

Salmonella Enterica Enteritidis Outbreak

At

Pints and Quarts (Including the dining room of C.F. Prime)

– Roosevelt Park, Michigan

License #: SFE3861043115, issued to Dave J. Harris & Michelle M. Harris

Epidemiological Investigation

Dates of Incident: October 30 – November 02, 2013

Public Health - Muskegon County
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Introduction

On November 7, 2013, Public Health - Muskegon County (PHMC) received notification of one positive case for Salmonella infection from the laboratory of North Ottawa Community Hospital in Grand Haven, Michigan. Through the investigation on food history, the patient indicated she consumed a meal at Pints and Quarts on October 31, 2013, which is a locally owned and operated independent restaurant in Muskegon County. On the afternoon of November 8, 2013, six Salmonella diagnoses were reported by Muskegon's Mercy Health Infectious Disease Control to PHMC and initial interviews identified that a common link of these cases was that they recently dined at the restaurant -- Pints & Quarts and C.F. Prime (PQ/CFP), a single restaurant with two dining rooms and separate menus. Initial interviews revealed that all of the patients had eaten at the restaurant in a four-day period from October 30 to November 2, 2013 before the onset of illness.

In Muskegon County, there were 16 Salmonella cases in 2011 and 7 cases in 2012 (Table 1). The increase in the number of these reported cases in such a short period was an indication of a possible outbreak of a Salmonella infection. The information from those patients led PHMC to believe that this was a large outbreak involving multiple parties. An investigation was initiated on November 8, 2013.

Background

Salmonella is a type of food poisoning caused by the Salmonella Genus Bacterium. There are many different species subtypes of these bacteria. *Salmonella enterica* serotype Enteritidis (Salmonella Enteritidis) is one of the most common types in the United States.

Every year, approximately 40,000 cases of Salmonella infection are reported in the United States.¹ Because many milder cases are not diagnosed or reported, the actual number of infected may be 30 or more times greater. Symptoms of Salmonella include diarrhea, fever, and abdominal cramps. These symptoms usually develop 12 to 72 hours after infection and the illness usually lasts four to seven days. Most individuals recover without treatment, however, some cases with more severe symptoms need to be hospitalized. Older adults, infants, and those who have impaired immune systems are at highest risk.

Salmonella bacteria are usually transmitted to humans through consumption of foods contaminated by *Salmonella enterica*. Contaminated foods usually look and smell normal. Contaminated foods are often of animal origin, such as poultry, milk, and eggs; however, any food, including vegetables, may become contaminated during food processing or food handling.

¹ CDC - General Information on Salmonella <http://www.cdc.gov/salmonella/general/>

In Muskegon County, a total of 126 confirmed Salmonella cases were reported to PHMC during the period 2003 through 2012. There is usually a slight increase of incidences of Salmonella during the summer time.

**Table 1. Salmonella Diagnoses by Year (2003-2012)
In Muskegon County**

By Year	Number of Diagnoses
2003	17
2004	11
2005	7
2006	16
2007	16
2008	13
2009	11
2010	12
2011	16
2012	7

Source: Michigan Disease Surveillance System (MDSS)

Epidemiological Investigation

Methods

PHMC initiated an epidemiological investigation to determine the extent of the outbreak, risk factors related to the outbreak, and steps necessary to control and prevent further infection. A Case-Control Study was conducted to ascertain if there was an association between the illness and any particular food item. For case findings, PHMC contacted confirmed Salmonella cases to compile a list of names and phone numbers and to request that patrons who dined at the restaurant between October 30, 2013 and November 2 contact PHMC. The Confirmed Cases' dining partners and identified ill individuals were included for the case-control study.

Case Definition

Confirmed cases were laboratory confirmed cases for persons who ate at PQ/CFP between October 30 and November 2, 2013 and had Salmonella isolated from a stool culture.

Probable Cases were defined as individuals who dined in the same restaurant within the same time frame with onset of diarrhea, fever, or other symptoms such as abdominal cramps, vomiting, and nausea within 6-72 hours after eating, but without laboratory confirmation.

Controls were non-sick friends or family members who consumed food at the same restaurant within the same time frame. The Control name list was obtained through contacts of confirmed cases or member of a risk group as identified by PHMC during the Salmonella outbreak.

A list of over 160 patrons was compiled. PHMC attempted to enroll approximately 100 Controls but only 58 agreed to participate in the study. Additionally, a complete list of 35 employees who worked between October 30 and November 2, 2013 was provided from the restaurant. Since these employees normally did not eat the food items from the restaurant's menu, they were excluded from the Case-Control Group but separate tests were performed to estimate the exposure rate and other risk factors associated with the outbreak.

Survey Administration

With assistance from the Region 6 Epidemiologist, two outbreak specific questionnaires were developed for this project (one for patrons and the other for employees). Telephone interviews were conducted of the patrons while face-to-face interviews were applied to the employees. Out of county respondents were interviewed by telephone by their own county public health departments. Thirteen PHMC staff members were involved in the interview process.

With more than 200 attempts made to contact individuals who were on the list of names, a total of 121 interviews were conducted. However, the answers for each question do not always total 121 since a few respondents did not complete every single question in the questionnaire.

Statistical Analysis

Data were entered and analyzed by using SPSS 20 (Statistical Software). Descriptive statistics for age, gender, hospitalization, and food specific attack rates were calculated for the study participants. The odds ratios and 95% confidence intervals were calculated to assess the association between particular food items and subsequent illness. Chi-squared (two-tailed) tests were performed to test statistical significance.

Environmental Investigation

PHMC conducted six onsite investigations at PQ/CFP connected to the outbreak. Early in the morning of November 8, the PQ/CFP Owner/Manager, A. Harris, stopped into PHMC and indicated that he had a sick employee working for his restaurant. As PHMC had received two additional reports of unrelated people with diagnosed Salmonella infections with a common link to PQ/CFP, later that afternoon, two PHMC Food Service Sanitarians were assigned to perform a foodborne illness inspection and visited the restaurant for the first time. At that time, PHMC only knew that Salmonella was the diagnosis. The kitchen facility was inspected in a focused manner. Coolers, date marks, cooking procedures, employee health policies, along with hand washing requirements were reviewed and discussed with Mr. Harris. At that time, another manager informed PHMC that there were a total of three employee illnesses. Employee health forms (see attached) were provided to him by the two Food Service Sanitarians.

During the second visit on November 13, employee interviews were conducted by PHMC staff at the restaurant. A list with a total of 35 employee names was provided by PQ/CFP management, 20 interviews were captured on site and 12 more were completed within the next few days. During this session of interviews, PHMC discovered that several employees had been sick with probable Salmonella symptoms after November 2. The Sanitarian reviewed policy and procedures with Mr. Harris and also provided him with a copy of CIFOR Industry Guidelines (Council to Improve Foodborne Outbreak Response). During this onsite visit, Mr. Harris stated that the Béarnaise sauce

uses raw egg yolk, but that the Caesar dressing does not contain raw egg. Therefore, the focus shifted to the processing of the chicken.

The third site visit was conducted on November 15. The entire process was reviewed from when the chicken was thawed to the time it went out as an order. Chicken was received frozen, thawed in the preparation sink under cold running water, placed in a marinade and then stored in the walk-in cooler on the bottom shelf until needed. Chicken containers were moved to the cook line cooler to be used on the grill when needed. Once a container was emptied, it was taken to the dish area to be washed. Mr. Harris reviewed with the sanitarian the process of how the *Thai Chicken Lettuce Wrap* was prepared and handled, focusing on the chicken. Raw chicken was cooked on a Char-Grill until it reached 165°F. During this inspection, the chicken was put into the microwave on a plate to increase temperature to over 190°F; it was then cut and placed onto salads, lettuce wraps and the *Chicken Balsamic Sandwich*.

On November 21, a fourth site visit occurred. Another Owner/Manager, F. Scharmer, informed PHMC that he will be the Lead Restaurant Contact Person from the date of this visit forward. Mr. Scharmer provided documentation of all food sales for the dates 10/30, 10/31, 11/01 and 11/02. This inspection focused on how the *Thai Chicken Lettuce Wrap* was prepared and handled with more emphasis on the lettuce itself. The Bibb lettuce that was used during the days in question was no longer used. This particular lettuce was washed when needed. The lettuce used for the wraps is prepared per order. A list was given to the Sanitarian identifying the dishes each type of lettuce is used in:

- Romaine- *All sandwiches, Caesars, Cobb and Chop salads*
- Bibb- *Thai Chicken Lettuce Wrap*
- Iceberg- *Wedge Salad*
- Mixed greens- *Michigan Field Salad*

At the fifth site visit on November 22, a process interview was conducted at PQ/CFP with five kitchen employees that worked during the days in question. Interviews were conducted to determine each employee's responsibilities and how they interpreted the current standard operating procedures (SOP). One of the variations in procedures was the process of lettuce washing. Some employees indicated that they always wash the lettuce prior to use and others stated that the lettuce is received prewashed and did not need to be washed at the facility. The Food Service Sanitarians learned from the five kitchen employees that two of the dressings, Caesar and Citrus were made with raw eggs. The Citrus dressing was added to the slaw which was used as a topping for *the Firecracker Shrimp, the Thai Chicken Lettuce Wrap, Ricky's Sloppy Joe* and *the Crispy Fish Sandwich*. The Caesar dressing was used for *the Caesar Salad*. Previously, during the November 13 interview, Mr. Harris had stated that the Caesar dressing did not contain raw egg. Mr. Scharmer gave PHMC a copy of current SOP at this site visit.

On December 10, PHMC sent a Food Service Sanitarian to PQ/CFP for a sixth site visit to take pictures of the different kitchen preparation locations, equipment and storage practices (see Appendix IV).

In addition to onsite investigations, PQ/CFP and PHMC communicated via email and phone calls (see Appendix V). PQ/CFP owners/management and staff have been very helpful and forth coming during the entire investigation. Mr. Harris was proactive on November 8 by informing PHMC that PQ/CFP had one sick employee.

At the end of the investigation, PHMC did not find any one particular area that could positively be identified as the sole cause of the outbreak. There are a few potential areas of concern which will be addressed later in these findings.

Result

Epidemiological Investigation

Among a total of 121 respondents in the study group, 89 (73.6%) were customers and 32 (26.4%) were employees. A majority of the customers (76 out of 89 customers or 85.4%) ate from the menu at PQ while a few others (13 customers or 14.6%) dined from the menu at CFP. Of the 32 employees interviewed, 18 worked in the kitchen (preparation cook, cook, dishwasher, etc.) and the other 14 worked in the front of the house (servers, bartender, and host). On examination of the data collection for ill and non-sick respondents, 31 (25.7%) out of the 121 met the case definition (laboratory confirmed), 32 (26.5%) were probable, and 58 (47.9%) were not sick (Controls). Among 32 employees, 8 identified themselves to be sick including two confirmed cases (see Table 2).

Table 2. Study Group Profile

Categories	Numbers	Percent
Customer Confirmed Cases	29	24.0%
Customer Probable Cases	25	20.7%
Non-Sick Customers	35	28.9%
Restaurant Staff Confirmed Cases	2	1.7%
Restaurant Staff Probable Cases	6	5.0%
Non-Sick Staff	24	19.8%
	Total: 121	100%

Descriptive Statistics: The median age for cases was 44.5 years ranged from 9 months old to 80 years of age. About two-thirds of the cases were females (Table 3). The median age for Controls was 44 years of age (range 10-67) and more than half (57.1%) were males. A majority of both Cases and Controls dined from the PQ menu. Of 13 individuals who dined from the CFP menu, 11 were Cases and only two were Controls. The respondents in the study group were from Muskegon County (77.5%), Ottawa County (16.9%), and other counties including Calhoun, Kent, Oakland, and Washtenaw (5.6%). Employees in this study group were young (median age: 27), and most of them were Muskegon County residents (96.9%) (see Table 4).

