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Staphylococcal Food Poisoning Outbreak from a Community Gathering, Wang Nuea District, Lampang Province, Northern Thailand, July 2022

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Abstract

On 17 Jul 2022, the Thailand Department of Disease Control was notified about a food poisoning cluster related to a local funeral. We investigated to identify epidemiological characteristics of the outbreak, determine sources, and provide recommendations. A descriptive study and a retrospective cohort analysis were performed. Suspected cases were funeral participants or their household members who had at least one of the following: nausea, vomiting, abdominal pain, diarrhea, or bloody mucous stool during 17–20 Jul 2022. We used multiple logistic regression and transformed the adjusted odds ratio (AOR) to the adjusted risk ratio (ARR). We interviewed chefs and inspected the kitchen. Clinical specimens and food samples were sent for bacteria culture. Three hundred eighteen cases were identified. Ten patients (3.1%) had a shock; three had a septic shock; none died. The median age was 58 (range 47–66). The pork in the lunch boxes (ARR 7.80, 95% CI 0.75–81.34) was the most likely source. Improper food storage and cross-contamination risk were recognized. This outbreak was due to *S. aureus* with enterotoxin genes A and C, which were isolated from patients, food, and food handlers. Safety standards should be monitored, particularly in large community gatherings where the elderly attend.

Keywords: food poisoning, outbreak investigation, Staphylococcus aureus, community-gathering, food-handlers

Introduction

Food poisoning is an illness resulting from consuming food contaminated with pathogenic bacteria, viruses, parasites, or chemical substances. Globally, foodborne hazards caused 600 million foodborne illnesses and 420,000 deaths in 2010 and bacteria are one of the most common causes of outbreaks.[1,2]

In Thailand, the morbidity rate of food poisoning from January to August 2022 was 58 per 100,000 population, and no fatal case was reported.[3] While in 2019 and 2020, the morbidity rates were 166 and 135 per 100,000 population, respectively, and only a single fatal case was reported each year. The reported pathogens from the surveillance of the food poisoning and acute diarrhea included *Clostridium perfringens*,

Staphylococcus aureus, *Vibrio parahaemolyticus*, *Salmonella* spp., *Escherichia coli*, rotavirus, and norovirus.[4,5] *Staphylococcus aureus* is a gram-positive cocci bacterium which commonly colonizes in the human's anterior nares and may be shed onto healthy skin.[6] Given the right conditions of warmth, moisture, pH, and time, some strains multiply and secrete enterotoxins which are heat-stable proteins[7]. Following the ingestion of staphylococcal enterotoxins, a person may develop staphylococcal food poisoning. The symptoms include nausea, vomiting, abdominal cramps, watery diarrhea, and, seldomly, fever. Incubation period and severity vary depending on the amount of toxins ingested and health condition of a person.[8] Usually, the incubation period is 30 minutes to 8 hours with recovery period varying within 12–48

hours.[8–10] Patients usually only need supportive and symptomatic treatments; however, appropriate fluid replacement should be ensured as severe dehydration may occur in infants, people with underlying illness, and the elderly.[8,9]

On 17 Jul 2022 around 20:00, the National Department of Disease Control was unofficially notified about a food poisoning cluster. All cases were related to a cremation ceremony at the funeral which was held at Rong Kor Subdistrict, Wang Nuea District, Lampang Province. There were approximately four hundred participants who mostly resided in Lampang Province, with a few coming from nearby provinces of Phayao and Chiang Rai. The lunch boxes were served from 10:30 to 11:00 on the same day. Around noon, groups of funeral participants visited Wang Nuea Hospital with gastrointestinal symptoms. As the number of patients exceeded the capability of the facility, some patients were transferred to other nearby district hospitals. The joint investigation team, comprising members of the Thailand Department of Disease Control and local health staff, launched a field investigation during 18–20 Jul 2022. The investigation objectives were to identify epidemiological characteristics of the outbreak, determine the sources of the outbreak and risk factors, and recommend appropriate preventive and control measures.

Methods

Setting

Wang Nuea District is the northernmost district of Lampang Province, Northern Thailand, connected to Phayao and Chiang Rai provinces. It has a 30-bed district hospital and ten sub-district health promoting hospitals (i.e., health centers) for eight subdistricts. Rong Kor Subdistrict, where the funeral was held, had a population of 10,908 and 17 villages. Approximately 28% of the residents were over 60 years of age. The funeral was arranged for an important community figure. Thus, a large number of the residents joined the event, though the exact number of the participants was unknown. On the last day of the funeral (17 July), the cremation ceremony was held at Village 3 of Rong Kor Subdistrict which included monk chanting session in the morning and cremation in the afternoon. The family members of the deceased were expected to prepare refreshment and lunch for every participant.

Descriptive Study

We interviewed epidemiologists, healthcare workers, and patients at Wang Nuea Hospital. We reviewed medical records and the number of cases from related ICD-10 codes (Table 1) in Wang Nuea Hospital and ten health centers in the district.

