PanAfrican Medical Journal

Open Access

Research

A foodborne disease outbreak investigation experience in a College in Lusaka, Zambia, 2017

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Key words: Foodborne illness, case-control study, Zambia, Field Epidemiology Training Program

Received: 31/12/2017 - Accepted: 17/01/2018 - Published: 05/02/2018

Abstract

Introduction: On 19 March 2017, an outbreak of unknown etiology was reported among students at a college in Lusaka, Zambia. We investigated to confirm the outbreak, identify exposures, determine the aetiological agent, and implement preventive measures. **Methods:** We conducted an unmatched case-control study. Cases and controls were selected conveniently. A suspected case was diarrhea or abdominal pains in any student at College A and Controls were asymptomatic students at College A during 18-23 March. We interviewed cases and controls about exposures to suspected food and water and collected saved food samples and swabs from food-handlers' hands and kitchen surfaces for culture. We analyzed data using Epi-info v 7.2 (Atlanta, Georgia). **Results:** We identified 59 suspected case-patients. Predominant symptoms were diarrhea (n = 51.83%) and abdominal pains (n = 44.75%). The outbreak started on 18 March, peaked on 19, and concluded on 20 March. We interviewed 30 case-patients and 71 controls. Exposures associated with increased odds of illness included eating food served at dinner on Saturday (18 March) in school cafeteria (OR = 5.8, 95% CI = 2.0-16.7); specifically, eating beans at Saturday dinner (OR = 21.6, 95% CI = 4.5-104) and drinking water supplied at school (OR = 8.8, 95% CI = 1.45-53.6). Samples from all food-handlers (n = 13) yielded *Staphylococcus aureus* and all food samples (n = 3) yielded *Escherichia coli*, *Staphylococcus aureus* and fecal coliforms. **Conclusion:** The results suggest a foodborne outbreak caused by consumption of contaminated food served at dinner on 18 March at College A. We educated the food handlers and school management about the importance of disinfection of preparation surfaces, supervision of food handling and handwashing practices.

Pan African Medical Journal. 2018;29:100. doi:10.11604/pamj.2018.29.100.14737

This article is available online at: http://www.panafrican-med-journal.com/content/article/29/100/full/

Introduction

Foodborne diseases are of major public health concern globally and are caused by the consumption of food or water contaminated with infectious microorganisms and/or toxic chemicals [1]. Contamination can occur during storage, transportation, and preparation of food for consumption [2]. The most common clinical manifestations are acute diarrhea and abdominal cramps [3, 4]. Most foodborne illnesses are mild and self-limiting but severe cases may occur, especially in children, the elderly and immunocompromised persons [5-7]. The global burden of foodborne diseases was estimated to be 600 million cases and 420,000 deaths in 2010 [3]. Children under five years of age bear 40% of this burden [3]. In Zambia, diarrheal diseases rank in the top five causes of morbidity and mortality in all ages; according to the Zambia Demographic and Health Survey 2013-2014, the annual incidence of diarrheal diseases among the under five children was 16% [8]. On 19 March 2017, Levy Mwanawasa General Hospital notified the Lusaka District Health Office of an outbreak of unknown etiology among students at College A. This was after the hospital received 72 students from College A experiencing sudden onset of abdominal pains and diarrhea. Because the etiology was uncertain and additional cases were feared, the Lusaka District Health Office then alerted the Ministry of Health headquarters and requested for the Zambia Field Epidemiology Training Program to investigate. The objectives were to confirm the outbreak, identify the exposures, determine the etiological agent, and institute control and preventive measures.

Methods

Case identification: We conducted the outbreak investigation during the 20 to 24 March, 2017. We identified cases by reviewing medical records at Mwanawasa General Hospital. It was assumed that all ill students would have presented to Levy Mwanawasa General Hospital, as it was the closest to the college, and any students transported in the college van were taken there. A suspected case was any student from College A complaining of or presenting with diarrhea or abdominal pains during 18 to 23 March.

