Salmonella I 4,5,12:i:- Gastroenteritis Outbreak Among Patrons of Firefly on Paradise Restaurant – Las Vegas, Nevada, 2013

Public Health Investigation Report

Southern Nevada Health District
Office of Epidemiology
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This report represents the findings of the Southern Nevada Health District (SNHD) in the investigation of a *Salmonella* gastroenteritis outbreak among patrons of Firefly on Paradise restaurant located in Las Vegas, Nevada in April-May, 2013.

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SUMMARY

We describe an investigation of a confirmed *Salmonella* I 4,5,12:i:- gastroenteritis outbreak in April–May 2013 at Firefly on Paradise restaurant in Las Vegas, Nevada, that affected at least 336 people, and suspected that the outbreak was likely due to cross-contamination in the restaurant's kitchen. The outbreak response consisted of conducting a facility inspection, closing the restaurant, testing clinical and food specimens, performing a case-control study, and carrying out surveillance for additional illnesses. During the restaurant inspection, we identified numerous conditions that could have fostered microbial growth and their cross-contamination among foods. Serotype *Salmonella* I 4,5,12:i:- was matched by pulsed field gel electrophoresis in 199 clinical stool specimens, and of these, 138 (69%) were confirmed to be associated with the restaurant. Univariate analysis implicated several food items served at the restaurant that were statistically significantly associated with illness. The outbreak strain of *Salmonella* was isolated from 1 food specimen (cooked chorizo), but this product likely became contaminated after the cooking process in the restaurant's kitchen. The original source of *Salmonella* was not determined. Timing of the illness onset dates of 4 restaurant employees suggested that none was the source of the illness. Residents from 29 American states and 2 foreign countries were affected, and Nevadans comprised 60% of those who were ill. Among 3,414 restaurant patrons served by the restaurant, the observed attack rate was 10%. Over half (N=172; 51%) of case-patrons sought medical care and 50 (15%) of those affected were hospitalized. No deaths were reported. To prevent such outbreaks, food service establishments should adhere to established food safety regulations, implement policies and practices that impede microbial proliferation, and eliminate opportunities for cross-contamination.

BACKGROUND

On April 26, 2013, the Southern Nevada Health District (SNHD), Office of Epidemiology (OOE) received reports of gastrointestinal illness from 8 independent groups of patrons of Firefly on Paradise restaurant (SNHD Permit Number PR0013375), or the adjacent affiliated restaurant Dragonfly on Paradise restaurant (SNHD Permit Number PR0015008) both located at 3900 Paradise Road, Las Vegas, NV 89109; hereafter, in combination, referred to as 'Firefly'. All 8 groups had eaten at the restaurant during April 21-24, 2013. Ill patrons reported symptoms of diarrhea and/or vomiting after they consumed food from Firefly and many sought medical care for their illnesses. In response to these illness reports, SNHD performed investigative inspections and closed Firefly to minimize ongoing risk of illness.

The SNHD OOE, Environmental Health (EH) and Southern Nevada Public Health Laboratory (SNPHL) collaborated on the investigation and response to this outbreak. The United States Centers for Disease Control and Prevention (CDC), the United States Department of Agriculture (USDA), and the Nevada Division of Public and Behavior Health (DPBH) were also notified of the outbreak investigation.

INVESTIGATION METHODS

Epidemiology

A probable case was defined as illness in a person who consumed food served by Firefly restaurant during April 21-26, 2013 and experienced diarrhea (defined as ≥ 3 bouts of loose stools in a 24-hour period) and/or ≥ 1 episodes of vomiting during a 7-day period after eating there. A confirmed case was defined as gastrointestinal infection with the outbreak strain of *Salmonella* I:4,5,12:i:- in a person who consumed food served by Firefly during April 21-26, 2013. A secondary case was defined as illness in people who were close contacts of cases and who also tested positive for *Salmonella* I:4,5,12:i:- infection. We selected 7 days after eating as part of the case definition to accommodate possible longer incubation periods for *Salmonella* than the most commonly observed 12-36 hours, since longer incubation periods can occur after ingesting low doses of the pathogen. Self-reported illness information submitted by patrons via the SNHD online foodborne illness complaint form was included in our analysis if reported before the end of the day on May 13, 2013 (midnight). Self-reported data inclusion was discontinued on this date because these reports were no longer needed to confirm or halt the outbreak.

On April 26, 2013, we visited the restaurant and interviewed restaurant management and employees regarding illnesses in the past 2 weeks, their knowledge of other recent illnesses in restaurant staff and patrons, whether the restaurant had a sick employee policy, and if there had been other recent customer complaints of illness.

We then performed telephone interviews with ill restaurant patrons to obtain more information regarding their symptoms, food history, and illnesses. The SNHD foodborne illness complaint database was searched to determine whether other complaints had been filed against the restaurant in the 30 days prior to these complaints.

