

ORIGINAL ARTICLE

INVESTIGATION OF DYSENTERY OUTBREAK AND ITS CAUSES, JIMMA CITY, SOUTHWEST ETHIOPIA

Fessehaye Alemseged¹, MD, MPH, Alemshet Yami², MD, Wondwossen Birke³, MSc, Zewdineh S/Mariam⁴, MSc, Kenate Worku⁵, MSc

ABSTRACT

BACKGROUND: The occurrence of bloody diarrhoea in Ethiopia is wide spread and is also associated with occurrence outbreaks. On 12th December 2008, several cases of bloody diarrhoea visited Jimma University Specialized Hospital (JUSH) and private clinics in the city. Investigation team comprising of professionals from different disciplines came together to confirm, control and prevent further spread of suspected dysentery epidemic.

METHODS: A data collection format containing address, demographic variables, risk factors and laboratory findings was prepared and distributed to all health facilities in Jimma City. Stool samples were collected from suspected cases and cultured to identify the causative organism and determine its antimicrobial susceptibility. Inspection of facilities and collection of water samples for bacteriological analyses was done from the suspected sources of the epidemic. The data was analyzed using SPSS version 12 and the result was presented in tables and figures.

RESULT: A total of 566 cases were seen in different health facilities in Jimma City in a period 29 days. Two hundred ninety nine (52.8%) of the cases were students from Jimma University and 56 (11.7%) were residents of Kefitegna 3. *Shigella flexneri* was identified from some of the stool specimens investigated. There was a sudden increase in the number of cases starting from Dec 9, 2008 with a peak (161 cases) on Dec 12, 2008. The epidemic curve then fell down slowly with one small peak during the decline. Three hundred forty four (60.8%) of the cases reported, consumption of products of Mars Foods processing plant.

CONCLUSION: There was an epidemic of dysentery in Jimma City from December 12 to 22, 2008 due to *Shigella flexneri*. The most likely common source of the epidemic was contamination of food at Mars food factory. Therefore, screening of food handlers need to be conducted in a regular manner.

KEY WORDS: *Shigella*, Outbreak, Jimma City, Southwest Ethiopia.

INTRODUCTION

Bloody diarrhea is usually a sign of invasive enteric infection that carries a substantial risk of serious morbidity and mortality especially in children in developing countries (1). Causes of bloody diarrhoea include *Shigella*, *Escherichia coli* (*E. coli*), nontyphoidal salmonella, *Campylobacter jejuni* and *E. histolytica* (2, 3). Bloody diarrhea is wide spread globally and occurs in outbreaks. *Shigella* is the most common cause of outbreak of bloody diarrhea worldwide affecting up to 30% of the population and case fatality rate up to 50% (2, 3, 4).

Shigellosis is a major public health problem in developing countries including Ethiopia (1, 2). The global estimates indicated that shigellosis affects 164.7 million under fives, 99% in developing countries with 1.1 million deaths annually (2-4). Shigellosis, caused by *Shigella* species, may occur as a self-limiting illness with watery diarrhoea but often episodes of acute fulminating bloody dysentery lead to high case fatality rates (3). The genus *Shigella* includes *S. dysenteriae*, *S. flexneri*, *S. boydii* and *S. sonnei*, also designated as A, B, C and D, respectively. The first three species include multiple serotypes. *S. sonnei* and *S. boydii* usually cause relatively mild illness in which diarrhoea

may be watery or bloody. Among the four species, *Shigella dysenteriae* type 1 (Sd1) is the most common in developing countries and may occur in large regional epidemics. *S. flexneri* is also the chief cause of endemic shigellosis in developing countries including Ethiopia (1, 4, 5).

In the near past decades major outbreaks have occurred in Africa, South Asia and Central America. Between 1993 and 1995, outbreaks were reported in several central and southern African countries. In 1994, an explosive outbreak among Rwandan refugees in Zaire caused approximately 20,000 deaths during the first month alone. Between 1999 and 2003, outbreaks were reported in Sierra Leone, Liberia, Guinea, Senegal, Angola, the Central African Republic and the Democratic Republic of Congo. In 2000, outbreaks of bloody diarrhoea due to Sd1 that were resistant to fluoroquinolones occurred in India and Bangladesh (4, 6). In Central America, between 1986 and 1988, there was a dramatic increase in the number of cases and deaths of shigellosis (7).

