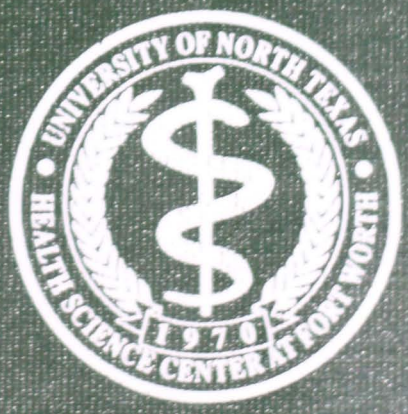
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Harris, Ann Marie., Assessment and Identification of Areas for Improvement of a Local Health Department Food Safety Program. Master of Public Health (Environmental Health), May 2008, 14 pp. 1 table, 1 figure, references, 14 titles.

The Fort Worth Public Health Department (FWPHD) established a standardized assessment to compare compliance rates for risk factors contributing to foodborne illness. The FWPHD identified significantly higher compliance rates in four out of six risk factors. Risk factors posing the greatest risk for out of compliance observations included threats from contaminated equipment and chemical/other hazards. Fast food establishments had a significantly greater risk for contaminated equipment (OR=1.81; CI=1.27,2.58). Chemical/other hazards was the only risk factor with a higher overall out of compliance rate than the FDA. The FWPHD can now accurately track the effectiveness of training and education programs for food handlers, consumer health specialists, and the overall inspection process.

ASSESSMENT AND IDENTIFICATION OF AREAS FOR IMPROVEMENT OF A LOCAL HEALTH DEPARTMENT FOOD SAFETY PROGRAM

Ann Marie Harris, B.S.

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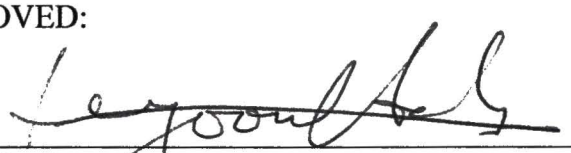

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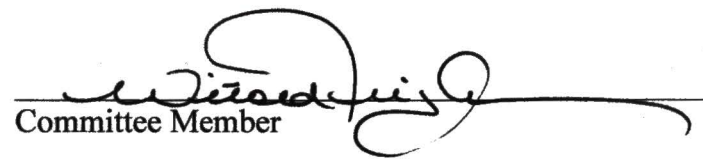

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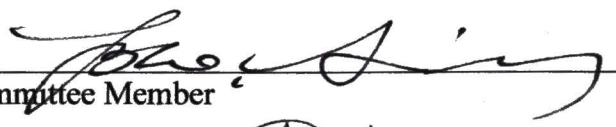

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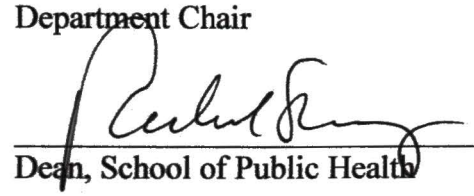

Dean, School of Public Health

ASSESSMENT AND IDENTIFICATION OF AREAS FOR IMPROVEMENT OF A LOCAL HEALTH DEPARTMENT FOOD SAFETY PROGRAM

JOURNAL MANUSCRIPT

Presented to the School of Public Health

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By

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Fort Worth, Texas

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INTRODUCTION

The US Food and Drug Administration (FDA) has provided guidelines for establishing a retail food program database of foodborne illness risk factors. The goal for establishing this database is to assist regulatory food programs in developing an assessment designed to track the occurrence of factors associated with foodborne illness. Identified risk factors include food from unsafe sources, inadequate cooking, improper holding temperatures, contaminated equipment, poor personal hygiene, and chemical/other contaminants (US Food and Drug Administration, 2000).

Foodborne illness may be responsible for over 76 million cases of illness each year in the United States alone (Batz et al., 2005). It is estimated that over 5,000 deaths and 325,000 hospitalizations each year are attributed to foodborne disease (Hardnett, Hoekstra, Kennedy, Charles, & Angulo, 2004). Presumably, many incidences of illness associated with food go unreported making the accurate quantification of the public health impact of foodborne illness difficult. Symptoms and complications from foodborne illness can range from mild stomach discomfort to congenital defects, meningitis, and even death (Jones & Angulo, 2006). Clearly, the risk of foodborne illness poses a substantial public health concern.

