Chapter 2

Characteristics of Microbial Foodborne Illness Relevant to Litigation

The Pathology of Foodborne Illness

More than 40 different foodborne microbial pathogens are known to cause human illness, including bacteria, parasites, viruses, fungi, and their toxins (CAST, 1994, pp. 11-15). The ecology of pathogens varies. Some pathogens, such as *Listeria monocytogenes*, are pervasive in the natural environment and may contaminate food during production or distribution. Others have found new ecological niches, such as *Salmonella* serotype Enteritidis in eggs.

Several pathogens were recognized only recently as a cause of foodborne illness (Tauxe, 1997). Some foodborne pathogens have not yet been scientifically identified. The CDC has estimated that these elusive, unknown pathogens account for 81 percent of the foodborne illnesses in the United States (Mead et al., 1999). These unknown pathogens probably account to some extent for epidemiologists' inability to identify the pathogens that caused over two-thirds of the 2,800 mass outbreaks of foodborne illness reported to the CDC during 1993-97 (Olsen et al., 2000).[1]

The illnesses caused by foodborne pathogens vary greatly in severity, duration, and clinical manifestations. Most foodborne illnesses are not severe or prolonged and are limited to brief episodes of diarrhea, nausea, or other acute gastrointestinal symptoms. A small proportion of foodborne illnesses are severe or fatal, however. The CDC has estimated that 0.43 percent of U.S. foodborne illnesses require hospitalization, while 0.01 percent result in death (Mead et al., 1999). The most severe acute illnesses associated with foodborne pathogens include complications such as septicemia (infection of the bloodstream), localized infections of other organs, and spontaneous abortion in pregnant women. About 2-3 percent of foodborne illnesses result in secondary complications that may become chronic health problems (Lindsay, 1997). The best-known complications associated with foodborne pathogens include reactive arthritis, hemolytic uremic syndrome (characterized by kidney failure), and Guillain-Barré syndrome (characterized by neuromuscular paralysis). Table 1 provides estimates of the annual foodborne illnesses, hospitalizations, and deaths for some of the most common or deadly foodborne pathogens.

Although most of the estimated 76 million annual foodborne illnesses in the United States are relatively mild and self-limiting, at least 325,000 of these illnesses are serious enough to result in hospitalization or death (Mead et al., 1999). Foodborne illnesses account for about 1 of every 100 U.S. hospitalizations and 1 of every 500 U.S. deaths.[2] The annual number of deaths due to food products contaminated by microbial pathogens is much smaller than the number of deaths associated with certain other products, notably tobacco, medical drugs, and alcoholic beverages. However, contaminated foods are responsible for many more accidental fatalities than some products commonly perceived as dangerous, including firearms, industrial machinery, and explosives.

Causes of Foodborne Illness

Epidemiological investigations of foodborne illnesses provide some information about the specific pathogens and foods that caused illness. Animal products such as meat, poultry, seafood, dairy products, and eggs are the foods most likely to cause outbreaks of human illness in the United States (CAST, 1994, p. 32). In recent years, the variety of foods associated with foodborne illness has increased (Tauxe, 1997). Some examples include salami, lettuce, bean sprouts, and raspberries.

Epidemiological investigations of foodborne illnesses also identify the kinds of errors in food production,

[1] CDC data on foodborne disease outbreaks define an outbreak as an incident in which two or more persons experienced a similar illness after ingestion of a common food, and epidemiologic analysis implicated a food as the source of the illness. There are two exceptions, botulism and chemical poisoning, for which one case constitutes an outbreak.

[2] The United States had 31.1 million community hospital admissions in 1996 (U.S. Census Bureau, 1999) and 2.3 million deaths in 1998 (Murphy, 2000).

distribution, or preparation that allow microbial pathogens to contaminate food.[3] Some food-handling errors introduce pathogens into uncontaminated food. Other errors permit the pathogenic organisms already present in raw food to survive or multiply to dangerous levels in prepared food. Potential errors include:

- the use of contaminated raw food,
- cross-contamination of prepared food by contaminated raw food,
- poor personal hygiene by infected food handlers,
- inadequate cleaning of equipment,
- inadequate cooking or reheating,
- improper holding temperatures,
- cooling food too slowly after heating,
- eating food too long after preparation,
- insufficient fermentation, acidification, salting, or sweetening during processing (Bryan et al., 1997).

The most common cause of recent mass outbreaks of foodborne illness reported to the CDC was improper holding temperatures, but many outbreaks involved more than one error (Olsen et al., 2000).

Both food firms and consumers make food-handling errors that result in foodborne illness.[4] Many illnesses are attributable to sequential errors by firms and consumers. Sequential errors occur when consumers improperly handle foods that were initially contaminated by microbial pathogens during commercial production or distribution. For example, a meatpacking plant may fail to prevent ground beef from being contaminated by *Salmonella* bacteria, and consumers may subsequently undercook hamburgers made from the ground beef, causing those who eat the hamburgers to become sick.