Foods are most commonly contaminated with *Shigella* by an infected food handler who practices poor personal hygiene. More over, due to low numbers of bacteria (10-100) required to cause illness, the transmission of infection can occur through inadequate

¹Department of Epidemiology, Jimma University,

²Department of Internal Medicine, Jimma University

⁴School of Environmental health, Jimma University

⁵Student Dean Office, Jimma University

hand washing after defecation or nappy changing, fecal contamination of nappy changing surfaces and fomites, or from person-to-person directly via the fecal-oral route. People living in poor, overcrowded urban communities with poor sanitation and hygiene have the greatest risk of developing shigellosis (3, 4, 8, 9).

In Ethiopia, as in other developing countries adequate and reliable information on foodborne diseases, including shigellosis are lacking. In urban centres of Ethiopia, the situation is quite complex and opportunities for food contamination and foodborne illnesses are very high because of the high density of population, scarcity of safe and adequate water and grossly inadequate sanitary means of safe waste disposal (5). Despite the risk, epidemiological studies regarding shigellosis are rare in Ethiopia in general and none for Jimma City. This is a report of an experience on investigation, management and control of out break of bloody diarrhoea in Jimma City, Ethiopia.

The Scenario

On 12th December 2008, several cases of bloody diarrhoea visited Jimma University Specialized Teaching Hospital (JUSH) and private clinics in the city. Most of the cases were students from the two campuses of Jimma University. The situation was communicated by the hospital health personnel to Jimma university higher officials promptly. Following the notification, the University president established a team composed of various professionals to investigate the suspected bloody diarrhoea outbreak. The team comprised of an Epidemiologist, an Internist, Environmental Health Expert, Microbiologist and Student Dean.

The team in collaboration with Jimma University Health Education Department, Team training programme (TTP) students from Jimma Training Health Centre and MPH epidemiology speciality students and professionals from Jimma City Health Bureau started the investigation after setting objectives. The objectives of undertaking the investigation were confirming presence of an outbreak, identify the causative organism and determine its antimicrobial susceptibility, identify source of the epidemic, assess the extent of the outbreak in terms of the population affected and geographic spread, identify contributing factors for the spread of the epidemic and design control and preventive strategy.

METHODS AND MATERIALS

A variety of methods were used to achieve the stated investigation objectives.

A format containing address, demographic variables, risk factors and laboratory findings was prepared and distributed to all health facilities in Jimma City to collect data from suspected individuals. The collected data were used to describe the attack by time, place and person.

Hypothesis was developed regarding the possible common sources of the outbreak based on analysis of preliminary data and review of literatures to identify

source and contributing factors. The hypothesized common sources for the epidemic were contaminated food source from Mars Food Factory and contaminated water source. Further investigation using interview, laboratory investigation, environmental inspections and bacteriological analysis of water were carried out to identify the exact source. Interview was made to the head of and workers of the Gibe branch of Mars food processing plant and seven sick individuals in the City.

Stool laboratory investigation was done on JU main campus students with bloody diarrhoea, Mars Food Factory food handlers and JU students' cafeteria food handlers. Stool specimen was collected using sterile cup and transported to Jimma University Microbiology Department within 30 minutes for analysis. Microscopic examinations, culture and sensitivity tests were done on collected samples. For isolation of *Shigella* species, stool samples were inoculated into the MacConkey agar and the characteristic colonies were identified by standard biochemical methods-Inoculation of Kligler iron agar [KIA] (9).

Using the Hazard Analysis Critical Control Point (HACCP) approach suggested by Bryan (10) inspection of Mars Food Premises (both the processing units and retail shops in the City) was undertaken to assess the factors that contributed to the outbreak. Areas of inspection included facilities in which food is processed, prepared, transported and stored; food establishment workers; equipments on which foods are processed and prepared; the operations, practices, procedures or processes to which foods are exposed; sanitary facilities, and washing and sanitizing activities. Toilets in student clinics of both campuses were also inspected for their sanitary status. The inspections were conducted by Environmental Health Sciences trainees attaching Team Training Program at Jimma Health Centre.

Water samples were collected for bacteriological analysis using standard water sampling procedure. Samples were taken from 2 sites of Mars food factory (Gibe and Ginjo branch), main water treatment plant of Jimma City (Boye), agriculture college Cafeteria, Main campus 'Zegeye' cafeteria, military camp, and from prison (both from pipeline and spring water). Water quality assessment was also complemented with sanitary inspections of the treatment plant. The analysis was done in the Environmental Health Sciences Laboratory of JU using standard technique to identify indicator organism and see its compliance with the national and WHO standards (11).