In designing a strategy to measure the risk associated with foodborne illness, the first step is developing an assessment mechanism that establishes a reliable baseline by which safe food handling practices can be gauged (Boyd, 2007). To measure food handler safety, many local health departments conduct jurisdiction-wide food establishment inspections in an effort to promote safe food handling practices. Exploring

the effectiveness of the inspection process is ongoing in regards to its actual impact on food safety (Cruz, Katz, & Suarez, 2001). Through development of a sensitive and specific assessment process, a safety program can document inspection observations and compare the incidence of foodborne illness risk factors through statistical analysis. These observations can be used over time to measure the association between risk factors, food preparation behaviors, and the inspection process. Collected data can be used to conduct periodic assessments to determine the effectiveness of public health food programs and drive revisions and modifications for safe food handling practices and other interventions. Periodic assessments ensure a commitment towards identifying deficiencies and resolving those deficiencies through food handler education and inspection standards with the goal of effectively reducing foodborne illness risks.

The Healthy People 2010 initiative for consumer health and food safety endorses an empirical approach towards describing the health of communities through the use of measurable outcomes and regular progress reports based on quantifiable results (US Food and Drug Administration, 2001). Establishing a standardized assessment allows for exploration and analysis of the data potentially revealing trends and patterns highlighting safe practices or areas in need of improvement. Dangers posed through prevalent foodborne pathogens that are known associates with certain food safety behaviors such as *Escherichia coli, Salmonella, Campylobacter,* and *Listeria* can be substantially improved through risk mitigation from cross-contamination, poor personal hygiene, or other risk factors (Bryan, 2002). Identification of which factors pose the greatest risk for a local health department's jurisdiction is a necessary step.

Food establishments offer fertile breeding grounds for potentially hazardous pathogens. Therefore, these sites are especially attractive as potential control points for demonstrating the effects of proven food safety training and education interventions. Identification and focus on critical control points during food preparation could prevent a lapse by a single food handler from resulting in an exponential consequence for high volume restaurants. There is substantial opportunity through a comprehensive assessment program anchored on dependable baseline measures to identify and target those modalities most effective at sustaining long-term proper food handling practice (Jones & Angulo, 2006).

METHODS

The first step toward establishing the foundation for an assessment of risk is to compare local jurisdiction measures to the national standard. The primary benefit of a standardized approach is to ensure the accurate identification of focus areas that are successful and those that require improvement. These focus areas may be used for programmatic improvement and for the efficient allocation of funding for best practices and successful education initiatives. The ability to identify and quantify weak versus effective food safety behaviors is critical for the development of successful food safety programs.

Using guidelines set forth by the FDA, the FWPHD's inventory of food establishments was used to determine sample size based on the number of permitted food establishments. Industry segments included institutions, restaurants, and retail food stores. Institutions included hospitals, nursing homes, and schools. Restaurants included

fast food and full service restaurants. Retail food stores included deli, meat, seafood, and produce purveyors. A strict randomization protocol was used to select facility types within industry segments to ensure all had the same chance of inclusion. Based on the inventory number of each facility type, sample sizes that would optimize statistical reliability were determined. Although school and hospital inspections were completed, the active inventory for these establishments yielded a very low sample size and therefore was not included for statistical comparison.

Only FDA food facility category types 2-5 with an active permit and regular inspection schedule were included. For those facilities where inspections could not be completed due to closure, unforeseen renovations, or hours of operation and inspection timing, oversampling ensured the required sample minimums would be met.

The selection of consumer health specialists (CHS) responsible for facility inspections included those best qualified due to field experience and inspection standardization criteria outlined within the National Voluntary Retail Food Regulatory Program Standards. Choosing standardized CHS with field experience helped ensure reliable inspection and data collection.

For facility inspection, the standardized FDA Baseline Data Collection Form was used. Based on the FDA Food Code, 42 items for observation were included. Four responses for each included in compliance (IN), out of compliance (OUT), not observed (NO), and not applicable (NA).

