

AN UNUSUAL OUTBREAK OF FOOD POISONING

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Abstract. On August 25 1990, over 400 people who attended a Thailand handicappeds' sport day at a provincial physical education college developed gastrointestinal symptoms after having dinner. An epidemiological team want to determine cause(s) and recommend how to prevent and control a food poisoning outbreak. The investigation included interviewing all 1,210 persons who attended the sport's day. In addition, an environmental survey, laboratory analysis of food samples, and rectal, ear, throat and nasal swabs from foodhandlers were also performed. A case was defined as a person who ate any items of dinner food and experienced vomiting, nausea, abdominal pain, and diarrhea. There were 485 cases out of 1,094 persons, an attack rate of 43%. Interviews were completed for 470 out of 485 cases. The three most common symptoms were nausea (93%), vomiting (88%), and abdominal pain (81.5%). The mean incubation period was 3.20 hours. Three out of four items of food had a significant association with illness. Among these 3 items, eclairs had the highest crude relative risk, 7.0 (95% CI = 4.8, 10.2). For statistical analysis, logistic regression by unconditional method was used, and found that only eclairs which were prepared during the night before the dinner and kept at room temperature for at least 12 hours before serving, remained statistically significant in the model (RR = 11.96; 95% CI = 9-22). Laboratory examination of foods and foodhandlers indicated heavy growth of *Staphylococcus aureus* producing toxins A and C and *Bacillus cereus* in eclairs. Culture of nasal swabs from healthy foodhandlers identified *B. cereus* and *S. aureus* of different phage types from those in eclairs. The incubation period, symptoms, and the laboratory results suggested that enterotoxin produced by *S. aureus* or *B. cereus* was the most likely responsible agent for this outbreak caused by improper food handling practices.

INTRODUCTION

At 20.00 hours on Saturday August 25, 1990, on the occasion of the National Handicapped's sports event, 485 persons developed similar upper gastrointestinal symptoms 2-3 hours after having dinner. The severe cases were referred to the Chao Phya Yomarat General Hospital. Almost all of them were discharged within 1 day.

This sports event took place at Suphan Buri Physical Education College during 24-28 August, 1990. Approximately 1,300 persons participated, including teachers, students, trainers and the handicapped. Almost all of the participants stayed in buildings 1 and 2 at the College. On Sunday 26th, the epidemiological officers from Suphan Buri Provincial Public Health Office went to investigate reports of gastrointestinal symptoms suffered by participants and collected suspected food and drinks. A team from the Division of Epidemiology, Ministry of Public Health, was invited to participate in the investigation. The objectives were:

1. To determine the characteristics of this outbreak.
2. To recommend prevention and control measures of food poisoning outbreaks.

MATERIALS AND METHODS

Descriptive epidemiological study

Time, place, person: We interviewed persons who participated in the handicapped sports event at the hospital and their residential areas. Because of difficulty in communication with the handicapped persons, some of them were interviewed by the trainers.

Environmental study: First we went to the Supan Buri Physical Education College to see the residence, cooking places and eating places. Next we went to the foodhandlers' house, where eclairs were made, for interviews; we performed physical examination and collection of throat, ear and nasal

OUTBREAK OF FOOD POISONING

swabs. We also inspected the cooking place. Attempts to review Out-patient Department cards were unsuccessful because approximately 400 people were treated and released on that Saturday night and information was not recorded. Finally we visited a six month old boy who ate only eclairs and was ill, in order to find out more detail about clinical symptoms.

Analytic epidemiology

The study design was a retrospective cohort study. Statistical tests used were: relative risk, to demonstrate an association between eating food and drinks and the risk of being ill; logistic regression by the unconditional method was used to assess the effects of contaminated foods by controlling for potential confounders.

Definition

Ill was defined as a person who stayed in the Suphan Buri Physical Education College and ate the prepared dinner on Saturday 25 August 1990 and developed at least one of these four symptoms: nausea, vomiting, abdominal pain, diarrhea.

Not-ill was defined as those stayed in the Suphan Buri Physical Education College and ate the prepared dinner on Saturday 25 August 1990 and had no symptoms.