Data collection: We visited Levy Mwanawasa General Hospital to abstract clinical data from presenting case-patients, and we visited College A to conduct hypothesis-generating interviews with students and school management. College A is a residential college, with most students living in dormitories on campus. The on-campus dining options consist of the main school cafeteria and a smaller snack shop. We then conducted an unmatched 1:2 case-control study. Interviews were conducted on a single day, three days following the start of cases, in order to limit recall bias. Controls were students at College A without a history of diarrhea or abdominal pains during the same time period. We selected suspected cases and controls conveniently; fliers were hung up on the day of the interviews inviting any student who had been sick and who was available and willing to be interviewed to come to the location of the interviews. In addition, students who passed by the interview room during the day of the interviews were asked if they wanted to participate, which generated the majority of the controls. This method of selection was performed in order to cause minimal disruption to scheduled classes. We designed a structured questionnaire to collect data on residence, food consumed during the two days preceding the outbreak (17 and 18 March), source of drinking water, and sanitation practices.

Data analysis: We used Epi Info version 7.2 (Atlanta, Georgia) for data entry and analysis. We conducted univariable logistic regression to identify exposures associated with case-patient status. We then conducted backwards logistic regression to develop a multivariable logistic regression model, starting with all exposures that were statistically significant ($p<0.05$) during univariable analyses. We present adjusted odds ratios (OR) and 95% confidence intervals (CI) for all exposures that remained statistically significant in the final multivariable logistic regression model.

Laboratory investigations: We collected swabs from the hands of the food handlers found working at the time of the visit (20 March) and swabbed kitchen preparation surfaces. We collected available food samples from remaining leftover foods served on Saturday 18 March (cabbage, fried meat balls, and fried beef). The Food and Drug Laboratory at Lusaka's University Teaching Hospital conducted culture of *Salmonella spp., Escherichia coli, Staphylococcus aureus* and fecal coliforms. We conducted unstructured interviews with food preparers and kitchen management to learn the general process of food preparation and storage; however, due to limited time and resources, no formal environmental investigation was performed and no water samples were tested.

Ethical considerations: We used unique identifiers to protect participant confidentiality and we obtained oral consent before the

interviews. Permission to conduct the investigations was granted by the Lusaka District Health Management Team. The investigation was regarded as a response to a public health emergency by the Zambia National Health Research Authority (ZNHRA) and thus did not receive a formal review by the ethics committees but rather ZNHRA ethics body provided an expedited review of the protocol. The ZNHRA also granted consent to publish the findings of the investigations. The report of the investigations has been communicated to the Ministry of Health, the Lusaka District Health Management Team and the college management.

Funding: The investigation was funded by the U.S President's Emergency Plan for AIDS Relief (PEPFAR).

The findings and conclusions in this manuscript are those of the authors and do not necessarily represent the official views of the U.S. Centers for Disease Control and Prevention.

Results

Descriptive epidemiology

We identified 59 case-patients who presented to Levy Mwansa General Hospital; half (53%; n = 31) were males and mean age was 20.8 years (range 18-28 years). The majority (78%, n = 46) lived on campus. The predominant signs and symptoms were diarrhea (86%) and abdominal pain (75%) (Table 1). The first case-patients presented at 6 am on Saturday, 18 March; the next cases did not occur until 5 pm on Saturday; presentations peaked in the early morning on Sunday, 19 March, and the last reported illness onset was 1 am on Monday, 20 March. All case-patients had complete resolution of symptoms within 48 hours of onset. During hypothesis-generating interviews, the only common exposures shared by all case-patients were food from the school cafeteria, and drinking water from the school campus. Based on this information, the epidemic curve, and the clinical presentation, we hypothesized that consumption of contaminated food from the school cafeteria or water from the school campus was the source of the outbreak.

