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A Comparison of Food Inspection Practices of the U.S. Air Force and Ohio Local Public Health

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Abstract

Objective: As Americans consume more meals outside the home, food safety of restaurants is more critical. The purpose of this study is to examine the effect of food service establishment (FSE) inspection frequency on FSE performance. In this study, the U.S. Air Force (USAF) public health system is compared to Ohio local public health departments (Ohio LPHDs). The USAF inspects FSEs more frequently than Ohio LPHDs do. The goal is to determine if this increased frequency leads to higher food safety in the FSEs.

Methods: We reviewed 1482 reports from three USAF bases and 1909 reports from six Ohio LPHDs for the years 2011 and 2012. Data evaluated includes: total, critical, and non-critical food safety violations and inspection frequency. We looked at violations per inspection, which were determined by dividing violations (total, critical, and non-critical) by the total number of inspections. Annual frequency for both groups is determined by taking the total number of inspections for both years divided by two. Test for significance of the violations and frequency differences are performed by t-test using the 95% confidence level.

Results: The USAF shows significantly lower rates in total, critical, and non-critical violations, and inspects at significantly higher frequency.

Conclusion: The results show that frequent inspections coincide with fewer violations. The more frequent schedule affords greater opportunities to conduct food safety education. Further research might determine if an intermediate inspection schedule could offer similar protection as observed with the USAF schedule.

Keywords: food inspections, public health, food safety, violations

A Comparison of Food Inspection Practices of the U.S. Air Force and Ohio Local Public Health

Foodborne illness in the United States constitutes a heavy burden on the public health system. According to the Centers for Disease Control and Prevention, foodborne illness affects 48 million Americans each year, or roughly one in six people. Of this number, 128,000 are hospitalized, and 3,000 people ultimately die due to the illness or any of the complications that can arise from the illness (Centers for Disease Control and Prevention, 2011). In a study by Robert Scharff and colleagues of the Ohio State University (Scharff, McDowell, & Medeiros, 2009), the estimated cost of foodborne disease due to treatment, lost productivity, and pain and suffering is $77.7 billion annually. The lost productivity includes time missed from work either due to the illness or by parents missing work to take care of sick children. Scharff further describes the burden with respect to Ohio. Within the state, Scharff estimates an economic toll of roughly one to seven billion dollars annually. This equates to an amount ranging from $91 to $624 per Ohio resident per year (Scharff et al., 2009).

In the U.S., the percent of the population obtaining their food from outside of the home, rather than cooking it themselves in their homes, is increasing. One estimate by Cates et al. (2009) shows that in the U.S., approximately one out of every five meals is consumed outside of the home in food service establishments (FSEs). A significant proportion of the cases of foodborne illnesses originate from FSEs. Kwon, Roberts, Shanklin, Liu, and Yen (2010) report that 60% of all foodborne outbreaks originate in FSEs. Food service establishments have the potential to result in larger outbreaks due to the amount of people served. Poor food safety practices at an individual FSE have the potential to affect a greater amount of people than the same poor practices if done at an individual's home. To protect the public against foodborne

disease, public health departments employ sanitarians to inspect local food establishments on a routine basis.

Purpose Statement

The goal of this study is to determine whether frequency of inspection affects individual food establishment inspection results. Different health districts employ various inspection schedules. These schedules can be based on restaurant risk level, available resources to conduct inspections, or prior restaurant performance. This study will look at inspection frequencies as numerous as monthly to less frequent schedules of three or four times annually. Food safety inspections, inspector training, and inspection frequency is reviewed in the literature.

Literature Review

Inspector Training

Both the training and duties for public health technicians varies between the military and civilian sectors. According to the Air Force Careers website (United States Air Force, 2013), the educational prerequisite to becoming a public health technician is possession of a high school diploma or GED and completion of fifteen college credit hours. This contrasts the civilian sanitarian requirement of completion of a bachelor's degree with 45 college hours being in specific science courses (Ohio State Board of Sanitarian Registration, 2012). Sanitarians in Ohio first are classified as sanitarian-in-training, and promote to registered sanitarian (RS) upon completion of two years of on-the-job training and successful passing of the registered sanitarian certification exam (Ohio State Board of Sanitarian Registration, 2012). An RS can maintain certification with an annual completion of 18 continuing education hours.

The Air Force has a public health training program lasting 60 days. This program consists of training in the following areas: food and public facility inspections for sanitary

conditions, performing sanitary practices education, occupational health monitoring, and public health patient interaction skills (United States Air Force, 2013). Upon completion of public health training, air force personnel generally work in one of two public health career tracks. The first track is in Force Health Management. Here personnel manage occupational health related issues. The second career path is Community Health. In this path, primary responsibilities include: food safety and public facility sanitation programs, medical entomology, communicable disease monitoring programs, and conducting public health education programs (United States Air Force, 2002). Like the civilian sector's sanitarian-in-training classification, Air Force public health technicians completing their initial training have on-the-job training to complete. Air Force public health technicians also have ongoing requirements for further educational training in order to achieve career progression and rank promotion (United States Air Force, 2002).

Food Service Establishment Inspections

Restaurants are routinely inspected by trained sanitarians that look for food safety code violations. These violations are recorded, and appropriate action can be applied to mitigate future violations. The Air Force uses an adapted version of the Food and Drug Administration's (FDA) food code from 2005 (United States Food and Drug Administration, 2005). The state of Ohio uses an adapted version of the FDA's food code from March 2009 which is titled the Ohio Uniform Food Safety Code (Ohio Department of Health, 2009). While both food codes have basically the same violations, Ohio uses a more recently updated version. This means that Ohio likely has more up-to-date regulations for food service operators to follow to help prevent food borne illness. Enforcement practices vary among military installations and Ohio local public health departments but can include re-inspecting the facility looking for positive changes shortly

after the original inspection, a temporary shut-down of the facility while corrections to the violations are made, or a revocation of the facilities food license.

The impact of food inspections can vary. With regards to predicting foodborne outbreaks, studies by Cruz, Katz, and Suarez (2001) and Jones, Pavlin, LaFleur, Ingram, and Schaffner (2004) both fail to show a relationship between poor inspection results and the likelihood of foodborne outbreaks. In the study by Cruz et al. (2001), a comparison is made between the inspection reports of restaurants with a history of foodborne outbreaks and the inspection reports of a control group of restaurants without an outbreak history. The study does not reveal a difference in food safety violations in the inspection reports of the case (outbreak) restaurants compared to the control restaurants. However, Irwin, Ballard, Grendon, and Kobayashi (1989), in a similar study also compare inspection data of restaurants with the history of foodborne outbreaks to a sample of restaurants free of an outbreak history. They find that restaurants causing outbreaks have significantly worse inspection results compared to the control restaurants.