Subsequently, we conducted ongoing surveillance for additional cases by collecting patron-reported complaints in our online foodborne illness complaint system, by performing telephone and oral interviews of known ill people to identify other ill persons in their meal groups, and by receiving reports from local diagnostic laboratories and out of state public health agencies. On April 29, 2013, we posted a notification on the CDC Epidemic Information Exchange (Epi-X), a web-based national communications system for public health professionals, asking other health departments to report to us salmonellosis case-patrons with histories of travel to Las Vegas during April 21-26, 2013.

The number of patrons served by Firefly between April 21 and April 26, 2013 was used to estimate the attack rate among case-patrons.

Early in the investigation, we performed a case-control study to attempt to identify statistical associations between having consumed specific food or drink items and developing illness, and to allow trace-back of suspect foods should associations be identified. We selected case-

patients from among the first parties identified with the outbreak. Control subjects were selected from non-ill persons among people who had accompanied case-patrons or those who had made reservations for Firefly on OpenTable® (www.opentable.com), an online restaurant reservation system. Case-patrons and control subjects were interviewed by telephone using a standardized questionnaire to collect information on meal dates/times, illness symptoms, onsets, and durations; and food/drink consumption histories. Univariate analysis (odds ratio (OR) and 95% exact confidence intervals (CI)) was performed. Food items associated with illness that had CI ranges not including the value 1.0 were considered statistically significant.

When choosing from among food samples collected on April 26, 2013 by EH staff (Table 1) for pathogen testing, we considered food items with the highest OR (Table 2) values or that had past associations with *Salmonella* outbreaks.

Laboratory

We requested clinical specimens from ill patrons to rapidly determine the causative organism. Kits were dispensed to 15 ill restaurant guests and employees to collect stool specimens. Bacterial culture (for *Salmonella, Shigella, Campylobacter*, Shiga toxin-producing *Escherichia coli* (STEC) O157 and non-O157, Y*ersinia*) was performed on all collected stool specimens. *Vibrio* culture, STEC enzyme immunoassay (EIA), and norovirus real time reverse transcriptase polymerase chain reaction (qRT-PCR) testing was also performed on some of the collected stool specimens early in the outbreak investigation, when the causative agent of the outbreak was not yet known.

We further characterized *Salmonella* isolates that were delivered to us after being cultured at local commercial laboratories. We performed *Salmonella* serotyping and pulsed field gel electrophoresis (PFGE, commonly known as “molecular fingerprinting”) [1] on *Salmonella* culture isolates to determine the outbreak patterns, and submitted these PFGE patterns to PulseNet, a CDC program that maintains a nationwide database to enable rapid comparison of the PFGE patterns and facilitate identification of common source outbreaks.

Upon receiving the outbreak-related PFGE patterns from us, the CDC asked other states’ public health laboratories to send *Salmonella* I:4,5,12:i:- PFGE patterns obtained from persons who resided outside of Nevada to the CDC, which allowed us to search the PulseNet database for out-of-state case-patrons who were tested outside our jurisdiction.

We sent *Salmonella* isolates associated with the outbreak to the CDC for multiple-locus variable number tandem repeat analysis (MLVA) [2]. MLVA is a research method used to study possible transmission routes and sources of infection.

We stored and maintained chain-of-custody of 35 food specimens collected from both Firefly kitchens, and sent 21 of these food specimens to the Nevada State Public Health Laboratory (NSPHL) for *Salmonella* testing (Table 1).

Environmental Health

We performed an environmental inspection of Firefly on April 26, 2013 and reviewed the restaurant's inspection history.

We collected various food items (Table 1) during the inspection for possible testing to determine whether 1 or more food item(s) could have been the source of the illness. These samples were submitted to SNPHL utilizing chain-of-custody procedures. On April 26, 2013 *Salmonella* had not yet been identified as the source of the outbreak; thus, the selection of these food items was based on SNHD staff's on-site assessment of the likelihood of the food being contaminated with pathogens (*e.g.* foods found at unsafe temperatures, or those known to have historical associations with foodborne outbreaks).

Inspections of the two other Firefly restaurant outlets located in Clark County were conducted on April 29, 2013.

We met with Firefly representatives on May 2, 2013 and notified them of the actions that were necessary for the restaurant to re-open.

The DPBH requested that USDA's Food Safety Inspection Service (FSIS) consider performing a trace-back of the food item chorizo, which was identified as having been contaminated with the outbreak strain of *Salmonella*.

RESULTS

Epidemiology

A total of 336 (198 probable, 136 confirmed, and 2 secondary cases) people reported illnesses that met the case definitions. Illness onset occurred between April 22 and May 10, 2013. The epidemic curve is presented in the Figure and shows the distribution of illness onset dates of all except 10 cases (8 that lacked illness onset dates and 2 that were secondary cases, with onset dates May 3 and 8, 2013).

The peak illness onset date among restaurant patrons was April 24, 2013.

Search results from the SNHD foodborne illness complaint database revealed 1 other complaint had been filed against the Firefly restaurant in the 30 days prior to the detection of the outbreak on April 26, 2013.

