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Foodborne Illness Risk Factor Study: Phase III

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Foodborne Illness Risk Factor Study: Phase III

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Abstract

According to the Centers for Disease Control & Prevention (CDC), every one in six Americans contracts a foodborne related illness, and more than half of those foodborne related illnesses are affiliated with restaurants (2013). This study focuses on the risks of foodborne related illnesses for Portland, Maine and the identification of the five most violated inspection items by local restaurants. Based on the data analysis and literature review, it is recommended that the City of Portland conduct trainings and advanced certifications around food safety protocols for local restaurants. Evidence shows that repetition of food safety education is the most successful for continued restaurant safety practices.

Keywords: food safety, inspections, hand washing, training

Foodborne Illness Risk Factor Study: Phase III

Introduction

Scope of Project

The purpose of this project was to complete food inspection data entry for the City of Portland, which is located Southern Maine. When combined with the first two phases of the overall project, the completion of this data entry resulted in an interim database for the City of Portland's Environmental Health & Safety Program that spanned from 2012 to 2015. With the resulting database, the researcher investigated appropriate intervention methods based on an analysis of each food inspection risk factor's presence among Portland restaurants. Out of the twenty-seven items food inspectors examine at the numerous Portland food service establishments, this project followed the five most violated items in an attempt to identify relevant improvement methods that will reduce the risk of contracting foodborne illnesses among Portland residents and visitors.

Statement of Need

There were two questions the researcher hoped to answer through the conduction of this project. First, what are the five items food service establishments violate the most in Portland? Second, knowing what the five most violated items are, what are some appropriate interventions and recommendations that can be provided to the City of Portland? Addressing these two questions will help the City of Portland improve the restaurant and food safety environment for consumers.

Background

According to the Centers for Disease Control & Prevention (CDC), every one in six Americans contracts a foodborne related illness, and more than half of those

foodborne related illnesses are affiliated with restaurants (2013). The considerably high possibility of obtaining a foodborne related illness in the United States emphasizes the importance of this project for the City of Portland. Not only does this show the significance of the current division of Environmental Health & Safety, it also illustrates the need to analyze the results from inspections conducted at food service establishments. It is important to determine whether or not the inspection violations are caused by a much larger problem within the city, which will allow for more effective intervention opportunities.

In addition to the probable likelihood of obtaining a foodborne related illness while eating at a restaurant, people in the United States are eating at restaurants quite frequently. Nearly half of the money Americans spend on food is spent on food from restaurants (Angulo and Jones 2006). Since Portland has a large number of restaurants within its city limits, it is likely that the amount of money spent on food from restaurants may be greater than half of the overall money spent on food. This frequency of eating in restaurants puts people at a greater risk for contracting a foodborne related illness. Annually, it is estimated that foodborne diseases are responsible for approximately seventy six million illnesses and approximately five thousand deaths within the United States (Angulo and Jones 2006). Therefore, it is essential to understand the specifics of which illnesses could be originating in food service establishments, as well as how this type of environment may be encouraging the growth of these illnesses, in order to properly intervene.

A review titled *Attributing the Human Disease Burden of Foodborne Infections to Specific Sources* conducted by Pires et al (2009) investigated the categorization of

foodborne illnesses, as well as current approaches for human contraction of these illnesses. This review was developed in order to define current nomenclature and illness approaches within the public health field, in order to develop appropriate intervention methods. This review determined that sources of foodborne illnesses must be identified in order to accurately measure the effectiveness of specific interventions (Pires et al 2009). With Portland's current protocol for inspecting food service establishments, the twenty-seven items evaluated at each establishment help to specify any potential sources of concern within each facility, which further assisted in determining appropriate intervention recommendations while conducting research.

Over the last few decades, the United States has experienced quite a few foodborne disease outbreaks. Learning about the history of these outbreaks can help Portland to prevent similar outbreaks in the future. For example, the CDC has conducted numerous investigations across the country regarding certain outbreaks. In 2000, the CDC released a report regarding their surveillance program for both data collection and data reporting on the causes of foodborne disease outbreaks in the United States. This reporting system showed that from 1993 to 1997, a total of 2,751 outbreaks related to foodborne disease were reported, which ultimately caused a total of 86,058 people to contract related illnesses. The reporting of this surveillance system allowed the CDC to review the process of reporting foodborne disease outbreaks, while also encouraging state and local health departments to continue investigating and studying the epidemiology of foodborne disease outbreaks (2000). In 2004, the Journal of the American Dietetic Association published a similar article that focused on emerging trends within foodborne surveillance. Researchers found that elderly people, pregnant women, children, and immune-

compromised people are most vulnerable to contracting foodborne related illnesses. They also determined that many foodborne illnesses originate from certain bacterial strains and viruses, and that other origins remain unknown. This article greatly cautioned against improper handling of fresh produce, and advised much more careful selection in order to reduce the onset of foodborne illnesses. Lastly, researchers advised positive food handling behaviors from those who come into contact with food within the workplace, since appropriate and safe behavior can reduce the possibility of contracting foodborne illnesses (McCabe-Sellers and Beattie 2004). Understanding these analyses of foodborne illness surveillance can help the City of Portland improve current restaurant policies, while also encouraging a closer look at the illnesses themselves.

In 2004, the CDC conducted another study that further analyzed the meaning behind restaurant inspection scores, in addition to foodborne disease. This study involved the examination of inspection records across multiple states from 1993 to 2000. Overall, it was found that the restaurant inspection system as a whole should be investigated, since the reports used across states were not always presented in a uniform manner. The CDC recommends that states unify their inspection methods, in order to ensure food safety within restaurants (2004). This is something the City of Portland may want to look into as a way to improve food safety across the region. It is also important to be aware of current surveillance methods in order to better comply with the overall system.

