Outbreak, Surveillance and Investigation Reports
Field Epidemiology Training Program, Bureau of Epidemiology
Department of Disease Control, Ministry of Public Health, Thailand
Tel: +6625901734-5, Fax: +6625918581, Email: osireditor@osirjournal.net, http://www.osirjournal.net

Salmonella Food Poisoning in an Army Camp, Northern Thailand, October 2009

Wathee Sitthi[1,*], Santayakorn S[1], Wongphruksasoong V[1], Poonaklom P[1], Piraban T[2], Kumpeera S[3], Piyaworakul D[3], Sermsuk A[4], Nisawatthananan P[4], Khadthasrima N[5], Thammawijaya P[1]

1 Field Epidemiology Training Program, Bureau of Epidemiology, Department of Disease Control, Ministry of Public Health, Thailand

2 Wang Nuea District Health Office, Wang Nuea District, Lampang Province, Thailand

3 Wang Nuea Hospital, Wang Nuea District, Lampang Province, Thailand

4 Lampang Provincial Health Office, Lampang Province, Thailand

5 Chae Hom Hospital, Chae Hom District, Lampang Province, Thailand

* Corresponding author, email address: aumaummed@hotmail.com

Abstract

On 16 Oct 2009, a provincial health officer notified to the Thailand Bureau of Epidemiology that 50 Army Reserve Force Students (ARFS) from a two-week training camp in a northern province received treatment at a hospital for diarrhea in the past two days. An outbreak investigation was initiated to verify diagnosis, identify risk factors and recommend control measures. We reviewed medical records and interviewed all camp participants to identify ARFS with diarrhea. A retrospective cohort study was conducted to identify risk factors. A total of 257 diarrhea cases were identified from 470 people at the camp, including 256 ARFS (AR=57%) and one trainer (AR=17%). Common symptoms included abdominal pain (85%), loose stool (83%), fever (63%) and watery diarrhea (59%). Green chicken curry in coconut milk served at dinner on 12 Oct 2009 might be a risk factor (Adjusted odds ratio=4.5, 95% confidence interval=0.5, 42.1). No food or raw materials of the suspected meal was left for laboratory testing. Rectal swabs from seven patients and four food handlers, including the cook who prepared the suspected meal, were tested positive for *Salmonella* serogroup B. The outbreak suggested a common source. Food sanitation, particularly health screening for food handlers, should be emphasized for mass gathering.

Keywords: Salmonella, food poisoning, Army Reserve Force Students, Thailand

Introduction

Bacterial foodborne infections are a common type of infection. Non-typhoidal *Salmonella* species are important causes of bacterial foodborne infections and public health problems worldwide.[1] In the United States during 1993-1997, over 2,700 foodborne outbreaks were reported, with majority (75%) were caused by bacterial agents.[2] In most instances, organisms are transmitted through consumption of contaminated food or water rather than through person-to-person contact.[3] Foodborne outbreaks of *Salmonella* have often been reported in institutional settings such as schools and nursing homes, and consumption of contaminated eggs or poultry were the common sources.[2] In Singapore, a *Salmonella* outbreak occurred in a military camp in January 2007. An investigation reported that the mashed potato was the most likely food associated with infection and food preparation in large quantities increased the risk of food contaminatation.[4]

In Thailand, foodborne diseases have been major problems for many years, with around 100 foodborne outbreaks reported annually.[5] Foodborne disease outbreaks associated with schools were commonly identified.[6] In 2007, two outbreaks of foodborne disease were reported from camps in Thailand: one in a scout camp and one in a military camp. Although the suspected foods were seafood soup and mushrooms, no causative organism was isolated. During 2008, more than 50 foodborne outbreaks in schools were reported to the Bureau of Epidemiology (BOE) of the Thailand Ministry of Public Health, including one outbreak in a scout camp. The suspected source of infection was green beans, yet no

causative organism was tested positive. Of these foodborne outbreaks, six and three outbreaks were due to *Salmonella* infection in 2007 and 2008 respectively.[5]

On 16 Oct 2009, the BOE was notified by a provincial health officer that 50 people in an Army Reserve Force Students (ARFS) camp had been treated at a hospital for diarrhea in the past two days. The BOE team, the staff from Provincial Health Office and the local Surveillance and Rapid Response Team (SRRT) conducted an investigation on 12-23 Oct 2009 to verify the diagnosis, describe the characteristics of the outbreak, identify the source and risk factors of infection, control the outbreak and recommend appropriate prevention measures for future food poisoning outbreaks in ARFS camps.

