An Investigation into a *Salmonella Enterica* serotype Typhimurium Outbreak in a BBQ Restaurant, Hillsborough County, June 18 - July 6, 2003

David Atrubin, MPH, Michael Friedman, MPH, Paul Fiorella, PhD, Eliot Gregos, MPH, Jylmarie Kintz, MPH

Department of Health Investigation Team:

David Atrubin, MPH, Florida EIS for Hillsborough CHD
Eliot Gregos, MPH, Environmental Manager, Environmental Health, Hillsborough CHD
Michael Friedman, MPH, Bureau of Community Environmental Health
Paul Fiorella, PhD, Medical Laboratory Scientist IV, Bureau of Laboratories
Xiomara Hewitt-Jeffrey, MPH, Epidemiologist, Hillsborough CHD
Jylmarie Kintz, MPH, Epidemiology Program Manager, Hillsborough CHD
Doug King, Environmental Specialist II, Hillsborough CHD

INTRODUCTION

On June 25, 2003, the Hillsborough County Health Department (HCHD) was informed that two persons who had eaten lunch on June 20, 2003 at a Tampa area BBQ restaurant had experienced gastrointestinal illness within 24 hours of finishing their meal. Their reported symptoms included vomiting, abdominal cramps and diarrhea. One of these two persons was hospitalized and placed on kidney dialysis. Twenty-six (26) additional ill individuals, who had all eaten food from this same BBQ restaurant during the period of June 18-26, 2003, were eventually identified. Two other individuals contracted the illness from an ill family member who had eaten at the restaurant. In total, 30 individuals were stricken by this illness, which was subsequently identified as *Salmonella enterica* serotype Typhimurium. The use of pulsed-field gel electrophoresis (PFGE) greatly aided this investigation by identifying additional cases previously not connected to this outbreak. In recent years, PFGE subtyping of *Salmonella* Typhimurium isolates has proved beneficial in identifying common-source outbreaks in institutional and community settings - including restaurants (Bender et al., 2001). This molecular subtyping technique has been utilized to confirm the existence of an outbreak, to connect cases to an outbreak and to demonstrate that cases are sporadic and not

outbreak related. The results of this *Salmonella* outbreak investigation are presented here.

METHODS

An investigation of this outbreak was performed by the following Department of Health entities: the HCHD Environmental Health Division, the HCHD Epidemiology Division, the Bureau of Community Environmental Health and the Bureau of Laboratories in Jacksonville. Preliminary laboratory analysis of specimens was conducted by hospital and private laboratories. The Bureau of Laboratories conducted the PFGE analysis and the *Salmonella* spp. serotyping.

Interviews

Cases were identified from reports of illness that were made to the HCHD Environmental Health Division and from positive laboratory tests for *Salmonella* that were reported to the HCHD Epidemiology Division. The HCHD staff conducted interviews with ill restaurant patrons and one ill restaurant employee. Because the restaurant had shut down and the owner could not be located, no means existed for identifying other restaurant patrons (either ill or well) who had eaten at this BBQ restaurant. Ill patrons were queried with respect to symptomatology, onset dates and duration of illness, potential exposures (including food histories) and illness among their contacts. Efforts were made to identify other ill members of their dining parties (both from the BBQ restaurant and from other restaurants and gatherings that they had attended).

Case Definition

Typical clinical symptoms of Salmonellosis include diarrhea, abdominal pain, fever, nausea and sometimes vomiting. A confirmed case was defined as someone who had eaten at the BBQ restaurant during the period of June 18 – June 26, 2003 with clinically compatible symptoms and laboratory isolation of the *Salmonella* organism. Any contacts of the confirmed cases having clinical symptoms and laboratory confirmation of the *Salmonella* organism were also classified as confirmed cases. A probable case was defined as a clinically compatible case that is epidemiologically linked to a confirmed case.

The Restaurant Inspection

An onsite investigation of the BBQ restaurant by the HCHD Environmental Health Division, in conjunction with the Department of Business and Professional Regulation (DBPR), was performed on June 27, 2003. Employee illness, hygiene and food handling procedures were reviewed, and food chain investigations were performed. A second field visit was planned, however the self-imposed closure of the restaurant (sometime before July 1, 2003) prevented this from occurring. Additionally, a review of the DBPR's previous two inspection reports from this restaurant was conducted.

Disease Control

Disease control measures were limited to educating the affected individuals and their household contacts about the transmission routes of *Salmonella* and stressing the importance of good hand washing. Additionally, surveillance was undertaken to ensure that the restaurant did not reopen without the requisite facility improvements and inspections. Hospital laboratories were instructed to send isolates to the Bureau of Laboratories for PFGE analysis.