The proportion of foodborne illnesses due to separate food-handling errors by firms and consumers is unknown due to the limitations of the data on foodborne illness (Powell, 1999). Most information about the errors that caused illness is derived from epidemiological investigations of foodborne illness outbreaks by State and local public health agencies. However, investigated outbreaks account for only a small and nonrepresentative share of all foodborne illnesses for several reasons. Public health agencies are more likely to learn about outbreaks affecting many people than about sporadic cases of illness affecting only one person, although sporadic cases are much more frequent than outbreak cases (Bean et al., 1990). Public health agencies are also more likely to learn about certain kinds of outbreaks than others, notably large outbreaks and outbreaks involving restaurants or severe illness (Bean et al., 1996). Finally, public health agencies have limited resources and do not thoroughly investigate or report every known outbreak to the CDC (Berkelman et al., 1994; Bean et al., 1996).

The most recent CDC summary of foodborne illness outbreaks indicates that public health agencies reported an annual average of 550 outbreaks resulting in 17,200 foodborne illnesses during 1993-97 (Olsen et al., 2000). Reported outbreaks consequently accounted for only about one of every 4,000 foodborne illnesses in the United States. About two-fifths of the outbreak reports sent to CDC did not identify the food-handling errors that caused illness (Olsen et al., 2000).

Epidemiological case-control studies of sporadic cases of foodborne illness also provide information about food-handling errors that cause illness. For example, a case-control study revealed that sporadic *E. coli* O157:H7 infections are associated with eating undercooked hamburgers (Slutsker et al., 1998). However, case-control studies have important limitations, notably their reliance on consumers' self-reports about food handling.

Despite the lack of information about the specific errors that caused most foodborne illnesses, some experts have concluded that most illnesses are attributable to food-handling errors by consumers (Scott and Sockett, 1998). Many consumers engage in unsafe food-handling practices, and some consumers prefer to eat "risky" foods. Examples include placing cooked hamburgers back on a plate that contains raw meat juices, and eating Caesar salad made with raw eggs. To conclude that most foodborne illnesses are due to consumers alone, however, ignores ample evidence that firms also make food-handling errors resulting in foodborne illness.

[3] For simplicity, we use the term "food-handling errors" to include errors in food production, distribution, or preparation.

[4] The discussion of firms in this report covers noncommercial organizations such as schools and churches as well as commercial firms, because noncommercial organizations may also handle food and be held liable for injuries due to foodborne pathogens.

Food-Handling Errors by Firms

The most recent CDC summary of reported foodborne disease outbreaks covering the 1993-97 period (Olsen et al., 2000) provides a sample of food-handling errors, most of which were never reported in the mass media. The sample includes information about the food product, the place where the food was eaten, and the food-handling errors responsible for causing illness. The 2,751 outbreaks included in the sample involved a wide variety of places and food products, indicating that food-handling errors were not restricted to a few error-prone firms or "risky" foods.

The CDC summaries of reported foodborne disease outbreaks reveal that most reported outbreaks were caused by food-handling errors by firms. During 1993-97, nearly 78 percent of the outbreaks with information about the place where contaminated food was eaten occurred in a commercial or institutional establishment, while only 22 percent occurred in a private residence (Olsen et al., 2000). The proportion of outbreaks attributed to food prepared by firms has increased over time, rising from 63 percent in 1973-75 to 78 percent in 1993-97, although the reasons for the increase are unknown (Bean and Griffin, 1990; Olsen et al., 2000). Although food-handling errors by firms were involved in most reported outbreaks, little information is available about the role of firms in causing either unreported outbreaks or sporadic cases of foodborne illness.

Food-Handling Errors by Consumers

The high frequency of risky food-handling practices and food preferences among consumers suggests that many illnesses are due at least in part to consumer behavior. In addition to the risky food-handling practices already mentioned, other common risky practices include undercooking raw meat and poultry, and preparing salad and raw meats with the same utensils and cutting boards. The 1998 FDA Food Safety Survey of U.S. adults found that 4 percent ate raw

Table 1—Estimated annual foodborne illnesses, hospitalizations, and deaths due to selected pathogens, United States, 1999

