Guests of any eating establishment have certain expectations regarding the food that is prepared for and served to them. Minimally they expect it to be pleasing to the eye, flavorful, satisfying, and priced at a fair value. Patrons select dining establishments based on these and other aspects of quality.

One aspect of quality that is simply assumed is that of food safety. Customers take it for granted that food has been purchased from safe sources and handled properly from reception at the dock to the point of service. It is the responsibility of the foodservice manager to ensure that these expectations are met every time food is served. To accomplish this, the manager needs the knowledge and skills to build, implement, and maintain a program of food safety that is consistent with the unique features of a given foodservice operation.

The purpose of this chapter is to provide the reader with the foundation knowledge needed to build a comprehensive program of food safety. We begin with information on the prevalence and seriousness of foodborne illness with an emphasis on the role of the food manager and prevention. The chapter continues from the systems perspective by providing an overview of laws and regulations that can help establish a framework for building a comprehensive food safety program. From there, detailed information relative to inputs and operations is provided to ensure that food safety is assured throughout the operation regardless

**OUTLINE**

**Foodborne Illness**
- Scope of the Problem: Incidence of Foodborne Illness
- Costs Associated with Outbreaks of Foodborne Illness

**The Role of the Food Manager**

**Causes of Foodborne Illness**
- Hazards Inherent to Food
- Hazards Introduced to Food by People and Practices

**A Systems Approach to Food Safety**
- Controls and Food Safety

**Food Safety: An Integrated Program of HACCP and Prerequisite Programs**
- Prerequisite Programs: The Foundation of an Integrated Food Safety Program
- Prerequisite Programs and Standard Operating Procedures (SOPs)

**Employee Health and Personal Hygiene**
- Proper Attire
- Personal Hygiene Habits

**Flow of Food through the Foodservice Operation**
- Proper Food Handling
- Potential Hazards in Production

**Hazard Analysis and Critical Control Point**

**Managing an Integrated Food Safety Program**

**Enforcement**

**Summary**
of the form of contamination or the means by which it can become a threat. Key topic areas include basics of food microbiology, up-to-date information on allergens and allergen risk reduction programming, HACCP and its contribution to an integrated food safety program, and the importance of well-defined prerequisite programs. Basics of personal hygiene, food handling, and cleaning and sanitation are highlighted. It is important to note that the authors assume readers have or will complete a certified food safety course such as SERVSAFE to ensure they have thorough knowledge in all food handling practices. The chapter concludes with a section of food defense, the purpose of which is to provide guidance on how to ensure an adequate and safe food supply during natural and manmade disasters.

LEARNING OBJECTIVES

After studying this chapter, you will be able to:

1. Describe the prevalence and significance of foodborne illness as a threat to public health.
2. Identify knowledge and skill sets needed to develop, implement, and manage an integrated food safety program.
3. Identify common food pathogens and the foods most likely to serve as their source.
4. Describe and provide examples of physical and chemical hazards associated with food.
5. List the common food handling failures that contribute to outbreaks of foodborne illness.
6. Identify and describe the impact of major laws on the design and management of food safety programs.
7. Define and provide examples of common prerequisite programs for foodservice operations.
8. List the seven steps of HACCP, and describe the unique contribution that HACCP makes to an integrated food safety program.

KEY CONCEPTS

1. Foodborne illness is a serious threat to public health.
2. The foodservice manager plays a leadership role in the prevention of foodborne illness.
3. Pathological hazards are inherent to some foods and can cause disease if allowed to grow.
4. Physical and chemical hazards, including allergens, pose threats to food safety.
5. Failures in operations and food handling practices contribute to outbreaks of foodborne illness.
6. A matrix of food laws, regulations, codes, and standards provide the legal framework for food safety programming.
7. Well-designed and quantifiable prerequisite programs serve as the foundation of an integrated food safety program.
8. The single most important prerequisite program for an effective food safety program is personal hygiene.

9. Prerequisite programs that establish standard operating procedures for purchasing, production, and service maximize safety as food flows through a facility.

10. **Hazard analysis and critical control point (HACCP)** is a systematic approach to controlling identified hazards specific to foods or processes.

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**FOODBORNE ILLNESS**

**KEY CONCEPT:** Foodborne illness is a serious threat to public health.

The incidence of foodborne illness is expressed in outbreaks. According to the **Centers for Disease Control and Prevention (CDC)** in Atlanta, an outbreak of foodborne illness is an incident where two or more people experience the same illness after eating the same food. An outbreak is confirmed when laboratory analysis shows that a specific food is the source of the illness. A case in a specific outbreak represents one individual in that outbreak. Number of cases per outbreak can vary widely from as few as two to hundreds of thousands. Table 3.1 represents a sampling of outbreaks confirmed by the CDC in 2011.

**Scope of the Problem: Incidence of Foodborne Illness**

One of the most challenging aspects of managing a food safety program and the employees who handle the food is presenting a convincing argument that foodborne illness is indeed a serious problem. Relative to the daily problems that foodservices encounter, the risk of an actual outbreak is low. In addition, there tends to be a lack of appreciation for the realities of the scope of the problem, given that the reported and confirmed outbreaks represent only a fraction of how many people actually get sick from food. The CDC estimates that there are 48 million cases of foodborne illness in the United States each year, yet only 19,531 cases were confirmed through laboratory analysis for 2012. It is further estimated that there are 128,000 hospitalizations and 3,000 deaths related to foodborne illness on an annual basis. Underreporting and underestimating the true incidence is a reflection of the complexity of tracking foodborne illness.

Keeping track, or surveillance, of foodborne illness is complicated. Symptoms among victims vary widely. Some experience only mild symptoms, and their discomfort is temporary and short-lived. Others, especially those in highly susceptible populations, can experience much more severe, extended, and potentially life-threatening reactions. These populations include the elderly, very young children, and those with compromised immune systems. Chances that low-risk populations will go through the effort of reporting an illness, even if they suspect that it is foodborne, are quite small.

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**Table 3.1 Examples of Confirmed Outbreaks: 2011**

<table>
<thead>
<tr>
<th>BACTERIAL</th>
<th>NUMBER</th>
<th>LOCATION</th>
<th>VEHICLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norovirus</td>
<td>22</td>
<td>Banquet Facility</td>
<td>Cantaloupe; pineapple</td>
</tr>
<tr>
<td>Campylobacter jejuni</td>
<td>30</td>
<td>School</td>
<td>Chicken (BBQ)</td>
</tr>
<tr>
<td><em>Escherichia coli</em> 06:H16</td>
<td>19</td>
<td>Caterer</td>
<td>Spinach strudel; tabouleh</td>
</tr>
<tr>
<td><em>Clostridium perfringens</em></td>
<td>32</td>
<td>Prison</td>
<td>Potatoes, scalloped</td>
</tr>
</tbody>
</table>

Source: Center for Disease Control
Another complicating factor is that agents of foodborne illness can be transmitted through water and through contact with infected farm animals and pets. Person-to-person contact is another means by which an individual can become infected with the very same causative agents that are attributed to foodborne illness. Surveillance has, however, greatly improved following a concerted effort on the part of the federal government to better track and document the incidence of foodborne illness.

During the mid- to late 1990s, there was a recognition on the part of the Clinton administration that oversight of food safety in the United States needed to be overhauled. This included better tracking of foodborne illness outbreaks to determine more accurately how widespread the problem is. A better program would also provide the framework to assess whether interventions were actually working. In 1997, the National Food Safety Initiative (NFSI) was launched. This initiative included a number of goals and triggered tracking programs for foodborne illness. One such program is the CDC’s Emerging Infections program, Foodborne Diseases Active Surveillance Network (FoodNet). The surveillance program collects data on foodborne diseases at 10 U.S. sites. Each year the CDC releases a report that describes preliminary surveillance data and compares them to previous data. Although accuracy and timeliness have improved as a result of the NFSI, a number of social, economic, and political issues present ongoing challenges to ensuring that the U.S. food supply is indeed safe. These issues include:

- Advances in trade and transportation that have brought more food variety but new pathogens
- People eating a greater variety of food including raw seafood and more fresh produce
- An increase in the “at-risk” or “highly susceptible” populations comprising the elderly, very young children, and people with compromised immune systems
- More meals prepared and eaten outside of the home
- Changes in food preparation and handling practices
- Newly recognized microorganisms that cause foodborne illness
- Centralized, high-volume food processing and distribution
- The globalization of the food system

These issues are further complicated by the complexities of the U.S. food regulatory system. For example, at least 12 federal agencies are charged with some oversight responsibility for at least 30 laws.