Methods

Setting

Training in the ARFS camp began on 12 Oct 2009 and lasted for 12 days. The camp was organized at the School A located in central part of a rural district. People from five schools in the same province participated in the camp. There were 493 persons in the camp at the time of the outbreak, including 467 students (359 males and 108 females), seven military trainers, five school teachers, four cooks and 10 cooks' helpers.

Although the ARFS camp included students from three classes, students were grouped by training year. The students were not permitted to go outside during the training period. General activities for ARFS in the camp are shown in Figure 1.

Food in the camp was prepared by four cooks from the School A. They usually bought fresh food, ingredients and seasoning from a local market located near the school. Each chef took turns in preparing the meals, with two or three assistants. The first meal in the camp was started on 12 Oct 2009 and the last meal on 23 Oct 2009. Three meals were provided to school teachers, military trainers and ARFS every day. Each meal for ARFS included two food items whereas three items were prepared for school teachers and military trainers which included two items similar to the ARFS and one additional item.

Epidemiologic Investigation

We performed active case finding and a descriptive study in the camp using self-administered questionnaires and reviewing 60 medical records of ill people from the camp. Information included demographic characteristics such as age, gender, occupation, training year and school; clinical information such as signs, symptoms, date and time of onset, and treatment; risk factors such as suspected food consumed at the camp; and risk behaviors such as not washing hands before eating, drinking water from a friend's glass, eating with a friend's spoon and eating with bare hands.

We defined a suspected case as a student or staff who joined the ARFS camp during 12-22 Oct 2009 and had at least one of the following symptoms: watery diarrhea, mucous or bloody stool; or had at least three of the following symptoms: loose stool, tenesmus, abdominal pain, fever, nausea, or vomiting.