**Table 3. Demographic Profile of the Investigation Participants
(Cases and Controls n=89)**

Characteristic	Cases (n=54)		Controls (n=35)	
	Numbers	%	Numbers	%
Gender				
Male	19	35.2%	20	57.1%
Female	35	64.8%	15	42.9%
Age, Years				
Median	44.5		44	
Range	9 Months-80 Years		10-67 Years	
Menus				
Pints & Quarts	43	79.6%	33	94.3%
C.F. Prime	11	20.4%	2	5.7%
County of Residents				
Muskegon	44	81.5%	25	71.4%
Ottawa	9	16.7%	6	17.1%
Calhoun	1	1.9%	1	2.9%
Kent	0	---	1	2.9%
Oakland	0	---	1	2.9%
Washtenaw	0	---	1	2.9%

Table 4. Employee Demographic Profile (n=32)

Characteristic	Numbers	%
Gender		
Male	18	56.3%
Female	14	43.8%
Age, Years		
Median	27	
Range	19-41 Years	
County of Residents		
Muskegon	31	96.9%
Ottawa	1	3.1%

Clinical Symptoms:

The sick respondents presented a number of gastrointestinal symptoms after eating from the PQ/CFP menus or working at the restaurant from October 30 through November 2, 2013. These symptoms included diarrhea, bloody diarrhea, nausea, vomiting, stomach cramps, chills and/or sweats, headache, body and/or muscle aches, bloating/gas, and fever (see Table 5). The most common reported symptoms were diarrhea (98.4%) and stomach cramps (92.1%).

Almost two-thirds of the sick individuals (64.5%) sought medical treatment. In some cases, patients made multiple visits either to their Primary Care Providers (41.2%), an Emergency Room (34.9%), or a Medi-Center/Urgent Care Facility (3.0%). Five cases were hospitalized, including one secondary case. The secondary case, which had an underlying medical condition, was clinically confirmed on November 12. The two Epi-linked family members ate from the CFP menu on November 1, 2013 and both became ill on November 3.

Table 5. Prevalence of Symptoms Among Cases (n=63)*

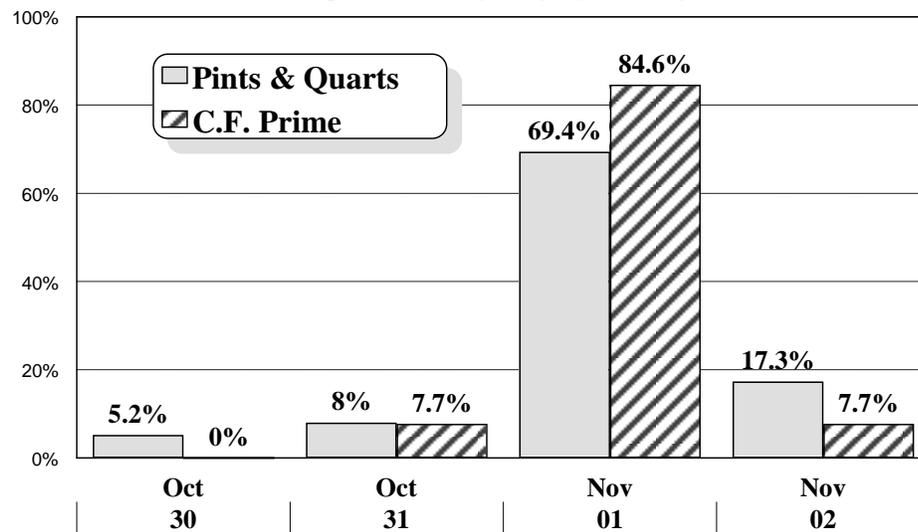
Symptom/Outcome	Number	Percent (%)
Diarrhea	62	98.4%
Diarrhea with blood	12	19.4%
Nausea	43	68.3%
Vomiting	18	28.6%
Stomach cramps	58	92.1%
Fever	40	64.5%
Chills and/or sweats	45	71.4%
Headache	41	68.3%
Body or muscle aches	47	74.6%
Bloating or gas	34	56.7%
Seen by health care provider**	40	64.5%
Primary Care Providers (PCP)	26	41.2%
Emergency Room (ER)	22	34.9%
Hospitalization	4	6.3%
Medi-Center/Urgent Care Facility	2	3.0%

*Answers do not always total to 63 since some individuals did not answer every single question.

** Counts included same Cases who made multiple visits to PCP, ER, or Medi-Center/Urgent Care Facility

Dining Time: Of all the patrons included in the study between October 30 and November 2, 2013: 85.4% ate from the PQ menu while the other 14.6% of the respondents dined from the CFP menu. As Figure 1 shows, 69.4% of PQ and 84.6% CFP respondents reported that they consumed meals at the restaurant on November 1, 2013.

Figure 1. Dining Dates Among 88 Patrons*
Pints & Quarts Menu: n=75
C.F. Prime Menu: n=13



*Data available for 88 patrons

Employees

Eight sick employees indicated onset of the illness between November 2 and November 10. Five out of eight sick employees reported that they consumed meals at the restaurants between October 30 and November 2.

The Epidemic Curve and Incubation Period

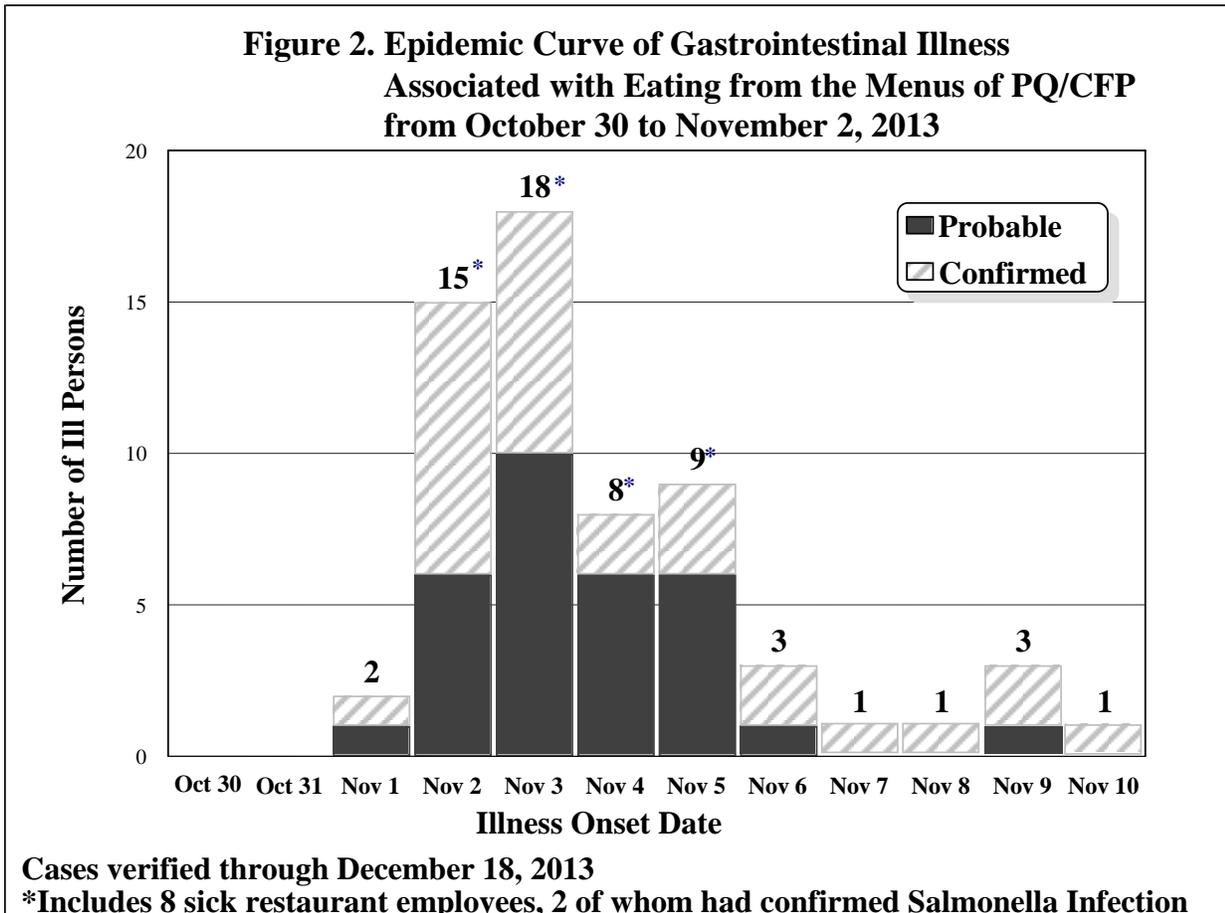
The Epidemic Curve is indicated as a common source curve which shows that the outbreak has occurred as the result of continuous exposure to a common source. Food was determined to be the most likely potential harmful source. As shown in Figure 2, the respondents had onset of illness between 8 and 183 hours after food consumption. The onset of symptoms continued to occur over the next 10 days. It peaked on November 3, 2013 with a total of 18 sick respondents reporting onset of symptoms. The last day of onset of symptoms being reported was November 10, 2013.

Incubation information was available for 55 sick individuals. The median incubation period was 39 hours. On average, the incubation period for Salmonella infections is 12 to 72 hours. Altogether, 72.7% (40 cases) of the cases had onset of symptoms within 72 hours and 27.3% (15 cases) had onset of symptoms after 72 hours.

Illness Duration

The duration of symptoms was known for 57 sick individuals. The median duration of symptoms was 11.4 days. Salmonella infections usually last 5 to 7 days and most do not require treatment other than oral fluids. In the case of this outbreak, approximately 30% (17 cases) of the sick respondents had

illness duration within a 7 days range while most sick respondents 70% (40 cases) reported that their symptoms lasted much longer, particularly among younger and older cases.



PQ Menu: Based on the questionnaire responses, all of the food items consumed from the PQ menu were analyzed for statistical significance. It was concluded that multiple food items were significantly associated with the illness.

The odds ratios found in the Case Control Study are represented in Table 6. When the odds ratios and 95% confidence intervals were taken into consideration, the highest risk was found in the group who ate Salad (odds ratio=5.3; 95% CI=1.09-26.01). That means those who ate Salad were 5 times more likely to develop the illness than those who did not consume the food item. *Thai Chicken Lettuce Wraps* and *Grilled Chicken Added to Salad*, both were only consumed by the sick individuals, were significantly associated with the outbreak. The exposed attack rate for the sick group is 39.5% (p<0.001) for *Thai Chicken Lettuce Wraps* and 19% (p<0.01) for *Grilled Chicken Added to Salad*.