Among 336 case-patrons (Table 3), the median age of ill persons was 33 (range 2-87 years). Males comprised 46% (N=154) of ill people. We received reports of illness from restaurant

patrons who resided in 29 U.S. states and 2 foreign countries (Canada and United Kingdom) and 60% (N=202) of case-patrons were Nevada residents.

The clinical characteristics of case-patrons are presented in Table 4. Among case-patrons for whom these data were reported: The median incubation period was 38.5 hours (range 1-147 hrs), the duration of illness of most case-patrons (N=160, 61%) was < 3 days (range 0.5-7 days), over half (N=172, 51%) of case-patrons sought medical care, and 50 (15%) of all case-patrons were hospitalized. No deaths were reported.

We interviewed a total of 33 Firefly employees on April 26, 2013. Among the 4 employees who were identified as having been recently sick with illness that met the case definition, 3 submitted stool specimens. The onset dates of the 4 ill employees are included in the Figure. The restaurant has a sick employee policy and employees may call-in sick when necessary.

We were notified of 1 customer complaint of illness made to the restaurant.

From April 21 through April 26, 2013, Firefly management reported serving a total of 3,414 patrons, which translated into an observed attack rate among Firefly case-patrons of nearly 10% (332 case-patrons / 3,414 exposed).

A total of 32 case-patrons and 38 control-patrons (restaurant patrons who ate at Firefly during April 21-26, 2013 but did not subsequently develop illness) were interviewed for a case-control study. The OR and 95% CIs for food items eaten by case-patrons and controls are presented in Table 2, and show that case-patrons were significantly more likely than controls to have consumed certain menu items. However, no single menu item stood out as the source for the outbreak. We also looked for associations between illness and several common ingredients in menu items including parsley, aioli, and grated hard cheeses (parmesan and manchego). Of these, only grated hard cheeses showed a statistical association with illness; however, many of the statistically significant menu items (Table 2) did not contain grated hard cheeses. Suspicions were also directed at the raw unpasteurized egg-based aioli sauce served at Firefly, because many ill patrons had reported eating it and the historical association between shelled-eggs and *Salmonella* [3]. However, epidemiologic analysis showed that aioli was not associated with illness.

During the course of the investigation, we posted 4 interim reports on the SNHD website at http://www.southernnevadahealthdistrict.org/stats-reports/index.php to notify the public of the ongoing outbreak investigation.

Laboratory

Of 14 stool specimens tested by SNPHL (which included specimens from 3 employees), 12 were positive and 2 were negative for *Salmonella* species. All 12 *Salmonella* serotypes and PFGE patterns matched each other, and all were determined to be *Salmonella* I 4,5,12:i:-.

We tested a total of 88 *Salmonella* isolates (Table 5). The PFGE patterns for all 88 *Salmonella* isolates (12 isolated by SNPHL and 76 isolated by local laboratories) were submitted to CDC's PulseNet program. PulseNet confirmed a MLVA pattern match for all 88 isolates.

We identified an additional 111 isolates with PFGE patterns matching the Firefly outbreak pattern that were posted by other states to PulseNet from April 21, 2013 through June 24, 2013 (Table 5). In conjunction with epidemiological data, each PFGE pattern was further assigned by its association with the Firefly outbreak into 1 of 3 categories (Table 5): "confirmed" association with the Firefly outbreak (illness in person who ate at Firefly) (N=138, 69.3%), "no known" association with the outbreak (sporadic cases) (N=24, 12.1%), and those with "unknown" association with the Firefly (people whom we were unsuccessful in contacting for interviews) (N=37, 18.6%).

PulseNet did not identify any active U.S. clusters of salmonellosis matching the outbreak pattern during the time period of the outbreak investigation, other than those linked to the Firefly restaurant.

From the 35 food items collected from Firefly restaurant on April 26, 2013 (Table 1), 21 food items were sent to the NSPHL for analysis. Of the 21 food items that were analyzed, 1 item, cooked chorizo (a type of sausage), tested positive for *Salmonella* by PCR and culture (Table 1). The CDC confirmed the PFGE pattern of the *Salmonella* isolate obtained from the cooked chorizo matched the outbreak pattern.

In addition, all 88 *Salmonella* isolates we submitted to the CDC (Table 5) and the isolate obtained from the chorizo exhibited matching MLVA patterns.

Environmental Health

Firefly management fully cooperated with SNHD staff during the investigation. Firefly used 2 adjacent permitted kitchens, 1 each in Firefly on Paradise and Dragonfly on Paradise, to prepare food for their patrons. During the inspections, a number of violations of food safety regulations were observed. These violations included employees not washing their hands properly, employees using bare hands to dispense ready-to-eat foods, foods contaminated by debris-filled liquid, improper cooling practices of potentially hazardous foods, improper holding temperatures of numerous potentially hazardous foods, improper food storage that included raw animal products stored above ready-to-eat foods, improper storage of in-use utensils, and inadequate cleaning and sanitizing of food preparation surfaces.