In recognition of these challenges, the federal government has reinvigorated its commitment to ensuring a safe food supply for Americans. Newly introduced legislation addresses administrative and structural issues with our current system of laws and regulations. Issues include outdated laws, inadequate resources for inspection, suboptimal management structures, and inadequate coordination across agencies at the federal, state, and local levels. On March 14, 2009, President Obama announced the formation of the Food Safety Working Group, a group specifically charged with advising the president on issues in food safety and how to correct them. As a result of this work, the Food Safety Modernization Act was signed into law on January 4, 2011. The intent of this legislation is to better protect public health by strengthening the U.S. food safety system. It provides the FDA, for example, with new enforcement authority for inspections, recalls, and traceability.

**Costs Associated with Outbreaks of Foodborne Illness**

It is difficult to account for the total and true costs of foodborne illness, but the economic loss associated with foodborne disease outbreaks can be devastating and more broad than most foodservice directors realize. Medical care, lost business, and lawsuits against the foodservice contribute most to the cost, but loss of income for victims and infected food handlers is also considerable. The social costs of pain and suffering are impossible to measure, not to mention the embarrassment and damage to the reputation of the foodservice. The Economic Research Service (ERS) is the division of the U.S. Department of Agriculture (USDA) that calculates the economic costs of foodborne illnesses outbreaks and estimates
the loss at billions of dollars per year. To put this in perspective, the ERS estimates that salmonellosis (nontyphoidal) alone accounts for an economic loss in the billions of dollars.

THE ROLE OF THE FOOD MANAGER

**KEY CONCEPT:** The foodservice manager plays a leadership role in the prevention of foodborne illness.

Food managers, especially those responsible for providing food to highly susceptible or at-risk populations, have a critical role in the prevention of foodborne illness. In effect, food managers and the employees they oversee are public health providers. It is their job to protect their customers from food that could become unsafe through mishandling. Foodservice managers need to instill a sense of professionalism and urgency about the potential for foodborne illness. Foodservice managers themselves must be well educated on the related topics of food microbiology, food law, risk analysis, HACCP, and standard operating procedures. These are a few of the knowledge and skill requirements needed on the part of the manager to design, implement, and manage an effective, comprehensive, and integrated food safety program. Figure 3.1 provides a more comprehensive list of the knowledge expectations for the foodservice manager or person in charge.

Areas of knowledge for the Foodservice Manager:

- Federal, state, and local laws and regulations that pertain to a specific foodservice operation
- Relationship between the prevention of foodborne disease and the personal hygiene of a foodservice worker
- Means to prevent transmission of foodborne disease by a food worker who has a disease or medical condition that may cause foodborne disease
- Symptoms associated with the diseases that are transmitted through food
- Relationship between maintaining the time and temperature of potentially hazardous food and the prevention of foodborne illness
- Inherent hazards associated with potentially hazardous foods
- Minimum end-point temperatures for the safe cooking of potentially hazardous foods
- Required temperatures and times for safe and proper storage, hot holding, cooling, and reheating of potentially hazardous foods
- Relationship between prevention of foodborne illness and management of cross-contamination, bare hand contact with ready to eat food and handwashing
- Procedures for proper care, cleaning, and sanitation of equipment and facilities in the prevention of foodborne illness
- Major food allergens and symptoms of allergic reactions

**CAUSES OF FOODBORNE ILLNESS**

Investigations of foodborne illness outbreaks indicate that contaminated food in itself does not explain why people get sick. In fact, the CDC identifies the following as the five most common risk factors that cause foodborne illness:

- Purchasing food from unsafe sources
- Failing to cook food correctly
- Holding food at incorrect temperatures
- Using contaminated equipment
- Practicing poor personal hygiene

The food manager needs to understand the contaminants and the operational failures that result in foodborne illness in order to design and implement effective preventive measures in the foodservice facility.
**Hazard**
A biological, chemical, or physical property that may cause an unacceptable consumer health risk

**Pathogen**
A disease-causing microorganism

**Time/temperature control for safety (TCS) food**
Foods that are more likely than others to be implicated in an outbreak of foodborne illness

**Code**
A collection of regulations

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**KEY CONCEPT:** Pathological hazards are inherent to some foods and can cause disease if allowed to grow.

**Hazards Inherent to Food: Forms of Food Contamination**

Any biological, chemical, or physical property of food that affects a person’s health is called a hazard. The biological pathogens or disease-causing pathogens include bacteria, viruses, parasites, and fungi (yeasts and molds). Illness resulting from live disease-causing or pathogenic microorganisms is called infection. Illness caused by eating toxins produced by microorganisms is called intoxication. Growth of pathogenic microorganisms in foods or on food contact surfaces increases the likelihood of either of these types of illness. Certain conditions support the survival and growth of harmful microorganisms. It is the responsibility of the foodservice manager to recognize these hazards and conditions, then implement procedures that will prevent them from becoming a food safety threat. This is challenging because microorganisms differ among food items and how they behave under various environmental conditions.

Most bacteria grow best in low-acid food; a few grow in acid food. Some grow best if sugar is present in the food, others if proteins are present. Some need oxygen for growth, and others thrive in its absence. The temperature most favorable for growth of pathogenic bacteria is body temperature, about 98°F; temperatures below 41°F inhibit their growth either totally or markedly, and temperatures above 130°F for a period of time are lethal to vegetative cells of pathogenic microorganisms. The federal government defines the temperature range of 41°F to 135°F as the temperature danger zone, and all food handling in this range should be minimized.

The time required for growth and multiplication depends on the other environmental conditions present and the type of food being processed. Fungi require nutrients, oxygen, and time to grow. They are usually the dominant microorganisms only in foods that are too dry, acidic, or sugary for optimal growth by bacteria. Viruses and protozoa do not reproduce in foods and thus only cause infections.

Any food can be a vehicle for foodborne illness, but some are more likely to be involved than others. These foods are termed time/temperature control for safety (TCS) foods. According to the 2013 FDA Food Code:

1. “Time/temperature control for safety food” means a food that requires time/temperature control for safety (TCS) to limit pathogenic microorganism growth or toxin formation.
2. “Time/temperature control for safety food” includes:
   - An animal food that is raw or heat-treated; a plant food that is heat-treated or consists of raw seed spouts, cut melons, cut leafy greens, cut tomatoes or mixtures of cut tomatoes that are not modified in a way so that they are unable to support pathogenic microorganism growth or toxin formation, or garlic-in-oil mixtures that are not modified in a way so that they are unable to support pathogenic microorganism growth or toxin formation.

   Simply put, TCS are those foods that favor rapid growth of microorganisms. The conditions that favor rapid growth can be remembered by the acronym FAT-TOM: food, acid, time, temperature, oxygen, and moisture.

**Foodborne Illness and Applied Microbiology**

Microorganisms play a number of important roles in our food supply both harmful and beneficial. Probiotics, for example, are increasingly recognized for their positive implications for digestive health. Spoilage microorganisms on the other hand cause foods to deteriorate in appearance and texture leading to waste. Pathogens are disease-causing microorganisms and are the focus of food safety programs in foodservice operations. The food manager needs...
to understand the types of pathogens, the diseases they cause, the foods implicated, and, most importantly of all, the preventive measures that must be implemented throughout the foodservice operation.

There are three types of diseases that can be caused by the pathogens attributed to outbreaks of foodborne illness. The first is infection that results from the ingestion of live pathogens. These pathogens colonize and cause damage to the intestinal tract through an invasive process. Another type of illness is intoxication. In this case, the pathogens produce a toxin in the food that is subsequently ingested. These toxins then cause illness. Finally, there is what is referred to as toxicoinfection. This illness is caused when live pathogens are ingested, which produce a toxin in the digestive tract that makes the individual ill.

These illnesses are caused by four types of pathogens that contribute to foodborne illness: bacteria, parasites, viruses, and fungi (yeasts and molds). According to the CDC, there are 31 known pathogens that cause foodborne illness but they account for only 20 percent of the outbreaks. The other 80 percent are caused by “unspecified agents,” meaning that there are insufficient data to identify the specific microorganism. Regardless, it is clear from CDC data that there are major pathogens that account for much of the foodborne illness confirmed in the United States each year. These include bacteria such as Salmonella spp., Toxoplasma gondi, Listeria monocytogenes, Campylobactor spp., Clostridium perfringens, and E. coli. Viruses including Norovirus and Hepatitis A are of particular concern because of their prevalence and link to poor personal hygiene. The primary preventative measures will depend on the pathogen and the food source. Table 3.2 summarizes the six pathogens that, collectively, cause the most illnesses, hospitalizations, and deaths. Complete details on all confirmed outbreaks, contributing pathogens, implicated foods, and venues can be found on the CDC Web site.