Table 6. Frequency of Exposure to Potential Sources of Salmonella from Pints & Quarts Menu in Paired Cases and Controls (Cases = 43 and Controls = 33)

	Items	Cases*	Controls*	Odds Ratio	95% Confidence Interval	P Value**
Appetizers	Thai Chicken Lettuce Wraps	17 (39.5%)	0			< 0.001
	Spinach Artichoke Dip/Chips	2 (4.7%)	0			0.223
	Hand Dipped Onion Rings	1 (2.3%)	3 (9.7%)	0.2	0.02-2.25	0.168
	Hand Dipped Onion Ring with Spicy Buttermilk Ranch	0	4 (12.9%)			0.02
	Hand Dipped Boneless Wings	4 (9.3%)	0			0.08
	Crispi Calamari	1 (2.3%)	3 (9.7%)	0.2	0.02-2.25	0.168
	The Best Mini Cheeseburger	3 (7.0%)	0			0.133
	Chips and Cheese	2 (4.7%)	2 (6.5%)	0.7	0.09-5.32	0.735
	Chips & Cheese with shredded Chicken	0	1			0.24
	Famous Crispy Pickle Chips	2 (4.7%)	8 (25.8%)	0.1	0.03-0.72	0.009
	Gary's gravy Fries	0	5 (16.1%)			0.006
	Homemade Tear & Share Pretzel	4 (9.3%)	6 (19.4%)	0.4	0.11-1.67	0.212
	Homemade Tear & Share Pretzel with Pints' Cheese Sauce	3 (7.0%)	3 (9.7%)	0.7	0.13-3.72	0.68
	P's & Q's Quesadilla	2 (4.7%)	0			0.223
	Mini Seared Rare Tuna Tacos	1 (2.3%)	1 (3.2%)	0.7	0.043-11.88	0.814
	Firecracker Shrimp	5 (11.6%)	2 (6.5%)	1.9	0.345-10.544	0.453
Sandwich	Chicken Balsamic	6 (14.0%)	2 (6.5%)	2.4	0.442-12.522	0.305
	TBCG	1 (2.3%)	2 (6.5%)	0.3	0.030- 3.987	0.375
	Hot Ham & Swiss	1 (2.3%)	1 (3.2%)	0.7	0.043-11.878	0.814
	Oven Roasted Turkey Club	2 (4.7%)	0			0.223
Salad	Salad without specific name	11 (25.6%)	2 (6.1%)	5.3	1.091-26.011	0.025
	Grilled Chicken Added to Salad	8 (19%)	0			0.010
	BLT Wedge	2 (4.7%)	1 (3.2%)	1.4	0.127-16.894	0.759
	Caesar	1 (2.3%)	0			0.393
	Michigan Field	2 (4.7%)	0			0.223
	Healthy Greens	0	1 (3.2%)			0.236
Any Sides	House Slaw	0	1 (3.1%)			0.243
	French Fries	6 (14.0%)	3 (9.7%)	1.5	0.348- 6.585	0.579
	Tater Tots	3 (7.0%)	5 (15.6%)	0.41	0.089- 1.838	0.230
	House Salad	3 (7.0%)	1 (3.1%)	2.32	0.230-23.452	0.453
	Hand Dipped Onion Rings	1 (2.3%)	2 (6.2%)	0.36	0.031- 4.121	0.391

*Answers do not always total to 43 for Cases and 33 for Controls because several subjects could not remember if they ate the indicated item.

**Bolded areas for items of statistical significance

Table 6. Frequency of Exposure to Potential Sources of Salmonella from Pints & Quarts Menu in Paired Cases and Controls

(Continued)

	Exposure	Cases	Controls	Odds Ratio	95% Confidence Interval	P Value
Burger	Traditional Burger	3 (7.0%)	2 (6.5%)	1.01	0.171- 6.930	0.929
	Modern American	0	1 (3.2%)			0.236
	American Cheddar Cheese on burger	3 (7.0%)	2 (6.5%)	1.1	0.171- 6.930	0.929
	Provolone on burger	0	1 (3.2%)			0.236
	BBQ Sauce on burger	0	2 (6.5%)			0.91
	Spicy G on Burger	1 (2.3%)	0			0.393
	Burger – Topping Lettuce	1 (2.3%)	4 (12.9%)	0.2	0.017- 1.516	0.074
	Burger – Topping Tomato	1 (2.3%)	3 (9.7%)	0.2	0.022- 2.246	0.168
	Burger – Topping Onion	0	5 (16.1%)			0.006
	Burger -- Topping Bacon	2 (4.7%)	2 (6.5%)	0.7	0.094- 5.315	0.735
	Burger – Topping caramelized onions	0	1 (3.2%)			0.236
Soup	Soup of the Day	2 (4.7%)	1 (3.2%)	1.5	0.127-16.894	0.759
	French Onion	0	1 (3.2%)			0.236
Dinner	Skillet Mac-Michigan Ballpark	0	2 (6.2%)			0.97
	Water	18 (46.2%)	14 (42.4%)	1.2	0.457- 2.961	0.751
Beverage	Soda	9 (21.4%)	4 (12.5%)	1.9	0.530- 6.873	0.317
	Alcohol	27 (64.3%)	27 (81.8%)	0.4	0.135- 1.186	0.093
	Beverage with ice	22 (52.4%)	20 (60.6%)	0.7	0.284- 1.802	0.476

***Answers do not always total to 43 for Cases and 33 for Controls because several subjects could not remember if they ate the indicated item**

CFP Menu: In this study, a total of 13 individuals ate from the CFP menu. Table 7 represents the food items eaten by the respondents in the study group. Among meals consumed or eaten were several main dishes (Prime Rib, Steak, and Shrimp) with salads and main dishes without salads. All of those who consumed food contained with salad were sick while the two non-sick respondents did not eat food that contained salad. In this case, consumption of any dish containing salad was strongly associated with the illness.

This finding, combined with the study result of the PQ Menu, certainly provided strong evidence that *the Thai Chicken Lettuce Wraps, Various Salads, and Grilled Chicken Added to Salad* were the sources of the outbreak. Based on the analysis of the food items from the menus implicated to have significantly contributed to the illness associated with this outbreak, it was theorized that the various salads and chicken could have been contaminated sometime during the preparation cycle.

Table 7. Potential Sources of Salmonella from the C.F. Prime Menu

Among 13 Interviewed Clients

	Type	Main Dish	Sick	Status
Salad	BLT Wedge Salad	Prime Rib with twice baked potato	Yes	Probable
	BLT Wedge Salad	Sirloin Steak	Yes	Confirmed
	Caesar Salad	Prime Rib, green beans/potato	Yes	Confirmed
	Caesar Salad	Strip Steak with mashed potato	Yes	Confirmed
	Chopped Salad	---	Yes	Probable
	Wedge Salad	Filet Mignon	Yes	Probable
	Wedge Salad	New York Strip Steak with potato	Yes	Probable
	House Salad	Prime Rib with garlic mashed potatoes	Yes	Probable
	Caesar Salad	Prime Rib with twice baked potatoes	Yes	Probable
	House Salad	Prime Rib with twice baked potatoes	Yes	Probable
	House Salad	Prime Rib with twice baked potatoes	Yes	Confirmed
		Total Sickness	= 11	Confirmed = 4 Probable = 7
Brussels Sprouts	With Walnuts, Bacon & Balsamic	Grilled Shrimp with bread	No	
	With Walnuts, Bacon & Balsamic	Grilled Shrimp with bread	No	
		Total Non-Sickness	= 2	

Laboratory Investigation

Among 32 Confirmed Cases (including one secondary case), all 32 Cases were of the Salmonella Enteritidis serotype. Further testing of the stool samples was done at the state laboratory, with the following results: PFGE (Pulsed-field Gel Electrophoresis) 1st Enzyme: All 32 of the stools were a match. Of these 32 isolates, a second test was done on 17 of them by PFGE and all 17 continued to be an identical match (see Appendix III).

Environmental findings

PHMC found areas of good practice. All of the coolers were holding at proper temperature (41°F). Food was properly located in the coolers by storing ready to eat (RTE) food above or separate from raw meats/eggs. Sanitarian observed chicken with a final cook temperature of 190°F. Chicken must reach a minimum cook temperature of 165°F. Overall the kitchen and coolers were clean and maintained.

PHMC found a few areas and processes that could potentially cause foodborne illness in the facility:

1. The SOP was reviewed and it was found that they were missing many of the following sections that could help prevent a foodborne illness outbreak:
 - An inadequate employee health policy
 - No SOP for cross contamination prevention
 - No SOP for hot/cold holding
 - No date marking SOP
2. Management was unaware of total number of employees that were sick while working.
3. The inadequate Employee health policy was not clearly relayed to the employees. The evidence was shown by employees working while sick with one or both of the following symptoms:
 - Vomiting
 - Diarrhea
4. Some employees indicated that they were unfamiliar and/or did not understand the Michigan Modified Food Code of 2009 requirement of reporting symptoms of vomiting and diarrhea.²
5. Pantry location stored two containers of dressing made with raw egg. This location is the one area where raw product and ready to eat food may cross contaminate.
6. Inconsistency in preparation of the chicken, salad, and raw vegetables.
7. The foods prepped in sinks/work tables during the morning were not prepared in the order of minimum cook temperatures. This could potentially lead to cross contamination if the person washing the prep sink does not clean it properly.
8. Hand sinks were being used for more than hand washing. (i.e., using as a fill sink, disposing of utensil storage waste water). Hand sinks may only be used to wash hands in order to help prevent contamination.
9. Raw unpasteurized eggs were used in two of the dressings (Citrus and Caesar) as well as the Béarnaise sauce. Consuming raw eggs may increase the risk of foodborne illness since a cook/kill step is not in place.
10. Management did not know that raw unpasteurized egg was used in two of the dressings.

² http://www.michigan.gov/documents/mdard/MI_Modified_2009_Food_Code_396675_7.pdf
Section 2-201

Hypotheses

PHMC investigators generated a list of hypotheses about the possible method of contamination or exposure to the Salmonella based on the information gathered through observations, discussions and analysis of the data. The foods most associated with people who were ill were *the Thai Chicken Lettuce Wrap*, *Various Salads*, and *Grilled Chicken added to Salad*.

Hypotheses #1: Sick Employee

During the investigation, it was learned that some of the employees were unaware of the Food Code requirements to notify restaurant management of certain symptoms of illness. An employee who was ill with Salmonella could contaminate food or objects, especially if their hands were not properly washed after using the toilet. The investigators agreed that this was a possibility, but of low likelihood. A person would have had to exhibit the poor hygiene behavior a period of four days and to have contaminated a very large number of meals on November 1 in order to create this type of outbreak.

Hypothesis #2: Cross Contamination in Sinks

The investigators found that restaurant employees consistently prepared foods in the two-compartment sink in the opposite sequence that was recommended. For example, they were thawing chicken and preparing it first, then preparing any other meats, and lastly, preparing the raw ready-to-eat vegetables. Poor cleaning of the sink between items prepared could also contaminate other foods. Although this is a high-risk way to prepare foods, it was seen as unlikely to have caused this particular outbreak. The breakdown in cleaning would have had to occur during a four-day period then stop and then would have had to peak on November 1.

Hypothesis #3: Cross Contamination of Cutting Boards or Knives

Although SOP's did not address an approved method of using and cleaning cutting boards and knives to prevent cross contamination, the investigators did not observe or have staff describe a situation where cross contamination of cutting boards or knives was occurring. This hypothesis was given a low probability of causing the outbreak.

Hypothesis #5: Separation and Protection in the Cooler

The investigators observed very good management of foods in the cooler. Chicken was placed on the lowest shelf on one side, lettuce and other vegetables were placed on the top shelf on the opposite end of the cooler.

Hypothesis #6: Raw Eggs

Raw unpasteurized eggs were routinely used in at least three food items. The kitchen staff reported that items were made in small batches and they informed the investigators that eggs were never pooled (i.e., eggs are removed from their shells and then stored in a container for later use). Eggs have been identified by the U.S. Centers for Disease Control and Prevention as the most common source of Salmonella Enteritidis infection³. Raw eggs were used in the Citrus dressing, Caesar dressing and Béarnaise sauce. Use of raw unpasteurized

³ CDC - Salmonella serotype Enteritidis: General Information - NCZVED
http://www.cdc.gov/nczved/divisions/dfbmd/diseases/salmonella_enteritidis/

eggs would be expected to periodically cause illness for some restaurant patrons. The reported method of raw egg use in recipes did not adequately account for the large number of people ill from Salmonella.

Hypothesis #7: Chicken Marinade Getting into Other Foods

Raw chicken in a marinade should always be expected to carry pathogens, including Salmonella. The processing of chicken was closely reviewed by investigators. There was no part of the processing of chicken described or observed that would lead to easy cross contamination.

Hypothesis #8: Sabotage

The hypothesis of sabotage was discussed on several occasions. Deliberate contamination can occur and has been known to occur as a cause of an outbreak, however, no disgruntled person was identified and no evidence was identified that would substantiate this hypothesis.