Additionally, the Journal of Food Protection conducted a study in 1995 that examined perceptions and preventive behaviors around the concept of foodborne illnesses.

Through phone surveys, researchers asked consumers what their perceptions were of foodborne illnesses, in addition to inquiring about general knowledge of food safety.

This study showed that participants typically thought that foodborne illnesses were relatively minor, usually involving a fever. Researchers also found that people who believed they had experienced a foodborne illness had a greater amount of awareness and concern about food safety (Fein, Lin and Levy 1995). To fully utilize the researcher's recommended strategies, it is significant to understand how consumers currently view foodborne illnesses. Having general knowledge about peoples' views and behaviors around food safety will help tailor intervention and recommendation ideas for the City of Portland.

While conducting research about foodborne illnesses, it was also important to study the two most common sources of foodborne illnesses: *E. coli* and *Salmonella*. In regard to *E. coli*, one study investigated outbreaks in the United States from 1982 to 2002. While using the CDC database, researchers found that 49 states reported a total of 350 outbreaks, which resulted in 8,598 cases—including 40 deaths. Over half of these cases originated from foodborne environments, in addition to 14% of cases coming from person-to-person contact. The primary food vehicle for *E. coli* was ground beef, with produce contributing to 21% of cases (Rangel, Sparling, Griffin and Swerdlow 2005). Looking into the origins of *E. coli* in a food service environment can help state and local health departments to become more aware of these areas, while also becoming more knowledgeable of the environments *E. coli* can thrive in.

Salmonella is another primary source of foodborne illnesses. In 2004, one study determined that chicken consumption has become an important risk factor for contraction of *Salmonella*. This particular study involved population-based case-control methodology over a twelve-month period, with an overall case count of 182 and 345

controls. This study showed that most cases were associated with eating undercooked eggs and eating chicken prepared outside of the home, with a multivariate analysis determining that eating chicken outside of the home as the most significant risk factor for Salmonella related illnesses (Kimura et al 2004). Chicken consumption was not known to be a risk factor for Salmonella until this study was conducted, which indicates the significance of continuing education with food safety and proper handling techniques. Another study conducted in 2004 looked at the potential burden of illness caused by Salmonella within the United States by analyzing population-based surveillance for confirmed Salmonella infections between 1996 and 1999. Researchers estimated that Salmonella infections resulted in 15,000 hospitalizations and 400 deaths annually (Voetsch et al 2004). Understanding more about the seriousness of E. coli and Salmonella will help the City of Portland to further improve current food safety practices and keep the intensity of these illnesses at a minimal level.

This preliminary literature review shows that there is ample evidence regarding foodborne related illnesses in the public health field. Each of these sources calls attention to the intensity of this issue in the United States, which indicates that conducting more research on this topic will allow for the ability to effectively determine a final recommendation for interventions among Portland's restaurants.

Materials and Methods

The two goals of this project were to determine the five most violated items among Portland restaurants, and to provide information to the City of Portland regarding appropriate intervention methods and recommendations. This will assist the City of Portland with its long-term goal of reducing the risk of foodborne illnesses among

Portland residents and visitors. These goals were accomplished through the use of four project objectives:

- Transcribing data from June 2015 to December 2015 inspection forms to the database created and used during the first two phases of the project.
- Analyzing the database in order to determine the top five food inspection violations, along with studying the seasonal and annual trends to ensure relevant intervention research.
- Studying the current goals of the City of Portland and FDA Program Standard.
- Conducting a literature review in regard to the top five inspection violations and the goals of the City of Portland and FDA Program Standard.

This project was carried out through the use of a wide variety of information, ranging from the City of Portland's food inspection information and the corresponding Program Standard to analyzing outside intervention methods and reviews about the top five foodborne illness risk factors. The collaboration of this information through a data analysis and literature review will result in the ability to provide an educated recommendation to the City of Portland on how to minimize the risk of foodborne illnesses within food service establishments. For this project, there were no plans for human subjects review.

In order to address the first question of the project (*What are the five most violated items?*), it was essential for the researcher to complete the database that was used during the first two phases of the overall project. This completed database contains food safety information from 2012 to 2015, and provides an extensive amount of data that ensured a more effective analysis. While determining what the five most violated items are among

Portland restaurants, the researcher needed to look at the frequency of violation for each of the twenty-seven items under consideration. She examined the data on an annual basis at first, and then further analyzed each year by examining any possible seasonal trends among the restaurants. In order to reach a conclusion about the five most violated items, the researcher looked at the entirety of the data from 2012 to 2015. The examination of annual and seasonal trends helped to determine specifics on frequency patterns throughout the database's timeline of the five most violated items. Determining the frequency patterns of the five most violated items helped guide the focus of the intervention and recommendation research.

In order to address the second question (*What are some appropriate interventions and recommendations I can provide to the City of Portland?*), research was conducted on a variety of information. This began by reviewing the City of Portland and FDA Program Standards, which helped the researcher get a better sense of what types of intervention and recommendation ideas the city would prefer. After this research was completed, any possible interventions that other cities with similar violations have attempted were looked into, in order to determine if similar methods could be applied within Portland. Lastly, this project concluded with searching for literature online that addresses the five violations and other intervention ideas that could be recommend to the City of Portland.