### Table 3.2 Major foodborne pathogenic microorganisms.

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Disease</th>
<th>Common food sources</th>
<th>Onset/incubation</th>
<th>Symptoms</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmonella (non-thyphoidal)</td>
<td>Bacterial infection</td>
<td>Poultry, Eggs, Dairy products, Produce</td>
<td>6 to 48 hours</td>
<td>Diarrhea, Abdominal cramps, Vomiting, Fever</td>
<td>1 to 4 days</td>
</tr>
<tr>
<td>Listeria monocytogenes</td>
<td>Bacterial infection</td>
<td>Raw meat, Unpasteurized dairy products, Ready-to-eat food, such as deli meats, hot dogs, and soft cheeses</td>
<td>12 hours to several days</td>
<td>Miscarriage in pregnant women, Sepsis, pneumonia, meningitis in newborns</td>
<td>Depends on severity and treatment</td>
</tr>
<tr>
<td>Norovirus (Norwalk Virus)</td>
<td>Viral infection</td>
<td>Ready-to-eat food, Shellfish from contaminated water</td>
<td>Up to 2 days</td>
<td>Vomiting, Diarrhea, Nausea</td>
<td>1 to 3 days</td>
</tr>
<tr>
<td>Campylobacter spp.</td>
<td>Bacterial infection</td>
<td>Poultry, Meat, Water contaminated with the bacteria, Meats, Stews and gravies</td>
<td>3 to 5 days</td>
<td>Diarrhea, Abdominal cramps, Fever, Vomiting, Headaches</td>
<td>1 to 4 days</td>
</tr>
<tr>
<td>Clostridium perfringens</td>
<td>Bacterial toxicoinfection</td>
<td>Ground beef (raw and undercooked), Contaminated produce</td>
<td>8 to 22 hours</td>
<td>Diarrhea, Kidney failure</td>
<td>24 hours</td>
</tr>
<tr>
<td>E. coli O157:H7</td>
<td>Bacterial toxicoinfection</td>
<td>Contaminated produce</td>
<td>12 to 72 hours</td>
<td>Diarrhea</td>
<td>Up to 8 days</td>
</tr>
</tbody>
</table>

Communicable disease
An illness that is transmitted from one person to another through direct or indirect means

Foodborne illness
Illness that results from ingesting foods containing live microorganisms

Accident
An unintentional incident that results in injury, loss, or damage to property

The routes of transmission for pathogens are diagrammed in Figure 3.2. It should be noted that human wastes, particularly fecal material, are especially hazardous. An individual who has used the toilet is certain to have contaminated hands. If careful and thorough hand washing is ignored, the worker’s hands can be a dangerous “tool” in the kitchen. Standards of personal hygiene are presented later in this chapter.

Carriers are an important source of infection or intoxication-causing microorganisms in foods. A carrier is a person who, without symptoms of a communicable disease, harbors and gives off from his or her body the specific pathogen of a disease, usually without being aware of it. Hepatitis A and Norovirus are examples of viruses that can be “carried” without notice and are both major contributors to the incidence of foodborne illness. An infected person is one in whose body the specific pathogens of a disease are lodged and have produced symptoms of illness. Thus, others may be aware of the possible danger of contamination. Consumers can become infected by ingesting water, milk, or other food products that have been contaminated with the fecal material of an infected person, animal, or carrier. Still another path of infection is drinking raw milk drawn from cows with infected udders.

An infectious disorder of the respiratory system such as a common cold can be spread by the droplet spray of infected discharges of coughing and sneezing without safeguard. An indirect route of infection spread through respiratory discharges is the used handkerchief, or the contaminated hand, and the subsequent handling of food or plates and cups in serving a patron.

KEY CONCEPT: Physical and chemical hazards, including allergens, pose threats to food safety.

Chemical and Physical Contaminants

Accidental Chemical Contamination. Microbial causes of foodborne illness are common, but disease and illness can also be caused by chemical contaminants in food. This type of foodborne illness results from eating food to which toxic chemicals have been added, usually by accident.
Chemical poisoning may result from contamination of food with foodservice chemicals such as cleaning and sanitizing compounds, excessive use of additives and preservatives, or contamination of food with toxic metals. The foodservice manager is responsible for implementing the necessary precautions to ensure that food is protected from these hazards. Minimum precautions include proper labeling and storage of all chemicals and frequent in-service training for employees on the hazards associated with the improper use of chemicals.

**Physical Hazards.** Physical hazards account for the third category of causes that contribute to outbreaks of foodborne illness. These, as the name suggests, include material or foreign contaminants that are accidentally or intentionally introduced into foods. Examples include metal shavings from cans, glass from service ware, and staples from packing materials. Compared to pathogenic microbes, physical hazards are rarely a cause of foodborne illness or injury.

### FOOD ALLERGENS

A Contaminant of Growing Concern

Naturally occurring allergens in some foods are a form of food contamination that increasingly influence the design of food safety programming in foodservice operations. The food manager needs to be well versed on the incidence, common food vehicles, symptoms, regulatory guidelines and preventive practices in order to design an Allergen Risk Reduction Program that will protect guests who are sensitive to food allergens.

According to Food Allergy Research and Education—FARE (formerly known as Food Allergen and Anaphylaxis Network—FAAN), 90 percent of food allergies are caused by eight common foods; collectively referred to as “the big 8.” These include milk, eggs, fish, shellfish (including lobster, shrimp, and crab), wheat, soy, peanuts, and tree nuts such as almonds, walnuts, and pecan. Food safety programs must minimally address these common foods but it is important to note that many other foods can cause allergic reactions. Other food ingredients may cause adverse, but nonallergic, reactions. These include food intolerances such as lactose in dairy products and food sensitivities including MSG.

Symptoms of allergic reactions vary from mild to life-threatening. Most serious is anaphylaxis, a severe allergic reaction that can cause death. Less serious symptoms include nausea, shortness of breath, hives, swelling, vomiting, diarrhea, and/or abdominal pain.

It is estimated that 11 million Americans suffer from food allergies and that 30,000 individuals are hospitalized each year. As many as 200 deaths are attributed to food allergies. The incidence of allergic reactions linked to food does appear to be on the rise. In fact, it is estimated that there was an 18 percent increase between the years 1997 and 2007. Peanut allergies are believed to have tripled during this same time period.

From a regulatory perspective, there are a number of federal laws that address food allergens and allergies throughout the food system. Laws that are particularly influential include the Food Allergen Labeling and Consumer Protection Act (FALCPA) of 2004, the Americans with Disabilities Act (ADA) of 1990, and, most recently, the Food Safety Modernization Act (FSMA) of 2011. FALCPA mandates that ingredient lists on packaged food clearly identify the food source names of the eight most common food allergens. The Americans with Disabilities Act was recently interpreted to define severe food allergies as disabilities meaning that foodservice operators must provide reasonable accommodations for guests with allergies. Finally, FSMA mandates that the Secretary of the U.S. Department of Health and Human Services make available voluntary guidelines for developing plans to manage the risk of food allergy and anaphylaxis in schools and early childhood education programs.

These guidelines are available through the Center for Disease Control and Prevention. The food manager can use these regulatory guidelines to build an Allergen Risk Reduction program to ensure that allergens are identified and carefully controlled through the foodservice operation all the way to point of service.
A SYSTEMS APPROACH TO FOOD SAFETY

KEY CONCEPT: Failures in operations and food handling practices contribute to outbreaks of foodborne illness.

Ensuring food safety entails identifying every potential hazard within a foodservice operation that could, if left uncontrolled, lead to an outbreak of foodborne illness. Ultimately, it is the responsibility of the foodservice manager to design and implement a program of food safety that addresses each one of the identified hazards and includes procedures that prevent any and all potential hazards from becoming a threat to the well-being of diners. The challenge of designing such a program can be overwhelming, especially in high-volume, multitunit operations that handle hundreds, if not thousands, of menu items every day. A systems approach to food safety allows the manager to assess the entire operation, identify the good food safety practices already in place, and address those that need attention. Emphasis for food safety on inputs, operations, and outputs should be self-evident as the reader proceeds through the rest of this chapter and those that follow.

Controls and Food Safety

The food safety plan itself serves as an operational control, but there are other common controls in a foodservice that can be used to establish sound food safety practices for the operation. Menus, for example, are the formal documents of what will be served from the foodservice operation. Food safety can start at the menu planning process (Chapter 5 provides an in-depth review of the menu planning process). It is during menu planning when the manager decides whether a potential menu item, regardless of its popularity, can be prepared and served safely. If there is any doubt, it may be wise to eliminate that item as part of the menu offerings. Some managers in long-term care facilities, for example, have eliminated poached eggs out of concern for the risk of salmonella from unpasteurized shell eggs. Other organizations will not place sprouts on menus because of the FDA warning for the risk of E. coli O157:H7.

