salt Sucrose (TCBS) and Xylose Lysine Desoxycholate agar (XLD) (Oxoid, UK). After 18-24hrs growth of distinct colonies were identified, sub-cultured on non selective media and re-incubated for 18-24 hrs.
Subsequent biochemical testing was done on Pink red colonies from XLD. The confirmation of Vibrio cholera was done by oxidase test and agglutination with polyvalent antiserum. Sero-typing was made using Monovalent antisera (WHO, 2003).

Antibiotic sensitivity testing of V. cholera isolates was also done on Muller Hinton agar by the Kirby and Bauer disc diffusion method (Bauer et al., 1966; NCCLS, 1993).

Bacteriological water quality was analyzed using multiple tube method in MacConkey broth following standardized microbiological procedures at Ethiopian health and nutrition research institute (EHNRI) (ANON, 1985).

**Data quality and analysis**

Secondary data was compiled manually using a new line list from the log book and line lists of the health facilities and district health offices. Then all data transcribed electronically to Excel file and checked for quality. Data entry for the case control group, importing the secondary data from Excel file and univariate analysis was made using EPI Info version 3.5.1. We considered also the fisher exact test when less than five cases or controls appear in the two by two table distribution.

**Ethical issue**

The outbreak investigation was done after the approval of the Ethiopian Federal Ministry of Health / Public Health Emergency and the districts of Gewane, Burimedayto and Amibara in Afar region. Verbal consent was also secured from study participants.

**RESULTS**

A total of 1076 cases and 48 deaths were registered during April 29 to May 16, 2009 in the three districts of Afar with an attack rate (AR) and case fatality rate (CFR) of 0.85% and 4.4% respectively. Among cases, 945 (87.8%) were males and 561(52.1%) were in the age median of 15-44 years old (15-44 years old was also the median interval age).

In Gewane district, the onset date of the first cases was recorded on April 29, 2009. From this district, 639 cases and 24 deaths were reviewed with a case fatality rate of 3.7%. Males and the age category 15-44 years old constituted 531 (83.2%) and 499 (78.3%) of the cases respectively. The highest proportion of cases [178 (28.0 %)] and deaths [6 (26%)] was seen in Gediadda village followed by Briforo with 125 (19.7 %) cases and 6 (26%) deaths.

In Burimedayto district the onset date of the first case was on 3rd of May, 2009. From this date to 15th of June 2009, 329 cases and 22 deaths were reviewed from the district health office and health facility registry which gave a case fatality rate of 6.7%. Similar to Gewane district most of the cases [304 (92.7 %)] were males and 127 (38.80%) of the cases were in the age range of 19-24 yrs with median of 22 years old. All 13 villages / Kebeles in the district were affected by AWD and 225 (68.6 %) of the cases were from Debel village followed by Fiaeto [60(18.3 %)].

In Amibara district, a total of 108 cases and 2 deaths (CFR, 1.9 %) were occurred from 13th -16th of June 2009. Only daily workers employed in a private cotton plantation farm which is found in Sheleko village were affected. All were males with age range of 15-44 years old. No report from the district health office or health facility was reviewed for any other village.

From a total of 24 villages affected in three districts the highest proportions of cases were reported from Debel (21 %), Gediadda (16.6%), Briforo (11.7%), and Sheleko (10.2%) villages (Table 1).

**Questionnaire based interviewed study group**

From 31 cases and 23 controls (without symptoms of the disease), 85.5% were males and the median age was 20 years old.

Twenty five (80.6 %) of the cases and 13 (56.5 %) of the controls were daily workers. Daily workers were also constitute 69.1% from the total respondents (cases and controls) followed by pastoralists (local community), which were 20% (Figure 1).

Eighteen (58%) of cases and 22 (91.6 %) of controls used drinking water from river; out of which only 4/31 (12.9 %) cases and 8/23 (34.7 %) of controls used treated water. From the case-control study subjects, 15 (48.3 %) respond for having access to latrine and from these 20 (64.5%) of them used latrine always. Only four (13.0 %) of respondents ate/drink in another’s home/restaurant. Twenty nine (93.5%) of the respondents wash their hands before having any meal/preparing food and 83.3 % practice hand washing after latrine usage.