Based on the preliminary findings which indicated that majority of the cases were JU students, survey of some water and toilet facilities in the main campus of the university was done to evaluate for contributing factors to the epidemic. Interview was held with key informants from students, students' dean office and student clinic and observation of toilet facilities at student clinics was made.

A suspected case was defined as a recorded diagnosis of shigellosis by physician or nurse and for whom stool culture was not done.

And confirmed cases as suspected cases whose stool culture was positive for *Shigella* species.

Asymptomatic individuals whose stool culture was positive for *Shigella* species were labeled as carriers.

RESULTS

A total of 566 cases of bloody diarrhea were seen in different health facilities in Jimma City in a period 29 days. This is higher than the usual number of cases evidencing an outbreak.

Shigella species were isolated from three of the five stool specimens taken from JU main campus students with bloody diarrhea. Serotype identification revealed *Shigella flexneri* which was sensitive to Cotrimoxazole, floxacine, Amoxicillin, Ampicillin,

ceftraxione, Nalidixic acid, Tetracycline, chloramphenicol, Gentamycine and Ciprofloxacin.

Of the total cases, 128(22.6%) were seen in Jimma University College of Agriculture and Veterinary Medicine student's clinic, 92(16.3%) in JUSH and 79(14%) in main campus student's clinic.

Three hundred fifty five (62.7%) of the cases were in the age group 20-29 years and 438 (77.4%) males. One hundred twenty two (21.6%) and 344 (60.8%) of the cases had history of contact with person having similar illness and had consumed food prepared by MARS food factory, respectively (Table 1).

Of 477(84.3%) cases whom residential area was recorded, 171(35.8%) were students from JU main campus, 128(26.8%) students of from JUCAVM and 56(11.7%) residents of Kefitegna 3 (Fig 1). Of those cases outside the university campus, address was recorded only for 112(20%) and out of which majority accounting for 34(30.4%) were from Kebele 7.

Table 1. Personal profiles of suspected cases of dysentery who visited health facilities in Jimma City from Dec 12-22, 2008.

Variables	Number	Percent
Age group		
≤9	28	4.9
10-19	101	17.8
20-29	355	62.7
30-39	46	8.1
≥40	34	6.0
Sex		
Female	128	22.6
Male	438	77.4
Outcome of treatment		
alive	332	58.7
unknown	234	41.3
History of contact		
Yes	122	21.6
No	342	60.4
Not recorded	102	18.0
Consumption of food prepared by MARS food factory		
Yes	344	60.8
No	142	25.1
Not recorded	80	14.1

Large number of suspected cases started visiting the health facilities in Jimma City on December 12 2008. Only one patient had onset of symptoms before December 9, 2008. The epidemic curve indicated sudden increase in the number of cases starting from Dec 9, 2008 onwards and the number of cases peaked (161cases) on Dec 12, 2008. The curve fell down slowly with one small shoulder during decline (Fig 2).

Majority of the suspected cases (52.8%) visiting health facilities in Jimma City from

December 12, 2008 to December 22, 2008 were students of JU. On further investigation it was recognized that the food (Injera and bread) served to students came from Mars food factory and the factory has a food selling sites in Kebele 7 of the City.

Among those cases for whom contact history was recorded, a quarter (26.3%) had contact history with similar case and among those for whom history of food prepared by Mars food factory was recorded most (70.8%) had consumed the food (Table 1).

Interview with the head and workers of the Gibe branch of Mars food factory revealed the presence of four individuals with bloody diarrhoea. On interview of seven sick individuals in the City, five replied that they

ate bread and two ate 'Injera' bought from Mars a day before the onset of their illnesses and all of them used pipe water for drinking.

