Chapter 8

Safety, Sanitation, and Maintenance

Enduring Understanding

- Handwashing and control of time/temperature of food items are the most critical elements of food safety.
- Planning and monitoring are important elements of successful sanitation, maintenance, and risk management programs.

Learning Objectives

After reading and studying this chapter, you should be able to:

1. Describe components of the safety, sanitation, and maintenance subsystem.
2. Differentiate the terms *clean* and *sanitary*.
3. Compare and contrast methods of solid waste management.
4. Develop policies for helping ensure food, employee, and customer safety.

Safety, sanitation, and maintenance are critical in a foodservice operation. As a future foodservice manager, you will be responsible for ensuring the safety of your employees and customers. An important component of this safety will be the sanitation and maintenance of your equipment and facility. In this chapter, we will discuss the safety, sanitation, and maintenance subsystem of the foodservice system model. Emphasis will be placed on food safety and techniques that you as a manager can implement to help ensure food safety in your operation. Concepts such as risk management and solid waste management also will be discussed.

FUNCTIONAL SUBSYSTEM: SAFETY, SANITATION, AND MAINTENANCE

Safety, sanitation, and maintenance is the last major functional subsystem in the foodservice system, and it permeates all other subsystems (Figure 8-1).

Ensuring safety in a foodservice operation is a major responsibility of the manager of that operation. This responsibility includes the safety of employees and guests of that operation and the safety of the food served. Risk management activities often focus on safety issues.

In comparison with many industrial jobs, those in hospitality are relatively safe occupations. Bureau of Labor Statistics data (www.bls.gov) found that the number of nonfatal occupational injuries at leisure and hospitality places in 2012 was 3.9 per 100 full-time employees, which was a decline from 8.4 in 1990 and was equal to the average for all industries. A foodservice facility, however, has many potential hazards; minor injuries from cuts and burns are common, and more serious injuries occur all too frequently. The quantity of hot foods handled, type of equipment used, weight and size of products lifted and moved, potential for spills, and the frequently frenetic pace of a foodservice operation require that safety consciousness be a high priority. Accident prevention must be a priority for foodservice managers because accidents may involve injury or even death of employees or customers.

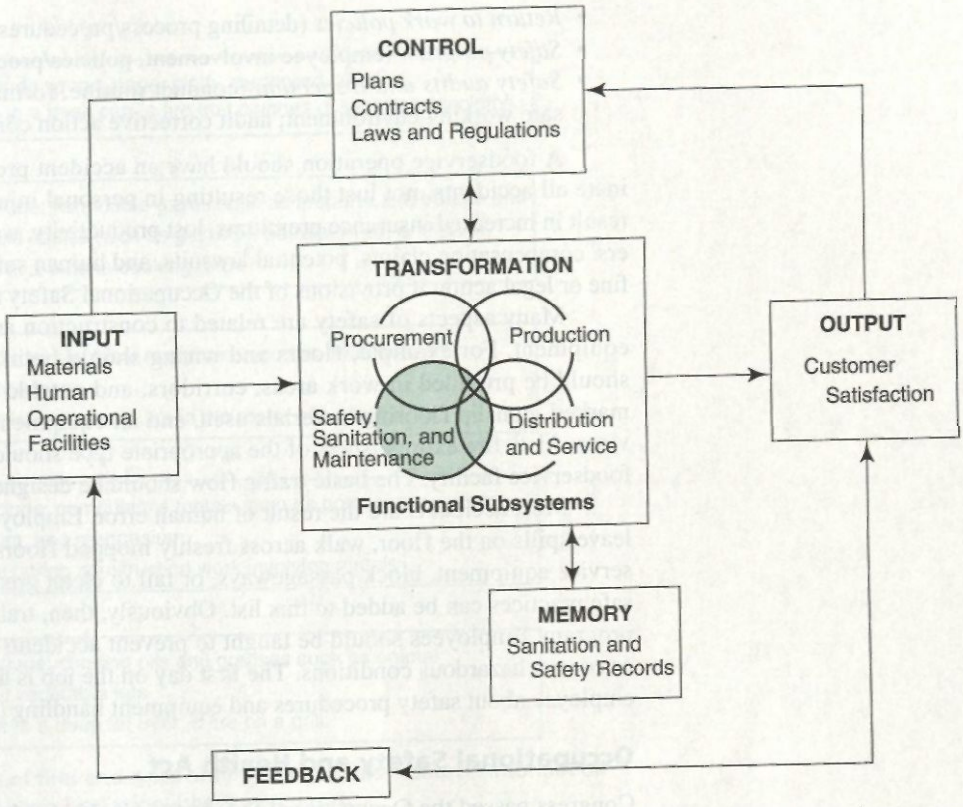


FIGURE 8-1 Foodservice systems model with the safety, sanitation, and maintenance subsystem highlighted.

Maintenance of equipment and facilities is important. The safety of surroundings often is related to cleaning and maintenance practices. Two examples are spills that are not cleaned up properly, which may cause people to fall, and grease buildup in the hoods over the production equipment, which is a major cause of fires in foodservice operations.

EMPLOYEE SAFETY

Accident
Unexpected event resulting in injury, loss, or damage.

An **accident** is frequently defined as an event that is unexpected or the cause of which was unforeseen, resulting in injury, loss, or damage. An accident is also an unplanned event that interrupts an activity or function. Although they may or may not be the result of negligence, many accidents can be prevented. Safety is every employer's responsibility. Accidents do not just happen—something causes them, and the majority are controllable (Somerville, 1992). According to Goetsch (2010), the most common causes of workplace accidents are overexertion (employees working beyond their physical limits), impact accidents (employee being struck by or against an object), and falls. Filiaggi and Courtney (2003) indicated that the most common injuries in restaurants were sprain/strains (34%), cuts/punctures (18%), burns (10%), bruises (10%), fractures (7%), and all other types of injuries (21%). Schweitzer (2010) encouraged inclusion of the following major components in a best-practices foodservice safety program:

- *Management commitment* (managers model safe behaviors, show concern and investigate employee injuries, modify work environment as needed to make it safer)
- *Employee involvement* (employees attend safety meetings, view posted safety information, follow safe practices)
- *Communication* (communication of required safety behaviors/practices and suggestion boxes and meetings as ways to share safety concerns)
- *Education and training* (orientation to safety, on-the-job training for safe behaviors)
- *Injury reporting and treatment* (forms and process for reporting injuries, mechanism for reviewing injury reports and implementing corrective action as needed)

- *Return to work policies* (detailing process/procedures for clearance to return to work)
- *Safety program* (employee involvement, policies/procedures detailed, training)
- *Safety audits and inspection* (conduct routine, formal inspections of operation to assure safe working environment; audit corrective action completion)

A foodservice operation should have an accident prevention program that seeks to eliminate all accidents, not just those resulting in personal injury. Accidents are expensive and can result in increased insurance premiums, lost productivity, wasted time, overtime expenses, workers' compensation claims, potential lawsuits, and human suffering. Accidents can also result in a fine or legal action if provisions of the Occupational Safety and Health Act (OSHA) are violated.

Many aspects of safety are related to construction and maintenance of the structure and equipment. For example, floors and wiring should be in good repair, and adequate lighting should be provided in work areas, corridors, and outside the facility. Exits should be clearly marked, nonslip flooring materials used, and all equipment supplied with necessary safety devices. Also, fire extinguishers of the appropriate type should be readily available throughout the foodservice facility. The basic traffic flow should be designed to avoid collisions.

Most accidents are the result of human error. Employees may lift heavy loads incorrectly, leave spills on the floor, walk across freshly mopped floors, fail to use safety devices on foodservice equipment, block passageways, or fail to clean greasy filters regularly. Many other unsafe practices can be added to this list. Obviously, then, training is an important part of a safety program. Employees should be taught to prevent accidents by learning to recognize and avoid or correct hazardous conditions. The first day on the job is the best time to start educating a new employee about safety procedures and equipment handling (Spertzel, 1992b).

Occupational Safety and Health Act

Congress passed the Occupational Safety and Health Act in 1970. The purpose of the act is "to assure, so far as possible, every working man and woman in the Nation safe and healthful working conditions, and to preserve our human resources."

OSHA allows a compliance officer to enter a facility to determine adherence to standards and to determine if the workplace is free of recognized hazards. During an OSHA inspection, some of the specific conditions for which the compliance officer will be searching include the following:

- Accessibility of fire extinguishers and their readiness for use
- Guards on floor openings, balcony storage areas, and receiving docks
- Adequate handrails on stairs
- Properly maintained ladders
- Proper guards and electrical grounding for foodservice equipment
- Lighted passageways, clear of obstructions
- Readily available first-aid supplies and instructions
- Proper use of extension cords
- Compliance with OSHA posting and recordkeeping requirements

Citations are issued by an OSHA area director upon review of the compliance officer's inspection report if standards or rules have been violated. Several kinds of violations are possible, which may involve fines or legal action if the violation is sufficiently serious.

Many hospitals will have an Occupational Safety Officer, or Department of Occupational Safety that consists of several individuals, who works with managers in all departments to ensure compliance with OSHA and other health and safety regulations. Foodservice accidents and health inspections are monitored by this individual.

Fire Safety

More fires start in foodservice than in any other kind of business operation (NRA Educational Foundation, 1992). Oxygen, fuel, and heat are required to start and sustain a fire; most fires start with the mishandling of fuel and heat. Suppressing a fire typically focuses on reducing or eliminating oxygen or the source of the fuel for the fire (Goetsch, 2010).

Managers must check their operations regularly and must establish procedures for handling any hazards that could start fires. Hot oil in fryers can burst into flames at its flammable

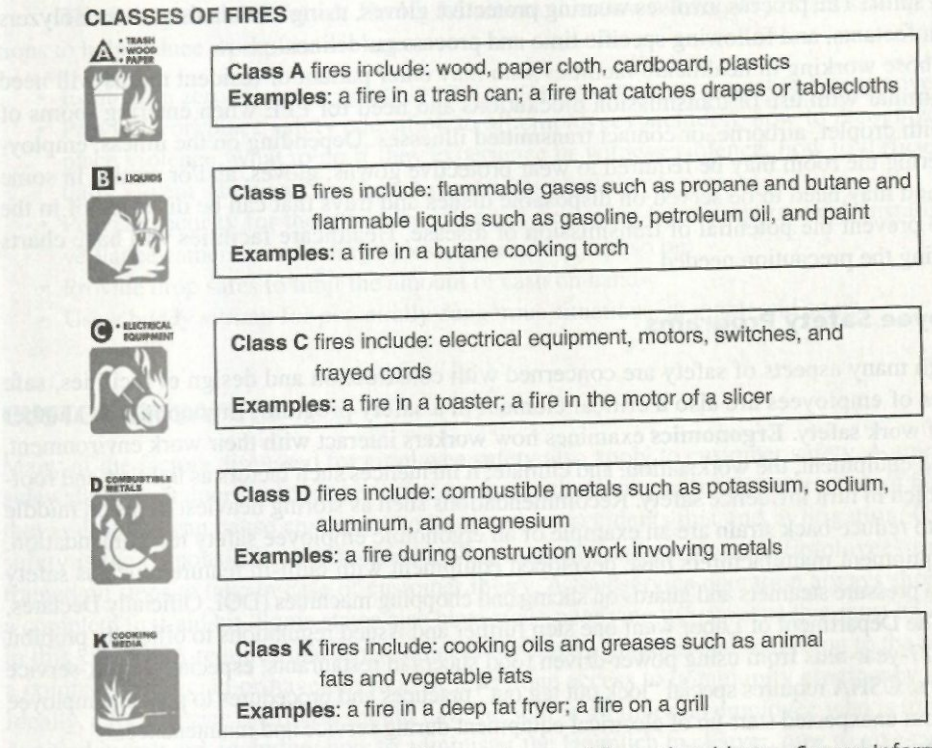


FIGURE 8-2 Description of the classes of fires and types of fire extinguishers. *Source:* Information from www.hanford.gov/fire/safety and www.FireExtinguisherTraining.com

limit of between 425°F and 500°F and be the source of a fire, or it can increase the severity of a fire that is started another way. Also, oil in ventilation systems and on walls, equipment, and other surfaces is highly flammable. Hoods over ranges and filters that are not cleaned regularly provide an ideal environment for a grease fire (Bendall, 1992). A good solution for high-volume restaurants is the extractor ventilator, which is a series of baffles on the hood to extract grease through a centrifugal action. Some have an automatic wash-down feature to clean the inside of the hood with detergent and hot water at scheduled times. Tests have shown that some of these ventilators can remove more than 90% of the grease from the air.

The National Fire Protection Association has identified ABC classes of fire, which are described in Figure 8-2 along with the types of extinguishers for each. The foodservice manager should know the differences among the extinguishers and purchase the proper kind. The local fire department usually is willing to demonstrate extinguishers.

In addition to fire extinguishers, heat and smoke detection devices and some form of fire protection, such as dry/wet chemicals, should be installed over cooking equipment. Water mist operates from the building's water sprinkler, which has an unlimited supply of water, and is effective in suffocating most types of fires. Dry/wet chemicals in containers are piped to outlet nozzles above each piece of equipment; once the chemicals are discharged, they have to be replaced immediately to provide continuing fire protection. In many states, a state fire marshal has responsibility for approving the design and construction of buildings from a safety and fire protection standpoint.

Personal Protective Equipment

Personal Protective Equipment (PPE) items are used to help protect the foodservice worker from injury or illness. Examples of PPE use include: wearing protective glasses and rubber gloves when deliming the dishmachine to protect the eyes and hands from harsh chemicals; using stainless steel mesh gloves when cleaning the slicer to prevent cuts; or wearing asbestos arm guards when working over a hot grill.

PPE and special cleaning materials must be used when cleaning up spills of blood or other body fluids. Most organizations will have a procedure and special chemicals to use for cleaning

up such spills. The process involves wearing protective gloves, using chemicals such as isolyzers and disinfectants, and following specific time and process guidelines.

Those working in healthcare facilities who may enter patient or resident rooms will need to be familiar with use of transmission precautions and need for PPE when entering rooms of those with droplet, airborne, or contact transmitted illnesses. Depending on the illness, employees entering the room may be required to wear protective gowns, gloves, and/or masks. In some cases food may need to be served on disposable dishes and trays that can be disposed of in the room to prevent the potential of transmission of disease. Healthcare facilities will have charts identifying the precaution needed.

Employee Safety Programs

Ergonomics
Study of how workers interact with their work environment.

Although many aspects of safety are concerned with construction and design of facilities, safe practices of employees are also a critical element in a safety program. Ergonomics is another factor of work safety. **Ergonomics** examines how workers interact with their work environment, including equipment, the workstation, and climate; it influences such factors as lighting and footwear, which in turn influence safety. Recommendations such as storing heaviest items on middle shelves to reduce back strain are an example of an ergonomic employee safety recommendation.

Equipment manufacturers have developed equipment with built-in features such as safety valves on pressure steamers and guards on slicing and chopping machines (DOL Officially Declares, 1991). The Department of Labor went one step further and issued regulations to officially prohibit 16- and 17-year-olds from using power-driven food slicers in restaurants, especially quick-service operations. OSHA requires special "lock out tag out" practices and procedures to prevent employee injury from unexpected start-up of electrical equipment during service and maintenance.