Hand washing after latrine usage was protective of illness (crude OR = 0.13, p= 0.03), access to latrine (unsanitary latrine) [OR = 10.5, P-value= 0.001], contact with a case (OR = 200, P-value= 0.001) and visiting a place which has similar illness (OR=33.6, P=0.001) had shown statistically significant association with being a case. Whereas, shortage of water supply (OR=1.9, CI=.05-6.25, P=021), washing hands with soap/detergent before having meal and preparing food (OR=0.65, CI= 0.05-7.74, P=0.61) and eating /drinking in another’s home in a week before your illness (OR=0.48, CI= 0.09-2.41, P= 0.3) could show statistically significant association (Table 2).

Regarding to treatment, 17 (54.8%) of the patients treated with antibiotics, intravenous (IV) fluid and oral rehydration salt (ORS) whereas 10 (32.3 %) of them get
Table 1. Distribution of cases of AWD by villages/Kebeles, in three districts of Afar, Ethiopia

<table>
<thead>
<tr>
<th>Ser. No.</th>
<th>Address</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Amasabura</td>
<td>33</td>
</tr>
<tr>
<td>2</td>
<td>Bedula</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Beida</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Berimedayto</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Briforo</td>
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</tr>
<tr>
<td>6</td>
<td>Burka</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Danglafia</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Debel</td>
<td>225</td>
</tr>
<tr>
<td>9</td>
<td>Degita</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Fiaeto</td>
<td>58</td>
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<tr>
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<td>Geliabora</td>
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<tr>
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<td>Gewane</td>
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<td>14</td>
<td>Hengoyuo</td>
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</tr>
<tr>
<td>15</td>
<td>Kodae</td>
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<td>Leras</td>
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<td>Urafita</td>
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<tr>
<td>24</td>
<td>Yigil</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1076</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

Figure 1. Distribution of cases and controls (combined, n=54) by occupation in three districts of Afar, 2009
only IV fluid. 24/31 (78.1 %) of cases had vomiting and 25/31 (80.6 %) had more than 3 episodes of diarrhea within 24 hours. Of which 8/31 (25.8%) had seven episodes within 24 hours and only 3/31 (9.6 %) of cases had fever.

Observation for farm camps situation

The team observed the daily workers hygiene and sanitation condition in all 11 investor camps and there were no latrines or safe drinking water sources for daily workers. Water was fetched directly from river Awash. They live in overcrowded (about 60 persons per room) conditions, with shared drinking and eating utensils (1 utensil for more than 50 individuals), inadequate /no provision of medical supplies, and except for one investor camp (in Amibara) all others have no clinic and health worker to provide treatment and health education activities.

Observation for local community situation

The team visited and observed different villages in the districts; similar to the investor camps, the local communities which reside in villages (rural) without access to safe drinking water (see photo June 16 2009 (Photo 1) and latrines.

Health extension workers and other health professionals are scarce, and there were inadequate medical supplies and other resources (hygienic materials, water treatment kits, etc). The team found also that awareness of the rural community to personal hygiene, to the causes and prevention of diarrheal disease was low.

Laboratory confirmation

Vibrio cholera 01 serotype Inaba was isolated from eight of the nine stool samples which were collected from three districts. All Vibrio cholera 01 Serotype Inaba isolates were sensitive to ciprofloxacin, doxycyclin, tetracycline, erythromycin, amoxicillin, and chloramphincinol. However, all isolates were resistant to co-trimoxazole. No other enteric pathogenic bacteria were isolated from stool samples.

Escherichia coli type I and other faecal coliform bacteria were also isolated from all four water samples collected from the canals that residents and daily laborers in Farm Companies were being used for drinking and other home purposes.