Hypothesis #9: Contamination at the Pantry Station

This hypothesis seemed to locate the most likely place where contamination may have occurred. The various foods most associated with Salmonella infection in this outbreak were stored or assembled at the Pantry Station. The Citrus dressing, Caesar dressing, various lettuces and other salad ingredients were kept at this table and menu items containing chicken were brought to this location for assembly before going to the customer. However, no clear means of contamination were identified.

Conclusion

A foodborne illness outbreak related to *Salmonella enterica* serotype Enteritidis (Salmonella Enteritidis), all with the same PFGE, occurred during the period from October 30 to November 2, 2013. It was Confirmed that 31 people who consumed food or worked at PQ/CFP during the time frame subsequently developed the illness. Those Cases included 27 Muskegon County and 4 Ottawa County residents. One secondary case was epidemiologically linked to the outbreak. In addition, 32 Probable Cases who ate from the PF/CFP menus developed clinical symptoms compatible with Salmonella.

The clinical picture of this outbreak was consistent with Salmonella infections with the majority of the ill respondents presented with diarrhea, cramps, and fever. The median incubation period was 39 hours and the duration of the illness was 11.4 days.

The source of the outbreak was PQ/CFP. The result of the investigation concluded that food items significantly associated with the Salmonella outbreak were various *Salads, Thai Chicken Lettuce Wraps, and Grilled Chicken Added to Salad*. The mentioned food items could have resulted from cross-contamination and mishandling of food during the preparation cycle. In particular, Citrus dressing, one of the *Thai Chicken Lettuce Wraps* ingredients made from raw eggs might have provided a potential source of contamination.

During the course of investigation, PHMC found several areas and processes that could potentially cause cross contamination for the facility, such as use of raw unpasteurized eggs in dressings, hand

sinks were being used for more than hand washing, along with other observations listed in the Environmental findings section.

Although no single source or act was specifically identified that caused this contamination, several practices were observed that could cause foodborne exposure to Salmonella. The most suspicious location was the area of the kitchen called the Pantry Station where ingredients for salads, dressings (including two containing raw unpasteurized eggs), and other condiments were kept and used to prepare salads and chicken dishes. It was unlikely that the Salmonella with the same PFGE came in from various farms or processors; however, it was more likely that the contamination of various menu items were contaminated in the facility and the Pantry Station-which was the only location where all of the foods most highly associated with the outbreak were assembled.

Furthermore, seven employees including two tested positive for *Salmonella enterica* serotype Enteritidis (Salmonella Enteritidis) could have been infected during preparation, handling or consumption of contaminated food during the outbreak. An infected employee could transmit Salmonella organisms to food ingredients, work surfaces, and utensils, if personal and food hygiene is insufficiently practiced.

Lastly, SOP's were written but did not provide clear direction to staff and completely missed several key practices in order to avoid contamination of food products. It was learned that the current procedures were seldom used and several employees had never read them. The SOPs should be clear, concise, and provide the employee with the organization's approved procedure related to the critical control points in processing food. SOP's should be the basis for a comprehensive quality control program which provides for monitoring and documentation, assuring that SOP's are followed and documentation of corrective actions taken when deviation from the SOP's is identified.

Recommendations

Based on the investigation and all evidence to date, PHMC makes the following recommendations to the PQ/CFP:

- Create SOP's so they are easier to follow, separate from the employee hand- book, adjustable/flexible to protect the customers/employees and inclusive of every step to assure they are thorough and complete. The following website is a tool you may use to create SOP's:
(<http://www.muskegonhealth.net/programs/environmental/SOPBuilder.htm>)
- Use SOP's as a basis for a Quality control system. Have an individual person(s) responsible for assuring SOP's are followed. Create a system to document/verify the monitoring and corrective actions have been taken when needed.

- Do not use or store any raw potentially hazardous product at the Pantry Station. (example: raw unpasteurized egg) This will help prevent potential cross contamination of raw and ready to eat (RTE).
- Change the preparation procedure that occurs during the morning shift. Prepare RTE food first and then prepare other potentially hazardous food in the order of cooking temperature (lowest to highest) or use a completely different sink for the preparation of RTE and raw potentially hazardous food.
- Review and use the Foodborne Illness Response Guideline Manual. The manual has many tools to help prevent foodborne illness and steps if necessary that a restaurant may take to limit an outbreak. Develop a SOP and put one person in charge of monitoring for outbreaks.
- Substitute raw eggs in the dressings/slaw with a pasteurized egg product (whole shell or containerized); and revise the menu Consumer Advisory (CA) so each food item that may be served with raw eggs/meat or may be undercooked are asterisked with the following statement: “Asterisked (*) items can be cooked to order or may be served with raw eggs/meat. Consuming raw or undercooked meats, poultry, seafood, shellfish, or eggs may increase your risk of foodborne illness, especially if you have certain medical conditions.” in place of your current menu’s CA.

Discussion

It is important to understand the purpose of the public health investigation and actions taken as well as the limitations inherent in this type of epidemiological investigation process. This process is intended to achieve the local public health department’s statutory responsibility to “...provide for epidemiological...studies for the purpose of protecting the public health. Make investigations and inquiries as to: ...The causes, prevention, and control of environmental health hazards...and sources of illness.”⁴

This was not an investigation to assign blame, responsibility, or liability. It was an effort by PHMC to identify, as quickly as possible, in a scientific manner, with very limited resources, the reason for an outbreak of Salmonella infections. This was imperative in order to determine if the outbreak was going to continue so that interventions could be made to stop the transmission of the infection and to prevent further infections from the pathogen in the future.

When it became apparent that the exposure to Salmonella had stopped after November 2, 2013, there was no additional effort made to gather information as to the extent of illness. This did, however, change the focus of the investigation efforts toward the most likely source(s) of contamination. Although PHMC was unable to enroll 100 Controls to achieve the desired 1 Case to 2 Controls ratio, the analysis did provide a clear distinction as to which food items were most highly associated with this outbreak. Recall bias became increasingly difficult in getting accurate food histories from patrons

⁴ Michigan Public Health Code, Act 368 of 1978, as amended, Section 2433(2)(b)(c)(iii).

as time had elapsed between when the foods were eaten (between October 30 to November 2) and the dates that the food histories were being taken. As a result, this further diminished the number of people who could be included in the analysis. The identified Probable Cases never had stool samples tested, and it would be expected that others who were infected never participated in the investigation, therefore limiting the ability to get an accurate number for the Salmonella attack rates in order to gain a complete understanding of the extent of this outbreak.

None of the foods from PQ/CFP menus that would have been associated with this outbreak were available for testing by the time the investigation started because they had already been discarded as required under the Food Code. None of the Confirmed or Probable Cases had any leftovers available for testing by the time they were questioned about the illness.

Despite these barriers, PHMC investigators were able to gather enough information to reasonably conclude that the contamination of several food items with Salmonella Enteritidis with the same PFGE had occurred inside the PQ/CFP restaurant from October 30 to November 2, 2013 and that the most likely location of the contamination was the Pantry Station which was the only place that all highly associated foods were brought together. Recommendations for more comprehensive SOP's with integration into a quality management system have been made along with adjustments in food preparation sequencing (i.e. use of sinks, discontinued use of raw unpasteurized eggs, and a more explicit consumer advisory on the menu). It is unlikely that the specific cause of this Salmonella exposure will ever be found, but several proactive actions can be taken by management to reduce the likelihood of another foodborne outbreak occurring at this facility.

Appendix I

Pints & Quarts and C.F. Prime Customer Survey Instrument

Section A: Demographic/General Information

Date of Interview ___/___/___

Last Name: _____ First Name: _____

Address: _____ Phone: _____

Date of Birth: _____ Age: _____ Gender: Male Female

Were you part of a group? Yes No Unknown

How many people were in your party? _____ Did any family or friends eat with you? Yes No

If yes, we would like to interview this person also—including any children, regardless of whether they became ill. Please obtain name and phone number of guest. (For children under 18, ask for parental/guardian consent to interview children 11-17 years of age. For children less than 11, ask the parent/guardian if the child would remember what they ate or interview the parent.)

Meal Companion # 1 Name: _____ Relationship _____ Phone # _____

Meal Companion # 2 Name: _____ Relationship _____ Phone # _____
If more continue list on the back of this sheet

Did you eat at Pints & Quarts? Yes No Unknown

What date did you eat at Pints & Quarts? ___/___/___

What time did you eat at Pints & Quarts? Time _____:_____ AM/PM

Section B: Clinical Information

Have you been ill at all since eating at the Pints & Quarts (particularly **ANY** diarrhea, vomiting, or stomach cramps)?
 Yes No If no, skip to Food, Section C, page 2.

If yes, when did you become ill with your **first** symptom? Date ___/___/___ Time _____:_____ AM/PM

Did you experience any: (Read and mark Yes, No or Unknown for "don't know, can't remember")

Diarrhea Yes No Unknown

If yes, number of loose stools in one day: _____

please describe:

liquid Yes No Unknown

bloody Yes No Unknown

mucus in stool Yes No Unknown

Nausea Yes No Unknown

Vomiting Yes No Unknown

If yes, list number of episodes in one day: _____

Stomach cramps Yes No Unknown

Fever Yes No Unknown

If yes, list highest fever measured: _____

Chills and/or sweats Yes No Unknown

Headache Yes No Unknown

Body or Muscle Aches Yes No Unknown

Bloating or Gas Yes No Unknown

Other symptoms Yes No Unknown

If yes, please list: _____

What was the **first symptom** that you experienced? _____

Are you still experiencing symptoms? Yes No

If no: When did your symptoms subside? Date ___/___/___ Time _____:_____ AM/PM

Did you consult a physician regarding your illness? Yes No

If yes:

Name of physician: _____

Date consulted: ___/___/___ Phone number: _____

Did you take any medicine for your illness? Yes, please list _____ No

Did you submit any stool samples for laboratory analysis? Yes No

If yes, Where _____ Date: ___/___/___

If no (AND DID NOT TAKE ANTIBIOTICS),

Would you be willing to submit stool samples for laboratory analysis? Yes No

If yes, verify their contact information and tell them that someone from the Health Dept. will contact them with the details for submitting a specimen or arrange if possible.

Name: _____ Phone #: _____

Address: _____

Do you know of a household member or very close contact that was ill with diarrhea or stomach cramps in the days before you first became ill? Yes No

If yes, please provide the following information:

Last Name: _____

First Name: _____

Relationship to ill individual _____

Describe type of contact with ill individual _____

Ill person's symptoms _____

Do you know of a household member or very close contact who did not eat at Pints & Quarts with you that was ill with diarrhea or stomach cramps in the days after you first became ill? Yes No

If yes, please provide the following information:

Last Name: _____

First Name: _____

Relationship to ill individual _____

Describe type of contact with ill individual _____

Ill person's symptoms _____

Date and time of onset Date: ___/___/___ Time: ___:___ AM/PM

Section C: Exposure Information

We'd like to know all the foods-- including beverages and desserts-- that you consumed at the restaurant. We do need this information even if you were not ill. I will be asking you a list of items that you may or may not have consumed in the next few sections of this questionnaire. Please answer "Yes" or "No" to the following questions.