Another control that can be used to reduce the risk of foodborne hazards is the purchasing contract for foodservices that buy through the competitive bid process (see Chapter 6 for a comprehensive review of purchasing). Under the terms and conditions of the contract, the manager can specify, for example, that delivery trucks be refrigerated. Forms of food can be specified such that food safety is “bought” as part of the product. Precooked meat, for example, significantly reduces, if not eliminates, the risk of E. coli O157:H7 as compared to bringing raw product in.

Menus and purchasing contacts are examples of internal controls that can establish standards for food safety. External controls influence food safety programs as well. The most obvious example is the laws and regulations that pertain to the safety of food.

KEY CONCEPT: A matrix of food laws, regulations, codes, and standards provide the legal framework for food safety programming.

Laws, Regulations, and Codes. There are myriad laws and regulations that apply to foodservices, and several are specific to food safety. For example, the Food Drug and Cosmetic Act of 1938 and its many amendments address issues such as inspections, labeling, cleaning, and sanitation of facilities. Major food laws and the agencies that oversee their enforcement are presented in Chapter 6. Laws in themselves, however, are not particularly useful in establishing policies and procedures for a food safety program. The details and parameters of laws are found in regulations and codes.
A regulation, by definition, is a legal restriction set forth, or promulgated, by a government agency. Several levels of government mandate regulations including federal, state, and local, but the most direct enforcement comes from the local level. Enforcement is typically done through local branches or agencies. For example, the food and nutrition service within the USDA establishes food safety rules and regulations on food safety for schools that participate in child nutrition programs. State, county, or city agencies, however, enforce these regulations for the individual school districts. Similarly, the Center for Medicare and Medicaid Services within the Department of Health and Human Services is the federal agency that establishes food safety regulations for skilled care facilities. Enforcement is typically done by a state agency such as the Division of Health. In addition, foodservices may be regulated by a third-party organization specific to the type of industry in which the on-site foodservice is housed. For example, The Joint Commission for Healthcare organizations sets and oversees high standards of patient care for health care organizations in the United States. It establishes its own standards for food safety, which carry the same force as regulation once a facility is accredited. Regulations and standards established through laws and enforced by various agencies must serve as the minimum standards for food safety practices.

The Food Code. The Food Code was first developed in 1993 by the FDA in cooperation with the USDA as a guide for setting standards of food safety. The code is neither law nor regulation but is provided for guidance and consideration for adoption by jurisdictions that have regulatory responsibility for food service, retail, and vending operations. According to the FDA, the code provides the latest and best scientifically based advice for preventing foodborne illness. Highlights include the importance of time, temperature control, and safe hand washing. A most important and useful feature of the code is the framework it provides for designing a food safety program. The code promotes HACCP as the best available system for assurance of food safety. The code is updated every four years, and supplements are released every two years as guidelines are revised to reflect the latest science. The most recent code was released in 2013. More than 30 states have adopted or adapted the code as regulation because it is recognized as the best science-based source for standards of food safety.

FOOD SAFETY: AN INTEGRATED PROGRAM OF HACCP AND PREREQUISITE PROGRAMS

HACCP is not, and was never intended to be, a stand-alone food safety program. Rather, HACCP is intended to be a part of a larger system of control procedures. These procedures must be in place for HACCP to function effectively. To understand these control procedures, one needs to understand the nature of hazards. As explained earlier, hazards can be categorized by type such as microbiological, chemical, and physical. These categories can be further subdivided relative to how they are introduced into a foodservice operation. As described earlier, there are hazards that are naturally occurring components of food. There are also those hazards that are introduced into or onto the food materials in the foodservice itself. The first classification of hazards is referred to as inherent hazards (e.g., a hazard specific to the food item) and would include, for example, salmonella on eggs. The second group of hazards represents environmental hazards and includes procedural failures such as cross-contamination from equipment that has not been properly cleaned and sanitized. HACCP addresses the first category. More detail on HACCP is provided later in this chapter. Methods to control the second grouping of hazards require prerequisite programs and standard operating procedures (SOPs).
KEY CONCEPT: Well-designed and quantifiable prerequisite programs serve as the foundation of an integrated food safety program.

Prerequisite Programs: The Foundation of an Integrated Food Safety Program

Prerequisite programs are groupings of procedures that address operational conditions. By definition, the term prerequisite implies that something is required as a precondition to something else. In this case, prerequisite programs serve as the foundation for the development and implementation of HACCP. Prerequisite programs are not part of the formal HACCP plan, which is focused on the inherent hazards specific to individual menu items. Rather, prerequisite programs define interventions relative to people, facilities, and the work environment that are practiced routinely regardless of the nature of the food being prepared. If consistently and properly followed, prerequisite programs create an environment in which the food can safely flow from receiving to service with a minimum risk of being contaminated by environmental conditions.

In other words, prerequisite programs define the practices that the foodservice operation should be following regardless of the food item passing through. For example, clean utensils should always be used regardless of what food item is being prepared. Each foodservice operation must provide the conditions necessary to protect the food under its control. Once these programs are in place, HACCP can be more effective because it can concentrate on hazards specific and inherent to the food and its preparation rather than on the food preparation environment.

Prerequisite Programs and Standard Operating Procedures

Prerequisite programs are documented procedures that address the operational conditions necessary for the production and service of safe food. Individual prerequisite programs focus on one aspect of the foodservice operation such as personnel, a specific functional operation, or a physical aspect of the facility. Each of these programs includes defined procedures relative to its area of emphasis. Table 3.3 is a listing of the prerequisite programs and topics for SOPs that would likely be included in the food safety program of a typical foodservice. Many of the standard conditions and practices used to quantitatively define the SOPs are specified in federal, state, and/or local regulations and guidelines. The Food Code can serve as a basis for defining the standard operating procedures within each prerequisite program and the parameters by which compliance will be measured. For example, an SOP for receiving would be that any refrigerated meat or dairy products arriving at a temperature above 41°F shall be rejected at the dock. From there, individual foodservice operations can expand their prerequisite programs as necessary by adopting policies and procedures based on the unique needs of their operation and/or industry “best” practices. The following sections of this chapter provide detail for common prerequisite programs.

EMPLOYEE HEALTH AND PERSONAL HYGIENE

KEY CONCEPT: The single most important prerequisite program for an effective food safety program is personal hygiene.

A wise foodservice manager instills the importance of food safety during the hiring process. As discussed earlier in this chapter, many cases of foodborne illness can be linked directly to lack of attention to personal hygiene, cleanliness, and food-handling procedures. In fact, the CDC issues a list of infectious and communicable diseases that are often transmitted through food contaminated by infected food handlers. Some of the pathogens that can cause diseases after an infected person handles that food include:
Hepatitis A
Norwalk and Norwalk-like viruses
Salmonella typhi
Shigella species
Staphylococcus aureus
Streptococcus pyogenes

There are preventive measures that the manager can implement beginning at the hiring stage to minimize the risk of food contamination and mishandling. This is accomplished through health screening and careful training of foodservice employees after they have been hired.

Individuals being considered for positions that involve food handling should undergo a health examination before being hired and at routine intervals thereafter. The exam should include a tuberculin test, and many foodservice operations, especially those in health care organizations, require screening for hepatitis A. Many state and local regulatory agencies require specific health tests before hiring. The manager should consult the local health department for specific requirements.

