

# Eating in Restaurants: A Risk Factor for Foodborne Disease?

Timothy F. Jones<sup>1,2</sup> and Frederick J. Angulo<sup>3</sup>

<sup>1</sup>Tennessee Department of Health and <sup>2</sup>Department of Preventive Medicine, Vanderbilt University School of Medicine, Nashville, Tennessee; and <sup>3</sup>Centers for Disease Control and Prevention, Atlanta, Georgia

**Foodborne disease is a common, but preventable, burden of illness worldwide. Almost one-half of every dollar spent on food in the United States is spent on food from restaurants. A growing body of data from foodborne disease outbreaks and studies of sporadic (non-outbreak-associated) gastrointestinal disease of various etiologies suggest that eating food prepared in restaurants is an important source of infection. These data suggest a critical need for action that is focused on preventing disease transmission within the food service industry. Clinicians should report all suspected foodborne disease to public health authorities to ensure appropriate epidemiologic investigation.**

Restaurants served >70 billion meals in the United States in 2005. Of all the money spent on food in the United States, 47% is spent in restaurants, and the food service industry employs >9% of the nation's workforce [1]. Four in 10 Americans eat in restaurants on any given day, and 1 in 6 eats >5 meals per week in restaurants [2]. Foodborne disease causes ~76 million illnesses and ~5000 deaths in the United States each year [3]. The proportion of these illnesses that result from the consumption of food from restaurants is unknown, but it is clear that the restaurant industry plays an important role in the safety of the US food supply. Although it is not possible to precisely determine the contribution of food eaten at restaurants to the burden of foodborne illness, a number of recent studies raise important questions about the safety of eating in restaurants and demonstrate the need for additional studies. Clinicians play an important role in identifying and reporting potential foodborne disease to public health authorities to ensure appropriate epidemiologic investigation and follow-up.

## OUTBREAK DATA

National foodborne disease outbreak surveillance data include some information on the association of restaurants with reported outbreaks. From 1998 to 2004, an average of ~1290 foodborne disease outbreaks each year (involving an average of ~25,600 ill people each year) were reported to the Centers

for Disease Control and Prevention (CDC) [4]. Of the 9040 foodborne disease outbreaks that were reported to the CDC from 1998 to 2004 [4], 4675 (52%) were associated with restaurants or delicatessens (including cafeterias and hotels; figure 1). Of these, 622 (13%) had a bacterial etiology, 535 (11%) were viral, and 3377 (72%) had an unknown etiology (table 1). Furthermore, when stratifying the 9040 reported outbreaks by etiology, restaurants were associated with substantial proportions of outbreaks associated with all etiologies, including bacterial (39%), chemical (47%), parasitic (24%), viral (48%), and unknown etiology (56%) outbreaks. CDC outbreak reports categorize restaurants and delicatessens together, precluding the determination of the precise proportion of outbreaks that are specifically associated with restaurants.

Although outbreaks play a substantial role in our understanding of the sources of foodborne disease, it is important to appreciate that outbreak-associated cases that are reported account for <3% of reported cases with culture-confirmed infection [5], and account for only a fraction of a percent of the total cases of foodborne disease estimated to occur each year [3]. Determining probable sources for "sporadic" (i.e., non-outbreak-associated) cases of disease is particularly challenging, but it is clearly important in understanding the contribution of restaurants to the burden of foodborne disease.

## SPORADIC DISEASE

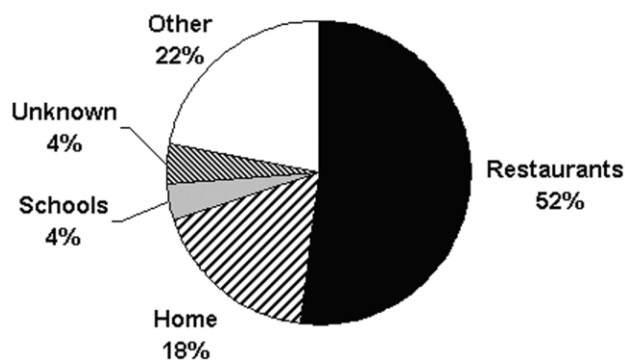
The Foodborne Diseases Active Surveillance Network (FoodNet) is a collaborative project that involves the CDC, selected state health departments, the US Department of Agriculture Food Safety Inspection Service, and the US Food and Drug Administration and is conducted under the auspices of

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Reprints or correspondence: Dr. Timothy Jones, Tennessee Dept. of Health, CEDS, 4th Fl., Cordell Hull Bldg., 425 5th Ave. N., Nashville, TN 37247 (tim.f.jones@state.tn.us).