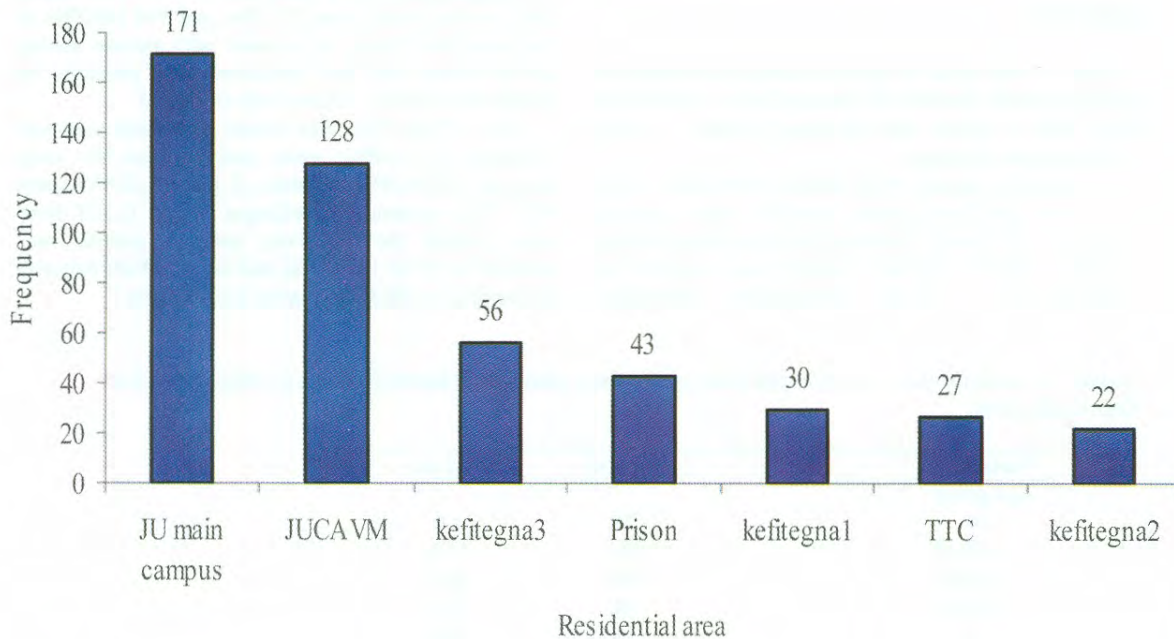


Figure 1: The residential area of suspected dysentery cases who visited health facilities in Jimma city from Dec. 12-22, 2008.

Of the cases managed in health facilities from Dec 7, 2008 to Dec 20, 2008, 255 (45.1%) had given stool specimen. The main findings on stool microscopy were red blood cells (RBCs) with or without white

blood cells (WBCs)/pus cells in 56.2% and WBCs/pus cells only in 29.4% of the samples (Fig 3).

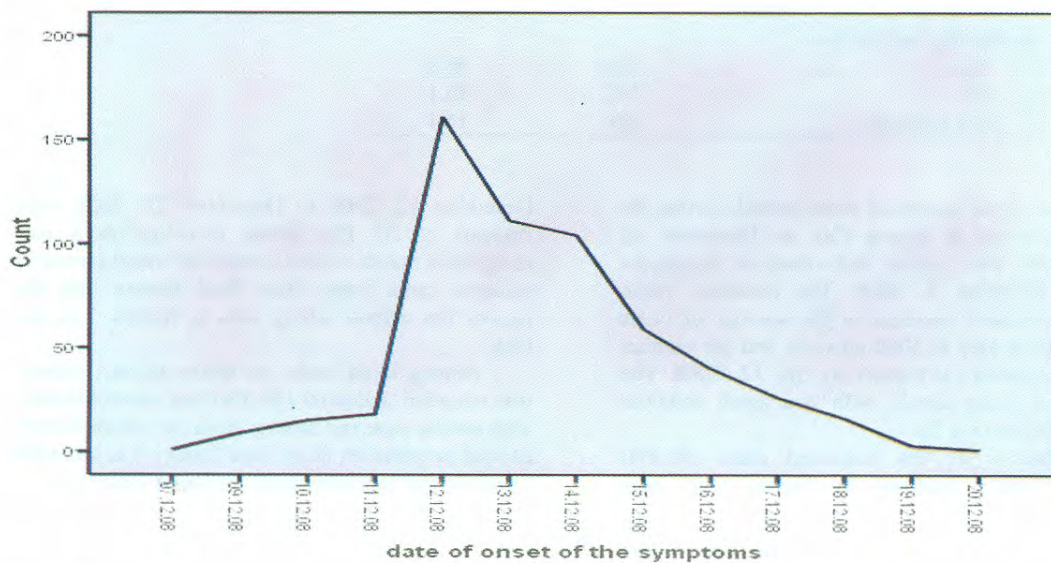


Figure 2. Date of the onset of symptoms of the disease in suspected cases of dysentery who visited health facilities in Jimma town from Dec 12-22, 2008, Jimma City.