Contamination
The unintended presence of harmful substances such as microorganisms in food and water

<table>
<thead>
<tr>
<th>Table 3.3</th>
<th>Suggested prerequisite program topics for foodservice operations.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PERSONNEL</strong></td>
<td><strong>STORAGE</strong></td>
</tr>
<tr>
<td>Training and education</td>
<td>Temperature control</td>
</tr>
<tr>
<td>Employee health and illness</td>
<td>Cleaning</td>
</tr>
<tr>
<td>Hygienic practices</td>
<td>Inventory rotation</td>
</tr>
<tr>
<td>• Hand washing</td>
<td></td>
</tr>
<tr>
<td>• Gloves</td>
<td></td>
</tr>
<tr>
<td>• Attire and jewelry</td>
<td></td>
</tr>
<tr>
<td>MEAL PLANNING</td>
<td><strong>PREPARATION</strong></td>
</tr>
<tr>
<td>Recipe development for potentially hazardous foods</td>
<td>Thawing</td>
</tr>
<tr>
<td></td>
<td>Time/temperature abuse (4-hour rule)</td>
</tr>
<tr>
<td></td>
<td>Prevention of cross-contamination</td>
</tr>
<tr>
<td></td>
<td>Cooling (two-stage method)</td>
</tr>
<tr>
<td>PURCHASING</td>
<td><strong>SERVICE</strong></td>
</tr>
<tr>
<td>Vendor relations</td>
<td>Meal assembly</td>
</tr>
<tr>
<td>Specifications</td>
<td>Hot holding</td>
</tr>
<tr>
<td></td>
<td>Self-serve units</td>
</tr>
<tr>
<td></td>
<td>Time span and temperature maintenance</td>
</tr>
<tr>
<td></td>
<td>Handling leftovers</td>
</tr>
<tr>
<td>RECEIVING</td>
<td><strong>CLEANING, SANITATION, WAREWASHING</strong></td>
</tr>
<tr>
<td>Temperatures</td>
<td>Waste disposal</td>
</tr>
<tr>
<td>Quality standards</td>
<td>Manual washing</td>
</tr>
<tr>
<td>Inspection</td>
<td>Machine washing</td>
</tr>
<tr>
<td></td>
<td>CIP equipment (clean in place)</td>
</tr>
<tr>
<td></td>
<td>Food contact surfaces</td>
</tr>
</tbody>
</table>
The successful hiring process should be followed by a thorough orientation and training on the standards of personal hygiene established for the foodservice operation. Personal hygiene is simply the application of principles for maintaining health and personal cleanliness. Policies should be designed, implemented, and monitored that cover proper attire, personal hygiene habits, and employee illness. The specific methods designed to fulfill the intent of these policies are frequently referred to as infection control procedures. Policy on infection control minimally should address the following:

**Proper Attire**

- Employees should wear clean, washable clothing. Uniforms are recommended, but, if not feasible, clean aprons are essential.
- Effective hair restraints must be worn to cover head and facial hair. Commonly used restraints include nets, bonnets, and caps. The purpose of hair restraints is to prevent hair from falling into the food and to discourage the food handler from touching his or her hair.
- Jewelry is discouraged because bacteria can lodge in settings and contaminate food.

**Personal Hygiene Habits**

The single most important practice in preventing the spread of foodborne illness is proper and frequent hand washing. Foodservice employees should wash their hands using the procedure illustrated in Figure 3.3. This technique is referred to as the double hand-washing technique and is recommended under the following circumstances:

- After defecating, contacting body fluids and discharges, or handling waste containing fecal matter, body fluids, or other bodily discharges (e.g., personal care attendants in day care centers and nursing homes may be responsible for changing diapers and serving food)
- Before beginning work or before returning to work following a break
- After coughing, sneezing, or using a handkerchief or disposable tissue

**Infection control**

Specific procedures to prevent the entrance of pathogenic organisms into the body.

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**Figure 3.3** Proper hand-washing technique.
Source: Pearson Education/Richard Embery

1. Using hot water (100°F/38°C), wet hands and forearms.
2. Apply an antibacterial soap.
3. Rub hands and arms briskly with soapy lather for at least 20 seconds.
4. Scrub between fingers and clean nails with a clean nail brush.
5. Rinse thoroughly under hot runner water. Reapply soap and scrub hands and forearms for another 5–10 seconds. Rinse again.
6. Dry hands and arms with a single-use towel, using the towel to turn off the water. Discard the towel in a trash receptacle.
• After smoking, using tobacco, eating, or drinking
• After handling soiled equipment or utensils
• Immediately before food preparation, such as working with food, clean equipment, utensils, and supplies
• When switching from working with raw to cooked food

It is important to note that the hand-washing procedure in the Food Code does not require the nailbrush step. This is a somewhat controversial issue that is undergoing further study and consideration for future editions of the code.

Other Personal Hygiene Habits. Other personal hygiene habits to be addressed by policy include:

• Foodservice personnel should keep their fingernails trimmed and clean.
• Hands should be kept away from face, hair, and mouth.
• Disposable gloves should be encouraged for direct food contact and are required by law in some areas of the country. Employees should be trained to change gloves frequently to prevent cross-contamination.
• Smoking should be permitted in designated areas only and away from food preparation and service areas (preferably outdoors).
• Only authorized personnel should be allowed in production areas.

Cuts, Abrasions, and Employee Illness

• All cuts and abrasions, such as burns and boils, should be covered with a waterproof bandage.
• Cuts on hands should be covered with a waterproof bandage and a watertight disposable glove.
• Employees with symptoms of vomiting, diarrhea, fever, respiratory infection, or sore throat should not work as food handlers.
• Any employee suspected of having a communicable disease as listed by the CDC should be referred to employee health or their personal physician for clearance before returning to work.

Key Concept: Prerequisite programs that establish standard operations procedures for purchasing, production, and service maximize safety as food flows through a facility.

FLOW OF FOOD THROUGH THE FOODSERVICE OPERATION

Gaining basic knowledge of microbiology and applying it to personal hygiene practices are preliminary steps to the ultimate goal of designing an effective food safety program for the foodservice operation. A well-designed food safety program will address the entire foodservice operation. It is therefore essential that the manager understand how food moves through the operation.

The movement of food through a foodservice operation is referred to as the flow of food. It begins at the point where a decision is made to include a food item on the menu and ends with the final service to the customer. The functions basic to food flow in any operation include receiving, storage, preparation, holding, service, cooling leftovers, and reheating. Figures 3.4 through 3.7 illustrate how these functions relate to one another in the various types of foodservice systems and how food items typically flow through each type of system. The foodservice manager must be able to identify potential hazards at each step in the food flow and design a food safety program that will prevent the potential hazards from being realized. Part of the program design will include procedures for safe and proper food handling at each stage of the food preparation process.
Figure 3.4  Flow of food for a conventional foodservice operation.

Figure 3.5  Flow of food for a ready-prepared foodservice operation.
Figure 3.6 Flow of food for a commissary foodservice operation.

Figure 3.7 Flow of food for an assembly/serve foodservice operation.
Proper Food Handling

Hiring healthy employees and providing thorough, ongoing training in personal hygiene are important aspects of food safety but by no means guarantees against outbreaks of foodborne illness. Proper food handling techniques must be used to avoid conditions suitable for microbial growth and cross-contamination. Cross-contamination is the transfer of harmful microorganisms from one item of food to another via a nonfood surface such as human hands, equipment, or utensils. It may also refer to a direct transfer from a raw to a cooked food product.

**Precautions for Safe Food Production.** Proper food handling throughout the purchasing, storage, production, and service of food is critical in safeguarding the food against contamination. Legal safeguards are provided by federal, state, and local regulatory agencies, which are responsible for setting and enforcing standards for raw and processed foods (see Chapter 6). Minimum standards for sanitation in foodservice establishments are monitored by city and state agencies, but managers are responsible for the maintenance of sanitation standards in their respective foodservices.

**Time-Temperature Relationships.** Temperature has long been recognized as a particularly important factor in the control of harmful organisms. Time is an equally important factor in minimizing microbial growth during food storage, production, holding, transportation, and service. An important rule in food protection, then, is the time-temperature principle, which is based on three tenets regarding the handling of potentially hazardous foods:

1. Food items must be rapidly cooled to 41°F or less using the two-step method as defined in the code.
2. Cold food should be held at an internal temperature of 41°F or less.
3. Hot foods should be held at 135°F or higher.

According to the Food Code, the temperature range of 41°F to 135°F is referred to as the danger zone because disease-causing bacteria are capable of rapid multiplication in this temperature range. Figure 3.8 is a temperature guide for food safety and highlights the

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**Danger zone**
The temperature range between 41°F and 135°F in which most bacteria grow and multiply

**Figure 3.8** Temperatures and bacterial growth.
Source: Pearson Education
danger zone. The time that food is allowed to remain in this critical temperature zone largely determines the rate and extent of bacterial growth. Most food handling techniques are designed to keep food items, especially potentially hazardous foods, out of this temperature range. Various stages of food preparation require that foods be in the danger zone at various times. For example, cooked meat will be at room temperature while it is being sliced and again while it is being used to make sandwiches. The Food Code recommends that the total time in the danger zone should be limited to four hours for any given food product.

The food manager must be aware of time-temperature relationships throughout the entire food production process. This concept is explained fully later in this chapter. It is imperative that the internal temperature of potentially hazardous food be kept below 41°F or above 135°F to ensure safety. This means that the temperature of the refrigerator should be colder or the holding equipment hotter to maintain the proper internal temperature in the food. Temperature controls on walk-in and other refrigerators should be in good working order and checked and documented daily to make certain that temperatures are maintained below 41°F as appropriate for the specific foods stored in them. Figure 3.9 is an example of a temperature documentation form for refrigerator units. It is important to note that electronic devices are available for temperature recording. For example, rapid-chill (or blast chillers) come equipped with probes that record the temperature of the product while it cools in increments set by the operator. Proper cooling methods are illustrated in Figure 3.10.