Did you have any beverages at the restaurant?..... Yes No Unknown

Water..... Yes No Unknown

Soda..... Yes No Unknown

If yes, please specify _____

Other beverage..... Yes No Unknown

If yes, please specify _____

Ice..... Yes No Unknown

If yes, please specify from where _____

Did you have any appetizers..... Yes No Unknown

Spinach Artichoke Dip..... Yes No Unknown

Chips..... Yes No Unknown

Celery..... Yes No Unknown

Bruschetta..... Yes No Unknown

Hand Dipped Onion Rings..... Yes No Unknown

Spicy Buttermilk Ranch..... Yes No Unknown

Hand Dipped Boneless Wings..... Yes No Unknown

Traditional Bone-in Wings..... Yes No Unknown

Honey Buffalo Sauce..... Yes No Unknown

Spicy Garlic Sauce..... Yes No Unknown

BBQ Sauce..... Yes No Unknown

Asian Firecracker Sauce..... Yes No Unknown

Sweet Thai Chili Sauce..... Yes No Unknown

Spicy Buttermilk Ranch Sauce..... Yes No Unknown

Crispy Calamari..... Yes No Unknown

The Best Mini Cheeseburger..... Yes No Unknown

Chips and Cheese..... Yes No Unknown

- With Nacho beef..... Yes No Unknown
- With Shredded Chicken..... Yes No Unknown³
- Famous Crispy Pickle Chips..... Yes No Unknown
- Gary's Gravy Fries..... Yes No Unknown
- Homemade Tear and Share Pretzel..... Yes No Unknown
- Pints' Chees Sauce..... Yes No Unknown
- P's & Q's Quesadilla..... Yes No Unknown
- Mini Seared Rare Tuna Tacos..... Yes No Unknown
- Thai Chicken Lettuce Wraps..... Yes No Unknown
- Firecracker Shrimp..... Yes No Unknown

- Did you have any soup.....** **Yes** **No** **Unknown**
- Daily Creation (Soup of the day)..... Yes No Unknown
 - Sweet & Spicy Chili..... Yes No Unknown
 - French Onion..... Yes No Unknown

- Did you have a burger.....** **Yes** **No** **Unknown**
- If yes, what type: Traditional, Gluten Free, Mushroom Onion & Swiss, Homemade Black Bean, Black & Blue, California, Southwest, Breakfast, Spicy Blue, Signature, Cowboy, Knife & Fork Chili Cheese, Modern American, Hot Mess, or House favorite?

- Did you have cheese on your burger..... Yes No Unknown
- If yes, what type: American Cheddar, Gorgonzola, Pepper Jack, Provolone, or Swiss?

- Did you have a sauce on your burger?..... Yes No Unknown
- If yes, what type: BBQ, Gorgonzola Fondue, Guacamole, Pico de Gallo, Pints' Cheese Sauce, or Spicy G?

- Did you have any of the following toppings?
- Lettuce..... Yes No Unknown
 - Tomato..... Yes No Unknown
 - Onion..... Yes No Unknown
 - Bacon..... Yes No Unknown
 - Caramelized Onions..... Yes No Unknown
 - Eggs Your Way..... Yes No Unknown
 - Fried Pickles..... Yes No Unknown
 - Haystack Onions..... Yes No Unknown
 - Sautéed Mushrooms..... Yes No Unknown

- Did you have a sandwich.....** **Yes** **No** **Unknown**
- If yes, which one: Chicken Balsamic, TBCG, Hot Ham & Swiss, Ricky's Sloppy Joe, Crispy Fish, Chunky Chicken Salad, Oven Roasted Turkey Club, or Italian Beef?

- Did you have any sides.....** **Yes** **No** **Unknown**
- Chips & Pico de Gallo..... Yes No Unknown
 - House Slaw..... Yes No Unknown
 - French Fried..... Yes No Unknown
 - Tator Tots..... Yes No Unknown
 - House Salad..... Yes No Unknown
 - Fresh Fruit..... Yes No Unknown
 - Chef's Vegetables..... Yes No Unknown
 - Hand Dipped Onion Rings..... Yes No Unknown
 - Gary's Gravy Fries..... Yes No Unknown

- Did you have a salad.....** **Yes** **No** **Unknown**
- If yes, which one: BLT Wedge, Caesar, Chef's Cobb, Caprese, the Pub's Warm Spinach, Michigan Field, or Healthy Greens?

- Did you add any of the following to your salad?
- Grilled Chicken..... Yes No Unknown
 - Crispy Chicken..... Yes No Unknown
 - Turkey Salad..... Yes No Unknown

- Cranberry-Walnut Chicken Salad..... Yes No Unknown
 Grilled Salmon..... Yes No Unknown
 Rare Ahi Tuna..... Yes No Unknown

Dinners:

Skillet Mac..... Yes No Unknown
 If yes, which one: Old School, B.M.T, Chili Mac, Veggie Head, or Michigan Ballpark

- Crispy Fish Tacos**..... Yes No Unknown
Fish & Chips Basket..... Yes No Unknown
Pints' Pub Platter..... Yes No Unknown
6oz Grilled Sirloin..... Yes No Unknown
 Did you add Mushrooms & Onions Yes No Unknown
10oz Grilled Sirloin..... Yes No Unknown
 Did you add Mushrooms & Onions Yes No Unknown
Grilled BBQ Prime Rib..... Yes No Unknown
Ahi Tuna or Thai Salmon..... Yes No Unknown

Did you bring any food items to the Restaurant?..... Yes No Unknown
 If yes, please specify _____

Did you take any food home with you?..... Yes No Unknown

Section D: Generic Food History

Day of illness outbreak Date: _____	Day before illness outbreak Date: _____	Two Days before illness outbreak Date: _____
Breakfast Place: _____ Hour: _____ Item: _____	Breakfast Place: _____ Hour: _____ Item: _____	Breakfast Place: _____ Hour: _____ Item: _____
	Lunch Place: _____ Hour: _____ Item: _____	Lunch Place: _____ Hour: _____ Item: _____
	Dinner Place: _____ Hour: _____ Item: _____	Dinner Place: _____ Hour: _____ Item: _____
Non-Meal Snacks/Water Ingested Place: _____ Hour: _____ Item: _____	Non-Meal Snacks/Water Ingested Place: _____ Hour: _____ Item: _____	Non-Meal Snacks/Water Ingested Place: _____ Hour: _____ Item: _____

Please list any other common events or gatherings during the 3 days prior to illness onset:

Is there anything you can think of that may help us with the investigation?

**This is the end of the questionnaire.
THANK YOU for your time!**

Notes:

Appendix II

Pints & Quarts and C.F. Prime Employee Survey Instrument

Pints & Quarts Restaurant: GI Illness Investigation, October-November 2013

Public Health Muskegon County is investigating an outbreak of salmonella infections among customers who visited Pints & Quarts Restaurant in Muskegon, MI on October 31 to November 2, 2013 and we need your help! We would like to collect information from employees who have worked at the restaurant *regardless of whether or not you were ill*. The information collected on this questionnaire will be kept strictly confidential and access to the data for analysis is limited to authorized public health personnel. Any questions regarding this outbreak survey should be directed to Public Health Muskegon County

Part I. Demographics and Job History

Name: _____

Age: _____ DOB: _____ Gender: Male Female

Address: _____ City: _____ Zip: _____

Home phone: _____ Cell/Alternate Phone: _____

Job Title: _____

Which day(s) did you work and what times? (Check all that apply)

Tuesday, October 29th Shift start: ____:____ am/pm Shift end: ____:____ am/pm

Wednesday, October 30th Shift start: ____:____ am/pm Shift end: ____:____ am/pm

Thursday, October 31st Shift start: ____:____ am/pm Shift end: ____:____ am/pm

Friday, November 1st Shift start: ____:____ am/pm Shift end: ____:____ am/pm

Saturday, November 2nd Shift start: ____:____ am/pm Shift end: ____:____ am/pm

What job duties do you perform? (Please check as many boxes as appropriate.)

Pre-Preparing Produce

What types of produce do you prepare? (Lettuce (types), vegetables, tomatoes, etc.)

Describe specific duties (washing, chopping, cutting, shredding, etc.):

Pre-Preparing Poultry/Meat Describe specific duties: _____

Salad Prep/Assembly Describe specific duties: _____

Sandwich Prep/Assembly Describe specific duties: _____

Cook Line

What foods do you handle on the cook line? _____

Describe specific duties: _____

Expo-finishing Describe specific duties: _____

Other duties Please specify _____

Part IIa. Clinical information: Employee

Are you currently ill or have you been ill with gastrointestinal symptoms (nausea, vomiting, diarrhea) at any time since October 2013? Yes No Not Sure

(If you did NOT EXPERIENCE ANY SYMPTOMS, PLEASE SKIP TO PART IIb, FURTHER CLINICAL INFORMATION)

Did you have any of the following symptoms (please circle your answer for each symptom)?

Nausea	Yes	No	Not Sure
Vomiting	Yes	No	Not Sure
Abdominal cramps	Yes	No	Not Sure
Diarrhea	Yes	No	Not Sure

If yes to Diarrhea: How many stools in a 24-hour period: _____

Was there blood in stools? Yes No Not Sure

Fever	Yes	No	Not Sure
-------	-----	----	----------

If yes: What was highest temperature: _____

Chills	Yes	No	Not Sure
Body aches	Yes	No	Not Sure
Fatigue	Yes	No	Not Sure
Other: _____	Yes	No	Not Sure

What was the date and time you first experienced vomiting and/or diarrhea?

___ / ___ / ____ :__ am/pm

Do you still have symptoms? Yes No

If No, what date and time did you recover?

___ / ___ / ____ :__ am/pm

Did you work at Pints & Quarts while you were sick? Yes No

What date(s) did you work while sick? _____

Did you visit a healthcare professional, such as a doctor or a nurse? Yes No

If YES, when? ___ / ___ / ____ Where? _____

Were you admitted to a hospital? Yes No If YES, where? _____

Was a stool culture done? Yes No Not Sure If YES, did you receive results? _____

Did you get diagnosed with any disease? _____

Part IIb. Further Clinical information

Has anyone in your household had a similar illness (abdominal cramps, vomiting, or diarrhea) in October? Yes No Not Sure

If YES, who else was sick? _____ When did their illness begin? ___ / ___ / ____

Part III. Exposure History

Did you travel in or out of state in **October 2013**? **Yes** **No**

If YES, where: _____

What dates did you travel? _____

Do you work at another food establishment? **Yes** **No**

If YES, where: _____

If YES, what are your job duties: _____

Did you eat any meals or food prepared at Pints & Quarts between October 29th and November 2nd?

Yes No Not Sure

If YES, please answer the following for all the meals/food that you ate.