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**Figure 1.** Sources of foodborne disease outbreaks reported to the Centers for Disease Control and Prevention during the period 1998–2004. Data are from [4]. “Restaurants” includes delicatessens, cafeterias, and hotels.

the Emerging Infections Program at the CDC. In 2004, FoodNet performed active surveillance for foodborne disease in 10 states, covering a population of 44.1 million persons (15.2% of the US population) [6]. FoodNet has performed a number of studies that provide unique insight into risk factors for sporadic foodborne diseases.

A large, population-based telephone survey administered in FoodNet sites during the period 1998–1999 suggests a possible association between an increased frequency of dining in restaurants and an increased frequency of gastroenteritis [2]. The questionnaire was administered to 12,755 persons. Persons with chronic gastrointestinal illness or who underwent prior gastrectomy were excluded from analysis. Of the 12,052 persons that were included in the analysis, 1192 (9.9%) reported an episode of acute diarrhea within the previous month; 634 (5.4%) of 11,849 persons who had complete data reported a diarrheal illness (diarrhea lasting >1 day or causing curtailment of daily activities). Approximately 8.6% of persons who reported eating at fast food restaurants  $\geq 5$  times in the past week reported diarrheal illness in the previous month, compared with 5.1% of those who ate at those venues <5 times per week (relative risk [RR], 1.7; 95% CI, 1.36–2.13). This association was observed in persons with and without underlying immunocompromising conditions (RR, 1.63 and 1.81, respectively). In contrast, no such association was evident with increased patronage of full-service restaurants.

FoodNet has conducted pathogen-specific case-control studies to identify sources of sporadic infection (table 2). In a large case-control study of persons infected with *Escherichia coli* O157:H7, eating at a table-service restaurant was associated with illness among persons consuming ground beef (matched OR [mOR], 1.7; 95% CI, 1.0–2.9; population-attributable risk, 20%) [7]. Eating pink hamburger meat prepared away from home was associated with an mOR of 5.0 (95% CI, 1.3–2.0).

A large study of persons with infection due to *Salmonella* serogroups B and D (which includes infection due to *Salmonella*

serotype Enteritidis) revealed an association with the consumption of eggs in a restaurant [8]. In a later case-control study involving persons infected with *Salmonella* serotype Enteritidis, among persons with no recent international travel, consumption of chicken prepared outside the home was associated with illness, with an mOR of 2.8 (95% CI, 1.8–4.4) [9]. Persons consuming fewer meals prepared at home had an mOR of 2.4 (95% CI, 1.5–3.8). Overall, 35% of cases of *Salmonella* serotype Enteritidis infection in this study were attributed to eating chicken prepared outside the home.

In a small case-control study involving persons infected with *Salmonella* serotype Heidelberg, illness was associated with eating eggs that were prepared outside of the home (mOR, 6.0; 95% CI, 1.2–29.6) and had a population-attributable risk of 39% [13].

In a case-control study involving persons infected with *Salmonella* serotype Typhimurium, eating fried eggs that were prepared outside of the home was associated with illness (mOR, 4.2; 95% CI, 1.4–12.9) [12]. In analyses comparing persons infected with multidrug-resistant strains of *Salmonella* serotype Typhimurium with healthy control subjects, eating scrambled eggs prepared outside of the home was a risk factor, with a population-attributable risk of 13%.

In a large case-control study involving persons infected with *Campylobacter* species, infection was associated with eating chicken, turkey, or nonpoultry meat prepared at a restaurant [16]. In a study of infection due to domestically acquired, fluoroquinolone-resistant *Campylobacter* species, eating chicken or turkey cooked at a commercial establishment was implicated as an important source of infection [11].

Studies performed by other groups have found similar results. In a study of *Campylobacter jejuni* infection in England, consumption of chicken in a restaurant was associated with illness (and was the explanation for 11% of cases), whereas eating chicken elsewhere was not associated with illness [16].

