

SPECIAL FEATURE

OUTBREAK OF SALMONELLOSIS TRACED TO CONSUMPTION OF CREAM CAKES

Introduction

Non-typhoidal salmonellosis is an acute food-borne disease caused by multiple serotypes of the bacterium, *Salmonella*. The infection has a short incubation period which ranges from 6-72 hours. Clinical features commonly manifest as fever and gastroenteritis with sudden onset of abdominal pain, headache, diarrhoea, nausea, and/or vomiting.¹ One of the commonest causative agents of this disease is *Salmonella* Enteritidis.² The incidence of gastroenteritis caused by *Salmonella* Enteritidis has increased in the last decade while outbreaks have been reported since the 1970s.³

Notification

In Nov-Dec 2007, the Ministry of Health noted an unusual increase in clusters of cases reporting gastroenteritis associated with the consumption of cakes. The first cluster was notified on 23 Nov 2007 and involved 15 people who developed symptoms after eating cream cake on 21 Nov 2007.

Epidemiological investigations

As soon as the unusual increase in gastroenteritis was noted, epidemiological investigations were stepped up to determine the source of infection and mode of transmission. Stool analyses in a number of cases had detected the presence of *Salmonella* Enteritidis. We defined a case as a person who suffered symptoms of gastroenteritis with or without fever within 72 hours after having consumed cake in the period of Nov-Dec 2007. All reported cases were interviewed and information obtained on their clinical symptoms, date of onset of illness, food items eaten, food establishments visited, medical treatment sought, and other relevant epidemiological data.

Preliminary findings from the investigations showed that cases were distributed all over Singapore and not restricted to any particular locality. They had purchased and consumed a variety of cakes from different retail establishments located throughout the island, and no specific cake outlet could account for all the cases. One important observation was that these establishments were all franchisees of a large and well known local confectionery.

A case-control study was initiated to determine the specific vehicle of transmission. Besides a detailed food history on the cakes that were eaten, enquiries were also made on the cases' exposure to other risk factors such as contact with pets or anyone who was ill, consumption of poultry or dairy products, and involvement in food preparation. For every case, attempts were made to obtain controls from the same household, workplace, school and community and they were asked identical questions. Differences in food-specific attack rates between cases and controls were analysed using SPSS version 15.0 (SPSS Inc., Chicago, IL). Chi Square and Fisher's Exact tests were used to determine significant differences between proportions. To quantify the extent of risk, odds ratio and the corresponding 95% confidence intervals were computed.

Further investigations and inspections were made into the food supply and methods of food preparation in various establishments and the cake factory. Special attention was paid to the factory and its line of production and distribution. Samples of the implicated cakes and raw ingredients were collected from the factory as well as cake outlets for microbiological examination. Two remnant samples of cake were also obtained from the cases and sent for analysis. All the food samples were tested in the Singapore General Hospital's Food and Water Laboratory. Samples that were positive for *Salmonella* were subsequently serotyped, and phage typed in the molecular laboratory.

Outbreak control

Outbreak control measures were concurrently implemented during epidemiological investigations. The factory was ordered by the licensing authority (Agri-Food & Veterinary Authority) to cease production and recall all implicated cake products from their franchisees on 30 Nov 2007. The factory was subsequently ordered to cease all manufacturing activities on 04 Dec 2007 and retail establishments were closed on 05 Dec 2007. Both factory and retail establishments underwent thorough disinfection. All food handlers from the factory and cake outlets were considered suspects and referred to the Communicable Disease Centre for stool screening. Legal orders were served on those found to be positive for food-borne pathogens to require them to refrain from engaging in the preparation of food until certified fit. They

were allowed to return to work only after they had been re-screened and confirmed to be no longer positive.

