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Restaurant *Salmonella* Enteritidis Outbreak Associated with an Asymptomatic Infected Food Worker

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ABSTRACT

Salmonella is the most common bacterial cause of foodborne outbreaks in the United States; approximately half of *Salmonella* outbreaks occur in restaurant settings. In February 2008, investigation of a cluster of *Salmonella* Enteritidis cases with indistinguishable pulsed-field gel electrophoresis (PFGE) patterns revealed that five cases had eaten at the same restaurant. Cases were identified through routine surveillance activities and by contacting meal companions of culture-confirmed cases. Well meal companions and well patrons contacted via check stubs served as controls. Illness histories and stool samples were collected from all restaurant employees. Sandwiches were the only menu item or ingredient significantly associated with illness (15 of 15 cases versus 17 of 37 controls; odds ratio, undefined; $P < 0.001$). None of the six restaurant employees reported experiencing recent gastrointestinal symptoms. The outbreak PFGE subtype of *Salmonella* Enteritidis was identified in two food workers. One of the positive employees began working at the restaurant shortly before the first exposure date reported by a case, and assisted in the preparation of sandwiches and other foods consumed by cases. The other positive employee rarely, if ever, handled food. The restaurant did not have a glove use policy. There was no evidence of ongoing transmission after exclusion of the positive food workers. This was a restaurant *Salmonella* Enteritidis outbreak associated with an asymptomatic infected food worker. Routine PFGE subtyping of *Salmonella* Enteritidis isolates, routine interviewing of cases, and an iterative approach to cluster investigations allowed for timely identification of the source of an outbreak of *Salmonella* Enteritidis infections.

Nontyphoidal salmonellae cause an estimated 1.4 million illnesses in the United States each year *(21)*. From 1998 through 2002, *Salmonella* was the most common bacterial foodborne outbreak etiology reported to the Centers for Disease Control and Prevention Foodborne Disease Outbreak Surveillance System, accounting for 585 outbreaks; 271 (46%) of those outbreaks occurred at a restaurant or delicatessen *(12)*.

From 1995 through 2003, there were 39 confirmed foodborne outbreaks of salmonellosis in Minnesota; 23 (59%) of these occurred in restaurants *(13)*. The same pulsed-field gel electrophoresis (PFGE) subtype of *Salmonella* was isolated from food workers at 19 (83%) of the 22 restaurants where food workers had submitted stool specimens. Fifty-three percent of these *Salmonella*-positive food workers reported not experiencing recent gastrointestinal symptoms. The median duration of shedding for asymptomatic food workers was 3 days, and bacterial shedding occurred for 20 days or more in 13 (20%) of asymptomatic food handlers *(13)*.

Infected food workers have been implicated as the source of foodborne outbreaks of salmonellosis in multiple investigations *(1, 2, 6–11, 13, 16)*. *Salmonella* has the ability to survive on contaminated fingertips and to be transferred from infected fingertips to food *(17)*. Transmission in restaurant settings can occur because of inadequate removal of the pathogen from the hands of infected food workers who then handle food later consumed by patrons.

Early in 2008, the Minnesota Department of Health (MDH) identified a cluster of *Salmonella* Enteritidis cases with indistinguishable PFGE patterns who resided in the Minneapolis–St. Paul metropolitan area. Interviews revealed that most of the cases had dined at the same restaurant during the week prior to illness onset. This report details the investigation, which indicated that an asymptomatic food worker was the likely source of contamination at the restaurant.