Case-control study

Of the 59 case-patients, 30 were available to be interviewed for the case-control study. Mean age of 30 interviewed case-patients was 20.7 years (range: 18-26 years). We also interviewed 71 controls (mean age: 21.2 years, range: 18-26 years). In univariable analyses, the exposures that were statistically significantly associated with case-patient status were eating beans (OR = 39.1, 95% CI: 10.9-140), beef meat balls (OR = 9.42, 95% CI: 3.5-25.2), or nshima (local dish made from maize flour; OR=8.0, 95% CI: 2.7-23.3) served at the main cafeteria for dinner on Saturday (18 March); eating cabbage (OR = 4.5, 95% CI: 1.6-12.8) or beans (OR = 4.0, 95% CI: 1.4-11.0) served at the main cafeteria for lunch on Saturday, and drinking water from the school's borehole (OR = 14.7, 95% CI: 4.1-53.0) Table 2. In multivariable analyses, the beans eaten at dinner on Saturday, 18 March had the strongest association with case-patient status (OR = 21.6, 95% CI: 4.5-104), although drinking water at the school remained statistically significant (OR = 8.8, 95% CI: 1.45-53.6) (Table 3).

Laboratory investigations

The swab results (Table 4) revealed that all the food handlers and the kitchen preparation surfaces had *Staphylococcus aureus*. Additionally, seven (54%) food handlers and five (83%) of kitchen preparation surfaces had fecal coliforms. Cultures from all three food samples from the school kitchen yielded *E.coli* and *Staphylococcus aureus*. Coliform testing identified fecal coliforms in all three food samples tested (Table 5).

Discussion

Foodborne disease outbreaks in institutional settings where large quantities of food are prepared several hours before serving is common [9-12]. Several micro-organisms have been implicated but the common ones include *Bacillus cereus, Clostridium perfringens, Escherichia coli, Staphylococcus aureus, Salmonella species* or even *Campylobacter jejuni* [13,14]. In our study one of these micro-organisms or a mixture of organisms could be responsible for this outbreak. Our findings suggest that this was likely a foodborne disease outbreak. There was an association between case-patient status and eating food served at dinner on Saturday, 18 March at the school cafeteria (Figure 1). The epidemic curve suggests a point source exposure and the short incubation period suggests a toxin-producing pathogen contamination such as *Staphylococcus aureus, Bacillus cereus or Clostridium perfringens* [15,16]. *Staphylococcus aureus* has been linked to several food-borne disease outbreaks. In

a study at the Midlands State University on bacteriological assessment of the cleaning and disinfection efficacy, 40% of tested food handlers' hands were contaminated with *Staphylococcus aureus* [17]. The main factors contributing to this are inadequate hygiene during preparation, retailing, and consumption, and that foods can be easily contaminated by foodborne pathogens such as *Escherichia coli, Salmonella spp., Listeria*, and *Staphylococcus aureus* [18]. All case-patients had complete resolution of symptoms within 48 hours of onset. The first two case-patients with symptom onset the morning of Saturday 18 March likely were not connected to this outbreak. Both cases had diarrhea before the implicated Saturday dinner. However, diarrhea is a feature of many other illnesses, and it is possible that they could have had an unrelated infection. The food was likely contaminated by food handlers during the preparation process. Although we did not receive any reports of ill food handlers during the investigation, laboratory results revealed contamination with *Staphylococcus aureus* and fecal coliforms on the hands and kitchen preparation surfaces. Contamination of hands is commonly reported among food handlers during foodborne outbreaks [5,19-22]. In this outbreak, *E.coli* and *Staphylococcus aureus* were isolated from the leftover food samples tested. However, the symptoms and course of the illness exhibited by case-patients were not typical of *E.coli* infection. In addition, the incubation period of 2-34 hours observed among the cases in this outbreak contrasts with 3-4 days incubation period of *E.coli*. Therefore, it is unlikely that the responsible organism for this outbreak would be *E.coli* [23].