Table 1. ICD-10 codes used for active case finding in food poisoning outbreak in Wang Nuea District, Lampang Province, Thailand, 17–18 Jul 2022

ICD-10 Code	Diagnosis	Total number reviewed	Number of food poisoning cases (%)
A04.8	Other specified bacterial intestinal infections	0	0
A04.9	Bacterial intestinal infection, unspecified	115	115 (100.0%)
A49.9	Bacterial infection, unspecified	5	5 (100.0%)
A05.8	Other specified bacterial foodborne intoxications	1	1 (100.0%)
A05.9	Bacterial foodborne intoxication, unspecified	27	27 (100.0%)
A08.3	Other viral enteritis	0	0
A08.4	Viral intestinal infection, unspecified	0	0
A08.5	Other specified intestinal infections	0	0
A09.0	Other and unspecified gastroenteritis and colitis of infectious origin	110	109 (99.1%)
A09.9	Gastroenteritis and colitis of unspecified origin	10	10 (100.0%)
R10.4	Other and unspecified abdominal pain	0	0
R11	Nausea and vomiting	0	0
	Total	**268**	**267 (99.6%)**

Suspected cases were funeral participants or their household members who had at least one of these symptoms: nausea, vomiting, abdominal pain, diarrhea, or mucous bloody stool during 17–20 Jul 2022. Confirmed cases were suspected cases with rectal swabs testing positive for the bacterial or viral pathogen.

Active case finding was conducted at all public health facilities in Wang Nuea District, and three hospitals in the nearby districts (two in Lampang Province and one in Chiang Rai Province). We contacted health officers at each hospital to retrieve lists of patients from relevant ICD-10 codes through the hospital information system and lists of patients who had complaints of symptoms as in the suspected case

definition from the hospital registry during 17-20 Jul 2022. Then, we reviewed each medical record and interviewed the patients using a questionnaire via phone if the subjects were already discharged. The questionnaire included demographic data, onset and symptoms, funeral participation, and food consumption listed from the funeral.

Active case finding in the communities was done in Village 3 where the funeral was held and Villages 9 and 16, the nearby villages (Figure 1) as these areas were the residences of the majority of the funeral participants. We announced via the village loudspeakers asking anyone who had symptoms compatible with the definition of the suspected case to visit the nearby health promoting hospital. There, health personnel interviewed the villagers, collected rectal swabs in those who still had diarrhea, and provided supportive treatment.
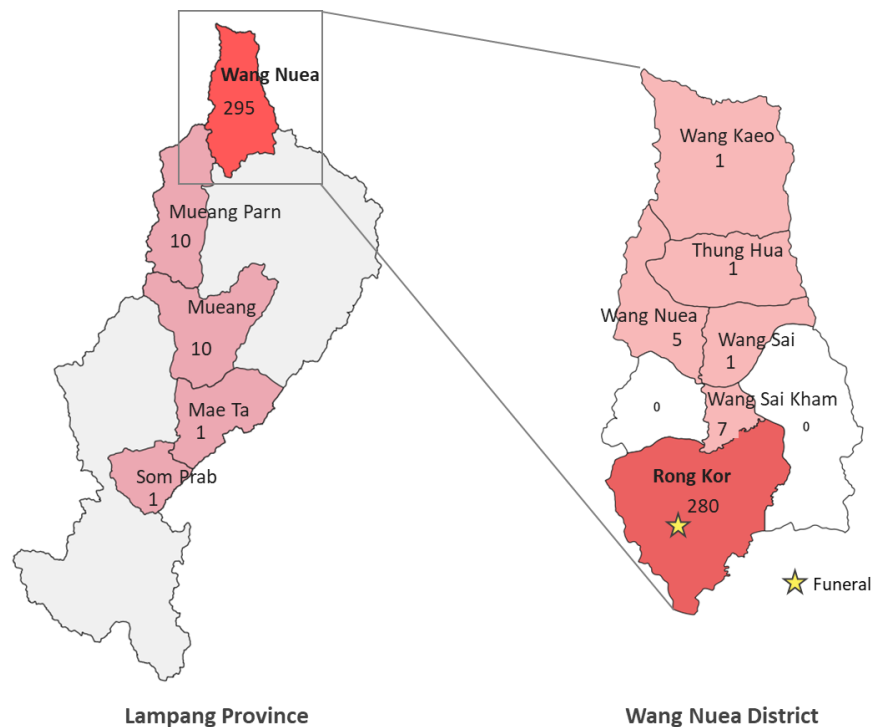

Figure 1. Distribution of food poisoning cases in Lampang Province and Wang Nuea District, Thailand, 17–18 Jul 2022 (n=308)

We presented the demographic characteristics, food consumption items from the funeral, and clinical features using median with the interquartile range for continuous data and frequency and percentages for categorical data. We used Microsoft Excel and Stata 16.0 to analyze the data.

Analytic Study

A retrospective cohort study was conducted to determine association of potential risk factors and being a case. The participants were patients who lived in Villages 3, 9, 16, and their family members. We used a single-stage cluster sampling approach with households as the primary sampling unit and individuals as the elementary sampling unit. The sample size required to estimate the odds ratio with 95% confidence and relative precision of 70% was approximately 30 for the unexposed groups. Adding the exposed group in a 1:1 ratio, the cohort needed at least 60 persons (Appendix 1). Given the design effect

of 2.5 and the non-response rate of 0.1, the study needed around 170 persons. Based on the civil registry of Villages 3, 9, and 16, the average number of people per house was 2.58 persons. The number of sampled households in each village was calculated to represent the distribution of household that had at least one case in that village. From 144 household of cases (100, 27, 17 houses in Villages 3, 9, 16, respectively), we recruited 85 households (59, 16, 10 houses in Villages 3, 9, 16, respectively). We sorted house numbers of each village from the smallest to largest, then used circular systematic sampling to select the houses. Then we asked the index member for the phone numbers of everybody in their house to interview them directly. If the call could not be reached twice, we would ask another member about the history of funeral participation, food consumption, and symptoms.