Obviously, safety training must have major emphasis in both initial and in-service employee training. Many resource materials on safety and accident prevention are available, such as those of the National Safety Council and the American Red Cross. Also, personnel from state and local fire prevention agencies are often available as speakers. The National Restaurant Association (www.restaurant.org) has published a variety of workplace safety training materials and mini-posters to help foodservice managers continually improve the safety in their operation. The Institute of Child Nutrition (ICN) (www.nfsmi.org) also has posters and training materials available for foodservice managers to use to train employees.

Workplace Violence

Workplace violence is defined by the National Institute for Occupational Safety and Health (NIOSH) as violent acts directed toward persons at work or on duty (www.cdc.gov/niosh). Workplace violence includes verbal or written threats, threatening body language, physical assaults, or aggravated assaults. According to the U.S. Occupational Safety & Health Administration (OSHA) website (www.osha.gov), more than 2 million workers in the United States are victims of workplace violence each year. The likelihood of workplace violence is increased in organizations such as restaurants and similar foodservice operations that work with the public, have an exchange of money taking place in the organization, and deliver service.

The University of Iowa Injury Prevention Research Center (2001) categorized workplace violence into the following four types:

- **Criminal intent.** The perpetrator has no legitimate linkage to the business and its employees; commits the violence as part of a crime such as a robbery
- **Customer/client.** The perpetrator has a legitimate relationship with the business and becomes violent while being served
- **Worker-on-worker.** The perpetrator is an employee or former employee of the business and attacks or threatens another employee or former employee
- **Personal relationship.** The perpetrator usually is not an employee of the business but has a personal relationship with an employee

They reported that the majority of workplace homicides were a result of criminal intent; the majority of healthcare incidents of workplace violence were because of customer/client violence.

The Occupational Safety & Health Administration (www.osha.gov) offers several suggestions to help reduce workplace violence:

- Establish a zero tolerance policy toward workplace violence against or by employees
- Provide workplace safety education to all employees including how to recognize workplace violence, what to do if they experience or witness violence, how to diffuse potentially violent situations, and how to protect themselves
- Provide security for the workplace through deploying security personnel, installing surveillance cameras, restricting access to outsiders, and so on
- Provide drop safes to limit the amount of cash on hand
- Use a buddy system for potentially dangerous situations, at night, and so on

CUSTOMER SAFETY

Many of the factors discussed for employee safety also apply to customer safety. A crack in the sidewalk, an exit door that does not open, grease on the dining room floor, or a cup of hot coffee that is dropped can cause customers to have serious accidents that end in litigation. Customer safety is the responsibility of the foodservice manager and employees. Employees should be trained on steps to take in case of customer injury. A foodservice operation always should have a complete first-aid kit. Some states also have laws specifying the supplies that must be included in this kit. OSHA requires that a restaurant either have a kit equipped according to the advice of a company physician or have physical or telephone access to community emergency services. Ideally, a foodservice operation should have present at all times an employee who is trained and certified in first aid, including how to administer the Heimlich maneuver, how to give cardiopulmonary resuscitation (CPR), and how to identify potential allergic reactions.

Approximately 60% of all choking incidents occur in restaurants (Herlong, 1991). Prior to 1974, when the Heimlich maneuver was introduced, about 20,000 choking fatalities occurred each year; currently about 2,000 to 3,000 occur. Laws on first-aid training requirements vary by state. Some states require only that restaurants post Heimlich maneuver instructional diagrams where all employees can see them, but others require formal training for foodservice employees as well as posting of instructions. The National Restaurant Association, the American Red Cross, and the Heimlich Institute all provide charts and instructional materials on the Heimlich maneuver.

FOOD SAFETY

The Centers for Disease Control and Prevention (CDC) warns that mishandling of food has caused many foodborne outbreaks in the foodservice segment of the industry where food is prepared and served to the public. Food protection began in the early 1900s when the U.S. Public Health Service (PHS) studied the role of milk in the spread of disease. Model codes were developed to help state and local governments start and maintain effective programs for prevention of foodborne illnesses.

The Food and Drug Administration (FDA), Food Safety and Inspection Service (FSIS), and CDC jointly published the *Food Code* (2013) (see www.fda.gov). It is a reference document for regulatory agencies responsible for overseeing food safety in retail outlets such as restaurants, grocery stores, and institutions (nursing homes, hospitals, schools, childcare centers, etc.). It may be adopted and used by agencies at all levels of government that are responsible for managing food safety risks. The model *Food Code* provisions are designed to be consistent with federal food laws and regulations and are written for ease of legal adoption at all levels of government. Since publication of the first version of the *Food Code* in 1997, important progress has been made in efforts to monitor and prevent foodborne diseases and ensure that consumers are provided the safest possible foods.

The model *Food Code* is neither federal law nor federal regulation. Rather, it represents the FDA's best advice for a uniform system of regulation to ensure that food is safe and properly protected. Each state, county, and city health department has the option to adopt all or part of the code, thus food safety regulations often vary in different health department jurisdictions. Food

safety information included in this chapter will reflect recommendations in *Food Code* (2013). Those using this text should check with their local health department to determine specific regulations for local foodservice operations.

Without question, public awareness has made consumers more cautious about the handling of food at home (Featsent, 1998). Nationwide recalls of meat and produce items have created increased customer awareness and scrutiny of the food supply. Foodservice managers must eliminate any perception of food safety risk in their operations.

Foodborne pathogen
Virus, microorganism, or other substances that cause disease.

The CDC is expanding its prevention efforts to focus on heading off new **foodborne pathogens**, specific causes of diseases such as bacteria or viruses that can be spread globally by foods tainted with low-level contamination. The CDC has developed the PulseNet system, which will help public health experts determine whether the illnesses are from the same strain or from a common exposure source. PulseNet is a national network of public health laboratories that perform a "fingerprinting" on bacteria that may be foodborne. PulseNet provides an early warning system for outbreaks of foodborne disease by having bacteria "fingerprinting" data on a central CDC computer that is linked to state and local health departments (see www.cdc.gov/pulsenet).

Spoilage
Denotes unfitness for human consumption due to chemical or biological causes.

The safety of food can be impacted by both spoilage and contamination. **Spoilage** denotes unfitness for human consumption due to chemical or biological causes. Longrée and Armbruster (1996) identified the following criteria for assuring foods are fit to eat:

- The desired stage of development or maturity of the food
- Freedom from pollution at any stage in production and subsequent handling
- Freedom from objectionable chemical and physical changes resulting from action of food enzymes; activity of microbes, insects, and rodents; invasion of parasites; and damage from pressure, freezing, heating, or drying
- Freedom from microorganisms and parasites causing foodborne illnesses

Contamination
Presence of harmful substances in food.

Contamination is the presence of harmful substances in food. Contamination can occur naturally or be caused by humans or the environment. Contamination of food typically is categorized as biological, physical, or chemical. The extent of contamination of some foods may be difficult to determine from their appearance, odor, and taste; in other foods, mold, discolored or altered appearance, off-odors, or off-flavors are obvious signs of contamination.

Biological Contamination

Microorganism
Organism so small it requires a microscope to be seen.

Pathogen
Harmful microorganism.

Thousands of species of **microorganisms** have been identified. Many are harmless, but others, termed **pathogens**, are harmful and can cause illness or death. Biological contamination occurs when harmful microorganisms contaminate food and cause foodborne illness.

Today, foodborne illnesses are recognized as a major health problem in the United States. The CDC estimates that 48 million people get sick, 128,000 are hospitalized, and 3,000 die of foodborne disease in the United States each year (information from www.cdc.gov, 2014). According to the CDC, more than half of all reported foodborne outbreaks were caused by mishandling food in commercial and onsite foodservices where ready-to-eat (RTE) food is prepared and served to the public. According to economists of the Economic Research Service (ERS) (see www.ers.usda.gov), the most costly foodborne bacterial pathogens are *Salmonella, Toxoplasma gondii, Listeria monoytogenes, Norovirus,* and *Campylobacter.* The ERS estimates the economic costs of medical care, productivity losses, and premature death from these five pathogens is nearly $14 billion a year (www.ers.usda.gov).

Pathogens can be categorized as bacteria, viruses, parasites, fungi, and natural toxins. They are found everywhere that temperature, moisture, and substrate favor life and growth. Some species are valuable and useful in preserving food, producing alcohol, or developing special flavors if they are specially cultured and used under controlled conditions. Other microbial activity, however, can be a primary cause of foodborne illness or intoxication.

AT TOM
cronym for conditions impacting bacria growth: food, acidity, time, temrature, oxygen, and moisture.

Foodborne microorganisms need the right conditions to grow. **FAT TOM** is an acronym used to identify the ideal conditions for foodborne microorganism growth (NRA Education Foundation, 2014):

- F is for Food: specifically carbohydrates and proteins
- A is for Acidity: a pH of 4.6 to 7.5 is ideal

- T is for Temperature: growth is best between 41°F and 135°F (5°C and 57°C)
- T is for Time: food should be in the temperature danger zone for limited amounts of time
- O is for Oxygen: some need oxygen, others do not
- M is for Moisture: water activity (A_w) of 0.85 or higher is ideal for growth

BACTERIA Bacteria are microscopic, unicellular organisms of varying size and shape, including spherical, rod, and spiral. According to the CDC, the most commonly recognized foodborne infections are those caused by the bacteria *Campylobacter,* Nontyphoidal *Salmonella, Staphylococcus aureus,* and *Escherichia coli O157:H7* (information from www.cdc.gov, 2010).

Although requirements for growth vary among different types of bacteria, all bacterial cells pass through various phases (McSwane, Rue, Linton, & Williams, 2004). When the multiplication of bacteria is steady, the number of cells produced over a certain period of time can be plotted. Figure 8-3 shows a typical bacterial growth curve. The growth curve typically is divided into four phases as follows:

- Lag phase—initial stage where, although bacterial cells exist, little to no growth occurs
- Log phase—a period of rapid growth in a relatively short period of time
- Stationary phase—the rate of growth is slowed and eventually stops as bacterial cells begin to die
- Death phase—bacterial cells die more rapidly, new cells are created due to lack of nutrients and the excess waste the cells create

Food is the most important condition needed for bacterial growth (McSwane et al., 2004). Foods high in protein or carbohydrate are the most supportive of bacterial growth.

The degree of a food's acidity or alkalinity, expressed as **pH value**, also affects bacterial growth. The pH value represents the hydrogen ion concentration and is expressed on a scale from 0 to 14, with 7 expressing neutrality. Values below 7 indicate acidity; those above 7 indicate basic or alkaline materials. Bacteria vary widely in their reaction to pH. Although some are quite tolerant to acid, they generally grow best at a pH near neutral, so acid is frequently used in food preservation to suppress bacterial multiplication. Multiplication of the organisms causing food infections and foodborne illnesses are supported in slightly acidic, neutral, and slightly alkaline food materials (Longrée & Armbruster, 1996). The pH of some common foods is listed in Figure 8-4.

pH value
Degree of a food's acidity or alkalinity.

Microorganisms have specific temperature requirements for growth. At its optimum temperature, a cell multiplies and grows most rapidly, but a cell will also grow within the minimum

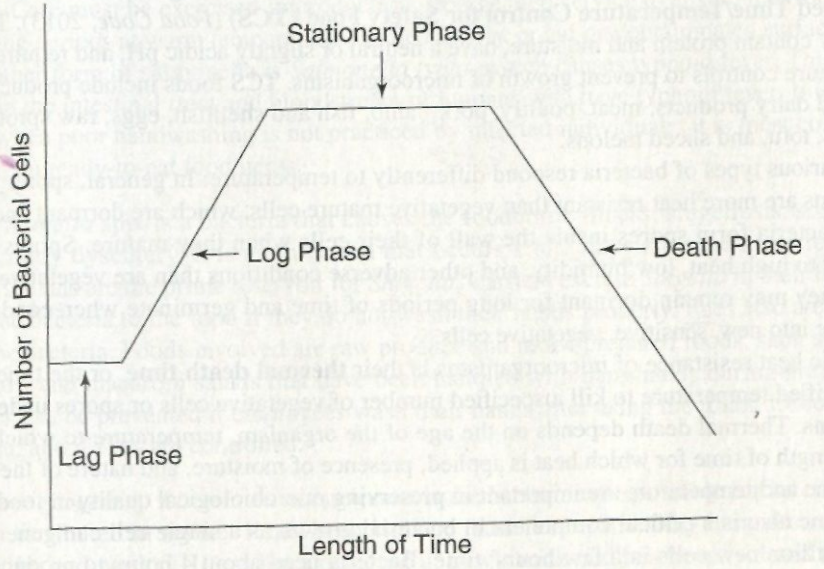


FIGURE 8-3 Curve of growth of bacterial cells.

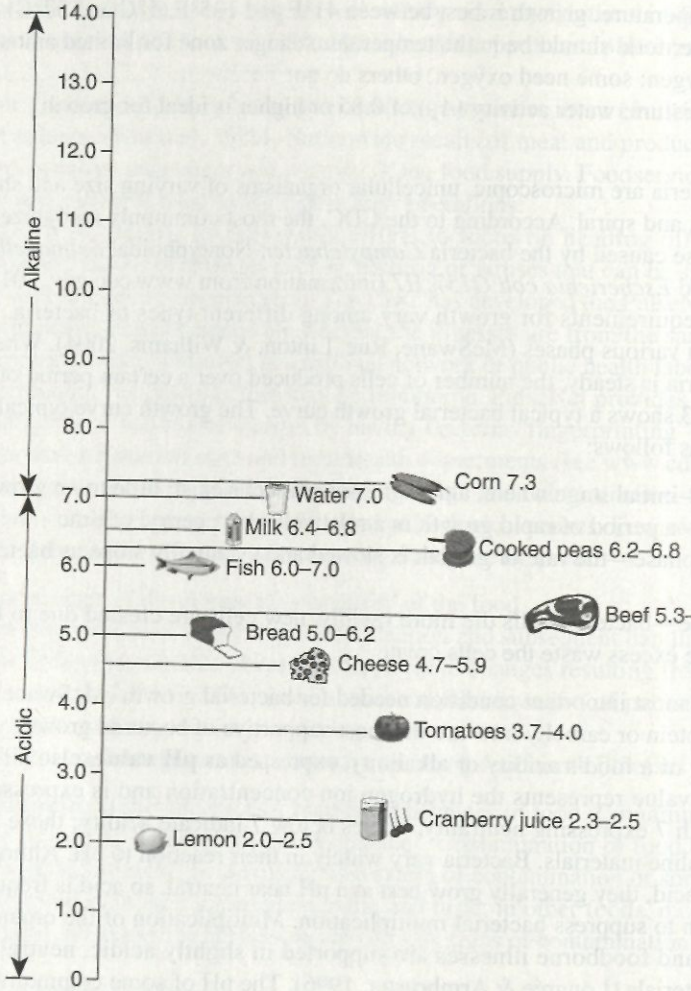


FIGURE 8-4 The pH of some common foods.

and maximum temperatures around its optimum. Foods that require time and temperature control because they are capable of supporting growth of pathogenic microorganisms or toxin formation are termed **Time/Temperature Control for Safety Food (TCS)** (*Food Code,* 2013). TCS foods typically contain protein and moisture, have a neutral or slightly acidic pH, and require time and temperature controls to prevent growth of microorganisms. TCS foods include products such as milk and dairy products, meat, poultry, pork, lamb, fish and shellfish, eggs, raw sprouts, baked potatoes, tofu, and sliced melons.

