
A multi-state outbreak of *Salmonella* serotype Thompson infection from commercially distributed bread contaminated by an ill food handler

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SUMMARY

Foodborne transmission is estimated to account for 95% of non-typhoidal *Salmonella* infections reported in the United States; however, outbreaks of salmonellosis are rarely traced to food handlers. In August 2000, an increase in *Salmonella* serotype Thompson infection was noted in Southern California; most of the cases reported eating at a restaurant chain (Chain A) before illness onset. A case-control study implicated the consumption of burgers at Chain A restaurants. The earliest onset of illness was in a burger bun packer at Bakery B who had not eaten at Chain A but had worked while ill. Bakery B supplied burger buns to some Chain A restaurants in Southern California and Arizona. This outbreak is notable for implicating a food handler as the source of food contamination and for involving bread, a very unusual outbreak vehicle for *Salmonella*. Inadequate food-handler training as well as delayed reporting to the health department contributed to this outbreak.

INTRODUCTION

Salmonella is the most common cause of foodborne outbreaks with a known aetiology, and foodborne transmission accounts for an estimated 95% of all non-typhoidal *Salmonella* infections reported in the United States [1, 2]. However, food handlers have rarely been identified as the source of *Salmonella* outbreaks [3, 4]. Here we report a multi-state outbreak of *Salmonella* serotype Thompson infection

associated with consumption of commercially distributed bread, a highly unusual vehicle for any infectious foodborne outbreak. The initial source of the *S.* Thompson contamination was likely to be an infected bakery employee who worked while ill with diarrhoea.

On 14 July 2000, an outbreak of gastroenteritis occurred among approximately 78 out of 200 attendees of a barbecue luncheon held in Los Angeles County (LAC) and catered for by Company C. The crude analysis of a retrospective cohort study did not identify any single food item as having a strong association with illness; however, hamburger was among the short list of food items which was suspect

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[relative risk (RR) 1.4, 95% confidence interval (CI) 0.8–2.3]. Further, most of the cases (62%) had taken food from one of two serving tables (RR 2.0, 95% CI 1.2–3.6). Multivariate analysis stratified by serving table and suspect food items identified only hamburger from one of the tables as having an association with illness (RR 2.0, 95% CI 1.1–3.6). Stool specimens from 12 ill persons from this outbreak yielded *S. Thompson*.

In August 2000, an increase in *S. Thompson* isolates from Southern California patients with onset of illness in July was noted. Preliminary investigation by local health departments revealed, after excluding those cases associated with the LAC outbreak, that many of the cases had eaten at Chain A restaurants prior to their illness. We, therefore, initiated an investigation to determine the source and extent of the outbreak, and to interrupt possible ongoing transmission.

METHODS

Case finding

All persons with confirmed *S. Thompson* infection in California with onset of illness in July and August 2000 were questioned about Chain A restaurant exposure, as well as exposures to items typically associated with *Salmonella* infections, such as chicken and eggs. Health departments of states with Chain A restaurants, i.e. Arizona, Colorado, Nevada and Texas, were alerted to the possibility of a Chain A-associated multi-state outbreak.

Case-control study

The preliminary interviews confirmed that many of the patients with *S. Thompson* infection had eaten at a Chain A restaurant in the 5 days before illness onset. Therefore, a case-control study was conducted to evaluate specific food and drink exposures at Chain A restaurants. For the purposes of the case-control study, a Chain A outbreak-related case was defined as a person from whom *S. Thompson* was recovered between 1 July and 30 August, and who reported eating at a Chain A restaurant within 5 days of illness onset. Controls were well friends or family members who shared meals with cases at Chain A during the exposure period. A questionnaire listing Chain A menu items was administered to all cases and controls by telephone.

Environmental investigation

Based on the results of our case-control study, the implicated product, hamburger buns, was traced back to the producer, Bakery B, and on-site inspections were conducted. The investigation included interviews with employees working at the bakery, formal observation of manufacturing processes, and review of all records pertaining to the distribution, and sale of bakery goods.

Laboratory investigation

Selected *S. Thompson* isolates from the Company C barbecue luncheon outbreak, Chain A-associated cases, and sporadic cases underwent pulsed-field gel electrophoresis (PFGE). Faecal specimens were obtained from all staff employed at Bakery B and examined for salmonellae.