The independent variables were gender, age, underlying disease, and food items from the funeral.

The dependent variable was being a case. In the univariable analysis, we calculated risk ratio (RR) with 95% confidence interval (CI). We selected variables with a p-value less than 0.1 for the multivariable analysis. We used logistic regression to estimate the adjusted odds ratio (AOR). Due to high disease incidence in this particular event and to conform with the crude RR in the univariable analysis, we transformed it into adjusted risk ratio (ARR) using the "adjrr" package in Stata for better interpretation.[11] We also performed additional analysis by adjusting for clustering effect on the ARR in order to check the robustness and the consistency of the results using the "svy" function in Stata.[12,13] Dose-response analysis was calculated in the form of risk ratio with 95% CI on significant variables.

Environmental Study

We interviewed the funeral host about the food items served and the source of each one. We conducted a walk-through survey of the kitchen and drinking water plants to observe the process and sanitation. We screened for coliform bacteria on kitchenware and drinking water in the kitchen using test kits. The chefs were interviewed about their current illnesses, the source of each food item, and the food preparation, cooking, and serving procedure. For the drinking water plants, we interviewed the pharmacists on the board of consumer protection, the owners, and the managers about the process and quality control.

Laboratory Study

We collected rectal swabs and vomitus from the suspected cases who still had diarrhea or vomiting and from every food handler on 18 Jul 2022. The rectal swabs were stored in tubes with Cary Blair medium and viral transport media, and vomitus was stored in plastic bags. Blood samples of the admitted cases whom the physician suspected sepsis were sent for hemoculture. On the same day, surface swabs from the kitchen and two lunch boxes were collected. One lunch box was sent out as a sample and each food component of the other lunch box was sent out as six separate samples. During the survey at the water plants, we collected bottler's hand swab, bottle swab, and water sample. Water samples were collected in new plastic bottles on 20 Jul 2022. All rectal swab specimens were sent for bacterial culture at the National Institute of Health laboratory, and we also randomly sent seven rectal swab specimens for viral polymerase chain reaction (PCR) testing. All specimens placed in foam boxes with ice packs were transported to the laboratory via buses, which took around 1–2 days. The temperature inside the boxes was cool but not measured.

Ethical Approval

This investigation was part of an emergency public health response. Verbal informed consent was requested before the interview and specimen collection. Only designated members of the investigation team could access the data files.

Results

Overview of Food Poisoning Situation in Wang Nuea District

By extracting food poisoning-related ICD-10 codes, we found the number of cases visiting hospitals in Wang Nuea District rose from 1–3 cases per day from 14–16 Jul 2022, to 250 cases on 17 Jul 2022. The epidemiologists and health care workers also reported incoming groups of patients having gastrointestinal symptoms starting around noon of 17 July.

Descriptive Study

This cremation ceremony was opened to all people in the community. The host ordered about 500 ice cream cups, 700 lunch boxes and water bottles. On 08:00, approximately 30 people who prepared the ceremony ate bok choy soup and steamed pork together. Ice cream cups and lunch sets, composed of Kao Moo Dang lunch box and a water bottle, were distributed to the participants at 10:00 and 10:30–11:00, respectively. Some participants (with unknown figure) took the extra lunch boxes back home.

From the active case finding, we found 318 cases (308 suspected and 10 confirmed cases). The male-to-female ratio was 1:1 and the median age was 58 years (range 47–66). Approximately 96.3% (308/318) lived in Lampang Province, others were from Chiang Mai, Payao, Nan, and Chiang Rai Provinces. About 88.1% (280/318) resided in the Rong Kor Subdistrict, particularly in Villages 3, 9, and 16 (Figure 1). Half of the patients (50.5%) were agriculturists.

Approximately 84.1% of cases attended the funeral. All cases ate the Kao Moo Dang lunch box, a Thai dish of marinated pork, steamed rice, boiled egg, sweet gravy, cucumber, coriander and black soy sauce. Approximately 74.7% of cases drank water from the packed bottle distributed at the funeral, 61.8% ate ice cream, 5.6% ate bok choy soup, and 4.9% ate steamed pork.

The epidemic curve (Figure 2) showed that the first case was a chef who had packed the lunch boxes but did not attend the funeral. She started developing symptoms at 10:00 on 17 Jul 2022. The number of cases increased from 10:00 and peaked at 13:00. The median and mean incubation period was 2.3 hours

(range 1.5–3.0) and 3 hours (range 20 minutes–7.5 hours), respectively.

The most common symptoms were vomiting (88.2%), diarrhea (81.3%), and abdominal pain (80.7%). Half of the patients had nausea (53.5%), whereas only one-tenth had fever (9.9%). Most of the cases received hospital care (75% as outpatient and 14% as inpatient). Approximately 12.9% of patients received antibiotics. Ten patients (3.5%) had shock and three had septic shock; however, no deaths were reported. About one-third (35.2%) of patients had chronic medical conditions such as hypertension and diabetes.

