Outbreak Reports

A Foodborne Disease Outbreak Caused by *Salmonella* — Guiyang City, Guizhou Province, China, September 2024

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Summary

What is already known about this topic?

Salmonella infection represents a common etiology of foodborne disease outbreaks in educational settings, posing substantial health risks to both students and faculty while simultaneously generating significant public concern. This constitutes a major public health challenge requiring vigilant surveillance and intervention.

What is added by this report?

On September 11, 2024, the local center for disease control and prevention received notification from a school physician regarding a clustered foodborne disease outbreak at a middle school. Investigators promptly deployed to assess the situation. Based on comprehensive epidemiological investigations, environmental hygiene assessments, clinical symptomatology, and laboratory analyses, the outbreak was determined to be caused by *Salmonella* contamination. Specifically, *Salmonella* Newport was detected in 22 patients, 1 canteen worker, and 3 food samples.

What are the implications for public health practice?

We have implemented measures to identify the pathogenic agent, contaminated food vehicles, and associated risk factors, while emphasizing preventive and control recommendations to mitigate similar incidents in the future. The risk of foodborne illness caused by *Salmonella* Newport contamination warrants serious consideration, and public health practitioners must maintain heightened vigilance against this pathogen.

ABSTRACT

Introduction: On September 11, 2024, a foodborne disease outbreak occurred at a middle school. Upon receiving the report, investigators promptly arrived at the scene to verify the incident, identify suspicious food items and risk factors that contributed to the outbreak, providing a reference for the prevention and investigation of similar incidents in the future.

Methods: Epidemiological methods were employed to characterize the clinical and epidemiological features of cases. A case-control study was conducted to identify suspicious meals and food items. Samples from cases, food products, and environmental sources were collected for laboratory testing.

Results: A total of 112 cases met the case definition, with an attack rate of 3.20%. The predominant clinical manifestations included fever (100.00%), diarrhea (92.86%), and vomiting (34.82%). The case-control study indicated that egg cakes and soybean milk sold at window 17 of the Second canteen were the suspicious food items. By September 12, 252 samples had been collected, with laboratory testing detecting *Salmonella* Newport in 26 samples.

Conclusion: Based on epidemiological investigation, hygienic assessment, and laboratory testing results, this incident is classified as an outbreak of foodborne disease caused by *Salmonella* Newport contamination. The health and well-being of students is paramount, necessitating strengthened food hygiene supervision in schools, regular food safety knowledge training, and comprehensive measures to reduce the risk of foodborne disease in educational settings.

At 12:50 p.m., September 11, 2024, the local CDC received a report from a school doctor regarding multiple students exhibiting symptoms including vomiting, diarrhea, and fever. Investigators promptly arrived at both the hospital where cases were concentrated and the school where the incident occurred to verify the situation. During the investigation, additional students continuously presented at the hospital emergency department with symptoms of fever, diarrhea, and vomiting. They immediately activated the provincial response

mechanism and established a coordinated provincial, municipal, and county-level investigation team to conduct a comprehensive epidemiological investigation.

This investigation aimed to confirm the cause of the clustering event, identify potential risk factors, and implement effective preventive and control measures.

INVESTIGATION AND RESULTS

The school encompasses an area of 678 hectares with a total built area of 18,000 square meters. It accommodates 3,193 students and 312 teachers (1,472 in middle school and 1,721 in high school). The institution operates 2 dining facilities, designated as the First and Second canteens, which provide 3 daily meals: breakfast, lunch, and dinner. The First canteen employs 69 food service workers, while the Second canteen has 48 staff members. Beginning at 07:00 on September 10, students and teachers across multiple classes began experiencing symptoms including diarrhea, abdominal pain, vomiting, and fever. Case numbers peaked on September 11, as illustrated in Figure 1.

Case identification was conducted through multiple channels, including review of case information from local medical institutions, the National Foodborne Disease Case Surveillance Network, examination of school illness-related absence records, and interviews with affected students and their families. Since September 8, 2024, it identified individuals who experienced fever (≥37.5 ℃) and diarrhea (≥3 times/24 hours) or vomiting (with expulsion of gastric contents ≥1 time), with or without accompanying symptoms such as headache, nausea, abdominal pain, or dizziness after consuming meals at the school. Among 3,505 individuals investigated, 112 met the case definition, yielding an attack rate of 3.20%.