Laboratory study

Samples of food and drinks were collected from the Saturday night dinner for culture and chemical laboratory testing. In addition, rectal swabs for culture were performed from 15 persons at Chao Phya Yomarat General Hospital. All specimens were sent to confirm the laboratory test at the Department of Medical Science, Ministry of Public Health.

All suspected foods were cultured on blood agar plates.

RESULTS

Descriptive epidemiology

Time: There were approximately 1,300 persons who attended the sports event. We interviewed

1,210 persons. One hundred and thirteen persons did not eat any item of dinner food, and 3 persons who were ill had incomplete data. These 116 persons were excluded, resulting in 1,094 persons left for the study. Hence, there were 470 ill persons and 624 not-ill persons, an attack rate of 43%. The majority of people developed diarrheal symptoms around 8-12 pm on August 25 (case starting at 3 pm for the first case and followed by the last case at 9 am on August 26 ; Fig 1). The mean incubation period was 3 hours and 20 minutes after dinner. This large number of people who developed similar symptoms in a short period suggested that there was a common source of outbreak and the most probable meal was likely to be the dinner they had together on August 25, 1990.

Persons: According to 1,094 records there were 333 male cases (attack rate = 46.2%) and 137 female cases (attack rate = 36.7%).

From 470 cases the highest attack rate (70.0%) was in the less than 9 year old group (7/10). The second most common was 46.7% (417/913) in the age group 10-29 years and the third was 30.6% (34/111) in the age group over 30 years as shown Fig 2.

There were 378 cases out of 459 cases (11 had incomplete data) admitted at the Chao Phya Yommarat Hospital and almost all of them were discharged within one day.

The highest attack rate (66.9%) occurred in the handicapped group characterized by a mental defect, the second most common in those who had a physical handicap (55.3%), followed by those with

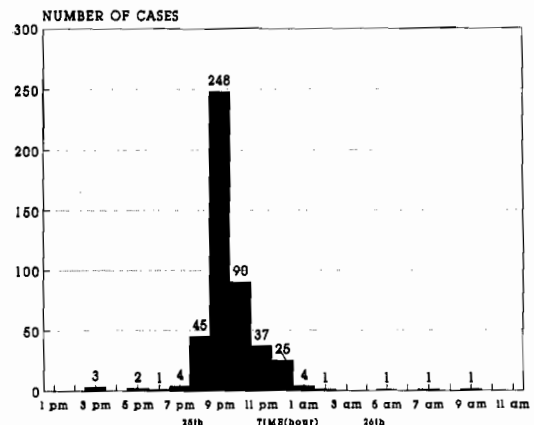


Fig 1-Epidemic curve of food poisoning.

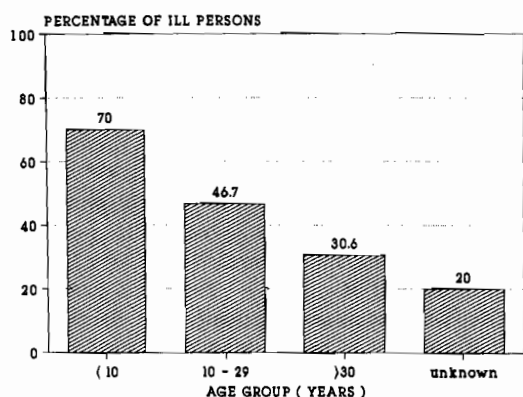


Fig 2—Age-specific attack rate.

hearing (37.5%) and visual (36.3%) handicaps. For those with an undertermined handicap for which data were limited, we found an attack rate of 48.8% as shown in Fig 3.

Four hundred and seventy ill persons with completed interviews reported upper gastrointestinal symptoms such as; nausea (92.8%), vomiting (88.3%), abdominal pain (383 cases, 81.5%), diarrhea (49.8%) and 31 cases (6.5%) reported other symptoms (headache, dizziness, fever) as shown in Fig 4.

Place: Participants were divided according to where they lived in 2 buildings at the Physical Education College, Suphan Buri. All of them had meals at the cafeteria on the ground floor of the buildings.