Three males who had septic shock were 55–74 years old and two of them had chronic medical conditions

(diabetes mellitus, hypertension, and dyslipidemia). After consuming the pork and rice in the lunch box for 1–2 hours, they started having nausea, vomiting 5–20 times, diarrhea 5–15 times, abdominal cramp, and syncope. They visited the hospital within a day after the onset. The initial systolic blood pressure was 58–83 mmHg and diastolic blood pressure was 40–58. No skin lesion was noted. The white blood cell was 13,060–18,740/µL, in which neutrophil was accounted to 79–88%. Two of them had acute kidney injury. White blood cell was also found in the stool. They received intravenous hydration, antibiotics, and norepinephrine, then they were discharged with complete recovery within 6 days.
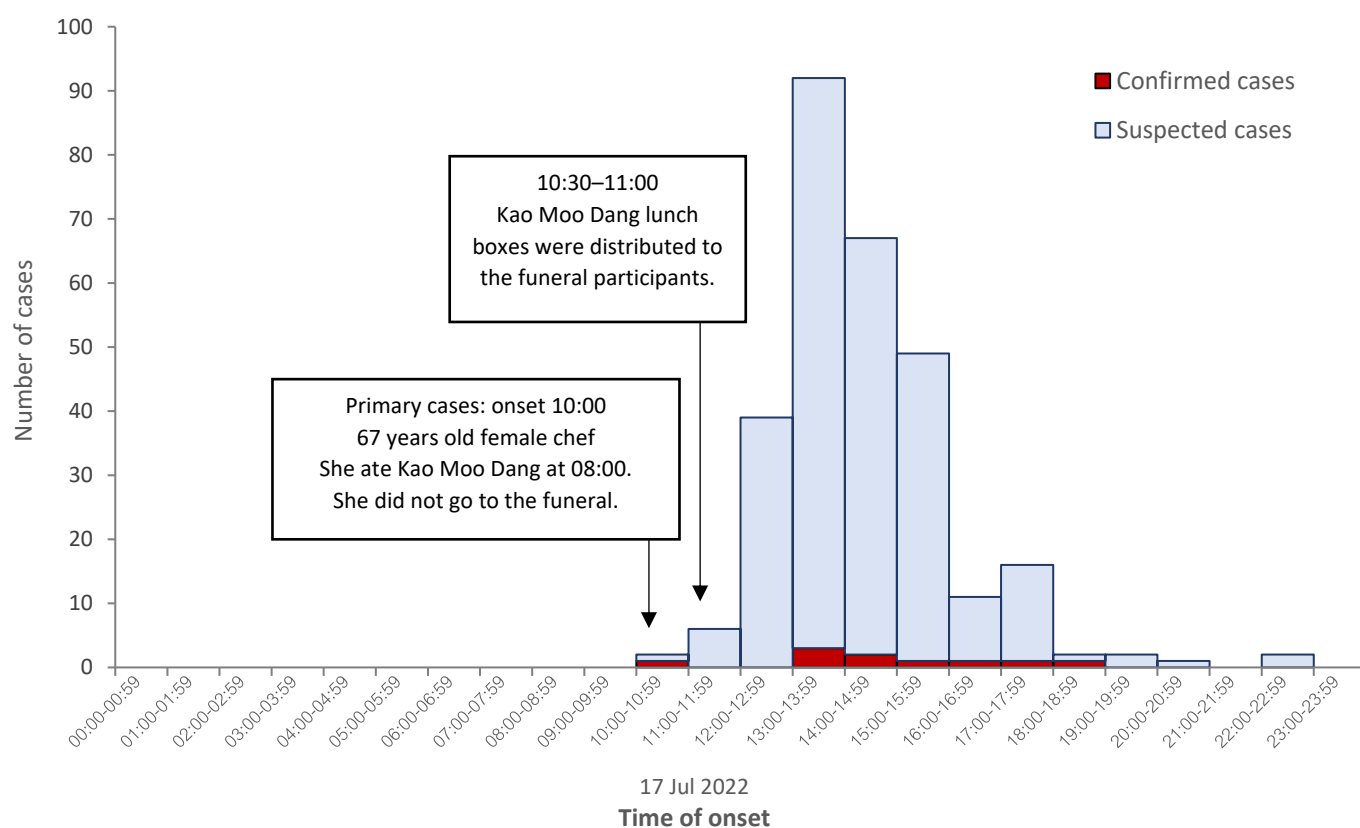

Figure 2. Epidemic curve of food poisoning cases in Wang Nuea District, Lampang Province, Thailand, 17–18 Jul 2022 (n=289)

Analytic Study

A total of 85 households or 228 persons were recruited to participate in the study from Villages 3, 9 and 16. The number of funeral participants and their family members were 139 (108 cases and 31 non-cases) and 89 (24 cases and 65 non-cases) persons, respectively.

From univariable analysis, the potential risk factors with a p-value less than 0.1 were pork, rice, steamed egg, cucumber, gravy, dipping sauce, ice-cream, drinking water, and steamed pork (Table 2). From the

multivariable analysis with adjustment for clustering effect, only the pork had a p-value of less than 0.05 with the AOR of 90.94 (95% CI 3.42–2,420.46, p-value 0.008) and ARR of 7.80 (95% CI 0.75–81.34, p-value 0.0861). The actual design effect to account for the pork item for all households combined was 1.23. Table 3 presented dose-response relationship between the illness and amount of pork consumption, 2–3 tablespoons, half, and all pork in a lunch box. We found that the RR increased with the consumed amount increased, however the increasing trend was not statistically significant.

