Epidemiological investigation of food poisoning outbreak among hajj pilgrims from Sudan at hotel in Jeddah, KSA in August 2017

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Abstract
Objective: An investigation of the outbreak was initiated because of the number of cases of gastroenteritis among Sudanese population reporting to a general hospital Jeddah during the pilgrimage to Makkah (HAJJ). This cases control study was conducted to identify the source of the outbreak, assess its magnitude, and make recommendations to prevent similar outbreaks in the future.

Materials and Methods: A case was defined as any individual who developed. A case was defined as anyone who stayed at the hotel on 23rd August 2017 and developed GI illness (nausea, vomiting, abdominal pain or diarrhea) diarrhea with or without abdominal pain after eating at the hotel on 24th August 2017. Laboratory tests included stool cultures of all diarrhea patients, and rectal swabs from all food handlers were cultured for enteric pathogens and result were negative.

Results: A total of 141 cases hajj pilgrims Sudanese living in hotel were interviewed. Out of these, 83% had developed nausea, 80% abdominal pain and 75% diarrhoea most commonly and the mean incubation period was 2.16±0.98 hours and the epidemic curve suggested a common point source outbreak. Out of three food items, chicken was found a statistically significant association with illness (p=0.033) food leftovers were found for eating. All results of stool cultures of all diarrhea patients, and rectal swabs from all food handlers were inconclusive.

Conclusions: This outbreak was most likely caused by eating contaminated chicken served at lunch on 23rd August 2017. The most likely organisms were Bacillus cereus, and/or Clostridium perfringens. Consuming food that was kept at an unsafe temperature poor level of food hygiene among food handler probable important factor leading to this outbreak.

Keywords: Foodborne outbreak, Saudi Arabia, Hajj, Sudanese.

Introduction
Each year, more than three million Muslims from around 185 countries depart for hajj as the largest mass gathering of the world. Diarrheal is common among hajjis, no study has documented their incidence and etiological factors. During the hajj of 1986, gastroenteritis has been the most common reason of hospital admissions. A previous Study carried out during 2002 indicated diarrhea as the third reason of hospital admissions among hajjis. Available studies about diarrhea among Hajj pilgrims indicate a mean prevalence of 2% with the highest prevalence of 23% among a group of French pilgrims in 2013. There is an obvious lack of information about the etiology of diarrheal disease at the Hajj. Hajj-associated communicable public health hazards mainly involve the transmission of respiratory infections, foodborne diseases, blood borne diseases, and zoonotic infections.

A batch of 1,246 hajj pilgrims from Sudan had reached Jeddah port in the afternoon of 23rd August 2017. They reached the designated hotel for stay at 4 PM. The food was made available at the hotel of stay by a local restaurant. The meal was prepared at the restaurant at 12 noon, packed into separate 1250 food packets and supplied to hotel of stay at 4:30 PM. One food packet for each person contained chicken, okra (bamia), white beans (fawsliya) and salad (carrot, cucumber and pickle). The food was informed to be prepared with due precautions of wearing gloves and head covers. There were no pet animals in the restaurant. Cooks and helpers did not have fresh wounds on their hand or visible parts of the body. Pilgrims started eating meal from 7pm onwards until 11 PM. Pilgrims consumed only bottled water. First few case(s) started complaining of GI illness at 8 PM. Investigators did environmental assessment in the restaurant where the food was prepared was assessed to be of poor standards in terms of general cleanliness, organization of the kitchen, food storage, handling, cooking, packing and transfer of cooked food. The food establishments come under the purview of municipality and restaurant had violated in terms of maintaining prescribed standards for food establishments. The restaurant was closed down with immediate effect until further orders.

Materials and Methods
In this study, present the food poisoning outbreak from the emergency department of King Abdul Aziz Hospital and Oncology Center (KAAHOC), Jeddah, which had just received 20 patients with gastrointestinal illness, at 1:00 AM, early hour of 24th August 2017. The patients were described as hajj pilgrims from Sudan and there were more cases that are similar in the hotel where they stayed. Immediately upon receiving the alert, the hospital called food safety department in ministry of health. The team divided itself into teams to reach the hospital and the hotel scene. Based on the clinical profile and a brief history, it was realized that the number of cases of GI illness cases exceeded regular occurrence indicating a GI illness outbreak. The investigation team at the hotel learnt that there were more cases of GI illness and some patients had been taken two other hospitals such as king abdulaziz university hospital (KAUH) besides KAAHOC. Initial
enquiry confirmed that these were 1,246 haj pilgrims had put up at the said hotel.

