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Foodborne Illness

Risks and Prevention

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In recent memory, there has been a considerable increase in food recalls and foodborne illness outbreaks. To ensure food safety, everyone involved in the food production chain needs to understand the different factors that could contaminate food and lead to foodborne illness. Food can become contaminated in many ways as it is being grown, prepared, and eaten, including the following common situations.

- Inadequate cooking
- Poor personal hygiene
- Improper holding/storage time and
- temperatures
- Cross-contamination
- Unsafe sources

It is important to remember the difference between a food recall and a foodborne illness outbreak. Not all recalls are related to or cause foodborne illness. All foodborne illness outbreaks trigger an investigation and most likely a food recall.

Types of Food Recalls

Food recalls fall into three categories.

- **Class I** refers to products that could cause serious illness, injury, or death.
- **Class II** refers to products that might cause serious injury or temporary illness.
- **Class III** refers to products that are unlikely to cause illness or injury but violate USDA/FDA regulations.

For more information on recalls, refer to the following links for USDA and FDA recall pages.

- **USDA**: http://www.fsis.usda.gov/wps/portal/fsis/topics/food-safety-education/get-answers/food-safety-fact-sheets/production-and-inspection/fsis-food-recalls/fsis-food-recalls
- **FDA**: http://www.fda.gov/downloads/ForConsumers/ConsumerUpdates/UCM143332.pdf

Any food item has the risk of three primary hazards:

- **Biological** hazards that can contaminate food include microorganisms such as bacteria, viruses, and parasites.
- **Chemical** hazards include pesticides, cleaners, sanitizers, toxins, and other chemicals such as processing aids.
- **Physical** hazards include metal, glass, wood, stone, plastic, etc.

A biological hazard caused by microbes is the biggest cause of concern because 95 percent of foodborne illness is caused by microbes. Harmful microorganisms cause two types of foodborne illness: intoxication and infection.

Table 1. Infection and intoxication

Infection	Intoxication
Microorganisms gains access to the food	Microorganisms produce toxins in the food
⬇	⬇
Consumption of the contaminated food item	Food item might be heated to the point the microbes are killed
⬇	⬇
Microorganisms multiply and infect the digestive system and causes illness	Heat resistant toxins are not destroyed
	⬇
	Toxins cause intoxication/poisoning

SYMPTOMS

Foodborne illness can result in minor symptoms such as nausea and vomiting, although some cases result in hospitalization and even death.

General symptoms of foodborne illness include severe gastric distress, with accompanying diarrhea or vomiting, or both. Table 2 shows symptoms, incubation times (time from consumption of the contaminated food to onset of symptoms), and sources of different foodborne pathogens that most often cause illness in the United States. The difference in the range of symptoms may be due to the severity of the contamination of the food, the virulence or strength of the pathogen, the amount of contaminated food ingested by the consumer, and whether the consumers fall into the highly susceptible or immunocompromised population. The term *immunocompromised* refers to individuals with feeble immune systems, such as persons battling various illnesses, infants, pregnant women, and the elderly.

Factors That Could Minimize Foodborne Illness Risks

Microorganisms that represent biological hazards cause the majority of foodborne illnesses, so controlling them significantly reduces the risk of foodborne illness. The following factors help prevent foodborne illness.

Personal hygiene/handling

Food handlers present a direct risk of contaminating the food, since humans carry human pathogens. Food workers' personal hygiene is of prime importance to prevent contamination. For consumers and food workers, this means washing hands thoroughly with soap before and after handling food. Recent stricter regulatory guidelines have forced food processors and producers to exclude ill workers from handling food. Both at home and at food processing facilities, it is important to have a well-stocked toilet, including toilet paper, single use towels, and soap. Wherever possible, direct contact with food should be avoided and workers should use disposable gloves and tongs, especially when handling ready-to-eat or cooked food.

Adequate cooking

Adequate cooking—that is, following proper time and temperature requirements—is one of the best ways to destroy human pathogens and ensure safety of the food, zoonotic pathogens (those normally transferred from animals and

Table 2. Foodborne pathogens that frequently cause illness in the United States

Microbe or Toxin	Symptoms	Incubation Times	Food Sources
Campylobacter jejuni	Nausea, vomiting, stomach cramps, and intense diarrhea	2–5 days	Raw and undercooked poultry, unpasteurized milk, contaminated water
Clostridium botulinum	Blurred vision, breathing and swallowing difficulties, dry mouth, respiratory failure	12–36 hours	Improperly canned foods, especially home-canned vegetables, fermented fish, baked potatoes in aluminum foil
Escherichia coli O157:H7	Vomiting, watery turning to bloody diarrhea, kidney failure	1–8 days	Undercooked beef (especially hamburger), unpasteurized milk and juice, raw fruits and vegetables (e.g. sprouts), and contaminated water
Listeria monocytogenes	Slight fever, stomach cramps, diarrhea, abortion, meningitis	1 day to many weeks	Unpasteurized milk, soft cheeses made with unpasteurized milk, ready-to-eat deli meats
Salmonella enteridids	Chills, fever, nausea, vomiting, stomach cramps, diarrhea	24–36 hours	Eggs, poultry, meat, unpasteurized milk or juice, cheese, contaminated raw fruits and vegetables
Staphylococcal enterotoxin	Sweating, chills, nausea, vomiting, stomach cramps, diarrhea	1–6 hours	Unrefrigerated or improperly refrigerated meats, potato and egg salads, cream pastries