Time/Temperature Control for Safety Food (TCS)

Food items that require temperature control because they are capable of supporting growth of pathogenic microorganisms or toxin formation.

Various types of bacteria respond differently to temperature. In general, spores of microorganisms are more heat resistant than vegetative mature cells, which are dormant and asexual. Some bacteria form spores inside the wall of their cells when they mature. Spores are more resistant to high heat, low humidity, and other adverse conditions than are vegetative bacterial cells. They may remain dormant for long periods of time and germinate when conditions are favorable into new, sensitive, vegetative cells.

Thermal death time

Time required at a specific temperature to kill a specified number of vegetative cells or spores.

The heat resistance of microorganisms is their **thermal death time**, or the time required at a specified temperature to kill a specified number of vegetative cells or spores under specific conditions. Thermal death depends on the age of the organism, temperature to which it is exposed, length of time for which heat is applied, presence of moisture, and nature of the medium. Thus, time and temperature are important in preserving microbiological quality in foods.

Time also is a critical component in bacterial growth as a single cell can generate more than a million new cells in a few hours' time. Bacteria need about 4 hours to produce enough cells to cause illness.

Bacteria differ in their need for oxygen for growth. **Aerobic bacteria** need oxygen to grow; **anaerobic bacteria** reproduce without oxygen.

Aerobic bacteria
Bacteria that need oxygen to grow.

Anaerobic bacteria
Bacteria that reproduce without oxygen.

Multiplication of bacteria is affected by available moisture in food. The amount of water available to support bacterial growth is termed *water activity* (A_w). Bacteria need a water activity higher than 0.85 to grow (McSwane et al., 2004). Water becomes less available through the presence of solutes such as salt and sugar, through freezing, or through dehydration.

Various inhibitors have a pronounced effect on bacterial multiplication and death. According to Longrée and Armbruster (1996), inhibitors may be integral in the food, developed during processing as a product of the microorganism's metabolism, or added purposely by the processor. The benzoic acid in cranberries and lysozyme in egg whites, for example, are natural inhibitors of these foods. Alcohol produced in the growth and fermentation of yeast, in fruit juices, or in the production of wine is an example of an inhibitory substance that may accumulate and become toxic.

Some bacteria produce toxins in food as they grow and die. The toxin often cannot be destroyed by heating or freezing and can cause illness or death.

Foodborne infections are caused by the activity of large numbers of pathogenic bacterial cells carried by the food into the gastrointestinal system of the victim and causing illness. **Foodborne intoxications** are caused by toxins formed in the food prior to consumption. Consumption of the toxins causes the illness. The symptoms from ingesting toxin-containing food may occur within as short a period of time as 2 hours. The incubation period of an infection, however, is usually longer than that of an intoxication.

Foodborne infection
Caused by activity of large numbers of bacterial cells carried by the food into the gastrointestinal tract.

Foodborne intoxications
Caused by toxins formed in food prior to consumption.

Tables 8-1 and 8-2 summarize information about various pathogenic bacteria that can cause foodborne illness or intoxication. Symptoms of each are frequently severe and commonly include nausea, cramping, vomiting, and diarrhea.

Salmonella Nontyphoidal *Salmonella* frequently has been associated with foodborne illnesses and causes salmonellosis. The bacterium does not release toxins into the food in which it multiplies; rather, the ingested cells continue to multiply in the intestinal tract of the victim, causing illness. The primary source of Nontyphoidal *Salmonella* is the intestinal tract of carrier animals. A carrier appears to be well and shows no symptoms or signs of illness but harbors causative organisms. Various insects and pets may be reservoirs of Nontyphoidal *Salmonella.* Food animals are important reservoirs, especially hogs, chickens, turkeys, and ducks. The disease salmonellosis is spread largely by contaminated food and is believed to be one of the major communicable diseases in the United States.

A number of raw and processed foods have been found to carry Nontyphoidal *Salmonella,* especially raw meat, poultry, shellfish, processed meats, egg products, and dried milk. Meat mixtures, dressings, gravies, puddings, and cream-filled pastries are among the menu items frequently indicated in salmonellosis. Food handlers and poor sanitation practices are often associated with outbreaks. Care must be exercised in production, storage, and service to ensure that food is not held for long periods at warm temperatures, cooled slowly, or cut on contaminated surfaces.

Another form of salmonella is *Salmonella typhi,* which causes typhoid fever. This organism lives in the intestinal tract and bloodstream of humans who have typhoid fever. It is passed to others when poor handwashing is not practiced by infected individuals. It is most commonly transferred on ready-to-eat food items.

Shigella *Shigella* spp. is a bacteria that causes the foodborne illness, shigellosis, sometimes called bacillary dysentery. It is an infection that occurs 1 to 7 days after the ingestion of the bacteria. Humans are the prime reservoir for *Shigella.* Carriers excrete *Shigella* in their feces and transmit the bacteria to the food if they do not wash their hands properly. Flies also are thought to carry the bacteria. Foods involved are raw produce and moist-prepared foods, such as potato, tuna, turkey, and macaroni salads that have been handled with bare hands during preparation. Shigellosis can be prevented if employees wash their hands after using the toilet, if food is rapidly cooled, and if flies are controlled.

Listeria monocytogenes *Listeria monocytogenes* is the bacterium responsible for listeriosis and is widely distributed in nature. It has been isolated from feces of healthy human carriers and sheep, cattle, and poultry. It has been detected in cow's milk and has been isolated from unwashed leafy vegetables and fruit and soil. Also, the bacterium has been found in dairy and

	Salmonella (nontyphoidal)	*Shigella* spp.	*Listeria monocytogenes*	*Staphylococcus aureus*	*Clostridium perfringens*	*Bacillus cereus*	*Clostridium botulinum*
Onset Time	6–48 hours	12–50 hours	3–70 days	1–6 hours	8–22 hours	1/2–5 hours; 8–16 hours	12–36 hours
Duration of Illness	2–3 days	Indefinite; depends on treatment	Indefinite; depends on treatment, but has high fatality in the immunocompromised	1–2 days	24 hours; lingering symptoms 1–2 weeks	6–24 hours	Several days to a year
Symptoms	Abdominal pain, headache, nausea, vomiting, fever, diarrhea	Abdominal pain, diarrhea, fever, chills, dehydration, vomiting	Nausea, vomiting, headache, fever, chills, backache, meningitis	Nausea, vomiting, diarrhea, dehydration	Abdominal pain, diarrhea	Nausea and vomiting, diarrhea, abdominal cramps	Vertigo, visual disturbances, inability to swallow, respiratory paralysis
Source	Water, soil, domestic and wild animals; also humans, especially as carriers	Human feces, flies	Humans, domestic and wild animals, fowl, soil, water, mud	Humans (skin, nose, throat, infected sores); also animals	Humans (intestinal tract), animals, and soil	Soil, cereal crops	Soil, water
Associated Foods	Poultry and poultry salads, meat and meat products, milk, shell eggs, egg custards and sauces, and other protein foods	Potato, tuna, shrimp, turkey and macaroni salads, lettuce, moist and mixed foods, milk and milk products	Unpasteurized milk and cheese, vegetables, poultry and meats, seafood, and prepared, chilled, ready-to-eat foods	Reheated foods, ham and other meats, dairy products, custards, meat, egg, potato salads, cream-filled pastries, and other protein foods	Cooked poultry and meat products that have been improperly cooked, held, or cooled before serving	Rice and rice dishes, custards, seasonings, dry food mixes, spices, puddings, cereal products, sauces, vegetable dishes, meatloaf	Improperly processed canned goods of low-acid foods, garlic-in-oil products, grilled onions, stews, meat/poultry loaves
Spore Former	No	No	No	No	Yes	Yes	Yes
Prevention	Avoid cross-contamination, thoroughly cook poultry to at least 165°F, cool cooked meats and meat products quickly and properly, avoid fecal contamination from food handlers by practicing good personal hygiene	Avoid cross-contamination, avoid fecal contamination from food handlers by practicing good personal hygiene, use sanitary food and water sources, control flies, rapidly cool food	Use only pasteurized milk and dairy products, cook foods to proper temperatures, avoid cross-contamination, clean and sanitize surfaces	Avoid contamination from bare hands, exclude sick food handlers from food preparation and serving, practice good personal hygiene, practice sanitary habits, proper heating, cooling, and refrigeration of food	Use careful time and temperature control in cooling and reheating cooked meat dishes and products	Use careful time and temperature control and quick chilling; proper reheating	Do not use home-canned products; use careful time and temperature control for sous vide items and all large, bulky foods; keep sous vide packages refrigerated; purchase garlic-in-oil in small quantities for immediate use; cook onions only on request; rapidly cool leftovers

Source: Based on information from ServSafe® Essentials by the Educational Foundation of the National Restaurant Association, 2006, Chicago, IL: Author and the Bad Bag Book by the Center of Food Safety and Applied Nutrition (see www.fda.gov).

Table 8-2 Additional Bacterial Pathogens That Cause Foodborne Illness

	Bacteria			
	Campylobacter jejuni	***Escherichia coli***	***Vibrio parahaemolyticus, Vibrio vulnificus***	***Yersinia enterocolitica, Yersinia pseudotuberculosis***
Onset Time	3–5 days	12–72 hours	4–96 hours	24–48 hours
Duration of Illness	1–4 days	1–3 days	1–8 days	Days to weeks
Symptoms	Diarrhea, fever, nausea, abdominal pain, headache	Bloody diarrhea, severe abdominal pain, nausea, vomiting, diarrhea, and, occasionally, fever	Diarrhea, abdominal cramping, vomiting, headache, fever, chills	Abdominal pain, vomiting, diarrhea, headache
Source	Domestic and wild animals	Humans (intestinal tract), animals, particularly cattle	Fish and shellfish (especially from the Gulf of Mexico)	Soil, water, pigs, wild rodents
Associated Foods	Raw vegetables, unpasteurized milk and dairy products, poultry, pork, beef, and lamb	Raw and undercooked beef and other red meats, imported cheeses, unpasteurized milk, raw fin fish, cream pies, mashed potatoes, and other prepared foods	Raw or improperly cooked oysters or shellfish from contaminated water	Raw or partially cooked meat (beef, pork, lamb), oysters, fish, raw milk
Spore Former	No	No	No	No
Prevention	Avoid cross-contamination, cook foods thoroughly	Cook beef and red meats thoroughly, avoid cross-contamination, use safe food and water supplies, avoid fecal contamination from food handlers by practicing good personal hygiene	Avoid raw or undercooked seafood, purchase seafood from approved sources	Thoroughly cook foods, minimize cross-contamination, properly clean and sanitize facilities

Source: Based on information from ServSafe® Coursebook by the Educational Foundation of the National Restaurant Association, 2014, Chicago, IL: Author and the Bad Bag Book by the Center of Food Safety and Applied Nutrition (see www.fda.gov).

meat processing factories with some degree of frequency. Unlike other bacteria, it grows in cool, moist environments. Listeriosis disease has been linked to consumption of contaminated delicatessen food, milk, soft cheeses (like Mexican-style feta, Brie, Camembert, and blue-veined cheeses), and undercooked chicken. Preventive measures include discarding outdated products, cooking foods to the recommended internal temperature, preventing cross contamination between raw and cooked foods, and avoiding unpasteurized milk.

Staphylococcus aureus *Staphylococcus aureus,* a bacterium commonly referred to as *staph* or *S. aureus,* is the principal causative agent in the foodborne illness, Staphylococcal gastroenteritis. The staph bacteria can produce a toxin when allowed to grow in large numbers. Staphylococcal intoxication is a fairly frequent cause of foodborne illness, with foods high in protein the usual culprits. Cream pies, custards, meat sauces, gravies, and meat salad are among the products most likely to be involved in foodborne intoxication. The appearance, flavor, or odor of the affected food items are not noticeably altered. Temperatures must be carefully controlled to prevent multiplication of staphylococci in food. The organism multiplies even under refrigeration if temperatures are not sufficiently low or if the cooling process does not proceed rapidly enough.

Clostridium perfringens *Clostridium perfringens* is a common inhabitant of the intestinal tract of healthy animals and human beings and occurs in soil, sewage, water, and dust and causes the illness Clostridium perfringens gastroenteritis. The infected food has invariably been held at room temperature or refrigerated in a large mass at the inappropriate temperature for several

hours. Meats, poultry, meat mixtures, and gravies are frequently implicated. Overnight roasting of meat has been a contributing factor in some cases because of the low temperatures often used. Prevention of *C. perfringens* multiplication can be achieved by refrigerating foods at 40°F or below or holding them at 145°F or higher. In addition, rapid cooling of cooked foods is an important practice.

Bacillus cereus Foodservice managers are beginning to be concerned about the *B. cereus* toxin, which is found in soil and, therefore, gets into many foods once thought to be safe (NRA Educational Foundation, 2014). *B. cereus* bacteria are found in grains, rice, flour, spices, starch, and in dry mix products such as those used for soups, gravies, and puddings and can cause Bacillus cereus gastroenteritis. Time and temperature are very important in preventing rapid increase in the vegetative bacteria and development of spores. Foods should not be held at room temperature for any period of time, but should be held hot or quickly chilled to at least 40°F.

Clostridium botulinum *Clostridium botulinum* produces a toxin that affects the nervous system and is extremely dangerous. The disease, botulism, is the food intoxication caused by this bacteria. Improved food processing techniques have led to greatly reduced incidence of botulism, although inadequately processed home-canned foods are still frequently associated with botulism. Meats, fish, and low-acid vegetables have been found to support toxin formation and growth.

Precautions for avoiding botulism include procuring foods from safe sources, rejecting home-canned products and low-acid products, destroying canned goods with defects such as swells or leaks, storing foods under recommended conditions, and using appropriate methods for thawing frozen foods.

In addition to improperly processed products, other suspicious foods include smoked, vacuum-packed fish; garlic products packed in oil; grilled onions; baked potatoes; turkey loaf; and stew. Sous vide products offer a potential risk because they are vacuum packaged. Soil-grown vegetables, particularly potatoes, can be prime carriers of this toxin.

Campylobacter jejuni *Campylobacter jejuni* was a well-known pathogen in veterinary medicine before it was considered a human pathogen. It is now recognized as one of the most common causes of gastroenteritis in humans, termed *Campylobacteriosis* or *Campylobacter enteritis.* A pathogen of cattle, sheep, pigs, and poultry, it is present in the flesh of these food animals and thus may be introduced into the food supply. It is particularly common in poultry; the FDA cites survey estimates that 20–100% of raw poultry is infected with *C. jejuni* (see *Bad Bug Book* at www.fda.gov). Properly cooking food and preventing cross contamination between raw and cooked foods are recommended preventative practices.