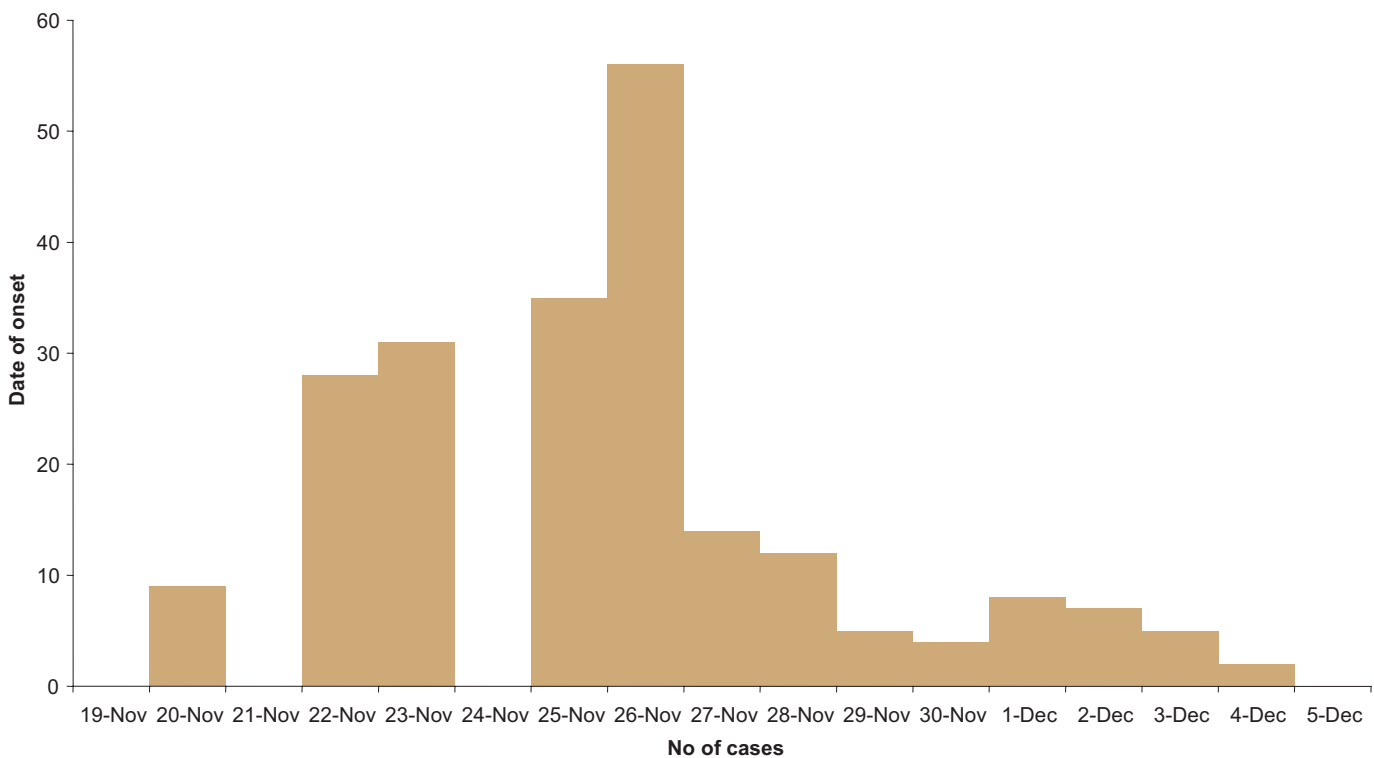
The public was alerted of the outbreak and advised to discard all cake products purchased from the implicated retail establishments. At the same time, they were advised to observe proper food and personal hygiene, to store high risk food items appropriately, and not to consume food items that had passed their expiry or use-by dates. An advisory on salmonellosis was also made available on the Ministry of Health website.

Transmission ceased following closure of the factory, and the last case reported onset of illness on 4 Dec 2007.