A total of 338 inspections with 6,339 observations for out compliance items from the restaurant and retail store industry segments were used for analysis with data

compiled from the FDA's national study. Paper hardcopies were filled out for each inspection and entered into a Microsoft Access database custom designed for the FWPHD according to FDA guidelines for data entry. The Access database, Microsoft Excel, and SPSS v.15.0 statistical software were utilized for data analyses. Chi-square and odds ratios were computed for out of compliance inspection observations identified for the six foodborne illness risk factors including food from unsafe source, inadequate cooking, improper holding, contaminated equipment, poor personal hygiene, and chemical/other contaminants. Within each of the six risk factors, analyses included an overall comparison, an industry segment comparison between restaurants and retail stores, and a facility type comparison. The quantification of risk factors posing the greatest risk for foodborne illness in the local jurisdiction was thus achieved.

RESULTS

The overall comparison for out of compliance rates for each risk factor between the FWPHD and the FDA's assessment is presented in Figure 1. The FWPHD was significantly more likely to be in compliance than the FDA assessment for four out of the six risk factors including food from unsafe source, inadequate cooking, improper holding, and poor personal hygiene (indicated by an asterisk in Figure 1). Tables 1-6 provide the results of analyses for each risk factor by industry segment compared to the FDA assessment with corresponding odds ratio and 95% confidence intervals. General comparison of FWPHD performance with the FDA assessment indicates the FWPHD is more likely to be in compliance. However, as Tables 1-6 indicate, there are specific areas

that warrant targeted attention, specifically, contaminated equipment and chemical/other hazards.

Although the overall percentage for contaminated equipment was found to be more likely in compliance (OR = 0.94; CI = 0.81, 1.10), the significant result for the FWPHD was found in the fast food industry segment of this risk factor, which reflected an odds ratio of 1.81 times the FDA's assessment (OR = 1.81; CI = 1.27, 2.58). Otherwise, fast food restaurants had mixed results with significantly better compliance rates for inadequate cooking, improper holding, and poor personal hygiene only.

The overall percentage for chemical/other hazards was the only risk factor for which the FWPHD that had a higher out of compliance rate than the FDA (OR = 1.10; CI = 0.82, 1.47). Although not significant, review of the industry segments reflects a consistent elevated level of risk for this factor. For example, fast food restaurants (OR = 1.41; CI = 0.79, 2.54) and deli markets (OR = 1.51; CI = 0.78, 2.94).

Within each risk factor category, the restaurant industry segment was significantly more likely to be in compliance for all six risk factors except chemical/other hazards (OR = 1.06; CI = 0.70, 1.61). The retail store industry segment was significantly more likely to be in compliance than the FDA standard only for food from unsafe source (OR = 0.16; CI = 0.07, 0.41) and improper holding risk factors (OR = 0.15; CI = 0.12, 0.21) making this industry segment a primary target for improvement.

Within the retail industry segment, several areas were identified for improvement including meat markets for poor personal hygiene (OR = 1.34; CI = 0.92, 1.93) and contaminated equipment risks (OR = 1.33; CI = 0.92, 1.94), and seafood markets

identified for poor personal hygiene measures (OR = 1.28; CI = 0.81, 2.02). Another remarkable finding was identified with respect to produce facilities and the risk from unsafe food source (OR = 2.75; CI = 0.17, 44.50).

DISCUSSION

By establishing a point of reference for the current status of the FWPHD food safety program using the FDA's method, a risk assessment unique to the local jurisdiction can be developed identifying specific areas for risk mitigation. Mitigation may be achieved through educational programs, heightened inspection processes, or other interventions.

For the FWPHD, results of this study identified overall better compliance rates for four out of six foodborne illness risk factors. However, contaminated equipment and chemical/other hazards are two specific areas of concern for the local community. The danger that various pathogens pose for cross contamination from raw animal foods to ready-to-eat products presents a challenge for identifying critical control points during the course of food preparation. Bacterial pathogens such as *Escherichia coli* represent a significant risk causing 1 in 5 foodborne disease outbreaks (Centers for Disease Control and Prevention, 2006). This has historically been the case in most of the largest food recalls and consumer infection events.

For the local jurisdiction's fast food industry, contaminated equipment presents significant importance for the role of food handling within the industry. Past outbreaks due to *Escherichia coli* O157:H7 in various parts of the country have been linked to cross-contamination from raw beef to ready-to-eat foods during food preparation.

Currently, the only preventive measure for avoidance of the risk posed by cross-contamination is the prevention of consumption of contaminated food (Jackson et al., 2000). Emphasis on safe and effective food handling at all stages of preparation, particularly within the local jurisdiction's fast food industry, is borne out through these analyses.