Disease or agent	Illnesses	Hospitalizations	Deaths	Comment
	- - - - - - - - *Number* - - - - - - - -			
Bacterial				
Campylobacter spp.	1,963,141	10,539	99	A small percentage of people develop Guillain-Barré Syndrome.
Clostridium perfringens	248,520	41	7	Usually causes mild gastrointestinal distress lasting only a day.
Escherichia coli O157:H7	62,458	1,843	52	Usually a mild gastrointestinal illness, but severe complications such as bloody diarrhea and kidney failure may develop (e.g., hemorrhagic colitis and hemolytic uremic syndrome (HUS)).
Listeria monocytogenes	2,493	2,298	499	Women infected with *Listeria* during pregnancy may transmit the infection to the fetus, possibly leading to stillbirths or babies born with mental retardation.
Salmonella, nontyphoidal	1,341,873	15,608	553	Relatively mild and common.
Staphylococcus foodborne illness	185,060	1,753	2	Characterized by severe nausea, vomiting, cramps, and diarrhea.
Vibrio cholerae, toxigenic	49	17	0	Causes epidemic cholera.
Vibrio vulnificus	47	43	18	Fatality rate is about 50 percent in people with chronic liver disease.
Parasitic				
Toxoplasma gondii	112,500	2,500	375	Infection may be transmitted to fetuses, possibly leading to stillbirths or babies born with birth defects ranging from hearing or visual impairments to mental retardation.

Source: Data from Mead et al., 1999.

steak tartare, 37 percent ate raw eggs or products with raw eggs, and 12 percent ate raw oysters (Fein and Riggins, 1998).

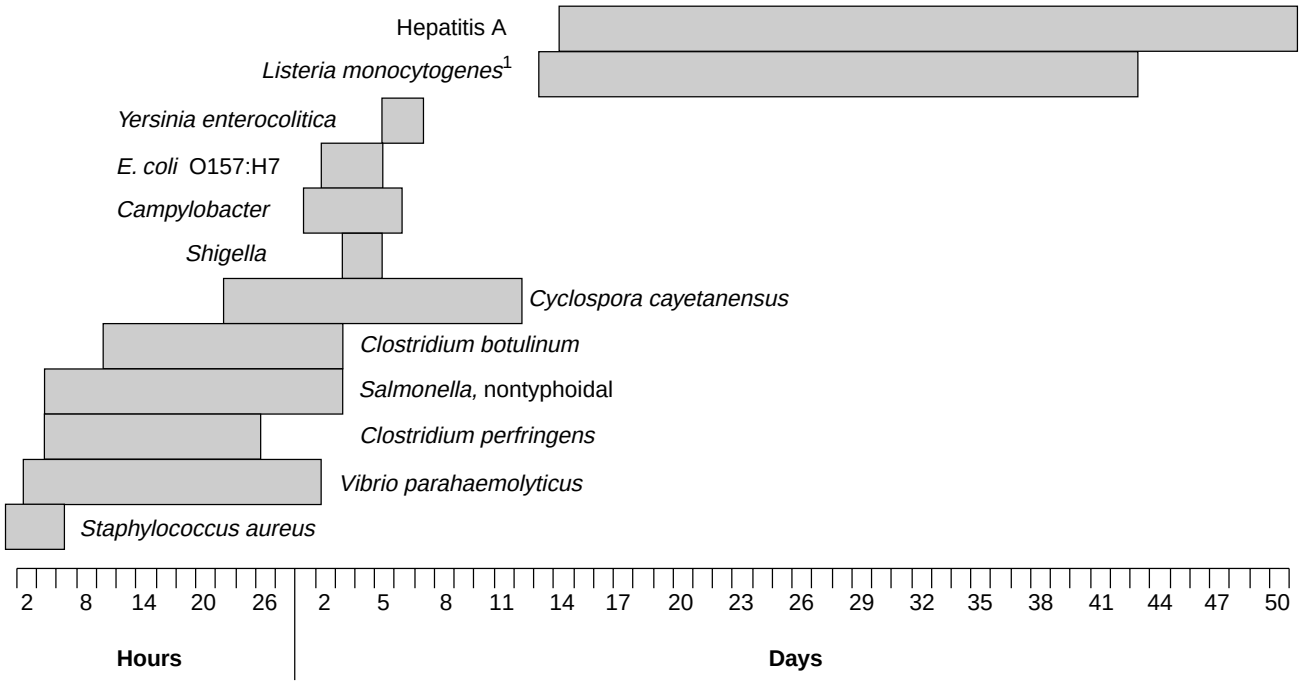
Consumers should follow proper food safety practices because raw foods might be contaminated by microbial pathogens. Proper handling, cooking, and storage procedures will eliminate most pathogens.

Epidemiological and Legal Perspectives on the Causes of Foodborne Illness

The epidemiological perspective on foodborne illness is separate from the legal perspective discussed more fully in the next chapter. From an epidemiological perspective, the example of *Salmonella*-contaminated ground beef mentioned earlier was due to errors by both the meatpacking plant and consumers who prepared hamburgers. In essence, the epidemiological perspective focuses on exactly how a food product became contaminated by a pathogen and caused human illness. In contrast, the legal perspective on foodborne illness focuses on liability for the damages due to illness, which depends on other factors in addition to responsibility for the food-handling errors that caused illness. For example, although consumers and food firms may share responsibility for causing foodborne illness under the law, lawyers for food firms generally avoid blaming consumers for making food-handling errors because jurors also make the same errors at home and would likely be sympathetic to consumers accused of such errors (Clark, 2000).[5] The law also imposes different standards of conduct on food firms than on consumers because food firms are expected to know about the risks of foodborne pathogens and to take effective measures to prevent pathogen contamination (Clark, 2000).