Table 2. Univariable and multivariable analysis of risk factors in food poisoning outbreak in Wang Nuea District, Lampang Province, Thailand, 17–18 Jul 2022

Factors	% Attack rate (case/total)		Crude RR (95% CI)	Adjusted OR with clustering effect (95% CI)	Adjusted RR with clustering effect (95% CI)
	Exposed	Non-exposed			
Male	58.68 (71/121)	57.01 (61/107)	1.03 (0.82–1.29)	-	-
Age ≥60	59.60 (59/99)	56.59 (73/129)	1.05 (0.84–1.31)	-	-
Underlying disease	64.93 (50/77)	54.30 (82/151)	1.20 (0.96–1.49)	-	-
Pork	89.04 (130/146)	2.44 (2/82)	39.51 (9.28–143.68)[a]	90.94 (3.42–2,420.46)	7.80 (0.75–81.34)
Rice	88.43 (130/147)	2.47 (2/81)	35.82 (9.10–140.94)[a]	10.94 (0.35–343.40)	1.96 (0.37–10.31)
Steamed egg	87.69 (114/130)	18.37 (18/98)	4.77 (3.13–7.28)[a]	1.09 (0.29–4.15)	1.01 (0.87–1.18)
Cucumber	90.91(90/99)	32.56 (42/129)	2.79 (2.16–3.61)[a]	2.06 (0.61–6.92)	1.09 (0.92–1.30)
Gravy	88.80 (111/125)	20.39 (21/103)	4.36 (2.96–6.41)[a]	0.34 (0.32–3.64)	0.91 (0.79–1.06)
Dipping sauce	88.79 (95/107)	30.58 (37/84)	2.90 (2.20–3.83)[a]	1.06 (0.25–4.46)	1.01 (0.86–1.18)
Ice-cream	86.73 (85/98)	36.15 (47/130)	2.40 (1.88–3.05)[a]	1.59 (0.61–4.15)	1.05 (0.94–1.18)
Water bottle	84.03 (100/119)	29.36 (32/109)	2.86 (2.12–3.87)[a]	1.21 (0.44–3.34)	1.02 (0.91–1.15)
Steamed pork	90.00 (9/10)	56.42 (123/218)	1.60 (1.26–2.02)[a]	35.52 (0.91–1,390.35)	1.27 (0.95–1.70)
Bok choy soup	83.33 (10/12)	56.48 (122/216)	1.48 (1.12–1.95)	-	-

RR: risk ratio, OR: odds ratio

[a]*p-value <0.1*

Table 3. Dose response analysis of pork in food poisoning outbreak in Wang Nuea District, Lampang Province, Thailand, 17–18 Jul 2022

Amount of pork consumption	% Attack rate (case/total)	Crude RR (95% CI)
2-3 tablespoons	85.71 (18/21)	35.14 (8.84–139.69)
Half	86.84 (33/38)	35.61 (9.01–140.75)
All	90.80 (79/87)	37.23 (9.46–146.59)

RR: risk ratio, CI: confidence interval

$Chi^2 = 0.7$*, p-value = 0.706*

Environmental Study

The cooking location was a half-cement, half-timber, 2-story detached house with a storefront for selling items and a large kitchen area at the back of the house. The kitchen was open and well-ventilated. It has a cement floor and a table for cooking in the middle. The shelf for storing was within 60 centimeters above the floor. The caterer team, composed of 6 persons, was experienced in making approximately 200–300 boxes lunch boxes for banquets/group gatherings.

The chefs purchased raw ingredients for the lunch boxes from various sources. Fresh pork packed in plastic bags were bought, transferred on a pickup truck from a shop in Phayao on 15 Jul 2022 at around 18:00–20:00, and stored in an ice cooler with crushed ice roughly 10 centimeters high for cooking on the following day. The other ingredients were purchased from shops and markets in the district to use only for this cooking session.

The cooking process started in the early morning on 16 Jul 2022. The chefs did not wear masks or gloves when preparing the food. At 06:00, the pork was taken out of the ice cooler, washed, cut, put in the bags, and placed in the same ice cooler. Then, at 13:00, the pork was marinated in the pot. From 19:00–24:00, other ingredients were prepared including cooking the rice using six normal-sized rice cookers. The rice was then scooped out and set aside in a large pot. Then, seven hundred eggs were steamed. The marinated pork was then brought out and heated until boiling. Once finished, the pork was put in a pot on top of the ice cooler as they thought this would be cold enough. The gravy and dipping sauce were then prepared. The cucumbers were peeled, sliced, and put on a tray, and the coriander was prepared. On 17 Jul 2022, from 03:00–08:00, all chunks of pork were chopped into thin pieces. The same cutting boards and similar knives were used for raw and cooked items. Then, the food items were distributed into 700 lunch boxes. The chefs used bare hands to pick a handful of chopped pork, one whole unpeeled steamed egg, a few pieces of coriander and cucumbers, a small bag of gravy, and a small bag of dipping sauce into each lunch box. Then all lunch boxes were packed into bags (10 boxes per bag) and delivered to the funeral at about 09:00 (Figure 3 and 4).