Escherichia coli There currently are four classes of enterovirulent *Escherichia coli* or *E. coli:* enterotoxigenic *E. coli,* enteropathogenic *E. coli,* enterohemorrhagic *E. coli O157:H7,* and enteroinvasive *E. coli.* The most common is *E. coli O157:H7,* which is a shiga toxin-producing form that causes Hemorrhagic colitis. *E. coli O157:H7* most often has been transmitted by eating raw or undercooked ground beef, and has caused serious illness and death. This bacterium is found in the intestinal tract of cattle and is transferred to the surface of meat during the slaughtering process. The bacteria on the surface of cuts such as steaks and roasts are killed when these pieces of meat are grilled or roasted (McCarthy, 1993). Grinding meat, however, transfers the bacteria from the surface to the inside of the product, making *E. coli* more difficult to kill prompting recommendations by the U.S. Department of Agriculture (USDA) (www.usda.gov) that hamburgers and ground meat mixtures be cooked to at least 160°F. Several national recalls have occurred related to ground beef found to be contaminated with *E. coli O157:H7.*

Vibrio parahaemolyticus, Vibrio vulnificus *Vibrio parahaemolyticus* and *Vibrio vulnificus* are bacteria that grow in seawater and can contaminate shellfish such as oysters, clams, and crabs. Both bacteria can cause Vibrio gastroenteritis. *Vibrio vulnificus* can cause septicemia in diabetes. Illness, which results in diarrhea, nausea, vomiting, fever, and chills, occurs when infected shellfish are eaten raw; both bacteria are killed when shellfish is cooked.

Yersinia enterocolitica, Yersinia pseudotuberculosis Yersiniosis, the illness caused by *Yersinia enterocolitica* and *Yersinia pseudotuberculosis,* is characterized by fever and abdominal pain, often

mimicking an appendicitis. The exact cause of the contamination is not known but the organisms are commonly found in soil and water. It is more common in Northern European and Scandinavian countries and Japan than in the United States.

VIRUSES Viruses are small pathogens that are not a complete cell. They multiply in the living cells of the host but not in cooked food. They are capable of causing diseases in plants, animals, and humans. Viruses can be carried in food and water, but they multiply only in the living cell. They are easily transferred between people and between food and people. In many respects, viruses resemble bacteria in that the right temperature, nutrients, moisture, and pH are necessary for effective growth and reproduction. Examples of human diseases caused by viruses are influenza, poliomyelitis, chickenpox, and hepatitis, some of which have been associated with foodborne outbreaks. Many viruses are inactivated by high temperatures (149°F–212°F) and by refrigeration. Information about viruses that cause foodborne illness is included in Table 8.3.

Norovirus Norovirus is a viral illness caused by poor personal hygiene among infected food handlers (NRA Educational Foundation, 2014). Because it is a virus, it does not reproduce in food but remains active until the food is eaten. It is very contagious and consuming even a small amount can make someone ill. It has been identified as the cause of several incidents of

Table 8-3 Viruses That Cause Foodborne Illness

	Virus		
	Norovirus	**Hepatitis A**	**Rotavirus**
Onset Time	24–48 hours	10–50 days	1–3 days
Duration of Illness	1–3 days	1–2 weeks	4–8 days
Symptoms	Nausea, vomiting, diarrhea, abdominal pain, headache, and low-grade fever	Sudden onset of fever, fatigue, headache, nausea, abdominal pain, jaundice	Abdominal pain, vomiting, diarrhea, mild fever
Source	Humans (intestinal tract), contaminated water	Humans (intestinal tract), contaminated food and water	Humans (intestinal tract), contaminated water
Associated Foods	Raw vegetables, prepared salads, raw shellfish, and water contaminated from human feces	Water, shellfish, salads, ice, cold cuts, fruit and fruit juices, vegetables, milk and milk products	Water, ice, foods that do not have further cooking after handling such as salads, fruits, raw vegetables
Spore Former	No	No	No
Prevention	Use safe food and water supplies, avoid fecal contamination from food handlers by practicing good personal hygiene, thoroughly cook foods, purchase shellfish from reputable suppliers	Obtain shellfish from approved sources, prevent cross-contamination by proper handwashing by employees, use sanitary water sources, exclude food handlers diagnosed with hepatitis A	Use sanitary water sources, prevent cross-contamination by proper handwashing by employees

Source: Based on information from *ServSafe® Coursebook* by the Educational Foundation of the National Restaurant Association, 2014, Chicago, IL: Author and the *Bad Bag Book* by the Center of Food Safety and Applied Nutrition (see www.fda.gov).

foodborne illness on cruise ships, sometimes causing the early return of the ship to port. The Norovirus (formerly known as the *Norwalk virus*) is rapidly increasing as a health threat. Outbreaks have occurred through water contaminated with sewage, raw shellfish harvested from polluted growing areas, and feces of infected food handlers who have not scrubbed their hands after using the toilet and transferred the virus to ready-to-eat foods. The CDC estimates that Norovirus and similar viruses account for more than half of all foodborne outbreaks of gastroenteritis (information from www.cdc.gov, 2014).

Hepatitis A *Hepatitis* is a common disease that affects the liver, causing inflammation. The liver does not function normally and jaundice, yellowing of the skin, results. Hepatitis A, B, and C are the three main types of viral hepatitis. Type A, or infectious hepatitis, is one of the most contagious types and often occurs in children and young adults. It is caused by:

- Drinking polluted water
- Eating food cooked or washed in polluted water
- Eating food contaminated by individuals infected with the Hepatitis virus
- Touching a contaminated cup or eating utensil and then putting hands in the mouth or touching a cut or open sore
- Eating shellfish, clams, mussels, and oysters that live in polluted waters

Consuming even a small quantity of the virus can infect a person. Although infected individuals may not show symptoms for several weeks, they can be very infectious to others prior to showing symptoms themselves.

Rotovirus There are six identified types of rotoviruses; three (Group A, B, C) are known to cause gastroenteritic reactions in humans. They are found in the feces of an infected person and are transmitted to others because of poor hygiene by one person, which results in the contamination of food for another. The most commonly reported cases have been in nursing facilities and day care centers. Ready-to-eat products such as salads, sandwiches, and desserts are common carriers as these products are not cooked after being contaminated.

PARASITES Parasites are living organisms that need a host to survive. They include *Trichinae, Anisakis simplex, Cryptosporidium parvum, Giardia duodenalis* or *G. lamblia,* and *Cyclospora cayetanensis.*

Trichinae Trichinosis is a foodborne disease that affects the muscles of the body and is caused by the Trichinae parasite. Anyone who eats undercooked meat from infected animals can develop trichinosis. Although once common in pork and pork products, improved livestock production practices of using controlled feed rather than allowing pigs to eat garbage has nearly eliminated its existence in pork products. Wild animal meat is the primary sources of trichinella. This disease is preventable, however, if food is cooked to a proper end-point temperature. The USDA Food Safety and Inspection Service recommend that pork be cooked to an end temperature of 160°F.

Anisakis simplex The current popularity of raw seafood dishes, like sushi, sashimi, and ceviche, and undercooked fin fish has introduced a new source of tapeworm and roundworm infestation. *Anisakis,* a form of round worm, can be particularly devastating because the parasite attaches itself to the wall of the digestive organs and requires surgery to dislodge it. Consumption of the *Anisakis* parasite results in an illness termed *anisakiasis.* The *Anisakis* parasite is destroyed by cooking or freezing. The *Food Code* (2013) indicates that fish that is not to be cooked thoroughly must be frozen to –31°F and stored at –4°F or below for 24 hours, frozen to –31°F or below, and stored for 15 hours or frozen to –4°F or below and stored for 168 hours (7 days). In addition, the foodservice operator must keep a record of the process on file for 90 days.

Cyclospora cayetanensis, Cryptosporidium parvum, Giardia duodenalis Several parasites are found in feces of contaminated individuals or contaminated water, including *Cyclospora cayetanensis, Cryptosporidium parvum,* and *Giardia duodenalis (G. lamblia* or *G. intestinalis).* These parasites sometimes are transmitted when improperly treated water is used to irrigate produce and

that produce is not washed properly before eating. Infected individuals also can transmit the parasite to others, if proper handwashing practices are not used.

Cyclospora cayetanensis *Cyclospora cayetanensis* is a microscopic parasite composed of a single cell. *Cyclospora* infection often is found in people who live or travel in developing countries and consume contaminated water or fresh produce washed in contaminated water. Time between becoming infected and showing symptoms usually is a week or longer.

FUNGI Fungi includes single and multicellular organisms such as molds, yeasts, and mushrooms. **Molds** are larger than bacteria and more complex in structure. In general, they grow on a wide range of substrates—moist or dry, acid or nonacid, high or low in salt or sugar. Molds also grow over a wide range of temperatures, although the optimum temperature is between 77°F and 86°F. Because mold growth may appear as highly colored, cottony, powdery, or fuzzy tufts and patches, it is probably the most common type of spoilage that can be identified by the naked eye. Some food products, such as Gorgonzola and blue cheese, have mold as a natural component of the product.

Mold
Multicellular fungi.

Yeasts are not known to cause foodborne illnesses, but they may cause spoilage of sugar-containing foods. They are unicellular plants that play an important role in the food industry, particularly in the fermentation or leavening of beer, wine, and bread. Yeasts can induce undesirable reactions, however, resulting in a sour or vinegary taste.

Yeast
Unicellular form of fungi.

Mushrooms are a type of fungi. Many forms are safe to eat. Some are toxic and can cause foodborne illness if eaten (discussed in the next section).

NATURAL TOXINS Biological contamination can occur from the microorganisms themselves or by the toxins produced from these microorganisms. Fish, shellfish, and mushroom toxins are examples. These toxins cannot be killed by freezing, cooking, or curing; thus, they are passed on to the humans consuming them. Fish toxins include histamine, ciguatoxin, saxioxin, bretoxin, and domoic acid.

Histamine Scombroid poisoning occurs when persons consume scombroid and related species of fish (tuna, mackerel, mahi mahi) that have been time/temperature abused and bacteria on the fish have produced high levels of histamine. This histamine is a toxin that causes allergic reactions such as headache, burning in throat and mouth, reddening of the face and neck, and sweating.

Ciguatoxin, Saxitoxin, Brevetoxin, and Domoic Acid Many species of marine algae contain toxins. The toxins enter fish and shellfish that consume the algae or smaller fish who have consumed the algae and are passed on to humans who consume the fish. Ciguatera fish poisoning occurs with the consumption of *Ciguatoxin* and is found in predatory tropical reef fish such as barracuda, grouper, jacks, and snapper who eat smaller fish who have consumed the algae toxin. *Saxitoxin,* which causes paralytic shellfish poisoning; *brevetoxin,* which causes neurotoxic shellfish poisoning; and *domoic acid,* which causes amnesic shellfish poisoning, can be in shellfish (clams, mussels, oysters, scallops) from contaminated waters (NRA Education Foundation, 2014). These toxins are passed on to humans when infected fish is consumed. None of these fish toxins are destroyed by cooking or freezing, thus purchasing seafood from approved, reputable suppliers is critical to help prevent illness.

Mushroom Toxins There are four categories of mushroom toxins: protoplasmic poisons (amanitin, gyromitrin, orellanine), neurotoxins (ibotenic acid, muscimol, psilocybin), gastrointestinal irritants, and disulfiram-like toxins. These toxins are produced naturally by a variety of types of mushrooms. The toxins cannot be destroyed by cooking or freezing and depending on the type of toxin can cause gastrointestinal distress, neurological impairment, organ failure, and even death. Poisoning by mushroom toxins most often occurs when eating mushrooms found growing in the wild.

PRIONS One of the newest foodborne disease concerns is a group of organisms termed *prions* (PROteinaceous INfectious particle). According to Cody and Kunkel (2002), prion proteins are small glycosylated protein molecules found in brain cell membranes. Prion diseases, often termed *transmissible spongiform encephalopathy* (TSE), are infectious diseases of the brain that can occur in both animals and humans. The disease is termed *bovine spongiform encephalopathy* (BSE) (mad

cow disease) in cattle, *scrapie* in sheep, *chronic wasting disease* in deer and elk, and *Creutzfeld Jakob disease* (CJD) or *Gerstmann Sträussler syndrome* (GSS) in humans. Prions are extremely resistant to heat; heating to 100°C often does not inactivate them. Prion diseases are transmissible between species. The period of time between infection and appearance of clinical symptoms can be years. The disease course in humans includes behavioral changes, ataxia, progressive dementia, and death (Cody & Kunkel, 2002).

Physical Contamination

Physical contamination occurs when particles that are not supposed to be in a food product are accidentally introduced into that product (National Restaurant Association [NRA] Educational Foundation, 2014). Chips of glass or metal from broken glasses or enamelware dishes are obviously dangerous. Metal curls from a worn-out can opener can fall into the food when the can is being opened. Other physical contaminants would include staples from cartons, fingernails or hair, dirt, bones, jewelry, or fruit pits. Dangers caused by physical contaminants may result from tampering incidents, particularly with soft-packed food items. Food items delivered to the foodservice operation should be rejected if evidence of tampering is seen.

Chemical Contamination

Chemical contamination occurs when substances such as chemicals, toxic metals, or sanitizers are introduced into a food product (NRA Education Foundation, 2014). The following are examples of chemical contamination that can occur in a foodservice operation:

- Contamination of food with foodservice chemicals, such as pesticides, detergents, and sanitizers
- Use of excessive quantities of additives, preservatives, and spices
- Acidic action of foods with metal-lined containers
- Contamination of food with toxic metals

Pesticides are chemicals that kill or discourage the growth of pests, which are defined as organisms that cause damage to food, making it inedible, unappealing, or unsafe (Chaisson, Petersen, & Douglass, 1991). Pesticides typically are applied to crops growing in the field but also may be applied after harvest to prevent insect or mold infestation during transport or storage. Much research is being conducted on ways to reduce reliance on applied pesticides.

Integrated pest management (IPM) is an alternate approach being used in agriculture to control pests; it is also a program in foodservice operations to prevent pests from entering an operation or to eliminate them if they do enter. In agriculture, IPM incorporates the latest agricultural technologies and biological controls, including pest predators and pest diseases, to decrease the amount of pesticide used. The USDA and FDA are responsible for monitoring the food supply to ensure that residue levels are within tolerance limits.

In a foodservice operation, IPM involves preventing pests' access to the operation; eliminating sources of food, water, and nesting places for pests within an operation; and working with a licensed Pest Control Operator (PCO) to eliminate pests if they do enter the operation. The most common pests in a foodservice operation are cockroaches, rodents (mice, rats), flies, and fruit flies. Cockroaches live and breed in moist, warm, dark places, so often they are only seen by the signs they leave behind, such as a strong oily smell, droppings that look like grains of pepper, and/or capsule-shaped egg cases. Rodents, too, are often not seen, as they tend to live in holes in quiet places. Signs of rodent infestation include signs of gnawing, shiny black droppings, tracks on dusty surfaces, and nesting materials.

