FOOD-BORNE SALMONELLA OUTBREAK IN A SINGLE HOSPITAL WARD

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Abstract. In June 2012, an outbreak of *Salmonella* group C gastroenteritis occurred on a single hospital ward among 54.2% (13/24) of volunteers undergoing an unrelated clinical trial and among14.3% (1/7) hospital ward worker. Food-borne transmission was suspected, so a retrospective cohort study was conducted to identify the vehicle of the outbreak along with implementing outbreak control measures. None of the food items was significantly associated with the outbreak. An epidemic curve suggests a common source of the outbreak. No cases were reported after outbreak control. Food should be stored, cooked and handled using strict hygiene to prevent future outbreaks.

Keywords: Salmonella, gastroenteritis, food-borne outbreak

INTRODUCTION

Food-borne outbreaks are common in a community setting but are seldom reported in a hospital setting. The severity of illness may be higher in patients, especially immunocompromised patients. Food-borne outbreaks in the hospital are worth investigating to determine the source and guide prevention measures. Food-borne outbreaks in hospitals are not uncommon. There have been many reports of nosocomial food-borne outbreaks caused by various of pathogens, including *Salmonella* spp, *Bacillus cereus* and Norovirus (Maguire *et al*, 2000; Tsang *et al*, 2008; Al-Abri *et al*, 2011; Lee and Greig, 2013).

On June 13, 2012, 13 of 24 volunteers and 1 of 14 attending staff on a trial ward in a hospital developed diarrhea. A food-borne outbreak was suspected and an investigation was conducted to identify the cause of the outbreak and implement control measures.

MATERIALS AND METHODS

The study ward is designed for clinical trials. There are separate bedrooms, treatment rooms, toilets and a pantry with no mixing of activities in the areas. On June 6, 2012, 24 volunteers were enrolled in a clinical trial and 14 attending staff comprised of 4 doctors, 8 nurses, and 2 housekeepers, worked on the ward during the study period.

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Three cases of diarrhea reported on the morning of June 13, thus an outbreak was suspected. The first case was a 22-year male who developed diarrhea at 8:00 AM on June 12, 2012. After morning rounds, an outbreak was declared and the volunteers and attending staff were asked to report any symptoms (Fig 1).

Demographic data was collected from all the volunteers and 7 of the attending staff who worked on the study ward who consumed food served on the ward during June 10-13, 2012. Clinical information and food history data were obtained using a structured questionnaire.

Stool samples for bacterial culture were obtained from all individuals with a history of having symptoms of abnormal stools.

A diarrheal case was defined as passing 3 or more loose or liquid stools per day or more frequently than normal (WHO, undated). A confirmed case of salmonellosis was a person who had a laboratory-confirmation of *Salmonella* infection and had lower gastrointestinal (GI) symptoms during June 12-13, 2012. A suspected case of salmonellosis was a person with a negative stool culture for *Salmonella* who had lower GI symptoms during June 12-13, 2012.

An epidemic curve was plotted to try to estimate a probable period of exposure by counting back from median time of onset of symptoms among cases (WHO, 2008). After receiving the results of the investigations, the period of exposure was rechecked using specific pathogen's incubation period.

An environmental study and food handler interviews were performed to identify the possible causes and mechanisms for bacterial contamination. Control measures were immediately conducted along with the outbreak investigation. The menu was reviewed and only well-cooked food items were allowed to be served to volunteers. Proper toilet cleaning was instituted and hand hygiene among the volunteers and staff using soap and alcohol gel were taught. All symptomatic volunteers and staff were evaluated and treated with ciprofloxacin 500 mg twice a day along with oral rehydration solution. A house keeper was the only symptomatic staff member and was asked to provide stool sample for bacterial culture. She took sick leave for one week and resumed work after a negative stool culture.

We conduced a retrospective cohort study. Food specific attack rates for all food items were calculated. The food items prepared separately and mixed together, such as "pandan rice noodles with coconut milk sweetened with palm sugar" and "rice stick noodle soup with minced pork, pork balls and sliced fish cake", were separately analyzed. Risk differences and risk ratios with 95% confidence intervals were calculated to estimate health impacts and any associations between exposures to individual food items and the illness. *p*-values from chi-square and 2-sided *p*-values from Fisher's exact tests were reported. Data management and analysis was done using Epi info version.3.5.1 of US CDC.

