ORIGINAL ARTICLE

Investigating a Foodborne Outbreak at A Nationwide School Event in Northeast Malaysia

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ABSTRACT

Background: Investigating complex food and waterborne outbreaks poses challenges due to diverse pathogens and symptoms. ***Objectives:*** This study focused on a foodborne outbreak during a national-level event in Kota Bharu, Malaysia, which aimed to describe the outbreak, identify risk factors, locate the source, and detail control measures. ***Methods:*** Active and passive methods, interviews, record reviews, lab tests, and environmental assessments were used. A case-control study defined cases as individuals experiencing abdominal pain, diarrhoea, dizziness, nausea, and vomiting. They were compared with a 1:2 asymptomatic control group. Demographic and food history data were collected through an online form distributed to related health district offices, involving 81 boarding schools across the country and international counterparts from Indonesia, Thailand, and China. Statistical analysis was performed using Microsoft Excel 365 and Hazard Analysis and Critical Control Point (HACCP) application. ***Results:*** Among 941 exposed individuals, 126 cases (attack rate:13.8%) occurred. Common symptoms included abdominal pain(84%), nausea(51%), diarrhoea(44%), dizziness(44%), and vomiting(44%). The epidemiological curve indicated a point source pattern, with a 1-to-20-hour incubation period. Causative foods were white rice (OR:8.2, 95% CI:3.66,18.37) and chicken with paprika sauce (OR:8.5, 95% CI:3.80,19.03), both statistically significant ($p<0.001$). HACCP analysis identified food handling issues, with Bacillus cereus isolated from food handlers. To mitigate the situation, premises were temporarily closed, and a health education program was conducted. ***Conclusion:*** This study underscored the significance of digital tools and food safety protocols in tracing foodborne outbreak origins. These are crucial for safeguarding public health and averting future incidents.

Keywords: Foodborne outbreak, Bacillus cereus, Kelantan, Malaysia

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INTRODUCTION

Food poisoning is a pervasive global phenomenon, with outbreaks occurring when two or more individuals suffer similar illnesses after consuming the same contaminated food[1]. the growth of pathogenic microorganisms responsible for food spoilage, poisoning, and toxicities, as well as foodborne illness[2]. The World Health Organization (WHO) underscores the severity of diarrheal diseases, attributing 3% of global mortality to this category of illnesses[3]. In Malaysia, the issue of food-related illnesses is particularly notable, with over half of such cases being linked to inadequate food handling procedures, emphasizing the critical role of proper food safety measures[4].

On October 9, 2023, the Kota Bharu District Health Office, Kelantan, received reports of 12 instances of food poisoning from the Gua Musang District Health Office, Kelantan with an additional 9 cases reported by the Bentong District Health Office, Pahang. Swift response and action teams were promptly dispatched to investigate a suspected school canteen that had supplied

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packed food for a school event attended by all the affected individuals. The investigation identified a total of 34 cases, comprising 28 students and 6 teachers. Concurrently, an alert was disseminated to health authorities in Kelantan and other states across Malaysia. The official declaration of the outbreak was issued on the same day.

Investigating complex food and waterborne outbreaks poses challenges due to diverse pathogens and symptoms. This study focused on a foodborne outbreak during a national-level event in Kota Bharu, Malaysia, which aimed to describe the outbreak, identify risk factors, locate the source, and detail control measures.

METHODS

Epidemiological investigation: A case was defined as an individual who attended the event and manifested symptoms such as abdominal pain, diarrhea, dizziness, nausea, vomiting, with or without fever. Inclusion criteria encompassed those who consumed the provided food between October 6 to October 8, 2023, or individuals with an epidemiological link to the outbreak. Active and passive methods, interviews, record reviews were used. To identify causal and risk factors, a case-control study and Hazard Analysis and Critical Control Point (HACCP) analysis were undertaken. Demographic details, clinical information, and food histories were collected through digital tools, specifically Google Forms in the national language, creating a comprehensive line listing. Food-specific attack rates and risk ratios were calculated for each food item, and the analysis was carried out using Microsoft Excel 365.

Environmental investigation: An environmental investigation was conducted at the kitchen facility responsible for preparing pre-packaged food for the school event gathering. The parameters under scrutiny included environmental hygiene, the Hazard Analysis and Critical Control Point (HACCP) analysis, and the cleanliness of equipment.

Laboratory investigation: Stool cultures were randomly obtained from affected individuals, and environmental samples were specifically collected, with emphasis on suspected food items and equipment used during their preparation. Stool samples were gathered in sterile containers, while 250 g samples of any remaining food or drink were collected in sterilized sampling bags. Swab samples from the hands of food handlers and kitchen utensils (such as cutting boards) were obtained using 3M quick swabs. Subsequently, all samples were sent for culturing and sensitivity testing.