Flies are a greater menace to human health than cockroaches. They transmit foodborne illnesses because they feed on human and animal wastes and garbage. Flies enter the facility primarily through outside doors or other external openings. Control can be facilitated by having tight-fitting and self-closing doors, closed windows, and good screening. Screened or closed storage for garbage is also important. Control, however, should be handled by a licensed PCO. Fruit flies are small, flying insects usually congregating around food. They typically breed in warm, moist areas such as floor drains. A licensed PCO can help with their control (NRA Education Foundation, 2014).

Foodservice chemicals, including detergents, polishes, caustics, and cleaning and drying agents, are poisonous to humans and should never come in contact with food. Labels should be read carefully for directions on how to use and store these products under safe conditions away from food.

Preservatives used to preserve the flavor, safety, and consistency of foods have been linked to food contamination. *Additives,* which are used to enhance appearance and/or flavor of products, also can become a chemical contaminate if used in excess or if given to someone with a sensitivity or allergy to the product. Several preservatives and food additives, when used in excessive amounts, have caused illness.

Nitrites, for example, are preservatives used by the meat industry to prevent growth of certain harmful bacteria and as a flavor enhancer (NRA Educational Foundation, 2004). Scientists have established a link between cancer and nitrites when meat containing them is overbrowned or burned. As a result, the meat industry has decreased levels of nitrites in meats.

In the 1980s, a number of food-related illnesses, allergic in type, were traced to sulfites used on fresh fruits and vegetables, shrimp, dried fruit, and wine. For packaged foods, if sulfites are used, proper labeling now is required. Foodservice operators now use lemon juice or citric acid for preserving color in fresh produce as the FDA prohibits the use of sulfites on raw fruits and vegetables that are to be served or sold to customers.

One foodborne illness that remains in question is that which can result from the use of too much monosodium glutamate (MSG), a food additive that serves as a flavor enhancer. Because it is often heavily used in Chinese and Japanese foods, apparent reactions to MSG have been called the "Chinese Restaurant Syndrome." MSG also is very high in sodium. Most of the symptoms after ingestion are subjective. They include a feeling of tightening of the face and neck skin, tingling sensations, dizziness, and headache. MSG apparently affects only persons with sensitivity to MSG (Cody & Kunkel, 2002). Federal law requires that MSG be listed on the label of any product to which it is added.

Food irradiation is classified as a food additive and is regulated by the FDA. It controls microbes responsible for foodborne illness and extends the shelf life of refrigerated foods, such as fresh fruits and vegetables, by delaying ripening. It also extends the shelf life of stored foods like spices and dried herbs.

A **food allergy** is the body's immune system reaction to certain foods. Symptoms of an allergic reaction include itching or swelling in or around the mouth, face, and scalp; tightening in the throat; wheezing or shortness of breath; hives; abdominal cramps, vomiting or diarrhea; loss of consciousness; and even death. (NRA Education Foundation, 2014). Food allergens are primarily protein in nature. Some of the most common food allergens include peanuts and treenuts, milk and dairy products, eggs, shellfish, wheat, and soy. According to physicians at the Mayo Clinic (www.mayoclinic.com) food allergies affect 6 to 8% of young children and about 4% of adults. Labeling of foods with these allergens, having waitstaff be able to describe ingredients, and avoiding cross-contamination in food production areas will help reduce the chance of allergic reactions by customers.

Food allergy
Body's immune system reaction to certain foods.

Chemical contamination can occur when high-acid foods are prepared or stored in metal-lined containers. Poisoning may result if brass or copper, galvanized, or gray enamelware containers are used. Fruit juices should never be stored in enamelware coated with lead glaze or tin milk cans. Cases of poisoning have been recorded that are attributed to use of improper metal utensils. Sauerkraut, tomatoes, fruit gelatins, lemonade, and fruit punches have been implicated in metal poisonings.

Toxic metals also have been implicated in food poisoning cases. Copper may become poisonous when it is in prolonged contact with acid foods or carbonated beverages. The vending industry voluntarily discontinued all point-of-sale carbonation systems that do not completely guard against the possibility of backflow into copper water lines (backflow may dissolve the copper). Also, food such as meat placed directly on cadmium-plated refrigerator shelves may be rendered poisonous.

Foodservice Operational Practices to Assure the Safety of Food

The ultimate goal of a foodservice manager is to assure that a safe food product is served to customers to protect them from foodborne illness. The role of the foodservice manager is to take responsibility for purchasing, producing, and serving safe food to customers and for training employees on a continual basis.

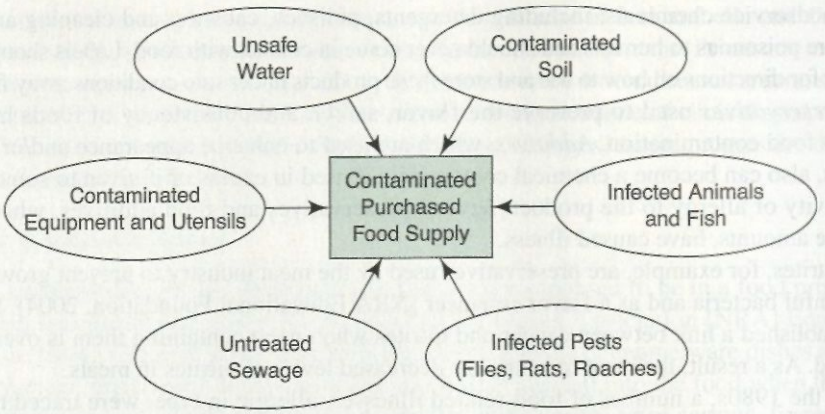


FIGURE 8-5 Sources of contamination of purchased food supply.

Control of the safety of food must focus on the food itself; the people involved in handling food, either as employees or customers; and the facilities and equipment. The legal fees, medical claims, lost wages, and loss of business associated with foodborne illness can be overwhelming (NRA Educational Foundation, 2004).

FOOD SAFETY IN FOOD PURCHASING Possibilities for contamination of food before it is purchased include contaminated equipment, infected pests and animals, untreated sewage, unsafe water, and soil, as shown in Figure 8-5. After purchase, possibilities of contamination exist in storage, preparation, and service of food. Following human consumption, illness occurs. Figure 8-6 illustrates the possible transmission routes from infected persons through respiratory tract discharges, open sores, cuts, and boils, or through hands soiled with feces into food being prepared. The consumed food then completes the transmission to other persons.

The USDA's Economic Research Service (www.ers.usda.gov) reports that imports are very common in the American diet. In 2013, nearly $105 billon in food was imported into the United States. Nearly 70% of all the fish and shellfish consumed in the United States in 2012 were imported, as were 35% of fruits and nuts, 20% of vegetables, and 10% of red meat. Imported foods, particularly produce, have been linked to a growing number of foodborne illness outbreaks. Foodservice operators can avoid potentially contaminated food items by using reputable producers and suppliers, who should comply with growing and transportation standards set by the Produce Marketing Association.

Food should be purchased from approved, reputable suppliers. Foodservice managers should visit and inspect the vendor's facilities to assure they are using Good Manufacturing Practices (GMP) or Good Agricultural Practices (GAP).

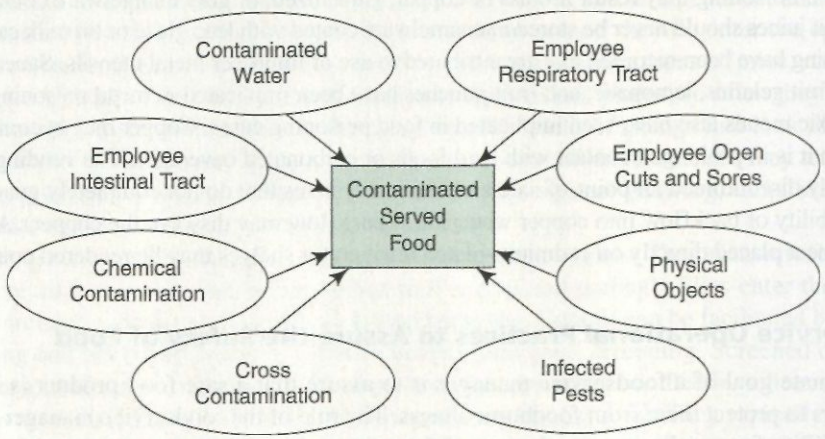


FIGURE 8-6 Sources of contamination of served food.

FOOD SAFETY IN RECEIVING AND STORAGE Food safety starts in the receiving area of a foodservice operation. Deliveries should be made in off-peak hours to allow sufficient time to inspect deliveries carefully. Both the temperature and condition of packaging should be inspected at delivery. Food safety criteria to check in receiving include (NRA Education Foundation, 2006, 2010):

- **Meat.** 41°F or below; bright red color; firm, nonslimy texture; no odor; intact and clean packaging
- **Poultry.** 41°F or below; no discoloration; firm; no odor; frozen or packed in crushed, self-draining ice
- **Fish.** 41°F or below; bright red gills and bright shiny skin; firm flesh; mild ocean or seaweed smell; bright, clear full eyes; frozen or packed in crushed, self-draining ice
- **Shellfish.** Live on ice or at temperature of 45°F or below; shucked at internal temperature of 45°F or below; mild ocean or seaweed smell; unbroken shells; closed shells if alive; shellstock identification tags (packer's name, address, and certification number) on container (manager must date when the last shellfish was served and then keep tags on file for 90 days from date)
- **Shell eggs.** Temperature of 45°F or below; no odor; clean and unbroken shells
- **Liquid, frozen, dried eggs.** Must be pasteurized and have a USDA inspection mark
- **Dairy.** Temperature of 41°F or below; milk must be pasteurized and comply with FDA Grade A standards; cheese with typical flavor, texture, and uniform color
- **Canned goods.** Can and seal in good condition (no swollen ends, leaks, dents)
- **Dry goods.** Intact packaging (no holes, tears, punctures, water stains)
- **Produce.** Temperature of 41°F or below for fresh cut greens, melons, tomatoes, or other processed produce

Cold chain management, temperature control throughout the supply chain delivery process, has become increasingly important in the foodservice industry. The focus is on maintaining a temperature-controlled environment throughout the distribution and storage stages of a food product. Cold chain management would involve, for example, tracking the temperature of meat from the time it was initially processed at a meat packing plant through storage and transportation until it reached the foodservice operator to ensure that the temperature of the product was maintained at acceptable levels throughout the supply chain stages. This often involves use of refrigerated or frozen trucks, insulated containers, temperature data logger devices, and closely monitored conditioned storage units in warehouses.

Cold chain management
Temperature control throughout the supply chain delivery process of perishable foods.

Food safety during storage of food is another area of concern for the foodservice manager. Proper storage temperatures were discussed in Chapter 5. Proper storage practices should prevent **cross-contamination**, the transfer of microorganisms from one food product to another, by storing raw meat, poultry, and fish separate from cooked and ready-to-eat foods. Raw poultry should go on the lowest shelves. Raw ground meat should be placed on shelves above raw chicken but under raw whole meats and fish. Raw meats should be placed above raw poultry and raw ground meat but under cooked and ready-to-eat foods. Ready-to-eat foods and cooked food items should be placed on upper shelves above any raw meat, fish, or poultry. Wrapping food correctly can reduce risk of cross-contamination in the storage units.

Cross-contamination
Transfer of microorganisms from one food product to another.

Foods placed into storage should be labeled and dated, rotated to facilitate use of oldest product first, stored in shelving that is at least six inches off the floor, and held at the proper temperature. Food items should be stored in durable, leakproof containers that are intended for food use. Food should never be stored in empty chemical containers or in plastic garbage bags. Chemicals need to be stored separately from food products.

FOOD SAFETY IN PRODUCTION AND SERVICE Safety of the food supply during production and service needs to focus on food products and how they are handled. Also of importance are the hygiene and practices of employee and cleanliness of facilities and equipment.

Relationship of Time and Temperature Many of the foodborne illness outbreaks are caused by inadequate cooking and improper holding of food (see www.cdc.gov). Minimum, maximum, and optimum temperatures vary for the various pathogenic microorganisms; in general, however, they flourish at temperatures between 41°F and 135°F (Figure 8-7). This temperature range is

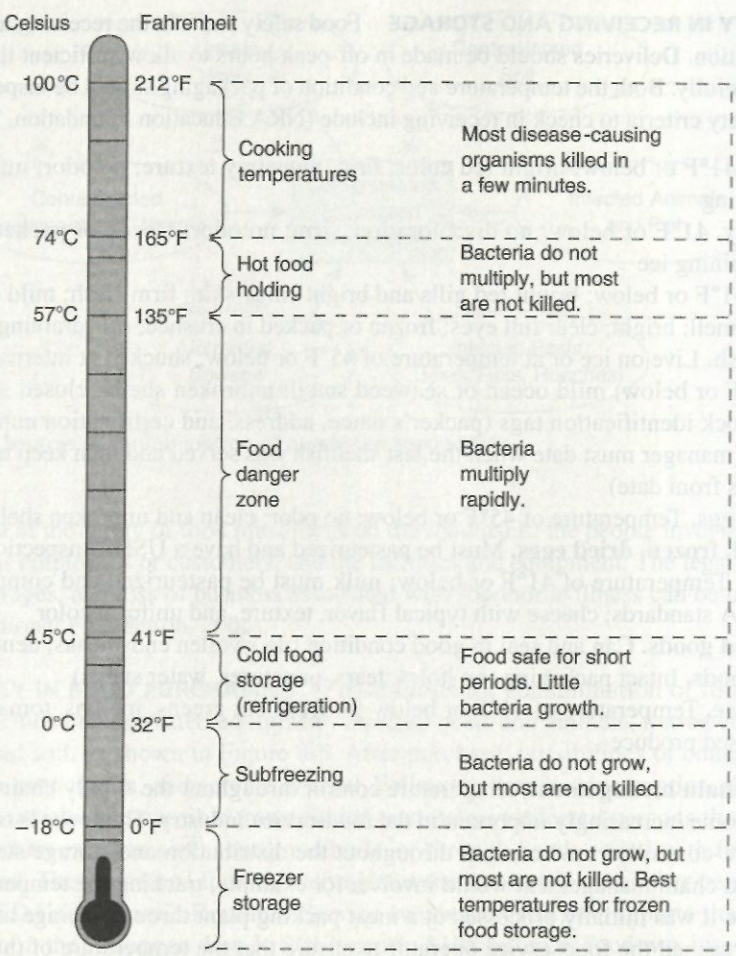


FIGURE 8-7 Important temperatures in sanitation and food protection. *Source:* Adapted from *Keeping Food Safe to Eat,* Home and Garden Bulletin No. 162, 1970, Washington, DC: U.S. Department of Agriculture. Revised based on *Food Code 2013.*

Temperature danger zone
Temperature range (41°F to 135°F) in which bacteria multiply rapidly.

commonly called the **temperature danger zone** because bacteria multiply rapidly within it. The *Food Code* (2013) indicates that TCS foods, termed *time/temperature control for safety (TCS)* food, should be cooled within 2 hours from 135°F to 70°F; and within 6 hours from 135°F to 41°F or less (www.fda.gov). Safe temperatures, then, as applied to TCS food, are those of 41°F and below and 135°F and above.