Data Results and Analysis

Completing the interim database for the City of Portland involved transcribing data from 758 reports, spanning from June 2015 to December 2015, into the previously established database from former phases of the project. This resulted in an overall database for 1,877 restaurant inspections within the city. Out of the total inspection

reports completed, the initial analysis focused on reports completed during the 2013-2015 summer seasons, because of the small data pool collected in 2012. Since summer is the height of tourist season for Portland, many restaurants employ temporary staff to assist with the increased influx of consumers. This increase in new staff members combined with a rise in demand for meal outputs places many restaurants at a higher risk of violating Portland's safety standards.

For the purpose of this analysis, the "summer season" was set for a June to September time period. Since many seasonal restaurants close during Labor Day weekend, and the cruise ship season ends in October, September was chosen as an end of season midpoint in order to best represent both situations within the study. Additionally, the analysis solely focused on "full service" restaurants within Portland, due to the low number of venues representing the other categories in the database. The researcher chose to eliminate "fast food" restaurants from the analysis, due to the fact that many of these establishments belong to national chains that already have their own corporate food safety strategies implemented. After these specifications, the restaurants remaining in the analysis pool were further narrowed based on the amount of times they were inspected in the 2013-2015 summers. Restaurants that were inspected at least twice during the summer 2013-2015 time frame were placed in the final group—in order to have a more comparable data analysis. This resulted in an overall examination of 64 restaurants within the City of Portland.

As seen in Appendix I, restaurants with an average violation number higher than four have been highlighted as cautionary venues (Table 1.1-1.3). Based on the city's inspection policies, venues with five or more violations during an inspection are

classified as failed inspections for that particular visit, indicating that venues with an average of at least four violations during the summer seasons should be evaluated more in-depth. In addition to examining the number of violations per restaurant, the frequency of each risk factor per year was identified as well (Chart 1.1-1.3). The five items with the highest frequency numbers for each year are noted in blue. Lastly, the five most violated items numbers across the entire analysis period are noted in red on Table 2. As indicated on Table 4, the most violated items full service restaurants violated during the 2013-2015 summer seasons (in decreasing order of frequency) are items:

- 14: Food-contact surfaces: cleaned and sanitized,
- 8: Adequate handwashing facilities supplied & accessible,
- 20: Proper cold holding temperatures,
- 23: Consumer advisory provided for raw or undercooked foods, and
- 13: Food separated & protected.

These five items determined the direction of research for the remainder of the project.

Discussion

After identifying the five inspection items that restaurants violated the most, the researcher opted to learn more about each of these inspection items, including what possible heightened risks consumers are subject to when these items are breached. Furthermore, the researcher wanted to delve further into some potential educational initiatives that the City of Portland could implement in order to assist with restaurant staff knowledge retention around proper food safety practices. She also looked into additional intervention strategies, in the event that other underlying issues exist beyond knowledge retention.

Item 14: Food-Contact Surfaces: Cleaned and Sanitized

Having food-contact surfaces cleaned and sanitized (Item 14) was the most violated inspection item within Portland during the reviewed time period. As seen in Charts 1.1-1.3, the overall violation trends have seen a decreasing pattern in the analysis of the 2013-2015 summer seasons (Appendix I). Item 14 seems to be following its own pattern that contradicts the trend. In fact, Item 14 experienced a substantial increase in violations from 2013-2014, going from 18 violations in 2013 to 25 violations in 2014. In 2015, its violation numbers decreased to 19. However, the next highest violation numbers for a different item in 2015 was 11, showing quite a visual difference for Item 14 on Chart 1.3. Item 14 poses the biggest concern for consumer safety.

According to the City of Portland's Food Handler's Manual, there are a few contingencies that restaurants must meet in order to comply with this inspection item. These three contingencies entail:

- "For hot water sanitizing the surface of the dishes must reach 160 degrees F. This usually means the dial must reach 180 degrees F;
- Separate buckets of sanitizer must be provided for wiping off food-contact areas (cutting boards, prep tables, etc); and
- Wiping a surface with a sanitized cloth is NOT cleaning and sanitizing. Wiping cloths are to be used to clean up spills and food debris only" (2013).

Reasons for maintaining clean and sanitized food-contact surfaces are relatively simple. Without proper cleaning, bacteria and microorganisms that live on those surfaces are much more likely to contaminate foods that come into direct contact with those surfaces. In turn, this creates an increased chance to harm the consumer. Failing to

sanitize food-contact surfaces after each food is prepped leaves a lot of potential for cross contamination. For example, if raw meats or poultry are prepped for cooking on the same surface as each other (as well as other foods), the likelihood of Salmonella or E. coli spreading to consumers is much more probable than if those surfaces are cleaned and sanitized after each incidence of food contact. Violating Item 14 is currently the biggest problem for Portland restaurants. Because of this, the researcher looked into reasons why this may be, and how to alleviate those reasons.

In 2008, Howells et al. conducted focus groups with food handlers in a study titled *Restaurant Employees' Perceptions of Barriers to Three Food Safety Practices*. During the focus groups, food handlers discussed the topic of cleaning and sanitizing food-contact surfaces. The two biggest barriers expressed involved time constraints and management/employees not caring. Based on the perceptions of food handlers, there are many competing tasks as demands expected of them by those in management. Additionally, many felt they did not have enough space in the kitchen as well as a lack of cutting boards or other utensils that could reduce the risks with violating Item 14. Lastly, many of the focus group attendees felt they did not receive proper training on the importance of cleaning and sanitizing food-contact surfaces, and did not have incentives to take the time for proper cleaning (Howells et al. 2008). Based on this feedback, the researcher interprets that food handlers would be more likely to comply with Item 14 if some of these barriers are either reduced or eliminated.