Food handler training should, therefore (at least locally), focus on utensils, work surfaces, equipment, and hand washing practices to augment protection from these cross contamination risks. Adequate cleaning and sanitizing is essential for minimizing the risk of cross contaminants such as *Salmonella* and *Escherichia. coli* (Jones & Angulo, 2006). However, the challenge is to develop intervention strategies that ensure that practices causing such undesirable outcomes are consistently implemented.

Although not statistically significant, analyses of FWPHD data indicated that contamination of food from chemical/other toxic substances has also been identified as posing a risk for the local jurisdiction. This being the single risk factor for which the FWPHD had a lower compliance rate than the FDA assessment. Therefore, focus on proper labeling of chemical containers and proper storage of cleaning or chemical agents separate from food items should be targeted. The presence of poisonous or toxic materials chemicals, pesticides, medicines, or other personal care items stored near food preparation areas should be restricted and special attention given to education efforts to identify the need for proper labeling and prevention of personal items in and around food preparation areas. These educational efforts perhaps augmented by strict inspection citation practices may help foster appropriate storage practices.

According to the data, poor personal hygiene for the FWPHD's retail store industry should be addressed for all facility types. From tracking FoodNet (Centers for Disease Control and Prevention, 2006) data, poor personal hygiene was the second most commonly reported behavior linked to illness and contributing to foodborne disease outbreaks nationwide (Todd, Greig, Bartleson, & Michaels, 2007). The role of food handlers and the risks they pose through contamination is one factor related to the etiology of many pathogens and subsequent disease. Although difficult to confirm as a foodborne pathogen through laboratory testing, several groups of viruses pose a significant threat to food safety. The two most recognized are the norovirus and hepatitis A virus. Documented outbreaks can typically be traced back to food handler's poor personal hygiene. Working while ill and failure to adequately wash hands are the most typical factors contributing to contamination. Training programs should promote heightened awareness through food handler education and managerial promotion of the identification and prohibition of sick workers and other hygiene practices (Koopmans & Duizer, 2004).

One serious limitation of the FWPHD assessment was the exclusion of highly susceptible individuals as represented by schools, nursing homes, and hospital populations since the number of these institutions was insufficient for appropriate statistical analysis and therefore not included in this study. Although the numbers of samples collected were insufficient for adequate statistical analyses, inspections were completed by the FWPHD for schools, day care centers, hospitals, and nursing homes. These data can be used internally for preliminary tracking of areas in need of

improvement. Since this segment represents the highest percentage of the population categorized as highly susceptible to foodborne illness, continued data collection and analysis is warranted (Kendall, Hillers, & Medeiros, 2006).

When compared to the FDA's national assessment for restaurant and retail industry segments, the FWPHD's food safety program demonstrates a statistically significant protective effect for compliance against four out of six risk factors identified for foodborne illness. Standardized consumer health training and education for consumer health specialists, an effective inspection process, and mandatory food handler certification for all food establishment employees appear to contribute to an effective food safety program. Requiring food handlers to be recertified every two years affords the opportunity to impact the industry with modified or revised food handler curriculum improving on-site practices. Knowledge of which risk factors pose the greatest threats to the local jurisdiction is paramount in designing these educational modalities so that risk factors can be effectively reduced. Based on the FWPHD's assessment of areas in need of improvement, course requirements for all local food handlers consequently should require the food handler to demonstrate a working knowledge of protection from contamination, risks posed by improperly labeled chemicals or toxins, and personal hygiene standards for proper hand washing. However, because every major municipality has its own individual character, it is important that similar assessments be conducted in other areas with a large consumer health responsibility (Texas Department of State Health Services, 2006).

Without a vehicle for comparing the effectiveness of training and education across jurisdictions, it is impossible to gauge the effectiveness of food safety programs. This mechanism enables comparison of food safety performance across jurisdictions thereby validating standardization efforts attempted through legislation. Up to this point, research attempting to compare the effectiveness of food safety programs has been impractical due to the lack of standardized measures through which comparison can be achieved. In Texas, differences in the inspection process, inspection documentation, scoring processes, and consumer health specialist standardization obstruct the ability to effectively compare and analyze food safety programs. This study demonstrates that a common framework towards quantifying a local health department's food safety program by comparison to a national standard is not only achievable but practical. Periodic assessments, such as five and ten year programmatic assessments advocated by the FDA, can now provide data through which trends and patterns can be identified. A multi-year, long-term commitment towards identifying the successes and failures within a food safety program can be used to direct the efficient allocation of limited resources and optimize the well-being of the community. It is an essential commitment by every health department to ensure the integrity of the local food safety program. The results of the FWPHD study provide insight into methods that can be used to isolate those contributors in a food safety program that offer the greatest return towards reducing risk and safeguarding the health of the local consumer.