Source: Introducing Food Science by Robert L. Shewfelt, Alicia Orta-Ramirez, and Andrew D. Clarke, and The U.S Food and Drug Administration Center for Food Safety and Applied Nutrition.

humans), and vegetative forms of toxin-producing microorganisms. It is highly recommended that food preparers use a food thermometer and follow minimum holding times to ensure that the food is adequately cooked.

Table 3. Minimum internal temperature and time chart for different food products

Product	Minimum Internal Temperature & Rest Time
Beef, pork, veal and lamb steaks, chops, roasts	145 °F (62.8°C) and allow to rest for at least 3 minutes
Ground meats	160 °F (71.1 °C)
Ham, fresh or smoked (uncooked)	145 °F (62.8 °C) and allow to rest for at least 3 min.
Fully cooked ham (to reheat)	Reheat cooked hams packaged in USDA-inspected plants to 140 °F (60 °C); all others to 165 °F (73.9 °C).
All poultry (breasts, whole bird, legs, thighs, wings, ground poultry, and stuffing)	165 °F (73.9 °C)
Eggs	160 °F (71.1 °C)
Fish and shellfish	145 °F (62.8 °C)
Leftovers	165 °F (73.9 °C)
Casseroles	165 °F (73.9 °C)

Source: The United States Department of Agriculture Food Safety Inspection Service

Proper holding/storage time and temperatures

Potentially hazardous foods (foods of plant and animal origin such as meat, dairy, and cooked vegetables) or foods that need temperature control for safety inherently favor the growth of microorganisms. Even a small amount of bacterial contamination could result in rapid multiplication, leading to dangerous levels of contamination, especially in the temperature "danger zone" range (between 40 and 140^0 F), which also applies to slower growing pathogenic microorganisms other than bacteria, excluding viruses that require a host to multiply. Refrigerated foods should not be left out for more than two hours (one hour if the outside temperature is above 90^0 F).

Cross-contamination

Cross-contamination is one of the most common ways harmful microorganisms get into food. Cross-contamination is prevented by blocking the three common access points for contaminants:

- **Cleaning and sanitation** of cooking utensils and the cooking environment
- **Separation** of ready-to-eat food from raw food products and cooked food from uncooked items
- **Washing of hands** before and after handling food, and in particular while switching between handling raw food and cooked foods

Food from unsafe sources

The term "farm to table" describes how food passes through a long handling chain that originates at the farm where the food is grown. Contaminants have many opportunities to gain access to food long before the food enters a store, restaurant, or home. Various aspects of food safety are regulated by the United States Department of Agriculture and the Food and Drug Administration. Consumers should pay close attention to labels, particularly with products that might not have been subject to inspection, such as certain home-processed or canned foods, wild game, and plants picked from the environment (e.g., mushrooms).

Incidence of Foodborne Illness

Based on the Center for Disease Control and Prevention's surveillance system, 18,211 outbreaks were reported between 1998 and 2015. This 17-year period also had 358,391 illnesses, 13,715 hospitalizations, and 318 deaths. The leading cause of illnesses during this period was Norovirus (5,362 outbreaks) followed by *Salmonella* (2,437 outbreaks). Other organisms responsible included clostridium (1,039 outbreaks), *E.coli* (554 outbreaks), *Campylobacter* (440 outbreaks), *Staphylococcus* (649 outbreaks), and *Listeria* (61 outbreaks). During the same time period, Kentucky had 46 outbreaks, which resulted in 8,411 illnesses, 1,845 hospitalizations, and 31 deaths.

Summary

Foodborne illness is a significant health and economic burden to society, and risks may be minimized or eliminated by simple procedures to ensure proper sanitation, cooking, storage, and packaging of foods. Proper sanitation of the environment where food is being prepared can prevent cross-contamination. Cooking food to the recommended temperatures (Table 3) destroys disease-causing microorganisms. Proper packaging can ensure that no contaminants gain access to the food. Finally, proper storage means keeping the food out of the temperature danger zone (40° F - 140° F) by keeping hot foods hot (above 140° F) and cold foods cold (below 40° F).

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