As a first step, initial interviews were conducted among the first 10 patients at the hospital using a questionnaire and a line-list of cases was prepared. The questionnaire collected information on personal details like age and gender, whether they stayed at the same hotel, exposure to similar case(s) in the last 3-4 days and food history and symptoms and time of onset. A total of 1,246 haj pilgrims from Sudan had reached Jeddah by ship in the afternoon of 23rd August 2017 and had reached hotel for stay at 4pm on 23rd August 2017. It was noted that the patients did not have anything in common besides the last meal from 7 pm on 23rd August 2017. Occurrence of more than two cases with history of common shared food and presenting with similar clinical features of GI illness met the criteria of food poisoning outbreak epidemiologically. As immediate prevention and control measures, the investigation team members at the hotel ensured that no more people consume this particular meal suspected to be the cause of the present outbreak. An immediate environmental assessment was done for the local restaurant where the food was cooked and supplied, and the restaurant was closed down until further orders. Stool samples of patients were sent for microbiology.

Epidemiological investigation started by Information was collected from all 141 cases (100%) by face-to-face interviews using questionnaire eliciting personal information (age and gender), whether he/she stayed at the hotel on 23rd August 2017, time of eating last meal, food items consumed, time of start of symptoms, symptoms, treatment taken, recovery time, and whether they shared their packet with anyone else. A case was defined as anyone who stayed at the hotel on 23rd August 2017 and developed GI illness (nausea, vomiting, abdominal pain or diarrhea) on 23rd August 2017 or 24th August 2017.

When the investigating officers reached hotel, all food packets had been opened with some left-over food in few packets. Food samples from the left-over packets were taken for laboratory testing. At the time of environmental assessment, necessary food samples/raw materials and food handler samples (nose swab, throat swab, and stool) were collected and sent to laboratory for testing. None of the guests or hotel staff had reported GI illness in the previous 2 days. Everyone at hotel interviewed with standardized questionnaires to check if they meet case definition. About 8 cases were included from the hotel which didn’t go to hospital but had managed some local relief at hotel. Rest of the at-risk population did not meet case definition. Eight cases at hotel adding to the 133 cases that presented to three hospitals made the final tally to 141 cases. The data analysis was done by using Statistical Package for Social Sciences (SPSS) version-21 software.

**Results**

At-risk population was 1,246 and the total number of cases 141 the attack rate of (11.3%) was calculated (141/1246 *100). The Fig. 1 and 2 shows that the age and gender distribution of cases in the outbreak. Female cases were considerably more compared to male (62% vs 38%) cases. The mean age group 53.9(±10.9) years comprised 66% of the cases.

The Fig. 3 shows the number of cases against the time of onset of symptoms (epidemic curve) for the present outbreak. The curve has one peak and the earliest onset of symptoms is at 8 PM 23rd August 2017 and latest at 1 AM 24th August 2017.

It was seen from Fig. 4 that minimum incubation period was 1 hour and maximum incubation period (IP) was 5 hours. The mean 2.16 hours with standard deviation 0.98 hour. Mean and median (2 hours) are not much different although the epidemic curve looks slightly right skewed. The period of earliest exposure has been 7 PM onwards and latest exposure at 11 PM. The outbreak lasted till 10 AM on 24th August 2017, when the last case was discharged from hospital. Figure 4 shows the distribution of incubation periods by duration. The Fig. 5 presents the distribution of symptoms among the cases. The epidemic curve is one of point source outbreak with short duration, typical of a food outbreak caused by toxins from *Staphylococcus aureus* and *Bacillus cereus*. The clinical features, incubation period, association of *Staphylococcus aureus* with wide range of food sources make it the most probable cause of the outbreak.

