A FOOD BORNE OUTBREAK OF GASTROENTERITIS DUE TO SHIGELLA AND POSSIBLY SALMONELLA IN A SCHOOL

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Abstract. On August 5, 2005, a private hospital reported a large number of students with gastrointestinal illness from the same school in Bangkok, Thailand. The Bureau of Epidemiology along with the Bangkok Metropolitan Administration investigated this outbreak, to determine risk factors, identify the source of infection and possible causative organism, and recommend prevention and control strategies. A case was defined as a person who was studying or working at School A and who developed abdominal pain, diarrhea, nausea or vomiting during the five-day period of August 4 to 8, 2005. A descriptive study was carried out for active case-finding, medical records review, and case interviews. We conducted the retrospective cohort study among third and fourth grade students. Stool samples were collected and tested at the Thai National Institute of Health and at private hospital laboratories. The overall attack rate was 37%. Main symptoms were diarrhea, fever, headache, abdominal pain, vomiting, and nausea. The highest attack rate (63%) was among fourth-grade students. Based on food-history data collected from ill and well students, a multiple logistic regression analysis showed that a mixed chicken and rice dish served for lunch on August 4 was associated with illness (OR 3.28, 95% CI 1.46-7.36). Among stools samples from 103 cases, *Shigella* group D was found in 18 cases, *Salmonella* group C in 5 cases, and *Salmonella* group E in 2 cases. This food borne outbreak of gastroenteritis was most likely caused by *Shigella* spp although the possibility of mixed contamination with *Shigella* and *Salmonella* spp cannot be ruled out. Food borne outbreaks such as this can be prevented through simple and effective hygienic measures.

INTRODUCTION

Food borne disease outbreaks are commonly reported from developing countries. They may be caused by various types of organisms, such as bacteria, parasites, and viruses, as well as chemical agents. In the USA from 1993 to 1997, over 2,700 food borne outbreaks were reported with most (75%) being caused by bacterial infections (Olsen *et al*, 2000). In most instances organisms are transmitted through consumption of contaminated food or water rather than through person-to-person contact (Niyogi, 2005). Children seem to be particularly susceptible to food borne disease, and some reports suggest that the virulence of food borne bacterial agents may be higher among younger children (Srison and Pornpatkul, 1995; Alamanos *et al*, 2000).

In Thailand, food borne disease outbreaks in schools are common (Thaikruea *et al*, 1995; Tangkanakul *et al*, 2000). In 2004, there were more than 20 such outbreaks reported to the Bureau of Epidemiology (BoE) of the Thai Ministry of Public Health (BoE, 2004). On August

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5, 2005, the BoE was notified by a private hospital of a large number of students from the same private school (School A) who sought care for diarrhea (some stools were bloody), fever, and vomiting. The outbreak was suggestive of a common-source of exposure at the school. The investigating team from the BoE and Bangkok Metropolitan Administration jointly investigated the outbreak to identify the source and possible mechanism of contamination and to recommend prevention and control strategies.

MATERIALS AND METHODS

Setting

Outbreak investigation was conducted at the school and five private hospitals where the students sought care. School A is a private co-educational facility that serves preschool (children age 3 to 4 years) through Grade 9 students. Available for interview were 4,164 students (93.3% of students) along with 147 teachers (49.8% of teachers) and 16 food handlers (100% of food handlers). The school is located in two main buildings, one for a regular program with 4,078 students and one for an English program with 86 students. The school serves milk at the morning break and lunch to all students and staff. Food prepared from the same kitchen is served to the regular and English program students in two separate canteens.

Epidemiologic investigation

We defined a case of outbreak-related illness as a student, teacher, or staff member, who developed abdominal pain, diarrhea, nausea or vomiting during the five-day period of August 4 to 8, 2005. We reviewed absentee records and interviewed teachers to identify cases. Grade 3 and 4 students had the highest attack rate, and were selected for a retrospective interview of food selection at the lunch served on August 3 and 4. After data collection, a number of students in those two grades who had previously been reported as well, reported symptoms similar to their friends, however very mild. To reduce the information bias, we decided to exclude this group of students in the subsequent analysis, because it was not clear whether to put them into the case or non-case categories. Odds ratios were calculated for implicated food items, and tested for significance using the chi-square statistic, with a p-value of ≤ 0.05 defined as significant. Multivariate analysis was conducted comparing ill to unaffected students to determine the adjusted odds ratios (OR) for significant risk factors. We analyzed data using Epi Info version 3.3.2 (CDC, Atlanta, Georgia).

Laboratory and environmental analysis

Rectal swabs and vomitus from ill students were tested at hospital laboratories at which the cases were initially seen and also at the Thai National Institute of Health (NIH). We also collected rectal swabs from food handlers and swabs of kitchen utensils, food items, and water, all of which were tested at the NIH for anaerobic and aerobic pathogenic bacteria.