Cross-Contamination Cross-contamination can occur in production and service when improper food-handling practices are used. Cross-contamination can occur from the following actions:

- Using a cutting board to cut raw meats and then not cleaning and sanitizing it properly before using that same cutting board to cut produce
- Handling raw meat or poultry and then not washing hands appropriately before handling ready-to-eat products

Employee Hygiene and Practices Employee personal hygiene and good food-handling practices are basics of a food safety program in a foodservice facility. One major risk is that unsanitary employees can contaminate, or infect by bacteria, food products in production and service (Beasley, 1993). When interviewing prospective employees, managers should note their personal grooming habits and appearance. Employees who practice poor hygiene at home and at work can be the cause of outbreaks of foodborne illnesses. Foodservice managers, therefore, should emphasize the importance of food safety and sanitation to employees before hiring and then after hiring, when an educational process should begin.

A foodservice employee personal hygiene program should include three major components: maintaining personal cleanliness, wearing proper work attire, and following hygienic hand practices (NRA Education Foundation, 2013). Personal cleanliness involves proper bathing and hair washing. Proper work attire includes using proper hair restraints, having clean and appropriate clothing, wearing proper shoes (closed toed, nonskid soles), removing aprons when leaving work areas, and removing jewelry. Because the most critical aspect of personal cleanliness is frequent and thorough handwashing, proper methods should be emphasized in training programs. Although regulations vary in local areas, most indicate that fingernails should be short and clean, false fingernails and nail polish cannot be used, and cuts or wounds on hands need to be covered with clean bandages and finger cots or gloves. Using gloves can give a false sense of security because the food handler might not change the gloves after handling a contaminated product, resulting in cross-contamination of other products. Many local regulations stipulate that ready-to-eat foods cannot be handled with bare hands, requiring use of serving utensils or gloved hands. Because saliva can contain pathogens, employees should not be allowed to eat, drink, smoke, or chew gum or tobacco when preparing or serving food or cleaning work areas or equipment. Managers need to conduct daily inspections of all employees to ensure that proper sanitation practices are being followed.

Customer Controls Control of contamination from customers is more difficult, but various aspects of facility design or policies and procedures can assist in this arena. Sneeze guards on a service counter or salad bar can help reduce the spread of bacteria as can isolation procedures for a patient hospitalized with a highly communicable disease.

Maintaining the safety of food served to customers from salad bars can be challenging. Customers often spill food around or in other containers. Observations have been reported of poor sanitation practices such as customers using fingers to pick up items or to dip into the salad dressing to taste it or returning with an already eaten from plate for refills. Sneeze guards are provided with salad bars to help reduce the chance of contamination; however, depending on the configuration of the salad bar, customers may place heads under the sneeze guards to better see and choose items.

Facilities and Equipment Proper cleaning of food production and service surfaces and equipment is an important component of any food safety program. The *Food Code* (2009) stipulates that room temperature food contact surfaces used in the preparation of TCS foods need to be cleaned at least every 4 hours.

Food Safety Programs

A well-designed food safety program monitors all food production activities for errors in handling and eliminates those errors. Critical control points (CCPs) must be identified, standard operating procedure put in place, and a Hazard Analysis Critical Control Point (HACCP) model selected.

Although the FDA publishes the *Food Code* as a guideline for food safety practices, individual health departments set the sanitation policies and procedures for their jurisdiction.

HAZARD ANALYSIS CRITICAL CONTROL POINT MODEL The **Hazard Analysis Critical Control Point (HACCP)** concept refers to a model developed initially for quality control in the food processing industry, with special emphasis on microbial control. Critical control points are those steps in production processing in which loss of control would result in an unacceptable safety risk. HACCP is a preventive approach to quality control, identifying potential dangers for corrective action.

Hazard Analysis Critical Control Point (HACCP)

Systematic analysis of all process steps in the foodservice subsystems, starting with food products from suppliers and ending with consumption of menu items by customers.

The HACCP program was developed in 1971 for the National Aeronautics and Space Administration (NASA) to be sure food fed to astronauts in outer space is absolutely safe. The system had to ensure zero defects in handling food during processing. It had to correct errors before they happened rather than sample finished products to identify those with high levels of contamination (Dulen, 1998).

The original HACCP model was modified for use in foodservice operations by Bobeng and David (1978) to include not only microbiological but also nutritive and sensory quality. They applied the model to quality control of entrée production in conventional, cook-chill,

and cook-freeze hospital foodservice operations. HACCP models were developed during three phases: selection of control points, using flow diagrams; identification of critical control points; and establishment of monitors for control.

In 1988, the National Advisory Committee on Microbiological Criteria for Foods (NACMCF) was formed to provide guidance and recommendations to the Secretary of Agriculture and the Secretary of Health and Human Services regarding the microbiological safety of foods. The NACMCF, an advisory committee chartered under the U.S. Department of Agriculture, includes participants from the USDA (Food Safety and Inspection Service), the Department of Health and Human Services (U.S. Food and Drug Administration and the Centers for Disease Control and Prevention), the Department of Commerce (National Marine Fisheries Service), the Department of Defense (Office of the Army Surgeon General), academia, industry, and state employees. In November 1992, NACMCF defined seven widely accepted principles to consider when developing a HACCP plan:

- Principle 1: Conduct a hazard analysis.
- Principle 2: Determine the critical control points.
- Principle 3: Establish critical limits.
- Principle 4: Establish monitoring procedures.
- Principle 5: Establish corrective actions.
- Principle 6: Establish verification procedures.
- Principle 7: Establish recordkeeping and documentation procedures.

Hazard

Unacceptable contamination of food.

Critical control points

Locations in the food product flow where mishandling of food is likely to occur.

At each step in the flow of food through operation, risk, which is a chance that a condition in foodservice will lead to a hazard, can occur (Spears, 1999). A **hazard** is considered an unacceptable contamination. As risks are determined, managers need to identify **critical control points**, defined as a step or procedure in a foodservice process at which control can be applied and a food safety hazard can be prevented, eliminated, or reduced to acceptable levels. The objective is to identify the points during the production process where food is most likely to be contaminated (Dulen, 1998).

Having a HACCP program in place is required by federal agencies, accrediting bodies, or local health departments for many foodservice operations. The USDA (2005), the National Restaurant Association (2004), the Institute of Child Nutrition (2002), and the Iowa State University (ISU) HACCP Information Center (www.extension.iastate.edu/foodsafety/HACCP) have developed manuals and materials to help foodservice managers develop HACCP plans and procedures for their foodservice operations.

According to the ISU HACCP Information Center, the basis of a strong HACCP program is having the necessary prerequisite programs in place. Those prerequisite programs include:

- Sanitation standard operating procedures
- Quality management
- Employee education and training
- Personal hygiene
- Safe food-handling and storage practices
- Temperature monitoring
- Specifications and suppliers
- Food recalls and disaster plans
- Equipment monitoring and calibration
- Preventative maintenance programs
- Integrated pest management

Standard Operating Procedures (SOPs)

Written, step-by-step instructions for routine tasks.

One of the prerequisite programs is documentation of **Standard Operating Procedures (SOPs)**. SOPs are written, step-by-step instructions for routine tasks. SOP checklists and samples can be found at the online ISU HACCP Information Center. An example of an SOP for handwashing is included in Figure 8-8.

In a HACCP program, temperatures must be monitored and recorded. Placing deep containers of hot foods, especially soups and stocks, in refrigeration units is one of the most often-cited cases of food safety risk. Not only does hot food not reach recommended safe temperatures within the specified time frame, but the heat from the containers can raise the

School District: _____
Department: _____
Policy No: _____

Standard Operating Procedure

Handwashing

Policy: All food production personnel will follow proper handwashing practices to ensure the safety of food served to children.

Procedures: All employees in school foodservice should wash hands using the following steps:

1. Wash hands (including under the fingernails) and forearms vigorously and thoroughly with soap and warm water (a temperature of at least 110°F is required) for a minimum of 20 seconds.
2. Wash with soap—either liquid or powder soap.
3. Use a sanitary nail brush to get under fingernails.
4. Wash between fingers thoroughly.
5. Use only hand sinks designed for that purpose. Do not wash hands in sinks in the production area.
6. Dry hands with single use towels or a mechanical hot dryer. (Retractable cloth towel dispenser systems are not recommended.) Turn off faucets in a sanitary fashion using a paper towel in order to prevent recontamination of clean hands.

The unit supervisor will:

1. Monitor all employees to ensure that they are following proper procedures.
2. Ensure adequate supplies are available for proper handwashing.
3. Follow up as necessary.

Policy last revised on: _____

FIGURE 8-8 Example of a standing operating procedure for handwashing.
Source: www.iowahaccp.iastate.edu/sections/foodservice.cfm.

temperatures in refrigerators. Hot foods should be put into shallow pans before refrigeration to speed the cooling. Blast chillers can help reduce very quickly the temperature of these foods. Results of study on cooling confirm these recommendations. Olds and Sneed (2005) found that a 3-gallon pot of chili placed in a walk-in refrigerator took more than 24 hours to cool from 135°F to 70°F (Olds & Sneed, 2005). When hot chili was placed in a 2-inch pan in the walk-in refrigerator, it cooled from 135°F to 70°F in 7 hours. A 2-inch pan of chili cooled in a blast chiller dropped from 135°F to 70°F in less than 2 hours.

After determining the critical control points, methods have to be established to avoid breakdowns in those problematic areas. Monitoring must be in place to make sure the controls are working successfully. Detailed recordkeeping, such as temperature checks, also is part of the HACCP, as is verification of cleanliness (e.g., conducting laboratory tests for bacteria). The HACCP program requires a lot of recordkeeping, which may present challenges for small operations. HACCP implementation does not eliminate the risk of foodborne illness. Contamination problems may be reduced, but the possibility of mishandling food remains real throughout the food chain.

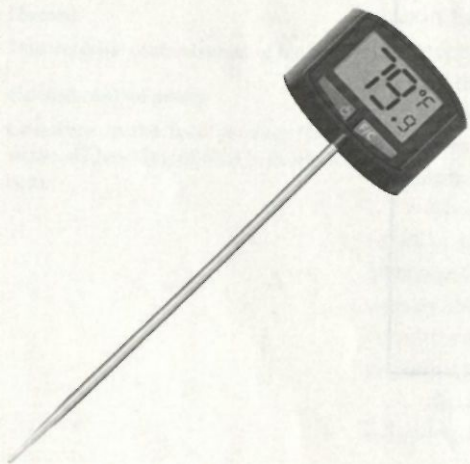
By charting the flow of food through the operation, points can be identified where contamination or growth of microorganisms can occur. Often similar food items (like cold meat sandwiches or cream soups) can be grouped together under one HACCP plan as they will follow the same flow through the operation and have the same CCPs. Implementation of HACCP

programs is responsible for making thermometers more sophisticated than they have ever been. The same thermometer often was used for finding out the temperature in a refrigerator or an oven, and results were seldom analyzed. Currently, thermometers are becoming very specialized; for example, some models are designed for ovens, deep fat fryers, and coffee. All TCS foods should be prepared according to specific HACCP guidelines. The minimum number of thermometers needed in a foodservice operation are the bimetallic stemmed or digital pocket test, refrigerator/freezer/dry storage, hot holding, and meat thermometers shown in Figure 8-9. The third one, called the HACCP Manager, is an electronic device for recording and transmitting temperature, time, and location for any food preparation process that requires accurate recordkeeping; a downloading feature allows the user to graph and chart data to review and analyze for corrective action or required recordkeeping. A newer option is infrared thermometers. These thermometers are not inserted into food; rather they use infrared technology to measure the temperature of the food on the surface.

Calibrate

Process to assure temperature testing equipment is providing an accurate temperature reading.

The bimetallic stemmed thermometer is the most commonly used thermometer. It has a dimple on the stem indicating the length of thermometer that needs to be inserted in a food product to get an accurate temperature reading. The accuracy of the stemmed thermometer must be checked and recalibrated as needed on a regular basis. The easiest way to **calibrate** it is to place the thermometer in a glass of ice water for at least 30 seconds. If the thermometer is not reading 32°F, the calibration nut under the indicator head should be held with a wrench and the indicator head rotated until it reads the correct temperature.



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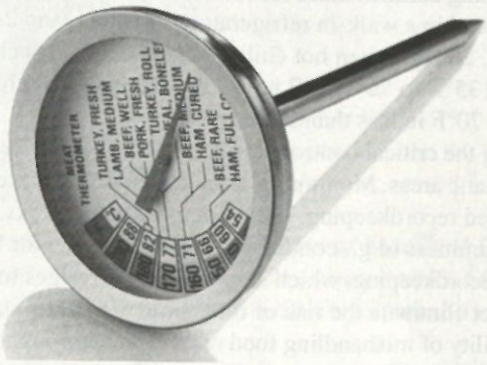
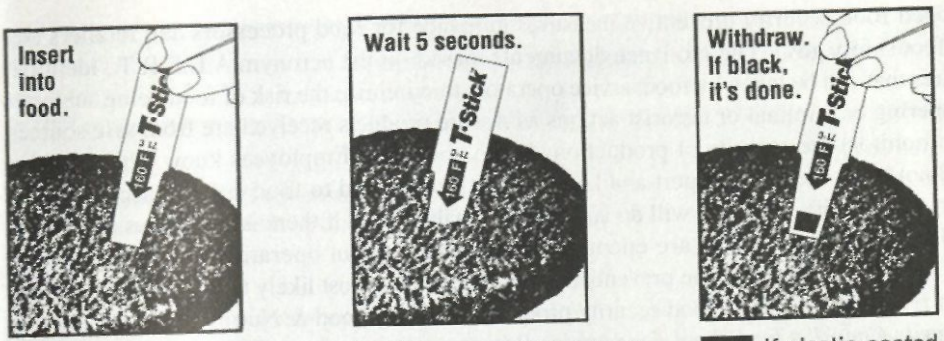
HACCP Manager Kit, Cooper-Atkins, used by permission.

Jo De Vulder/Shutterstock



Milos Luzanin/Shutterstock

FIGURE 8-9 Foodservice operations thermometers. *Source:* Cooper-Atkins. Used by permission.



1 Insert white plastic-coated end of T-Stick into the center of the hamburger to be tested. **Do not remove the protective plastic coating. Wait 5 seconds.**

2 Remove T-Stick from hamburger. If plastic-coated end has turned black, temperature of food has reached 160°F (71°C). T-Stick can be discarded.

3 If plastic-coated end still white, food has not yet reached 160°F (71°C). Cook further and repeat steps 1 and 2, using the same T-Stick in the same hamburger.

FIGURE 8-10 Monitoring the temperature of hamburgers with a T-Stick 160 while cooking.
Source: ECOLAB®. Used by permission.