The study by Jones et al. (2004) shows a trend of improving inspections results over a seven year period, with the greatest improvements being in the initially poor performing restaurants. This result points to positive impact from food safety inspections on the food industry. Alternatively, a study examining a large multi-county sample of restaurants in Oklahoma finds that roughly fifty percent of all critical violations found on an inspection are repeat offenses from the previous inspection (Phillips, Elledge, Basara, Lynch, & Boatright, 2006). This finding counters the idea that inspections have a positive impact on food safety. The authors theorize that repeat violations on inspections are a clear indication that food service operations are not using the findings of the inspections to improve their procedures. Phillips,

Elledge, Basara, Lynch, and Boatright (2006) further claim that while repeat violations are a good indicator of problem restaurants, an absence of repeat violations does not necessarily mean that a restaurant is performing at higher standards. This is due to inspections reflecting a "snap shot" of time in a single day of operations. This picture of operations is also generally performed during business hours of the public health departments and may not be representative of the sanitary conditions of the establishment during evening hours, holidays, and weekends.

Multiple studies have examined the relationship between restaurant risk class and inspection performance. Restaurants are assigned to different risk classes based on multiple criteria: serving of potentially hazardous foods, the number of steps in the food preparation process, and the likelihood of serving to at risk populations (Newbold, McKeary, Hart, & Hall, 2008). In the study by Phillips et al. (2006), there is a direct correlation between violation type and quantity of violations with high risk establishments. Specifically, high-risk restaurants had more critical violations and repeat critical violations as compared to medium-risk restaurants. However, a study of facilities on a U.S. Naval base in San Diego, California by Boyd (2007) finds that higher risk restaurants on the base routinely outperformed the lower-risk restaurants. Boyd points out that the full service food establishments on the base are more likely to be staffed by enlisted military members who typically have more formalized food handling training. In comparison, the fast food or medium-risk restaurants tend to be staffed by younger employees and had higher employee turnover rates. Also noted in this sample, is the fact that there is a greater incentive for higher performance in the military staffed establishments, as bonuses and promotions can be tied to restaurant performance. Interestingly in this study, the medium-risk fast food restaurants performed below the Food and Drug Administration (FDA) national baseline, while the full service restaurants performed higher than a matched FDA baseline.

Inspection Frequency

Restaurants are routinely inspected for compliance with standards in the food safety code. The individual health department typically determines the frequency of inspections for restaurants operating in that district. Often the frequency is based on requirements by the food safety code and associated law. However, the question remains as to what constitutes the ideal frequency. Much of the literature is mixed as to optimum number of inspections per year. The following section will focus on the research found in literature examining this question of frequency.

Kaplan (1978) uses statistics to determine the optimum frequency of restaurant inspections that would be effective to prevent or detect unsafe restaurant conditions. As an example, Kaplan uses a restaurant that has unsafe conditions that would constitute violations during 50% of the year. If that restaurant is only inspected twice a year, there is a 25% chance that the unsafe conditions will not be detected during an inspection. For a second example, there is a restaurant that has unsafe conditions that would constitute violations during 10% of the year. Even if this restaurant is inspected four times a year, there is a 65.6% chance that the unsafe conditions will not be detected during an inspection. The article shows that it is risky to judge the safeness of a restaurant or determine the needed frequency of inspections based on a restaurants previous inspection reports. The report goes on to say that inspection frequency is still an important aspect because it allows sanitarians the opportunity to deliver health education that may prevent restaurant workers from contributing to unsanitary behavior. Additionally, the fear of being caught by an inspection many incentivize some workers to follow safe food handling practices.

A study by Bader, Blonder, Henriksen, and Strong (1978) was done in Seattle-King County, Washington from 1970 to 1971 to see if quarterly inspections were necessary for food service establishments. Restaurants were randomized into two paired groups based on their prior inspections scores and violation histories. The control group continued to have a quarterly inspection schedule while the experimental group was inspected once a year and upon receipt of a complaint against the restaurant. The control and experimental groups' inspections scores and violations were then compared. Their study finds that thirty-five percent of the restaurants on the less frequent inspection schedule were rated as unsatisfactory on the follow-up inspection the following year. Seventeen percent of the restaurants on the quarterly inspection schedule were found to have unsatisfactory inspections at the one-year point. The telling statistic in this study is that twelve percent of the experimental group registered foodborne illness complaints from the public during the year of the study, as compared to only two percent of those in the control group.

Allwood, Lee, and Borden-Glass (1999) had a similar study. Due to financial constraints, the local public health department in Bloomington, MN needed to decrease the frequency of inspections for restaurants. Restaurants were placed into one of three groups; each group was inspected less frequently than the year prior to the study. One group went from four inspections to three inspections a year. The second group went from three inspections to two inspections a year. The third group went from four inspections to two inspections a year. The group of restaurants that went from four inspections to two inspections a year had statistically significant decreases in inspection scores; however, the other two groups also showed decreasing inspection scores with the decrease in inspection frequency. Allwood et al. (1999) theorize that the

decrease in scores is at least partially due to decreased opportunities for sanitarians to educate restaurant staff about food safety and violations.

However, studies by Corber, Barton, Nair, and Dulberg (1984) and Newbold, McKeary, Hart, and Hall (2008) find that increased frequency does not lead to better food code compliance. Corber et al. (1984) find that there is no significant improvement of inspection findings when inspection frequency is increased from bi-monthly to monthly. The study by Newbold et al. (2008) examines restaurants inspected on a frequency of three, four, or five times annually and finds no statistically significant difference between the different inspection schedules. The study does note that the frequency of inspection might be more beneficial if it were based on a risk assessment of the individual restaurant. Risk based frequency timing is also recommended in an article by Hoag, Porter, Uppala, and Dyjack (2007), who support higher-risk restaurants being inspected three times a year while medium risk restaurants being inspected twice annually.