No biologic samples were collected from case-patients for laboratory testing, so we cannot pinpoint the single agent responsible for the outbreak. One possibility is *Staphylococcus aureus* infection, which is compatible with the clinical characteristics and which was isolated from the food handlers' hands and the kitchen surfaces. However, *Staphylococcus aureus* is in the normal flora of nasal passages, so it would not be unusual to detect this in a healthy person. Additionally, the surface contamination could have occurred the day the swabs were collected. We also did not detect staphylococcal enterotoxins in food samples, which is required for conclusive diagnosis [24]. These findings are similar to a study in Zimbabwe on *Staphylococcus aureus* food poisoning among Bulawayo City Council employees, in which they found that *Staphylococcus aureus* was isolated from the hands of food handlers although no leftover food could be sent for microbial analysis [13,25]. Another possibility is *C. perfringens*. The beans-epidemiologically implicated in this outbreak-are prepared by soaking them in water for a period, cooking them, and then storing them often at room temperature for several hours before consumption. This could make it ideal for germination and multiplication of *C. perfringens* spores. A third possibility is *B.cereus*, which is compatible with the clinical characteristics exhibited by case-patients. This is similar to a study in Ghana on "outbreak of foodborne gastroenteritis in a high school in South-eastern Ghana". They found that it was difficult to pinpoint to a single etiological agent for the outbreak [12]. However, in our study, it is clear that there was a foodborne disease outbreak linked to the contamination of food served at dinner on Saturday, 18 March 2017 at the College A cafeteria.

Study limitations

The study had a few limitations. Stool samples were not collected from case-patients, which prevented us from confirming the aetiology of illness. In addition, although beans were most strongly associated with illness, leftover beans from the implicated dinner were not collected because they had been discarded by the time we arrived at College A. There is also a possibility of recall bias, as case-patients might have recalled differently from the controls. Finally, diarrhea being common, it is possible that some non-cases may have been included as suspect cases, as well as we may have missed some of the less severe cases.

Conclusion

This was a foodborne disease outbreak among students at College A. The epidemic curve suggested a point source. We concluded that the food served at dinner on 18 March in the school cafeteria was likely responsible for the outbreak. The incubation period profile fit that of toxin-producing bacteria such as *Staphylococcus aureus*, which was isolated from swabs from food handlers, surfaces, and from food cultures. However, other organisms like *C. perfringens* and *B. cereus* can also fit this picture. What is clear is that there was a food borne disease outbreak at college A in Lusaka. The general response to this outbreak was prompt and effective. First, we conducted health education to reminded food handlers on the importance of hand washing before food preparation. Second, we reminded food handlers on the recommended disinfecting procedures for kitchen preparation surfaces. Third, we advised the food handlers and school

management to periodically sample the foods for microbial analysis. Lastly, we recommended that health facilities collect and test stool samples when they detect unusual clusters of patients with diarrhea. We held a joint dissemination meeting with the school management, local authority, and the district health officials to discuss these recommendations.

What is known about this topic

- Foods are sometimes contaminated during storage, transportation and preparation processes;
- Definitive diagnosis of foodborne disease outbreaks is usually missed due to lack of implicated food samples for microbial analysis.

What this study adds

- Inability to identify the most likely aetiologic agent in this foodborne outbreak highlights gaps that hamper response activities;
- The implication of food served at dinner in the school cafeteria, reinforces the importance of stringent control measures in the storage and preparation of food in colleges to prevent future outbreaks;
- Prompt and effective epidemiological investigation and response is essential in the control of FBD outbreaks when comprehensive microbiological analysis is lacking.

Competing interests

The authors declare no competing interests.

Authors' contributions

FK participated in the design, data collection, statistical analysis and drafted the manuscript. FDM, PS, AG, N L, OC, LM and FN participated in the design, data collection and statistical analysis. GC, NK, NS, SC and EY were involved in the design of the study and reviewed the manuscript for intellectual content. All authors have read and agreed to the final version of this manuscript and have equally contributed to its content and to the management of the case.

Acknowledgments

We are grateful to the Zambia Ministry of Health for the support and we are particularly grateful to the staff at Levy Mwanawasa General Hospital and the Lusaka District Health Office.

