Disclosing Inspection Results at Point-of-Service: Affect of Characteristics of Food Establishment Inspection Programs on Foodborne Illness Outcomes

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Abstract
The significant proportion of foodborne illnesses attributed to restaurants highlights the importance of food establishment inspections. The objectives of this cross-sectional study were to characterize local inspection programs and evaluate the effects of programmatic characteristics, such as active public disclosure of inspection results, on select operational and foodborne illness outcomes. Between January 7 and April 6, 2020, an online 36-question survey was administered to 790 government-run food establishment inspection programs at state and local levels. Of 149 survey respondents, 127 (85%) represented local food establishment inspection agencies. Agencies that disclosed at the point-of-service reported fewer mean numbers of re-inspections by 15%, foodborne illness complaints by 38%, outbreaks by 55% (p = .03), and *Salmonella* cases by 12% than agencies that disclosed online only. Agencies that used some type of grading method for inspection results reported fewer mean numbers of re-inspections by 37%, complaints by 22%, outbreaks by 61%, and *Salmonella* cases by 25% than agencies that did not grade inspections. Programmatic characteristics appear to be associated with foodborne illness outcomes. These results warrant future research to improve the effectiveness of food establishment inspection programs.

Introduction

Approximately 51% of each consumer dollar dedicated to food spending in 2019 was spent in the food service industry, specifically in restaurants, compared with just 25% in 1955 (National Restaurant Association, 2020). Coincidentally, there is growing evidence that restaurants are an important source of sporadic and outbreak-associated foodborne disease in the U.S. (Jones & Angulo, 2006). In 2017, there were 841 foodborne illness outbreaks resulting in 14,481 illnesses, 827 hospitalizations, 20 deaths, and 14 food recalls in the U.S., including Puerto Rico and Washington, DC (Centers for Disease Control and Prevention [CDC], 2019).

Among the illnesses and outbreaks for which a single location was identified, 44% and 64%, respectively, were attributed to foods prepared in a restaurant setting (CDC, 2019). The rise in expenditure on foods eaten away from the home and the significant proportion of foodborne illnesses attributed to restaurants have highlighted the importance of food establishment inspections, as they could flag the existence of food safety hazards and mitigate their public health impact.

Public disclosure of inspection results from food establishments enables consumers to make informed decisions about where they choose to eat (Fung et al., 2007). Consumer priority of hygienic food preparation practices, in turn, incentivizes food establishments to improve hygiene practices—a proxy for better sanitary conditions—within their facility. Improved and maintained sanitary conditions, theoretically, lead to fewer foodborne illnesses. From a programmatic standpoint, however, disclosure of inspection results can create more work for the environmental health workforce tasked with putting the information into a presentable format. In a survey of the environmental health workforce, 76% of workers surveyed indicated working in food safety and protection programs; however, 17% of all respondents performed public health duties outside of environmental health, and of those, 37% spent >50% of their time working in nonenvironmental health programs (Gerding et al., 2019).

The value of actively disclosing inspection results to the public has been dem-

Summary Statistics for Local Agency Respondents (*n* = 124)

	# (%)
Active disclosure	82 (66)
Active disclosure methods	
Online	75 (91)
Point-of-service	24 (29)
Other	4 (5)
No active disclosure	42 (27)
Grading methods	
Numerical score	53 (43)
Letter grade	20 (16)
Other	34 (27)
No grading	30 (24)
Inspection violation schemes (*n* =75)	
P-PF-C	24 (32)
C/NC	21 (28)
RF-GRP*	23 (31)
P-PF-C	10 (43)
C/NC	4 (17)
Major/minor	3 (13)
Other	7 (9)

P-PF-C = Priority-Priority Foundations-Core; C/NC = Critical/Noncritical; RF-GRP = Risk Factor-Good Retail Practices.
*Of the 23 agencies that indicated using RF-GRP, 6 agencies used RF-GRP only. The other 17 agencies used RF-GRP in combination with the other schemes listed below.

onstrated in several settings throughout the U.S. The debate about the best mode to convey inspection results to the public, however, is still ongoing. A study of people at the Minnesota State Fair found increased interest in public access to inspection results. Furthermore, fairgoers expressed interest in disclosure methods of posting online and at the point-of-service, that is, at a food establishment (Firestone & Hedberg, 2020). For local inspection agencies that disclose inspection results, the most common method is through online disclosure only, typically accessed via departmental websites. Drawbacks of this method include difficulty in navigating these websites and lengthy reports that are confusing to the general public. Moreover, this method might not be accessible to those who are most vulnerable to foodborne illness, such as older adults (Fleetwood, 2019).