Item 8: Adequate Handwashing Facilities Supplied & Accessible

Item 8: Adequate Handwashing Facilities Supplied & Accessible was the second most violated inspection item for the 2013-2015 summer seasons. Based on the collected

data, Item 8 violations have drastically reduced from 2013 to 2015 (Appendix I). During the summer season of 2013, Item 8 was violated 27 times—the highest violation number of any item at any time during the analysis period. This observation alone is enough for the City of Portland to be continuously cautious on the enforcement of proper hand washing facilities in restaurants. A slight decrease the following summer showed a total of 20 violations for 2014, which is still a substantial amount. On the other hand, Item 8 was only violated 7 times in 2015. This shows that Portland restaurants are increasing staff accessibility to proper hand washing facilities, which is an encouraging observation.

In order for Item 8 to be violated, these incidents must be breached:

- “Hand washing sinks must be used for hand-washing ONLY and must be stocked with:
 - Hot running water (100 degrees F for at least 15 seconds)
 - Soap
 - Paper towels;
- Do not block hand-washing sinks or use for any other purposes; and
- Hand sanitizers should never be used instead of hand washing. Just rinsing our hands with water does not remove germs” (City of Portland 2013).

Failing to provide appropriate hand washing facilities to restaurant workers creates many opportunities for foodborne related illnesses to place consumers at risk. A study conducted in 2004 titled *Prevention of Food Worker Transmission of Foodborne Pathogens: Risk Assessment and Evaluation of Effective Hygiene Intervention Strategies* focused on an in-depth analysis of foodborne illness outbreaks that were recorded to have begun with a food handler (Michaels et al.). Of the 308 outbreaks reviewed, 182 of those

outbreaks involved hand contact that resulted in a contaminated food product.

Additionally, 161 of those 182 outbreaks further reported bare hand activities taking place. Implementing proper hand washing practices has been shown to effectively remove microorganisms from hands and reduce the spread of foodborne illnesses. For example, *Salmonella* can survive for several hours on fingertips. However, hand washing followed by drying one's hands with paper towels has been shown to effectively reduce the risk of transmission (Michaels et al. 2004). Ensuring the availability of proper hand washing facilities—and the use of those facilities by restaurant workers—is a continued effort that might be worth investing in by the City of Portland.

Although poor hand washing poses a prominent threat to consumer health, the act of hand washing itself is seemingly simple enough that proper intervention can encourage continued hand washing practices from restaurant workers. In 2007, Pragle, Harding and Mack held focus groups in Oregon for food handlers regarding the challenges around maintaining cleanliness in the restaurant environment. The researchers discovered that there are many barriers around proper hand washing techniques for restaurant workers, including time pressure, lack of accountability, inadequate facilities and supplies, and lack of involvement of managers. They also learned that many of the current knowledge-based hand washing training programs do not address these barriers (Pragle, Harding and Mack 2007). It was recommended that future educational programs include more education about the seriousness of foodborne illnesses, hold continued training for managers as well as staff, and to present local health departments as a resource for continued advice or consultation. Another study conducted in 2013 also discovered the prominent role that food workers have in spreading outbreaks, and also strongly

recommended local interventions to address prevention techniques around proper hand washing (Gould, Rosenblum, Nicholas and Jones). Outbreaks have most commonly resulted from contamination introduced by an infected food handler or inadequate hand washing by food handlers.

While it is notable that violations of Item 8 have been reducing over time, the researcher recommends ongoing education and involvement around hand washing from the City of Portland. Based on research, continuing to address the many barriers that food handlers come across in the workplace during continued trainings may also assist management in understanding the pressures food handlers face to prepare meals as quickly as possible. Repetition of education appears to be key in the reduction of Item 8 violations.

Item 20: Proper Cold Holding Temperatures

Maintaining proper cold holding temperatures was the third most violated item for Portland restaurants. As seen in Appendix I, Item 20 was violated consistently during 2013 and 2014—with 20 violations for each year. However, in 2015 the amount of violations was noticeably reduced to 8. Based on the stagnant trend from 2013-2014, the researcher is curious to know if any safety initiatives were implemented in an attempt to reduce the amount of violations of Item 20, that were perhaps unsuccessful until the 2015 summer season.

Violations of Item 20 occur when the following criteria are not met:

- “Cold food must be maintained cold at 41 degrees F or less at all times;
- This includes refrigeration, salad bars, and during transport;
- Cold food must be 41 degrees F or below when delivered, except for milk, eggs and

shellfish, which can be delivered at 45 degrees F” (City of Portland 2013).

Based on additional research conducted, food service workers may have little to do with maintaining proper cold holding temperatures. According to a 2009 study titled *Certified Kitchen Managers: Do They Improve Restaurant Inspection Outcomes?*, cold holding temperatures may be beyond staff control (Cates et al.). This study focused on introducing certified kitchen managers (CKM) into restaurants, in order to determine if the advanced training would improve restaurant inspection scores. While CKMs greatly assisted with other inspection items, the improvement of maintaining proper cold holding temperatures was not affected by CKMs. When compared to hot holding, hot holding is easier for staff to accomplish due to a more acceptable temperature range. Additionally, hot holding only needs to occur for a certain length of time, whereas cold holding is an ongoing state. Cates et al. also suggested that violations in cold holding could be due to poorly operating equipment, which staff has little control over (2009). In learning about this information, the consistent 20 violations for 2013 and 2014, followed by a sudden decrease to 8 violations in 2015 could be due to restaurant investments in more adequate equipment for cooling storage. If this information is shared by the City of Portland to those still in violation of Item 20, there is a possibility of all restaurants in the city to be in 100% compliance.