Statistical analysis

We calculated the odds ratios (ORs) and CIs with Epi-Info, version 6.04 (CDC, Stone Mountain, GA, USA).

RESULTS

Case finding

A total of 55 *S. Thompson* isolates were identified in Southern California during the study period. Twelve of the isolates were associated with the LAC luncheon outbreak and excluded from further analysis. Among the remaining 43 isolates, the median age of patients was 27 years (range 5–90 years); 55% were female. Nine (21%) were hospitalized; there were no deaths.

Thirty-four patients in Southern California with *S. Thompson* infection during the study period were able to be contacted for interview; 17 (50%) reported eating at a Chain A restaurant in Southern California in the 5 days prior to illness onset. Six additional patients were identified by the Arizona Department of Health as having eaten at a Chain A restaurant in Arizona. However, the earliest onset of illness, 13 July, was reported by Patient X, who had not eaten at a Chain A restaurant but was an employee of Bakery B. Three patients with *S. Thompson* infection who had not eaten at a Chain A restaurant, reported eating at other restaurants that received bread from Bakery B. Risk factors were not able to be identified for the remaining patients. Symptoms most frequently

Table. Selected associations of exposures among patients with *S. Thompson* infection and matched controls, California and Arizona, 2001

Food exposure	No./total (%)		OR (95% CI)	P value
	Case patients	Controls		
Hamburger	23/23 (100)	4/30 (13)	Undefined	<0.0001
Hamburger buns	20/20 (100)	0/30 (0)	Undefined	<0.0001
Sandwich	0/23 (0)	0/29 (0)	n.a.	n.a.
Soup	5/23 (22)	11/18 (61)	0.18 (0.03–0.83)	0.01
Salad	2/22 (9)	14/29 (48)	0.11 (0.01–0.62)	<0.01
Other main dish	1/23 (4)	9/21 (43)	0.06 (0.00–0.06)	<0.01

OR, Odds ratio; CI, confidence interval; n.a., not applicable.

reported by outbreak-associated patients included diarrhoea (100%), fever (89%), vomiting (63%), and bloody diarrhoea (24%).

Case-control study

Twenty-three cases and 30 well meal companions were enrolled in the case-control study. The Table summarizes the results of the statistical analysis. The only Chain A menu item associated with illness was a burger; all 23 (100%) cases reported eating some type of burger vs. four (14%) controls (OR undefined, $P < 0.001$). Among the cases recalling the specific type of burger, they most commonly reported consuming hamburger (16), but also reported eating chicken burgers (2), turkey burger (1) and vegetarian burger (1), which were all served in the same type of hamburger bun. All four controls who ate burgers reported eating a French-style beef sandwich served on grilled garlic sourdough bread. When analysed by type of bread, 20 (100%) out of 20 cases ate hamburger buns compared with 0 (0%) out of 30 controls (OR undefined, $P < 0.001$).

Environmental investigation

Bakery B is located in Orange County (OC), California; it supplied bread, hamburger buns, and rolls to only those Chain A restaurants located in Southern California and Arizona. These bread products contained no preservatives and were not refrigerated; their shelf life was only 3 days. The grilled garlic sourdough bread reportedly eaten by the four controls was not bread supplied by Bakery B. Although Chain A was by far the highest volume client of Bakery B, the bakery also supplied bread products to a variety of other businesses in Southern

California, including Catering Company C, which verified that Bakery B hamburger buns had been served at the LAC luncheon. All known Bakery B-associated illnesses, including those from the LAC outbreak, had onsets between 13 and 30 July (Fig.).