Meal 1: Date of Meal ___/___/___ Time of Meal ___:___ am/pm

Name of menu item and description of food items eaten: _____

Meal 2: Date of Meal ___/___/___ Time of Meal ___:___ am/pm

Name of menu item and description of food items eaten: _____

Meal 3: Date of Meal ___/___/___ Time of Meal ___:___ am/pm

Name of menu item and description of food items eaten: _____

Meal 4: Date of Meal ___/___/___ Time of Meal ___:___ am/pm

Name of menu item and description of food items eaten: _____

Meal 5: Date of Meal ___/___/___ Time of Meal ___:___ am/pm

Name of menu item and description of food items eaten: _____

Meal 6: Date of Meal ___/___/___ Time of Meal ___:___ am/pm

Name of menu item and description of food items eaten: _____

Appendix III

Second PFGE Testing Results

BOL SPECIMEN			# Confirmed for PFGE 1st Enzyme Match	# Confirmed for PFGE 2nd Enzyme Match
ID	County	Serotype		
CL13-175041	Muskegon	<i>Salmonella enteritidis</i>	X	X
CL13-175079	Ottawa	<i>Salmonella enteritidis</i>	X	
CL13-175066	Muskegon	<i>Salmonella enteritidis</i>	X	X
CL13-175031	Muskegon	<i>Salmonella enteritidis</i>	X	X
CL13-175057	Muskegon	<i>Salmonella enteritidis</i>	X	
CL13-175064	Muskegon	<i>Salmonella enteritidis</i>	X	X
CL13-175067	Muskegon	<i>Salmonella enteritidis</i>	X	X
CL13-175055	Muskegon	<i>Salmonella enteritidis</i>	X	X
CL13-175061	Muskegon	<i>Salmonella enteritidis</i>	X	
CL13-175062	Muskegon	<i>Salmonella enteritidis</i>	X	
CL13-175054	Muskegon	<i>Salmonella enteritidis</i>	X	X
CL13-175065	Muskegon	<i>Salmonella enteritidis</i>	X	X
CL13-175070	Ottawa	<i>Salmonella enteritidis</i>	X	
CL13-175071	Muskegon	<i>Salmonella enteritidis</i>	X	
CL13-175059	Muskegon	<i>Salmonella enteritidis</i>	X	
CL13-175060	Muskegon	<i>Salmonella enteritidis</i>	X	X
CL13-175073	Muskegon	<i>Salmonella enteritidis</i>	X	
CL13-175056	Muskegon	<i>Salmonella enteritidis</i>	X	
CL13-175080	Ottawa	<i>Salmonella enteritidis</i>	X	
CL13-175077	Muskegon	<i>Salmonella enteritidis</i>	X	
CL13-175078	Muskegon	<i>Salmonella enteritidis</i>	X	
CL13-175076	Muskegon	<i>Salmonella enteritidis</i>	X	
CL13-175086	Muskegon	<i>Salmonella enteritidis</i>	X	
CL13-175088	Ottawa	<i>Salmonella enteritidis</i>	X	X
CL13-175092	Muskegon	<i>Salmonella enteritidis</i>	X	
CL13-165078	Muskegon	<i>Salmonella enteritidis</i>	X	X
CL13-165079	Muskegon	<i>Salmonella enteritidis</i>	X	X
CL13-165080	Muskegon	<i>Salmonella enteritidis</i>	X	X
CL13-165097	Ottawa	<i>Salmonella enteritidis</i>	X	X
CL13-165085	Muskegon	<i>Salmonella enteritidis</i>	X	X
CL13-165086	Muskegon	<i>Salmonella enteritidis</i>	X	X
CL13-165098	Muskegon	<i>Salmonella enteritidis</i>	X	X
		27 Musk/5 Ottawa		

Appendix IV

PowerPoint Presentation of Photographs

Pints and Quarts/CF Prime Kitchen facility 12-10-13

- Back kitchen hallway that shows the locations of the walk-in freezer (1st door on left) and cooler (2nd door on left)



Pints and Quarts/CF Prime Kitchen
facility 12-10-13

- Storage of produce and ready-to-eat food in the walk-in cooler



Pints and Quarts/CF Prime Kitchen facility 12-10-13

- Storage of raw meats in walk-in cooler



Pints and Quarts/CF Prime Kitchen facility 12-10-13

- Kitchen cook line. Pantry station is first cooler on right with the hand sink located between prep coolers.



Pints and Quarts/CF Prime Kitchen
facility 12-10-13

- Kitchen food preparation sinks-
2 different views.



Pints and Quarts/CF Prime Kitchen
facility 12-10-13

- Kitchen preparation table- 2
different views.



Pints and Quarts/CF Prime Kitchen
facility 12-10-13

- Storage in the top portion of the Pantry station prep cooler (top picture-left side, bottom picture right side)



Pints and Quarts/CF Prime Kitchen facility 12-10-13

- Pick-up/server preparation area of the kitchen.



Pints and Quarts/CF Prime Kitchen
facility 12-10-13

- Items stored in the bottom cabinets of the pantry station prep cooler.



Pints and Quarts/CF Prime Kitchen facility 12-10-13

- Kitchen cook line- Grill, griddle and raw meat drawer coolers.



Pints and Quarts/CF Prime Kitchen facility 12-10-13

- Kitchen cook line



Pints and Quarts/CF Prime Kitchen facility 12-10-13

- Kitchen 2-door reach-in cooler.



Pints and Quarts/CF Prime
Kitchen facility 12-10-13

- Items stored in the kitchen 2-door reach-in cooler.



Pints and Quarts/CF Prime
Kitchen facility 12-10-13

- Server preparation area directly across from the kitchen pantry station.



Pints and Quarts/CF Prime
Kitchen facility 12-10-13

- Dish wash room.



Appendix V

Listing of email contact & phone call summary



PINTS AND QUARTS SALMONELLA FBI- Email correspondence summary:

- 11/8/13- Email to AH with questions regarding servers and cooks that worked between 10/30-11/1/13, type of chicken used for the Chicken Balsamic.
- 11/8-AH provided an emailed list of the food items sold between 10/30-11/1, as requested during the on-site FBI investigation that occurred earlier on 11/8.
- 11/9- Email list of cooks and when they worked along with some clarification on which type of chicken is used for the different dishes.
- 11/12- Email with an attachment list of all employees, positions and phone numbers.
- 11/12- Email requesting a mass meeting/interview with all workers at P&Q for 11/13.
- 11/13- Email requesting any info regarding catered events that occurred between 10/30-11/5.
- 11/14- Email information received from James (JC) regarding food orders for a group of customers and clarification on the actual amount of food served during this time frame.
- 11/15- Emails regarding questions on new cook and a better method to clean food prep sinks and to see if any workers would submit stool samples.
- 11/21- Email forwarded from FS regarding food preparation- vegetable washing
- 11/25- Email Recipes for Caesar and citrus dressing was provided
- 11/26- Email with additional questions for AH and a request for workers phone number.
- 11/26- Emails with information on dressings and how/where raw eggs are used.
- 11/26- Email with photo copy of Return to work slip for a food service workers provided.
- 12/2- Email from FS wondering what was happening with this FBI
- 12/4- Email response.
- 12/5- Email requesting some additional information on employees.
- 12/5- Email response. FS said he did receive the letter with recommendations from PHMC and that he was working with nurse to get information requested.

Phone call summary:

- 11/12/13- (1255) PHMC called Andrew
- 11/12- (1327) Andrew called PHMC to confirm 0930 meeting at P&Q with workers at 11/13
- 11/12- PHMC called to confirm that list of employees was received
- 11/13- PHMC called and left voice message
- 11/14- (0926) Andrew called PHMC to inform that his friend that ate at P&Q was sick- Kip McCaro
- 11/14- (1445)- PHMC received VM from Andrew with information on Kip McCaro
- 11/14- (1513)- PHMC called and spoke with Andrew- Who said that people are calling P&Q and doctors are telling their patients that their illness came from P&Q
- 11/15- (0829)- PHMC called Andrew to schedule a focused evaluation at facility. He was also asked to talk with sick workers to see if they were willing to submit stool samples
- 11/15- (1520)- James called- He spoke with the cook Travis, who preps lettuce and is in culinary school, and said there is no way cook cross-contaminated food.
- 11/15- (1643) PHMC called and spoke with James- he was unsure if the workers would submit stool samples
- 11/21- (0937) PHMC called Fred and left voice message for him to call PHMC
- 11/21- (1707) PHMC called Fred and left voice message requesting complete set of SOPs, highlighting any recent changes and to provide all the spec info on greens and chicken and to set up meeting with prep workers/cooks for 11/22.
- 11/22- (0812) Fred called and said he would have SOPs and food spec info for lettuce by 1200
- 11/22- (0857) PHMC called Fred- Left VM- To confirm the meeting with PHMC and prep cooks

- 12/23- (0822)- Fred called- has one sick worker that is positive for salmonella. Worked on 12/11 and tested 12/12. No customer complaints were received by P&Q and PHMC. Fred also stated that he is discontinuing raw egg ingredient in dressings.
- 12/26- (1232)- VM from Fred- Has an issue to discuss with PHMC
- 12/26- (1130)- PHMC called Fred- Sick worker wants to return from work- Needs a doctors note or some confirmation that they are no longer sick with Salmonella. Licensing issues were reviewed regarding P&Q and the other restaurants run by The Harris Group.

Additional Attachments

List of Acronyms Used

CA – Consumer Advisory

CI – Confidence Interval

CIFOR – Council to Improve Foodborne Outbreak Response

ER – Emergency Room

PCP – Primary Care Provider

PFGE – Pulsed-field Gel Electrophoresis

PHMC – Public Health Muskegon County

PQ/CFP – Pints & Quarts and C.F. Prime

SOP – Standard Operating Procedure

SPSS 20 – Statistical Software

RTE – Ready to Eat



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November 26, 2013

Fred Scharmer
Pints and Quarts Pub & Grill
950 W Norton Ave
Roosevelt Park, MI 49441

Re: Recommendations for improvement

Dear Fred:

As you are aware, our investigation into the Salmonella outbreak associated with your facility was unable to pinpoint a specific incident that led to the contamination that occurred. However, we have identified some areas for improvement that will help reduce the likelihood of future food borne illnesses/outbreaks.

We wanted to share with you these recommendations for improvement now, rather than wait until the final report regarding the investigation is released, which may be another 60-90 days.

1. Simplify the Standard Operating Procedures (SOPs) to make them easier to follow, and inclusive of every step to assure they are thorough and complete. See enclosed SOP handout for more details.
2. Review and use the Foodborne Illness Response Guideline Manual.
3. Utilize a separate Employee Handbook and a SOP Manual. The Employee Handbook should include information and requirements that all employees must be aware of such as personnel rules.
4. Substitute raw eggs in the dressings/slaw with a pasteurized egg product (whole shell or containerized);
or
5. Revise the menu Consumer Advisory (CA) so each food item that may be served with raw eggs/meat or undercooked are asterisked with the following statement: "Asterisked (*) items can be cooked to order or may be served with raw eggs/fish" in place of your existing disclosure statement on the current CA.

Please know this is not the final report and additional information will be provided. We can assist in the development of the SOPs and can be used as a resource to review and revise them if needed. Please call or email if there are any questions.

Sincerely,

Eric Lieblang,
Food Service Sanitarian, PHMC
(231) 724-4428
LieblangEr@co.muskegon.mi.us

Kevin Green, REHS
Environmental Protection Supervisor, PHMC
(231) 724-4436
GreenKe@co.muskegon.mi.us



Standard Operating Procedures (SOPs)

Standard operating procedures are often called SOPs. They are procedures that describe the steps your employees need to take to complete a task. They also help to make sure you are complying with the food code and Michigan food law. The purpose of SOPs is to keep food safe throughout the preparation process. You should use the SOPs to train the staff members responsible for the tasks.

You must have SOPs for...

- Handwashing
- Personal hygiene, including cuts and sores
- Preventing bare hand contact with ready-to-eat food (gloves, utensils, etc.)
- Employee illness
- Purchasing food from approved sources
- Cleaning and sanitizing food contact surfaces

You may also need SOPs for...

- Cross-contamination prevention
- Warewashing
- Date-marking ready-to-eat, potentially hazardous food
- Using time only (not time and temperature) as a method to control bacterial growth
- Time and temperature control for thawing potentially hazardous food
- Time and temperature control for cooking potentially hazardous food
- Time and temperature control for cooling potentially hazardous food
- Time and temperature control for reheating potentially hazardous food
- Time and temperature control for hot holding potentially hazardous food
- Time and temperature control for cold holding potentially hazardous food
- Special transitory food units (STFU's) only – water supply
- Special transitory food units (STFU's) only – wastewater disposal

SOP Builder

To help you write your SOPs, you can use the SOP Builder which you can download from our website at:

www.muskegonhealth.net/programs/environmental/SOPBuilder.htm

If you choose to download it, the program and all data will reside entirely on your personal computer. (The SOP Builder does not work on Mac computers.)

SOP Manual

Another resource available to you is the Michigan Department of Agriculture SOP Manual. The manual contains blank forms in a suggested format, a sample handwashing SOP, and suggested questions to answer, technical help and Food Code references for each required SOP. It can be found at the MDA website at:

www.michigan.gov/documents/mda/MDA_SOPMn106-09rev_290207_7.pdf

FORM	Conditional Employee and Food Employee Interview
1-A	Preventing Transmission of Diseases through Food by Infected Food Employees or Conditional Employees with Emphasis on illness due to Norovirus, <i>Salmonella Typhi</i> , <i>Shigella</i> spp., Enterohemorrhagic (EHEC) or Shiga toxin-producing <i>Escherichia coli</i> (STEC), or hepatitis A Virus

The purpose of this interview is to inform conditional employees and food employees to advise the person in charge of past and current conditions described so that the person in charge can take appropriate steps to preclude the transmission of foodborne illness.