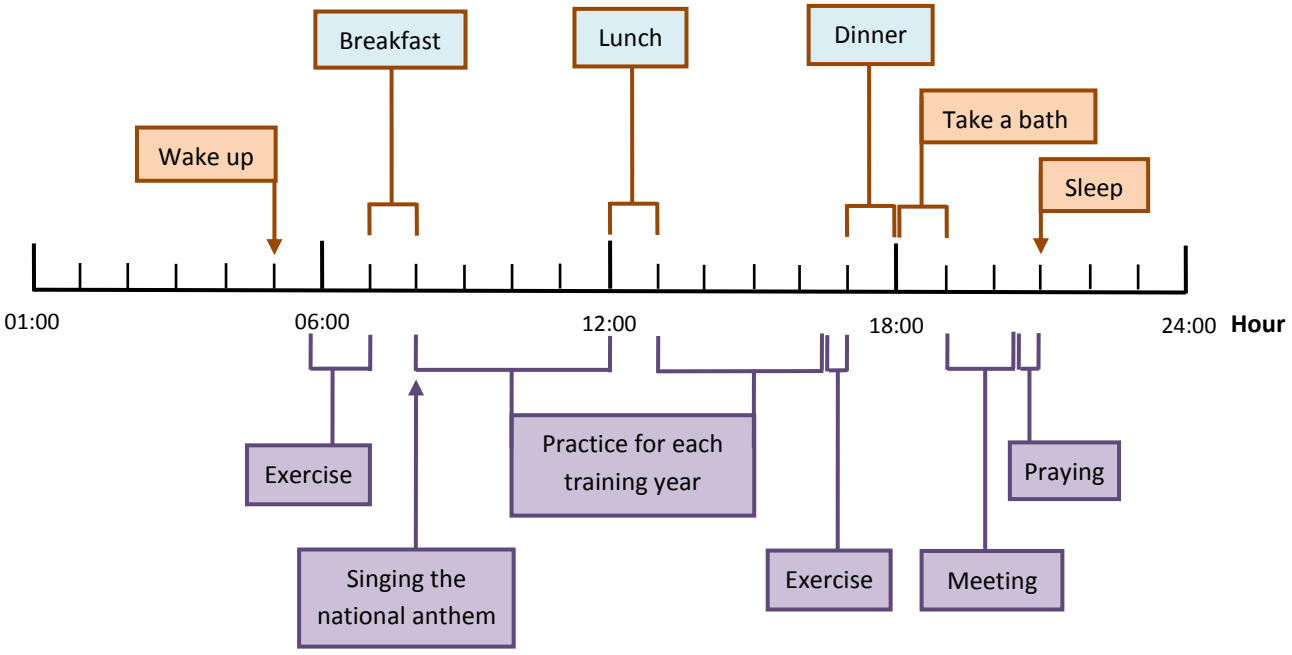

Figure 1. Daily activities in Army Reserve Force Students (ARFS) Camp, Thailand, 12-22 Oct 2009

A confirmed case was a suspected case that was tested positive for *Salmonella spp.* in stool culture while a carrier was an asymptomatic person with positive stool culture.

Environmental and Laboratory Study

We conducted an environmental study by reviewing the food menu and drinking water consumed in the camp, interviewing cooks and cooks' helpers about history of illness before the outbreak, food preparation and cooking processes, and observing the food preparation processes and eating behavior of students in the canteen during lunch. We also surveyed kitchen, cooking areas, water sources and toilets.

Rectal swabs from all ARFS with diarrheal symptoms on 16-20 Oct 2009, hand swabs and rectal swabs of cooks and cooks' helpers, and swabs from kitchen equipment were collected. In addition, samples of bottled drinking water and tap water were obtained. All specimens were sent to a laboratory in the provincial hospital for bacterial culture.

Statistical Analysis

A retrospective cohort study was conducted among students who attended the ARFS camp during 12-22 Oct 2009. Cases were either suspected or confirmed food poisoning cases identified in the descriptive study. Risk ratios were calculated for suspected risk behavior and food item, and were tested for their association with the disease by using the Chi-square, with a p-value of 0.05 or less defined as being statistically significant. Multivariable analysis (logistic regression) was conducted to calculate the adjusted odds ratio (OR) in order to identify the significant risk factors. We selected variables with a p-value 0.20 or less to be included in the adjusted model and used the backward approach to fit the model. Epi Info version 3.5.1 was used for statistical analysis (US CDC, Atlanta).

Results

Epidemiologic Investigation

During our investigation, 470 (96%) out of 493 persons in the camp returned the questionnaires. We identified 257 ill persons, corresponding to an attack rate of 55%, which included 250 suspected cases and seven confirmed cases. Seven out of 55 rectal swabs from ARFS were tested positive for *Salmonella* serogroup B by bacteria culture. Four rectal swabs from two cooks and two cooks' helpers were also cultured positive. The female to male ratio of all patients was 1:2.9 and the median age was 17 years old (Interquartile range=16-18). The attack rate for females and males was 59% and 53% respectively. Sixty people received treatment at a hospital (45 out-patients and 15 in-patients). The attack rate was the highest among the ARFS (57%). There was only one case among trainers (attack rate=17%) and no case among cooks and cooks' helpers. A few people had illness onset on 12 and 13 Oct 2009. The number of cases increased rapidly on 14 Oct and reached its peak on 15 and 16 Oct 2009 (Figure 2).

There was an unusual event on 14 Oct 2009. On that day, the ARFS were punished to mix and ate the food with their bare hands during lunch.