Bakery B did not offer any formal training on safe food-handling practices. Furthermore, although many of the employees spoke only Spanish, the procedure manuals were written in English. Patient X, a full-time employee, was responsible for removing freshly baked bread and buns from the cooling rack, feeding them through an automatic slicer, then packaging the bread for distribution. She did not wear gloves and handled every individual bread item (notably hamburger buns) at least twice with bare hands. Patient X worked from the day of illness onset on 13 July until she required overnight hospitalization on 17 July. She resumed work after hospital discharge on 18 July and continued working until termination of employment on 23 July. Although stool cultures were taken during her hospitalization, results were not reported to the OC Health Department until 31 July, 2 weeks after her illness onset. Further, Patient X's brother was also employed at Bakery B and became ill on 17 July. Although his primary responsibility was to mix the dough, there was some rotation of job duties. He continued to work while ill until he was removed from work on 3 August by the Health Department for being a symptomatic close contact to a confirmed salmonellosis case.

Laboratory investigation

The *S. Thompson* isolates from the LAC luncheon, the Chain A cases, and patient X, had a PFGE pattern indistinguishable from each other but distinct from the sporadic cases. Except for Patient X and her

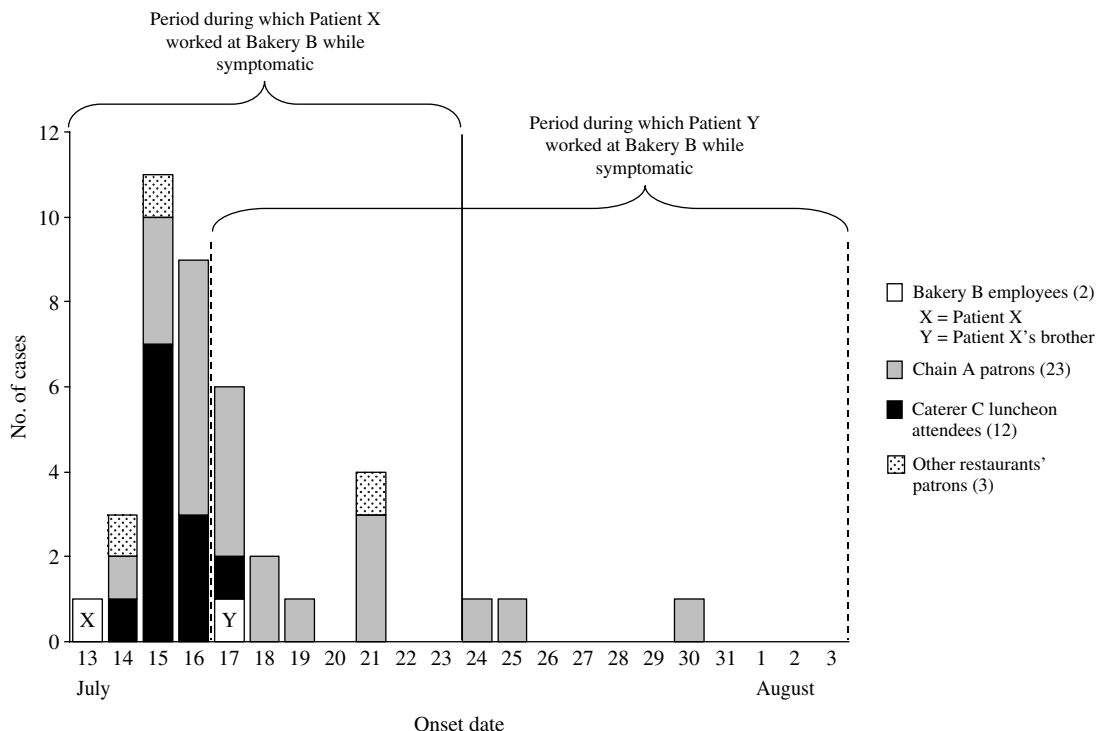


Fig. Onset dates of *Salmonella* Thompson by Bakery B association, California and Arizona, July 2000 (n=40).

brother, all other stool samples from Bakery B employees were negative for enteric pathogens. Because of their short shelf life, hamburger buns from the outbreak period were no longer available for culture.

DISCUSSION

This unusual outbreak of salmonellosis probably occurred as a result of an ill bakery employee who contaminated hamburger buns just prior to packaging and distribution. Supportive findings include the following: (1) Bakery B hamburger buns were the common factor of the burger items implicated in our case-control study; (2) in addition to Chain A restaurants, Bakery B hamburger buns were also served at the LAC luncheon and at three other restaurants where *S. Thompson* infections were reported; (3) the buns had been handled by a Bakery B employee who had been infected by *S. Thompson* with the outbreak-associated PFGE pattern; (4) her illness onset preceded those of all other outbreak-associated cases; and (5) the outbreak ended after she and her ill brother were removed from work.