![Fig. 1: Gender distribution of cases (N=141)](image_url)
Fig. 2: Age & Gender distribution of cases in the GI illness outbreak among hajj pilgrims from Sudan at a hotel in Jeddah on 23rd August 2017 (N=141)

Fig. 3: Number of cases of GI illness among hajj pilgrims from Sudan after eating food at a hotel in Jeddah, by time of onset on 23rd August 2017 (N=141)

Fig. 4: Distribution of incubation period in the GI illness outbreak among hajj pilgrims from Sudan after eating food at a hotel in Jeddah on 23rd August 2017 (N=141)

Fig. 5: Distribution of symptoms in the GI illness outbreak among hajj pilgrims from Sudan after eating food at a hotel in Jeddah on 23rd August 2017 (N=141)
It was seen from Table 1 that case-control study analysis to identify the food source of contamination among food items eaten in the common meal a hypothesis was generated. The hypothesis in the present outbreak wanted to test whether chicken on the menu was the contaminated food source and that it was through from Staphylococcus aureus toxin. Several samples were taken from food items on the menu and conducting the laboratory tests. Results of the case-control study are given below those who eat chicken have 3 times to have food poisoning than those not eat it and these are statistically significant (p=0.033)

### Discussion

The results from the case-control study provide good support to incriminate chicken as the food source that caused the outbreak (OR for chicken - 3.0, 95% CI 1.0-8.6; p=0.033). The odds of having eaten chicken was 3 times higher among cases compared to controls. However, stool samples from patients and food handlers were negative for the standard food poisoning organisms like *Salmonella*, *Shigella* species and *Clostridium* microorganisms. Nose and throat swabs did not isolate *Staphylococcus aureus*. Food samples both from restaurant and left-overs were heavily contaminated with non-standard organisms and unsuitable for human consumption, but were negative for *Salmonella*, *Shigella* species and *Clostridium* microorganisms. One study reported food poisoning incidence among hospitalized patient and the conclusion contaminated food by sick food handler.\(^{[6]}\) There is previous incidence of foodborne illness was reported by Al-Mazrou a total of 50 Saudi male soldiers who are developed food illness after taking the lunch and found who eat the rice in lunch developed diarrhea.\(^{[11]}\)

Food samples were not tested for *Staphylococcus aureus* toxin or *Bacillus cereus* toxin as the kits for toxin testing were not available. It is plausible that samples could be negative for *Staphylococcus aureus* for many reasons and one being toxin was performed and organism no more viable to be isolated and grown. However, the environmental assessment of restaurant coupled and with the food samples being reported unsuitable for human consumption having contaminated with fecal flora and unspecified organisms of animal origin points towards the unhygienic operations in the restaurant. Toxin testing could have cleared the air of suspicion in incriminating the correct food item and the mechanism. Lack of this facility is a clear gap that needs to be addressed to resolve the food poisoning outbreaks scientifically. Lack of association of *Bacillus cereus* toxin with the food items on the menu and the mixed symptoms of vomiting and diarrhea make it less likely than *staphylococcus aureus* toxin to be the cause in this outbreak. The symptoms in bacillus cereus toxin food outbreaks depend on the type of toxin produced (neurotoxin-vomiting; enterotoxin-diarrhea) but not both at once.\(^{[6,10]}\)

The most likely food item that acted as a vehicle for the transmission in this outbreak was chicken served at lunch on 23\(^{rd}\) August 2017. A statistically significant association was found between eating lunch and illness and between eating chicken and illness. Food was probably contaminated when it was kept at ambient temperature for a prolonged period of time permitting the multiplication of the causative organism.\(^{[11]}\) However, it was not possible to discriminate between okra and chicken, as the vehicle of transmission in this scenario since they were mostly eaten together. The lack of a statistically significant association between Okra and illness does not rule out the possibility of cross contamination of chicken with okra or beans because they were served together on the same dish, though cooked separately.

### Conclusion

In the absence of microbiological toxin test results, it is a golden rule in medicine that if the observed clinical picture fits the standard presentation of a single identified cause, it is most likely to be the correct diagnosis. Epidemiologically, the clinical features, of sudden onset of explosive GI illness with nausea, vomiting, with or without diarrhea, abdominal pain, headache and lack of fever, A short incubation period (Average- 2.16 hours), and association of *Staphylococcus aureus* with environment and wide array food items including chicken, result of the case-control study with high odds ratio for chicken (OR for chicken - 3.0, 95% CI 1.0-8.6; p=0.033) the quick recovery pattern observed with no complications, match with the conclusion that this outbreak was caused by eating chicken which had preformed *Staphylococcus aureus* toxin. Improper storage in the form inadequate refrigeration and poor food handling practices appear to have contributed to occurrence of contamination of chicken with *Staphylococcus aureus* preformed toxin. Strict hygienic conditions during food preparation for large numbers of people, proper food delivery, and hygienic handling as well as temperature control during serving are strongly recommended.

**Conflict of Interest:** None.
References

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