Newbold et al. (2008) include in their study a survey of practicing sanitarians to find what they feel is an optimum frequency. In the pre-study survey a majority of sanitarians believed that increased frequency would lead to better compliance as well as decreased need of re-inspection. However in the post study questionnaire, most sanitarians report that frequency of inspection should be based on multiple factors, such as risk status and previous history of inspections. They support a reward based inspection schedule, where poor performing restaurants would be inspected more frequently.

Some public health districts are insufficiently staffed, and increased inspection frequency of poor performing restaurants is not possible. Zablotsky Kufel et al. (2011), in a study of Maryland's health district's capacity to handle foodborne illness, find that higher capacity health districts, in the terms of budget and manpower, show a significant improvement in foodborne

illness rates when compared to lower capacity districts. While public health districts have to contend with short manning and budget issues, some health districts encourage food code compliance through means other than increased inspection frequency. Among these methods are public disclosure of inspection findings via news media or posting on the internet databases and assigning letter or numerical scores to the restaurant inspection reports which the restaurant is subsequently required to post in a visible location in the restaurant. A study by Serapiglia, Kennedy, Thompson, and Burger (2007) finds that public reporting of restaurant inspection findings is a highly statistically significant method in reducing restaurant operator non-compliance.

Methods

Food inspection data was obtained from standard inspection reports from Ohio local public health department websites. Specifically, six Ohio local public health departments are examined: Cincinnati, Cleveland, Columbus, Franklin County, Hamilton County, and Montgomery County. Inspection data was also collected from three U.S. Air Force Bases. The three bases include Lajas Field, Maxwell Air Force Base, and Wright-Patterson Air Force Base. Air Force data was obtained by requesting access to inspection results from each individual base. Permission to use the data for research purposes was also obtained prior to data processing from each of the three Air Force bases. Restaurants in the Ohio local public health department data set were chosen to match a specific restaurant, type of eating establishment, or food retail establishment found on the Air Force bases to aid in data comparison. These food establishments were put into one of nineteen different establishment categories which include the following: subs or sandwich shop, day care, youth center, school, coffee shop, ice cream, golf club, liquor store, Burger King, Chinese, Japanese, service station, grocery, bowling, theater,

chicken, Taco Bell, club, and pizza. The club category refers to an All Ranks Club on base or a family dining establishment such as a steak house or Bob Evans in Ohio. These categories were chosen to match a specific restaurant on a military installation.

To establish a baseline and detect inspection frequency trends for the individual restaurants, inspection reports for each restaurant were reviewed from January 2011 through the most recent available reports. For the military installations, the review included everything from January 2011 through December 2012. For the Ohio local public health departments, the review started in January 2011 and extended through any 2013 data that was available. The total violations, total critical violation, and total non-critical violations per inspection report are recorded from each inspection report. Violations are classified as critical or non-critical according to the food code utilized by the inspectors. Violations at each inspection were reviewed and classified into one of nine categories for this study. Categories used during this study include surfaces, employee related, temperature issues, pests, cross-contamination, floors/ceilings, date marking/labeling, supply, and other. The category "other" is a catch-all category for violations that did not fit into any of other categories. Most often violations fitting into this category concerned equipment or maintenance issues. These categories were chosen based on the most frequently seen violations in the inspection reports reviewed during the study.

Data was put into Microsoft Excel spreadsheets during the data gathering phase of the research. The data was then transferred into the IBM Statistical Package for Social Sciences (SPSS) for Windows, version 20, for statistical analysis. Descriptive statistics were used to calculate the total number of inspections reviewed from the combined data and then individually from the Air Force data and Ohio local public health department data. Similarly, the total violations, critical violations, and non-critical violations were reviewed for each of the groups.

The number of establishments reviewed in each of the nineteen establishment categories was calculated for each of the three groups. The percent of the total number of establishments reviewed was obtained by dividing the number establishments in an establishment category by the total number of establishments reviewed in the study. This was done for the combined Air Force and Ohio local public health department data, the Air Force data, and the Ohio local public health department data.

The frequency of inspections was calculated by counting the number of inspections completed at each establishment between January 2011 and the end of December 2012 and dividing by two. This was done prior to entering the data into SPSS for further analysis. SPSS was used to find the establishment category's mean inspection frequency, range, and standard deviation for the combined Air Force and Ohio local public health department data, Air Force data, and the Ohio local public health department data.

The mean number of violations per visit was calculated by dividing the total number of violations (critical and noncritical) by the number of inspections completed. The mean number of critical violations per visit was calculated by dividing the total number of critical violations by the number of inspections completed. The mean number of noncritical violations per visit was calculated by dividing the total number of noncritical violations by the number of inspections completed. These statistics were performed with SPSS through the ratio statistics function for each establishment category, segmented by the combined Air Force and Ohio local public health department data, the Air Force data, and the Ohio local public health department data. The 95% confidence interval and standard deviation are also reported for each of the categories.

Direct comparisons were made between establishment categories found on Air Force bases and those found in Ohio local public health departments to see if there was a difference in

the frequency of inspections per year, average number of all violations per inspection, average number of critical violations per inspection, and average number of noncritical violations per inspection. Statistical analysis for significance of these comparisons was performed by analyzing the data in Microsoft Excel using a t-test.

Results

Table 1 shows the comparisons of the number of inspections reviewed and violations found from the inspection reports. Fewer establishments were reviewed from Air Force bases as compared to those from Ohio local public health departments. The Air Force data also shows drastically lower numbers in all categories of violations reviewed from the inspection data. In all cases there were fewer critical violations than non-critical violations.

Table 2 compares the number of restaurants in each of the nineteen different establishment categories used during this study. There was some variation between the Air Force data and Ohio local public health department data on the percentage of establishments reviewed in each category. The highest discrepancy is seen in the youth center category followed by the school and coffee shop categories.