Among the 112 cases, 46 were 12-year-old students, 59 were students aged 13–16 years, with the age range spanning from 12 to 53 years. The affected population included 3 teachers and 1 canteen worker. The male-to-female ratio was 1.15∶1, comprising 60 males and 52 females. Clinical manifestations predominantly included fever in all 112 cases (100.0%), diarrhea in 104 cases (92.86%), and vomiting in 39 cases (34.82%), with predominantly watery stool consistency, often accompanied by additional symptoms such as headache, dizziness, limb weakness, and nausea. By September 13, all patients had stabilized with no severe cases and significant symptomatic improvement. As depicted in the epidemic curve (Figure 1), case distribution included 17 cases on September 10, 82 cases on September 11, and 6 cases on September 12. The temporal distribution of case onset was concentrated between 00:00 and 23:00 on September 11.

To further identify the suspicious food items implicated in this outbreak, it conducted a case-control study comparing 112 cases (including both suspected and confirmed cases) with 221 controls who dined at the same locations during the same time period since September 8, 2024, but remained asymptomatic. Based on the epidemic curve and typical incubation period, we hypothesized that the contaminated food was consumed on September 10. Our investigation revealed that most affected individuals had dined in the Second canteen. Analysis of meals served in this canteen on September 10 showed statistically significant associations for breakfast [odds ratio

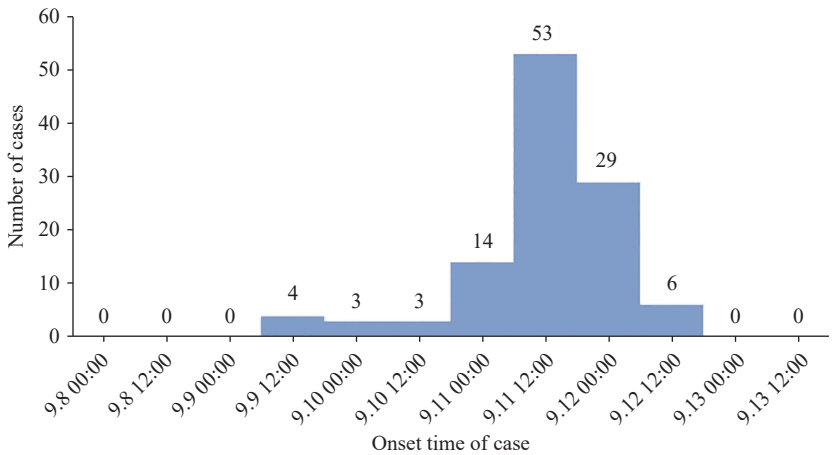

FIGURE 1. Epidemic curve of a *Salmonella* contamination in a middle school (*n*=112).

(*OR*)=7.026; 95% confidence interval (*CI*): 4.228, 11.674], lunch (*OR*=6.896; 95% *CI*: 4.120, 11.540), and dinner (*OR*=7.845; 95% *CI:* 4.584, 13.427), as shown in Table 1. To control for potential confounding factors, this study performed logistic regression analysis on all three meals served on September 10. The results indicated that breakfast was not statistically significant after adjustment. The adjusted *OR*s are presented in Table 1. Based on this preliminary analysis, lunch and dinner served at the Second canteen were identified as the suspicious meals. A detailed analysis was subsequently conducted for all serving windows providing lunch and dinner in the Second canteen on September 10. Window 17 primarily served noodle products, Window 18 served rice, and Window 19 sold pre-packaged foods such as milk and mineral water. Our analysis revealed that both lunch (*OR*=21.500; 95% *CI*: 8.768, 52.718) and dinner (*OR*=7.852; 95% *CI*: 3.555, 17.342) from Window 17 were statistically significant, identifying Window 17 as the suspicious serving location, as shown in Table 2. Further analysis of specific food items served at Window 17 for lunch and dinner on September 10 demonstrated that soybean milk (*OR*=3.351; 95% *CI*: 2.829, 3.969) and egg cakes (*OR*=3.085; 95% *CI*: 2.638, 3.608) at lunch, as well as soybean milk (*OR*=3.278; 95% *CI*: 2.777, 3.870) and egg cakes (*OR*=6.350; 95% *CI*: 1.684, 23.948) at dinner, were all statistically significant risk factors, as shown in Table 3. To strengthen our analysis, this study stratified cases based on consumption patterns: those who consumed only egg cakes, only soybean milk, or both items, as detailed in the Supplementary Table S1(available at https://weekly.chinacdc.cn/). The results consistently identified both egg cakes and soybean milk as significant risk factors. Therefore, our epidemiological investigation strongly implicated egg cakes and soybean milk served at Window 17 of the Second canteen on September 10 as the likely contaminated food vehicles, warranting further laboratory confirmation.