RESULTS

Of the 24 volunteers (females:males = 11:13) and 7 staff (females:males =6:1), there were 14 cases (7 confirmed, 6 suspected and 1 with abnormal bowels who did not meet WHO criteria for diarrhea. This gave an attack rate of 45.2% (14/31); 54.2% (13/24) of the trial volunteers and 14.3% (1/7) of the ward personnel. Attack rates among females and males were

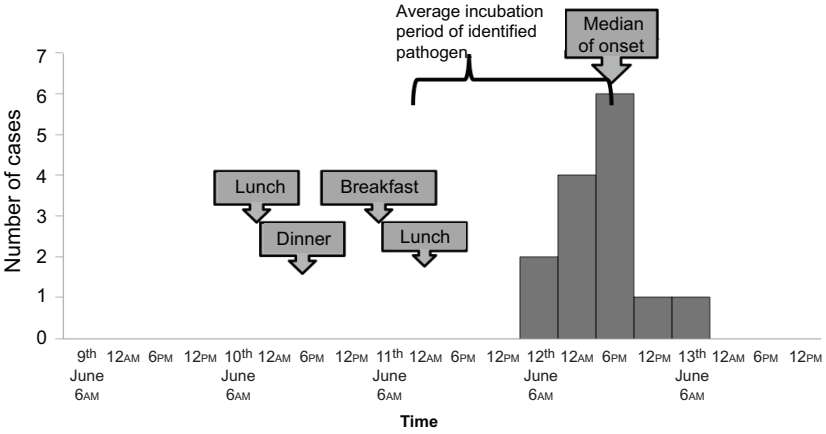

Fig 1–Epidemic curve of food-borne outbreak at a hospital in Bangkok, June 2012.

41.2% (7/17) and 50.0% (7/14), respectively. The median age of cases was 28 years (range: 19-45 years). Main symptoms were loose stools (14 cases, 100%), varying from 1 to 10 times per day, and mild abdominal pain (7 cases, 50%). None of the cases had fever or vomiting.

The epidemic curve of this outbreak is compatible with a common source outbreak (Fig 1). The illness onset of the first and last cases were 8:00 AM on June 12 and 6:30 AM on June 13, respectively. The median illness onset time was 6-11 PM on the 12 June. The symptomatic house keeper was an outlier case. She shared food with the volunteers for four meals. By using the house keeper's duty times we narrowed down the suspected meals from lunch of June 10 to lunch on June 11.

Retrospective interviews were conducted among 23 of the 24 volunteers and all 7 staff who worked on the trial ward during June 10-11. The food specific attack rates were: ice (57.1%), pandan rice noodles (56.3%), taro (55.6%), coconut cream (55.6%), rice soup with prawns (54.5%) and sliced fish cake (52.0%) (Table 1).

On univariate analysis, the highest risk ratio (RR) was rice soup with prawns (RR 4.36; 95%CI: 0.67-28.39; *p*-value 0.047) while sliced fish cake, which had an undefined RR, had the highest risk difference (RD) (RD 52%; *p*-value 0.043) (Table 2).

To prove a hypothesis of risk factors associated with a food poisoning outbreak, a food item with a high food item-specific attack rate is usually the most likely item implicated, especially when the non-cases were not exposed to that particular food item (CSELS, 2004). None of the persons who did not consume sliced fish cake developed symptoms. The highest risk difference (the attack rate of the exposed group subtracted from the attack rate of the non-exposure group) was observed for the sliced fish cake (52.0%); the house keeper was one of the consumers. Unfortunately, no leftover foods or raw ingredients were available for lab testing. However, samples from a new lot of the same brand of fish cake bought at the same market were culture negative.

Stool cultures revealed *Salmonella* group C in 6 trial volunteers and the 1 house keeper, resulting in 50% (7/14) of symptomatic subjects had laboratory-confirmed *Salmonella* group C infection. This confirmed our hypothesis that a food-borne outbreak occurred. No cases were reported by the 5 staff who did not share food with the volunteers. The median time from ingesting the sliced fish cake to onset of symptoms was 32.8 (range: 20.30-42.60) hours, which is within the incubation period of *Salmonella* spp infection of the lower gastrointestinal

Table 1
Food specific attack rate of salmonellosis (*N*=30).