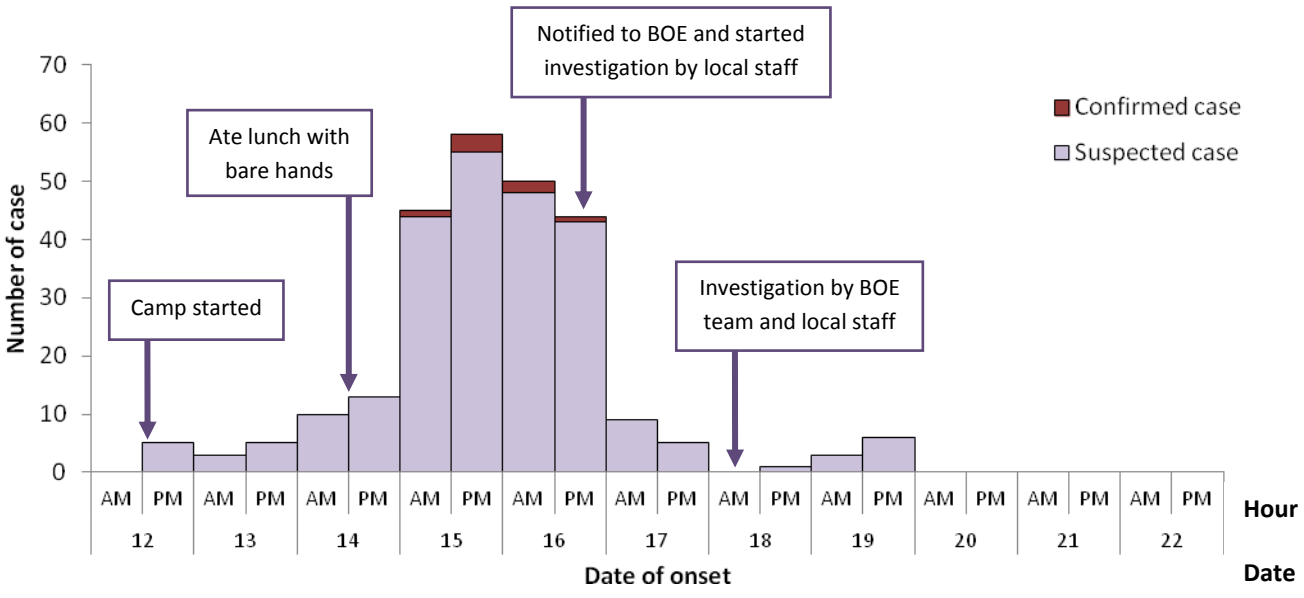

Figure 2. Number of food poisoning cases by date and time of onset in Army Reserve Force Students (ARFS) Camp, Thailand, 12-22 Oct 2009 (n=257)

The local SRRT notified the BOE about the outbreak and started the investigation on 16 Oct 2009. The joint team with BOE investigated again on 18 Oct 2009. The cases were distributed throughout all training years. The attack rate was highest among ARFS in the third training year (65%), followed by the first year (54%) and the second year (49%). Among the 257 cases (250 suspected cases and seven confirmed cases) with detailed clinical information, the most common manifestations were abdominal pain (85%), loose stool (83%) and fever (63%) (Figure 3).

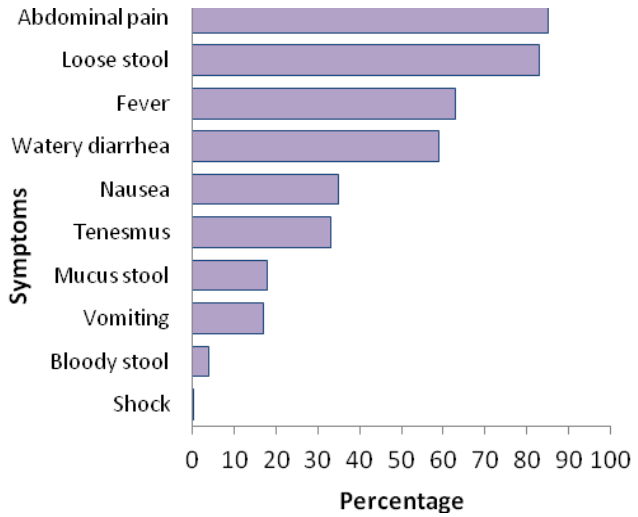

Figure 3. Symptoms of food poisoning cases in Army Reserve Force Students (ARFS) Camp, Thailand, 12-22 Oct 2009 (n=257)

