

# An Investigation to Determine Association Between Foodborne Illness and Number of Citations in a Food Establishment

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**Abstract** This article analyzes the inspectional data for the food protection program at the Cincinnati Health Department prior to the implementation of a standardization program for food inspections and food inspection training. The main objectives of the authors' study were to assess if current foodborne illness risk factors were associated with different risk classes of food establishments and the relationships between foodborne illness risk factors using non-Centers for Disease Control and Prevention (CDC) foodborne illness risk factors and CDC foodborne illness risk factor criteria. Additionally the authors' study provides information on whether the standardization of staff reduced the number of risk factors at food establishments, reducing the opportunity for a foodborne illness. This research compares the mean number of violations cited per inspection at food establishments of various risk classes. The authors' findings show that both CDC and non-CDC foodborne illness risk factors were positively associated to the risk class of the food establishment; however, more non-CDC than CDC foodborne illness risk factors were cited by the sanitarians at each level of risk class.

## Introduction

The Cincinnati Health Department (CHD) embarked on the standardization initiative of their food safety program staff as part of Standard 2 in the Food and Drug Administration's (FDA's) Voluntary National Retail Food Regulatory Program Standards (VNRFRPS) (FDA, 2007). The department continually conducts the assessment of its food safety program to determine where the organization stands in relation to FDA's nine program standards. CHD has 25 staff members assigned to

the food protection program including 17 field sanitarians who are responsible for the inspections of food service operations (FSO) and retail food establishments (RFE) within their assigned jurisdiction.

The primary objective in standardizing the staff was to identify the training needs and to begin the department's total quality improvement process of the food protection program required in Standard 2 of the FDA VNRFRPS. The staff standardization is currently ongoing and proceeds as the

schedules of the sanitarian and the certified training officer allow. The standardization of both the field sanitarians and the training officer requires an estimated 50 to 75 hours. This estimate is based upon the sanitarians' understanding and knowledge of the Ohio Uniform Food Safety Code and their field experience in the food protection program. The inspection by a trainee is considered as a standard inspection by the Ohio Department of Health and the Ohio Department of Agriculture. The current budget for the food protection program is approximately \$1 million with about 85%–90% of the program cost covered by licensing fees.

At the conclusion of the project, a policy/guidance document will be developed for CHD's food safety program that will bring uniformity in the way sanitarians conduct their inspections of FSO and grocery stores.

The Ohio Department of Health and the Ohio Department of Agriculture have classified FSO and RFE into four risk categories in the Ohio Revised Code 3717 and Ohio Administrative Code 3701 (License Fees and Categories, 2010), as illustrated in Table 1.

The *Report on the Occurrence of Foodborne Illness Risk Factors in Selected Institutional Food Service, Restaurant, and Retail Food Store Facility Type* (FDA, 2004) has enumerated several risk factors that can cause foodborne illnesses. Food from an unsafe source, inadequate cooking time/temperature control for safety (TCS) of food, inadequate hot/cold holding of TCS food, employee hygiene, and contamination are the most common causes of foodborne illnesses. The report incorpo-

TABLE 1

**Description of the Different Risk Classes**

Risk Class	Description	Food Examples
1	Poses potential risk to public in terms of sanitation, storage practices, labeling, and sources of food	Coffee, prepackaged food items, and baby food and formula
2	Poses higher risk than class 1 because of hand contact and employee health; minimal pathogenic growth exists	Holding TCS <sup>a</sup> foods at the temperatures received and heating individual packaged portions of TCS foods
3	Proper cooking temperatures of TCS foods, processing raw food items; cook and serve establishment	Hamburgers, deli sandwiches, cutting or grinding raw meats
4	Preparing TCS foods requiring several steps including reheating and serving ready-to-eat raw TCS foods	Soups, sushi, reheated food items, and catered foods

<sup>a</sup>Time/temperature controlled for safety.

rates details from inspections for compliance/noncompliance of approximately 900 facilities across the country by 21 FDA standardized food safety specialists. The results from these inspections were classified into nine types of establishments: hospitals, nursing homes, elementary schools, fast food, full service, produce, deli, seafood, and meat and poultry. These establishments were further divided into two groups: group one facilities had someone on the premises who was certified in food protection at the time of inspection, while group two facilities did not have a person certified in food protection on site during the inspection.