Disclosure at the point-of-service eliminates a barrier to using inspection data in the decision-making process, as this approach does not require a person to have online access to check a website for inspection results. With the introduction of public disclosure by means of a color-coded inspection sticker placed at or near restaurant entrances, Columbus Public Health (Ohio), saw inspection scores improve by 1.14 points out of a possible 100 points (Choi & Scharff, 2017). In New York City, New York, implementation of public disclosure at the point-of-service in the form of letter grades was associated with improvements in sanitary conditions (Wong et al., 2015) and a 5.3% decrease in *Salmonella* cases per year (Firestone & Hedberg, 2018). Furthermore, in Los Angeles County, California, public disclosure of letter grades at the establishment led to a 13% decline in

hospitalizations due to foodborne illness (Simon et al., 2005).

While the act of disclosure is important, what information is disclosed and how the public interprets it is also important. Familiarity with the symbols used to represent inspection results lends to easier interpretation by the general public. Grading practices can include letter grading and/or numerical grading, similar to most grading methods in a school system (e.g., A, B, C grades or 100%, 90%, 80%) or other ordinal methods (e.g., stoplight colors, emoticons).

During inspections, a labeling system is used to classify different types of violations and convey severity of the violations. These violation schemes often correlate with the version of the Food and Drug Administration (FDA) *Food Code* an agency has adopted and can be used in combination at the agency's discretion. For example, in *Food Code* versions before 2009, violations that were more likely "to contribute to food contamination, illness, or environmental health hazard" were classified as critical. In 2009, FDA revised the *Food Code* to distinguish critical items as priority if the item includes a quantifiable measure to show control (e.g., cooking), or priority foundation if the item requires the purposeful incorporation of specific actions (e.g., training) (Food and Drug Administration [FDA], 2015). The categorization of risk factor or good retail practices corresponds to the organization of the FDA Food Establishment Inspection Report.

Current inspection practices and methods of disclosure vary widely across jurisdictions in the U.S. and present unique challenges to evaluating program effectiveness. The objectives of this cross-sectional study were to 1) characterize local inspection programs and 2) evaluate the effects of programmatic characteristics, such as active public disclosure methods, on select operational and foodborne illness outcomes.

Methods
An online 36-question survey was administered via Qualtrics to 790 government-run food establishment inspection programs at state, county, city, district, and territorial levels. Recipients were chosen based on availability of program inspection data online or participation in FDA's Voluntary National Retail Food Regulatory Program Standards

TABLE **2**

Mean, Standard Deviation, and Median Estimates for Outcomes by Disclosure Methods, Grading Methods, and Inspection Violation Schemes

	Average # of Re-Inspections/Establishment/Year (n = 109)		Average # of Complaints/1,000 Establishments/Year (n = 100)		Average # of Outbreaks/1,000 Establishments/Year (n = 101)		Average # of *Salmonella* Cases/100,000 Population Served/Year (n = 48)	
	Mean (*SD*)	Median	Mean (*SD*)	Median	Mean (*SD*)	Median	Mean (*SD*)	Median
Disclosure methods								
Online	0.40 (0.55)	0.24	44.2 (49.6)	27.3	1.7 (2.4)	0.84	14.4 (7.2)	14.0
Point-of-service	0.35 (0.46)	0.17	30.3 (45.3)	22.2	0.9 (1.4)	0.25	12.9 (6.5)	14.0
None	0.53 (0.46)	0.50	31.3 (36.0)	18.5	7.0 (24)	0.00	9.9 (9.9)	6.7
Other*	0.36 (0.43)	0.17	74.5 (86.4)	42.7	3.7 (4.7)	2.39	–	–
Grading methods								
Numerical score	0.32 (0.37)	0.17	40.6 (54.6)	22.2	3.0 (10.7)	0.35	12.4 (6.8)	13.6
Letter grade	0.31 (0.48)	0.13	34.9 (41.7)	24.6	1.3 (1.6)	0.71	13.0 (7.0)	14.2
None	0.59 (0.64)	0.50	49.1 (49.2)	29.2	6.5 (25.0)	0.82	15.9 (12.2)	13.1
Other	0.46 (0.57)	0.27	36.4 (35.0)	27.6	1.9 (2.7)	0.95	12.0 (5.2)	12.7
Inspection violation schemes								
P-PF-C	0.39 (0.45)	0.18	47.2 (53.3)	29.0	1.5 (1.7)	0.95	15.7 (7.4)	16.4
C/NC	0.38 (0.49)	0.25	48.7 (45.2)	42.7	1.1 (1.4)	0.85	12.7 (8.8)	13.1
RF-GRP	0.32 (0.39)	0.17	38.1 (51.1)	22.8	2.4 (2.2)	1.97	16.8 (8.1)	17.1
Other	0.29 (0.37)	0.19	57.9 (73.9)*	11.8*	0.77 (0.78)*	0.62*	10.9 (7.8)*	11.7*