The school campus serves approximately 3,300 individuals daily through two canteens, both operating with valid food business licenses and staffed by workers with current health certificates. The Second canteen can accommodate approximately 1,000 diners simultaneously per meal. It comprises three floors, with the upper levels designated as dining areas. The basement level, characterized by poor ventilation and proximity to the parking lot, functions as the food

TABLE 1. Case-control analysis of suspicious meals in a middle school.

Suspicious meal	Case		Non-case		*OR* (95% *CI*)	χ^2	Wald χ^2	*P*
	Exposed	Non-exposed	Exposed	Non-exposed				
Breakfast on Sep 10	80	32	58	163	7.026 (4.228, 11.674)	62.534	–	<0.001
Lunch on Sep 10	84	28	67	154	6.896 (4.120, 11.540)	59.882	–	<0.001
Dinner on Sep 10	89	23	73	148	7.845 (4.584, 13.427)	64.149	–	<0.001
Breakfast on Sep 10*	80	32	58	163	–	–	–	>0.05
Lunch on Sep 10*	84	28	67	154	47.300† (17.230, 129.846)	–	56.025	<0.001
Dinner on Sep 10*	89	23	73	148	19.304† (8.336, 44.705)	–	47.740	<0.001

Note: "–" means not applicable.
Abbreviation: *OR*=odds ratio; a*OR*=adjusted odds ratio; *CI*=confidence interval.
* Logistic regression analysis of suspicious meals in a middle school.
† a*OR*s.

TABLE 2. Case-control analysis of suspicious window in a middle school.

Suspicious window	Case		Non-case		*OR* (95% *CI*)	χ^2	*P*
	Exposed	Non-exposed	Exposed	Non-exposed			
Window 17 of lunch on Sep 10	42	70	6	215	21.500 (8.768, 52.718)	72.904	<0.001
Window 18 of lunch on Sep 10	1	111	0	221	2.991 (2.570, 3.481)	–*	>0.05
Window 17 of dinner on Sep 10	28	84	9	212	7.852 (3.555, 17.342)	32.961	<0.001
Window 18 of dinner on Sep 10	4	108	5	216	1.600 (0.421, 6.08)	–*	>0.05

Note: "–" means not applicable.
Abbreviation: *OR*=odds ratio; *CI*=confidence interval.
* Fisher's exact test was used because the expected count was <5.

TABLE 3. Case-control analysis of suspicious food in a middle school.

Suspicious food	Case		Non-case		*OR* (95% *CI*)	χ^2	*P*
	Exposed	Non-exposed	Exposed	Non-exposed			
Soybean milk of lunch	18	94	0	221	3.351 (2.829, 3.969)	37.547	<0.001
Egg cake of lunch	6	106	0	221	3.085 (2.638, 3.608)	–*	<0.05
Soybean milk of dinner	15	97	0	221	3.278 (2.777, 3.870)	30.994	<0.001
Egg cake of dinner	9	103	3	218	6.350 (1.684, 23.948)	–*	<0.05

Note: "–" means not applicable.
Abbreviation: *OR*=odds ratio; *CI*=confidence interval.
* Because the expected count was <5, Fisher's exact test was used.

processing and production area. The canteen layout is illustrated in the Supplementary Figure S1 (available athttps://weekly.chinacdc.cn/). During our on-site inspection, we observed inadequate cleaning of the pancake pan in the pastry processing area. Review of security camera footage revealed that workers did not wear gloves during egg cake preparation. Additionally, some Second canteen staff failed to properly wear masks and gloves during food service. The preparation processes for egg cakes and soybean milk are detailed in the Supplementary Figure S2 (available at https://weekly.chinacdc.cn/). The Second canteen's processing area exhibited multiple deficiencies, including inadequate separation of raw and cooked foods, absence of cleaning and disinfection records, and non-standardized food sample retention practices. These conditions created a substantial risk of cross-contamination between food processing equipment and prepared foods.