The results of the restaurant inspections were 44 demerits for Firefly on Paradise and 47 demerits for Dragonfly on Paradise. Both facilities were closed by SNHD on April 26, 2013 because of the investigation into the reports of illness (SNHD Regulations Governing the

Sanitation of Food Establishments 8-304.11) and for exceeding 40 demerits each (SNHD Regulations Governing the Sanitation of Food Establishments 8-303.11B).

Inspections of the two other Firefly restaurant outlets located in Clark County resulted in 30 demerits at Firefly Westside (9560 W. Sahara Avenue, Las Vegas) and 6 demerits at Firefly on Eastern (11261 S. Eastern Avenue, Henderson). Both of these restaurants remained open because neither establishment received > 40 demerits, and were required by SNHD to rectify their respective infractions within 15 business days of the inspection. On May 1, 2013, Firefly Westside restaurant was re-inspected and found to be in compliance, receiving 0 demerits. Because Firefly on Eastern received < 10 demerits for its first inspection, it was not re-inspected.

We gathered additional information from Firefly management about the handling of the chorizo product. The chorizo arrived at the restaurant raw and was subsequently cooked by Firefly kitchen staff. We did not collect any raw chorizo in the initial inspection. All chorizo items collected from Firefly and tested (Table 1) had already been cooked by restaurant staff.

In light of the negative laboratory result on 20 tested food items (Table 1), the lack of epidemiological links to any of the foods collected, and the isolation of the outbreak strain of *Salmonella* from the cooked chorizo, we curtailed our trace-back efforts. Instead, we aided the DPBH in the submission of information regarding the outbreak and about the cooked chorizo product that tested positive for *Salmonella* I 4,5,12:i:- to the USDA. The USDA decided not to have FSIS trace back the source of chorizo, because there was no epidemiological data to support its having been the source of the outbreak.

We met with Firefly executives and their hired food safety consultant on May 16, 2013 to discuss food safety processes and training to be implemented before the facility would be permitted to re-open. On May 21, 2013 the Firefly on Paradise and Dragonfly on Paradise were re-inspected and allowed to be re-opened because they met (or agreed to meet) the following requirements at the time of inspection:

1. A Person-In-Charge (PIC) who has completed a Certified Food Safety Manager (CFSM) training program must be present and responsible at the facility at all times including evenings, weekends, and breaks. The designated PIC staff must be knowledgeable of all food safety measures associated with the operation and be actively supervising to assure the food-handling staff performs duties in compliance with SNHD Regulations.

2. The SNHD verified that the facility owner has obtained the services of a Food Safety Consultant who will assist the facility in implementing measures to assure ongoing active managerial control of risk factors for foodborne illness. This includes Standard Operating Procedures, employee training, and methods to verify ongoing safe food-handling practices by facility management.

3. The facility actively monitored all food products during cooling and maintains cooling logs until further notice by SNHD. These logs are required to be kept on-site for a minimum of 1 year.

4. Any menu items including sauces/dips that contain raw or undercooked animal products had a consumer advisory statement and proper disclosure next to the item.

5. SNHD OOE determined that the outbreak had ended.

6. The facility paid the associated closure fee and passed the scheduled inspection with <10 demerits and no repeat critical or major violations.

Firefly restaurant management chose not to re-open the original location at 3900 Paradise to the public, but rather expedited the planned relocation of the Firefly at 3824 Paradise. The new Firefly was required to meet and maintain the above requirements for at least 1 year.

CONCLUSION / DISCUSSION

At least 336 patrons and employees who consumed food and/or drinks at Firefly restaurant during April 21-26, 2013 have been identified to be associated with this *Salmonella* outbreak. Over half of those ill sought medical care, and 15% of case-patrons were hospitalized. No deaths were reported. Because the incubation period for *Salmonella* is usually 12-36 hours, this suggests that patrons who ate at Firefly on April 22-23, 2013 had the highest risk of exposure to the pathogen. The identical strain of *Salmonella* I 4,5,12:i:- was isolated in 138 epidemiologically linked clinical specimens (Table 5) and in 1 food item (cooked chorizo). It is likely that the outbreak was due to local cross-contamination in the restaurant's kitchen and not from a contaminated commercial food. With the exception of 2 confirmed secondary cases, there was no evidence of disease transmission after the closure of the restaurant on April 26, 2013.

Bacteria of the genus *Salmonella* live in the intestinal tracts of infected humans and animals, and can be transmitted to others through the ingestion of the organisms in food and/or drink contaminated by the feces of those infected. Beef, dairy, fish, and poultry have often been implicated in *Salmonella* outbreaks [4], and the most important risk factors for the proliferation of *Salmonella* in food include temperature abuse of food during preparation and cross-contamination during food handling [5].