P-PF-C = Priority-Priority Foundations-Core; C/NC = Critical/Noncritical; RF-GRP = Risk Factor-Good Retail Practices.
*Contains data from ≤5 respondents.

(Retail Program Standards). The Retail Program Standards provide recommendations aimed at facilitating inspections that are more effective and implementing foodborne illness prevention strategies. Enrollees in this program intend to actively use these standards as a tool to assess and improve their regulatory programs (FDA, 2019).

We administered the survey in two rounds. The first round consisted of 151 recipients whose inspection data were publicly available online, resulting in a 40% response rate (n = 60 respondents). The second round included 639 recipients who participated in the Retail Program Standards, resulting in a response rate of 19% (n = 122 respondents). Via the survey, we obtained information on general program characteristics such as size of population served; number of routine inspections conducted; number of licensed establishments within the inspection jurisdiction; and

operational characteristics such as public disclosure method, grading method, and FDA *Food Code* version in use.

The time period for the survey was chosen to match the availability of inspection data from the agencies. Three geographically diverse local inspection agencies piloted the survey to ensure appropriateness and relevancy of questions and answer choices. The data collection period was January 7–April 6, 2020. We paused data collection in April due to the COVID-19 pandemic response taking precedent at state and local health departments.

We categorized inspection agencies into two main types, state and local. A state agency was defined as an inspection program that oversees the inspection of food establishments at the state government level, including U.S. territories and Washington, DC. A local agency differs in that the oversight of the inspection programs is at the county, city,

city–county, or district government level. One survey respondent represented a university and thus was excluded from this analysis, as there could be significant policy differences between government agencies and universities. Local agencies were the primary focus of this analysis, as most food establishment inspection programs are operated at the local government level.

Four operational and foodborne illness outcomes were calculated as rates from a combination of variables obtained from the survey and expressed as an average number of:
1. Re-inspections/establishment/year (calculated as the quotient of average number of re-inspections and number of licensed food establishments within the jurisdiction of the agency).
2. Foodborne illness complaints/1,000 licensed food establishments/year (2016–2018; most recent years included in data set).

Mean, Standard Deviation, and Median Estimates for Outcomes by Point-of-Service (POS) Disclosure Versus Online (no POS) Disclosure

	Average # of Re-Inspections/ Establishment/Year (*n* = 71)	Average # of Complaints/1,000 Establishments/Year (*n* = 62)	Average # of Outbreaks/1,000 Establishments/Year (*n* = 63)	Average # of *Salmonella* Cases/100,000 Population Served/Year (*n* = 31)
p-value	.65	.16	.03	.44
POS disclosure				
Mean (*SD*)	0.35 (0.46)	30.3 (45.3)	0.92 (1.4)	11.7 (6.6)
Median	0.17	22.17	0.25	12.5
Online (no POS) disclosure				
Mean (*SD*)	0.41 (0.57)	48.6 (50.0)	2.04 (2.69)	13.3 (8.5)
Median	0.24	29.0	0.95	12.7

3. Foodborne outbreaks/1,000 licensed food establishments/year (2016–2018).
4. *Salmonella* cases reported/100,000 population served/year (2016–2018).

In addition to the survey data, we were able to obtain some *Salmonella* case counts using departmental websites for jurisdictions that reported these data online.

For the purposes of this study, active disclosure was defined as agencies that voluntarily and preemptively publicize some or all inspection data to the public. Inspection violation scheme was not included in the survey, but was determined by searching online for inspection data from the responding agencies.

Predictors were classified into three categories:
1. Disclosure method consisting of online, point-of-service, no disclosure, and other disclosure methods.
2. Grading method consisting of numerical score, letter grade, no grading, and other grading methods.
3. Inspection violation scheme used for routine inspections consisting of subcategories Priority-Priority Foundations-Core; Critical/Noncritical; Risk Factor-Good Retail Practices; and other schemes.