From 19:00 on September 11 to 13:00 on September 12, we collected a total of 252 samples from the investigation site. These included 145 human samples (144 anal swabs and 1 vomit sample), 59 environmental samples, 10 water samples, and 38 food samples. Preliminary polymerase chain reaction (PCR) screening indicated that 11 samples from patients and canteen workers tested positive for *Salmonella*. Among the 3 retained food samples from lunch and dinner served at the Second canteen on September 10, egg cake samples tested positive for *Salmonella*. Following bacterial culture and identification, a total of 26 samples were confirmed as *Salmonella* Newport (*S.* Newport), including 22 patient samples, 1 canteen worker sample, and 3 food samples (retained egg cake samples from September 10 and retained soybean milk samples from September 11).

DISCUSSION

Based on a comprehensive analysis of the epidemiological and hygienic investigation findings, clinical symptomatology, and laboratory test results, in conjunction with the "Diagnostic Criteria and Treatment Principles of *Salmonella* Food Poisoning" (WS/T 13-1996), it was determined that this incident constituted a cluster infection caused by *Salmonella* contamination of egg cakes and soybean milk sold at window 17 of the Second canteen. This conclusion is supported by several key findings: 1) Patients presented with consistent clinical manifestations — predominantly fever, diarrhea, abdominal pain, and vomiting — with a concentrated incubation period characteristic of *Salmonella* infection. 2) Hygiene investigation revealed significant irregularities in food sample retention practices and evidence of potential cross-contamination between processing tools and food items during preparation. Notably, canteen workers failed to wear gloves during egg cake production, and the same personnel who transported egg cakes to the sales window also prepared soybean milk. 3) Multiple PCR analyses confirmed *Salmonella* positivity in 11 clinical specimens and canteen worker sample, and 3 food samples. Subsequent bacterial culture identified *Salmonella* Newport in 26 samples. Although epidemiological analysis strongly implicated soybean milk, definitive evidence was limited by the absence of *Salmonella* detection in the retained soybean milk samples from September 10. This discrepancy may be attributed to cross-contamination during the sales process, whereby workers potentially contaminated by egg cakes subsequently prepared soybean milk. Additionally, the soybean milk collected by investigators had been stored in a sample cabinet after morning preparation, suggesting it may not have been contaminated at the time of collection.

Salmonella represents a prevalent foodborne pathogen, with numerous emerging strains demonstrating enhanced virulence and antimicrobial resistance (*1*). Among these, *S.* Newport constitutes a particularly significant serotype (*2*). *S.* Newport

exhibits high detection rates in farmed animals, livestock carcasses, and animal-derived products including meat, eggs, and milk (*3*–*4*). Despite its prevalence in food sources, food poisoning outbreaks attributed specifically to *S*. Newport remain relatively uncommon in the literature. Previous investigations have documented *S*. Newport isolation from beef, duck meat, clinical specimens, and food handlers (*5*–*7*). In the present outbreak, *S*. Newport was detected in egg cake samples, patient specimens, and a canteen worker. The contamination pathway may have involved either the use of contaminated eggs in cake preparation, with subsequent transmission to ungloved workers during handling, or alternatively, asymptomatic carriage of the pathogen by food handlers who subsequently contaminated egg cakes during processing. Communication with Window 17 personnel revealed that soybean milk was freshly prepared for morning, afternoon, and evening service; however, unsold product was not promptly refrigerated but rather continued to be served at subsequent meals. Furthermore, the workers responsible for soybean milk production also transported egg cakes to the sales window, creating opportunities for cross-contamination. The subsequent distribution of contaminated products to students likely facilitated pathogen dissemination. Given the relative rarity of S. Newport food poisoning outbreaks, this pathogen warrants heightened vigilance and further epidemiological investigation.