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References

1. Al-Goblan AS, Jahan S. Surveillance for foodborne illness outbreaks in Qassim, Saudi Arabia, 2006. Foodborne Pathog Dis. 2010; 7(12): 1559-62. **PubMed** | **Google Scholar**

2. Kadariya J, Smith TC and Thapaliya D. Staphylococcus aureus and staphylococcal food-borne disease: an ongoing challenge in public health. Biomed Res Int. 2014; 2014: 827965. **PubMed** | **Google Scholar**

3. Havelaar AH et al. World Health Organization Global Estimates and Regional Comparisons of the Burden of Foodborne Disease in 2010. PLoS Med. 2015; 12(12): e100192. **Google Scholar**

4. Kuchenmuller T et al. World Health Organization initiative to estimate the global burden of foodborne diseases. Rev Sci Tech. 2013; 32(2): 459-67. **PubMed** | **Google Scholar**

5. Jones G et al. Outbreak of Salmonella Enteritidis linked to the consumption of frozen beefburgers received from a food bank and originating from Poland: northern France, December 2014 to April 201 Euro Surveill. 2016; 21(40). **PubMed** | **Google Scholar**

6. Fleury MD et al. A descriptive analysis of hospitalization due to acute gastrointestinal illness in Canada, 1995-2004. Can J Public Health. 2008; 99(6): 489-93. **PubMed** | **Google Scholar**

7. Hird S et al. Meeting report: Second annual meeting of the World Health Organization initiative to estimate the global burden of foodborne diseases. Int J Food Microbiol. 2009; 133(1-2): 210-2. **PubMed**| **Google Scholar**

8. CSO. Zambia Demographic Health Survey. CSO. 2015. In press.

9. Daniels NA et al. Foodborne disease outbreaks in United States schools. Pediatr Infect Dis J. 2002; 21(7): 623-8. **PubMed** | **Google Scholar**

10. Niehaus AJ et al. An outbreak of foodborne salmonellosis in rural KwaZulu-Natal, South Africa. Foodborne Pathog Dis. 2011; 8(6): 693-7. **PubMed** | **Google Scholar**

11. Mellou K et al. Epidemiological investigation of two parallel gastroenteritis outbreaks in school settings. BMC Public Health. 2013; 13: 241. **PubMed** | **Google Scholar**

12. Ameme DK et al. Foodborne disease outbreak in a resource-limited setting: a tale of missed opportunities and implications for response. Pan Afr Med J. 2016; 23: 69. **PubMed** | **Google Scholar**

13. Bennett SD, Walsh KA and Gould LH. Foodborne disease outbreaks caused by Bacillus cereus, Clostridium perfringens, and Staphylococcus aures -United States, 1998-2008. Clin Infect Dis. 2013; 57(3): 425-33.**PubMed** | **Google Scholar**

14. Moffatt CR et al. A large outbreak of Campylobacter jejuni infection in a university college caused by chicken liver pate, Australia, 2013. Epidemiol Infect. 2016; 144(14): 2971-2978. **PubMed** | **Google Scholar**

15. Greig JD et al. Outbreaks where food workers have been implicated in the spread of foodborne disease, Part 1: Description of the problem, methods, and agents involved. J Food Prot. 2007; 70(7): 1752-61.**PubMed** | **Google Scholar**

16. Moffatt CR, Howard PJ and Burns T. A mild outbreak of gastroenteritis in long-term care facility residents due to Clostridium perfringens, Australia 2009. Foodborne Pathog Dis. 2011; 8(7): 791-6. **PubMed** |**Google Scholar**

17. Manyahi J et al. Detection of CTX-M-15 beta-lactamases in Enterobacteriaceae causing hospital- and community-acquired urinary tract infections as early as 2004, in Dar es Salaam, Tanzania. BMC Infect Dis. 2017; 17(1): 282. **PubMed** | **Google Scholar**