The Risk Factor-Good Retail Practices subcategory relates to the inspection report form and therefore can be used in combination with other violation schemes. The mean and median values of outcomes for each combination of schemes were assessed in addition to the nonmutually exclusive scheme categories previously stated. One respondent used a combination of three schemes: Risk Factor-Good Retail Practices, Critical/Noncritical, and Red/Blue. Of note, Red/Blue is similar and is sometimes used in reference to Critical/Noncritical; therefore, this respondent's jurisdiction was included in the Risk Factor-Good Retail Practices and Critical/Noncritical scheme combination.

Mean and median values were calculated to identify trends in outcomes based on each subcategory. The means were compared using *t*-tests; *p*-values were reported assuming unequal variance. The analysis was conducted using SAS 9.4m6 University Edition. Linear regression was used to determine associations between the outcome variables reported by the local responding agencies. The level of statistical significance was set at $\alpha = .05$.

Results

Of the 149 survey respondents, 127 (85%) represented a local food establishment inspection agency. More than one half of agencies (66%) actively disclosed inspection scores to the public and most (91%) did so by posting online; only some (30%) posted at the point-of-service. Approximately 43% of the agencies used numerical scores as a grading method, 24% used no grading method, and 16% used letter grades (Table 1). Frequently used inspection violation schemes included Priority-Priority Foundations-Core (32%) and Critical/Noncritical (28%). The scheme Risk Factor-Good Retail Practices (31%) was used in combination with other violation schemes. Of the 23 agencies that used Risk Factor-Good Retail Practices with another scheme, 43% used Priority-Priority Foundations-Core, 22% used Critical/Noncritical, and 13% used Major/Minor schemes. Violation schemes for 53 respondents could not be determined using online searching.

Agencies disclosing at the point-of-service had lower mean values for all outcome measures than did agencies disclosing online (Table 2). Of the 24 agencies disclosing inspection results at the point-of-service, however, 21 (88%) also disclosed inspection results online (Table 1). Due to this overlap, we made further comparisons of agencies disclosing at the point-of-service and agencies disclosing online only (Table 3). Agencies that disclosed inspection results at the point-of-service reported fewer mean numbers of re-inspections by 15%, complaints by 38%, outbreaks by 55% (*p* = .03), and *Salmonella* cases by 12% than did agencies that disclosed online only.

Agencies that used some type of grading method for inspection results reported fewer mean numbers of re-inspections by 37%, complaints by 22%, outbreaks by 61%, and *Salmonella* cases by 25% than did agencies that did not grade inspection results. Agencies using letter grades had lower mean values for complaints by 14% and outbreaks by 43%

TABLE **4**

Linear Regression Comparisons of Outcomes

	Average # of Re-Inspections/Establishment/Year			Average # of Complaints/1,000 Establishments/Year			Average # of Outbreaks/1,000 Establishments/Year			Average # of *Salmonella* Cases/100,000 Population Served/Year		
	Parameter Estimate (*SE*)	*p*-Value	#	Parameter Estimate (*SE*)	*p*-Value	#	Parameter Estimate (*SE*)	*p*-Value	#	Parameter Estimate (*SE*)	*p*-Value	#
Average # of re-inspections/establishment/year	–			11.49 (11.16)	.306	91	0.943 (3.44)	.784	92	-0.18 (3.21)	.956	44
Average # of complaints/1,000 establishments/year	0.001 (0.000995)	.306	91	–			0.058 (0.033)	.079	93	0.06 (0.031)	.051	48
Average # of outbreaks/1,000 establishments/year	0.00089 (0.00323)	.78	92	0.579 (0.326)	.079	93	–			0.40 (0.50)	.43	47
Average # of *Salmonella* cases/100,000 population served/year	-0.00042 (0.0074)	.96	44	1.305 (0.652)	.051	48	0.035 (0.044)	.43	47	–		

than agencies using numerical scores, but 5% more *Salmonella* cases (Table 2). Almost one third of agencies, however, using numerical scores also used letter grades (Table 1).