On Saturday, July 12, 2003, an HCHD employee spotted an open-for-business mobile food vehicle bearing the implicated restaurant's name. This mobile unit, parked on the property of a permanent outdoor produce market, was located 10 miles from the restaurant's permanent location. On Monday, July 14, HCHD staff conducted a site visit at the location of this mobile unit. Additionally, DBPR was notified about the existence of this mobile unit which was owned and operated by the BBQ restaurant owner.

Molecular Subtyping

Salmonella serotyping was performed by standard biochemical tests at the Bureau of Laboratories (Bopp et al, 1999; Brenner and McWhorter-Murlin, 1998). PFGE was performed according to a standardized protocol used by the PulseNet laboratories (PulseNet, 1998; Swaminathan et al., 2001). The *Salmonella* DNA was restriction digested with XpaI. Some isolates were also digested with SpeI in separate reactions and run. The restriction enzymes were purchased from New England Biolabs, Beverly, MA. Separation of the restricted DNA fragments was done on a CHEF DR-III electrophoresis instrument (Bio-Rad Laboratories, Richmond, CA). PFGE patterns in

Salmonella isolates were identified and the information was relayed back to the HCHD for further epidemiologic investigation and analysis.

RESULTS

Case Identification

A total of 30 (13 confirmed and 17 probable) *Salmonella* cases were identified, with the ill restaurant employee being classified as a probable case. With the exception of the two secondary cases, all confirmed and probable cases had eaten in the restaurant or consumed carryout food from the restaurant during the period of June 18-26, 2003. Extended data (e.g., individual food items eaten and other potential exposure data) were available for most of the affected restaurant patrons, but some of the ill could not be reached. With the exception of one husband who ate at the restaurant with his wife during the defined exposure period but did not become symptomatic, all members of each case's dining party became ill.

Demographic and Illness-Related Data

Of the 30 cases, 21 (70%) were male. The ill persons ranged in age from 3-62 years, with the median age being 42 years. Both the mean and median incubation period of the illnesses were 30.5 hours, with the range being 2-54 hours. Tables 1, 2 and 3 and Figure 1 (shown below) are derived from extended data gathered from the cases. Table 1 lists symptoms experienced by the ill restaurant patrons; diarrhea (100%) and abdominal pain (60%) were reported most frequently. The duration of the illnesses ranged from a couple of days to over two weeks. Thirteen of the ill individuals were treated by physicians. Two affected individuals, who were both hospitalized, suffered complicated courses of illness. One of these two individuals experienced acute renal failure, and the other person presented with atrial fibrillation. Both individuals did recover from these complications. Table 2 shows a summary of the foods eaten by 23 of the cases. BBQ sauce was the only item common to all 23 cases for which specific food item histories were available. Table 3 shows the number of cases eating the BBQ restaurant food by date. On the peak day (June 20, 2003), 12 individuals were exposed. Figure 1 shows the epidemiologic curve for the onset times of illness for 27 of the cases.

Table 1: Number and percentage of cases experiencing symptoms (n=30)

Symptom	Number (%)
Diarrhea	30 (100%)
Abdominal Pain	18 (60.0%)
Fever	16 (53.3%)
Vomiting	13 (43.3%)
Nausea	9 (30.0%)
Cramps	7 (23.3%)
Headache	6 (20.0%)
Chills	4 (13.3%)
Bone Aches	1 (3.3%)
Dizziness	1 (3.3%)
Acute Renal Failure	1 (3.3%)
Atrial Fibrillation	1 (3.3%)

Table 2: Foods consumed by the ill and the number and percentage of cases eating that food item (n=23)*

Food Item	Number (%)
BBQ Sauce	23 (100%)
Bread	13 (56.5%)
Baked Beans	11 (47.8%)
BBQ Ribs	9 (39.1%)
Pork	7 (30.4%)
Chicken	6 (26.1%)
Cole Slaw	6 (26.1%)
Potato Salad	5 (21.7%)
Beef	4 (17.4%)
Potato	2 (8.7%)
Spaghetti	2 (8.7%)
Corn on the Cob	1 (4.3%)
Pork Sausage	1 (4.3%)
Ice Tea	2 (8.7%)
Coke	1 (4.3%)