Item 23: Consumer Advisory Provided for Raw or Undercooked Foods

The fourth most violated inspection item was Item 23: Consumer Advisory Provided for Raw or Undercooked Foods. Based on the data, the number of violations of Item 23 followed the overall data trend of displaying a decrease over time (Appendix I). In 2013, Item 23 was violated 14 times. 2014 saw a slight decrease in violations, with a

total of 7 occurrences. Lastly, the summer of 2015 only experienced 2 violations. This data shows that consumer advisories for raw or undercooked foods are becoming much more commonplace in Portland.

Violations of Item 23 include inability to comply with the following:

- “If an animal food is served or sold raw or undercooked, is in a ready to eat form without otherwise being processed to eliminate pathogens, you must notify the consumer of the significantly increased risk of consuming such foods; and
- If you have a menu, the items that will be undercooked or raw must be marked with an asterisk (*). On the bottom of the menu, there must be a corresponding * with the following message: ‘Consuming raw or undercooked meats, poultry, seafood, shellfish or eggs may increase your risk of foodborne illness.’ If you don’t have a menu, the same message must be posted in plain public view at the place where food is ordered” (City of Portland 2013).

Item 23, when properly complied with, gives the consumer an opportunity to make more conscious choices about his or her meal selections at restaurants. Based on the data trends from 2013-2015, restaurants are improving on Item 23 and ensuring that consumers are knowledgeable about the risks they are subject to when eating certain foods. However, it is possible that consumers are not entirely aware of the risks that are involved with an advisory. According to a 2004 study conducted by Wilcock, Pun, Khanona and Aung, consumers’ willingness to change their behavior is determined by their perceptions and beliefs. These perceptions and beliefs are largely influenced by knowledge of food safety, or rather the lack thereof, that most of the public has. Many people are subject to “optimistic bias,” indicating that people believe they are at less risk

for contracting a foodborne illness than others. However, people are much more likely to make rational decisions about food consumption when they are aware of the associated health risks (Wilcock, Pun, Khanona and Aung 2004). This indicates that when Item 23 is complied with that consumers will be much more cautious about their meal selections. Therefore, it is important for all Portland restaurants to meet the terms of providing consumer advisories for raw or undercooked foods. Based on the drastic decline of Item 23 violations during the analyzed time period, providing advisories to consumers is greatly improving. In order to maintain low violation levels, the researcher recommends continuing education for restaurants around consumer behaviors.

Item 13: Food Separated & Protected

Lastly, the fifth most violated inspection item was Item 13: Food Separated & Protected. Based on the data reviewed, Item 13 does not appear to be violated to too high of a degree to pose much concern for the City of Portland. Item 13 was violated 8 times in 2013, 9 times in 2014, and 5 times in 2015. Over the analysis period, the trend for violating Item 13 appears to be decreasing. However, any amount of violation puts consumers' health at an increased risk.

The following criteria must be breached in order for a violation of Item 13 to occur:

- All food should be at least 6 inches off the floor;
- Cover and label food in dry storage areas;
- Never store food beneath or near chemicals, wastewater lines, tools, or any other possible sources of contamination; and
- Store canned goods at 86 degrees F or less” (City of Portland 2013).

As is similar with many of the other items violated by restaurants, Item 13 is a

seemingly simple enough factor for restaurants to fulfill its requirements. The decreasing number of violations from 2013 to 2015 indicates that many restaurants do not have difficulty complying with Item 13. However, for those that are not in compliance, this may be a result of the many barriers to safety that have been previously discussed. For example, time restraints are a huge concern for food handlers, as well as small spaces to work in and a lack of incentive from management to follow proper protocol (Howells et al. 2008). Ensuring that food is accurately separated and protected can be supported further by the City of Portland through ongoing restaurant education, as well as serving as a consultant to any restaurants who have concerns about their inspection violations and food safety practices.

Ways to Improve Retention of Food Safety Knowledge

During the course of reading into literature around improving food safety, the researcher came across a few educational practices that may be beneficial to the City of Portland and the restaurants within its jurisdiction. A study in 2007 titled *Self-Reported Changes in Food Safety Behaviors Among Foodservice Employees: Impact of a Retail Food Safety Education Program* looked at a food safety education program implemented for the State of Texas by the Texas Cooperative Extension (Anding, Boleman and Thompson). This program was evaluated by the researchers to assess the degree to which participants were practicing selected behaviors linked to reducing the risk of foodborne related illnesses (i.e. hand washing, wearing gloves etc). The results of this assessment showed that upon program completion, participants reported more frequency of practicing positive hand washing behaviors and preventing cross contamination, among many other improvements. It is important to mention that many of those involved in the

study indicated that the program hosted by the Texas Cooperative Extension was their first exposure to proper food safety education (Anding, Boleman and Thompson 2007). This is especially important to convey to the City of Portland, given the fact that many restaurant workers employed during the summer season may not have time to be properly trained on food safety upon hire. It is likely that many seasonal workers also do not have any background in working in restaurants and the demands that the environment entails—further indicating that feeling rushed and skipping hand washing or sanitation may be heightened by new hires. Offering educational services at the beginning of the summer season may improve continued safety practices throughout the season.