Serotyping of the *Salmonella* isolates indicated that the outbreak strain was *Salmonella* serotype I 4,5,12:i:-, ranked 7th among the most frequently reported *Salmonella* serotypes in the U.S. in 2009 [6]. This serotype has been responsible for many human salmonellosis outbreaks [7,8] and has been isolated from different foods and animals [9-11]. Other recent outbreaks of *Salmonella* I 4,5,12:i:- showed that exposure to live animals (*i.e.,* hog farms, live animal markets, slaughterhouses, animal exhibits, farms, petting zoos), or eating beef or pork obtained from custom slaughterhouses were risk factors [Communication between CDC and SNHD].

We relied on PFGE and MLVA to link illnesses between different groups of Firefly patrons and to study possible sources of infection, respectively. In tandem with epidemiological and environmental investigations, these molecular methods are valuable as they allowed us to further delineate between outbreak and non-outbreak related *Salmonella* illnesses. Although the original source of *Salmonella* and how it was introduced to the Firefly restaurant was not determined, results of the different public health investigative approaches all support the conclusion that the Firefly restaurant was likely the source of this outbreak.

Infected food handlers who do not thoroughly wash hands with soap and water after using the bathroom can also contaminate food. Although we observed poor food handling practices by employees, our findings suggest that that none of the 4 identified ill Firefly workers was the source of the illness, since their illness onset dates occurred at the same time as the majority of restaurant patrons, rather than earlier.

We concluded the outbreak was most likely due to local cross-contamination and temperature abuse of food in the Firefly restaurant's kitchen, because during the April 26, 2013 inspection of the restaurant, we identified numerous conditions and temperatures that could have fostered microbial growth and cross-contamination of food in the restaurant's kitchen. One of the more likely areas that cross-contamination of food could have occurred at the restaurant was the kitchen refrigerated preparation (prep) tables, as we found many notable food safety violations there, including cooked and ready to eat food held at unsafe temperatures, bare hand contact with ready-to-eat foods, and counter wipe cloths that had no sanitizing agent. These and other major factors can contribute to the multiplication and distribution of *Salmonella* in the food preparation environment. Furthermore, *Salmonella* I 4,5,12:i:- was isolated in the chorizo, a type of sausage that was cooked by restaurant staff and held on a refrigerated prep table prior to being incorporated in various menu dishes. The detection of *Salmonella* in a cooked food item located on the prep table implies that food items were being contaminated in the restaurant's kitchen, most likely while they were being held for service on the restaurant's kitchen refrigerated prep table. Here, the improper holding temperatures of food could have allowed for the proliferation of *Salmonella* to an infective dose that can cause illness [12]. In addition, the lack of sanitizing agents in cleaning supplies could have aided the spread the pathogen on food preparation surfaces, thereby contaminating foods that were prepared on those counters.

Our results also suggest that the source of the contamination was not from a contaminated commercial food. Chorizo, a type of pork sausage that was commercially-produced, arrived at the restaurant raw and was subsequently cooked by Firefly restaurant staff. Cooked chorizo should not have harbored *Salmonella* if the cooking process had been sufficient to kill the pathogen. Had the raw chorizo been contaminated further back in the food supply chain, we would have expected to have observed clusters of illnesses due to *Salmonella* I 4,5,12:i:- infections among other consumers of the chorizo wherever the product was distributed. However, although there were sporadic appearances of *Salmonella* I 4,5,12:i:-, there were no concurrent clusters of salmonellosis caused by the outbreak strain identified elsewhere in the U.S. other than the one linked to the Firefly restaurant. Furthermore, as there was no additional

epidemiological evidence to suggest that raw chorizo was the source of the Firefly or any other outbreak, the FSIS did not perform a trace back of the chorizo.

Having identified 336 case-patrons among 3,414 patrons served from April 21 through the time of restaurant closure on April 26, 2013, we estimate the overall attack rate to have been nearly 10%. This number is probably low because the CDC estimates that the actual number of *Salmonella* infections in the U.S. might be many times higher than those reported [13]. Although we believe it to be likely that people with mild symptoms often do not report their illnesses to SNHD or seek health care, the fact that this outbreak received significant media attention might have prompted a greater than normal proportion of them to have done so. It is still possible that underreporting occurred among infected people in this outbreak. Although the majority (60%) of case-patrons was from Nevada, 40% of cases-patrons normally resided outside of Nevada and became ill after eating at the Firefly while visiting Las Vegas. Underreporting of ill people might have occurred if infected Firefly patrons developed symptoms after they returned to their home states or countries, failed to contact us, experienced mild symptoms that were not diagnosed, or did not submit stool samples for testing.

The outbreak has ceased. The Firefly restaurant was the only illness cluster linked to *Salmonella* I 4,5,12:i:- as reported by PulseNet between April 21 to June 21, 2013. The outbreak appeared to be localized to the Firefly on Paradise restaurant and there was no indication that it has spread to the general community. No illness clusters have been reported among staff or patrons of the other 2 Firefly restaurants located in Clark County.