Table 1

Number of Restaurant Inspections and Violations Reviewed

	Combined Air Force and Ohio Data	Air Force Data	Ohio Data
Number of Inspections Reviewed	3391	1482	1909
Total Number of Violations	3542	279	3263
Total Number of Critical Violations	1398	85	1313
Total Number of Non-Critical Violations	2153	194	1959

Table 2

Number of Restaurants Reviewed by Category

Restaurant Category	Combined Air Force and Ohio Data		Air Force Data		Ohio Data	
	Number	Percent of Combined Restaurants (%)	Number	Percent of Air Force Restaurants (%)	Number	Percent of Ohio Restaurants (%)
Subs	37	6.5	4	4.0	33	7.1
Day Care	39	6.9	7	7.0	32	6.9
Youth Center	31	5.5	20	20.0	11	2.4
School	53	9.3	15	15.0	38	8.1
Coffee Shop	49	8.6	15	15.0	34	7.3
Ice Cream	25	4.4	1	1.0	24	5.1
Golf Club	29	5.1	6	6.0	23	4.9
Liquor Store	17	3.0	1	1.0	16	3.4
Burger King	33	5.8	2	2.0	31	6.6
Chinese	17	3.0	2	2.0	15	3.2
Japanese	14	2.5	1	1.0	13	2.8
Service Station	38	6.7	7	7.0	31	6.6
Grocery	34	6.0	5	5.0	29	6.2
Bowling	19	3.4	4	4.0	15	3.2
Theater	15	2.6	2	2.0	13	2.8
Chicken	28	4.9	1	1.0	27	5.8
Taco Bell	31	5.5	2	2.0	29	6.2
Club	26	4.6	3	3.0	23	4.9
Pizza	32	5.6	2	2.0	30	6.4
Combined Total	567	100.0	100	100.0	467	100.0

Table 3 compares the mean number of inspections completed in each of the nineteen establishment categories. The Air Force data shows a higher number of inspections per year in each category except for the liquor store category. The biggest difference in inspection

frequency between the Air Force data and Ohio local public health department data was seen in the club establishment category. The smallest difference was seen in the liquor store category. There is a significant difference seen when comparing the combined total mean frequency of inspections per year between the Air Force data and the Ohio local public health department data.

Table 3

Mean Number of Inspections per Year by Restaurant Category

	Combined Air Force and Ohio Data		Air Force Data		Ohio Data	
Restaurant Category	Mean (Range)	Standard Deviation	Mean (Range)	Standard Deviation	Mean (Range)	Standard Deviation
Subs	2.743 (1-12)	2.6474	9.500 (4-12)	3.7193	1.924 (1-3)	0.4352
Day Care	3.244 (1-12)	3.6326	10.571 (6.5-12)	2.4568	1.641 (1-2.5)	0.4792
Youth Center	3.081 (1-12)	2.1836	4.050 (2-12)	2.1576	1.318 (1-2)	0.4045
School	4.274 (0.5-12)	4.2670	10.767 (4-12)	2.0166	1.711 (0.5-2.5)	0.4596
Coffee Shop	2.643 (0.5-12)	2.6868	5.800 (4-12)	2.9326	1.250 (0.5-3)	0.5674
Ice Cream	1.780 (0.5-12)	2.1798	12.000 (12-12)	#	1.354 (0.5-2.5)	0.4773
Golf Club	3.259 (0.5-12)	3.0344	8.500 (4-12)	2.7929	1.891 (0.5-4)	0.7064
Liquor Store	1.147 (0.5-2)	0.4244	1.000 (1-1)	#	1.156 (0.5-2.0)	0.4366
Burger King	2.152 (1-12)	1.8603	8.000 (4-12)	5.6569	1.774 (1-2.5)	0.4442
Chinese	3.147 (1.5-12)	2.6444	9.500 (7-12)	3.5355	2.300 (1.5-4.5)	0.7512
Japanese	2.071 (1.5-6.0)	1.1744	6.000 (6-6)	#	1.769 (1.5-2.5)	0.3301
Service Station	2.118 (1-12)	1.8506	4.571 (2.5-12)	3.3470	1.565 (1-2.5)	0.5122

Table 3 (cont.)

	Combined Air Force and Ohio Data		Air Force Data		Ohio Data	
Restaurant Category	Mean (Range)	Standard Deviation	Mean (Range)	Standard Deviation	Mean (Range)	Standard Deviation
Grocery	2.956 (1-12)	2.7396	8.700 (4-12)	3.3838	1.966 (1-3.5)	0.5499
Bowling	3.237 (1.5-12)	3.0567	8.375 (4-12)	3.3009	1.867 (1.5-2.5)	0.3519
Theater	1.933 (1-5.5)	1.1318	3.750 (2-5.5)	2.4749	1.654 (1-2.5)	0.5911
Chicken	2.143 (1-8.5)	1.3323	8.500 (8.5-8.5)	#	1.907 (1-2.5)	0.4811
Taco Bell	2.468 (0.5-11)	2.2654	10.750 (10.5-11)	0.3536	1.897 (0.5-2.5)	0.5067
Club	3.635 (1-24)	5.1021	16.500 (12-24)	6.5384	1.957 (1-2.5)	0.4241
Pizza	2.297 (1-12)	1.8616	8.000 (4-12)	5.6569	1.917 (1-3)	0.4564
Combined Total*	2.765 (0.5-24)	2.8597	7.585 (1-24)	4.0980	1.732 (0.5-4.5)	0.5579

Note. # = only one inspection available in the category, so no standard deviation calculated; * = $p < 0.01$

Table 4 compares the combined violations per inspection, critical violations per inspection, and non-critical violations per inspection. In each of the nineteen establishment categories, the Air Force data had fewer mean total violations, critical violations, and non-critical violations per visit when compared to the Ohio local public health department data. The Air Force data did have several incidences of the 95% confidence interval crossing zero indicating non-significance. This can be seen in the Air Force data for the following establishment categories: subs, day care, Burger King, Chinese, service station, grocery, bowling, theater, Taco Bell, and club. Some of the confidence intervals and standard deviations were also not able to be calculated, as seen in the table. There is a significant difference in the total violations, critical

violations, and non-critical violations seen in the combined total category between the Air Force data and Ohio local public health department data.