18. Kotzekidou P. Microbiological examination of ready-to-eat foods and ready-to-bake frozen pastries from university canteens. Food Microbiol. 2013; 34(2): 337-43. **PubMed** | **Google Scholar**

19. Dagnew M et al. Survey of nasal carriage of Staphylococcus aureus and intestinal parasites among food handlers working at Gondar University, Northwest Ethiopia. BMC Public Health. 2012; 12(1): 837.**PubMed** | **Google Scholar**

20. Leyla Vatansever, Çi?dem Sezer, and Nebahat Bilge. Carriage rate and methicillin resistance of Staphylococcus aureus in food handlers in Kars City, Turkey. Springerplus. 2016; 5: 608. **PubMed** |**Google Scholar**

21. Loeto D, Matsheka MI and Gashe BA. Enterotoxigenic and antibiotic resistance determination of Staphylococcus aureus strains isolated from food handlers in Gaborone, Botswana. J Food Prot. 2007; 70(12): 2764-8. **PubMed** | **Google Scholar**

22. Byrd-Bredbenner C et al. Food safety in home kitchens: a synthesis of the literature. Int J Environ Res Public Health. 2013; 10(9): 4060-85. **PubMed** | **Google Scholar**

23. Hines JZ et al. Case Finding Using Syndromic Surveillance Data During an Outbreak of Shiga Toxin-Producing Escherichia coli O26 Infections, Oregon, 2015. Public Health Rep. 2017; 132(4): 448-450.**PubMed** | **Google Scholar**

24. Ostyn A et al. First evidence of a food poisoning outbreak due to staphylococcal enterotoxin type E, France, 2009. Euro Survei ll. 2010; 15(13). **PubMed** | **Google Scholar**

25. Gumbo A et al. Staphylococcus aureus food poisoning among Bulawayo City Council employees, Zimbabwe, 2014. BMC Res Notes. 2015; 8: 485. **PubMed** | **Google Scholar**

Table 1: Clinical characteristics of case-patients at College A (N=59)-Lusaka, Zambia, 2017

Clinical characteristics	**n**	**%**
Diarrhea	51	86
Abdominal Pains	44	75
Headache	22	37
Vomiting	19	32
Fever	16	27
Cough	9	15

Table 2: Univariable analysis showing associations between exposures of interest and illness status at College A-Lusaka, Zambia, 2017

Meal	Exposures	Cases (n=30)	%	Controls (n=71)	%	OR (95% CI)[1]	P-Value
Saturday Dinner	Ate any food from cafeteria	25	83	33	46	5.76 (2.0,16.7)	<0.01
	Meat balls	19	63	11	15	9.42 (3.5,25.2)	<0.01
	Beans	21	70	4	6	39.1 (10.9,139.9)	<0.01
	**Nshima	25	83	27	38	8.0 (2.7,23.3)	<0.01
	Soya Chunks	2	7	3	4	1.7(0.3,9.9)	0.63
Saturday Lunch	Ate any food	17	57	25	35	2.4(1.0,5.8)	0.05
	Cabbage	11	37	8	11	4.5(1.6, 12.8)	<0.01
	Beans	11	37	9	13	4.0(1.4, 11.0)	<0.01
	**Nshima	16	53	19	27	3.1(1.3,7.6)	0.01
Saturday Breakfast	Ate any food	14	47	20	28		
	Tea	11	37	14	20	2.4(0.9, 6.2)	0.07
	Bread	11	37	17	24	1.8(0.7, 4.6)	0.19
Water Source	School	27	90	27	38	14.7(4.1, 53.0)	<0.01

[1] Confidence interval

**Nshima is a staple food in Zambia made from maize flour (corn meal--mealie meal) and water

Table 3: Multivariable analysis showing association between exposures of interest and case-patient status at College A-Lusaka, Zambia, 2017