MATERIALS AND METHODS

***Salmonella* surveillance.** All *Salmonella* cases reported to MDH are interviewed about potential exposures during the 7 days prior to onset, including food consumption at home and at restaurants, as part of routine disease surveillance in Minnesota. Clinical laboratories are required to submit all *Salmonella* isolates to the MDH Public Health Laboratory (PHL) for confirmation, serotyping, and routine PFGE subtyping with the enzyme *Xba*I *(3, 18, 19)*. In addition, a second enzyme (*Bln*I) is routinely used for all *Salmonella* Enteritidis isolates to provide additional subtyping discrimination *(3, 18, 19)*. Interviews of cases in cluster investigations are conducted with an iterative process *(20)*. Using

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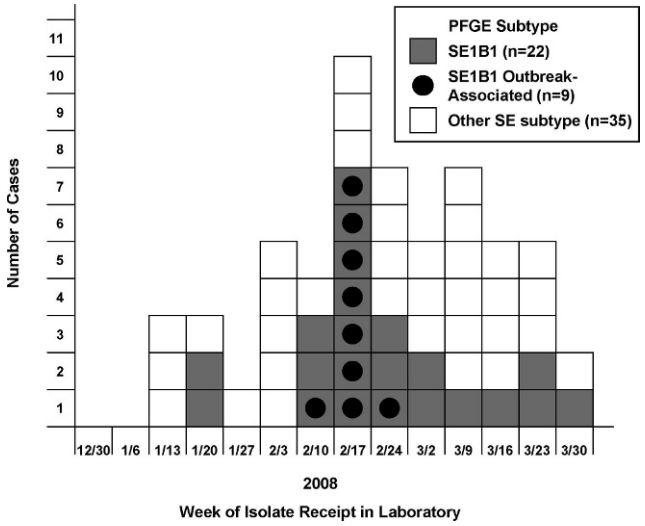

FIGURE 1. Salmonella *Enteritidis cases by pulsed-field gel electrophoresis subtype and week of isolate receipt in the Minnesota Department of Health Public Health Laboratory (MDH PHL), January to March 2008. The isolates from two culture-confirmed cases were not received at the MDH PHL, and are not represented in the figure.*

this dynamic model, suspicious exposures (including restaurants patronized) that are reported by initial cases are added to the standard interview for subsequent cases. Additionally, initial cases may also be re-interviewed regarding suspicious exposures mentioned by subsequent cases.

Outbreak detection. During February 2008, the MDH PHL received 26 clinical isolates of *Salmonella* Enteritidis, and PFGE subtyping indicated that this increase was largely due to one PFGE pattern (Fig. 1). The PFGE subtype was given the local Minnesota designation SE1B1 (the national PulseNet designation for this pattern is *Xba*I, JEGX01.0004 and *Bln*I, JEGA26.0002) (Fig. 1). This is the most common PFGE subtype of *Salmonella* Enteritidis in Minnesota; it accounted for 32% of *Salmonella* Enteritidis isolates identified in Minnesota in 2007 *(14)*. However, the observed increase in this particular subtype was unusual for a winter month. Specimen collection dates ranged from 10 to 13 February. All of the cases involved those who resided in Hennepin County. The first two cases did not report eating at restaurant A when initially interviewed using the standard MDH surveillance questionnaire on 17 February and 21 February. However, after the third case was interviewed on 22 February and reported eating at restaurant A in the week prior to illness, the first two cases were called back on 25 February and asked specifically about this restaurant. It was only during these second interviews that the cases recalled eating there. Two subsequent SE1B1 cases identified by way of routine surveillance were also asked specifically about the restaurant on their first interviews, on 22 February and 24 February, respectively. Hennepin County Public Health Protection (HCPHP) and the Minneapolis Division of Environmental Health (MDEH) were notified after the five cases reported patronizing restaurant A, and an investigation was initiated.

Restaurant A was a Vietnamese restaurant that served many traditional, vegetarian, and vegan food options. Items served included Vietnamese sandwiches, noodle salads, noodle soups, rice plates, and various appetizers including spring and egg rolls. All sandwiches included choice of meat (grilled pork, chicken, beef, or shrimp; cold deli meat; or mock duck), pickled carrots, cucumber, cilantro, and green bell pepper, unless otherwise specified by the patron. The restaurant functioned primarily as a delicatessen, where food is ordered and picked up by the patron at the main counter, but in-restaurant dining and limited catering also were available. After the investigation had been initiated, MDH was notified of illness in individuals who attended an event (up to 100 attendees) that received catered sandwiches from restaurant A on 13 February.