**Table 1. Etiology of restaurant-associated outbreaks reported to the Centers for Disease Control and Prevention during the period 1998–2004.**

Etiology	No. (%) of outbreaks
Unknown	3377 (72)
Norovirus	496 (11)
<i>Salmonella</i> species	349 (7)
Scombroid	119 (3)
<i>Escherichia coli</i>	57 (1)
<i>Clostridium perfringens</i>	54 (1)
<i>Shigella</i> species	50 (1)
Hepatitis A	36 (1)
<i>Staphylococcus</i> species	35 (1)
Other	122 (3)

**Table 2. Selected case-control studies demonstrating risk associated with food prepared outside of the home.**

Pathogen, risk factor	No. of cases	Multivariate OR (95% CI)	PAR, %	Reference
<i>Escherichia coli</i> O157				
Eating at a table service restaurant	196	1.7 (1.0–2.9)	20	[7]
Eating pink hamburger prepared away from home	196	5.0 (1.3–20)	7	[7]
<i>Salmonella</i> serogroup B or C				
Eating eggs prepared in a restaurant	463	1.6 (1.2–1.9)	9	[8]
<i>Salmonella</i> serotype Enteritidis				
Eating chicken prepared outside of the home	182	2.8 (1.8–4.4)	35	[9]
Eating fewer meals prepared at home	182	2.4 (1.5–3.8)	...	[9]
Eating at a restaurant in Wisconsin	35	7.3 (1.7–31.9)	...	[10]
Eating at a restaurant in Utah	43	5.7 (1.7–21.4)	...	[11]
<i>Salmonella</i> serotype Typhimurium				
Eating fried eggs prepared outside of the home	166	4.2 (1.4–12.9)	...	[12]
Multidrug-resistant <i>Salmonella</i> serotype Typhimurium				
Eating scrambled eggs prepared outside of the home	61	5.7 (1.3–26.1)	13	[12]
<i>Salmonella</i> serotype Heidelberg				
Eating eggs prepared outside of the home	44	6.0 (1.2–29.6)	39	[13]
<i>Campylobacter</i> species				
Eating chicken prepared at a restaurant	1316	2.2 (1.7–2.9)	24	[14]
Eating nonpoultry meat prepared at a restaurant	...	1.7 (1.3–2.2)	21	[14]
Eating turkey prepared at a restaurant	...	2.5 (1.3–4.7)	4	[14]
Domestically-acquired, fluoroquinolone-resistant <i>Campylobacter</i> species				
Eating chicken or turkey prepared at a commercial establishment	33	10 (1.3–78)	38	[15]

**NOTE.** PAR, population-attributable risk.

A study of a newly-introduced phage type of *Salmonella* serotype Enteritidis in Utah revealed that sporadic infections were significantly associated with eating in restaurants, particularly restaurants that used >2000 eggs per week or that used pooled eggs [11]. Although 1 farm appeared to be the source of introduction of the organism, this study suggested that restaurants in general are an important site of amplification (and potential control) of the pathogen. In a Wisconsin study of factors that were associated with a marked increase in *Salmonella* serotype Enteritidis, dining in restaurants was associated with infection [10]. A study of clinically defined cases of “food poisoning” in individuals who presented to an emergency department in London noted an association between illness and eating food prepared outside of the home within the previous day (adjusted OR, 2.41; 95% CI, 1.29–4.5; population-attributable risk, 37%) [17].

## COMMENTARY

A variety of studies of both sporadic and outbreak-associated illness involving diverse areas, methodologies, and pathogens suggest that restaurants are an important source of foodborne disease in the United States. Given the large (and increasing) proportion of meals prepared outside the home, this is of little surprise. There are many factors that may contribute to an increased risk of foodborne disease when foods are eaten in

restaurants. Innumerable reports of foodborne disease outbreaks have identified cross-contamination events within restaurants that have led to illness. A variety of studies have also brought attention to opportunities for improvement of hygiene and sanitation practices in the commercial food service environment [18–20]. Although many consumers may follow unsafe food-handling practices at home [21, 22], restaurants are obviously a setting in which improving these practices can have an important impact. Clearly, even momentary lapses in safe food-handling practices by food service employees can have dramatic consequences in high-volume establishments.