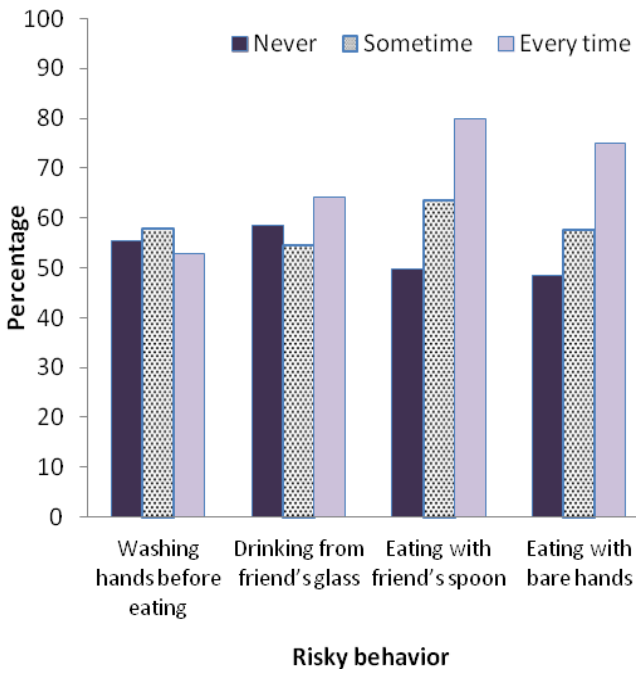

Figure 4. Attack rate by risky behavior of Army Reserve Force Students (ARFS) Camp, Thailand, 12-22 Oct 2009

We classified proportion of risk behavior into three groups: never, sometimes and every time. We found that the attack rates for hand washing before eating in each group were quite similar (55.5%, 57.9% and 52.9% respectively). However, the attack rate was higher for those who drank from a friend's glass, ate with a friend's spoon and ate with bare hands every time than that of those who behaved only sometimes or never (Figure 4).

Environmental and Laboratory Study

We surveyed the kitchen area and observed that raw and cooked foods were prepared near the canteen, and the dish washing zone was next to the preparation zone.

Cooks and cooks' helpers did not wear gloves for food preparation. Raw meat, raw vegetables and cooked food were kept together in the same cooler box. Sometimes, cooks used the same cutting board for raw meat and vegetables.

Cooking time and serving time are shown in Figure 5. Most food items contained egg, chicken and pork. Although each food item was cooked, it was served cold because cooks' helpers prepared the food, drinking water and utensils on the dining tables one to two hours before the meal time. The health screening of all cooks and cooks' helpers on 18-20 Oct 2009 did not find any person with the symptoms. However, they did not get the annual health check-up.

There was a hand washing zone in front of the canteen, but no soap was provided. The ARFS had little time to wash their hands and we found that all participants used the same toilet near the canteen. Although it appeared to be clean, there was no soap for hand washing.

We also surveyed the water supply in the camp and identified two sources of drinking water – the school water tank and the tap water tank. The school water tank was filled from a pond at the School A while the tap water tank was from the provincial waterworks authority. The camp mostly used water from the school water tank to supply canteen and toilet because water from the tap water tank was more expensive. On 18 Oct 2009, residual chlorine was measured in nine water samples. Eight samples from the school water tank and the tap water from the building and kitchen area had residual chlorine level of less than 0.2 ppm while one sample from the tap water tank had 0.5-1 ppm.

Drinking water and ice were bought from a water and ice factory which had been awarded for Good Manufacturing Practice (GMP). The ice was sent to