Figure 3. Pictures of Kao Moo Dang lunch boxes and transportation, Wang Nuea District, Lampang Province, Thailand, 17 Jul 2022
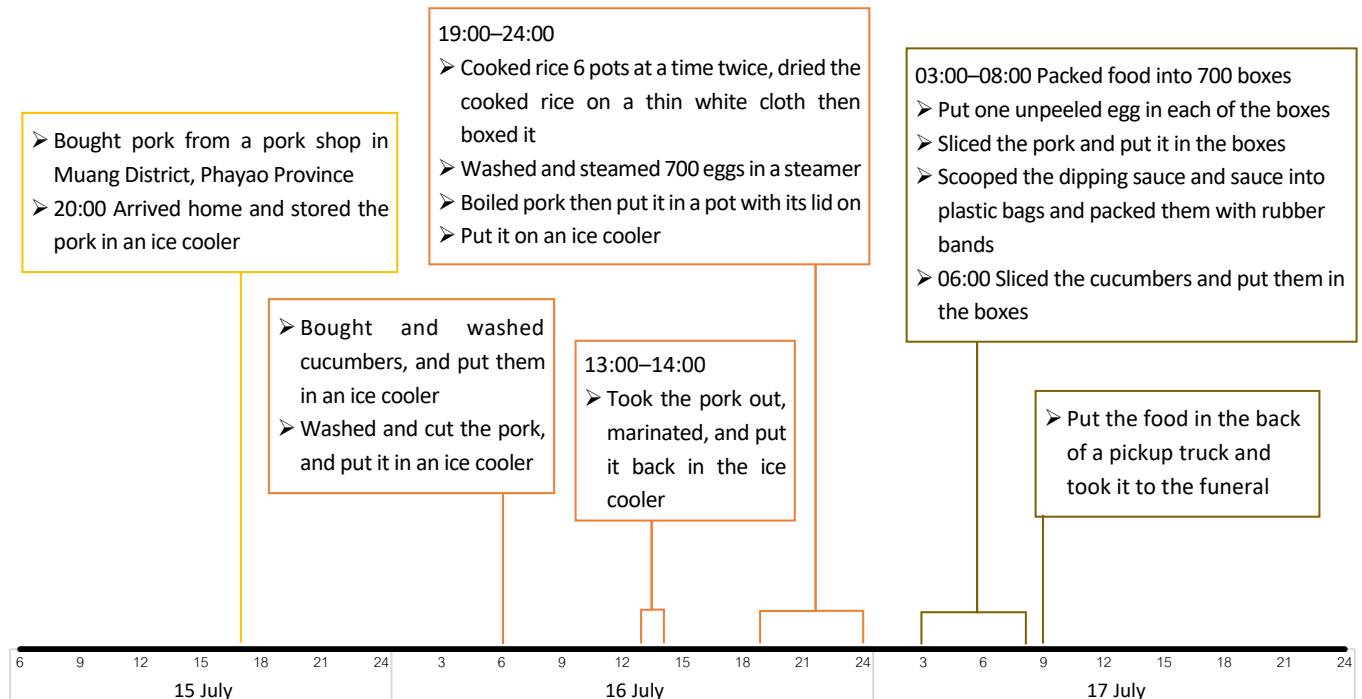

Figure 4. Timeline of the process of cooking Kao Moo Dang in food poisoning outbreak in Wang Nuea District, Lampang Province, Thailand, 17–18 Jul 2022

The chefs used cooking water ordered from three companies. The coliform bacteria screening was positive in the water from two agencies, A and B, and negative in water from agency C. For Drinking Water Plant A, the water had not been officially tested for hygienic standards in 2021. The staff reused the bottle caps after cleaning. For Drinking Water Plant B, the factory license could not be found on the day of the visit. The water had never been officially tested. There was no qualified quality control staff. Lastly, the practice of closing the bottle caps with bare hands was done in both plants.

Laboratory Study

Samples from the patients, food at the funeral, food handlers, kitchens, and drinking water plants were also sent for bacterial culture testing (Tables 4-6). *S. aureus* was found in all sample types: patient's rectal swab (6/20=30%), Kao Moo Dang (1/1=100% for the whole box, and also in its components, namely pork, cucumber, and steamed egg), food handler's rectal (1/6=16.7%) and hand swabs (3/5=60%). One S. aureus positive sample from each sample type was sent for susceptibility test and multiplex PCR. All four samples reported Methicillin-susceptible *S. aureus* (MSSA) with the detection of Staphylococcal enterotoxin genes A and C. Of seven rectal swab samples sent for viral PCR testing, one was positive for norovirus. *Samonella* spp. was also reported from rectal swabs of three patients and a food handler. The second most common organism identified from rectal swabs of the patients were *Salmonella* spp. and *Aeromonas* spp. (3/20=15% each). Several samples from surface swabs in the kitchen and water samples from the water plants were also found positive for Bacillus cereus group and Aeromonas species (detection rate equating 50–100% each).

Table 4. Results of the bacterial culture of samples from patients and food at the funeral in food poisoning outbreak in Wang Nuea District, Lampang Province, Thailand, 17–18 Jul 2022

Sample type	Number of samples sent for testing	Result	Number of samples with the bacteria (% positive)
Patients			
Rectal swab	20	S. aureus[1]	6 (30.0%)
		Salmonella spp.[2]	3 (15.0%)
		Aeromonas spp.	3 (15.0%)
		Aeromonas veronii biovarsobria	2 (10.0%)
		Plesiomonas shigelloides	2 (10.0%)
Vomitus	1	Aeromonas spp.	1 (100.0%)
Blood*	5	Staphylococcus hominis	1 (20.0%)
Food at the funeral			
Kao Moo Dang (whole box)	1	S. aureus[1]	1 (100.0%)
		E. coli[3]	1 (100.0%)
Kao Moo Dang components			
- Rice	1	E. coli	1 (100.0%)
- Pork	1	S. aureus	1 (100.0%)
		Aeromonas spp.	1 (100.0%)
- Cucumber	1	S. aureus	1 (100.0%)
		Aeromonas spp.	1 (100.0%)
- Steamed egg	1	S. aureus	1 (100.0%)
		B. cereus	1 (100.0%)
- Gravy	1	Aeromonas spp.	1 (100.0%)
		B. cereus group	1 (100.0%)
- Black source	1	-	0
Ice cream	1	Vibrio spp.	1 (100.0%)
Drinking water in closed bottle	1	Aeromonas caviae	1 (100.0%)

*Taken while being admitted in the hospital by attending physician.