LIMITATIONS

We collected only 35 items because it was impractical to collect and test all the foods and beverages served by the Firefly restaurant, which not only included menu items (72 tapas, entrees, and desserts) but also accompanying condiments, garnishes, and beverages served by the Firefly. In routine outbreak investigations, detailed food histories obtained from ill case-patrons would have guided food collection; however, due to the rapid development of this outbreak, it was not possible to perform detailed analyses of food consumption histories prior to the closing of the restaurant and the collection of food for testing. Thus, it is possible that although we detected *Salmonella* I 4,5,12:i:- in the cooked chorizo, there were food items in the Firefly kitchen that harbored the pathogen, but were neither collected nor tested.

Also, it was difficult for us to identify statistically significant menu items or common factors/ingredient among the tapas food served by Firefly, as tapas consists of a wide variety of small appetizers and snacks, and restaurant patrons generally order multiple tapas dishes to share among people in their dining parties. These factors complicated our analyses of illness associations with food exposures because case-patrons and controls from each dining group were likely to have consumed the same foods.

PUBLIC HEALTH RECOMMENDATIONS

Rapid public health response is needed to ensure the swift identification and management of this type of large *Salmonella* illness outbreak. Prompt closing of a restaurant after the detection of an outbreak should be considered as a way to halt the outbreak and to prevent further illness. Testing of clinical and food specimens can be crucial to determine the outbreak etiology and mode of spread. Interviews of restaurant patrons are necessary to help to establish risk exposures and outbreak timelines.

To prevent such *Salmonella* outbreaks in the future, the following public health measures are recommended:

1. Restaurants should quickly rectify faulty food storage equipment and food preparation practices to ensure that food will be produced in a safe manner for consumption.

2. Food-service workers who test positive for *Salmonella* must be excluded or restricted from work per the FDA Food Code and may require approval from the local public health authority to return to work.

3. Food-service employees should be educated and cautioned about how *Salmonella* is transmitted and be made aware of the heightened importance of hand hygiene through washing with soap and water. Information about salmonellosis can be found at the SNHD website http://www.southernnevadahealthdistrict.org/health-topics/salmonellosis.php

4. To reduce cross-contamination, food service workers should be educated to the ways to clean and sanitize food preparation surfaces. Types of acceptable sanitizer solutions for use in a food establishment are located at the SNHD website http://www.southernnevadahealthdistrict.org/ferl/sanitizer-fact-sheet.php

5. To prevent temperature abuse of food, which aids in the proliferation of *Salmonella*, food service establishments are advised to monitor and log all food products during cooling, and to cook all potentially hazardous foods thoroughly.

6. Since foods of animal origin can be contaminated with *Salmonella*, people should not eat raw or undercooked eggs, poultry or meat. All restaurant foods including ingredients that contain raw or undercooked foods must have a consumer advisory.

7. Report all outbreak-related suspected cases of *Salmonella* infection to the local public health authority. In Clark County, Nevada, illness clusters (*e.g*. restaurants, schools, hotels) are reportable under Nevada Administrative Code sections 441A.525 and the SNHD Regulations Governing the Reporting of Diseases, Exposures, and Sentinel Health Events section 4.9. Reports should be made to the SNHD Office of Epidemiology at (702) 759-1300, option 3, and can be made 24 hours a day, 7 days a week.

REFERENCES

1. **Centers for Disease Control and Prevention.** (2013, July 18). Pulsed-field gel electrophoresis (PFGE). *Centers for Disease Control and Prevention*. Retrieved August 20, 2013, from http://www.cdc.gov/pulsenet/pathogens/pfge.html.

2. **Centers for Disease Control and Prevention.** (2013, May 29). Multiple locus variable-number tandem repeat analysis (MLVA). *Centers for Disease Control and Prevention.* Retrieved August 20, 2013, from http://www.cdc.gov/pulsenet/pathogens/mlva.html.

3. **Centers for Disease Control and Prevention.** (2012, December 12). Multistate outbreak of human *Salmonella enteritidis* infections associated with shell eggs (Final update). *Centers for Disease Control and Prevention*. Retrieved August 15, 2013, from http://www.cdc.gov/salmonella/enteritidis/.

4. **Gould LH, et al.** Surveillance for Foodborne Disease Outbreaks — United States, 2009–2010. *Morbidity and Mortality Weekly Report* 2013; **62**: 41-47.

5. **Heymann DL, editor.** Salmonellosis. *Control of communicable diseases manual*. 19th edition. American Public Health Association, 2008: 534-540.

6. **Centers for Disease Control and Prevention.** (2009, January 4). National *Salmonella* surveillance annual summary 2009. *Centers for Disease Control and Prevention*. Retrieved August 19, 2013, from http://www.cdc.gov/ncezid/dfwed/PDFs/SalmonellaAnnualSummaryTables2009.pdf.

7. **Agasan A, et al.** Profile of *Salmonella enterica* subsp. *enterica* (Subspecies I) serotype 4,5,12:i:− strains causing food-borne infections in New York City. *Journal of Clinical Microbiology* 2002; **40:** 1924–1929.