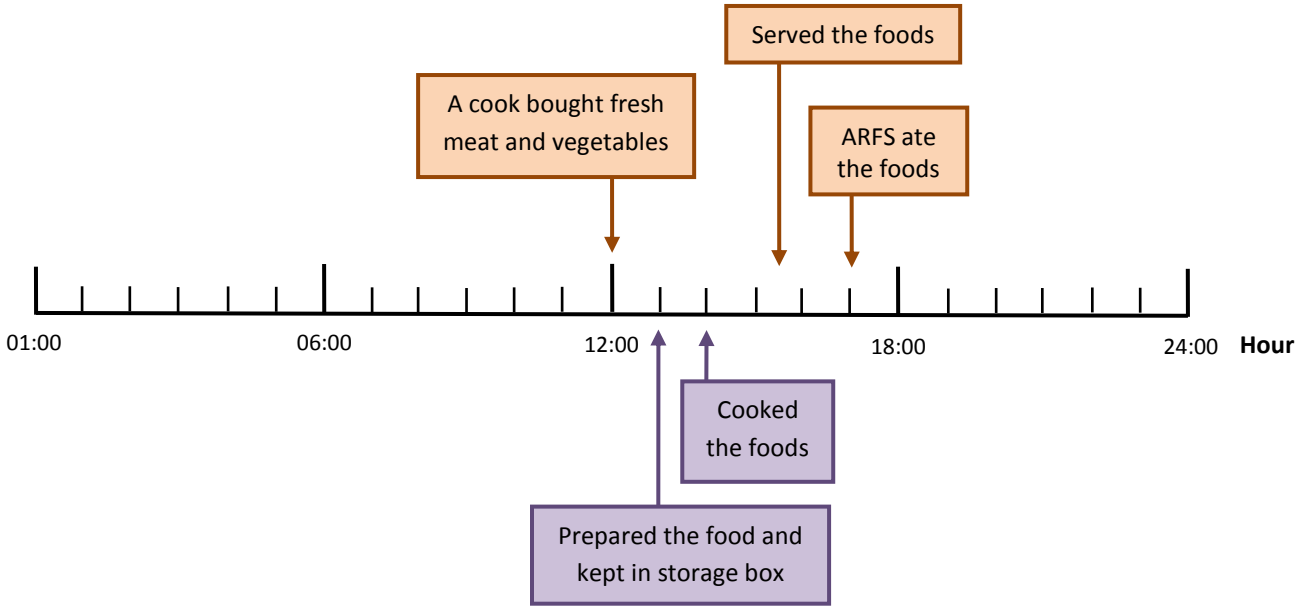

Figure 5. Timeline on food preparation for dinner in Army Reserve Force Students (ARFS) Camp, Thailand, 12-22 Oct 2009

the laboratory for testing bacteria and the results revealed negative.

The four cooks bought fresh food and ingredients from a local market located near the camp where food venders sold in the mornings and evenings. There were several kinds of food such as raw meat, vegetables, ingredients and fruits. The market was separated into four zones (cooked food zone, seasoning zone, raw meat zone and vegetable zone) and had been awarded with the "Clean Food, Good Taste" logo.

Laboratory Testing

Of 71 specimens sent for bacterial culture, 11 rectal swabs were positive for *Salmonella* serogroup B, which included samples from seven ARFS who had diarrheal symptoms and asymptomatic four cooks and cooks' helpers. Neither pathogenic bacteria nor coliform bacteria were found in hand swabs from cooks and cooks' helpers, bottled drinking water, tap water and kitchen equipment.

Statistical Results

From univariate analysis, we identified three potential risk factors: being female, being in a higher training year and eating with bare hands. The foods with a p-value of 0.2 or less included bean noodle soup, green chicken curry in coconut milk, and vegetable and pork soup.

Table 1. Univariate and multivariate analysis of risk factors and suspected foods in Army Reserve Force Students (ARFS) Camp, Thailand, 12-22 Oct 2009 (n=257)

Variable	Exposed		Non-exposed		Crude RR (95% CI)	Adjusted OR* (95% CI)
	Case	Non-case	Case	Non-case		
Female gender	65	31	191	163	1.3 (1.1-1.5)	1.7 (1.0-2.7)
Higher training year	101	54	155	140	1.2 (1.1-1.5)	1.6 (1.1-2.4)
Eating with bare hands	221	157	35	37	1.2 (0.9-1.6)	1.3 (0.8-2.2)
Bean noodle soup (lunch on 12 Oct)	250	189	1	5	3.4 (0.6-20.5)	3.0 (0.2-41.3)
Green chicken curry in coconut milk (dinner on 12 Oct)**	250	189	1	5	3.4 (0.6-20.5)	4.5 (0.5-42.1)
Vegetable and pork soup (breakfast on 14 Oct)**	218	186	3	8	2.0 (0.8-5.2)	1.5 (0.3-6.8)

** Final multiple logistic model included all cases and was adjusted for all variables in the table.*

*** The cook who prepared the meal was a carrier.*

On multiple logistic regression analysis, the adjusted OR for females was 1.7 (95% confidence interval = 1.0-2.7) and for persons in higher training years was 1.6 (95% confidence interval = 1.1-2.4). No food item was significantly associated with the illness. However, the green chicken curry in coconut milk had the highest OR of 4.5 (95% confidence interval = 0.5-42.1) (Table 1).