Exposures	Variable	Odds Ratio(95%CI)[1]	P-value
Saturday Dinner at NRDC cafeteria	Ate Dinner	5.8 (2.0, 16.7)	<0.01
	Meat balls	1.8 (0.3, 10.7)	0.51
	Beans	21.6 (4.5, 104)	<0.01
	**Nshima	0.9 (0.1, 5.7)	0.92
	Soya Chunk	0.6 (0.1, 16.3)	0.97
Primary source of drinking water	School vs	8.8 (1.5, 53.6)	0.02
	Non-school		

Adjusted odds ratios controlling for others foods eaten at dinner and source of water

Table 4: Laboratory swab results for suspected foodborne outbreak at College A-Lusaka, Zambia, 2017

Sample	% *Staphylococcus aureus positive*	% *Fecal coliform positive*

Food Handlers (n=13)	100%	54%
Kitchen-surfaces (n=6)	100%	83%

Table 5: Laboratory food sample results for suspected food poisoning at College A-Lusaka, Zambia, 2017

*Food Sample	*E.coli*	**Fecal Coliforms*	*Staphylococcus aureus*	*Salmonella*
Cooked cabbage (n=1)	Present	10	Present	Absent
Fried meat balls (n=1)	Present	10	Present	Absent
Fried beef (n=1)	Present	4	Present	Absent

**Fecal coliforms 10= number of colonies/ml of water (acceptable level of fecal coliform is 0)

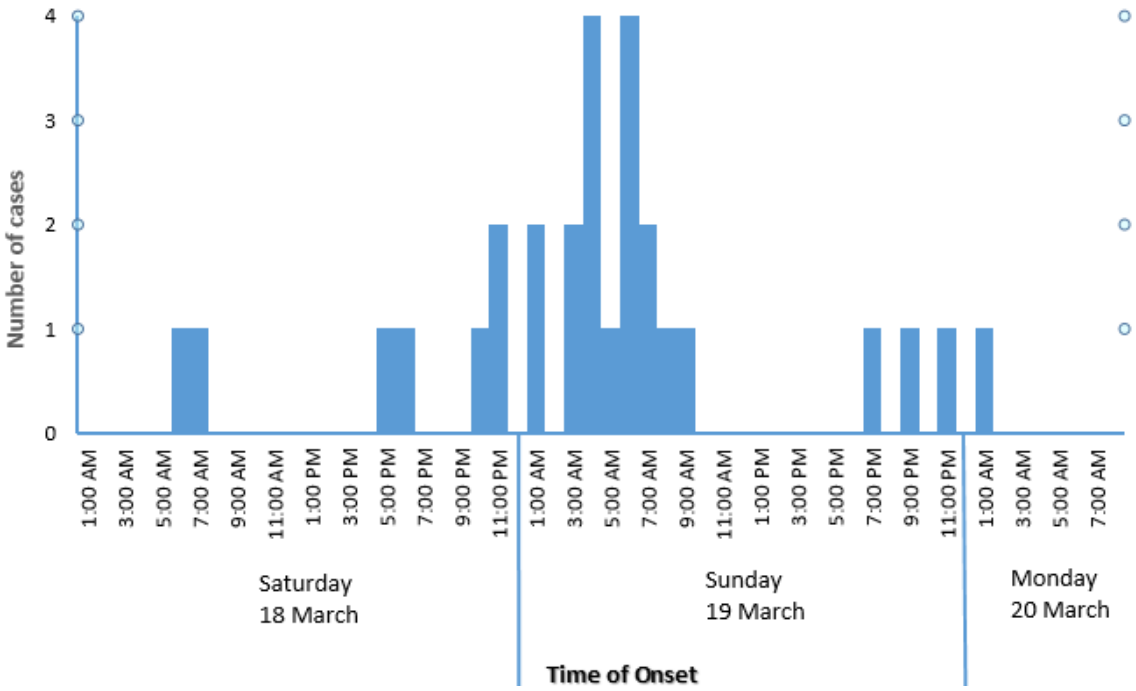

Figure 1: Epidemic curve of suspected foodborne disease outbreak at College A-Lusaka, Zambia, 2017