[1] One sample was sent for the Kirby-Bauer disk diffusion susceptibility test and multiplex PCR and reported Methicillin-susceptible S. aureus (MSSA) with the detection of Staphylococcal enterotoxin genes A and C.

[2] One sample was sent for serotyping and reported Salmonella serovar Rissen.

[3] One sample was sent for multiplex PCR and cell adherence assay and reported E. coli non O157:H7, non-enteroaggregative E.

Table 5. Results of the bacterial culture of samples from food handlers and kitchen in food poisoning outbreak in Wang Nuea District, Lampang Province, Thailand, 17–18 Jul 2022

Sample type	Number of samples sent for testing	Result	Number of samples with the bacteria (% positive)
Food handlers			
Rectal swab	6	S. aureus[1]	1 (16.7%)
		Salmonella spp.[2]	1 (16.7%)
Hand swab	5	S. aureus[1]	3 (60.0%)
		B. cereus group	3 (60.0%)
Kitchen			
Surface swab			
- Ice cooler	1	Aeromonas spp.	1 (100.0%)
		Aeromonas hydrophila	1 (100.0%)
- Pot for boiling pork	1	-	
- Random kitchenware	2	B. cereus	1 (100.0%)
- Chopping board	1	-	0
- Knives	1	-	0
- Water bottle pump	1	-	
Drinking water gallon (Plant A)	1	B. cereus group	1 (100.0%)
Drinking water gallon (Plant B)	1	B. cereus	1 (100.0%)

[1] One sample was sent for the Kirby-Bauer disk diffusion susceptibility test and multiplex PCR and reported Methicillin-susceptible S. aureus (MSSA) with the detection of Staphylococcal enterotoxin genes A and C.

[2] One sample was sent for serotyping and reported Salmonella serovar Rissen.

Table 6: Results of the bacterial culture of specimens from drinking water companies in food poisoning outbreak in Wang Nuea District, Lampang Province, Thailand, 17–18 Jul 2022

Sample type	Number of samples sent for testing	Result	Number of samples with the bacteria (% positive)
Drinking Water Plant A			
Bottler's hand swab	1	*Aeromonas hydrophila*	1 (100%)
		Aeromonas caviae	1 (100%)
Untreated water	1	*B. cereus*	1 (100%)
Cup-filled drinking water	1	*Aeromonas* spp.	1 (100%)
Bottle-filled drinking water	1	-	0
Inside surface of a bottle cap	1	-	0
Inside surface of a bottle	1	*Aeromonas hydrophila*	1 (100%)
Drinking Water Plant B			
Bottler's hand swab	2	*Aeromonas caviae*	2 (100%)
		Aeromonas hydrophila	2 (100%)
		Aeromonas spp.	1 (50.00%)
Untreated water	1	*Aeromonas* spp.	1 (100%)
		B. cereus group	1 (100%)
Bottle-filled drinking water	1	-	0
Inside of a bottle	1	*Aeromonas caviae*	1 (100%)
		Aeromonas spp.	1 (100%)
		B. cereus group	1 (100%)

Bottlers are the water plant staff who are responsible for filling the water in the drinking bottles and closing the caps.

Actions Taken

During our investigation, we advised people to discard the lunch boxes and the food handlers who hold the food catering, to boil utensils for at least 3 minutes as this could inactivate the enterotoxins and clean the food preparing surfaces using diluted sodium hypochlorite solution to obtain a concentration of 1 g/L.[8,21] The hospital epidemiology team had temporarily conducted an ad-hoc food poisoning surveillance and prevention in the communities until the outbreak subsided. The Wang Nuea and Wiang Pa Pao local board of consumer protection visited the drinking water companies and examined the factory hygiene against the standards.

Discussion

As cases exhibited only gastrointestinal symptoms, predominantly vomiting, as early as 30 minutes after consuming the food in the lunch box. Enterotoxin of *S. aureus* and toxin of *B. cereus* were considered as possible etiologic agents. The laboratory study showed that *S. aureus* with enterotoxin genes A and C was the main pathogen isolated from the patients, food, and food handlers. Although the other pathogens identified, including *Salmonella* spp*., Aeromonas* spp*., Plesiomonas shigelloides*, and norovirus may cause similar gastrointestinal symptoms, they usually have

a longer incubation period and less prominent vomiting Therefore, the most likely pathogen causing this outbreak was S. aureus whereas the identification of other organisms were likely due to concurrent contamination.[9,10]

Despite the outbreak occurring among the elderly, this event had lower hospitalization rate (14%) compared to previous staphylococcal food poisoning outbreaks where approximately 33.3–82.4% of the cases were hospitalized. Most of the cases in those studies were infants, elders, pregnant women, and handicapped persons, and they were mostly discharged within 1–2 days.[12–14] This might be because the district hospitals had limited bed and would only admit those with hypotension or persistent symptoms. Other than this, the patients were given intravenous fluid or medication as a supportive treatment at the emergency department and discharged after the clinical condition was stable. In addition, hypotension due to dehydration was known, however, septic shock was rarely reported.[8,9,12–17] Though the septic-shock cases in this event did not have confirmed bacteria culture from clinical specimens, considering the exposure, the early onset, and the symptoms, they still concurred with staphylococcal food poisoning. A study reviewed that enterotoxins could stimulate T lymphocyte activity which led to cytokine release and

systemic shock.[8] Therefore, the cause of the septic-shock cases was likely to be the same pathogen as other cases.