Another study titled *Effect of a Manager Training and Certification Program on Food Safety and Hygiene in Food Service Operations*, examined the benefits of having certified food safety managers, as well as the likelihood that having certified management improves inspection scores (Kassa, Silverman and Baroudi 2010). Of the inspection reports reviewed, it was discovered that the value of having certified management implemented by local health departments was only noticeable for independent restaurants and those with few branch locations. For chain restaurants, the certification made no difference due to formal national requirements and food safety training enforced by corporate that need to be met. This is especially crucial for the City of Portland, especially given the data analyzed by the researcher purposefully eliminated national chain restaurants for similar reasoning. Therefore, implementing a food safety and certification program for managers at the restaurants evaluated in this study has evident potential benefits.

Conclusions and Recommendations

Based on the examination conducted around the five most violated inspection items for restaurants within the City of Portland, the researcher recommends three intervention strategies. First, it is recommended that the City of Portland conduct separate focus groups with managers, wait staff and food handlers to further pinpoint any concerns around food safety that are tailored to the area. Second, based on focus group feedback, it is recommended that a citywide training become implemented multiple times during the summer season: once to coincide with the on-boarding of seasonal hires, and another time around the midpoint of summer (i.e. July). This training should address proper food safety techniques, including an emphasis on the importance of hand washing and food-contact surface cleaning and sanitation, as well as the risks that can happen when proper cleaning of hands and surfaces does not occur. The training should also acknowledge any environmental barriers that can discourage proper food safety practices, in addition to discussing how to reduce those barriers. Lastly, based on the types of restaurants prominent with in the Portland area, it is also recommended that managers of local restaurants undergo a second-tier food safety certification training, to be conducted by the City of Portland. It is also suggested that at these trainings the City of Portland present itself as an ongoing resource for restaurant managers around food safety.

For the most part, many Portland restaurants are exhibiting proper food safety protocol. Out of the restaurants displaying risky behavior in some areas, the above recommendations should aid in the reduction of inspection violations. Local cuisine is a prominent part of Portland's culture, and with the correct approaches to improve food safety, eating at restaurants should continue to be an enjoyed outing for both residents

and visitors to the area.

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Appendix I

Table 1.1: Violations by Restaurant

Restaurants	2013 Violations	2014 Violations	2015 Violations	Average
ANTHONY'S ITALIAN KITCHEN	1	1	0	0.67
ARTEMISIA CAFÉ	1	2	NULL	1.5
BECKY'S DINER	0	3	NULL	1.5
BIBO'S MADD APPLE CAFÉ	2	3	NULL	2.5
BLUE SPOON	4	3	NULL	3.5
BONOBO PIZZA	5	3	NULL	4
BREALU CAFÉ	7	NULL	2	4.5
CAIOLA'S CAFÉ	3	2	NULL	2.5
CONGRESS BAR & GRILL	3	3	NULL	3
CUMBERLAND CLUB	3	NULL	1	2
DENNY'S RESTAURANT-BRIGHTON AVE	NULL	3	1	2
DIAMONDS EDGE RESTAURANT	NULL	2	2	2
DUCKFAT	NULL	2	0	1
EMILITSA	NULL	0	3	1.5
FLATBREAD CO.	3	2	NULL	2.5
FORE STREET	3	2	3	2.67
FRONT ROOM	2	5	2	3
GINZA TOWN	5	NULL	1	3
GRACE	3	2	1	2
GREAT LOST BEAR	4	2	NULL	3
GREEN ELEPHANT VEGETARIAN BIST	2	1	1	1.33
GRILL ROOM	NULL	5	3	4
GRITTY MCDUFFS	NULL	2	0	1