8. **Kozlica J, Claudet AL, Solomon D, Dunn JR, Carpenter LR.** Waterborne outbreak of *Salmonella* I 4,[5],12:i:-. *Foodborne Pathogens and Disease* 2010; **7:** 1431-1433.

9. **Centers for Disease Control and Prevention.** (2011, August 25). Multistate outbreak of human *Salmonella* I 4,[5],12:i:- infections linked to alfalfa sprouts (Final update). *Centers for Disease Control and Prevention*. Retrieved August 19, 2013, from http://www.cdc.gov/salmonella/i4512i-/.

10. **Mody RK, et al.** Outbreak of *Salmonella enterica* serotype I 4,5,12:i:- infections: The challenges of hypothesis generation and microwave cooking. *Epidemiology and Infection* 2013; **5:** 1-11. Epub ahead of print.

11. **Sweat D, et al.** Notes from the field: Infections with *Salmonella* I 4,[5],12:i:- linked to exposure to feeder rodents — United States, August 2011–February 2012. *Morbidity and Mortality Weekly Report* 2012; **61**: 277-277.

12. **Madigan MT, Martinko JM, Parker J.** Salmonellosis. *Brock biology of microorganisms*. 10th edition. Pearson Education, Inc, 2002: 959-960.

13. Centers for Disease Control and Prevention. (2012, April 5). What is salmonellosis? *Centers for Disease Control and Prevention*. Retrieved August 19, 2013, from http://www.cdc.gov/salmonella/general/.

FIGURE AND TABLES

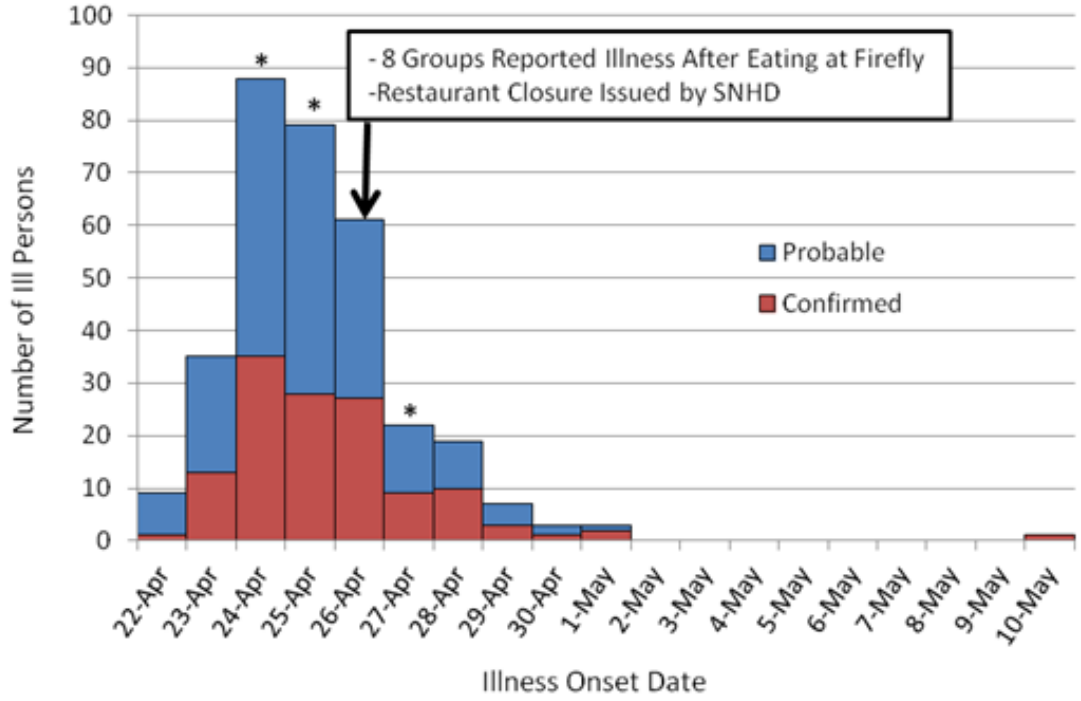

Figure. The epidemic curve of salmonellosis (n=326; Probable=197, Confirmed=129) associated with dining at Firefly on Paradise restaurant during April 21-26, 2013, reported through July 1, 2013. Illness onset dates occurred during April 22–May 10, 2013 and excluded 10 cases (8 lacking illness onset date, and 2 secondary cases with onset dates May 3 and 8, 2013). Las Vegas, Nevada.
* Restaurant employees (4 total, 3 of whom had confirmed cases of illness) had illness onset on dates marked.

Table 1. Food samples collected (n=35) from Firefly on Paradise and Dragonfly on Paradise restaurants on April 26, 2013.