Epidemiologic investigation. For this investigation, cases were defined as patrons who reported eating food from restaurant A since 28 January (and during the week prior to the onset of symptoms) and from whom *Salmonella* Enteritidis SE1B1 was isolated from stool or who had fever and diarrhea (three or more loose stools in a 24-h period). A case-control study was conducted to evaluate specific food items from restaurant A. Meal companions of cases and patrons identified via check stubs who reported no gastrointestinal illness symptoms since their restaurant A meal served as controls and were interviewed by phone. For the catered event meal, a complete list of attendees was not available, but questionnaires were distributed in person and electronically to many event attendees at a later gathering. These questionnaires were either administered by MDH or HCPHP staff over the phone, or were filled out by attendees and returned to HCPHP. Cases and controls who ate at the restaurant were interviewed about consumption of food from restaurant A, using a form that included all menu items. A shorter form with only foods served at the catered event meal was distributed to cases and controls who had attended the event. Ingredient-specific questions were also included on both interview forms. The two-tailed Fischer's exact test was used to analyze the association between illness and food items consumed at restaurant A, at a 0.05 significance level.

Environmental investigation. On 25 February, MDEH sanitarians conducted an inspection of the restaurant and began interviewing employees. The inspection included a review of food preparation and handling procedures. MDH staff did an environmental assessment that included taking 18 environmental samples. Environmental samples were taken from the stove, grill, cooler, cutting boards, knives, scissors, mixer, freezer, refrigerator, meat cutter, serving pans, ice bin, cash register, and four sinks. No food samples were collected. Names of patrons on check stubs from 19 to 24 February were obtained from the restaurant, as these were the only meal dates for which the restaurant had usable records. HCPHP epidemiologists called patrons from these meal dates to ascertain illness history and food consumption at the restaurant; individuals from this group who reported no recent gastrointestinal illness symptoms were enrolled as controls in the case-control study.

All employees at restaurant A were required to submit two stool specimens to the MDH PHL for *Salmonella* testing. All food workers were interviewed about their job responsibilities and history of gastrointestinal illness symptoms since 1 January 2008 by using a standard questionnaire. Duration of *Salmonella* shedding in the stool was defined as the number of days from the collection date of the first positive specimen until the collection date of the last positive specimen.

RESULTS

Epidemiologic investigation. Fifteen patron cases (11 culture confirmed and 4 not culture confirmed) were identified. The median age of cases was 28 years (range

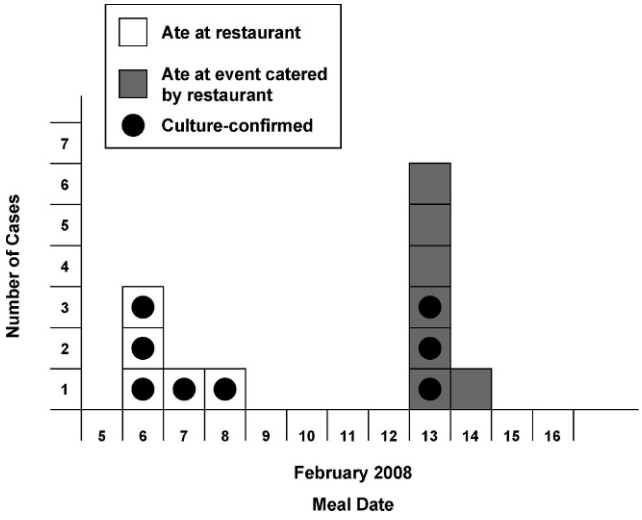

FIGURE 2. Salmonella *Enteritidis cases associated with restaurant A by meal date, February 2008. Specific meal dates were unknown for three culture-confirmed cases. The case who ate food from restaurant A on 14 February consumed leftovers from a 13 February catered event.*

of 3 to 56 years), and 62% were female. The median incubation period was 2.6 days (range of 0.5 to 6.4 days). Of the 15 cases, all reported diarrhea, 13 (87%) cramps, 12 (80%) fever, 6 (40%) bloody diarrhea, and 5 (33%) vomiting. None of the cases were hospitalized. The median duration of illness was 10 days (range of 8 to 18 days) for the 5 cases who had recovered at the time of interview.