The epidemic curve showed a point common source pattern with the likely onset around the same time when the food was distributed at the funeral. Most cases lived in the same subdistrict as where the funeral was held. Moreover, the cases were not only limited to the funeral participants, but also their family members. Laboratory results from this menu also showed the same suspected pathogen as found in the patients. Therefore, the Kao Moo Dang lunch box distributed at the funeral was the most likely source.

The pork In Kao Moo Dang was suspected to be the main source of *S. aureus*, either by the conventional multivariable logistic regression or by the multivariable logistic regression after adjusting for clustering effect. *S. aureus* in food poisoning outbreaks is often found in unrefrigerated or improperly refrigerated meat.[10] In this outbreak, raw pork was not stored at the optimal temperature for approximately a day before being cooked. This might have allowed the bacteria to multiply and produce the toxin. By storing raw meat at temperatures below 5 degrees Celsius and cooking meat or reheating it at a temperature of ≥72 degrees Celsius (duration depends on the temperature and food amount), the proliferation of bacteria and enterotoxin could be limited.[7,8,18]

S. aureus from pork might contaminate other food items. Though heat can kill *S. aureus*, the heat-stable toxin could remain through the subsequent cooking process. *S. aureus* might again contaminate the pork after being cooked since the cooks used the same cutting blocks, similar knives for raw and cooked meat, and the same ice cooler to store the raw meat. Each food item was then placed in the lunch boxes with bare hands. This process could cause contamination of bacteria and toxins with other food items. Although we could not identify how *S. aureus* primarily contaminated the pork, the contamination could have been mitigated by wearing face mask, using separated storage containers and utensils between raw and cooked food, and using separated ladle or wearing gloves when distributed each cooked food.[18]

For this event, *Aeromonas* spp. was considered an opportunistic pathogen that could cause diarrhea through the ingestion of contaminated water or foods. The genus Aeromonas originates from an aquatic environment. Typical habitats for these bacteria are freshwater.[9] Bacillus cereus group also has natural habitat in aquatic environments. Some strains are known to cause food poisoning outbreaks around the world.[19] In this outbreak, groundwater, reused bottles, and the hands of workers were found contaminated with Aeromonas species and *Bacillus cereus* group, but not in the water in packed bottles; however, in the kitchen, the *Bacillus cereus* group was found in water gallons from these two companies. Though this could be an accidental contamination of the water from the companies, the water treating standards should be monitored as both companies had not undertaken hygienic evaluation by responsible authorities for years. Since bacterial contamination could not be ruled out, always boiling water before consuming should be considered.[20]

Limitations

The identification of households based on known cases to be selected in the study cohort might have caused selection bias. Additionally, underestimation of the relative risk might have occurred given that family members of the patients might have been exposed to other risks (such as direct contact with the patients) apart from consuming the suspected food. Information bias might have occurred as exposure history of some family members was given by other family members and could have been inaccurate. Moreover, the list of cases from the hospital was given before the interviews, thus the interviewers could have been more determined to collect a more detailed history of the exposure. Furthermore, the cases might have not remembered the details clearly enough or amplified their recollections.

Public Health Recommendations

Strengthening food sanitation throughout the food chain is crucial. When transporting raw meat for more than 30 minutes, it is advisable to use ice coolers with sufficient ice. An appliance thermometer can be used to monitor storage temperature, aiming to keep it below 5 degrees Celsius. If a refrigerator is unavailable in the kitchen, storing meat for a maximum of 1-2 days with optimal temperature can be applied. To prevent contamination and cross-contamination, it is recommended to wear gloves and face masks, as well as to use separate kitchenware for the preparation and storage of raw and cooked food. Furthermore, reheating the food before distribution is advised. The health centers may consider engaging with the Village Health Volunteers to monitor large gatherings where food would be distributed to ensure food safety prior to the event. The Occupational and Environmental Health Unit of the District Health Office and Wang

Nuea Hospital could strengthen food sanitation surveillance, provide recommendations on food sanitation practices to local food handlers, and strictly monitor the standards of local kitchens. The district consumer protection board could continuously monitor the standards of local drinking water companies. As bacterial contamination along the process of bottling till consuming could not be excluded, people should be advised to boil drinking water from the local companies before consumption.

Conclusions

This event was a staphylococcal food poisoning outbreak that occurred among funeral participants and their household members in Wang Nuea District, Lampang Province. The pork in the Kao Moo Dang lunch boxes distributed at the funeral was the most likely source of contamination. Improper handling of food items and long preparation times could attribute to bacterial growth and cross-contamination, The local drinking water companies might pose a threat for future outbreak as they did not receive a recent hygienic evaluation. Local health authorities should enforce proper food sanitation practices and regularly monitor local food cateres.

Acknowledgments

Suggested Citation

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