Both the vehicle and the mode of transmission were remarkable. Among reported *Salmonella* outbreaks of known source, most have been linked to consumption of contaminated animal products [2, 5].

The few reported *Salmonella* outbreaks implicating bakery products have involved items containing undercooked eggs or milk products [6–8]. Bread is an unexpected source of salmonellosis, as bread does not usually contain animal products which could serve as a source of contamination, and because temperatures achieved during the baking process would typically destroy any contaminating enteric pathogen [9]. Indeed, we are only aware of one previous foodborne outbreak due to bread; a hepatitis A outbreak associated with sandwich bread and rolls thought to be contaminated by an infected employee who handled the bread after baking [10].

Large outbreaks of food-handler-associated salmonellosis are rare and generally have involved an ill worker contaminating food served at the retail level, such as at a single restaurant [3, 4, 11, 12]. To our knowledge, this is the only reported outbreak of salmonellosis due to a commercially distributed food product contaminated by an infected food handler further up the commercial food chain, i.e. at the food processing (bakery) level. Nonetheless, there is clear potential for similar outbreaks to occur, as there is a growing trend towards centralized food processing, and a point-source contamination can cause widespread disease [13]. Outbreaks due to food-handler contamination of a commercially distributed product

with a pathogen infective at a low infectious dose (such as *Shigella*) have already been demonstrated [14, 15]. Although *Salmonella* has traditionally been thought to require higher doses to cause illness, several outbreaks have occurred with infectious doses estimated to be less than 50 organisms [16–18]. Furthermore, it has been demonstrated that *Salmonella* can persist on heavily contaminated hands despite a 15-min wash with soap and water and can survive on fingertips for at least 3 h [19]. Since the contaminated buns in our outbreak were served with high-fat items (i.e. burgers), these might have enhanced the risk of salmonellosis, even if the original contaminating dose were low. High-fat foods are thought to provide a protective barrier for *Salmonella* as it transits the acidic stomach, allowing infection even with a small inoculum of *Salmonella* [16, 17].

The apparent failure of Bakery B to adequately train and supervise employees about food safety probably contributed to this outbreak. Food processors of ready-to-eat items must adhere to good manufacturing practices, including minimizing bare-hand contact in the preparation of the finished food product. This is critical in centralized food processing, where a point-source contamination could cause widespread disease [13–15]. Regularly scheduled, culturally sensitive and linguistically appropriate training for all employees on food-worker hygiene and sanitation is needed. Supervisors must maintain aggressive surveillance for diarrhoeal illness among workers having direct contact with food, and ill employees should not be financially penalized for missing work due to illness, so that there is no disincentive to reporting gastrointestinal illness or other potentially infectious diseases.

It is important to note that Patient X worked at Bakery B while ill with gastroenteritis during a 10-day period. The OC Health Department became aware that Patient X was a food handler with salmonellosis only when the OC Public Health Laboratory received her isolate 14 days after the specimen had been submitted to a clinical laboratory. In California, health-care providers are required to report all cases of non-typhoid *Salmonella* within one working day of identification (Title 17, California Code of Regulations, Section 2500). Physician-based reporting is notoriously poor [20, 21]; however, as this outbreak illustrates, prompt reporting of reportable communicable disease to the Public Health Department is crucial for preventing transmission by those in sensitive occupations. Expedient reporting by the

treating physician in this outbreak would have enabled the prompt removal of both Patient X and her brother from Bakery B, potentially preventing some of the cases; over half of the cases had occurred after Patient X was tested for *Salmonella*.

Public health surveillance relies on timely reporting of reportable diseases. Effective public health response relies on prompt notification by both health-care providers and clinical laboratories. There is heightened urgency for front-line providers to report promptly, particularly in this era of concern for bioterrorism [22]. This report illustrates how a series of events, from the level of the food processor to the treating health-care provider, can potentiate an outbreak. Further work is needed to provide education and training at every level to prevent the occurrence of similar outbreaks.

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