Many foodservice operations have supplemented the use of thermometers with a disposable product called *T-Sticks*. T-Sticks are multipurpose sensor sticks used to monitor food temperatures and the temperature in the dishwasher's final rinse section. They help promote food safety in restaurants and other foodservice operations. They are relatively inexpensive, and employees who might not take the time to track down a thermometer find them easy to use. T-Stick 140 Plus is used for monitoring food temperatures on hot lines or steam tables; food must be held at 140°F or higher to stop growth of harmful bacteria. It turns green at 142°F to 144°F for a margin of safety. T-Stick 160 monitors the cooking temperature of hamburger, ground meat, fish, pork, and eggs and verifies temperatures in the final rinse section of the dishwashing machine. It turns black if the temperature reaches 160°F. An illustration of how to use the T-Stick 160 for cooking hamburgers is shown in Figure 8-10. T-Sticks also are used to check the final rinse temperature in a dishmachine by attaching the T-Stick to a plate and sending it through the dishmachine.

The Iowa HACCP Web site (www.extension.iastate.edu/foodsafety/HACCP) contains a variety of resources to help a foodservice manager develop a HACCP program. Included is a case study detailing the process in a school, SOPs, forms for monitoring temperatures, and employee training materials.

BIOTERRORISM The terrorist attacks in the United States on September 11, 2001 prompted legislation and changes in operational practice to better protect the U.S. food supply. Congress passed and President Bush signed into law on June 12, 2002 the Public Health Security and Bioterrorism Preparedness and Response Act of 2002 (the Bioterrorism Act). Title III of the act focuses on protecting the safety and security of the food supply. **Bioterrorism** is the intentional use of biological agents or germs to cause illness. A U.S. Department of Homeland Security was formed as part of the Homeland Security Act of 2002 in part to help reduce the vulnerability of the United States to terrorist attacks. The nation's food and water were identified as potential targets for terrorist attacks.

Bioterrorism
Intentional use of biological agents or germs to cause illness.

In September 2005, the Department of Homeland Security (DHS), U.S. Department of Agriculture, Food and Drug Administration, and the Federal Bureau of Investigation (FBI) began collaborations with private industry and the states in a joint initiative termed the *Strategic Partnership Program Agroterrorism (SPPA) Initiative,* which is designed to protect the nation's food supply.

A number of organizations have developed food biosecurity guidelines for foodservice operations. The National Restaurant Association (NRA Education Foundation, 2014) encourages foodservice managers to have a food defense program that addresses points in the operation where food is at risk for tampering. The FDA Center for Food Safety and Applied Nutrition

developed food security preventive measures guidance for food processors and retailers (see www.foodsafety.gov). The guidance documents, based on the acronym A.L.E.R.T., identifies measures that can be taken by foodservice operators to minimize the risk of food being subjected to tampering or criminal or terrorist actions as **A**ssure products received are from safe sources, **L**ook (monitor) the security of productions in the operation, **E**mployees know who should or should not be in the area, **R**eport and keep information related to food defense accessible and **T**hreat, and identify what you will do and who you will contact if there is suspicious activity.

Foodservice operators are encouraged to implement an operations risk management (ORM) process to prioritize the preventive measures that are most likely to have the greatest impact on reducing the risk of food security problems. USDA's Food & Nutrition Service released *Biosecurity Checklist for School Foodservice Programs: Developing a Biosecurity Management Plan* (2004) to assist school foodservice directors with their food biosecurity planning. The Association of Nutrition & Foodservice Professionals (www.anfponline.org) offers the following suggestions for food protection:

- Awareness—be alert to unusual activity in and around your operation
- Procurement—use reputable suppliers and inspect deliveries carefully
- Access—control access to foodservice operation
- Personnel Management—screen applicants carefully and document, post, and enforce employee schedules
- Monitoring—observe employees and customers and check less used areas
- Planning—have detailed response plans in place that include call lists
- Education—educate employees on the role they need to play in helping monitor and report unusual occurrences

Procedures for Complaints

No foodservice manager is immune to outbreaks of foodborne illness (Cheney, 1993). A cook might fail to heat up the grill to the correct temperature, a refrigerator might break down, employees might forget to wash their hands before cutting meat or produce, and a supplier might deliver a contaminated product. Customers who believe their health has been harmed by food eaten in the foodservice establishment have a right to take the manager to court (NRA Educational Foundation, 1995). The customer might have a legitimate grievance, and managing this crisis correctly could be difficult.

When someone complains of foodborne illness, it is best practice to have that person complete a complaint report similar to the one shown in Figure 8-11. This will ensure that the right questions are asked even if the business is hectic at the time. Cheney (1993) suggested the following steps for receiving a complaint:

- Obtain all the pertinent information including the names and addresses of all party members, the employee who served the meal, the date and time of the customer's visit, and the suspect meal.
- Remain concerned and polite, but do not admit liability or offer to pay medical bills.
- Never suggest symptoms, but let the complainant tell his or her own story.
- Record the time that the symptoms started, which will help in identifying the disease and determining the foodservice operation's responsibility.
- If possible, try to get a food history of all the meals and snacks eaten before and after the person ate the suspect meal.
- Never offer medical advice; gather information but do not interpret symptoms.

All foodservice operations should have a crisis management plan in place for handling food safety complaints. Figure 8-12 details steps for developing a crisis plan.

SANITATION

A properly designed foodservice facility is basic to maintain a high standard of sanitation. The first requirement for a sanitary design is cleanability, which means the facility has been arranged so that it can be cleaned easily. Equipment and fixtures should be arranged and designed to

Foodborne Illness Complaint Form

Date: _____ Person Completing Report: _____

Complainant Contact Information:
(name, address, phone numbers, e-mail address)

Foods Eaten and Time Consumed:

Description of Symptoms and Timing of Onset:
(nausea, diarrhea, vomiting, dizziness, fever, headache, blurred vision, abdominal cramps)

Medical Treatment Obtained:
(name of doctor, hospital, contact information)

Agencies Notified:
(name of agency, contact, and contact information)

FIGURE 8-11 Foodborne illness complaint report.

comply with sanitation standards, and trash and garbage isolated to avoid contaminating food and attracting pests.

For a facility to be clean is not enough; it must also be sanitary. Although the two words are often used synonymously, **clean** means free of physical soil and organic matter (Fraser & Pascal, 2010). These objects may look clean on the surface but may harbor disease agents or harmful chemicals. **Sanitary** means "the application of cumulative heat or chemicals on cleaned food contact surfaces that, when evaluated for efficacy, is sufficient to yield a reduction of 5 logs, which is equal to a 99.999% reduction, of representative disease microorganisms of public health importance" (*Food Code*, 2013). Cleaning and sanitizing are both issues of concern in the maintenance of foodservice facilities and equipment, and together they form the basis for good housekeeping in foodservice operations. Any surface (counters, utensils, equipment) in a foodservice operation that touches food must be cleaned, rinsed, sanitized, and allowed to air dry. Several factors will affect the cleaning process.

Clean
Free of physical soil and with an outwardly pleasing appearance.

Sanitary
Free of disease-causing organisms and other contaminants.

- Type and condition of dirt—certain types of dirt require special cleaning methods
- Water hardness—cleaning is more difficult with hard water as the minerals in the water react with the cleaning detergent and decrease its effectiveness
- Water temperature—hot water aids in dissolving detergent and loosening dirt
- Surface to be cleaned—some surfaces require special cleaning supplies and techniques
- Agitation or pressure—additional pressure may be needed to remove dirt
- Length of treatment—longer exposure to detergent makes cleaning easier

Steps to Developing a Food Safety Crisis Management Plan

1. Assemble a team of managers and employees to develop the plan.
2. Put together a list of emergency names and contact numbers and post it by the phone.
3. Clearly identify who will be in charge of managing the crisis and who will be the official spokesperson for the foodservice operation.
4. Develop a step-by-step plan of action that includes completing a foodborne illness complaint form, saving samples of the suspected food, alerting appropriate managers and employees, and contacting the local health department inspector.
5. Develop a list of questions and answers for the media.
6. Develop a media crisis kit that includes a sample press release, a list of internal and external media contacts, and a list of do's and don'ts when dealing with the media.
7. Be sure your spokesperson is truthful and professional when communicating with the media.
8. Include instructions on communicating with your employees. Provide them with information on their role in the situation and dealing with the media.
9. Assemble all information in a notebook and keep it in a location for ease of use.
10. Test out the plan by running a simulation.

FIGURE 8-12 Developing a crisis management plan for outbreaks of foodborne illness.
Source: Adapted from *Food Safety Illustrated*, Vol. 1, Issue 1, Winter 2001.

Cleaners are chemicals that are used remove food, dirt, and other deposits. Four types of cleaners are commonly found in foodservice operations (NRA Education Foundation, 2013):

- Detergents—used to remove dirt from surfaces (floors, walls, counters, equipment)
- Abrasive cleaners—contain abrasive agent(s) to help more difficult to remove dirt
- Degreasers—used to remove grease from surfaces (ovens, grills, hoods)
- Delimers—used to remove mineral deposits (dishmachines, steam wells)

Sanitization is critical for any surface that comes in contact with food, which includes, of course, all dishes, utensils, pots, and pans. Sanitizing can be done using heat or chemical sanitizers.

Some sanitizing agents are toxic to humans as well as to bacteria and are, therefore, acceptable for use only on nonfood contact surfaces. Other agents may not be toxic but may have undesirable flavors or odors, which make them unacceptable for use in foodservice operations. The three most common chemicals used in sanitizing in foodservice operations are chlorine, iodine, and quaternary ammonia. Table 8-4 summarizes the properties of these sanitizers and outlines procedures for their use.

A sanitizer's effectiveness is impacted by the concentration of the sanitizer, the hardness, temperature, and pH of the water, and the contact time on a surface. Chemical sanitizers are regulated by the Environmental Protection Agency (EPA).

Cleaning and sanitizing chemicals should be stored in their original containers in an area separate from food preparation. If they are transferred to another container, that container must be clearly labeled with the information about the product.

Material safety data sheets (MSDS)
Sheet with use and safety information about a chemical.

Material Safety Data Sheets (MSDS) with information about each chemical must be readily available to foodservice employees. OSHA mandates that chemical manufacturers provide an MSDS with each chemical that lists identity and physical property information about the chemical, precautions for safe handling and use, physical and health hazards, emergency and first-aid information, when the MSDS sheet was prepared, and contact information of the manufacturer.

Sanitation in Receiving and Storage

The receiving area should be designed for ease in cleaning. The floor should be of material that can be easily scrubbed and rinsed and have adequate drains and a water connection nearby to permit hosing down the area. Storage for cleaning supplies should be located conveniently.

Table 8-4 Chemical Sanitizing Agents

	Chlorine	Iodine	Quaternary Ammonium
Minimum concentration, temperature, and time	50–99 ppm at ≥ 100°F/(38°C) for ≥7 seconds	12.5–25 ppm at 68°F/(20°C) for 30 seconds	As per manufacturer's recommendations
pH (detergent residue raises pH of solution so rinse thoroughly first)	≤8.0 if water temp 75°F/(24°C); ≤10 if water temp 100°F/(38°C)	≤5.0	As per manufacturer's recommendations
Corrosiveness	Corrosive to some substances	Noncorrosive	Noncorrosive
Response to organic contaminants in water	Quickly inactivated	Made less effective	Not easily affected
Response to hard water	Not affected	Not affected	Some compounds inactivated but varies with formulation; read label. Hardness over 500 ppm is undesirable for some quats
Indication of strength of solution	Test kit required	Amber color indicates presence; use test kits to determine concentration	Test kit required. Follow label instructions closely

Source: Based on information from *ServSafe® Essentials* by the Educational Foundation of the National Restaurant Association, 2014.

Because insects tend to congregate near loading docks, adequate control must be provided at this entrance.

Floors in the dry storage area must be easy to clean and slip resistant to prevent accidents. External walls and subfloors should be well constructed, insect- and rodent-proof, and insulated. Walls and ceilings should be painted light colors, have a smooth surface that is impervious to moisture, and be easy to wash and repair. Products must never be stored on the floor; they should be stored on shelves or pallets to permit frequent floor cleaning. If steam lines, ductwork, and hot water lines must pass through the dry storage area, they should be insulated.

Cleanability that promotes sanitation is a significant need in walk-in refrigerators and freezers. Hard-surface, easy-to-clean floors, walls, and fixtures should be of smooth, nonabsorbent material. Special floor cleaning products are available for cleaning and drying floors in cold storage units. Drains to remove scrubbing water and condensate should be located inside walk-ins. Finally, uniform ventilation and adequate lighting should be provided in these units as an aid in maintaining sanitary conditions.

Ware Washing

Ware washing is the process of washing and sanitizing dishes, glassware, flatware, and pots and pans either manually or mechanically. Sinks, dishmachines, and pot and pan washing machines are the most common equipment for this process. Specialized equipment, such as flatware washers and glassware washers, is available.

Ware washing
Process of washing and sanitizing dishes, glassware, flatware, and pots and pans either manually or mechanically.

DISHMACHINES Many different brands of dishmachines are on the market today. Most manufacturers have a series of machines starting with simple models to very sophisticated equipment. The dishwashing process, whether manual or machine driven, consists of scrapping, prewashing, washing, sanitizing, and air drying. Although dishmachines are the most reliable way to clean and sanitize dishes and utensils, many problems can occur if machines are not installed or operated correctly (see Table 8.5).

In choosing the size of a dishmachine to purchase, check the manufacturer's data chart that gives the maximum mechanical capacity of the machine. A factor of 70% should be used to determine what actually happens in the dishroom. Seldom is the maximum attainable. Production of clean dishes will vary depending on the type and efficiency of the dishroom layout, traffic

Table 8-5 Dishwashing Problems and Cures

Symptom	Possible Cause	Suggested Cure
Soiled Dishes	Insufficient detergent	Use enough detergent in wash water to ensure complete soil suspension.
	Wash water temperature too low	Keep water temperature within recommended ranges to dissolve food residues and to facilitate heat accumulation (for sanitization).
	Inadequate wash and rinse times	Allow sufficient time for wash and rinse operations to be effective. (Time should be automatically controlled by timer or by conveyor speed.)
	Insufficient pre-scrapping	Do a better job of water scrapping dishes prior to washing.
	Improper racking	Rack dishes according to size and type in appropriate rack. Silverware should always be presoaked.
Films	Water hardness	Use an external softening process. Use proper detergent to provide internal conditioning. Use a chlorinated cleaner. Check temperature of wash and rinse water. Water maintained above recommended temperature ranges may cause filming.
	Detergent carryover	Maintain adequate pressure and volume of rinse water.
	Improperly cleaned or rinsed equipment	Prevent scale buildup in equipment by adopting frequent and adequate cleaning practices. Maintain adequate water pressure and volume.
	Temperature. Improperly cleaned equipment	Unclog all wash and rinse nozzles to provide proper spray action. Clogged rinse nozzles may also interfere with wash tank overflow.
Greasy	Low pH. Insufficient detergent. Low water	Maintain adequate alkalinity to saponify greases; check detergent, water temperature.
Streaking	Alkalinity in the water	Use an external treatment method to reduce alkalinity.
Spotting	Rinse water hardness	Provide external or internal softening.
	Rinse water temperature too high or too low	Check rinse water temperature. Dishes may be flash drying, or water may be drying on dishes rather than draining off.
	Inadequate time between rinsing and storage	Allow sufficient time for air drying.
Foaming	Detergent: water too soft or too hard	Change to a low-sudsing product. Use an appropriate treatment method to adjust the condition of the water.
	Food soil	Adequately remove gross soil before washing. The decomposition of carbohydrates, protein, or fats may cause foaming during the wash cycle.
	Wash temperature too low	Increase wash temperature

Source: Recommended Field Evaluation Procedures for Commercial Warewashing Machines, 2009. Ann Arbor, MI: National Sanitation Foundation. Used by permission.

flow, type and length of time the food soil has remained on the dishes, relative hardness of water, skill of the dishmachine operator, and fluctuations in flow of soiled dishes.