Foods were prepared freshly for each meal the College's kitchen before being distributed to each

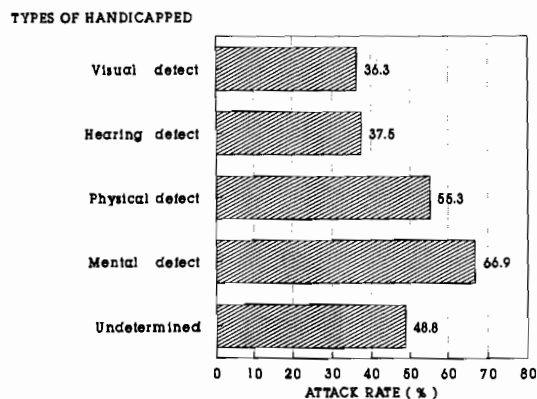


Fig 3—Attack rate by types of handicap.

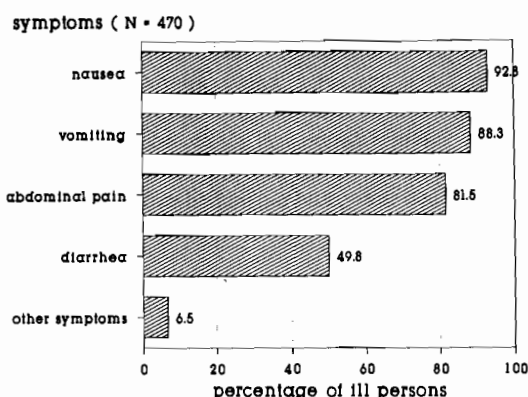


Fig 4—Symptoms of ill persons.

cafeteria. There was also another cooking place, the teachers' house kitchen, where eclairs were made. Sanitation in the teachers' house kitchen appeared to be better than the College central kitchen.

The cooks started making the outer shells of eclairs (from powder) at 16.00 hours on Friday 24 August. These components were baked in an oven at high temperature for 20 minutes and left to cool at room temperature. They began to make eclair cream at 3.00 am on Saturday 25 August, under low temperature and poured this into the outer shells; all processes were finished around 11.00 am. They packed 2 eclairs in one plastic bag (1 vanilla-flavor cream, 1 coffee-flavor cream) and put them into paper boxes for lunch but this was postponed to dinner.

There were 5 cooks, only 3 were available for interview, examination, ear, throat, and nasal swabs. Two of them were a married couple. Another one was the girl who lived with this couple. Except for the husband, who had thalassemic trait, all were healthy. They were normal for physical examination on the day we arrived and reported no history of being ill for at least 7 days prior to this outbreak. During 2 years of making eclairs as an extra job, they had had no such problem.

Analytic study

Food specific attack rate: From Table 1 we found that the ones who ate eclairs were 7 times more likely to become ill than the ones who did not. Similarly, the ones who ate beef curry and salt egg were 1.94 times and 1.86 times, respectively, more

OUTBREAK OF FOOD POISONING

likely to become ill than the ones who did not. Water consumption did not show any statistical significant effect on the illness.

Adjusted relative risk: There were significant increases in risk due to 3 items of food. To control for possible confounding factors, a multiple logistic regression by unconditional method was used. Eating eclairs was associated with food poisoning with an adjusted relative risk of 11.96 and 95% CI was from 9 to 22.

Dose-response relationship: To further assess the causal factor we assessed the dose-response relationship of eclairs and we found that the more eclairs consumed, the more likely people became ill as shown in Table 2.

Laboratory results

At the laboratory department of the Chao Phya Yommarat Hospital Suphan Buri Province, samples

collected on 26 August, 1990, were analyzed. Results are shown in Table 3.

The same samples which were collected on 26 August, 1990 and kept at 4°C were sent to the Department of Medical Science, Ministry of Public Health, for confirmation. The results are shown in Tables 4, 5, 6.

DISCUSSION

Besides the incubation period and clinical syndrome, additional clues to the etiology of an outbreak of food poisoning may be provided by the type of food responsible (Lynch and Hobbie, 1989; Evans and Feldman, 1982; Hodge, 1960). In this case it most likely due to dinner and eclairs appears to be implicated. More ill people had water than other item, as water was the only drink available.