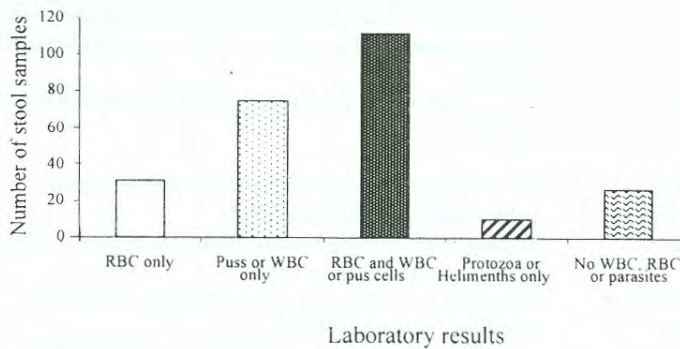


Figure 3. Laboratory results from stool of cases seen at health facilities, December 12-22, 2008, Jimma City.

From a total of 105 food handlers in Mars food factory from whom stool specimens were taken, 6 were infected with of *Shigella flexneri*, 10 were suspected cases, 18 unknown status, 70 non-cases and 1 was found to harbour *salmonella* species.

Shigella flexneri was identified from all the six confirmed cases of shigellosis. The stool samples taken of all of the 45 food handlers in JU main campus showed no growth (Table 2).

Table 2. Laboratory investigation results of stool samples taken from Mars food factory and JU cafeteria workers. Dec 2008.

Laboratory investigation	Results	Number	
		Mars food factory	JU cafeteria workers
Stool microscopy for RBC and WBC n=105	Positive	10	-
	Negative	95	-
Stool culture results among those with negative RBC and WBC results n=77	<i>Shigella flexneri</i>	6	0
	<i>Salmonella spp</i>	1	0
	No growth	70	45

Inspection of Mars food factory and some of its distributing shops revealed poor sanitary conditions (Table 3).

In the bacteriological analysis of water, *E. coli* was detected in the samples from JU Agriculture campus pipe water, Prison pipe and spring water and army tank water. The higher count (9 per 100ml) was observed in prison pipe water.

Interview with students of JU, students deans' office and student's clinic revealed that there is shortage of water supply and unsanitary toilet facilities around student dormitories.

Toilet inspection of student clinic in both campuses showed absence of hand washing basin and flush water, and unclean toilet which is full of debris and used tissue papers. Besides, the numbers of toilet rooms were very few to accommodate the clinic visiting students.

Table 3. Inspection findings of Mars Food Factory, Jimma, December 2008.

Items investigated	Components	Findings
Kitchens	Floor	The kitchen floor were old, rough and slippery, not easily cleaned, full of cracks and crevices and not well drained
	Walls	the kitchen walls were rough, dark coloured and not washable
	Ceilings	the kitchen ceilings were rough and dark coloured
Water supply	Doors and windows	poor ventilation and lightening
	Adequacy	shortage of running water was observed in food preparation and service rooms
Basic sanitation	Excreta and sewage disposal	inadequate, unsafe and inconveniently located toilet and hand washing facilities
	Waste disposal	Unsafe and unsanitary handling and disposal of leftover foods/garbage and rubbish and improper refuse disposal
	Cleaning	No proper washing, cleaning and sanitizing procedures Presence of unclean food contact surfaces and equipments
Food handlers	Surrounding environment	there were potential and actual fly breeding places
	Dressing	no head cover, dirty and not easily washable outer garments.
	Food preparation	Due to malfunctioning of machines dough was being prepared manually
	medical check-up and training	no medical check up was done prior to employment; during employment training was not provided by the company on safe handling of food and personal hygiene

DISCUSSION

Recognition of outbreaks of diarrheal disease requires intensified surveillance so that intervention strategies can be improvised and applied before an epidemic develops (3, 5, 8). Although, the Federal Ministry of Health (FMOH) of Ethiopia has requested that any cluster of bloody diarrhea among persons in the country be reported, outbreaks of foodborne disease including shigellosis are not commonly reported (5). So far, no major outbreaks of dysentery caused by the *Shigella* species have been documented and reported from Jimma City. Therefore, it was difficult to get any historical case data from existing disease surveillance system for this particular case in the area (3). This investigation identified 566 cases which is higher than other times. This confirmed that the situation was an epidemic. The extent of this outbreak is likely to be due to person-to-person transmission.