Results

A total of 216 cases of gastroenteritis were identified with onset of illness between 20 Nov and 4 Dec 2007 (Figure 1). 14 tested positive for *Salmonella* Enteritidis, while the rest were culture negative or not tested but epidemiologically linked to the outbreak. The main presenting symptoms were: diarrhoea (96.0%), fever (63.0%), vomiting (60.0%) and headache (16.0%). Median incubation period was 12.3 hours (reported range, 3-139 hours). The cases were aged 1-78 years (median age, 29 years) with a male to female ratio of 1. Among the major ethnic groups, Indians were not represented while Chinese accounted for 70.4% of cases; Malays, 27.3%; and others, 2.3%. 18(8.3%) of the cases were hospitalised while the remainder had outpatient treatment or self medicated.

Figure 1
Onset of symptoms of 216 cases linked to consumption of cream cakes, 20 Nov – 4 Dec 07



These cases reported a total of 38 separate incidents that occurred either in small clusters, or singly and sporadically. In our case-control study of the exposure risk factors among 55 cases (from four clusters) and 39 controls, a statistically significant association was found

between their illness and consumption of cream cakes from the specific confectionery (Table 1). No other risk factors involving exposure to family members who were ill, pets, food preparation, and poultry or dairy products were implicated.

Table 1
Analysis of risk factors in an outbreak of salmonellosis, Nov-Dec 2007

Risk factors	Cases (n=54)			Controls (N=39)			P value	OR	95% CI
	Exposed	Not exposed	% Exposed	Exposed	Not exposed	% Exposed			
Cream cakes (from specific confectionery)	52	2	96.3	6	33	15.4	<0.001	143	27.23-759.10
Family members who were ill	11	43	20.4	9	30	23.1	0.754	NS	NS
Contacts with pets	10	44	18.5	5	34	12.8	0.573	NS	NS
Involvement in food preparation	13	41	24.1	8	31	14.5	0.685	NS	NS
Consumption of chicken	20	63	37.0	27	12	69.2	0.002	NS	NS
Consumption of dairy products	9	45	16.7	25	14	64.1	<0.001	NS	NS
Consumption of eggs	6	48	11.1	23	16	59.0	<0.001	NS	NS

NS – not significant

Health inspections uncovered a number of hygiene irregularities in the factory. High risk food items such as cream were left at ambient temperature for prolonged periods. Finished cakes were also not immediately kept in chiller conditions with temperature display to prevent bacterial contamination. In addition, the layout of the kitchen was such that the manufacture of semi-processed and finished food products was not separated. Utensils and working surfaces were also not cleaned frequently enough and posed risks of cross contamination.

The food samples analysed for food-borne pathogens comprised 44 raw ingredients, semi-finished products and finished products obtained from the factory, 23 finished products sampled from nine of 38 cake outlets, and two cake remnants provided by the cases. Of the factory samples, five semi-processed products and finished products (chocolate cream, truffle chocolate cream, whole hazelnuts and two hazelnut pastes taken on different days) tested positive for *Salmonella* Enteritidis. Laboratory investigations also showed other coincidental bacterial contamination. One food sample showed high

bacterial count and another tested positive for *Bacillus cereus*. Eight cake samples taken from five outlets also tested positive for *Salmonella* Enteritidis and showed concomitant high bacterial count. Of the cake remnants provided by the cases, one was positive for *Salmonella* Enteritidis and the other for *Salmonella* Group C.

Six (3.4%) of 176 food handlers and staff from the factory and four (1.7%) of 232 from the cake outlets also tested positive for *Salmonella* Enteritidis. As an incidental finding, three other food handlers (two from the factory, one from the cake outlets) were positive for *Salmonella* Group C, and another food handler (from cake outlet) for *Salmonella* Group E.

The *Salmonella* Enteritidis isolates were further analysed by phage typing (Table 2). Typing results of isolates from the food handlers, food samples and cases were either phage type 1 or RDNC (reagents did not conform). The antibiogram pattern for each phage type was the same. Ribotyping results also showed that the *Salmonella* Enteritidis isolates were closely related at a genetic level.