**Temperature Measuring Devices.** Well-maintained temperature measuring devices, or thermometers, are essential to ensure that food temperatures are properly monitored. Thermometers should be used for checking incoming deliveries of refrigerated foods and for monitoring internal temperatures during all phases of storage, production, holding, and

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**Figure 3.9** Temperature documentation chart.

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<table>
<thead>
<tr>
<th>Refrigerator/Freezer Temperatures</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Month of: ________________________</td>
<td>--------------------</td>
<td>--------------------</td>
<td>--------------------</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Day</th>
<th>Walk-in Freezer</th>
<th>Walk-in Refrigerator</th>
<th>Cook’s Holding Refrigerator</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AM Temp PM Temp</td>
<td>AM Temp PM Temp</td>
<td>AM Temp PM Temp</td>
</tr>
</tbody>
</table>
service. Thermometers can be metal stemmed, numerically scaled from 0°F to 220°F, and accurate to ±2°F. Other features include easy-to-read numbers and a stem or probe of at least five inches. A thermometer with a calibration nut is recommended so that the scale can be easily adjusted for accuracy. Thermometers should be cleaned and sanitized after each use. Thermometers that have been approved by the National Sanitation Foundation International are recommended.

**Potential Hazards in Food Production**

Foods that are particularly hazardous include meat, poultry, fish, eggs, and fresh produce. These products are frequently contaminated with foodborne pathogens, which can spread to surfaces of equipment, to the hands of workers, and to other foods. If frozen turkeys, for example, are to be cooked whole, they should be thawed completely in the refrigerator before being cooked, and if cooked the day before service, they should not be cooled without first reducing their bulk. The practice of cooking, chilling, and then reheating beef roasts is also potentially hazardous because reheating may not produce a temperature high enough to destroy any bacteria that may have survived in the meat. In these and other situations of thawing, cooking, cooling, reheating, and holding, the operator should refer to the Food Code for food-specific guidelines.

Food requiring preliminary preparation, which may include cooking prior to the final preparation, should be refrigerated following the preliminary steps. This includes items such as sandwich and salad mixtures; sliced, chopped, cut, and boned poultry and meats; ground, mixed, and shaped cooked meats; cream pie fillings and puddings; and sliced ham and similar items.

Attempting to cool any food item at room temperature to save refrigeration is a practice to be eliminated. Masses of hot food cool slowly, even in large walk-in refrigerators. To be cooled quickly, the food should be divided into shallow containers to a depth of no more than two inches and refrigerated, as shown in Figure 3.10. Other suggestions for cooling large amounts of food quickly include stirring the food and placing the pan of food in an ice bath or vat of cold running water. The FDA Food Code recommends that potentially hazardous cooked foods be cooled from 135°F to 70°F within two hours, and from 70°F to 41°F or below within four hours.
As mentioned earlier, the incidence of foodborne illness resulting from salmonella contamination is particularly challenging. This problem has been associated with raw or undercooked shell eggs. In the past, contamination was thought to result from dirty or cracked shells. The more recent outbreaks, however, suggest that *Salmonella enteritidis* is, in some instances, transmitted directly from the laying hen to the *inside* of the egg (generally the yolk). This means that more stringent guidelines must be implemented to handle eggs safely.

The following are general egg handling recommendations:

- Purchase Grade A or better eggs from a reliable source.
- Check eggs upon delivery to ensure that they have been kept refrigerated during transport.
- Keep eggs refrigerated, removing eggs from such storage only as needed; never store eggs at room temperature.
- Raw eggs should not be used as an ingredient to prepare food that will not be thoroughly cooked.
- Rotate eggs in inventory using the first-in/first-out (FIFO) method.
- Use only clean, crack-free eggs.
- Thoroughly wash hands before and after handling eggs and make sure equipment is clean and sanitized.
- Avoid pooling large quantities of eggs; cook eggs in small batches, no more than three quarts per batch.
- Never combine eggs that have been held on a steam table with a fresh batch of eggs.
- Use pasteurized, frozen liquid eggs in place of raw shell eggs when possible.

Mishandling of food by cooks and other production workers also constitutes a hazard. Cooked ingredients in potato salad, for instance, can be contaminated by food handlers during peeling, slicing, chopping, or mixing operations. Cross-contamination by a worker or equipment that has been in contact with raw meat or poultry, and then with the cooked product, is to be avoided.

**HAZARD ANALYSIS AND CRITICAL CONTROL POINT**

**KEY CONCEPT:** Hazard analysis and critical control point (HACCP) is a systematic approach to controlling identified hazards specific to foods or processes.

Hazard analysis and critical control point (HACCP) is a proactive process of consecutive actions to ensure food safety to the highest degree through the identification and control of any point or procedure in a specific food system, from receiving through service, where loss of control may result in an unacceptable health risk. HACCP differs from traditional end-point food safety programs in that it is preventive in nature and focuses on the entire process of food preparation and service. In this sense, it is a self-inspection process sometimes described as a self-control safety assurance program. HACCP plans are designed to prevent the occurrence of potential food safety problems.

HACCP is not new; the concept originated more than 40 years ago. The Pillsbury Company is frequently credited with pioneering the application of HACCP to the food processing industry when, in 1971, they worked in cooperation with the National Aeronautics and Space Administration (NASA) to create food for the U.S. space program that approached 100 percent assurance against contamination by bacterial and viral pathogens, toxins, and chemical hazards or physical hazards that could cause illness or injury to the astronauts. HACCP has been used extensively in the food processing industry for many years.
Since the mid-1980s, HACCP has been recognized as a best-practice means of monitoring food safety in all segments of the food industry, including foodservice operations. On March 20, 1992, the National Advisory Committee on Microbiological Criteria for Foods (NACMCF) adopted a revised document on HACCP that included seven principles that provide guidance on the development of an effective HACCP plan. HACCP, as defined by NACMCF, emphasizes the concept of prevention and universal application and incorporates a decision tree for use in identifying critical control points (see Figure 3.11).

Unique to HACCP is that, by definition, it must be a documented system that delineates the formal procedures for complying with the seven principles. HACCP continues to evolve, especially for the foodservice segment of the food industry. Further refinements will evolve as new food products and systems are developed and as hazards and their control measures are more clearly understood.

Several issues have been raised specific to the foodservice segment as perceived barriers to the effective implementation of HACCP. These issues include:

- Lack of resources including time and personnel
- Complexity of foodservice operations
- High turnover of personnel
- Burden of required documentation procedures

**Figure 3.11  Critical Control Point decision tree.**

Source: From 2013 Food Code.
Barriers are inherent to any new concept or procedure. It is also important to note that HACCP does not replace programs for personal hygiene or cleaning and sanitation. These are important components of a comprehensive food safety program and are addressed through well-defined SOPs. Finally, HACCP is not a panacea; it does not address every conceivable or plausible hazard in a foodservice operation. The professional manager, however, accepts barriers and limitations as part of the challenge of implementing a system in the spirit that advantages far outweigh the perceived disadvantages.

HACCP is the best food safety system available to foodservice operators at this time. The primary benefit of HACCP is that it emphasizes control of hazards inherent to food at all stages of the processing continuum. Another advantage is that it clearly identifies the food establishment as the final party responsible for ensuring the safety of the food and handling procedures. HACCP is a rational, scientific approach and monitors both current and past conditions under which food is processed.

Because of its many advantages, HACCP is often a recommended, if not required, approach to food safety in all segments of the food industry. The seafood industry was the first processing segment to be required to implement HACCP, followed by the meat and poultry industries. Since the early 1990s, the foodservice industry has been under increasing pressure to adopt the principles of HACCP. The USDA, for example, recently mandated that schools receiving federal reimbursement implement HACCP plans for child nutrition programs.

Some state regulatory agencies have already adopted the HACCP principles for use in survey processes. The Joint Commission has integrated HACCP into its standards for health care organizations.

The Seven Principles of HACCP. The seven principles of the HACCP program are as follows:

1. **Identify hazards and assess their severity and risks:** A hazard, as defined in the Food Code, means a biological, chemical, or physical property that may cause an unacceptable consumer health risk. An example of a biological hazard would be the presence of *Salmonella* bacteria on raw chicken as it enters the foodservice operation. The best means to evaluate hazards is to draw a diagram of the flow of food and then analyze each specific step.

2. **Identify the critical control points (CCP) in food preparation:** A critical control point for raw chicken would be the final cooking step because this is the last opportunity to eliminate or reduce the *Salmonella* to a safe level.