Discussion

Interpretation of Results

In Thailand, *Salmonella* serogroup B is the most common among patients with non-typhoidal *Salmonella* diarrhea.[7] Several *Salmonella* serogroup B outbreaks in Thailand have been reported to the BOE in recent years. In 2006, there were four outbreaks in prisons, camps of construction workers and villages. Suspected foods were raw pork, raw minced pork and raw beef respectively. In 2007, there was one outbreak reported in a village, and the suspected food was raw meat.[5] In the past, most of the suspected food items associated with the outbreak were uncooked. However, the suspected food related to this outbreak was cooked. In this outbreak, the overall attack rate (55%) was similar to those from other outbreaks reported in Thailand (30-65%).[5] The most common symptoms of non-typhoidal *Salmonella* infection are diarrhea, abdominal cramps and fever,[8] which are consistent with the clinical manifestations of the outbreak described in this report.

The epidemic curve suggests a common source outbreak and the results from our study indicated that the green chicken curry in coconut milk, which was served at dinner on 12 Oct 2009, was the likely cause of the outbreak. The cook who was a *Salmonella* carrier prepared this meal. Even though the green chicken curry in coconut milk was cooked, the contamination could have occurred during the preparation process because the cook used the same cutting board for raw meat and vegetables. After the curry was cooked, the cook garnished the curry with chili, kaffir lime leaves and sweet basil with bare hands before serving. *Salmonella* in form of biofilms could survive and resist disinfection on leafy vegetables.[1] Moreover, the food was kept for two hours at room temperature before being eaten. This could allow *Salmonella* to multiply[4] and the contamination might be likely if cooks and cooks' helpers were *Salmonella* carrier. In addition, as food sanitation was not well established in the camp, it might increase the risk of contamination.

The residual chlorine levels in some areas of the camp were below the standard level and might not be strong enough to disinfect the infectious concentration of *Salmonella* in contaminated raw food and raw vegetables. High chlorine level in water could substantially reduce *Salmonella* contamination.[1]

Action Taken

We continued active case finding and follow-up of all students until two weeks after the camp finished. We also provided health education to the ARFS, military trainers, school teachers, cooks and cooks' helpers; cleaned the kitchen area with chlorine; and recommended that the water supply should be adequately chlorinated. Food handlers in the camp, who were *Salmonella* carriers, were recommended not to handle food until they had tested negative for *Salmonella* by rectal swab culture for the second time. No additional cases of diarrheal illness were reported in the camp, and no case associated with this outbreak occurred in nearby communities. In this investigation, early detection of the outbreak by the local staff and good co-operation between participants in the camp and the investigation team might have prevented infection spreading into nearby communities.

Limitations

We experienced several limitations in this outbreak investigation because the hospital had no facility for molecular analyses and typing of *Salmonella* samples such as Pulsed Field Gel Electrophoresis (PFGE) which would conclusively show that all rectal swab cultures had the same pathogenic strain. In addition, no left-over food was tested for bacterial contamination and since our multivariate analysis was not completed in time, we could not adequately evaluate the suspected meal and the associated food while we were at the camp. Furthermore, we also found some limitations in standards for food sanitation in the camp. These limitations reflected lack of understanding of the camp staff and inadequate budget to provide a sanitary storage space for food items, clean drinking water and relevant training for managerial and cooking staff. Strict rules for training activities and extremely rigid schedules made it difficult to convince training staff that adequate time should be provided for proper hand washing. Although we surveyed the market in this outbreak, we did not collect any specimen from the market such as food and seasoning.