Analytical epidemiological investigation: A case–control study was conducted aimed to identify and verify the food items and associated risk factors contributing to the outbreak, utilizing a 1:2 ratio, with 126 cases and 252 controls participating in the study. For cases, no sampling method was applied. To select controls, simple random sampling was done using Excel spreadsheet, matched to the gender and occupation of cases. A case was defined as previously described, while a control was identified as any asymptomatic individual who consumed the food items provided during the event. Statistical significance was determined by a p-value less than 0.05, and a 95% confidence interval was included.

Data management: The confidentiality of respondents' identities was maintained throughout the process. All data were gathered, organized, validated, and analyzed using Microsoft Excel 365.

RESULTS

Epidemiological results: A total of 126 reports of food poisoning occurring involving 914 people (attack rate 13.8%) that met the case definition were reported, with onset of illness between 8 October and 9 October 2023 (Figure 1). The main presenting symptoms were abdominal pain (84.0%), nausea (51.0%), diarrhea (44.0%), headache (44.0%) and vomiting (44.0%). Their ages ranged from 11 to 54 years (median age, 16 years) with predominant female (60.3%). Majority of the cases were Malays (Table 1). Of the reported cases, no hospitalization and all cases either sought outpatient treatment or self-medicated. No death was reported.

The epidemiological curve depicts a point-source pattern, signifying a shared origin, characterized by a swift rise, a singular peak, and a gradual decline in the number of cases, with an incubation period spanning from 1 to 20 hours. The earliest onset occurred on October 8 at 14:30, while the latest onset was observed on October 9 at 15:00, with a median onset time of October 8 at 23:00.

The exposure duration was from 13:30 to 20:45 on October 8, with a median duration of 9 hours (Figure 1).

In a case-control study involving 126 cases and 252 controls, the consumption of white rice (OR=8.20, 95% CI=3.66–18.36; p<0.001) and fried chicken with paprika sauce (OR=8.50, 95% CI=3.79–19.03; p<0.001) served in the implicated canteen emerged as potential sources of transmission, as indicated in Table 2. Both food items exhibited the highest attack rates, but this observation may be attributed to a considerable overlap in cases that consumed both white rice and fried chicken with paprika sauce.

Table 1: Characteristics and symptoms of cases (n=126) and controls (n=252)

Variables	Cases Frequency (Percentage)	Controls Frequency (Percentage)
Sex		
Male	50 (39.7)	100 (39.7)
Female	76 (60.3)	152 (60.3)
Age group (in years)		
<18	117 (92.9)	234 (92.9)
>18	9 (7.1)	18 (7.1)
Occupation		
Student	117 (92.9)	234 (92.9)
Teacher	9 (7.1)	18 (7.1)
Median age (range)	16 (11–59)	16 (13–59)
Ethnics		
Malay	119 (94.4)	238 (94.4)
Chinese	1(0.8)	2 (0.8)
Indian Bumiputera Sabah/ Sarawak	4 (3.2) 2 (1.6)	6 (2.4) 6 (2.4)
Symptoms		
Abdominal Pain	106 (84.0)	0 (0.0)
Nausea	64 (51.0)	0 (0.0)
Vomiting Diarrhea Dizziness Fever	56 (44.0) 55 (44.0) 55 (44.0) 0 (0.0)	0 (0.0) 0 (0.0) 0 (0.0) 0 (0.0)
Case Detection Active Passive	67 (53.2) 59 (46.8)	0 (0.0) 0 (0.0)
Treatment Outpatient Self-treatment Hospitalization Death	60 (47.6) 66 (52.4) 0 (0.0) 0 (0.0)	0 (0.0) 0 (0.0) 0 (0.0) 0 (0.0)

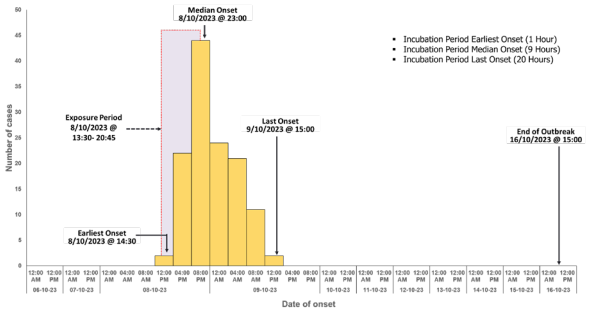

Figure 1: Epidemiological curve of outbreak cases, October 8 to October 9, 2023 (n=126)

Environmental results: The facility received an overall cleanliness rating of 91%. Adherence to Hazard Analysis and Critical Control Points (HACCP) principles is crucial to maintaining food safety[5]. Potential risks include neglecting appropriate temperature and time for raw ingredients, exceeding a 4-hour holding time, preparing excessive food, and the possibility of cross-contamination from food handlers, utensils, and the environment.

There were eleven food handlers at the facility, all of whom had undergone food handling training or received typhoid vaccinations. None exhibited symptoms of acute gastroenteritis during the inspection. The preparation of white rice and fried chicken with paprika sauce began 11 hours before consumption, with an anticipated holding time of up to 12 hours at room temperature.