When rates for eaters and non eaters are com-

Table 1
Crude relative risk of food and drinks.

Type of food and drinks	Ate		Did not eat		Crude RR	95% CI
	Ill	Not ill	Ill	Not ill		
Eclairs	445	340	25	284	7.01	4.8, 10.2
Beef curry	449	549	21	70	1.94	1.3, 2.8
Salt egg	449	553	21	66	1.86	1.3, 2.7
Water	460	604	10	15	1.10	0.7, 1.8

Table 2
Dose-response relationship of eclairs.

Eclair (pieces)	Not ill	Ill	RR	95% CI
0	270	15	1	
0.5 - 1	54	51	9.2	5.4, 15.7
2 - 4	225	299	10.3	6.2, 16.9
> 4	66	105	11.7	7.0, 19.4
Total	624	470		

Table 3
Laboratory data.

Specimens	Pieces	Result
Eclairs	20	
- culture		<i>B. cereus</i> , <i>Bacillus</i> sp.* (18) <i>B. cereus</i> , <i>Micrococcus</i> sp * (2)
- Gram stain		Gram positive bacilli
Beef curry	100 ml	negative
Salt egg	1	negative
Rectal swabs	15	negative

Note: *All had numerous bacterial colonies on blood agar plate, high *Bacillus* sp growth may have overgrown other bacterial species.

Table 4
Confirmatory laboratory data.

Specimens	Amount	Result*
Eclairs	18	
- microbiology		<i>S. aureus</i> (18*10 ⁷) (Toxin A, C)
- chemical		Negative for : metallic poison, zinc phosphide, insecticides
Salt egg	4	
- microbiology		<i>S. aureus</i> (14*10 ²)
- chemical		Negative for : metallic poison, zinc phosphide, insecticides
Beef curry	50 ml	
- microbiology		negative
- chemical		negative
Water (drinking, cooking, making eclair)	100 ml each	
- microbiology		negative
- chemical		negative

Note: *specific plate culture.

7 specimens from making eclairs (sugar, flour, salt, flavoring, cheese, baking powder, and milk) were negative result, as well.

pared, the implicated foods show the greatest differences in attack rates. The highest attack rate in the 0-9 age group (10 children, 7 of them were ill). This attack rate was due to the fact that

younger children tended to eat more eclairs than the older ones.

We had no opportunity to study why there was a high attack rate in the group with mental defects

OUTBREAK OF FOOD POISONING

Table 5

Results of swab culture.

Specimen	No.	Result
Nasal	1	<i>S. aureus</i>
	2	<i>B. cereus</i>
	3	<i>S. aureus</i>
Throat	1	<i>B. laterosporus</i>
	2	<i>Enterobacter cloacae</i>
		<i>K. ozaenae</i>
<i>B. cereus</i> plate cultures	4*	<i>Enterobacter cloacae</i>
		<i>B. cereus</i> (2) <i>B. laterosporus</i> (2)

Note: *These plates were collected from the Chao Phaya Yommarat Hospital laboratory.

Table 6
Phage typing results.

Specimen	<i>S. aureus</i> phage type
Cooks	
- No. 1	81
- No. 3	95
Eclairs	29/52/79/83A

(66.9%). However, the possibilities are: (1) More contaminated eclairs unevenly distributed to the mentally defective group than the others; (2) The mentally defective group could not differentiate between good eclairs and rotten eclairs.

The results of analytic epidemiologic study such as crude relative risk, adjusted relative risk and dose-response gradient suggested that eclairs were implicated in this outbreak.

Experiments on the survival and growth of six food poisoning organisms in stored goat's milk showed that *Bacillus cereus* or *S. aureus* survived quite well and multiplied at the higher storage temperature of 30°C (Roberts, 1985). The process of making eclairs took a long time from baking and filling (11 pots of cream and coffee flavored cream), packing (2 eclairs for each plastic bag) and distribution. This time at room temperature would

have allowed bacterial growth if the low temperatures used in cooking the cream filling did not kill bacteria, *B. cereus* spores and heat-stable toxin or if bacteria were introduced during filling.