The etiologic agent responsible for outbreaks of bacillary dysentery in Ethiopia and other parts of the world was *Shigella dysenteriae* serotype A (2, 3, 14, 15). However, *Shigella flexneri* was the cause of the current episode. Many studies have emphasized the importance of antibiotic effectiveness test in outbreak settings to design control measures (2, 12). Hence susceptibility test was done and the organism was found to be sensitive to all ten antimicrobials unlike the

finding in Central Africa where the organism was resistant to some of these antimicrobials (16).

Though the reported cases were 566, the exact figure is likely to be higher as some cases might not have been recorded or some might not have visited health facilities. If it was not for resource limitation community survey would have given a better picture of the extent of the spread. Regarding the geographic spread, all cases visiting the health facilities came from the City only, suggesting that the epidemic is limited to the City though difficult to be sure as data is not collected from surrounding areas.

The peak occurred during the start of the epidemic which suggests that there might have been common source at the beginning. Mean while, the cases have a date of onset which ranges from Dec 9, 2008 - Dec 31, 2008, which indicates that the epidemic has lasted for more than one incubation period. This could be due to secondary person to person transmission which is favoured by crowded living condition of students.

The sharp rise of epidemic curve indicated that the outbreak is point source. The latter slow decline with small peak may be due to secondary person to person spread.

The cases were mainly JU students, Jimma Prison, and residents of Bocho Bore Kebele. Mars Foods processing plant supplies food products ('Injera' and

bread) to the university and it has a distribution site in the highly affected Kebele. Laboratory result from food handlers from Mars Foods processing plant has also showed that six food handlers were infected by the organism identified as the cause of the outbreak. This shows that majority of cases were infected from a point source, most likely Mars Foods. Poor sanitary conditions were also observed in the Mars Foods facility. Contamination of water was considered to be unlikely source of the outbreak as the growth of *E. coli* was within the safe range (11). This further strengthens the factory to be the most likely primary source of the epidemic.

The fact that *salmonella* species was found in one of the stool cultures shows there is fertile ground for future occurrence of epidemic from contamination by the carriers. *Salmonella* infection can cause bloody diarrhoea but the other evidences do not support it as the cause for the current epidemic. The identified person could be one among the asymptomatic infections which is frequent among healthy persons in developing countries (4). The fact that some of the food handlers were infested with intestinal parasites could mean that there is a possibility of transmission to susceptible consumers. These call for regular check-up and screening of the workers.

Poor sanitary conditions observed in the food preparing plant and the university clinic could have contributed to the spread of the epidemic as indicated in many previously done studies (3,4,8,9).

Intervention measures to control the epidemic were undertaken side by side with the investigation. The intervention activities included measures targeting infected individuals, mode of transmission and susceptible host which are considered to be effective (13).

Appropriate treatment order was given for all food handlers who were found to be positive with stool microscopy or stool culture. International standards for prevention and control of shigellosis recommend that food handlers infected with the organism need to be relieved from work for few days after the start of treatment (4). Accordingly, infected food handlers were given work leave for one week.

In addition, international standards recommend that in institutions infected individual need to be isolated for the period of communicability of the disease. In line with this, the investigation team made recommendation to isolate students with bloody diarrhea for a week; however it was not implemented due to unavailability of rooms for such purpose.

Considering the feco-oral route, and contaminated food and water as main mode of transmission, action including health education at all levels, communication of the situation to all government and private health institutions in Jimma City and cleaning of water source were made. The department of health education and behavioral science of Jimma University prepared the messages in Amharic and Oromiffa languages and posted at different sites. Health education messages were also broadcasted by Jimma Community Radio

and student's mini-media. One of the water tankers in the City that harbored *E. coli* was cleaned.

The investigation team concluded that there was an epidemic of dysentery in Jimma City due to *Shigella flexneri* which started around Dec 9, 2008 and lasted till the end of December 2008 and the most likely common source of the epidemic was contamination of food at Mars food factory.

The investigation team recommended the need for establishment of epidemic control unit in Jimma University Specialized Hospital to prevent future occurrence of epidemic and undertake and coordinated investigation, control and monitoring activities in case epidemics occur. In addition regular health education and screening of all food handlers with strong and regular supervision of food establishments in Jimma town should be undertaken by Jimma City health bureau in consultation with Jimma University. Jimma City health bureau should take administrative measures on those not maintaining standards

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