[5] Any firm that raises the issue of consumer handling errors must also deal with the issue of why the firm did not warn the consumer about potential risks due to pathogen contamination of its food products. The legal concept of "failure to warn" is discussed further in the appendix.

Figure 1
Usual incubation period ranges for select foodborne diseases



[1]Invasive form, incubation period for diarrheal disease unknown.
Source: Data on the "usual" incubation period obtained from the Centers for Disease Control and Prevention, "Surveillance for Foodborne-Disease Outbreaks--United States, 1988-1992." MMWR 45,SS-5 (Oct. 25, 1996): 58-66.

Characteristics of Foodborne Illnesses

Several characteristics of foodborne illnesses may affect efforts to determine liability for the injuries due to these illnesses. These characteristics include the incubation period, mass outbreaks of illness, a person's susceptibility to foodborne infections, and medical practices.

Incubation Period. Many foodborne pathogens do not cause symptoms of acute illness until several days after the contaminated food is eaten, although the average incubation period before the onset of acute symptoms varies considerably by pathogen (fig. 1). Symptoms due to the toxins produced by *Staphylococcus aureus* appear within 2-4 hours, while symptoms due to invasive *Listeria monocytogenes* infections may not develop for 2-6 weeks (CDC, 1996). Chronic complications may take even longer to develop, often several weeks or months after the consumption of contaminated food.

The long incubation period for some pathogens makes it difficult to link specific contaminated food products with adverse health outcomes, particularly the often nonspecific symptoms of foodborne illness. This time lag also makes it difficult to trace problems back to specific producers, thus providing the food industry with some protection from litigation. Several meals may have been eaten before people noticed foodborne illness symptoms. In general, the difficulty of tracing a foodborne illness back to a specific food source increases as the incubation period lengthens. The longer the incubation period, the greater the number of other potential sources of foodborne illness and the lower the likelihood of having any samples of suspect food available for microbiological testing.

Mass Outbreaks of Illness. Public health authorities are more likely to investigate mass outbreaks than individual cases of foodborne illness. Therefore, outbreak cases tend to have more documentation, which can help determine liability for injuries due to food products contaminated by microbial pathogens. Additionally, plaintiffs in outbreaks have the added option of pursuing litigation via class action suits or mass litigation (see appendix).

Variations in Susceptibility to Foodborne Infections. People vary in their susceptibility to foodborne infections due to host factors, such as age, stress, health of their immune system, and personal hygiene, as well as diet-related factors, such as consumption of antacids and nutritional deficiencies (CAST, 1994, p. 27). Foodborne illnesses tend to have the most severe consequences in children, the elderly, and the immunocompromised (i.e., AIDS and cancer patients).

Medical Practice Patterns. Most foodborne illness patients never receive a definitive medical diagnosis, either because they did not seek medical care or because their physician did not test for the pathogen that caused the illness. For example, the Foodborne Diseases Active Surveillance Network (FoodNet) found that only 12-15 percent of people who experienced acute diarrhea (the most common symptom of foodborne illness) saw a doctor about their illness, and only about a fifth of diarrhea patients provided a stool specimen for the tests needed to determine the exact cause of their illness (Frenzen et al., 1999). A medical diagnosis can strengthen suspected linkages between a particular illness and food product, information important in pursuing foodborne illness litigation.

Economic Costs of Foodborne Illness

Because most foodborne illnesses are mild and do not require medical care, the average economic cost for ill consumers and their families is likely to be small. However, more severe illnesses can impose high monetary costs, including medical costs and income or productivity losses, as well as nonmonetary costs such as pain and suffering.

Some economic costs of illness are shifted to parties other than the person who became ill. Types of cost shifting include: (1) insured medical expenses for those with health insurance are shifted to private or public health insurers; (2) uninsured medical expenses for those unable to pay their medical bills are absorbed by health care providers (or by taxpayers) when medical expenses are deducted as a business loss; (3) time lost from work by employees with sick leave benefits, and reduced productivity by employees who report to work while ill, become costs for employers; and (4) medical expenses for foodborne illness covered under government health plans (e.g., Medicare) are borne by taxpayers. This cost-shifting reduces out-of-pocket costs for ill people and their families. The widespread prevalence of these cost-shifting mechanisms may reduce the economic incentives for ill individuals to seek compensation from those responsible for causing their illness.