3. **Establish critical limits for preventive measures associated with each identified CCP:** For example, time and end-point cooking temperatures should be established for cooking procedures.

4. **Establish procedures to monitor CCPs:** Examples of these procedures may include visual evaluation and time-temperature measurements.

5. **Establish the corrective action to be taken when monitoring shows that a critical limit has been exceeded:** For example, if a minimum end-point temperature is not met, the cook should be instructed to continue cooking until the minimum is met.

6. **Establish effective record-keeping systems that document the HACCP system:** Traditional records such as receiving records, temperature charts, and recipes can serve as the basis for documentation.

7. **Establish procedures to verify that the system is working:** This may be as simple as reviewing records on a timely, routine basis or as complex as conducting microbiological tests.
These guidelines were designed for the food processing industry and may seem complicated, if not overwhelming, as applied to foodservice operations. For example, initial HACCP guidelines for the food processing industry treated each food product as a separate HACCP plan. If literally applied to foodservice, this would imply that each menu item be treated as a HACCP plan and a flowchart similar to the one in Figure 3.12 would need to be designed for each menu item. This may simply not be realistic for foodservice operations, especially those of high volume with hundreds of menu items.

The previous model is one example of how HACCP might be adapted and applied from receiving to point of service (POS) in a small facility. The intent is that each phase of this model is supported with sound policies on food handling that include critical limits rather than starting at receiving for each menu item. Documentation requirements are achieved through existing records, including receiving records, storage temperature charts, standardized recipes, and service records (see, e.g., the time-temperature documentation sheet shown in Figure 3.13).

Figure 3.14 represents the flow of food from the time the ingredients are received to the point of service. Receiving, storage, and preparation are seen as individual HACCP plans because identified hazards, CCPs, critical limits, and monitoring procedures are similar for all ingredients regardless of the recipes in which they are used (see, e.g., the HACCP plan for receiving shown in Figure 3.15). Each recipe then is also an individual HACCP plan (see the sample recipe in Figure 3.16). Each recipe form includes identified hazards, CCPs, and critical limits (time and temperatures).

This process is cumbersome indeed! As mentioned earlier in this text, high-volume foodservices can have hundreds if not thousands of recipes. Applying the seven-step HACCP process to each recipe is simply not manageable or necessary. In April 2006, the FDA released a manual on HACCP specifically for foodservice and retail operations that accounts for and simplifies HACCP for high-volume foodservice. The title of this manual is ‘Principles and Guidelines for hazard analysis and critical control points (HACCP) systems for foods for public health protection’ (US Department of Health and Human Services, 2006).

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**Flowchart**

A written sketch of movement of people and/or materials from one step or process to the next.

---

<table>
<thead>
<tr>
<th>Steps</th>
<th>Hazard</th>
<th>Preventive Measure SOP</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiving</td>
<td>• Ground beef frozen</td>
<td>• Contamination and spoilage</td>
<td>Check for evidence of thawing</td>
</tr>
<tr>
<td></td>
<td>• Fresh vegetables</td>
<td></td>
<td>Reject delivery</td>
</tr>
<tr>
<td></td>
<td>• Dry and/or nonperishable</td>
<td></td>
<td>Packaging intact</td>
</tr>
<tr>
<td></td>
<td>ingredients</td>
<td></td>
<td>No signs of insects or rodents</td>
</tr>
<tr>
<td></td>
<td>• Cheeses</td>
<td></td>
<td>No dented, bulging,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>or rusted cans</td>
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<td></td>
<td></td>
<td></td>
<td>No molds, off-odors</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Accept cheese at 45F or less</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Storing</td>
<td>• Frozen beef</td>
<td>• Cross-contamination from other foods</td>
<td>Check freezer storage; 0 to –10°F</td>
</tr>
<tr>
<td></td>
<td>• Vegetables</td>
<td>• Bacterial growth and spoilage</td>
<td>Label, date, use FIFO</td>
</tr>
<tr>
<td></td>
<td>• Dry ingredients</td>
<td></td>
<td>Keep raw food stored</td>
</tr>
<tr>
<td></td>
<td>• Cheese</td>
<td></td>
<td>above cooked in refrigerators</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Discard ingredients</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>if evidence of time, temperature</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>abuse, or spoilage is noted</td>
</tr>
</tbody>
</table>

**Figure 3.12** Flow of food and hazard analysis for lasagna recipe; receiving through service.
**Chapter 3/Food Safety**

<table>
<thead>
<tr>
<th>Steps</th>
<th>Hazard</th>
<th>Preventive Measure SOP</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thawing</strong></td>
<td>Ground beef</td>
<td>• Cross-contamination from other foods</td>
<td>• Thaw under refrigeration at 41°F or less</td>
</tr>
<tr>
<td><strong>Preparation</strong></td>
<td>Trim and chop/mince vegetables</td>
<td>• Contamination and cross-contamination • Bacterial growth</td>
<td>• Wash hands • Clean and sanitize utensils, knives, cutting boards • Wash vegetables before chopping and mincing</td>
</tr>
<tr>
<td><strong>Cooking</strong></td>
<td>Beef with vegetables</td>
<td>• Bacterial survival • Contamination from food handler • Contamination from seasonings</td>
<td>• Use clean and sanitized utensils and equipment • Add seasoning only in cooking process (allow 1/2 hour)</td>
</tr>
<tr>
<td><strong>Simmering</strong></td>
<td>Add tomatoes &amp; seasonings</td>
<td>• Cook/simmer all ingredients to 165°F</td>
<td>• Continue cooking until 165°F is achieved</td>
</tr>
<tr>
<td><strong>Assembling</strong></td>
<td>Lasagna</td>
<td>• Contamination and cross-contamination from noodles, cheeses • Contamination from food handler</td>
<td>• Use gloves, tongs, ladles to handle cooked ingredients</td>
</tr>
<tr>
<td><strong>Baking</strong></td>
<td></td>
<td>• Bacterial survival and growth</td>
<td>• Bake to internal temperature of 165°F</td>
</tr>
<tr>
<td><strong>Holding</strong></td>
<td></td>
<td>• Bacterial growth on serving utensils</td>
<td>• Hot hold at 135°F or higher for 2 hours or less • Keep covered • Use clean and sanitized utensils</td>
</tr>
<tr>
<td><strong>Cooling</strong></td>
<td></td>
<td>• Bacterial survival and growth • Cross-contamination</td>
<td>• Cool to 41°F within 6 hours • Cover and store above raw foods • Label with “use-by” date</td>
</tr>
<tr>
<td><strong>Reheating</strong></td>
<td></td>
<td>• Bacterial growth and survival</td>
<td>• Reheat to 165°F within 2 hours</td>
</tr>
</tbody>
</table>

*Figure 3.12 (Continued)*
The existence and effectiveness of prerequisite programs should be assessed before initiating recipe-specific HACCP plans. Discrepancies and deficiencies need to be addressed to ensure that there is in fact a solid foundation of food safety procedures in place on which the HACCP plans can be built. Then, recipe by recipe, HACCP plans can be designed and implemented. These plans will focus on the hazards inherent with individual food items as they flow through the foodservice operation.

Given that HACCP and prerequisite programs are distinct but integrated components of a food safety program, they need to be managed as such. Prerequisite programs are established and can be managed separately from the HACCP plan as part of an organization’s quality management program. For example, refrigerator temperature charts need to be audited regularly to ensure temperature maintenance. HACCP, on the other hand, has by
definition a series of management procedures. These include the establishment and implementation of monitoring procedures, corrective actions, verification procedures, and record keeping specific to the HACCP plan.

**ENFORCEMENT: THE REGULATORY INSPECTION**

As described earlier in this chapter, many regulatory agencies at the federal, state, and local levels mandate minimum standards of food safety. These standards are documented in regulatory codes. Periodic inspections by agency representatives are required as part of the regulatory standards. Each agency specifies the frequency of these inspections, and the site visits are often staggered so that accurately predicting the arrival of unannounced
<table>
<thead>
<tr>
<th>Process Step</th>
<th>Hazards</th>
<th>Preventive Measures and Critical Limits</th>
<th>Monitoring Process</th>
<th>Corrective Action</th>
<th>Records</th>
<th>Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiving CCP</td>
<td>Bacterial contamination, physical contamination</td>
<td>1. Frozen foods must be received at a product temperature of no higher than 0°F. 2. All refrigerated product, including fresh meat, produce, dairy, and eggs, must be received at a product temperature of no more than 40°F. 3. No off odor. 4. Packing intact.</td>
<td>All deliveries will be checked against specifications immediately upon arrival. Check temperatures of refrigerated items and conduct visual analysis for physical damage (bulging cans, open containers, etc.)</td>
<td>Reject all product that does not meet standards established by specification.</td>
<td>Standard receiving records.</td>
<td>Supervisor to review receiving records on weekly basis.</td>
</tr>
</tbody>
</table>

**Figure 3.15** HACCP for receiving.
inspectors is less likely. A food safety program designed simply to “get through” the inspection is certainly not in the spirit of the intent, much less a professional approach to protecting customers from unsafe food.