Food items	#Cases/ #Exposed persons	Attack rate (%)	#Cases/ #Unexposed persons
June 10, 2012			
Lunch			
Stir fried Chinese mustard greens with minced pork	11/25	44.0	2/5
Stir fried prawns with garlic and pepper	11/23	47.8	2/7
Pandan rice noodles	9/16	56.3	4/14
Taro	10/18	55.6	3/12
Coconut cream	10/18	55.6	3/12
Ice	8/14	57.1	5/16
Dinner			
Deep fried snake-head fish with Chinese celery	13/26	50.0	0/4
Hot and spicy pork rib soup	12/25	48.0	1/5
June 11, 2012			
Breakfast			
Rice soup with prawns	12/22	54.5	1/8
Lunch			
Rice stick noodle	13/26	50.0	0/4
Minced pork	11/24	45.8	2/6
Pork balls	12/24	50.0	1/6
Sliced fish cake	13/25	52.0	0/5
Sprout	12/25	48.0	1/5
Fruit jelly with coconut milk sweetened with palm sugar	10/20	50.0	3/10

tract infection (6-96 hours) (WHO, 2008). No complications of the *Salmonella* infection were reported. Repeat stool cultures from the house keeper and food handlers showed no growth after completion of the three-day treatment. Anti-septic soap and alcohol gel were available in all the rooms for the volunteers and the toilets were cleaned twice a day. Universal precautions were strictly followed by the healthcare providers. Tap water was filtrated before drinking by the volunteers and staff, and a culture of the water revealed no growth. The volunteers cleaned their own food containers and kept them individually. Staff shared food containers which were washed by the house keepers. All containers were kept dry and clean. Some volunteers (43.3%) washed their own food containers with hot water before use.

After the outbreak, control measures instituted included providing only well-cooked food, toilet cleaning, strict hand hygiene and contact precautions. The symptomatic house keeper took sick leave until the stool culture was negative for 7 days after the illness onset. We also eliminated some foods reported as commonly being implicated in food-borne outbreaks from the food menu while the investigation was being conducted.

In a survey of the kitchen one refrigerator used for keeping fresh meat had no temperature monitor.

Table 2
Univariate analysis of associations between food items and risk for Salmonella gastroenteritis.

Food items	Risk Ratio (RR)	95%Confidence interval (CI)	Risk difference (RD) in percent	95%Confidence interval (CI)	*p*-value
June 10, 2012					
Lunch					
Stir fried Chinese mustard greens with minced pork	1.10	0.35, 3.51	4.00	-43.14, 51.14	1.00*
Stir fried prawns with garlic and pepper	1.67	0.48, 5.82	19.25	-19.95, 58.46	0.43*
Pandan rice noodles	1.97	0.77, 5.01	27.68	-6.25, 61.60	0.13
Taro	2.22	0.77, 6.44	30.56	-3.02, 64.13	0.10
Coconut cream	2.22	0.77, 6.44	30.56	-3.02, 64.13	0.10
Ice	1.83	0.78, 4.31	25.90	-8.57, 60.36	0.15
Dinner					
Deep fried snake-head fish with Chinese celery	Undefined	Undefined	50.00	30.78, 69.22	0.11*
Hot and spicy pork rib soup	2.4	0.40, 14.52	28.00	-12.16, 68.16	0.35*
June 11, 2012					
Breakfast					
Rice soup with prawns	4.36	0.67, 28.39	42.05	11.09, 73.00	0.09*
Lunch					
Rice stick noodle	Undefined	Undefined	50.00	30.78, 69.22	0.11*
Minced pork	1.38	0.41, 4.62	12.5	-30.16, 55.16	0.67*
Pork balls	3.00	0.48, 18.77	33.33	-2.58, 69.24	0.20*
Sliced fish cake	Undefined	Undefined	52.00	32.42, 71.58	0.05*
Sprout	2.4	0.40, 14.52	28.00	-12.16, 68.16	0.35*
Fruit jelly with coconut milk sweetened with palm sugar	1.67	0.59, 4.73	20.00	-15.87, 55.87	0.44*

* 2-sided *p*-value from Fisher's exact test.