Agencies that used a Critical/Noncritical violation scheme reported 3% more mean complaints but 3% fewer mean re-inspections, 27% fewer outbreaks, and 19% fewer *Salmonella* cases than those using Priority-Priority Foundations-Core schemes. Agencies that used Risk Factor-Good Retail Practices schemes tended to have fewer re-inspections and complaints but more outbreaks and *Salmonella* cases than did agencies not using these schemes (Table 2). Although most of these findings are not statistically different from each other, the overall pattern of results is noteworthy.

Regarding associations between outcome measures, we observed an almost statistically significant relationship between reported number of complaints/1,000 establishments/year and number of *Salmonella* cases/100,000 population/year. Every unit of increase in reported *Salmonella* cases/100,000 population/year was associated with an increase in 1.03 complaints/1,000 establishments (p = .051) (Table 4).

Discussion

The trends observed in this study complement the existing literature that supports the value of transparency in the disclosure of food establishment inspection data. Disclosure at the point-of-service was associated with fewer mean numbers of re-inspections, complaints, outbreaks, and *Salmonella* cases than disclosure online only, with a significant difference (p = .03) in the number of outbreaks between the two disclosure methods. These findings are consistent with previous studies in New York City and Los Angeles that demonstrated benefits to disclosure at the point-of-service. In this study, disclosure at the point-of-service included posting of inspection results inside and outside of the food establishment. It was not the goal of this study to parse the outcomes resulting from disclosures of inspection results posted inside or outside of food establishments. Future studies might be warranted to evaluate the effectiveness of the nuance of disclosure location at food establishments.

Letter grading methods were associated with fewer complaints and outbreaks than numerical scoring methods but both methods had better outcomes than for inspections in the absence of a grading system. The Critical/Noncritical inspection violation scheme was associated with fewer outbreaks and *Salmonella* cases than Priority-Priority Foundations-Core or Risk Factor-Good Retail Practices schemes. These results suggest that how local agencies conduct and score food establishment inspections and disclose results

to the public likely affect the success of the programs to control and prevent foodborne illnesses and food safety hazards.

A strength of this study is that use of the Retail Program Standards listserv allowed for direct contact and survey dissemination to managers or primary contacts of food establishment inspection programs. The use of this listserv also enabled access to a wide geographic range of potential respondents, as this program includes agencies from all 50 states and Washington, DC, as well as five U.S. territories: American Samoa, Guam, Northern Mariana Islands, Puerto Rico, and the Virgin Islands. Additionally, given the variations in inspection practices, many survey questions included an open-text option for "Other" answers that were not listed as potential answer choices. This feature allowed for the capture of unique or less common practices.

There are several limitations to this study. First, the presence of selection bias cannot be understated given the use of a convenience sample of survey recipients and online recruitment, which limits the representativeness of the results to those who participated in the FDA Retail Food Program. Second, *Salmonella* cases were self-reported. Many inspection agencies do not track the number of *Salmonella* cases, as that is typically the duty of epidemiology divisions. As such, the number of cases

reported by survey respondents might not reflect true case counts. Third, missing data and an abbreviated collection period weakened the survey data analysis; the data collection period was truncated by local and state health departments needing to focus on the COVID-19 pandemic response. This necessity limited the ability to obtain missing data points and limited the ability of agencies to respond. Fourth, the survey did not collect information about the number and types of triggers for re-inspection of an establishment, which vary across agencies. A potential confounder might be the size of the inspection agency or the number of inspectors, as agencies with more inspectors or more aggressive practices could potentially be able to conduct more re-inspections or to detect more violations, illnesses, and outbreaks than smaller agencies. Fifth, the survey did not allow for capture of programmatic changes that occurred between 2016 and 2018 (e.g., if a jurisdiction updated its food code during this time).

Although most findings were not statistically significant on an individual basis due to limitations in sample size, the overall pattern of results supports and enhances the existing literature on the performance of food establishment inspection programs. For example, for every unit increase in complaints, there was a corresponding increase in the number of re-inspections. There was a similar relationship with reported foodborne outbreaks. Future research should include a larger number of agencies by a factor of 2 or 3 to clarify several of these relationships.

Conclusion

Overall, characteristics of food establishment inspection programs appear to be associated with foodborne illness and outcomes. These results warrant future research efforts to improve the effectiveness of these programs. This study suggests that agencies that disclose at the point-of-service reported 55% fewer average number of outbreaks compared with those using online disclosure only. Similarly, applying a grading scheme as a summary measure of inspection results was associated with improved foodborne illness outcomes. Policy makers should consider these findings when evaluating program effectiveness measures and when considering changes to existing food inspection programs. ◆◆

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