Table 4

Mean Number of Violations per Inspection by Restaurant Category

	Combined Air Force and Ohio Data		Air Force Data		Ohio Data	
Restaurant Category	Mean (95% CI)	Std Dev	Mean (95% CI)	Std Dev	Mean (95% CI)	Std Dev
Subs						
Tot V/I	1.208 (0.894-1.522)	0.943	0.095 (-0.160-0.350)	0.160	1.343 (1.021-1.665)	0.908
Crit V/I	0.615 (0.451-0.779)	0.492	0.042 (-0.091-0.174)	0.083	0.685 (0.516-0.853)	0.475
NC V/I	0.593 (0.374-0.811)	0.656	0.054 (-0.072-0.179)	0.079	0.658 (0.422-0.894)	0.666
Day Care						
Tot V/I	0.493 (0.293-0.693)	0.616	0.092 (0.012-0.173)	0.087	0.581 (0.347-0.814)	0.648
Crit V/I	0.140 (0.061-0.219)	0.243	0.035 (0.010-0.060)	0.027	0.163 (0.068-0.258)	0.263
NC V/I	0.353 (0.193-0.513)	0.493	0.058 (-0.002-0.117)	0.064	0.418 (0.229-0.606)	0.522
Youth Center						
Tot V/I	0.409 (0.176-0.643)	0.636	0.164 (0.035-0.293)	0.276	0.856 (0.283-1.429)	0.853
Crit V/I	0.163 (0.058-0.267)	0.284	0.044 (0.005-0.083)	0.084	0.379 (0.119-0.638)	0.386
NC V/I	0.247 (0.099-0.395)	0.404	0.120 (0.024-0.216)	0.206	0.477 (0.098-0.856)	0.564
School						
Tot V/I	0.789 (0.478-1.101)	1.129	0.160 (0.048-0.273)	0.203	1.038 (0.628-1.447)	1.245
Crit V/I	0.348 (0.184-0.511)	0.593	0.041 (0.012-0.071)	0.053	0.469 (0.251-0.687)	0.663
NC V/I	0.442 (0.265-0.618)	0.641	0.119 (0.024-0.213)	0.171	0.569 (0.335-0.803)	0.712
Coffee Shop						
Tot V/I	0.756 (0.462-1.049)	1.022	0.245 (0.061-0.430)	0.333	0.981 (0.582-1.379)	1.141
Crit V/I	0.313 (0.150-0.476)	0.567	0.061 (0.010-0.112)	0.092	0.425 (0.198-0.651)	0.650
NC V/I	0.442 (0.269-0.616)	0.605	0.184 (0.001-0.367)	0.331	0.556 (0.324-0.788)	0.665
Ice Cream						
Tot V/I	1.215 (0.552-1.879)	1.608	0.167 (&)	#	1.259 (0.572-1.946)	1.627
Crit V/I	0.361 (0.164-0.558)	0.476	0.125 (&)	#	0.371 (0.166-0.575)	0.484
NC V/I	0.854 (0.344-1.365)	1.237	0.042 (&)	#	0.888 (0.360-1.417)	1.251
Golf Club						
Tot V/I	1.863 (1.113-2.613)	1.971	0.204 (0.044-0.365)	0.153	2.296 (1.432-3.160)	1.998
Crit V/I	0.752 (0.425-1.079	0.860	0.057 (0.000-0.113)	0.054	0.933 (0.553-1.314)	0.880
NC V/I	1.111 (0.659-1.564)	1.190	0.147 (0.031-0.263)	0.110	1.363 (0.837-1.889)	1.216
Liquor Store						
Tot V/I	0.621 (0.189-1.053)	0.840	0.000 (&)	#	0.659 (0.205-1.113)	0.852
Crit V/I	0.174 (0.049-0.298)	0.242	0.000 (&)	#	0.184 (0.054-0.315)	0.245
NC V/I	0.447 (0.059-0.835)	0.754	0.000 (&)	#	0.475 (0.065-0.885)	0.770
Burger King						
Tot V/I	1.570 (0.987-2.154)	1.646	0.167 (-1.951-2.284)	0.236	1.661 (1.053-2.269)	1.658
Crit V/I	0.468 (0.251-0.684)	0.611	0.042 (-0.488-0.571)	0.059	0.495 (0.267-0.723)	0.621
NC V/I	1.103 (0.668-1.537)	1.227	0.125 (-1.463-1.713)	0.177	1.166 (0.711-1.620)	1.239
Chinese						
Tot V/I	3.824 (2.656-4.993)	2.273	0.235 (-2.223-2.693)	0.274	4.303 (3.221-5.384)	1.952
Crit V/I	1.597 (0.965-2.228)	1.229	0.071 (-0.836-0.979)	0.101	1.800 (1.157-2.443)	1.161
NC V/I	2.227 (1.578-2.877)	1.264	0.164 (-1.387-1.714)	0.173	2.503 (1.913-3.092)	1.065

Table 4 (cont.)