DISCUSSION

The onset date of the first case was on April 29th in Gewane, on May 3rd in Burimedayo, and June 13th in Amibara. The rapid spread from Gewane to Burimedayo was likely due to the proximity and frequent movement of residents and daily laborers from one village to the other. The outbreak in Amibara started late on 13th of June 2009, stopped after a week and had low CFR (1.9%). Amibara is 70 Km from Burimedayo and 100 km from Gewane. So there could be less frequent contact with cases from the two adjacent districts. In addition, workers have access to health care services from their
own company which may have reduced the magnitude and severity of the outbreak. The high case fatality rate (CFR) in Burimedayto could be weak hygiene sanitation condition and intervention in farm camps, inaccessibility to health facility and prolonged outbreak.

The overall attack rate (AR) and case fatality rate (CFR) was 0.9% and 4.4 % respectively (total districts' population for AR and total cases for CRF were taken as denominator); which is almost similar with the cholera outbreak in Kampala-Uganda and Tanzania (Bauer et al., 1966; NCCLS, 1993). Age and sex specific attack rate and case fatality rate could not be calculated due to lack of estimate population and uniformity in data compilation system in the districts. The CFR was high as compared to the WHO guideline; which was supposed to be less than 1 % (WHO, 2004). This could be less attention given to employees working in the investor farms, shortage of medical supplies and poor case management in case treatment centers (CTCs). However when we compare with outbreaks occurred in other African countries, such as in Nigeria 6.1% (similar serotype isolated like in our outbreak investigation (ANON, 1985), 5.1% in Lusaka (14), 4% in Kenya (Acosta et al., 2001), and 3% in Burundi (Yvan et al., 2003) ours case fatality rate became median value. Unreported and unregistered cases and deaths especially in the 11 villages/kebeles of Burimedayto district might underestimate the total number of cases as well as the case fatality rate.

In all districts most of the cases were males and daily laborers employed in the farm companies (cotton plantations). This could be due to overcrowding compared to the much dispersed local community and which in fact the farms employed males as daily laborers.

The highest numbers of cases (21 %, 16.6% and 11.7% respectively) were occurred in Debel, Geliadura, and Sheleko villages (Table 1). This might also be due to the high number of daily laborers residing in these villages/kebeles and the prolonged duration of the epidemic which took more than one and half month. The Epi-curve has many peaks (Figure 2) which showed a progressive person to person transmission, this could be due to the absence of health infrastructure in the investor companies and weak response activity of the districts epidemic task force. Risk factors like hand washing after latrine usage, drinking treated water, access to latrine (unsanitary latrines) and contact to a case and visiting someone with similar illness had shown statistically significant association with AWD in univariate analysis. But shortage of Water supply, washing hands with soap/detergent before having meal and preparing food and eating/drinking in another’s home were not significantly associated (Table 2).

**Challenges during intervention and limitations of the study**

We found difficult to gather persons who came from other regions to the study areas primarily engaged for wooden charcoal production to provide health education about the disease. Eleven villages in Burimedayto district were inaccessible for vehicle transport because of Awash River during the investigation period. The epidemic response task force of Gewane district couldn't
also involve full time for the intervention of AWD because of other priorities like resolving dispute among clans.

It was difficult to undertake probability matched case-control study and interview more subjects during rapid epidemic investigation in a dispersed population. The team also reached late in the area and couldn’t spend much time on investigation of the outbreak rather engaged in the intervention activity.

In conclusion, in this outbreak the overall case fatality rate (4.4 %) was higher than the WHO’s recommendation. *Vibrio cholera* 01 serotype inaba was responsible for the acute watery diarrhea outbreak in all three districts. Isolated organisms like *Escherichia coli* Type I and other faecal coliform bacteria from drinking water sources could also support the cause for the situation in the area. Drinking untreated water, close contact with a case, unhygienic latrine and not practicing hand washing were the possible risk factors for the outbreak. The hygiene and sanitation condition in the farm camps was found worst and the response was also weak in districts which could resulted in increased number of cases and prolonged duration of an outbreak.

So, government and non government organizations at all levels should work on AWD and other diarrheal diseases prevention and control activities such as strict monitoring of hygiene and availability of safe water for daily workers in the investor companies and in the local community. Furthermore, early investigation and strong rapid response is indispensable to control further spread and not to encounter extended outbreaks.

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