The objectives of our study were to assess the association between risk classes of food establishments and foodborne illness risk factors and the association of foodborne illness risk factors between CDC and non-CDC criteria. After an exhaustive literature search, no studies addressing similar issues came to our attention. The results of our study illustrate the associations using evidence-based approaches and could provide useful information to decision makers and inspectors working in food safety institutions.

## Methods

CHD inspections of FSO and RFE establishments utilize an electronic inspection program. Sanitarians are required to record elec-

tronically inspection reports and violations observed during an inspection. All violations are printed and the sanitarian reviews the printed document with the person in charge (PIC) of the food establishment. After returning back to their offices, sanitarians download the information to the Cincinnati Area GIS (CAGIS). The CAGIS-generated data collected from January 1, 2009, to December 31, 2009, were analyzed.

All violations were grouped either by CDC foodborne illness risk factors or non-CDC foodborne illness risk factors, risk class of the operation, and the name of the inspector. The certified training officer identified which sections of the Ohio Uniform Food Safety Code were CDC or non-CDC foodborne illness risk factors cited by the sanitarian. Examples of non-CDC foodborne illness risk factors are dirty floors, walls, and ceiling. Examples of CDC foodborne illness risk factors are food-service-employee behaviors such as not washing hands prior to putting on gloves, not wearing gloves when handling ready-to-eat food, or failing to maintain temperatures of 41°F and below or 135°F and above on TCS food items.

Identifiable information of facilities and inspectors involved were removed before analyzing the data. Numbers or counts of foodborne illness risk factors using CDC and non-CDC criteria individually as well as us-

ing the summation of both criteria were collected at facility levels during inspection and they became the primary numerical variables of interest. Each numerical variable was assessed for its association to the fixed effect of food establishments and a categorical variable with four risk classes using an ANOVA model. Post hoc comparisons of means were performed under the ANOVA model framework and adjusted for multiple comparisons using Tukey's method.

At each risk class of food establishments, means of foodborne illness risk factor numbers were compared between CDC and non-CDC criteria using a paired *t*-test. In addition, nonparametric methods were used to validate and cross examine findings from the parametric analyses. Specifically, nonparametric Kruskal-Wallis tests and Wilcoxon rank-sum tests were used to examine results from ANOVA models and their post hoc comparisons, and nonparametric Wilcoxon signed rank tests were used to examine results from paired *t*-tests, respectively. Only results from parametric methods are reported in the final study as no discrepant findings were noticed between parametric and nonparametric methods. All statistical analyses were performed using the PASW 18 package. *P*-values < .05 were considered statistically significant.

## Results

A total of 2,657 facilities were inspected in the study by 20 sanitarians during 2009. Facilities were found to be 182 (7%), 266 (10%), 1,215 (46%), and 994 (37%) in the risk classes of 1–4, respectively. One sanitarian inspected only risk class 1 facilities, another sanitarian inspected facilities of all classes except risk class 1, and the rest of the 18 sanitarians inspected facilities of all classes.

The mean ± standard deviation (*SD*) of facilities inspected per sanitarian was 133 ± 82. A total of 9,614 foodborne illness risk factors, with 3,535 CDC risk factors and 6,079 non-CDC risk factors, were identified from inspections on all the facilities. This yielded an average 3.62 foodborne illness risk factors with 1.33 CDC foodborne illness risk factors and 2.29 non-CDC foodborne illness risk factors per facility per inspection.

The number of foodborne illness risk factors was found positively associated to the risk class of food establishments (*p* < .05). In

particular, the mean ± SD of number of foodborne illness risk factors was 4.98 ± 1.07 in risk class 4, higher than those of 3.25 ± .55, 1.90 ± .75, and 2.33 ± .87 at risk classes 3, 2, and 1, respectively ( $p < .05$ ); while the mean in class 3 was higher than those of classes 2 and 1, respectively ( $p < .05$ ) (Table 2).

Similar results were found in numbers of foodborne illness risk factors using CDC and non-CDC criteria individually. At each level of risk classes, the mean number of foodborne illness risk factors using non-CDC criteria was higher than that of CDC criteria ( $p < .05$ , Table 2). Differences of number of foodborne illness risk factors between non-CDC and CDC criteria were found ranging from 0.66 to 0.93; however, they were not statistically significant among the four risk classes ( $p > .05$ ).