Restaurant Category	Combined Air Force and Ohio Data Mean (95% CI)	Std Dev	Air Force Data Mean (95% CI)	Std Dev	Ohio Data Mean (95% CI)	Std Dev
Japanese						
Tot V/I	3.519 (1.974-5.064)	2.676	0.583 (&)	#	3.745 (2.148-5.342)	2.643
Crit V/I	1.586 (0.739-2.432)	1.466	0.083 (&)	#	1.701 (0.820-2.582)	1.458
NC V/I	1.933 (1.181-2.686)	1.304	0.500 (&)	#	2.044 (1.266-2.821)	1.287
Service Station	1.498 (0.888-2.108)	1.855	0.164 (0.030-0.299)	0.146	1.799 (1.090-2.508)	1.932
Tot V/I	0.525 (0.251-0.684)	0.834	0.012 (-0.017--.041)	0.031	0.641 (0.317-0.966)	0.885
Crit V/I	0.972 (0.581-1.364)	1.190	0.152 (0.022-0.283)	0.141	1.158 (0.701-1.614)	1.246
NC V/I						
Grocery						
Tot V/I	2.762 (1.962-3.562)	2.293	0.355 (-0.126-0.836)	0.388	3.177 (2.329-4.024)	2.228
Crit V/I	1.269 (0.904-1.634)	1.046	0.152 (-0.103-0.406)	0.205	1.461 (1.076-1.846)	1.012
NC V/I	1.493 (0.974-2.012)	1.487	0.203 (-0.045-0.451)	0.200	1.716 (1.145-2.286)	1.501
Bowling						
Tot V/I	1.481 (0.608-2.354)	1.811	0.339 (-0.015-0.693)	0.223	1.786 (0.716-2.855)	1.932
Crit V/I	0.524 (0.095-0.953)	0.890	0.093 (-0.024-0.209)	0.073	0.639 (0.099-1.179)	0.975
NC V/I	0.957 (0.429-1.485)	1.096	0.246 (0.000-0.493)	0.155	1.147 (0.502-1.792)	1.165
Theater						
Tot V/I	1.207 (0.390-2.024)	1.475	0.136 (-1.596-1.869)	0.193	1.372 (0.452-2.291)	1.521
Crit V/I	0.503 (0.147-0.860)	0.643	0.000 (0.0-0.0)	0.000	0.581 (0.183-0.979)	0.659
NC V/I	0.704 (0.183-1.224)	0.940	0.136 (-1.596-1.869)	0.193	0.791 (0.197-1.385)	0.983
Chicken						
Tot V/I	2.135 (1.465-2.805)	1.728	0.059 (&)	#	2.212 (1.535-2.889)	1.712
Crit V/I	0.648 (0.349-0.946)	0.770	0.000 (&)	#	0.672 (0.365-0.978)	0.774
NC V/I	1.487 (1.010-1.964)	1.230	0.059 (&)	#	1.540 (1.057-2.023)	1.220
Taco Bell						
Tot V/I	1.024 (0.581-1.466)	1.208	0.214 (-2.508-2.937)	0.303	1.079 (0.612-1.547)	1.228
Crit V/I	0.368 (0.147-0.588)	0.602	0.024 (-0.279-0.326)	0.034	0.391 (0.157-0.625)	0.615
NC V/I	0.656 (0.390-0.922)	0.725	0.190 (-2.230-2.611)	0.269	0.688 (0.408-0.968)	0.737
Club						
Tot V/I	1.179 (0.618-1.741)	1.390	0.372 (-0.635-1.378)	0.405	1.285 (0.661-1.908)	1.442
Crit V/I	0.582 (0.255-0.910)	0.811	0.171 (-0.182-0.523)	0.142	0.636 (0.269-1.003)	0.849
NC V/I	0.597 (0.316-0.878)	0.695	0.201 (-0.454-0.857)	0.264	0.649 (0.337-0.960)	0.720
Pizza						
Tot V/I	1.267 (0.787-1.748)	1.333	0.000 (0.0-0.0)	0.000	1.352 (0.854-1.850)	1.334
Crit V/I	0.435 (0.231-0.639)	0.566	0.000 (0.0-0.0)	0.000	0.464 (0.250-0.678)	0.573
NC V/I	0.832 (0.482-1.182)	0.971	0.000 (0.0-0.0)	0.000	0.888 (0.523-1.253)	0.978
Comb. Total						
Tot V/I*	1.369 (1.230-1.508)	1.685	0.193(0.144-0.242)	0.248	1.621 (1.462-1.780)	1.754
Crit V/I*	0.538 (0.473-0.602)	0.783	0.054 (0.037-0.071)	0.085	0.641 (0.566-0.716)	0.826
NC V/I*	0.832 (0.744-0.919)	1.057	0.140 (0.100-0.179)	0.199	0.980 (0.879-1.080)	1.106

Note. 95% CI = 95% Confidence Interval for Mean; Std Dev = Standard Deviation; Tot V/I = Total Violations / Number of Inspections Reviewed; Crit V/I = Critical Violations / Number of Inspections Reviewed; NC V/I = Non-Critical Violations / Number of Inspections Reviewed; Comb. Total = Combined Total; & = only one inspection available in the category, so no confidence interval calculated; # = only one inspection available in the category, so no standard deviation calculated; * $p < 0.01$

Discussion

The results obtained from the inspection reports were similar to what was expected based on the researchers' past experience observing inspections both in Ohio and different Air Force bases. The Air Force inspects establishments that sell or serve food more frequently than Ohio local public health departments. This could be due to several reasons. Military installations are much smaller than the area controlled by a civilian public health department. Following this observation, it is logical to say that most military installations have fewer establishments that sell or serve food that will need to be inspected than civilian local public health departments.

The sanitarians in local public health departments perform inspections on the civilian establishments that sell or serve food in their district. This task is usually performed by public health technicians on military installations. Both sanitarians and technicians have other tasks and duties involved with their jobs besides food establishment inspections, but it is perhaps easier for the sanitarian to maintain their skill in inspecting food establishments due to the volume of places that they need to inspect. One reason military food establishments get inspected more frequently is due to the need by the technicians to maintain their proficiency in this skill.

The mean number of inspections performed per year at the military installations exceeds those performed in the Ohio local public health departments in each of the nineteen food establishment categories except for in the liquor store category. This might be due to the small sample size obtained from the Air Force installations reviewed in this study. Excluding the liquor store category, the minimum mean number of inspections performed per year is seen in the theater category in the Air Force. This minimum mean number of inspections in the theater category seen in the Air Force data exceeds the maximum mean number of inspections performed per year in the Ohio local public health department data, which is seen in the Chinese

food category. The mean number of inspections performed per year in the combined food categories for the Air Force data is four times the number seen in the Ohio local public health department data.

The mean number of total, critical, and noncritical violations seen in the Air Force data in any of the food categories is less than that found in the Ohio local public health department data. The literature review showed mixed results as to whether or not an increased frequency of inspections would lower the number of violations. Our data shows that an increased frequency of inspections, as seen in the Air Force data, corresponds with a lower number of violations per inspection. This relationship could be due to many different reasons. The increased frequency of inspections could lead food establishment employees to being better prepared and the establishment showing fewer violations during inspections as a result. The increased frequency of inspections also allows the technician or sanitarian to do more education on safe food handling techniques that will help to decrease the number of violations found during an inspection. Therefore, positive behaviors are more frequently reinforced, while negative practices are quickly eliminated.

Another possible reason for the decreased number of violations seen in the Air Force data could be that food establishments on a military installation have a greater incentive to have low violation rates. Military technicians have perhaps more autonomy and leeway when deciding what establishments are safe to operate on base. Therefore it is in the best interest of the food establishment to have a low number of violations so that they may remain open.

A third possible reason for the decreased number of violations in the Air Force data could be that facility maintenance is probably performed faster on a military base when compared to the civilian restaurants. The buildings that are used for food service establishments are owned by

the military. If anything needs fixed, a work order is placed and it gets fixed. On the civilian side, it can sometimes take much longer to fix or change things that might be a violation or repeat violation on an inspection report. This is likely due to the companies who own and run the food service establishment in the civilian sector need to consider their finances. They need to have the money before they can get the repairs that would fix the violation. This can lead to more violations in the civilian sector.