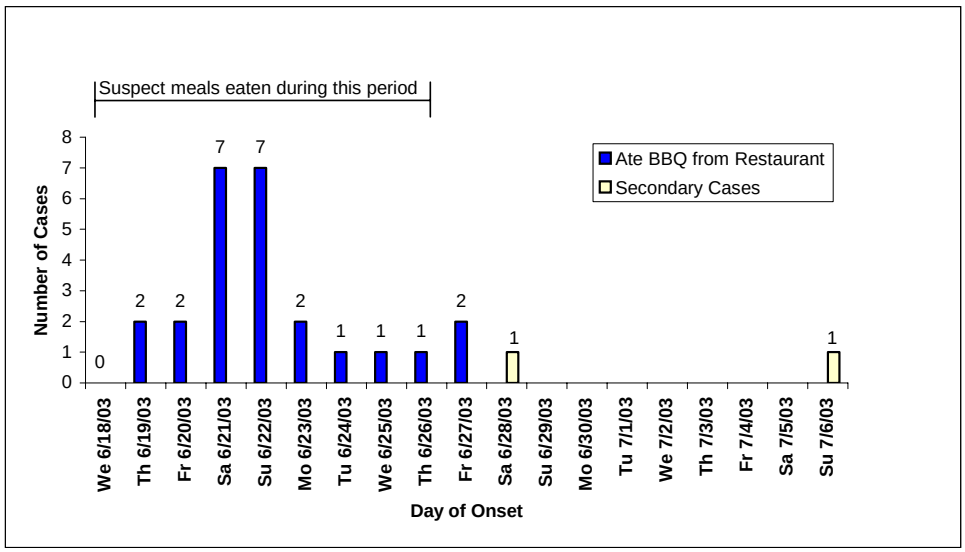
*specific items consumed were unavailable for 7 cases

Table 3: Number of Cases who ate suspect BBQ food by date (n=27)*

Date	# of cases eating meal
Wed 6/18	2
Thu 6/19	4
Fri 6/20	12
Sat 6/21	2
Sun 6/22	0
Mon 6/23	4
Tue 6/24	0
Wed 6/25	1
Thur 6/26	2

*does not include 2 secondary cases or the ill restaurant employee

Figure 1: Epi Curve – Salmonella Outbreak Onset Dates (n=27)*

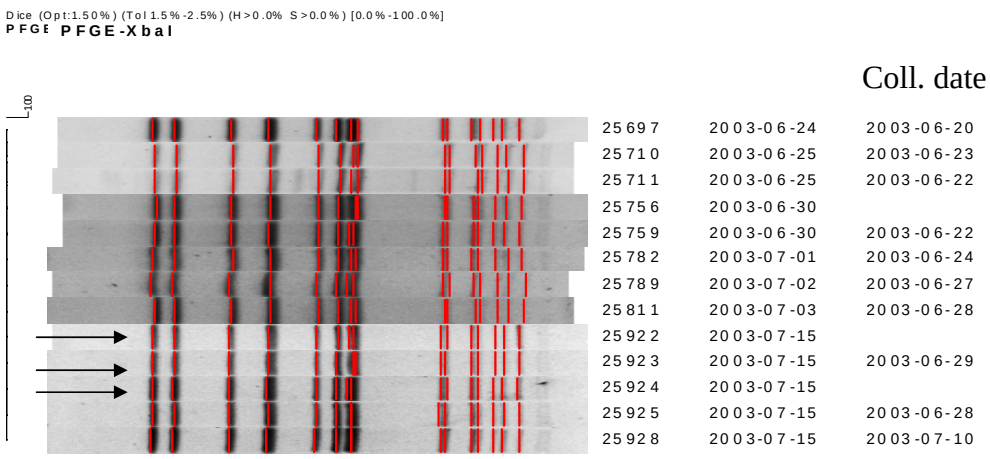


*exact onset dates were available for 27 of the 30 cases

Molecular Subtyping Results

Thirteen of the 30 illnesses were laboratory confirmed *Salmonella* cases, with 10 of these isolates having indistinguishable PFGE patterns (see Figure 2). *Salmonella enterica* serotype Typhimurium was determined to be the causative agent in these matching cases. PFGE analysis was utilized to connect 3 of the 10 individuals with matching isolates to the BBQ restaurant outbreak, as these cases, upon the initial health department interview, had not reported eating at the suspected restaurant. Upon re-interview, it was learned that these three persons had consumed food from the implicated restaurant during the June 18-26 time period. Additionally, three isolates among young children attending a daycare facility showed indistinguishable PFGE patterns (also shown in Figure 2) from the dominant strain in the BBQ restaurant outbreak. A brief description of the daycare outbreak is found in the Concurrent Salmonella Outbreak section.