This investigation employed a case-control methodology to identify exposure timing and implicated food vehicles, complemented by laboratory analyses for pathogen identification. However, several limitations merit acknowledgment. Practical constraints prevented identification of the index case, and comprehensive dietary histories were unavailable for approximately one-quarter of the population, potentially introducing bias into the case-control analysis. Additionally, genomic characterization of bacterial and food isolates was not performed, resulting in incomplete molecular epidemiological evidence. To prevent similar incidents, implementation of enhanced food hygiene supervision in educational institutions is imperative, including regular food safety training, standardization of food processing protocols, and prevention of cross-contamination throughout the food production, processing, storage, transportation, and service continuum. Prior to academic term commencement, a combination of mandatory and random inspections should be instituted to evaluate preparedness, with rigorous assessment of equipment functionality, food supply chains, and environmental conditions to identify and mitigate potential safety hazards.

Conflicts of interest: No conflicts of interest.

Ethical statement: Granted by Ethics Committee of Guizhou Provincial Center for Disease Control and Prevention (Q2024-07).

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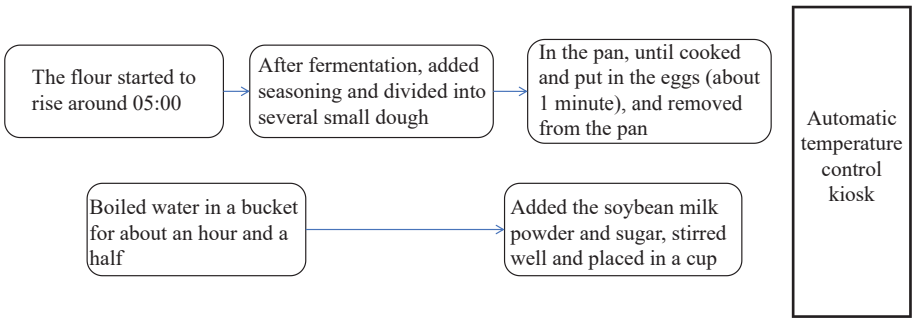
SUPPLEMENTARY MATERIAL

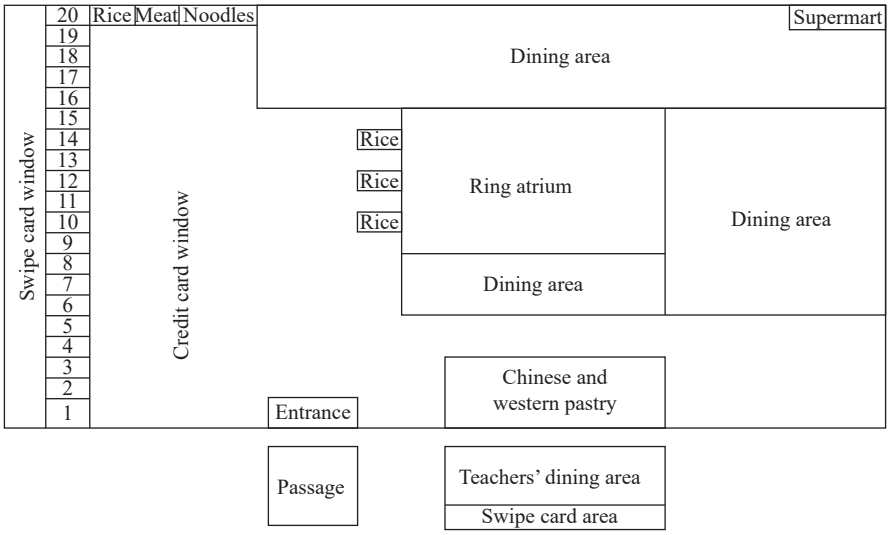
SUPPLEMENTARY TABLE S1. The consumption patterns of egg cake and soybean milk among cases on September 10.

	Soybean milk of lunch*	Egg cake of lunch†	Soybean milk and egg cake of lunch§	Soybean milk of dinner*	Egg cake of dinner†	Soybean milk and egg cake of dinner§
Case	18	6	4	15	9	7
Non-case	0	0	0	0	3	0

* Consumption of soybean milk only.
† Consumption of egg cake only.
§ Consumption of both soybean milk and egg cake.



SUPPLEMENTARY FIGURE S1. Process flow chart for egg cake and soybean milk production.



SUPPLEMENTARY FIGURE S2. Layout map of the Second canteen in a middle school.