The source of employees for the food establishments should have no impact in the differences found in the data. Generally, food establishment employees on military installations come from the same local public source as those working in the civilian sector. Civilians from the local communities are usually the ones who staff food establishments on a base. The only exception lies in the dining halls found on base, which can have military staffing. In this case, the military kitchen workers will likely have better and more extensive training than their civilian counterparts.

One limitation in this study is the researchers' limited access to the actual inspection reports from both the Air Force and the Ohio local public health departments. For the Ohio local public health department data, only public health departments that posted their inspection results online were used in this study. Typically, the results were not identical copies of the actual reports, but listings of the recorded violations. This opens the possibility that some violations were not transcribed to the online version. Also possible is that some reports were erroneously omitted from on-line posting. For example, although follow-up inspections were not included in this study, there were occasional follow-up reports listed with no original inspection preceding it listed. Some standard inspections might be missing from the data in this study for this reason. The Air Force data was also reviewed via in a more cumulative format as opposed to actual

inspection reports. There could have been an error or omission in the recording of data into this cumulative format prior to its reviewing it for this study. This could change the number of violations found or inspections done.

Another limitation to this study was that the food establishments from the Ohio local public health department data and Air Force data had to be matched for approximate similarities since not all establishments on military bases are also found in the civilian sector. Some of the establishments might have limited comparability, which could lead to an unequal comparison in violations or inspections frequency. For example, military snack bars were counted under the youth center category since they would serve similar food as seen in a typical youth center in the civilian sector. Another example is that the military cafeterias for trainees and enlisted personnel are listed under the "school" category. They best compare to a school cafeteria setting, although they probably serve a wider variety of foods than a typical school cafeteria.

A third limitation to the study is that all food establishments on the military installations were used in the study, but only a sample portion of the food establishments from the Ohio local public health departments in each category were used. This is due to the larger population of establishments found in the civilian sector. Restaurants from the Ohio local public health department data were selected randomly to match the restaurants found on base. There could still be some error or bias in the data since not every restaurant in the category was utilized for the study. Even with random selection of establishments, it is possible that only the worst or best performing establishments were reviewed, which might skew the data for that category.

A fourth limitation is that the Ohio local public health department data was collected for a longer time period than the Air Force data. The Air Force data was collected for the years 2011 and 2012. The Ohio local public health department data not only included data from 2011

and 2012, it also included partial data for 2013. This could potentially skew the data due to the extra time allotment included in the Ohio local public health department data. This extra time in 2013 undoubtedly gave the Ohio local public health department data more inspections reviewed than if 2013 would have been excluded. It does not have any impact on frequency of inspections as that was calculated with only 2011 and 2012 data. It might have a small impact on violations per inspection, but should not be a big difference since an inspection was added for each visit just like the violations were added to the total violations prior to calculation of the results.

Another limitation lies in the fact that the Air Force technicians use a different food code when evaluating food establishments than the sanitarians in Ohio. Ohio uses a more current version of the FDA food code over their Air Force counterparts. This could lead to differences in what constitutes a violation during an inspection and skew the number of violations reported. For example, newer regulations can lead to more or less stringent standards, thus changing frequencies of reported violations. In this study, this could lead to more violations reported in the Ohio local public health department data, while the same infraction may not be reported due to different regulations on an Air Force base.

Conclusion

Unsafe practices in food establishments have the potential to lead to foodborne illness. Foodborne illness has significant economic impact due to costs related to treating illness, missed days of work, and lost restaurant revenue. For the military, foodborne illness has a direct impact on combat readiness, troop morale, and can compromise the mission. Sanitarians and Air Force Public Health technicians inspect food establishments in order to prevent foodborne illness by finding and correcting the unsafe practices. The Air Force public health sections and Ohio local public health departments inspect restaurants on differing frequency schedules. Available

manpower, volume of food establishments, and need to maintain training proficiencies are the most likely reasons for the frequency differences. It is important to find the optimum frequency of inspections that will lead to fewer violations in food establishments, while maintaining efficiency of the workforce. While the data in this paper shows that more frequent inspections lead to better food establishment performance based on the number of violations found at the time of inspection, it is unlikely that many civilian local public health departments could employ enough sanitarians to achieve this frequency for the volume of establishments they are empanelled to inspect.

Further research might show a specific frequency which is efficient and effective in maintaining food safety. Other potential options for local public health departments can include performance based frequency schedules, or a schedule of more frequent but less detailed inspections. In a performance based frequency schedule, high performing establishments would be inspected less frequently than those with histories of numerous food safety violations. The second option of more frequent but less detailed inspections, inspectors would inspect restaurants more often, but would spend less time in the actual inspection. The benefit in this option is that the more frequent appearance of the inspector would provide more opportunities for education which reinforces positive behaviors while quickly eliminating negative practices. By spending less overall time in the inspection, local public health sanitarians would have the opportunity to inspect more facilities in a given day.

Disclaimer

The views and opinions expressed in this article/presentation are those of the authors and do not reflect official policy or position of the United States Air Force, Department of Defense, or US Government.

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Appendix A: WSU IRB Approval

WRIGHT STATE UNIVERSITY

Office of Research and Sponsored Programs
201J University Hall
3640 Col. Glenn Hwy.
Dayton, OH 45435-0001
(937) 775-2425
(937) 775-3781 (FAX)
e-mail: rsp@wright.edu

DATE: May 21, 2013

TO: Karen Rupp, MD, Grad. Student
Center for Global Health
Christopher Eddy, MPH, REHS, RS, Fac. Adv.
Community Health

FROM: B. Laurel Elder, Chair
WSU Institutional Review Board

SUBJECT: SC# 5182
'A Study of Food Inspection Practices'

At the recommendation of the IRB Chair, your study referenced above has been recommended for exemption. Please note that any change in the protocol must be approved by the IRB; otherwise approval is terminated.

This action will be referred to the Full Institutional Review Board for ratification at their next scheduled meeting.

NOTE: This approval will automatically terminate two (2) years after the above date unless you submit a "continuing review" request (see https://www.wright.edu/rsp/IRB/CR_sc.doc) to RSP. You will not receive a notice from the IRB Office.

If you have any questions or require additional information, please call Robyn Wilks, IRB Coordinator at 775-4462.

Thank you!

