On the Effectiveness of Restaurant Inspection Frequencies

O. BENJAMIN KAPLAN, PHD, MPH

Introduction

Sanitarians inspect restaurants to detect unsafe or unclean conditions and prevent food poisoning. Although it is generally believed that about four inspections per restaurant per year are necessary, Zaki, et al., believe that one or two suffice if a restaurant is found "safe" on two consecutive semi-annual inspections.[1]

"Beliefs" are not too reliable as a guide unless supported by valid statistics. This paper will quantify the theoretical effectiveness of various inspection frequencies used to detect unsafe food conditions (or preparation practices). The quantification may help administrators choose appropriate frequencies.

Theoretical Considerations

A potentially dangerous event or condition, such as food being held for long periods at bacterial incubation temperatures, may not exist all of the time in a given restaurant. An unsafe condition may exist during, say, 10 per cent of a day, week, or year. Let p = probability of one unsafe condition (or of one cluster of unsafe conditions) per unit time; let $P = 100p$ = per cent of time such condition exists; and let $q = 1 - p$.

A hypothetical sanitarian who always detects any and all unsafe conditions inspects restaurants during randomly chosen days and hours. The number of inspections r when this sanitarian does detect an unsafe condition in a given restaurant depends on p and on the frequency of inspections, n, to which the restaurant is subject. By chance alone, the sanitarian's four yearly inspections might occur during the only four days of the year when the unsafe condition does (or does not) exist.

Address reprint requests to Dr. O. Benjamin Kaplan, Environmental Health Planning Coordinator, and Land Use Specialist, Department of Environmental Health Services, 1111 E. Mill St., San Bernardino, CA 92415. This paper, submitted to the Journal November 10, 1977, was revised and accepted for publication December 7, 1977.

The probability of an unsafe condition (p), the frequency of inspections (n) and the number of inspections that detect an unsafe condition (r) can be related by the binomial expansion formula, $nCr\, p^r q^{n-r}$, where $nCr = n!/[r!(n - r)!]$. The right hand column in Table 1 is derived from the binomial expansion.

Discussion and Conclusions

Table 1 shows that two inspections (per restaurant per year) will fail to detect an unsafe condition in 25 per cent of the restaurants which are "unsafe" 50 per cent of the year, and four inspections will fail to detect an unsafe condition in 65.6 per cent of the restaurants which are "unsafe" 10 per cent of the year. It can be calculated that even 30 inspections will fail to detect an unsafe condition in 4 per cent of the restaurants in which such condition exists 10 per cent of the year. For any given restaurant and year, an unsafe condition must exist over 50 per cent of the year to be "reliably" (error $\leq 6\%$) detected in at least one of four inspections.

It can be seen in Table 1 that two, four, or even eight inspections per year may not be adequate to categorize a restaurant's relative "unsafety". For instance, should an administrator want to estimate the relative "unsafety" of a restaurant on the basis of recorded detections (of unsafe conditions) per eight inspections, and should the subject restaurant be truly unsafe 50 per cent of the year, the expected ratio of detections to total inspections should be 4/8 (i.e., 50 per cent). But ratios higher and lower than 4/8 will be obtained 72.7 per cent of the time.* In a similar vein, it can be shown that it is extremely risky to decide, on the basis of a few prior inspections, whether a restaurant is so "safe" that it needs to be inspected only once yearly.

Other difficulties arise when deciding whether a restaurant is unsafe P per cent of the year on the basis of past inspection records:

*Per Table 1, 100 minus 27.3 equals 72.7.

TABLE 1—Probability π of r detections (of unsafe conditions) when performing n inspections per year on a restaurant having an unsafe condition P per cent of the year. P = 100p, $\pi = nCr\, p^r q^{n-r}$ and 100 π = percentage of restaurants in which r detections are obtained, given n and P. (r times out of n the unsafe condition is detected.) For easy reference, numbers referred to in the text are italicized.

P	n	r	100π
100%	1	0	0
		1	100
50%	1	0	50
		1	50
	2	0	25
		1	50
		2	25
	4	0	6.25
		1	25
		2	37.5
		3	25
		4	6.25
	8	0	0.39
		1	3.1
		2	10.9
		3	21.8
		4	*27.3*
		5	21.8
		6	10.9
		7	3.12
		8	0.39
10%	*4*	0	*65.6*
		1	29.9
		2	4.9
		3	0.4
		4	0.01
	8	0	43
		1	37.6
		2	14.9
		3	3.3
		≥4	≤0.5

(a.) P may vary from year to year;

(b.) Inspections are usually not performed at statistically representative times. Unsafe conditions may be (and in this author's experience often are) flagrantly common during holidays, weekends, and during evenings. Yet the inspection activity usually occurs during normal workdays, 8:00 am to 5:00 pm;

(c.) Not all sanitarians detect all unsafe conditions. Some sanitarians are more able or conscientious than others. Often, sanitarians are not effectively "calibrated" against each other;

(d.) FDA-like restaurant sanitation scales[2] penalize unsafe conditions with semi-arbitrary demerit points. These points have *not* been obtained from food-poisoning-risk regression equations, or from other statistical analyses of food-poisoning variables. By inspecting and evaluating restaurants according to FDA-like scales, one may segregate restaurants into sanitation level categories, but not into food-poisoning-risk categories.

The detection and prevention powers of even highly frequent inspections are bound to be limited unless the above-mentioned problems are solved. With so much variability and margin for error, it is not surprising that a change in inspection frequency may appear to be inconsequential.

Although the average inspection activity appears to be somewhat ritualistic, it may be useful and important in a variety of other contexts: deterring the unsanitary behavior of restaurant personnel (who fear "getting caught"); collecting information about community problems (sewage disposal, vectors); disseminating health information, etc. Hence, the inspection activity merits improvement, not abandonment.

REFERENCES

1. Zaki, M., et al. A progressive approach to the problem of food infections. Am. J. Public Health 67:44–49, 1977.
2. U.S. Food and Drug Administration. Sanitation Program Formulator (SPIF) Vol. II. U.S.G.P.O., July 1976.

Use of an Edit Feedback System in Data Collection Quality Control

BETH GOLDMAN, MPH, AND OSCAR JONES, BS

Growing concern over individual privacy has affected the research world in the form of more and more restrictions on collecting data on human subjects. Within the federal government this concern has manifested itself in legislation such as the Privacy Act of 1974 and limits on new forms requiring personal identifiers. Fortunately, in some research involving statistical analysis, collecting data without personal identifiers is appropriate. However, since the lack of personal identifiers precludes correcting errors or collecting missing data after forms are completed, data of unacceptably low quality may result. An edit/feedback system may overcome this problem. Such a system does not lead to the immediate correction of errors, but effectively improves the quali-

From the Venereal Disease Control Division, Bureau of State Services, Center for Disease Control, Atlanta, GA. Address reprint requests to Technical Information Services, Bureau of State Services, Center for Disease Control, Atlanta, GA 30333. This paper, submitted to the Journal September 16, 1977, was revised and accepted for publication January 3, 1978.