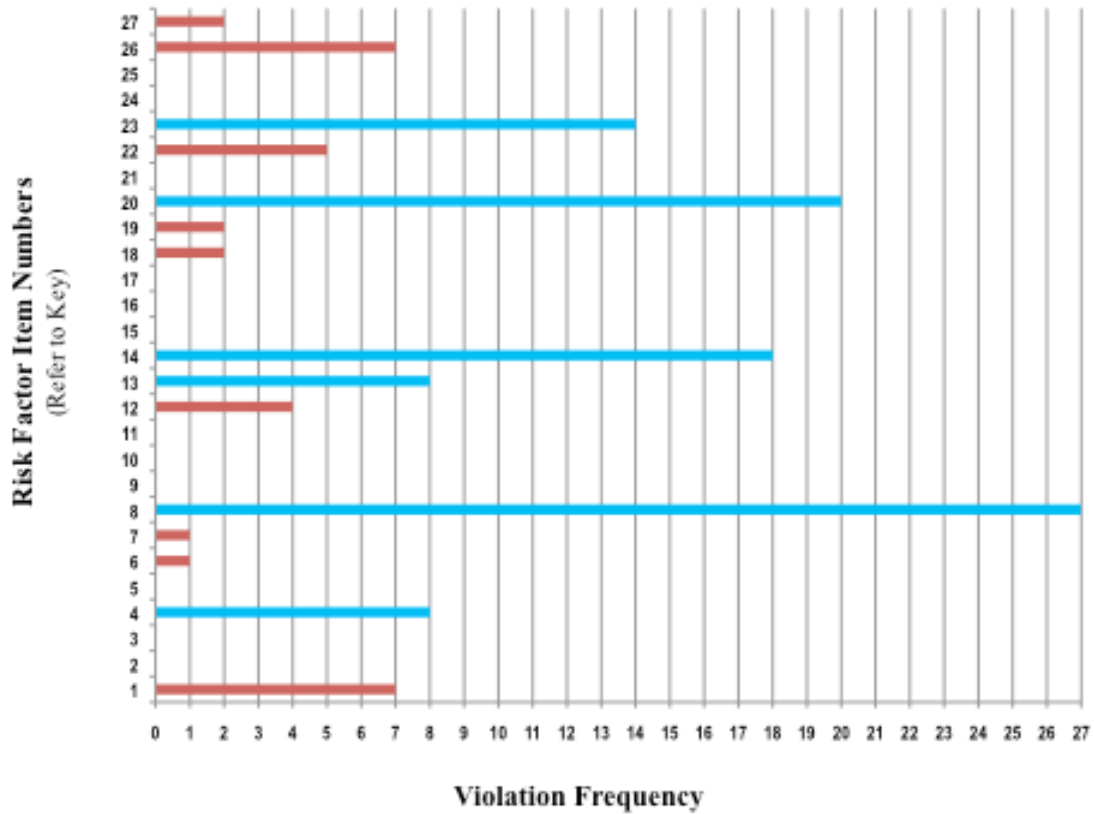
Table 1.2: Violations by Restaurant

Restaurants	2013 Violations	2014 Violations	2015 Violations	Average
HILTON GARDEN INN PORTLAND JET	NULL	3	2	2.5
JONES LANDING	NULL	1	1	1
J'S OYSTER BAR	NULL	4	1	2.5
KON ASIAN BISTRO	NULL	6	1	3.5
LITTLE TAP HOUSE	NULL	5	2	3.5
MAELILY & RYLEIGH'S	2	4	NULL	3
MAPS CAFÉ	NULL	0	0	0
MARGARITAS-ST JOHN	4	3	1	2.67
MERRY TABLE	5	2	NULL	3.5
MISS PORTLAND DINER	4	2	NULL	3
OLIVE CAFÉ	0	2	NULL	1
PANDA GARDENS RESTAURANT	3	NULL	5	4
PARKER'S RESTAURANT	2	NULL	3	2.5
PAT'S PIZZA OLD PORT	2	NULL	5	3.5
PEAKS CAFÉ	1	0	NULL	0.5
PEAKS ISLAND HOUSE	2	2	NULL	2
PICCOLO	0	NULL	0	0
PIZZA HUT	0	0	NULL	0
PIZZA JOINT	2	2	0	1.33
PIZZA TIME	2	NULL	0	1
POM'S THAI TASTE	1	4	4	3
PORHOLE RESTAURANT & PUB, THE	3	0	NULL	1.5
PORTLAND HOUSE OF PIZZA	1	NULL	1	1
PORTLAND LOBSTER CO.	3	NULL	2	2.5
PORTLAND PIE COMPANY	2	1	1	1.33

Table 1.3: Violations by Restaurant

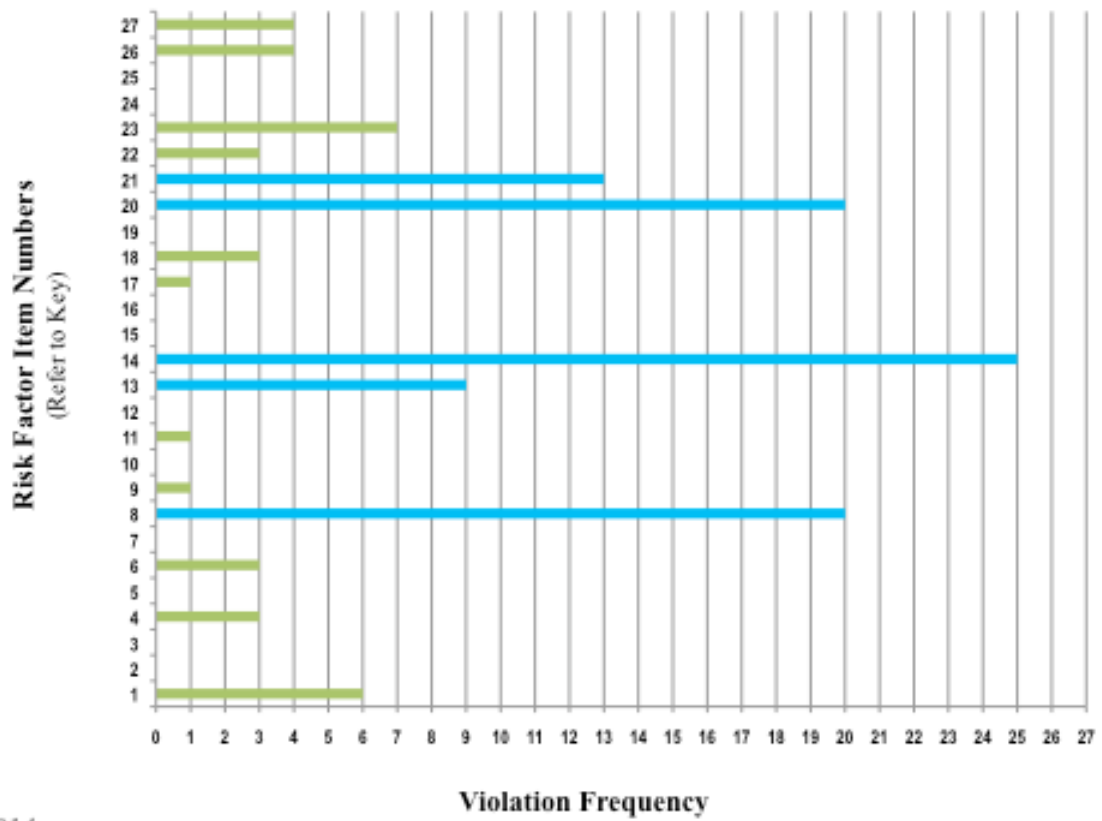
Restaurants	2013 Violations	2014 Violations	2015 Violations	Average
PORTLAND REGENCY HOTEL	5	NULL	2	3.5
PUNKY'S	1	2	NULL	1.5
RI-RA THE IRISH PUB & REST.	3	NULL	1	2
RIVALRIES	4	0	NULL	2
ROSIES RESTAURANT & PUB	NULL	1	0	0.5
SAENG THAI HOUSE II	3	NULL	3	3
SAIGON RESTAURANT	NULL	6	3	4.5
SAPPORO RESTAURANT	NULL	2	2	2
SENGCHAI THAI CUISINE	NULL	3	4	3.5
SIANOS	5	4	1	3.33
SONNY'S	1	3	NULL	2
STREET AND CO.	2	NULL	0	1
TANDOOR	NULL	3	3	3
VERANDA THAI	4	8	0	4
YOSAKU	6	NULL	6	6
ZAPOTECA RESTAURANT	2	4	NULL	3