Of the 15 cases, 8 ate at restaurant A, and 7 were attendees of the event catered by restaurant A on 13 February 2008. Known meal dates for cases ranged from 6 to 13 February 2008 (Fig. 2), and known onset dates ranged from 6 to 18 February. Illness onset dates for the three cases who could not recall the exact meal date were 6, 7, and 8 February. The case with the 7 February onset date reported dining at the establishment numerous times during the week prior to illness onset. None of the 32 patrons contacted from the check stubs met the case definition.

Cases had eaten a variety of foods, including sandwiches ($n = 15$, 100%), appetizers ($n = 3$, 20% [all had at least spring rolls]), and soup ($n = 1$, 7%). Of the available meat options for sandwiches, 6 (40%) cases had mock duck, 5 (33%) had grilled chicken, 3 (20%) had grilled barbeque pork, and 1 (7%) had grilled beef. All cases reporting having pickled carrots on the sandwiches, 8 (89%) of 9 cucumber, 11 (85%) of 13 cilantro, and 9 (82%) of 11 pepper. Of the available 37 controls, 2 were well meal companions of cases who ate at the restaurant, 4 were well attendees of the catered event, and 31 were well patrons with meals dates from 19 to 24 February. Consumption of sandwiches was statistically significant by univariate analysis (15 of 15 cases versus 17 of 37 controls; odds ratio, undefined; $P < 0.001$). Ingredient-specific analyses were performed among the whole group and among cases and controls who reported consuming sandwiches. No ingredient approached a statistically significant association with the illness.

Environmental investigation. Illness histories were obtained from all six restaurant A employees; none reported recent or current gastrointestinal illness symptoms. *Salmonella* Enteritidis PFGE subtype SE1B1 was isolated from two (33%) of the food workers. The two positive employees were excluded from working in the restaurant until they had submitted two negative stool samples that had been collected at least 24 h apart.

One of the positive food workers (employee A) had started working at this restaurant on 29 January 2008. Employee A was still in training at the time of the outbreak and therefore had limited work duties. These included preparation of only sandwiches and spring roll appetizers. Employee A was one of the two employees who prepared sandwiches for the catered event on 13 February. The other employee involved in the preparation of the catered sandwiches was culture negative for *Salmonella*. Duties of the second positive food worker (employee B) included waiting tables and working at the cash register, and rarely, if ever, handling food.

Employee A stopped working at the restaurant and stopped submitting samples before submitting two consecutive negatives. Of the two samples submitted by employee A, the first one (collected on 26 February) was positive and the second (collection date unknown, but received at MDH PHL on 3 March) was negative. Employee B submitted specimens until having two consecutive negative stool samples. The duration of shedding for this employee was 28 days.

Employee A did not report experiencing recent gastrointestinal illness symptoms. Additional follow-up with this employee did not reveal any remarkable exposures. Employee A had not worked in food service prior to this, and did not report any recent travel. This employee had two young children at home, but reported that no one in the household had been ill recently. Therefore, the initial source of infection was not determined.

The owner of restaurant A owned two additional restaurants in the Minneapolis area. These restaurants shared food suppliers, but there was no overlap in employees. During the outbreak period, there were no illnesses reported from patrons who ate at either of the other two restaurants.

The restaurant was closed on the day that the sanitarians and epidemiologists visited the facility; therefore, the investigators could not observe food handling and hand washing procedures. Instead, the manager walked through the kitchen and discussed the typical food preparation procedures. The restaurant did not have a glove use policy; bare hand contact occurred during the preparation of ready-to-eat foods. The grilled meats were cut and prepared in the morning and then stored in containers in the correct portion sizes until served. The restaurant also served assorted cold deli meat sandwiches, but none of cases reported consuming these. For the catered event, the only ingredient that was prepared in advance was the carrots, which were cut the day before and marinated overnight in a cooler. The sandwiches were prepared half hour prior to the event. The remaining vegetables (cilantro and cucumbers) were washed and cut, and the meats and tofu were stir fried and cooled. The

sandwiches were delivered within 10 min after being assembled at the restaurant.