Figure 2: Indistinguishable PFGE Patterns in Salmonella enterica serotype Typhimurium Isolates from the BBQ Restaurant and the Daycare Facility (n=13)



*Arrows indicate daycare isolates; the rest of the isolates are from BBQ restaurant patrons

The Restaurant Inspection

An environmental field investigation was performed at the BBQ restaurant on June 27, 2003 by the HCHD environmental health staff and the DBPR. Preparation procedures were reviewed for all identified common foods consumed by the ill persons, and the kitchen facility was inspected by the DBPR representative. Numerous sanitation, employee hygiene and temperature control violations were identified. Some of the most significant problems included roast pork held hot at 95 degrees, roast chicken held hot at 110 degrees and inadequate sanitizing of work surfaces and equipment. The restaurant's kitchen had neither a hand washing sink nor a proper three-compartment sink. Additionally, live roaches were present in the kitchen. One food worker who had experienced gastrointestinal symptoms was identified. However, this worker reported an onset date of June 22, 2003, which was several days after the onset of many of the other cases. A warning was issued by the DBPR inspector to correct all violations. Repeat visits by the HCHD and DBPR were attempted, but the restaurant facility had been vacated and the location of the owner was unknown.

A review of the two previous DBPR inspections for this restaurant (conducted on August 26, 2002 and March 19, 2003) revealed food debris being found on the upright refrigerator and the floor. At the time of the latter of these two inspections, the ansul system had not been inspected for 11 ½ months (an inspection is required every 6 months). The previous DBPR reports did not document a missing hand wash sink nor did they note the inadequate 2-compartment sink in the kitchen.

Concurrent Salmonella Outbreak

On July 22, 2003, the HCHD learned that a concurrent *Salmonella* outbreak at a daycare facility was linked to the restaurant outbreak by PFGE patterns. This daycare facility is located 5 miles from the BBQ restaurant. A total of 5 cases were identified among the daycare attendees, and all 3 isolates that underwent PFGE analysis had indistinguishable patterns from those seen among the 10 matching isolates from the restaurant outbreak. PFGE analysis was performed using a second enzyme to verify the match between the 3 isolates from the daycare facility and 3 of the isolates from the restaurant patrons. All six had indistinguishable PFGE patterns with both enzymes. No epidemiologic link was found between the affected daycare attendees and the ill restaurant patrons. The first two daycare cases had onset dates (June 14, 2003 and June 16, 2003) prior to the onset dates of the first cases identified from the BBQ restaurant, but the 3 daycare individuals with matching isolates had onset dates coinciding with the onset dates of the affected restaurant patrons.

The Mobile Food Unit

The discovery of the BBQ restaurant's mobile food unit provided contact information for the owner of the restaurant. This information was obtained from the business that was leasing the space to the BBQ restaurant owner. By the time of the mobile unit investigation (on July 14, 2003 - two days after it was first sighted), the trailer had been relocated. The DBPR contacted the restaurant owner who reported that he had attempted to sell food from the mobile food unit but was now giving up the food business entirely. An address for the owner's home, where the mobile food unit was allegedly situated, was obtained. On July 23, 2003, the HCHD verified that the trailer was at the owner's home and not being used for selling food. No *Salmonella* cases were identified that were linked to food purchased from this mobile food unit.

DISCUSSION

This outbreak of *Salmonella* Typhimurium with one dominant PFGE pattern is strongly associated with the consumption of food from this Tampa area BBQ restaurant during the nine-day period of June 18-26, 2003. All 28 of the primary cases had no other epidemiologic link and the onsets of symptoms, in each case, followed consumption of food from this particular restaurant. The close collaboration between the HCHD Environmental Health Division and the HCHD Epidemiology Division greatly facilitated this outbreak investigation, as cases were identified by both divisions.

The discovery of an ill food worker at the BBQ restaurant was noteworthy, but this particular employee was unlikely to be the cause of the outbreak, as her reported illness followed the onset dates for 11 of the affected restaurant patrons. Of course, it is possible that this ill employee may have contributed to the propagation of the outbreak while not initially introducing the organism into the restaurant. The wide variety of food consumed by ill individuals may be due to another ill food worker preparing multiple foods or cross-contamination among various food items. Nearly everyone that we could identify as having eaten at the restaurant became ill, indicating contamination of the facility on a broad scale or, alternatively, a food item common to all meals (e.g., BBQ sauce).