Enclosure

Appendix B: United States Air Force IRB Approval

DEPARTMENT OF THE AIR FORCE
88TH MEDICAL GROUP
WRIGHT-PATTERSON AIR FORCE BASE OHIO

23 April 2013

MEMORANDUM FOR CAPT (DR) KAREN RUPP
CAPT (DR) DANIEL PIZZINO

FROM: 88 MDG/SGNE

SUBJECT: Institutional Review Board (IRB) Research Determination

1. Your research protocol proposal entitled "A Study of Food Inspection Practices" has been reviewed by a member of the Wright-Patterson Medical Center (WPMC) IRB designated as a USAF Research Reviewer by the Air Force Surgeon General's Office of Research Oversight and Compliance. This research protocol involves a review of publically-available data regarding food service establishment inspections.

2. It has been determined that this research protocol does not meet the criteria to be considered human subject research because the activity does not collect data about living people through an interaction or intervention with people, nor does the activity involve identifiable, private information (45 CFR §46.102). Therefore, approval and oversight by an IRB is not required.

3. This determination does not give permission to conduct research; this authority lies with the commander or graduate department head. This determination also does not give permission to access food service facilities or private data; this authority lies with the facility, or through the Freedom of Information Act.

4. You should also be aware that any publications or presentations which arise using this information need to be cleared through the Clinical Investigations Office and the 88th Air Base Wing Public Affairs Office, and must include the disclaimer, "*The views and opinions expressed in this article/presentation are those of the author(s) and do not reflect official policy or position of the United States Air Force, Department of Defense, or US Government.*"

5. If you have any questions regarding this determination, please contact Mr. Fred Funke in Clinical Investigations at (937) 247-4242.

KAREN M. O'CONNELL, Lt Col, USAF, NC
Chair, WPMC Institutional Review Board

Appendix C: Lajas Field Permission Letter

DEPARTMENT OF THE AIR FORCE
65TH MEDICAL OPERATIONS SQUADRON (USAFE)
LAJES FIELD AZORES PORTUGAL

17 April 2013

MEMORANDUM FOR CAPT KAREN RUPP

FROM: 65 MDOS/CC

SUBJECT: Letter of Approval

1. Your request to utilize Military Public Health information on facility health inspections at Lajes Field, Azores, Portugal is approved. This information will be provided as statistics to be used for research only. All personally identifying information will be removed prior to release.

2. The 65th Medical Group's Public Health (PH) Flight Commander will determine the amount of information provided. If at any time the PH Flight Commander determines the request to interfere with the mission, this approval letter will become void. Questions and concerns can be addressed to Capt Melissa Peters at 011 351 295 57 3217 or DSN 314 535 3217, or melissa.peters.2@us.af.mil.

KENNY L. HARRYMAN, Lt Col, USAF, NC
Commander

Appendix D: Maxwell AFB Permission Letter

DEPARTMENT OF THE AIR FORCE
42D AIR BASE WING (AETC)
MAXWELL AIR FORCE BASE ALABAMA

APR 16 2013

MEMORANDUM FOR CAPT KAREN RUPP

FROM: 42 MDG/CC

SUBJECT: Letter of Approval

1. Your request to utilize Military Public Health information on facility health inspections at Maxwell Air Force Base, Alabama is approved. This information will be provided as statistics to be used for research only. All personally identifying information will be removed prior to release.

2. The 42d Medical Group's Public Health (PH) Flight Commander will determine the amount of information provided. If at any time the PH Flight Commander determines the request to interfere with the mission, this approval letter will become void. Questions and concerns can be addressed at (334) 953-7801 or DSN 493-7801.

MARINA C. RAY, Colonel, USAF, NC, CNA
Commander, 42d Medical Group

Appendix E: Wright Patterson AFB Permission Letter

DEPARTMENT OF THE AIR FORCE
88TH MEDICAL GROUP
WRIGHT-PATTERSON AIR FORCE BASE OHIO

6 May 2013

MEMORANDUM FOR CAPT (DR) KAREN RUPP
CAPT (DR) DANIEL PIZZINO

FROM: 88 AMDS/CC
4881 Sugar Maple Drive
Wright-Patterson AFB OH 45433

SUBJECT: Permission to Utilize Food Facility Data for Research Project

1. Your research protocol proposal entitled "A Study of Food Inspection Practices" has been received and reviewed by Maj Melinda Eaton, Public Health Flight Commander. This protocol requests documentation on food establishment inspections for on-base facilities for the past two years.

2. The requested data will be provided to the researchers with specific provisions. The data to be collected is For Official Use Only and must be deidentified when conducting the analysis and completing the report. Additionally, the data will not be published outside of the Wright State University Masters in Public Health program.

3. My POC for this memorandum is Maj Melinda Eaton and she can be reached at 937-257-9805 (DSN 787-9805) or melinda.eaton@wpafb.af.mil.

Roger W. Nelson

ROGER W. NELSON, Col, USAF, BSC
Commander

Appendix F: List of Tier 1 Core Public Health Competencies Met

Domain #1: Analytic/Assessment
Use variables that measure public health conditions
Use methods and instruments for collecting valid and reliable quantitative and qualitative data
Identify sources of public health data and information
Recognize the integrity and comparability of data
Identify gaps in data sources
Adhere to ethical principles in the collection, maintenance, use, and dissemination of data and information
Describe the public health applications of quantitative and qualitative data
Use information technology to collect, store, and retrieve data
Domain #2: Policy Development and Program Planning
Gather information that will inform policy decisions (e.g., health, fiscal, administrative, legal, ethical, social, political)
Describe the public health laws and regulations governing public health programs
Domain #3: Communication
Communicate in writing and orally, in person, and through electronic means, with linguistic and cultural proficiency
Solicit community-based input from individuals and organizations
Participate in the development of demographic, statistical, programmatic and scientific presentations
Apply communication and group dynamic strategies (e.g., principled negotiation, conflict resolution, active listening, risk communication) in interactions with individuals and groups
Domain #4: Cultural Competency N/A
Domain #5: Community Dimensions of Practice N/A
Domain #6:Public Health Sciences
Describe the scientific evidence related to a public health issue, concern, or, intervention
Retrieve scientific evidence from a variety of text and electronic sources
Discuss the limitations of research findings (e.g., limitations of data sources, importance of observations and interrelationships)
Domain #7: Financial Planning and Management N/A
Domain #8: Leadership and Systems Thinking
Incorporate ethical standards of practice as the basis of all interactions with organizations, communities, and individuals
Use individual, team and organizational learning opportunities for personal and professional development