The evidence suggesting that restaurants are an important source of foodborne infection must be interpreted with caution. Myriad factors are likely to influence the association between eating in restaurants and foodborne disease. Foodborne disease outbreaks occurring in restaurants, for example, may be reported more often than those occurring in other settings. Ill persons may be more inclined to attribute illness to a commercially prepared food than to other potential sources. Because of the high volume of food that is served, a food preparation error or a contaminated product in a restaurant may lead to more illnesses—and a greater likelihood of recognition—than in other settings where food is consumed. The FoodNet population survey relied on retrospective self report and did not involve laboratory confirmation of disease or col-

lect sufficient data to attribute illness to a particular cause, and, therefore, it demonstrated only ecological associations.

The case-control studies of sporadic disease in FoodNet and other sites also have limitations. Each study was performed differently, using varying methodologies, study populations, and questions. By definition, the specific source of a “sporadic” infection is almost impossible to identify with certainty. Studying the epidemiology of community-acquired illness is fraught with the difficulties of sorting out numerous complex and often related sources of infection. Although many of the case-control studies that have been cited demonstrate an apparent association with eating in restaurants, proving causality is difficult. Eating in restaurants is likely to be associated with many other behavioral and sociodemographic factors that can also affect disease risk.

Despite these important limitations, the consistent findings demonstrating an association between increased frequency of eating in restaurants and increased risk of foodborne disease bear further examination. The reservoirs and sources of many foodborne diseases have been described, many of which (e.g., eggs as a source of *Salmonella* serotype Enteritidis infection) were corroborated by the studies cited herein. International travel is also a commonly recognized source of many of these same diseases. Despite this, it is intriguing that, in so many of these studies, even when purportedly controlling for these factors, consumption specifically of foods prepared outside of the home was associated with a greater risk of foodborne disease than was home-cooked foods.

Although this cannot be the forum for a lengthy discussion of the complexities of the food service system and the challenges attendant in improving hygiene and sanitation in the food production industry, it is important to acknowledge that the barriers to improving hygiene and sanitation are substantial. The restaurant industry must deal with very high levels of staff turnover [23] and with a workforce composed, in large part, of young employees who have little background training in food safety. Whereas the industry has made dramatic strides in ensuring safe foodhandling practices, perfection is unattainable. One of the most challenging food safety issues for restaurants, from our perspective, is dealing with the problem of food handlers who work while they are ill. Although most establishments have policies discouraging such practices, enforcement of these policies is very difficult. Many restaurant workers are low-wage employees who have no health benefits or sick leave and, thus, will not get paid if they do not work. Gastrointestinal disease often cannot be detected by an employer; thus, there is little way to keep such employees from working if they do not self report their illness. Such challenges may make it impossible to completely eliminate the problem of food handlers working while they are ill, and, therefore, this

is likely to be an important factor contributing to the persistent, ongoing risks associated with eating in restaurants.

Many important improvements in food safety have been instituted by corporations; such advances must continue to be disseminated throughout the industry. Restaurants can take measures to ensure that meat, produce, and other foods are obtained from high-quality suppliers. Restaurant industry standards can significantly influence the chain of safe growing and handling practices of produce and other foods before they enter the kitchen. Training and certification of managers and appropriate training of food workers is important to ensure that safe food handling procedures are consistently followed. Health departments and government agencies should regularly evaluate inspection and regulatory policies to ensure that they effectively and efficiently protect the public’s health while appropriately meeting the education and guidance needs of the food service industry.

There is a critical need to focus intensely on specific, modifiable risks in the food production chain and to adopt new strategies to minimize risks even as studies and debates continue. Restaurants must follow strict policies of safe food handling. Consumers should avoid consumption of high-risk foods, such as undercooked eggs or undercooked ground beef, in any venue, including restaurants. Clinicians can help to ensure appropriate epidemiologic investigation and follow-up of suspected cases of foodborne disease by reporting them to local public health authorities.

Although the number of Americans who suffer from foodborne disease each year is too high, it is important to keep these statistics in perspective. Even under the most dramatic assumptions, the overwhelming majority of food that Americans eat in all venues is safer, cheaper, and more convenient than it has ever been in history. Although the risk of getting a foodborne disease can never be eliminated, we would all like it to be lower—the food service industry as much as the consumer. The issue of food safety is an immensely complex one, and studies suggesting that any particular industry, product, or group might be involved in associated risk will always stimulate vigorous and heated debate. In this case, all parties benefit from the ultimate common goal of a healthy and happy consumer.

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