Chart 1.1: Risk Factor Violations, 2013



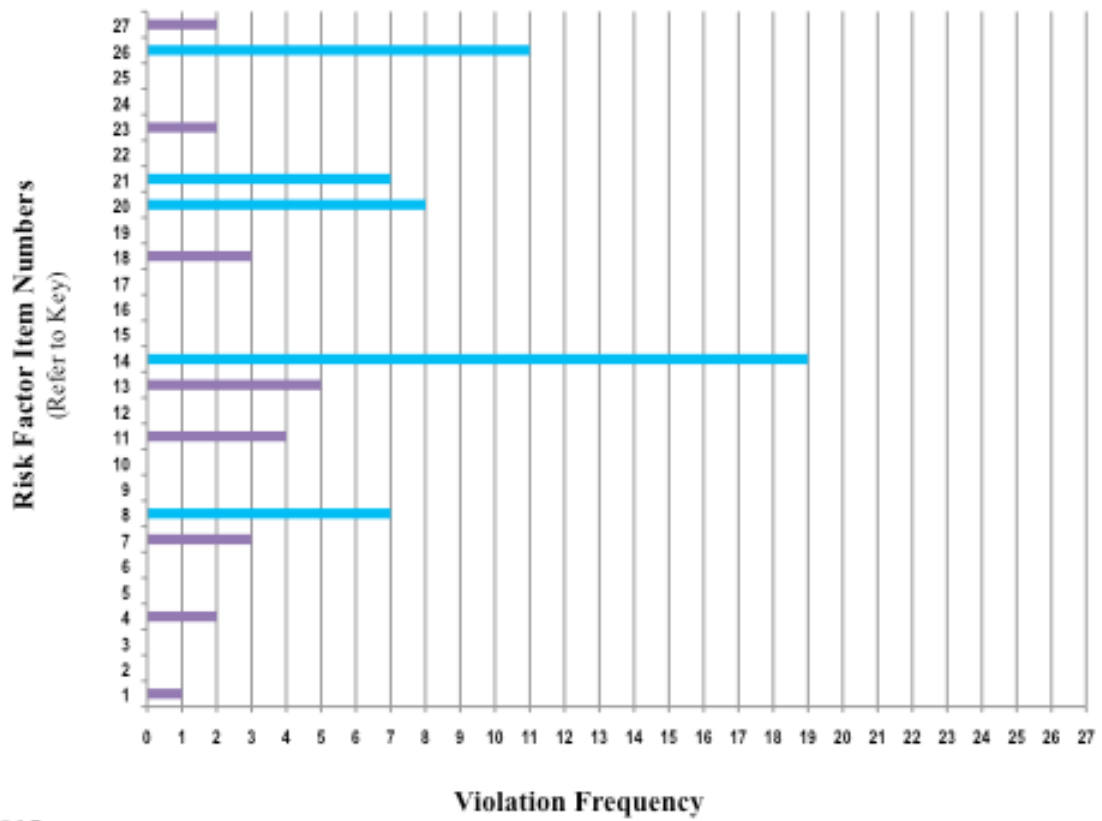
2013

Chart 1.2: Risk Factor Violations, 2014



2014

Chart 1.3: Risk Factor Violations, 2015



2015

Table 2: Risk Factor Key (Five Most Violated Factors in Red)**City of Portland, ME Risk Factors**

Source: www.portlandmaine.gov

1	PIC (Person in Charge) present, demonstrates knowledge, and performs duties.
2	Management awareness; policy present.
3	Proper use of reporting, restriction & exclusion.
4	Proper eating, tasting, drinking, or tobacco use.
5	No discharge from eyes, nose, and mouth.
6	Hands clean & properly washed.
7	No bare hand contact with RTE (Ready to Eat) foods or approved alternate method properly followed.
8	Adequate handwashing facilities supplied & accessible. (#2)
9	Food obtained from approved source.
10	Food received at proper temperature.
11	Food in good condition, safe, & unadulterated.
12	Required records available: shellstock tags parasite destruction.
13	Food separated & protected. (#5)
14	Food-contact surfaces: cleaned and sanitized. (#1)
15	Proper disposition of returned, previously served, reconditioned, & unsafe food.
16	Proper cooking time & temperatures.
17	Proper reheating procedures for hot holding.
18	Proper cooling time & temperatures.
19	Proper hot holding temperatures.
20	Proper cold holding temperatures. (#3)
21	Proper date marking & disposition.
22	Time as a public health control: procedures & record.
23	Consumer advisory provided for raw or undercooked foods. (#4)
24	Pasteurized foods used; prohibited foods not offered.
25	Food additives: approved & properly used.
26	Toxic substances properly identified, stored & used.
27	Compliance with variance, specialized process, & HACCP plan.