Table 2
Phage typing of isolates of *Salmonella* Enteritidis

Variable		Number of isolates analysed	No. of phage type 1 isolates	No. of RDNC isolates
Food Handlers	Factory	6	3	3
	Outlets	3	2	1
Food	Factory	5	3	2
	Outlets	8	4	4
	Remnant	1	1	0
Cases		13	11	2
Total		36	24	12

Comments

The epidemiological features in this outbreak were consistent with a pattern of common source infection. The onset dates of the cases were between 20 Nov and 4 Dec 2007 and based on the known incubation period of 6-72 hours, the period of exposure was narrowed down to between 20 Nov and 1 Dec 2007. Contaminated supply of raw eggs or other raw ingredients from a source farm during this time was ruled out because it would have affected non-cake products and led to a more generalised outbreak. The presence of multiple implicated retail establishments suggested that contamination had occurred somewhere after the farm but prior to the point of distribution and sale, and hence probably in the factory. Our case-control study implicated consumption of cream cakes produced from one specific confectionery and supported the likelihood that contamination had indeed occurred in the factory.

The microbiological findings of *Salmonella* Enteritidis in the factory cake products as well as semi-processed products (ie truffle chocolate cream, hazelnuts and hazelnuts paste) pointed to widespread contamination in the cake and decoration area of the factory. Three of the six food handlers who tested positive for *Salmonella* Enteritidis had worked in this area and two routinely taste-tested the quality of the ingredients. Since they were asymptomatic and did not report experiencing illness previously, it could not be ascertained if they were victims rather than the cause of the outbreak. Nonetheless, these food handlers could propagate the organisms via the work surfaces, utensils and food ingredients if hygiene practices were insufficiently observed. The molecular phage typing results reaffirmed this important epidemiological link between the

contaminated cake products, cake ingredients and food handlers at the factory.

In the preparation of the cream cakes at the factory, it was noted that the 'Truffle Cake', 'Truffle Divine Cake' and 'Hazelnut Indulgence' used the in-house processed butter cream while other cakes used ready-to-add fresh cream. Butter cream was a key semi-processed ingredient used in the icing of the cream cakes. A closer inspection into the production of the butter cream revealed that the butter cream was made from sugar syrup boiled at high temperature (120°C) and half whisked liquid egg white. Subsequently, other ingredients such as chocolate paste or hazelnut paste were mixed into the butter cream to form chocolate cream or hazelnut cream, respectively. The cream was then iced onto the chocolate sponge bases and the cakes were decorated to form the final product. There was no further baking of the cakes. Hence *Salmonella* is likely to have been introduced with the lapse in temperature control at the boiling stage. Moreover, exposing the iced cakes at the open preparation area at room temperature for a substantial period of time would have led to further multiplication of the *Salmonella*. Closure of the factory on 4 Dec 07 effectively broke the chain of infection and stopped further transmission of the disease.

This outbreak has highlighted three important points in the manufacture and sale of cream cakes by any confectionery. Firstly, all food handlers in the factory should constantly be reminded to observe proper food hygiene practices and not to report to work if they are experiencing illness. Secondly, cream cakes are considered to be high risk food items and more stringent microbiological testing of raw ingredients and finished

products should be put in place. Finally, in the event of a need for product recall, there must be a proper inventory system for tracing batch numbers of raw ingredients and the movement of finished products right up to end-of-sale.

References

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OUTBREAK OF NOROVIRUS GASTROENTERITIS IN A PRIMARY SCHOOL

Introduction

On 25 Jul 2007, the Ministry of Health (MOH) was notified of an outbreak of suspected food poisoning which affected many students in a primary school. This was a two-session school with an enrolment of 1,885 students supported by 98 teaching and 21 non-teaching staff. The school had shifted to a temporary premise in Dec 2006 while upgrading was being carried out at its original location. There was a school canteen with 13 food handlers working in eight food stalls.