The professional manager approaches food safety as a way of life within the foodservice. In that respect, inspections will simply be a way of doing business and not a dreaded obligation. In fact, the inspection process can be viewed as a partnership in which the manager and inspector can work together to ensure the safest approach to food service possible.

When an inspector arrives, the manager should ask for identification. Managers are encouraged to accompany the inspector, but some inspectors prefer to conduct the inspection alone. After the inspection, the representative often presents a verbal report with the understanding that a formal report will be provided and submitted to the representative agency. Managers are typically free to appeal violations with which they do not agree, and there is usually a formal process by which such appeals can be made. The report will also categorize any violations by severity and explain corrective actions that must take place within a specific period of time. Figure 3.17 is an example of an inspection report form.

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**Figure 3.16** Sample recipe including HACCP.

---

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount</th>
<th>Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetable spray</td>
<td></td>
<td>– Spray pan with vegetable spray; set aside.</td>
</tr>
<tr>
<td>Eggs</td>
<td>5 dozen</td>
<td>– Remove eggs from refrigerator, check shells for cracks and soil; discard cracked eggs, remove soil.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– Break clean eggs into mixer bowl.</td>
</tr>
<tr>
<td>1% Milk</td>
<td>4 cups</td>
<td>– Beat slightly on medium speed, using wire attachment.</td>
</tr>
<tr>
<td>Salt</td>
<td>1 Tbsp.</td>
<td>– Add milk, salt, and pepper Beat until well blended (3 to 5 minutes).</td>
</tr>
<tr>
<td>Pepper</td>
<td>1/4 tsp.</td>
<td>– Pour mixture into prepared pan.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– (CCP) Bake for 1 hour at 350°F to minimal internal temperature of 165°F and until product is firm in center (do not overbake).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– Transfer to steam table just prior to service.</td>
</tr>
</tbody>
</table>

**Critical Control Point**

Measure internal temperature of scrambled eggs. If internal temperature of scrambled eggs is less than 155°F continue to bake until internal temperature is at least 155°F and maintained for 15 seconds.
Figure 3.17  Example of a foodservice inspection report.
Source: Courtesy State of Wisconsin, Department of Health Services. Used with permission.
## Chapter 3 / Food Safety

### Figure 3.17 (Continued)

**FOOD SECURITY**  
**Preventing and Managing Disasters**

Even a glance at any news outlet is enough to convince anyone that unexpected, if not unthinkable, and disastrous events are far more prevalent than ever before. Blizzards, hurricanes, tornadoes, floods, and wildfires are just a few of the natural disasters that plague vulnerable regions across the United States. More disturbing perhaps are the man-made and intentional disasters such as environmental catastrophes including oil spills and terrorist attacks such as the mass shootings that have tragically become all too familiar at schools and work sites. Health epidemics such as broad flu outbreaks are yet another form of disaster that can cripple a community if not an entire region. As unthinkable as these events may be, every foodservice must be prepared to serve safe and adequate food during these most trying times of upheaval.
There is no single or best model for developing a disaster plan because of the broad variation of disasters and the unique needs of the communities in which they occur. The type of foodservice itself influences the degree to which a single disaster will be managed. Freestanding retail foodservices address disaster planning entirely differently as compared to an on-site operation. Even on-site operations have specific and unique issues that need to be addressed. For example, being forewarned of a blizzard allows schools to close in advance and adjust food production accordingly while hospitals in the same community would have to brace for a myriad of challenges including unexpected admissions, absent employees, and no food deliveries. How foodservices and their host facilities coordinate disaster planning within their communities too will dictate many of the components and details of a well-designed disaster plan.

With these variations in mind there is still much a food manager can do to design a preliminary plan. Minimally, a disaster plan would include each of the following components:

1. Partnerships and coordination with other departments within the organization and community as appropriate
2. Plans for resource audit to determine who will be available to work
3. Collaborations with food suppliers to ensure food and water supplies
4. Communication plans for best and worst case scenarios
5. Staff training and drills to ensure that staff is ready to respond

Numerous resources and organizations exist to provide support and guidance in preparation for a disaster. These include the National Incident Management System and the Federal Emergency Management Agency (FEMA). Industry-specific resources are available as well. Examples of these include The Hospital Emergency Incident Command Center and Hospital Associations. Finally, vendors and professional associations specific to foodservice operations provide a wealth of information and guidelines. The National School Food Service Management Institute and the School Nutrition Association are valuable resources specific to school foodservice. The food manager is encouraged to use these and other resources as they apply to their operation as a means to take a leadership role in disaster planning.

SUMMARY

Millions of people become ill each year as a result of consuming a food that was microbiologically, chemically, or physically contaminated. A single error in food handling in a foodservice operation can cause a major outbreak. It is the responsibility of the food manager to have the necessary knowledge base and an understanding of food handling principles to design, implement, and monitor a successful food safety program.

APPLICATION OF CHAPTER CONTENTS

“"The Problem with Peanuts” the newspaper headline proclaims. As you read the article, you learn that allergies to peanuts among children have been on the rise for the past decade, and schools and parents are wrestling with best ways to protect those who are afflicted. The allergic reaction, called anaphylaxis, occurs because the immune system basically goes berserk; white blood cells indiscriminately release agents intended to kill germs but instead affect one’s own body tissues. Symptoms are varied and may include sneezing, puffy eyes, vomiting, and may be so severe as to cause death. Allergic reactions are treated with an injection of epinephrine (adrenalin) that is most often given with an EpiPen.

Peanuts are legumes and, as such, are not related to tree nuts such as walnuts, almonds, and pecans. Many children who are allergic to peanuts are also allergic to other
legumes but not to tree nuts. Any product derived from or containing peanuts such as peanut butter and peanut oil must also be avoided. Products processed on equipment that also processes peanuts must be labeled as such and are a risk. Some children are affected just by the smell of peanuts and some have been affected just by touching playground equipment that somehow has some residue of, most likely, peanut butter on it.

Schools need to be very careful to not inadvertently “spotlight” or label a child with allergies. Banning or restricting peanut products can be met with strong resistance and anger that is directed at the child with the allergy.

Because of pressure from parents and concern for liability, an elementary school needs to develop a peanut policy. You have been appointed to a committee by the School Board whose charge it is to write a draft peanut policy that will be forwarded to the attorneys for the district and then the school board for review and approval.

Choose one of the following roles:

1. Director of the Child Nutrition Program
2. School Nurse
3. President of the PTO (you have a second grader with a peanut allergy)
4. Director of Risk Management for the school

The board has asked you to address the following questions and then to develop a draft policy. Be sure to represent the role you have chosen above. Answer each question thoroughly including the issues and how you have addressed them.

**CRITICAL-THINKING QUESTIONS**

1. Should all peanuts and peanut products be banned?
2. Should there be a peanut-free zone? Should this include the entire school? Or just the cafeteria? What about the playgrounds?
3. Should there be an area designated for peanut consumption?
4. Should peanut butter be the only peanut product allowed at the school?
5. Should children be allowed to bring peanuts/peanut butter in their own lunches? If not, how will this be enforced and by whom?
6. PB&J is often the default lunch for children whose accounts are running a negative balance. What should the default lunch be if peanut butter is banned?
7. Should foodservice workers be allowed to administer EpiPens?
8. How should field trips be handled? What about special occasions (Halloween for example)?
9. What are the legal implications of all of this?
10. Using your answers to the questions above, write a policy that you plan to forward to legal services and the school board.
11. How would you go about implementing this policy in order to obtain “buy in” from all interested parties?

CHAPTER REVIEW QUESTIONS

1. What is the definition of a foodborne illness?
2. Identify the federal agencies that oversee food safety in the United States.
3. What is the role of the food manager in food safety?
4. Identify the three “at-risk” populations as defined by the CDC.
5. Describe how knowledge of food microbiology can and should be applied to food safety programming.
6. Describe what is meant by a prerequisite program and how HACCP plans are integrated with prerequisite programs.
7. Describe what HACCP is and its unique contribution to an integrated food safety program.
8. Explain why control of allergens is becoming more challenging for on-site foodservice operations.
9. What is an Allergen Risk Reduction Program? How can it be a distinct, yet important, component of an integrated food safety program?
10. How can disaster planning be integrated into food safety programming?