Conditional employee name (print) _____
 Food employee name (print) _____
 Address _____
 Telephone Daytime: _____ Evening: _____
 Date _____

Are you suffering from any of the following symptoms? (Circle one)

		If YES, Date of Onset
Diarrhea?	YES / NO	_____
Vomiting?	YES / NO	_____
Jaundice?	YES / NO	_____
Sore throat with fever?	YES / NO	_____

Or

Infected cut or wound that is open and draining, or lesions containing pus on the hand, wrist, an exposed body part, or other body part and the cut, wound, or lesion not properly covered? YES / NO
 (Examples: boils and infected wounds, however small)

In the Past:

Have you ever been diagnosed as being ill with typhoid fever (*Salmonella Typhi*) YES / NO
 If you have, what was the date of the diagnosis? _____
 If within the past 3 months, did you take antibiotics for *S. Typhi*? YES / NO
 If so, how many days did you take the antibiotics? _____
 If you took antibiotics, did you finish the prescription? YES / NO

History of Exposure:

1. Have you been suspected of causing or have you been exposed to a confirmed foodborne disease outbreak recently? YES / NO
 If YES, date of outbreak: _____

a. If YES, what was the cause of the illness and did it meet the following criteria?

Cause: _____	
i. Norovirus (last exposure within the past 48 hours)	Date of illness outbreak _____
ii. <i>E. coli</i> O157:H7 infection (last exposure within the past 3 days)	Date of illness outbreak _____
iii. Hepatitis A virus (last exposure within the past 30 days)	Date of illness outbreak _____
iv. Typhoid fever (last exposure within the past 14 days)	Date of illness outbreak _____
v. Shigellosis (last exposure within the past 3 days)	Date of illness outbreak _____

FORM 1-A (continued)

- b. If YES, did you:
- i. Consume food implicated in the outbreak? _____
 - ii. Work in a food establishment that was the source of the outbreak? _____
 - iii. Consume food at an event that was prepared by person who is ill? _____

2. Did you attend an event or work in a setting, recently where there was a confirmed disease outbreak? YES / NO

If so, what was the cause of the confirmed disease outbreak?

If the cause was one of the following five pathogens, did exposure to the pathogen meet the following criteria?

- a. Norovirus (last exposure within the past 48 hours) YES / NO
- b. *E. coli* O157:H7 (or other EHEC/STEC (last exposure within the past 3 days) YES / NO
- c. *Shigella* spp. (last exposure within the past 3 days) YES / NO
- d. *S. Typhi* (last exposure within the past 14 days) YES / NO
- e. hepatitis A virus (last exposure within the past 30 days) YES / NO

Do you live in the same household as a person diagnosed with Norovirus, Shigellosis, typhoid fever, hepatitis A, or illness due to *E. coli* O157:H7 or other EHEC/STEC?
YES / NO Date of onset of illness _____

3. Do you have a household member attending or working in a setting where there is a confirmed disease outbreak of Norovirus, typhoid fever, Shigellosis, EHEC/STEC infection, or hepatitis A?
YES / NO Date of onset of illness _____

Name, Address, and Telephone Number of your Health Practitioner or doctor:

Name _____
Address _____
Telephone – Daytime: _____ Evening: _____

Signature of Conditional Employee _____ Date _____

Signature of Food Employee _____ Date _____

Signature of Permit Holder or Representative _____ Date _____

FORM 1-B Conditional Employee or Food Employee Reporting Agreement

Preventing Transmission of Diseases through Food by Infected Conditional Employees or Food Employees with Emphasis on illness due to Norovirus, *Salmonella Typhi*, *Shigella* spp., Enterohemorrhagic (EHEC) or Shiga toxin-producing *Escherichia coli* (STEC), or hepatitis A Virus

The purpose of this agreement is to inform conditional employees or food employees of their responsibility to notify the person in charge when they experience any of the conditions listed so that the person in charge can take appropriate steps to preclude the transmission of foodborne illness.

I AGREE TO REPORT TO THE PERSON IN CHARGE:

Any Onset of the Following Symptoms, Either While at Work or Outside of Work, Including the Date of Onset:

1. Diarrhea
2. Vomiting
3. Jaundice
4. Sore throat with fever
5. Infected cuts or wounds, or lesions containing pus on the hand, wrist, an exposed body part, or other body part and the cuts, wounds, or lesions are not properly covered (such as boils and infected wounds, however small)

Future Medical Diagnosis:

Whenever diagnosed as being ill with Norovirus, typhoid fever (*Salmonella Typhi*), shigellosis (*Shigella* spp. infection), *Escherichia coli* O157:H7 or other EHEC/STEC infection, or hepatitis A (hepatitis A virus infection)

Future Exposure to Foodborne Pathogens:

1. Exposure to or suspicion of causing any confirmed disease outbreak of Norovirus, typhoid fever, shigellosis, *E. coli* O157:H7 or other EHEC/STEC infection, or hepatitis A.
2. A household member diagnosed with Norovirus, typhoid fever, shigellosis, illness due to EHEC/STEC, or hepatitis A.
3. A household member attending or working in a setting experiencing a confirmed disease outbreak of Norovirus, typhoid fever, shigellosis, *E. coli* O157:H7 or other EHEC/STEC infection, or hepatitis A.

I have read (or had explained to me) and understand the requirements concerning my responsibilities under the **Food Code** and this agreement to comply with:

1. Reporting requirements specified above involving symptoms, diagnoses, and exposure specified;
2. Work restrictions or exclusions that are imposed upon me; and
3. Good hygienic practices.

I understand that failure to comply with the terms of this agreement could lead to action by the food establishment or the food regulatory authority that may jeopardize my employment and may involve legal action against me.

Conditional Employee Name (please print) _____

Signature of Conditional Employee _____ Date _____

Food Employee Name (please print) _____

Signature of Food Employee _____ Date _____

Signature of Permit Holder or Representative _____ Date _____

FORM
1-C

Conditional Employee or Food Employee Medical Referral

Preventing Transmission of Diseases through Food by Infected Food Employees with Emphasis on Illness due to Norovirus, Typhoid fever (**Salmonella Typhi**), **Shigellosis (Shigella spp.)**, **Escherichia coli O157:H7** or other Enterohemorrhagic (EHEC) or Shiga toxin-producing **Escherichia coli (STEC)**, and hepatitis A Virus

The **Food Code** specifies, under **Part 2-2 Employee Health Subpart 2-201 Disease or Medical Condition**, that Conditional Employees and Food Employees obtain medical clearance from a health practitioner licensed to practice medicine, unless the Food Employees have complied with the provisions specified as an alternative to providing medical documentation, whenever the individual:

1. Is chronically suffering from a symptom such as **diarrhea**; or
2. Has a **current illness** involving Norovirus, typhoid fever (**Salmonella Typhi**), shigellosis (**Shigella spp.**) **E. coli O157:H7** infection (or other EHEC/STEC), or hepatitis A virus (hepatitis A), or
3. Reports **past illness** involving typhoid fever (**S. Typhi**) within the past three months (while salmonellosis is fairly common in U.S., typhoid fever, caused by infection with **S. Typhi**, is rare).

Conditional employee being referred: (Name, please print) _____

Food Employee being referred: (Name, please print) _____

4. Is the employee assigned to a food establishment that serves a population that meets the Food Code definition of a **highly susceptible population** such as a day care center with preschool age children, a hospital kitchen with immunocompromised persons, or an assisted living facility or nursing home with older adults?

YES NO

Reason for Medical Referral: The reason for this referral is checked below:

- Is chronically suffering from vomiting or diarrhea; or (specify) _____
- Diagnosed or suspected Norovirus, typhoid fever, shigellosis, **E. coli O157:H7** (or other EHEC/STEC) infection, or hepatitis A. (Specify) _____
- Reported past illness from typhoid fever within the past 3 months. (Date of illness) _____
- Other medical condition of concern per the following description: _____

Health Practitioner's Conclusion: (Circle the appropriate one; refer to reverse side of form)

- Food employee is free of **Norovirus** infection, typhoid fever (**S. Typhi** infection), **Shigella** spp. infection, **E. coli O157:H7** (or other **EHEC/STEC** infection), or **hepatitis A** virus infection, and may work as a food employee without restrictions.
- Food employee is an asymptomatic shedder of **E. coli O157:H7** (or other **EHEC/STEC**), **Shigella** spp., or **Norovirus**, and is restricted from working with exposed food; clean equipment, utensils, and linens; and unwrapped single-service and single-use articles in food establishments that do not serve highly susceptible populations.
- Food employee is not ill but continues as an asymptomatic shedder of **E. coli O157:H7** (or other **EHEC/STEC**), **Shigella** spp. and should be excluded from food establishments that serve highly susceptible populations such as those who are preschool age, immunocompromised, or older adults and in a facility that provides preschool custodial care, health care, or assisted living.
- Food employee is an asymptomatic shedder of **hepatitis A** virus and should be excluded from working in a food establishment until medically cleared.
- Food employee is an asymptomatic shedder of **Norovirus** and should be excluded from working in a food establishment until medically cleared, or for at least 24 hours from the date of the diagnosis.
- Food employee is suffering from **Norovirus**, typhoid fever, shigellosis, **E. coli O157:H7** (or other **EHEC/STEC** infection), or **hepatitis A** and should be excluded from working in a food establishment.

Michigan Department of Agriculture

FORM 1-C (continued)

COMMENTS: (In accordance with Title I of the Americans with Disabilities Act (ADA) and to provide only the information necessary to assist the food establishment operator in preventing foodborne disease transmission, please confine comments to explaining your conclusion and estimating when the employee may be reinstated.)

Signature of Health Practitioner

Pulsed-field Gel Electrophoresis (PFGE)

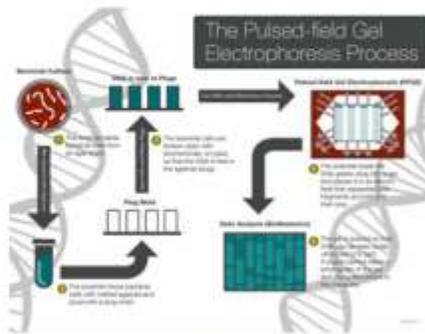
On this Page

- [What is PFGE?](#)
- [Advantages of PFGE](#)
- [Limitations of PFGE](#)

What is PFGE?

PFGE is a technique used by scientists to generate a DNA fingerprint for a bacterial isolate.

How does PFGE work?



PFGE Process: [Larger View](#)

PFGE uses molecular scissors, called restriction enzymes, to cut bacterial DNA at certain locations known as restriction sites. These molecular scissors are selected to generate a small number of DNA pieces that can be separated based on size. Usually these DNA pieces, or restriction fragments, are large and need to be specially treated and separated to generate a DNA fingerprint. First the bacteria are loaded into an agarose suspension, similar to gelatin, then the bacterial cell is opened to release the DNA. Once the DNA is released then the agarose and DNA suspension, also known as a plug, is treated with restriction enzymes. The treated plugs are then loaded onto an agarose gel and the restriction fragments are separated based on size using an electric field. What makes PFGE different from how scientists usually separate DNA is because PFGE can separate several large restriction fragments. To do this an electric field that constantly changes direction to the gel is used to generate a DNA fingerprint.

Advantages of PFGE

- PFGE subtyping has been successfully applied to the subtyping of many pathogenic bacteria and has high concordance with epidemiological relatedness.
- PFGE has been repeatedly shown to be more discriminating than methods such as [ribotyping](#) or [multi-locus sequence typing](#)¹ for many bacteria.
- PFGE in the same basic format can be applied as a universal generic method for subtyping of bacteria. Only the choice of the restriction enzyme and conditions for electrophoresis need to be optimized for each species.
- DNA restriction patterns generated by PFGE are stable and reproducible.