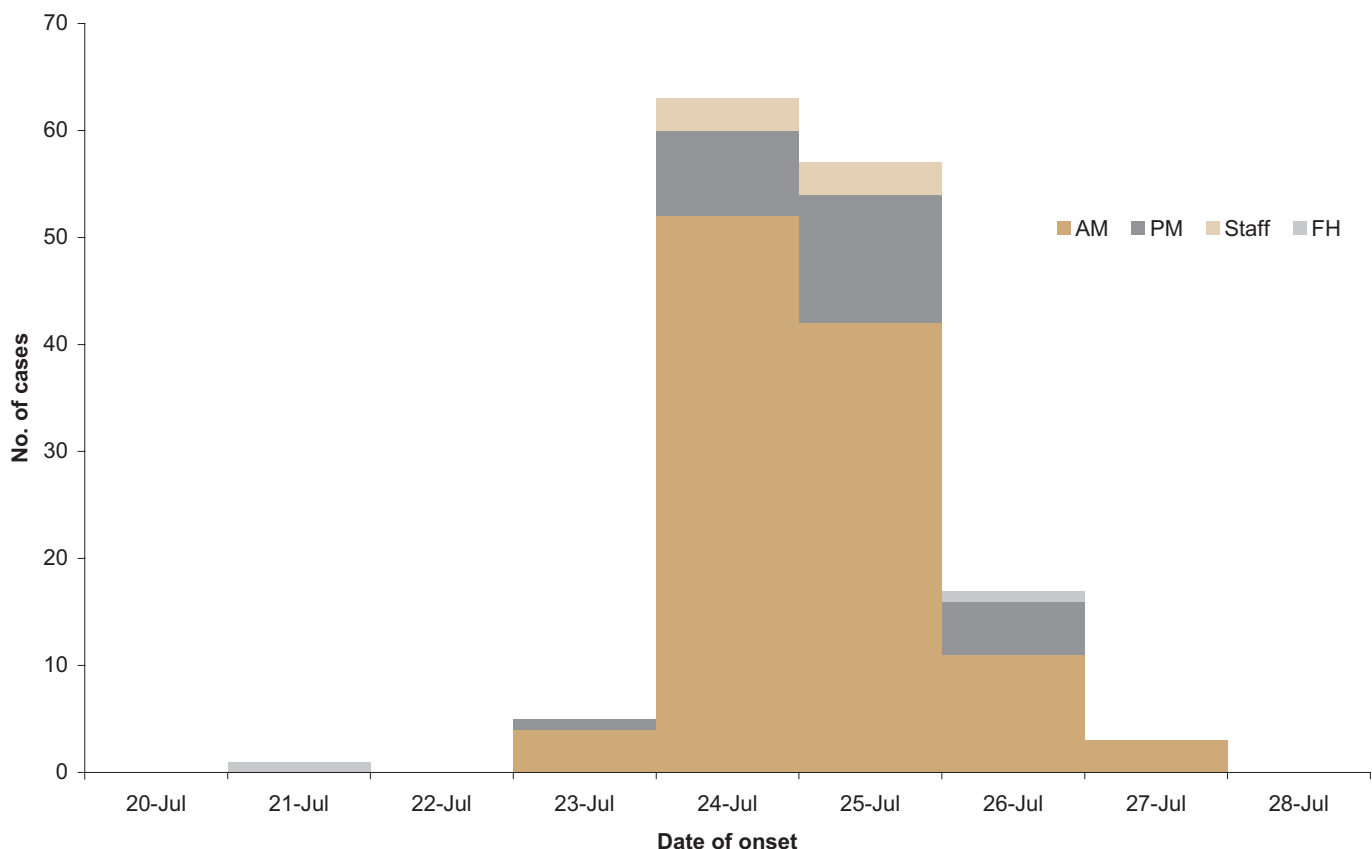
As soon as the notification was received, epidemiological investigations were conducted to determine the extent

of the outbreak, source of infection and mode of transmission.