The foods served on this ward were the same as for patients in the rest of the hospital, but were prepared separately. None of the food handlers or cooks reported gastrointestinal problems during the outbreak. The raw ingredients for meals were bought from a market one day before cooking except the noodles, pork balls and sliced fish cake which were bought early in the morning they were used. The pandan rice noodles were bought from a different shop the morning they were served. The food handling and preparation by the cooks followed standard methods. All precooked chilled foods, such as the pork balls and sliced fish cake, were re-heated but the temperature was not measured with a food thermometer. Ice was made by the refrigerator in the hospital kitchen using filtered tap water.

DISCUSSION

Salmonella spp, gram- negative bacteria belonging to the family Enterobacteraciae, are a common cause of food-borne disease, causing various degrees of illness, including gastroenteritis, enteric fever, bacteremia and death. The commonly reported *Salmonella* contaminated foods are poultry, meat and eggs (Mandell *et al*, 2010). A study from northern Thailand found the prevalences of *Salmonella* spp in chicken and pork at the market of 57% and 29%, respectively (Padungtod and Kaneene, 2006). *Salmonella* food-borne outbreaks have been reported worldwide with various causative foods and attack rates, such as turkey sandwiches with a 5% attack rate in a London hospital outbreak in 1994; from bread with a 10% attack rate in an outbreak among factory workers at Huizhou, Guangdong Province, China in 2004 and from meat and rice with an attack rate of 31% among guests at wedding ceremony in Saudi Arabia in 2010 (Maguire *et al*, 2000; Liu *et al*, 2006; Aljoudi *et al*, 2010). In our study, the attack rate was relatively high (45.2%).

The suspected food item, sliced fish cake, was a chilled precooked food. It was sliced before heating in boiling water. The cooked food was transported in closed containers and served within one hour of cooking. There was no temperature control using a food thermometer. The fish cake might have been improperly cooked or cross contaminated with uncooked food, but we are unable prove this. Fish commonly contain enteric pathogens (Norvotny *et al,* 2009). Improperly cooked fish products can cause food-borne illness (Norvotny *et al*, 2009). There is a report of food poisoning in Thailand caused by contaminated partly boiled fish balls (Tangkanakul *et al*, 2000); investigation identified contamination at a fish ball factory.

There were no severe illnesses in our study, no fever or dehydration needing intravenous fluid. This might be explained by the previously healthy status of the volunteers and staff as well as early detection and prompt treatment with empirical antibiotics. Antibiotic treatment does not shorten *Salmonella* gastroenteritis and has been reported to increase relapse rates (Mandell *et al*, 2010). The decision to give empirical antibiotics was made before knowing the pathogen. Food-borne organisms known to cause diarrhea and abdominal pain within a few days include: *Salmonell* spp, *Shigella*, *Aeromonas* spp, enteropathogenic *E. coli* (EPEC), enterotoxigenic *E. coli* (ETEC), *Campylobacter* spp, rotavirus and sometimes noncholera vibrios (WHO, 2008). Of those bacteria, antibiotic treatment is beneficial for treating *Shigella*, *Aeromonas* and *Campylobacter*-associated gastroenteritis (Mandell *et al*, 2010).

Actions taken to control this outbreak included enhanced hand hygiene, selection of well-cooked food for volunteers, isolation of symptomatic subjects and food preparation review, similar to a previously described nosocomial salmonella outbreak (Lee and Greig, 2013). Food safety in hospitals and healthcare settings is important because they may involve less healthy people and immunocompromised patients. Food preparation should follow Hazard Analysis and Critical Control Point (HACCP) principles (Lund and O'Brien, 2009). Precooked seafood, such as sliced fish cake, should be reheated to 75ºC for at least 2 minutes (Lund and O'Brien, 2009) prior to consumption.

There were several limitations in our study. First, it was a retrospective study in which there may have been recall bias. Second, the number of cases was small resulting in insufficient statistical power for analysis. Additionally, there were no leftover foods to culture.

In conclusion, this is a confirmed nosocomial *Salmonella* group C food-borne outbreak among trial volunteers and attending staff who worked in the study ward of a hospital. The high attack rate and the cluster of cases suggest a common source outbreak. Unfortunately, the implicated food item could not be confirmed due to the small number of cases and the food items were not cultured. Following implementation of control measures, no secondary cases were observed.

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