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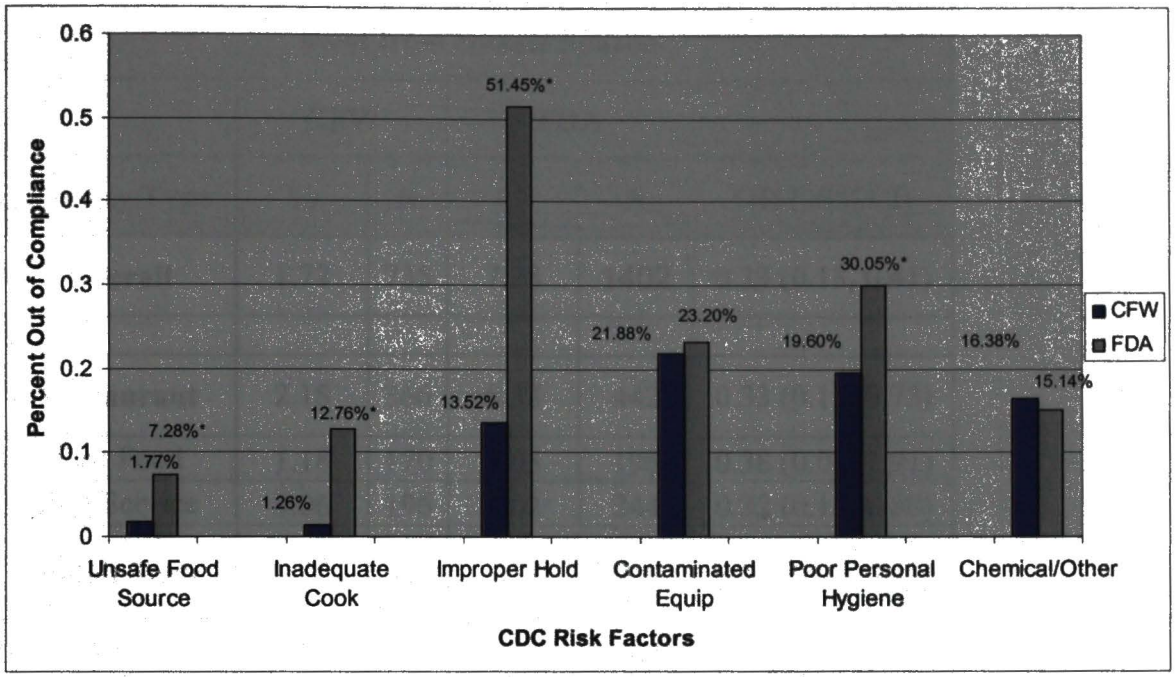

Figure 1. Comparison of percent out of compliance rates among the six foodborne illness risk factors.

Food from Unsafe Source					
	CFW		FDA		
Facility Type	%	N	%	N	OR (95%CI)
Overall	1.77	735	7.28	1402	0.23 (0.13, 0.41)
Restaurant	2.18	366	6.33	442	0.33 (0.15, 0.73)
Fast Food	1.18	170	3.03	198	0.38 (0.08, 1.91)
Full Service	3.06	196	9.02	244	0.32 (0.13, 0.80)
Retail Store	1.35	369	7.71	960	0.16 (0.07, 0.41)
Meat	0.00	104	5.39	204	$p < 0.01$
Produce	1.39	72	0.51	196	2.75 (0.17, 44.50)
Seafood	1.09	92	16.00	350	0.06 (0.01, 0.42)
Deli	2.97	101	2.86	210	1.04 (0.25, 4.25)

Table 1. Comparison of odds ratios and confidence intervals for Food from Unsafe Source