Epidemiological findings

A total of 147 cases reported symptoms of acute gastroenteritis between 21 and 27 Jul 2007 (Figure 1). They comprised 113 students from the morning session (Primary 3-6), 26 students from the afternoon session (Primary 1-2), four teachers, two food handlers, a cleaner and a security guard. The symptoms were vomiting (93%), abdominal pain (72%), fever (69%), diarrhoea (55%), headache (29%), and nausea (14%). 112 (76%) of them required outpatient treatment while the rest self-medicated. None were hospitalised.

Figure 1: Distribution of 147 acute gastroenteritis cases by date of onset in a primary school, July 2007



The affected students were distributed across Primary 1-6 with class-specific attack rates ranging from 3.7-9.7%. Case-control analysis to determine the food-specific attack rates based on the food items consumed prior to onset of illness did not implicate any specific item as the vehicle of transmission. The incubation period

based on food consumed during recess time ranged from 23-45 hours.

During epidemiological investigations, a food handler from the implicated food stall was found to be ill since 21 Jul 2007. She had vomiting and diarrhoea while in

the school on 23 Jul 2007. Despite her symptoms, she continued to prepare drinks in the canteen until the school ordered her home on 25 Jul 2007.

The canteen was inspected and found to be satisfactorily maintained. However, it was observed that the dedicated toilet for the exclusive use of food handlers and security guard had soap for hand washing but no toilet papers. The users were expected to bring their own toilet papers.

A total of six food samples, one water sample, and two environmental swabs were collected for microbial testing. *S. aureus* was found in a sample of ice and a styrofoam box (both from the implicated food stall) as well as in a canteen water tap.

All the 13 food handlers were referred to the Communicable Disease Centre (CDC), Tan Tock Seng Hospital for medical screening. Norovirus was identified in the stools of six of them, including the sick food handler from the implicated stall.

Prevention and control

The principal of the school was advised to undertake the following measures to break the chain of transmission and prevent a recurrence of the outbreak:

- prohibit infected food handlers from preparing food until they are certified free of infection and to refrain from handling food if they are unwell;
- remind food handlers to observe good food and personal hygiene, including use of properly maintained containers for ice-making;
- ensure that the school premises, including the canteen are cleaned and well maintained;
- make sure that foods are thoroughly cooked before serving and there is no cross-contamination between raw and cooked foods;
- ensure that toilets are in a sanitary condition and adequately equipped with soap and toilet papers;
- promote frequent hand washing, especially after toilet visits and before eating or preparing food;
- observe personal hygiene etiquette, including covering of mouth when coughing/ sneezing and washing hands thereafter;
- detect and isolate cases early;
- clean and disinfect areas contaminated by stool/vomit immediately by using household bleach;
- wash mop in a proper designated basin; and

- have adequate ventilation in places of congregation and avoid overcrowding.

Comments

This was an outbreak of norovirus gastroenteritis established by the detection of the aetiological agent in stool samples. Our investigative findings with vomiting as the predominant symptom, and of an incubation period falling within the range of 12-48 hours were consistent with the clinical and epidemiological features of this viral infection. The source of infection was traced to an infected food handler who was ill since 21 Jul 2007 but continued to prepare drinks in the canteen from 23-25 Jul 2007 until she was sent home. No further cases were reported after 27 Jul 2007.

In this outbreak, transmission probably occurred not only through the faecal-oral route, but also by environmental contact^{1, 2}. Infection could have spread from the index case to other food handlers through close contact at work and sharing of common toilet facilities. Poor hygienic practices, as evidenced by the detection of *S. aureus* in food and environmental samples, contributed to further spread of infection. As to why fewer cases were reported from the afternoon session, this could be due to diminished viral contact among the primary 1-2 students who brought their own food for consumption and stayed away from the canteen. The findings of this outbreak highlighted the importance of maintaining a high standard of good food and personal hygiene, and of prohibiting food handlers from preparing food when they are ill with gastroenteritis. Institutional outbreaks of norovirus gastroenteritis implicating sick food handlers have been documented³.

References

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