Disinfection procedures, proper food handling procedures, and exclusion policies for food workers were discussed. MDEH observed improper use of a food sink to sanitize utensils, improper refrigerator temperatures, lack of date marking for cooked meats, and areas underneath equipment in the kitchen that needed to be thoroughly cleaned. The restaurant was instructed to thoroughly clean and disinfect all kitchen surfaces prior to reopening. The 18 environmental samples taken on 25 February were negative for *Salmonella*. MDEH required that management and employees from all three restaurant locations attend food safety and security training.

DISCUSSION

This was an outbreak of *Salmonella* Enteritidis infections associated with eating at a restaurant in Minneapolis. The outbreak was identified through routine surveillance activities at MDH. Routine, real-time PFGE subtyping of *Salmonella* Enteritidis isolates, routine interviewing, and cluster investigation using an iterative approach allowed for the timely detection of this outbreak. *Salmonella* Enteritidis is one of the most common serotypes identified both in the United States and in Minnesota *(5, 15)*. PFGE subtyping provides a more specific way to discern which isolates may have been acquired from a common source, and previously has been demonstrated a useful tool in the detection of *Salmonella* Enteritidis outbreaks *(4, 13, 20)*. The discrimination provided by PFGE subtyping in this investigation allowed for a more rapid and focused cluster investigation. PFGE was useful even though the outbreak subtype is very common; indeed, some background cases did occur during the outbreak period (Fig. 1). However, the increase in this common subtype during the month of February, normally a low incidence month for this subtype, quickly alerted us to the potential for a common source outbreak. In this outbreak, the first two cases interviewed with a standard *Salmonella* questionnaire did not report eating at the implicated restaurant during their first interview. It was only after the third case had identified the restaurant and the first two were called back and asked specifically about it that they had recalled patronizing this establishment. This reinforces the value of our iterative approach, even for restaurant exposures, which may not be remembered consistently in initial surveillance interviews.

Based on the epidemiologic and environmental health findings, we conclude that this outbreak occurred as the result of an asymptomatic *Salmonella* Enteritidis infection in one employee. A specific ingredient was not statistically implicated in this outbreak. Consumption of a sandwich from restaurant A was associated with illness. The value of this comparison is limited, because the meal dates for most of the controls were different from meal dates for the cases. However, sandwich preparation was routinely done by employee A, and employee A was one of two employees who prepared sandwiches for the cases who ate at the event catered by restaurant A. The other employee's stool cultured negative for *Salmonella*. Meal dates reported by cases began shortly after employee A began working at the establishment. No illnesses were reported from individuals who patronized the other two restaurants that received common ingredients during the time period investigated. Finally, there was no evidence of ongoing transmission after the infected employees were excluded from working in the establishment until negative for *Salmonella*.

There is increasing recognition that food workers are an important source of illness in restaurant outbreaks of salmonellosis *(6, 9, 11, 13, 16)*. Our report adds to the growing number of investigations that have implicated asymptomatic food handlers as the probable source of foodborne outbreaks *(1, 8, 10)*. Transmission may have been facilitated in this outbreak because the infected food worker was new to food service, prepared ready-to-eat food items during training, and had extensive bare hand contact with these items. This investigation emphasizes the importance of following proper hand washing and food handling procedures in food service facilities. Although asymptomatic food workers shed *Salmonella* for a shorter period on average than those who reported gastrointestinal illness (median of 3 days versus 30 days), shedding occurred for up to 97 days in asymptomatic food workers *(13)*. Testing of employees, regardless of illness history, is important in restaurant outbreaks of salmonellosis as a means to end transmission to patrons and other employees.

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