Firefly on Paradise (N=20)	Dragonfly on Paradise (N=35)
Tetilla*	Aioli sauce*
Calamari*	Blanched fries*
Chorizo 1*	Calamari*
Chorizo 2, cooked*	Chorizo*
Cooked pasta	Eggplant
Cooked rice*	Heavy whipping cream
Cut cooked potatoes	Parmesan*
Cut cooked potatoes 2	Rice
Garlic cream sauce*	Shrimp
Garlic cream sauce 2*	Stuffed mushroom*
Garlic in oil*	Tartar sauce*

Table 1, continued.

Firefly on Paradise (N=20)	Dragonfly on Paradise (N=35)
Lentils	Tempura batter*
Macaroni and cheese*	Tuna*
Mussel sauce*	Tuna 2
Mussel sauce 2*	Tuna skewer
Potato bravas	
Salsa verde	
Shrimp, raw	
Stuffed mushroom*	
Tomato sauce	

* Samples sent (N=21) to the Nevada State Public Health Laboratory for testing.
Bolded food item was positive for *Salmonella* I 4,5,12:i:-. None of the foods tested was epidemiologically linked to illness.

Table 2. Illness association with selected food exposures at Firefly on Paradise restaurant. Interviews conducted on patrons eating on April 21–25, 2013.

Food Item	Ill Exposed (n=32)		Not Ill Exposed (n=38)		Odds Ratio	95% Confidence Interval	
	N	%	N	%			
White Sangria*	**9.5***	**28.8%**	**0.5***	**1.3%**	**31.1***	**1.7**	**560***
Thai Beef Salad*	**7.5***	**22.7%**	**0.5***	**1.3%**	**22.6***	**1.2**	**414***
Crispy Duck Roll	**8**	**25.0%**	**1**	**2.6%**	**12.3**	**1.4**	**105**
Petite Filet	**11**	**34.4%**	**2**	**5.3%**	**9.4**	**1.9**	**47**
Parmesan or Manchego Cheese on Dish (12 dishes)	**30**	**93.8%**	**25**	**65.8%**	**7.8**	**1.6**	**38**
Fried Calamari	**12**	**37.5%**	**4**	**10.5%**	**5.1**	**1.4**	**18**
Steamed Mussels	7	21.9%	2	5.3%	5.0	1.0	26
Fish Sticks	8	25.0%	3	7.9%	3.9	0.9	16
Firefly Fries	**18**	**56.3%**	**10**	**26.3%**	**3.6**	**1.3**	**9.8**
Manchego Mac N Cheese	**11**	**34.4%**	**5**	**13.2%**	**3.5**	**1.1**	**11**
Chicken and Chorizo Stuffed Mushrooms	**15**	**46.9%**	**9**	**23.7%**	**2.8**	**1.0**	**7.9**

Table only includes food items with statistically significant odds ratios, or food items which at least 20% of ill-persons ate with odds ratios ≥ 3.0.

Bolded food items show a statistically significant odds ratio.
*Two items were only consumed by case-patrons, resulting in incalculable odds ratios (due to having to divide by zero). Therefore, 0.5 was added to each cell in the 2x2 table to produce an approximation of the OR and CI values.

Table 3. Demographic characteristics of Firefly on Paradise case-patrons (n=336).

Median age	33* years (range 2–87)
Male	154 (46%)
Female	181 (54%)
Nevada Residents	202 (60%)
Out of State (29 states)	128 (38%)
Out of Country (Canada and U.K.)	5 (2%)

*Age unknown for 9 case-patrons

Table 4. Clinical characteristics of Firefly on Paradise case-patrons (n=336).

Median Incubation	38.5 hours (range 1.2–147 hrs)		
Symptoms			
Diarrhea	311 (n=311; 100%)		
Abdominal Cramps	48 (n=61; 79%)		
Vomiting	24 (n=44; 54%)		
Fever	24 (n=61; 39%)		
Bloody Stool	3 (n=61; 5%)		
Duration of Illness	(Range 0.5-7 days)		
<3 days	160 (48%)		
≥3 days	104 (31%)		
unknown	71 (21%)		
Illness Severity*	**Provider-Reported**	**Self-Reported**	**Total**
Sought Medical Care	139 (42%)	33 (10%)	172 (51%)
Hospitalized**	29 (9%)	21 (6%)	50 (15%)

Data obtained from both self-reported data (SNHD online foodborne illness complaint system) and healthcare provider/laboratory reports.
*Illness severity data may be incomplete if illness was reported before seeking medical care.
**Hospitalized patients are a sub-set of those who sought medical care but were admitted for at least 24 hours.

Table 5. *Salmonella* I 4,5,12:i:- isolates (n=199) with matching pulsed-field gel electrophoresis (PFGE) patterns submitted to PulseNet between April 21 to June 24, 2013 by the Southern Nevada Public Health Laboratory (SNHD) and other states' public health laboratories, categorized by epidemiological association with the Firefly restaurant.

Association with Firefly	SNPHL (N=88)*	Other Labs (N=111)	Total (%)
Confirmed	83	55	138 (69.3)
No known	2	22	24 (12.1)
Unknown	3	34	37 (18.6)

*All isolates had matching multiple-locus variable number tandem repeat analysis (MLVA) patterns