### Discussion

In a risk class 1 establishment, the health concerns are sanitation, food labeling, sources of food, storage practices, and food expiration dates. Because of the limited food handling in a risk class 1 establishment, the number of CDC foodborne illness risk factors is quite low. In many of these operations, selling of food items is secondary to their primary business and is usually considered a courtesy for their customers. Therefore, sanitation and storage practices would take a back seat in their business operation. This could explain the higher number of violations in a risk class 1 facility vs. a risk class 2 facility. Further investigation into the violations cited would help explain if they were due to contamination, food storage, or due to the establishment receiving unwholesome food.

Risk class 2 facilities have a greater potential for violations of foodborne illness risk factors and associated adverse effects on the public health as compared to the risk class 1 facilities. Employee health and hygiene start to become risk factors in addition to the risks considered in risk class 1 operations. In many of these operations, food represents a greater proportion of the sales in the establishment. Hence, a greater focus on employee training in food safety is present in this risk class.

Risk class 3 establishments are commonly referred to as cook and serve operations. These types of operations handle and prepare

**TABLE 2**  
**Summary of Foodborne Illness Risk Factors by Risk Class**

Risk Class <sup>a</sup>	CDC <sup>b</sup> and Non-CDC Combined <sup>c</sup>	(I) CDC <sup>c</sup>	(II) Non-CDC <sup>c</sup>	(II)-(I) <sup>§</sup>	p-Value* (II) vs. (I)
1	2.33 ± 0.87	0.79 ± 0.69	1.54 ± 1.30	0.75 ± 0.87	.001
2	1.9 ± 0.75	0.62 ± 0.40	1.28 ± 0.94	0.66 ± 0.77	.001
3	3.25 ± 0.55 <sup>d</sup>	1.19 ± 0.59 <sup>d</sup>	2.06 ± 0.98 <sup>d</sup>	0.87 ± 0.55	<.001
4	4.98 ± 1.07 <sup>t</sup>	2.02 ± 1.00 <sup>t</sup>	2.95 ± 1.04 <sup>t</sup>	0.93 ± 1.09	.001

*Note.* Source: Cincinnati Health Department. Superscript letters of “d” and “t” indicate means in the current risk class are significantly higher than those in the lower risk classes respectively, with  $p$ -values < .05.  
<sup>a</sup>Risk classes were defined using food service operations and retail food establishments;  $n = 25$  facilities for each risk class.  
<sup>b</sup>CDC = Centers for Disease Control and Prevention.  
<sup>c</sup>Values in cells are mean ± standard deviation of number of foodborne illness risk factors.  
<sup>§</sup>Values in cells are difference of mean ± standard deviation of (II) and (I).  
<sup>\*</sup> $p$ -Values are used to compare means of number of foodborne illness risk factors between CDC (I) and non-CDC (II) criteria.

TCS food items for sale or service. Our analysis shows that these factors are the reason the number of CDC and non-CDC foodborne illness risk factors and associated violations cited increased in this risk class. In a risk class 3 establishment food sales are frequently the main focus of the business.

Risk class 4 establishments are complex food operations. Food preparation in this class typically requires several steps that involve multiple temperature controls to minimize bacterial growth or includes service to high-risk clientele. Because of the complexity of the food preparation, the chance of a mistake increases and results in the increased number of violations cited per inspection.

Further studies are needed to verify if sanitarian standardization impacts the number and type of violations cited during a standard inspection. This goal can be accomplished by critically evaluating the staff practices after these practices are uniformly standardized.

### Conclusion

Based upon our findings, we have recommended that CHD consider training food program sanitarians so that they will consistently utilize the Ohio Uniform Food Safety Code when conducting risk assessments of the foods served or offered for sale at FSO and RFE. During the food in-

spection training, the sanitarians will apply CDC foodborne illness risk factors. These CDC foodborne illness risk factors are found in *The Report of Retail Food Program Database of Foodborne Illness Risk Factors* (FDA, 2000), in the section on food flow through an establishment. The CDC foodborne illness risk factors are food from unsafe sources, improper holding/time and temperature, inadequate cooking, poor personal hygiene, and contaminated equipment/prevention of contamination. The sanitarian will observe and verify the PIC's demonstration of knowledge in food safety, their duties and responsibilities, and also verify their certification in food safety. Currently, CHD has standardized more than 50% of its food safety staff. 🐾

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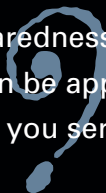
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