RESULTS

We identified 1,598 ill students, corresponding to an attack rate (AR) of 37%. There were no cases among the 86 English program students, but 13 among the teachers (AR 9%) and one among food handlers (the affected food handler only washes dishes). The AR was highest (63%) among students in Grade 4. Fifty-three percent of ill students sought medical attention at adjacent hospitals, and 19% of ill students were hospitalized (Table 1). The first case had an onset on the evening of August 4, and the number of cases peaked on the afternoon of August 5 (Fig 1). Among the 1,553 students for whom detailed clinical information was available, the most common manifestations were diarrhea (76%), fever

Table 1
Attack rate by population group in School A, 4 August to 8 August 2005.

Target population	Number of target population subjects	Number of study population subjects	Number of affected population subjects	Attack rate (%)
Pre-elementary 1	233	226	24	11
Pre-elementary 2	263	257	40	16
Pre-elementary 3	289	277	160	58
Grade 1	431	414	16	4
Grade 2	487	467	105	22
Grade 3	594	559	258	46
Grade 4	592	548	344	63
Grade 5	590	554	283	51
Grade 6	605	572	301	53
Grade 7	74	71	25	35
Grade 8	69	68	0	0
Grade 9	66	65	28	43
English program students	86	86	0	0
Food handlers	16	16	1	6
Teachers	295	147	13	9
Total	4,690	4,327	1,598	37

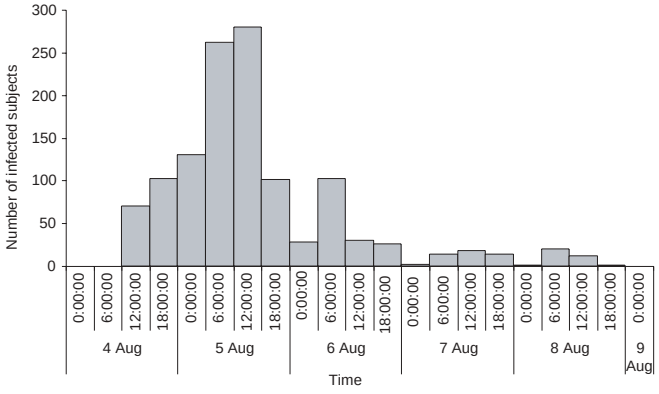

Fig 1–Distribution of food poisoning cases by time of onset, School A, 4-8 August 2005 (*n*=1,203).

(72%), headache (63%), abdominal pain (57%), vomiting (35%) and nausea (27%).

The school prepares milk, lunches and dessert for all students. A few food shops are also available for the children inside and outside the school. Due to the large number of students, School A has to prepare more than 5 batches for each menu. Raw and ready-to-eat food are prepared on the same site. Chicken and rice, which was the menu for lunch on August 4, was prepared two different ways, either with the chicken mixed into the rice or the chicken and rice served separately. The chicken was boiled and sliced into small pieces on a wooden chopping boards. It was then mixed with cooked rice by 3 food handlers, who used short plastic gloves while stirring a large pot (none of them had gastrointestinal tract infection symptoms during the week prior to the outbreak). The mixed chicken rice was held one to two hours at room temperature before serving to the regular program students. The chicken and rice were served separately for the English program students.

Of the 1,187 students in Grades 3 and 4 we were able to interview 1,111 (94%). Three hundred and sixty-three students were excluded from the final analyses because the outcomes were ill-defined, which left 748 students. Of these 748 students, 367 (49.1%)

developed disease and 381 (50.8%) did not. By unadjusted analyses, a lunch dish on 4th August (chicken mixed with rice) and a lunch dish on 3rd August (fried spaghetti) was associated with disease. On multivariate logistic regression analysis, the adjusted odds ratio for developing disease were 3.28 (95% confidence interval, 1.46-7.36) for students who ate the chicken mixed with rice dish (Table 2).

Of 78 samples submitted to private hospital laboratories, *Shigella sonnei* group D was found in 17 (22%), and *Salmonella* group C serovar Corvallis was found in one (1%). Of 25 samples submitted to NIH laboratories, *Shigella sonnei* group D was found in one (4%) and *Salmonella* spp was found in six (24%). Of the six *Salmonella* isolates, four were Group C and two were Group E. Group C serovars were Corvallis (three samples) and Virchow, and the Group E serovars were Senftenberg and Anatum. There were no dual infections among the students. Rectal swabs from two food handlers were positive for *Salmonella*, Group C serovar Corvallis and Group I (*enterica* subsp, *Enterica* serovar.16:b). No pathogenic bacteria or enterotoxins were found in drinking water, used water, ice, milk, preserved tamarind, sugar, margarine, or from swabs from food handlers' hands or kitchen utensils. We could not collect food samples of the suspected lunch items because they had been discarded before the investigation.