Inadequate Cook					
	CFW		FDA		
	%	N	%	N	OR (95%CI)
Overall	1.26	556	12.76	909	0.09 (0.04, 0.19)
Restaurant	0.21	478	13.53	665	0.01 (0.00, 0.10)
Fast Food	0.48	210	10.99	273	0.04 (0.00, 0.29)
Full Service	0.00	268	15.31	392	$p < 0.01$
Retail Store	7.69	78	10.65	244	0.70 (0.28, 1.76)
Meat	NA	NA	NA	NA	NA
Produce	NA	NA	NA	NA	NA
Seafood	NA	NA	NA	NA	NA
Deli	7.69	78	10.65	244	0.70 (0.28, 1.76)

Table 2. Comparison of odds ratios and confidence intervals for Inadequate Cook

Improper Hold					
	CFW		FDA		
	%	N	%	N	OR (95%CI)
Overall	13.52	1413	51.45	2241	0.15 (0.12, 0.17)
Restaurant	14.24	934	57.20	972	0.12 (0.10, 0.15)
Fast Food	12.23	425	49.16	415	0.14 (0.10, 0.20)
Full Service	15.91	509	63.19	557	0.11 (0.08, 0.15)
Retail Store	12.11	479	47.04	1269	0.15 (0.12, 0.21)
Meat	14.28	77	35.45	189	0.30 (0.15, 0.61)
Produce	15.38	78	51.29	271	0.17 (0.09, 0.33)
Seafood	2.33	43	33.67	294	0.05 (0.01, 0.35)
Deli	12.10	281	56.7	515	0.10 (0.07, 0.16)

Table 3. Comparison of odds ratios and confidence intervals for Improper Hold

Contaminated Equipment					
	CFW		FDA		
	%	N	%	N	OR (95%CI)
Overall	21.88	1385	23.20	2720	0.94 (0.81, 1.10)
Restaurant	23.65	744	29.59	963	0.74 (0.59, 0.92)
Fast Food	23.65	351	14.62	465	1.81 (1.27, 2.58)
Full Service	23.66	393	46.57	498	0.40 (0.30, 0.54)
Retail Store	19.81	641	19.69	1757	0.99 (0.79, 1.24)
Meat	27.88	208	22.46	463	1.33 (0.92, 1.94)
Produce	10.91	110	21.69	378	0.44 (0.23, 0.84)
Seafood	13.60	125	14.16	445	0.95 (0.54, 1.70)
Deli	20.20	198	20.59	471	0.98 (0.65, 1.47)

Table 4. Comparison of odds ratios and confidence intervals for Contaminated Equipment

Poor Personal Hygiene					
	CFW		FDA		
	%	N	%	N	OR (95%CI)
Overall	19.60	1786	30.05	2938	0.57 (0.49, 0.65)
Restaurant	16.65	865	45.11	1044	0.24 (0.20, 0.30)
Fast Food	27.23	481	36.63	516	0.75 (0.57, 0.98)
Full Service	27.96	515	53.41	528	0.34 (0.26, 0.44)
Retail Store	22.37	921	21.75	1894	0.96 (0.80, 1.17)
Meat	23.13	268	18.38	468	1.34 (0.92, 1.93)
Produce	19.58	189	26.1	456	0.69 (0.45, 1.04)
Seafood	19.28	166	15.77	463	1.28 (0.81, 2.02)
Deli	25.17	298	26.43	507	0.94 (0.68, 1.30)

Table 5. Comparison of odds ratios and confidence intervals for Poor Personal Hygiene

Chemical/ Other					
	CFW		FDA		
	%	N	%	N	OR (95%CI)
Overall	16.38	464	15.14	1242	1.10 (0.82, 1.47)
Restaurant	20.18	218	19.24	395	1.06 (0.70, 1.61)
Fast Food	24.24	99	18.46	195	1.41 (0.79, 2.54)
Full Service	16.81	119	20.00	200	0.81 (0.45, 1.46)
Retail Store	13.01	246	13.22	847	0.98 (0.64, 1.50)
Meat	15.28	72	16.9	213	0.89 (0.42, 1.85)
Produce	3.45	58	13.53	235	0.26 (0.06, 1.14)
Seafood	6.25	48	6.45	186	0.97 (0.26, 3.75)
Deli	23.53	68	16.9	213	1.51 (0.78, 2.94)

Table 6. Comparison of odds ratios and confidence intervals for Chemical/Other