Limitations of PFGE

- Time consuming
- Requires a trained and skilled technician
- Does not discriminate between all unrelated isolates
- Pattern results vary slightly between technicians
- Can't optimize separation in every part of the gel at the same time
- Don't really know if bands of same size are same pieces of DNA
- Bands are not independent
- Change in one restriction site can mean more than one band change
- "Relatedness" should be used as a guide, not true phylogenetic measure
- Some strains cannot be typed by PFGE

Page last reviewed: May 29, 2013

Page last updated: July 18, 2013

Content source: [Centers for Disease Control and Prevention](#)
[National Center for Emerging and Zoonotic Infectious Diseases \(NCEZID\)](#)
[Division of Foodborne, Waterborne, and Environmental Diseases \(DFWED\)](#)

¹National Center for Biotechnology Information - [Future Microbiol](#) 2007 Apr;2(2):175-85. – Abstract. Infections caused by foodborne bacterial pathogens continue to be a major public health issue around the world. During the past decade, pulsed-field gel electrophoresis (PFGE) has become the gold standard for molecular subtyping and source tracking of most foodborne bacteria. Owing to problems inherent in PFGE technology, new methods have been developed focusing on DNA sequence-based subtyping. This review discusses the feasibility of using multilocus sequence typing, multiple-locus variable-number tandem repeat analysis, single nucleotide polymorphisms, microarrays, whole genome sequencing and mass spectrometry for subtyping foodborne bacterial pathogens.



Salmonella serotype Enteritidis

General Information

Frequently Asked Questions

[Salmonella serotype Enteritidis infection \(#infection\)](#)

[Egg and chicken contamination \(#eggs\)](#)

[Who can be infected? \(#who\)](#)

[What is the risk? \(#risk\)](#)

[What you can do to reduce risk \(#you\)](#)

[What else is being done? \(#else\)](#)

[Keys to avoiding Salmonella serotype Enteritidis infection \(#keys\)](#)

Salmonella serotype Enteritidis infection

Salmonella serotype Enteritidis (SE) is one of the most common serotypes of *Salmonella* bacteria reported worldwide. During in the 1980s, SE emerged as an important cause of human illness in the United States. The number of outbreaks of SE rose dramatically during that time, beginning in the northeastern states and then spreading west during the 1990s. SE illness now occurs in most regions of the country. Consumers should be aware of the disease and learn how to minimize the chances of becoming ill.

Eggs have been the most common food source linked to SE infections. SE can be inside perfectly normal-appearing eggs. If eggs contaminated with SE are eaten raw or lightly cooked (runny egg whites or yolks), the bacterium can cause illness. Since the early 2000s, poultry has also been found to be a common food source for SE infections. Multiple other, less frequently identified sources include raw milk, pork, beef, sprouts, and raw almonds. International travel and contact with reptiles have also been associated with SE infection.

A person infected with the *Salmonella* bacterium usually has fever, abdominal cramps, and diarrhea beginning 12 to 72 hours after consuming a contaminated food or beverage. The illness usually lasts 4 to 7 days, and most persons recover without antibiotic treatment. However, the diarrhea can be severe, and the person may be ill enough to require hospitalization.

The elderly, infants, and those with impaired immune systems may have a more severe illness. In these patients, the infection may spread from the intestines to the blood stream, and then to other body sites and can cause death unless the person is treated promptly with antibiotics.

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Egg and chicken contamination

Most types of *Salmonella* live in the intestinal tracts of animals and birds and are transmitted to humans when feces from animals directly or indirectly contaminate foods that humans eat.

For example, if chicken feces get on the outside of the shell of eggs, *Salmonella* in the feces can contaminate the egg through cracks in the shell. This used to be a common problem. However, stringent procedures for cleaning and inspecting eggs were implemented in the 1970s and have made illness from *Salmonella* caused by chicken feces on the outside of egg shells extremely rare. However, unlike *Salmonella* infections from eggs in past decades, the epidemic that started in the 1980s and continues to cause illnesses today is due to SE being inside of intact grade A eggs with clean shells. The reason is that SE can silently infect the ovaries of healthy appearing hens and contaminate the inside of eggs before the shells are formed.

SE infection is present in hens in most areas in the United States. An estimated one in 20,000 eggs is internally contaminated. Only a small number of hens might be infected at any given time, and an infected hen can lay many normal eggs while only occasionally laying eggs contaminated with SE.

Chickens raised for meat, called broiler chickens, can also be contaminated with SE. During the period 2000–2005, as eating chicken emerged as a risk factor for SE infection, studies by the US Department of Agriculture's Food Safety and Inspection Service (USDA-FSIS) found an average of one in eight sampled broiler chickens were contaminated with *Salmonella*, and of the *Salmonella*-positive chickens, one in 20 were contaminated with SE.

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Who can be infected?

Anyone can get a *Salmonella* infection, but the elderly, infants, and persons with impaired immune systems are at increased risk for serious illness. In these persons, a relatively small number of *Salmonella* bacteria can cause severe illness. In outbreaks, most of the deaths caused by SE have occurred among persons in nursing homes and hospitals. Egg-containing dishes prepared for any of these high-risk persons, whether in hospitals, nursing homes, restaurants, or at home, should use pasteurized eggs. Poultry dishes prepared for these high-risk persons should be cooked thoroughly, to a minimum internal temperature of 165° F (74°C).

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What is the risk?

Eggs

According to estimates from the 1990s, about one in 20,000 eggs is contaminated with SE. With approximately 65 billion eggs produced per year in the United States and 30% sent for pasteurization, an estimated 2.2 million individual eggs remain contaminated with SE. Many dishes made in restaurants or commercial or institutional kitchens, however, are made from pooled eggs, not from eggs prepared individually. One contaminated egg can contaminate an entire batch of pooled eggs. Everyone who eats eggs from that batch is at risk for illness. In individual eggs and pooled eggs that are thoroughly cooked (firm egg whites and yolks), SE will be destroyed and will not make a person sick. A person who eats eggs can lower the risk of SE infection by eating eggs that are thoroughly cooked, or by eating foods that are made from pasteurized eggs.

1/23/2014

Chicken

Based on sampling at processing plants in 2007–2008, USDA-FSIS estimates that SE contaminates about one in 250 broiler chickens (USDA-FSIS communication, October 2010). Eating chicken prepared outside of the home, such as in restaurants, is a risk factor for becoming ill with SE. Lack of hand washing, not separating raw eggs or chicken from produce or other foods during preparation, and other unsafe food handling practices in homes and in commercial food establishments can increase risk of an SE infection.

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What you can do to reduce risk

Eggs, poultry, meat, milk, and other foods are safe when handled properly. Shell eggs are safest when stored in the refrigerator, individually and thoroughly cooked, and promptly consumed after cooking. The larger the number of *Salmonella* bacteria present in the egg, the more likely the egg is to cause illness. Keeping eggs adequately refrigerated prevents any *Salmonella* present in the eggs from growing to higher numbers, so eggs should be refrigerated until they are needed. Cooking reduces the number of bacteria present in an egg; however, a lightly cooked egg with a runny egg white or yolk still poses a greater risk than a thoroughly cooked egg. Lightly cooked egg whites and yolks have both caused outbreaks of SE infections. Cooked eggs should be consumed promptly and not be held in the temperature range of 40 to 140°F for more than 2 hours.

Cross-contamination occurs in the kitchen when unwashed hands or food preparation surfaces transfer SE from chicken to other foods. Keeping uncooked meat separate from other foods during storage and preparation can help prevent cross-contamination. Cooking chicken to 165°F (74°C) inside (use a thermometer!) kills SE and helps prevent illness. Prompt refrigeration of unused or leftover food prevents growth of bacteria. Dividing large amounts of leftovers into several shallow containers allows for quicker cooling in the refrigerator.

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What else is being done?

Government agencies and the egg industry have taken steps to reduce SE outbreaks. These steps include the difficult task of identifying and removing infected hens from flocks that supply eggs and increasing quality assurance and sanitation measures. The US Food and Drug Administration (FDA) issued a rule that went into effect on July 9, 2010 that requires shell egg producers to implement measures on the farm to prevent SE from contaminating eggs. Eggs from commercial flocks that are known to be infected are pasteurized instead of being sold as grade A shell eggs. The rule also includes refrigeration requirements during storage and transportation.

The US Centers for Disease Control and Prevention (CDC) has advised state health departments, hospitals, and nursing homes about specific measures to reduce SE infection in humans. The CDC, FDA, and select laboratories across the country also collaborate to monitor contamination of meats sold in stores and other suppliers by SE and other contaminants.

State agencies and authorized laboratories of the USDA Animal and Plant Health Inspection Service's National Poultry Improvement Plan, an industry-State-Federal cooperative program,

1/23/2014

certify participating breeding flocks and hatcheries of chickens that lay eggs as SE clean ("tested free"). USDA-FSIS regulates the safety of egg products, which are eggs removed from their shells for processing. USDA-FSIS also monitors contamination of broiler chickens with SE and other contaminants at all stages of chicken production at processing plants.

Research by these agencies and the egg industry is addressing many unanswered questions about SE, the infections in hens, and contaminated eggs. Informed consumers, food-service establishments, and public and private organizations are working together to reduce, and eventually eliminate, disease caused by this infectious organism.

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Keys to avoiding *Salmonella* serotype Enteritidis infection

- Buy eggs only from stores or other suppliers that keep them refrigerated.
- Consumers can consider buying and using pasteurized shell eggs, which are available for purchase from certain stores and suppliers.
- Keep eggs and chicken refrigerated.
- Discard cracked or dirty eggs.
- Wash hands and cutting boards, dishes, utensils, and counter tops with soap and water after contact with raw eggs or raw chicken.
- Eggs should be thoroughly cooked until both the yolk and white are firm. Recipes containing eggs mixed with other foods should be cooked to an internal temperature of 160°F (71°C).
- Chicken should be cooked until the internal temperature reaches 165°F (74°C).
- Eat eggs promptly after cooking. Do not keep eggs warm or at room temperature for more than 2 hours.
- Refrigerate unused or leftover foods promptly.
- Avoid eating raw eggs (as in homemade ice cream or eggnog). Commercially manufactured ice cream and eggnog are made with pasteurized eggs.
- Avoid restaurant dishes made with raw or lightly cooked, unpasteurized eggs. Restaurants should use pasteurized eggs in any recipe (such as Hollandaise sauce or Caesar salad dressing) that would result in consumption of raw or lightly cooked eggs.

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[National Center for Emerging and Zoonotic Infectious Diseases \(NCEZID\)](#)
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1/23/2014

**PUBLIC HEALTH STAFF ROLES IN THE
SALMONELLA ENTERICA ENTERITIDIS INVESTIGATION**

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Kathy Moore, Deputy Public Health Director – Administrator

Dr. Douglas Hoch, M.D. – Medical Oversight Advisor

Jean Chang, Epidemiologist – Incident Commander

Kevin Green, Environmental Protection Supervisor – Operations Chief

Max Bjorkman, Environmental Quality Supervisor – Observer

Pat Krehn, Nursing Supervisor – Confirmed Cases Employee Interviewer

Robert Olmstead, Emergency Preparedness Coordinator – Statistician

Eric Lieblang, Bob Kimball, Becky Capaldi, and Ann Schrader, Food Service Sanitarians – Interviewers

Kathy Gardner, Josh Maitner, and Jeff Croll, Environmental Quality Sanitarians – Interviewers

Jon Demol and Missy Gallegos, Public Health Educators – Interviewers

Linda Scott and Sally Schmieding, Public Health Nurses – Confirmed Cases Patron Interviewers

Dori Peters, Public Health Improvement Specialist – Public Information Officer

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