The complications seen in some of the *Salmonella* cases in this outbreak are cause for concern. In a study of 32,448 *Salmonella* cases, Brodov et al. (1996) reported that 2.01% of the cases experienced a complicated course of the disease. Renal failure, which was seen in one person in the Tampa BBQ restaurant outbreak, has been documented repeatedly in the scientific literature (Lin et al., 2002; Shibusawa et al, 1997). This 60-year old individual, who was one of the first two cases identified here, had no underlying medical conditions which contributed to his kidney failure. In the outbreak reported on here, the one case presenting with cardiac complications (atrial fibrillation) was a 62-year old male with a history of heart disease. Cohen et al. (1987) found *Salmonella* Typhimurium to be a cause of cardiac complications, especially in individuals with a history of heart disease. One ill restaurant patron developed reactive arthritis a couple of weeks after being infected with *Salmonella*. Reactive arthritis as a

complication of a *Salmonella* Typhimurium infection has also been reported by researchers (Buxton et al., 2002) and is thought to occur in approximately 10% of the cases in a *Salmonella* Typhimurium outbreak (Hannu et al., 2002).

Whether this cluster of complications is a result of chance or rather the result of a more virulent strain of *Salmonella* is unknown. These severe complications do underscore the need to act immediately in limiting the spread of *Salmonella* outbreaks such as these.

The match between the isolates of *Salmonella* Typhimurium from the BBQ restaurant and from the daycare facility is puzzling. Certainly, the two outbreaks may be unrelated, but that becomes less likely in light of the fact that no other cases with that particular PFGE pattern have been identified by the Bureau of Laboratories. Possibly, an epidemiologic link between the two outbreaks exists but was not discovered in the course of this investigation. The epidemiologic investigation was hindered by the fact the restaurant owner was, at first, unreachable, and, later, uncooperative. Efforts were made, through the daycare facility, to find out if a family member of one of the daycare attendees worked or ate at the BBQ restaurant, but no such link was discovered.

References

Bender JB, Hedberg CW, Boxrud DJ, Besser JM, Wicklund JH, Smith KE, Osterholm MT. Use of Molecular Subtyping in Surveillance for Salmonella enterica Serotype Typhimurium. New England Journal of Medicine 2001;344:189-195.

Bopp CA, Brenner FW, Wells J, Strockbine NA. Escherichia, Shigella and Salmonella 1999;459-474. *In* Murray PR, Baron EJ, Pfaller MA, Tenover FC, Yolken RH (ed.). Manual of clinical microbiology. 7th ed. ASM Press, Washington D.C.

Brenner FW, McWhorter-Murlin AC. Identification and serotyping of *Salmonella*. Centers for Disease Control and Prevention, Atlanta, GA, 1998.

Brodov LE, Maleev VV, Lushchuk ND. The clinical picture and pathogenesis of complications in food poisonings (salmonellosis). Zh Mikrobiol Epidemiol Immunobiol 1996;2:95-97.

Buxton JA, Fyfe M, Berger S, Cox MB, Northcott KA. Reactive arthritis and other sequelae following sporadic Salmonella Typhimurium infection in British Columbia, Canada: a case control study. J Rheumatol 2002;29(10):2154-2158.

Cohen JI, Bartett JA, Corey GR. Extra-intestinal manifestations of salmonella infections. Medicine (Baltimore) 1987;66(5):349-388.

PulseNet-the national molecular subtyping network for foodborne and disease surveillance. Foodborne and Diarrheal Diseases Branch, Division of Bacterial and Mycotic Diseases, National Center for Infectious Diseases, Centers for Disease Control and Prevention. One day standard protocol for molecular subtyping non-typhoidal *Salmonella*. Centers for Disease Control and Prevention, Atlanta, GA, 1998.

Hannu T, Mattila L, Siitonen A, Leirisalo-Repo M. Reactive arthritis following an outbreak of Salmonella typhimurium phage type 193 infection. Ann Rheum Dis 2002;61(3):264-266.

Lin WR, Chang CT, Yen TH, Lin JL. Diarrhea associated acute renal failure in a patient with Salmonella enteritidis sepsis. Ren Fail 2002;24(4):535-538.

Shibusawa N, Arai T, Hashimoto K, Hashimoto Y Yahagi K, Matsumoto J, Suzuki Y, Kondoh T. Fatality due to severe Salmonella enteritis associated with acute renal failure and septicemia. Intern Med 1997;36(10):750-753.

Swaminathan B, Barrett TJ, Hunter SB, Tauxe RV, CDC PulseNet Task Force. PulseNet: the molecular subtyping network for foodborne bacterial disease surveillance, United States. Emerg Infect Dis 2001;7(3):382-389.