Various measures were implemented to control and eliminate the outbreak. The caterers' operations at the facilities were suspended under the Section 18(1)(d) of the 'Prevention and Control of Infectious Diseases Act 1988' of Malaysia[6]. This step ensured that the caterers could take necessary actions to comply with the Food and Hygiene Regulation requirements, preventing further outbreaks before resuming their activities. An educational program was developed to provide knowledge and reinforce appropriate food handling and hygiene practices among food handlers. Additionally, a health education program was conducted with potentially exposed individuals through interviews or group discussions. The organizer of the mass gathering was advised to coordinate with the local health district authority before planning future events, ensuring preventive measures such as inspecting and sampling food handling facilities were in place.

Table 2: Result of case-control analysis in food poisoning outbreak, 9 October–16 October, 2023

Food items	Cases (n=126)			Controls (n=252)			p-value	Odds Ratio	95% confidence interval
	Exposed	Not exposed	% exposed	Exposed	Not exposed	% exposed			
Nasi Lemak	45	81	35.7	89	163	35.3	0.939	1.02	0.65–1.59
Fried anchovies	44	82	34.9	85	167	33.7	0.818	1.05	0.67–1.65
Peanuts	35	91	27.8	74	178	29.4	0.748	0.93	0.57–1.48
Boiled egg	42	84	33.3	87	165	34.5	0.818	0.95	0.60–1.49
Chocolate milk	40	86	31.7	89	163	35.3	0.490	0.85	0.54–1.34
Cream bread	84	42	66.7	146	106	57.9	0.101	1.45	0.92–2.27
White Rice	119	7	94.4	170	82	67.5	< 0.001	8.20	3.66–18.36
Fried Chicken	119	7	94.4	168	84	66.7	< 0.001	8.50	3.79–19.03
Paprika Sauce									

Microbiological results: A total of 11 specimens from cases (3), and food handlers (4), food items (3) and environmental (1) were taken. Salmonella spp. was isolated from the chopping board. Two from four food handlers also tested positive for *Bacillus cereus*. However, for the received stool cultures, the results were negative.

DISCUSSION

The documented food poisoning reports reveal a significant outbreak affecting 914 individuals with a high attack rate of 13.8%. The narrow onset period of illness from October 8 to October 9, 2023, indicates a potential common source. Following mixed gastrointestinal symptoms, the absence of hospitalizations suggests that the reported cases have mild symptoms. The case-control analysis, based on 126 cases and 252 controls, identifies white rice and fried chicken with paprika sauce from the suspected canteen as the likely source of transmission. The statistical significance reinforces the association between consuming suspected food and the reported illnesses.

The relatively short median incubation period of 9 hours further supports the hypothesis of a common exposure to the implicated food item. We are selecting the most likely cause of the outbreak between *Salmonella spp.*, *Staphylococcus aureus* and *Bacillus cereus*. By comparing criteria like symptoms, incubation period, type of food, laboratory results, and Hazard Analysis and Critical Control Points (HACCP) analysis. Our inclination was towards selecting *Bacillus cereus* as it scores the most in these comparisons. Furthermore, the odds of white rice consumption in cases was 8.20 times that of controls, and this result was statistically significant. The isolation of *Bacillus cereus* from the food handlers provide microbiological evidence supporting the suspected contamination. These findings corroborate the epidemiological data, linking the consumption of white rice to the reported cases of food poisoning. Low bacterial load could explain the negative clinical samples and the mild symptoms exhibited by the cases[7]. For further discussions, certain studies have affirmed that Bacillus cereus can present with both quick and delayed onsets[8], and frequently associated with the consumption of rice[9-11].

It is important to adhere to Hazard Analysis and Critical Control Points (HACCP) principles[5]. The identified lapses, including not paying attention to the right temperature and time for raw ingredients, going beyond a 4-hour holding time, preparing more food than usual, and the chance of cross-contamination from food handlers, utensils, and the surroundings are all important factors in this situation, point to potential sources of contamination. These lapses are crucial areas for corrective actions to prevent future outbreaks and uphold food safety standards[5].

As for the limitation of this study was the identification challenges emerged due to the absence of suspected residual food and vomitus samples, coupled with recall bias. We also have restricted opportunities for investigation and limited connectivity to other states and countries. For further research, consider longitudinal studies to track patterns and trends over time, allowing for a more in-depth analysis of potential outbreaks and contributing factors.

CONCLUSION

This study underscores the significance of leveraging digital tools and adhering to stringent food safety protocols in effectively tracing the origins of foodborne outbreaks. The report delineates the steps taken to identify cases and the causative pathogen during a foodborne outbreak at a mass school event, emphasizing measures implemented to prevent future occurrences. The findings underscore that the outbreak was preventable, shedding light on the importance of robust preventive measures in ensuring food safety.

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