Fenton *et al* (1984) reported unusually severe food poisoning from vanilla slices caused by *S. aureus*. They found unbaked custard provided an ideal environment for bacterial multiplication, especially when the ambient temperature was persistently high. In this outbreak, in the making process which took a long time, a low temperature was used for cooking, serving was postponed to dinner and packages were left in rather warm climate, all of which are good conditions for organisms to germinate, multiply, and produce enterotoxin.

Laboratory results both from the Chao Phya Yommarat General Hospital and the Department of Medical Sciences showed *B. cereus* was the causal agent; the emetic form is consistent because a short incubation period and the clinical features mentioned (Lynch and Hobbie, 1989). The same samples, which were kept in a refrigerator, were sent to Department of Medical Science and *S. aureus* was also identified by specific plate culture. Hence, the outbreak may possibly have been due to a dual infection. The evidence supporting a dual infection is:

1. Clinical symptoms were compatible with either *B. cereus* or *S. aureus*.

2. The significant number of specific pathogens recovered ($> 10^5$ per gram in epidemiologically implicated food) were too high to be a result of contamination during transfer to the other laboratory (Department of Medical Science).

3. Although there was a difference in the phage type between eclairs and the cooks who made eclairs, this does not rule out *S. aureus* as a causal agent because this organism may have come from another source such as poor sanitation and unclean practices in the kitchen or other foodhandlers. Environmental swabs from the kitchens were not available.

4. Windemann and Baumgartner (1985) who used sandwich ELISA with labeled antibody to determine staphylococcal enterotoxins A, B, C, and D, reported that enterotoxin type A was dominant in foods which were involved in food poisoning. Todd (1985) found that enterotoxins A through E were common causes of acute food poisoning characteristic by a short incubation period after ingestion of preformed toxin followed by nausea, vomiting, abdominal pain, and diarrhea. In this outbreak toxins A and C (*Staphylococcus*) were detected from eclairs and the clinical symptoms associated with these toxins were compatible with those reported by cases.

But there were some points which did not support a dual infection, namely:

1. Eclairs were left unrefrigerated at least 12 hours before being sent to the laboratory department of the Chao Phraya Yommarat Hospital and were kept refrigerated at least 48 hours before being sent to the Department of Medical Science, which was long enough to allow the growth of *S. aureus* in eclair samples before collection and during transfer. Thus, it may not be the causal agent.

2. Phage typing of *S. aureus* from the cooks did not match *S. aureus* from the eclairs. Other potential sources of *Staphylococcus* sp were not confirmed.

Conclusion

Unrefrigerated eclairs were reported as the vehicle of this outbreak indicating inadequate caution in the cooking process or in the manner of food handling. *B. cereus* was most likely to

responsible for this outbreak, while *S. aureus* was questionable of a co-infectant. Although *B. cereus* was isolated from nasal swab cultures from the foodhandlers, it was also very prevalent in the environment. The source of *Bacillus* sp in the eclairs could be either from the cooks or the environment. Most cases were discharged in one day. There were no fatal cases.

Recommendation

To prevent food poisoning outbreaks, attempts should be made to keep food uncontaminated. The food must be promptly, constantly, and adequately chilled. Actually, it is difficult in practice. Therefore, a possible way is to refrigerate food while it is still hot. The most rapid way of chilling food is to place it in flat, stainless steel pans in a freezing compartment rather than in the refrigerator. If food is not to be consumed immediately after preparation, it should be stored at refrigerator temperatures or rebaked at $> 190^\circ\text{C}$. for 30 minutes before serving. At a party, avoid serving cooked protein food, such as cream-filled pastries or any type of salad which takes a long time in preparation or which cannot be properly stored prior to serving, especially in a big party like this one.

Infection of food handlers has commonly been assumed to be the source of contamination of any food poisoning outbreak. This is not generally true except for some specific pathogens (*Salmonella* type, hepatitis A virus). However, it is recommended that food handlers who are clinically ill should be excluded from food preparation and serving until their symptoms resolved.

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OUTBREAK OF FOOD POISONING

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