Recommendations

Our recommendations for food handlers in such setting included that food preparation materials for

raw meat and vegetables should be completely separated, and the cooked and raw food should be separately stored, as well as for meat and vegetables. We also recommended that all food handlers should wear gloves, frequently wash their hands during food preparation and have the health check-up at least once a year. The camp or school staff must provide adequate time for hand washing during training. Soap should always be provided at the hand washing station and water supply in the camp should be adequately chlorinated. The provincial waterworks authority should provide adequate chlorinated water in this area for prevention of extensive outbreak. The officers from community hospitals and local Provincial Health Office should strengthen surveillance for diarrhea and food poisoning in hospitals and communities, and food samples should be collected and stored well, if possible, in order to identify the possible sources of outbreaks or diarrheal illness. For future investigation, after a pathogenic agent has been identified, it should be tested by molecular analysis and typing such as PFGE to determine the pathogenic strain. The suspected meal and food should be evaluated in the field to identify the source, and prevention and control measures should be applied in a timely manner.

As the outcomes after the outbreak, the carriers were not allowed handling of food as long as they shed the organism and until their rectal swabs were cultured negative in the second test. No additional case was identified in the camp and no transmission occurred in the communities.

Conclusion

The food poisoning outbreak occurred in an ARFS camp; *Salmonella* serogroup B was the causative organism. The ARFS had the highest risk. This outbreak might have been caused by a common source of food item consumed at dinner on 12 Oct 2009, yet this was not confirmed because the relevant food items were not available for testing. Major recommendations should emphasize on food sanitation, especially associated with food storage, food handling and screening for carriers among food handlers.

Acknowledgements

We would like to acknowledge the staff and trainees from Thailand Field Epidemiology Training Program, and the staff from Bureau of Epidemiology, Ministry of Public Health, 10th Regional Office of Disease Prevention and Control, Lampang Provincial Health Office, Wang Nuea District Health Office, Wang Nuea Hospital, Wang Nuea School, ARFS Camp and Dr. Naretrit Khadthasrima for their contribution to this investigation and also to Dr. Elliott Churchill, the Editor of MMWR, for editing the manuscript.

Suggested Citation

Sitthi W, Santayakorn S, Wongphruksasoong V, Poonaklom P, Piraban T, Kumpeera S, et al. *Salmonella* food poisoning in an army camp, Northern Thailand, October 2009. OSIR. 2012 Dec; 5(2):16-22. <http://www.osirjournal.net/issue.php?id=33>.

References

1. Lapidot A, Romling U, Yaron S. Biofilm formation and the survival of *Salmonella Typhimurium* on parsley. Int J Food Microbiol. 2006 Jun 15;109(3):229-33. Epub 2006 Apr 17.
2. Olsen SJ, Mackinon LC, Goulding JS, Bean NH, Slutsker L. Surveillance for foodborne disease outbreaks - United States, 1993-1997. MMWR CDC Surveill Summ. 2000 Mar 17;49(1):1-62.
3. Niyogi SK. Shigellosis. J Microbiol. 2005 Apr;43(2):133-43.
4. Lee VJ, Ong AE, Auw M. An outbreak of *Salmonella* gastrointestinal illness in a military camp. Ann Acad Med Singapore. 2009 Mar;38(3):207-11.
5. Thailand. Bureau of Epidemiology. Department of Disease Control. Ministry of Public Health. Outbreak notification report 2006-2008. [cited 2010 Oct 26]. <http://www.boe.moph.go.th/boedb/d506_1/ds.php>
6. Thaikruea L, Pataraarechachai J, Savanpunyalert P, Naluponjiragul U. An unusual outbreak of food poisoning. Southeast Asian J Trop Med Public Health. 1995 Mar;26(1):78-85.
7. Moolasart P, Sangsujja J, Eampokalap B, Ratanasrithong M, Likanonsakul S. Non-typhoidal *Salmonella* diarrhea in Thai children: a study at Bamrasnaradura Hospital, Nonthaburi, Thailand. J Med Assoc Thai. 1997 Oct;80(10):613-8.
8. Heymann DL, editor. Control of communicable diseases manual. 19th ed. Washington, DC: American Public Health Association; 2008.