DISCUSSION

We found evidence of two enteric pathogens in this outbreak: *Shigella sonnei* and *Salmonella* spp. Although, we were unable to ascertain definitive causality in our study, the clinical symptoms, especially the prominence of fever, suggests that *Shigella sonnei* was the major source of the outbreak (Heymann, 2004), if it was indeed caused by a single organism. In Thailand, salmonella carriage is found more often than shigella carriage (3.3% and 0.8%, respectively) (Sakdisiwasdi *et al*, 1982). We cannot definitively state that shigella was the only cause of the outbreak since 4 of 6 students who grew out salmonella had the same strain (Group C serovar Corvallis) as one food handler. We also note that four other students grew other serovars of salmonella as did one food handler, suggesting that carriage of salmonella in Thailand is relatively common, as has been found in previous studies: 12.9% in Thai army personnel (Khoprasert *et al*, 2000) and 9.5% among food handlers and ice factory workers in Bangkok (Pokawattana, 2001).

Shigella was recovered from only 22% of patients in private hospital laboratories and

Table 2
Crude and adjusted odds ratios for acute gastroenteritis association with suspected foods.

Date	Food items	Exposure		Non-exposure		Crude OR (95% CI)	Adjusted OR (95% CI)
		Case	Non-case	Case	Non-case		
3 Aug 05	Milk	348	363	14	10	0.68 (0.30-1.56)	1.13 (0.32-3.95)
	Fried spaghetti	332	326	24	45	1.91(1.14-3.21)	1.68 (0.92-3.07)
	Sweet sticky rice	71	77	285	291	0.94 (0.66-1.35)	0.89 (0.59-1.33)
4 Aug 05	Milk	340	351	24	26	1.05 (0.59-1.86)	0.71 (0.27-1.90
	Chicken mixed with rice	349	332	14	40	2.19 (1.09-4.41)	3.28 (1.46-7.36)
	Pineapple in syrup	153	140	205	234	1.25 (0.93-1.68)	1.27 (0.91-1.78)
Food shop inside school		197	210	168	167	0.93 (0.70-1.25)	0.91 (0.66-1.26)
Food shop outside school		80	86	282	291	0.96 (0.70-1.36)	0.99 (0.68-1.46)
Drinking water		252	248	104	114	1.11 (0.81-1.53)	1.18 (0.83-1.66)

only 4% of patients at the NIH laboratory. This may be due to less than optimal specimen collection. Since shigella is extremely fastidious and survives poorly in stool samples that are left in ambient temperature, specimens should be fresh, plated quickly onto solid media or inoculated into transport media and refrigerated before inoculation (Wells and Morris, 1981).

The epidemic curve is consistent with a common source outbreak, but additional person-to-person may have occurred, which is a common mode for spread of shigella. Thus, the odds ratio for the chicken mixed with rice (3.28) might underestimated the real figure. We could not conclude that contamination was not introduced by an infected food handler, since shigella was not recovered from any of the food handlers. Shigella can have asymptomatically carriers, and negative culture results do not mean they do not have shigella. It is also possible that some food was contaminated before it reached School A. Previous outbreaks have shown that shigella can present in various food items, *eg*, baby maize (Anonymous, 1998), fresh parsley (Anonymous, 1999), and iceberg lettuce (Kapperud *et al*, 1995). Shigella can survive up to 26 days at room temperature (Hutchinson, 1956), and can grow rapidly in food ingredients held at ambient temperature (Wu *et al*, 2000). In this outbreak, several food ingredients (*eg*, chicken, vegetables, or pineapple) could have been the source, and cross contamination between food ingredients might have occurred as they were prepared in the same area and the same utensils were used. The contamination may have occured in some batches during processing. Thus, there was great variation in attack rates between classes.

We recognize several limitations of our study. The investigation took place about 24 hours after the suspected meal. At that time, no remaining food could be collected for laboratory testing. There was panic in the school during the investigation and most subjects were small children, and therefore, information about food consumption and the onset of symptoms may not have been reported correctly. However, we simplified the study questionnaire to minimize misclassification and recall bias.

Following the outbreak, recommendations were made to the school regarding proper food preparation. Kitchen appliances used for raw food preparation and cooked food should be separated to prevent cross contamination, and all cutting boards and utensils should be washed frequently. The two food handlers with positive stool cultures were removed from food handling until two subsequent bacterial cultures were negative. Food handlers in the affectd community were instructed to have health check up-ups at least once a year, and they should be trained and evaluated periodically for hygienic practices. Proper hand washing before eating and after using the toilet should be promoted among students to prevent secondary spread.

ACKNOWLEDGEMENTS

We would like to acknowledge the Field Epidemiology Training Program-Thailand staff and trainees, the Bureau of Epidemiology, Ministry of Public Health, Epidemiological Subdivision of the Disease Control Division; the BMA Health Department, Drs Vibhavadi, Mongkutwattana, and Meyo, the Ramathibodi Central General Hospital; and the investigated school for their contributions to this investigation. Special thanks to George Rutherford, Tom Novotny and Hjordis Foy for reviewing, giving constructive advice and English editing of this manuscript.

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