To illustrate some of the differences in dishmachines, the Hobart brand will be used as an example (Figure 8-13a–c). Dishmachines generally are classified by the number of tanks they have and dishes are moved through the machine in racks or on a conveyor belt.

Scrapping

Disposing of fragments of discarded or leftover food in the dishwashing process.

- **Single tank.** For plates, cups, silverware, or glasses. **Scrapping** is a dishwasher term used for disposing of fragments of discarded or leftover food. The single tank model shown in Figure 8-13a has two doors that can be manually opened and one combined wash-and-rinse tank. It holds a rack of dishes that does not move. A tall version of this machine is available that can hold 18 in. × 26 in. sheet pans or up to a 60-quart mixing bowl.
- **Rack conveyor.** Dishes are still racked to be cleaned in the rack conveyor dishmachine models shown in Figure 8-13b. After dishes are scrapped and sorted, they are placed in racks and the racks with soiled dishes are put on a conveyor that moves the racks through

FIGURE 8-13A Single-tank dishmachine. *Source:* Image courtesy of Hobart, a division of ITW Food Equipment Group.

FIGURE 8-13B Rack conveyor dishmachine. *Source:* Taylor Jackson/Shutterstock.

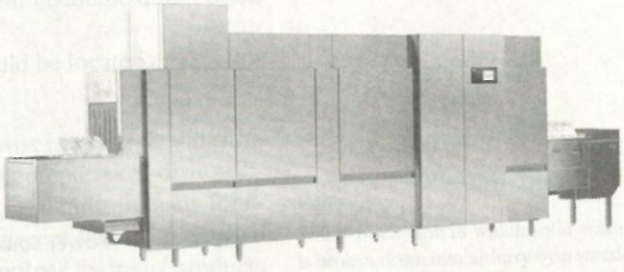


FIGURE 8-13C Flight-type continuous conveyor dishmachine. *Source:* Flight-Type Continuous Conveyor Dishmachine, MEIKO. Used by permission.

the dishmachine. Rack conveyor dishmachines have one, two, or three tanks. The two-tank machine has prewash and power-wash tanks, and the three-tank machine has a heavy-duty power prewash, power-wash, and power-rinse. The prewash tank has powerful jets that use overflow detergent water from the power-wash tank to quickly strip soil from the dishes.

- **Flight-type continuous conveyor.** This dishmachine is typically used in high-volume operations. As shown in Figure 8-13c, rather than being placed in racks, plates and trays are placed between rows of plastic pegs on a conveyor; smaller items such as glasses, cups, and flatware are racked before sending them through the machine.

POT AND PAN WASHERS Many smaller pots and pans can be washed in a dishmachine. The scraping with a knife or spatula and soaking required for burned-on food particles are usually done at the pot and pan sink close to the production areas. A common procedure is to transport pots and pans that have been prerinsed to the dishmachine for washing and sanitizing after the bulk of the dishwashing has been completed.

In large-volume operations, special pot- and pan-washing machines are used for this labor-intensive task. The machines are heavy duty and capable of cleaning cooked-on foods off pots and pans. Pot washing is quite different from dishwashing because pressurized hot water is sprayed directly on the soiled surface.

Power Soak

Pot- and pan-washing equipment that capitalizes on the natural scouring abilities of high-turbulence, heated water.

A piece of equipment called **Power Soak** (Figure 8-14) is considered the easiest way to clean pots and pans. Power Soak capitalizes on the natural scouring abilities of high-turbulence, heated water. Maintaining an optimum cleaning temperature of 115°F loosens soil while powerful jets blast clinging particles away. Dirty pots and pans are literally water-blasted clean, thus eliminating scrubbing by hand. Power Soak is so powerful that it can clean dirty hood filters and oven parts. The "power" behind Power Soak is in its recirculating wash pump, which dispatches more than 300 gallons of water every minute. At the beginning of the first shift of employees, the tank is filled with warm water, and detergent is added. Because the pans are prerinsed and scraped, the water and detergent should successfully perform for several hours. A heating element keeps the temperature at 115°F; the heating element automatically turns on with the presence of water and turns off when the wash tank is emptied.

Potable water

Water that is safe for human consumption.

PLUMBING ISSUES Proper plumbing is important to prevent mixing of **potable** and nonpotable water. Cross-contamination of the water supply can occur when contaminants from drains, sewers, and so forth enter the potable water supply. It can occur when the pressure of the potable water supply drops below that of the contaminated supply, such as when a hose connected to a

FIGURE 8-14 Power Soak. *Source:* Power Soak. Used by permission.

faucet is left submerged in a mop bucket. Cross-contamination is prevented by either installing a backflow-prevention device such as a vacuum breaker on a water line, or by leaving an air gap between the bottom of a faucet in a sink and the highest point of water in the sink (NRA Education Foundation, 2014).

Sanitation of Kitchen and Dining Areas

Sanitation of all foodservice facilities and equipment requires constant diligence on the part of the foodservice staff and management. Regularly scheduled training programs on proper cleaning procedures should be established.

Design for sanitation must begin when the facility is being planned. Floors, walls, and ceilings must be constructed for easy maintenance, and the arrangement and design of the equipment and fixtures should facilitate cleaning. Having equipment on wheels and using quick disconnects on gas equipment will facilitate movement of equipment for cleaning. Facilities for proper disposal of trash and garbage are necessary to avoid contaminating food and attracting pests.

In general, the following procedures should be followed regularly in cleaning of floors:

- Spills should be wiped up promptly to avoid tracking and to eliminate a safety hazard.
- Regular schedules for cleaning floors should be established. Floors subjected to heavy traffic and food spills, such as in the production areas, must be scrubbed at least daily and hosed, stripped, and steamed periodically for more thorough cleaning.
- Floor care equipment, including brooms, mops, and vacuums, should be cleaned regularly.

Dish Storage

Handling and storage of clean dishes are important aspects of a sanitation program in a foodservice operation. All dishes and utensils must be stored dry and in clean, dust-free areas above the floor and protected from dust, mop splashes, and other forms of contamination. Mobile equipment designed for storage of various types of dishes and glassware is ideal.

Garbage and Trash Disposal

Garbage and trash must be handled carefully in a foodservice operation because of the potential for contaminating food, equipment, and utensils and for attracting insects and other pests. The manager needs to establish procedures for handling garbage and trash within the operation and then disposing of the solid waste into the environment.

PROCEDURES FOR HANDLING The following general rules apply to trash and garbage handling in the foodservice operation:

- Garbage and trash containers must be leakproof, easily cleanable, pest-proof, and durable with tight-fitting lids. Today, plastic bags frequently are used for lining containers to facilitate disposal.
- Garbage and trash should not be allowed to accumulate anywhere but in containers.
- Garbage and trash should be removed from production areas on a frequent basis for appropriate disposal.
- Garbage storage areas should be easily cleanable and pest-proof. If long holding times for garbage are required, these areas should be refrigerated to prevent decomposition, odor, and infestation by vermin.
- A garbage can washing area with hot water and a floor drain should be located away from food production and storage areas.

Mechanical devices are used in most foodservice facilities to assist in garbage and trash disposal. At a minimum, garbage disposal units should be available in prepreparation, dishwashing, and pot- and pan-washing areas. **Pulpers** are replacing garbage disposal units in many foodservice operations. A pulper works somewhat like a garbage disposal except that it is designed especially for the disposal of cardboard, paper, and food waste. The pulper hydrates products into a slurry in a shredding device and then presses water out of it. The waste becomes a semidry, degradable pulp ready for disposal; the excess water is recycled in the pulping tank for reuse. Solid waste can be reduced by 85%, which means less space is used in a landfill. Pulpers can handle paper trays, foam, foil, corrugated boxes, bones, food scraps, and some plastics. Pulpers require daily cleaning.

Pulper
Water-filled tank in which solid waste is broken down into a slurry by a shredding device and then water is pressed out of it.

Mechanical trash compactors are used for dry bulky trash, such as cans and cartons. Compacting reduces the volume of trash to one-fifth of its original bulk.

SOLID WASTE Solid and semisolid products, such as food waste, paper, cardboard, metal, and plastic, that are being discarded from a foodservice are termed *solid waste*. Some of these products can be recycled; others will be disposed of in landfills or incineration units. Pollution prevention or reduction at the source was declared America's top priority in the Pollution Prevention Act passed by Congress in 1990. A goal to recycle at least 25% of the solid waste in America was established as part of this act. The Environmental Protection Agency developed a hierarchy of priorities for addressing solid waste management. The goal is to prevent pollution before it occurs (Mason, Shanklin, Hee Wie, & Wolfe, 1999). The hierarchy includes:

- Source reduction
- Recycling, including composting
- Landfilling
- Incineration

Managing solid waste efficiently and effectively requires planning. An integrated solid waste management program includes the following:

- Menu design and planning
- Purchase specifications
- Food production practices
- Service methods
- Portion control
- Waste-product disposal methods
- Consumer education
- Employee training

Generally about 60 to 70% of the solid waste discarded from a foodservice operation is service related (Hollingsworth, Shanklin, & Cross, 1995). Service waste includes food, napkins, straws, and condiment packaging. The remaining 30 to 40% is from the food production and preparation areas.

The Academy of Nutrition and Dietetics' positions on conserving the environment (Shanklin & Hackes, 2001) and supporting ecological sustainability (Harmon & Gerald, 2007) and the practice paper on promoting ecological sustainability (Robinson-O'Brien & Gerald, 2013)

encourage environmentally responsible practices that minimize the quantity of waste that is generated. The position papers indicate that an average of 0.32 to 1.47 lb. of food and package waste are discarded per meal served in foodservice operations. Foodservice managers are encouraged to develop integrated waste management systems that include **source reduction**, recycling, and waste combustion to reduce the amount of waste going to landfills. **Recycling** is the act of removing materials from the solid waste stream for reprocessing into valuable new materials and useful products (Foodservice and Packaging Institute, 1991). Many of the traditional packaging materials, including paper, metals, plastic, and glass, can be recycled. **Composting** is the controlled application of the natural process of organic degradation, according to the US Composting Council (Crosby, 1993). Any organic material, including food waste and paper or cardboard that has been contaminated with food, can be composted. A commercial composting plant accelerates natural biodegradation, converting mixed organic waste to a nutrient-rich soil conditioner in great demand in agriculture and horticulture.

Source reduction
Reducing the amount of waste going into the waste stream from a foodservice operation (source).

Recycling
Act of removing materials from solid waste stream for reprocessing into valuable new materials and useful products.

Composting
Controlled application of the natural process of organic degradation.

Combustion
Form of solid waste recycling in which the energy value of combustible waste materials is recovered.

Combustion, or incineration, is a form of solid waste recycling in which the energy value of combustible waste materials is recovered (Council on Plastics and Packaging in the Environment, 1991). Modern waste-to-energy plants reduce the volume of waste going to landfills by 80 to 90% while generating electricity and revenue for users.

Hospitals, nursing homes, schools, prisons, colleges and universities, and other onsite foodservice operations across the country are successfully recycling and composting their solid waste (Chen, Arendt, & Gregoire, 2010; Huang, Gregoire, Tangney, & Stone, 2010; King, 1995; Su, Mason, & Shanklin, 1994). The results showed that most of the onsite foodservice operators were:

- Recycling
- Practicing source reduction
- Incinerating
- Composting

The most common items being recycled were cardboard (84%), aluminum (79%), cooking oil and grease (79%), and paper (78%). The most common source reduction method reported was a reusable mug or cup program (74%). In addition, operators were decreasing the use of disposables and purchasing in bulk. Challenges noted by operators included lack of recyclers in the area (39%) and lack of customer interest (32%).

Regionalization occurs when two or more counties or governments combine resources to site a landfill or develop a system for waste disposal for their communities. Some communities use transfer stations to manage their solid waste. After being collected and compacted at a transfer station, the solid waste is taken to a landfill in another area of the state or in a nearby state. Some communities are now transporting garbage more than 100 miles for legal disposal (Mason, Shanklin, Hee Wie, & Wolfe, 1999).

Bioremediation companies take advantage of a technological breakthrough to offer a biological solution to an old and nagging restaurant problem, clogged drains and grease traps (Yaffar & Dibner, 1992). Restaurant managers can use a drain-cleaning company or a plumber whenever an emergency occurs or can hire a bioremediation company that can establish a chemical or biological preventive maintenance program. The **biological solution** is to use bacteria to break down animal fats and food products that clog drains. Naturally occurring organisms that grow on grease, flour, and other foods have been isolated. Once the food source is depleted, the organisms die and the environment returns to its original natural state. Using chemical or biological solutions on a regular basis provides preventive maintenance for a serious problem and is a known fixed cost in the budget.

Biological solution
Use of bacteria to break down animal fats and food products that clog drains.

Employee and Guest Facilities

Locker rooms should be provided for employees to change clothes. Individual lockers with locks are needed for storing street clothes and personal effects when employees are working. Adequate space and good lighting are necessary for changing clothes and for employee safety. Floors should be tile laid in cement or other nonabsorbent materials, especially in the toilet and handwashing sink areas. Employee facilities should be located near the work area.

Guest restrooms should be easily accessible from the dining room. In most commercial foodservice operations, the restroom foyer is decorated in harmony with the dining room. Walls

might be papered and the floor might be carpeted in this area, but the toilet and handwashing sink areas should have tile floors and walls.

Keeping both employee and guest restrooms clean can be a major management problem. Frequent management inspections are required, especially during changing of employee shifts or guest meal times, when traffic volume is the highest. These inspections are too important to delegate to an employee. Many customers will not return to a foodservice operation if they are dissatisfied with the cleanliness of a restroom. Employee restrooms should be maintained at the same quality as those for guests.

Employee Training in Sanitation

Trained personnel who have good personal hygiene habits and follow recommended food-handling practices are critical to an effective sanitation program. Equally important are strong leadership by management, provision of appropriate tools and equipment, and continual follow-up. The time, money, and effort that go into a sanitation program are wasted if the foodservice staff is not knowledgeable about appropriate sanitation practices (Longrée & Armbruster, 1996).

The education of foodservice managers should include microbiology and sanitation to equip them for leadership in design and implementation of inservice sanitation programs. *Food Code* (2013) stipulates that "based on the risks inherent to the food operation, during inspections and upon request the person in charge shall demonstrate to the regulatory knowledge of foodborne disease prevention, application of the Hazard Analysis and Critical Control Point principles, and the requirements of this Code." In many locations, a required certification such as ServSafe® is required to demonstrate this knowledge. Continuing education is needed to maintain competency.

Professional associations have played an important role in upgrading sanitation practices in the foodservice industry. The certification programs of several organizations, like the School Nutrition Association and the Association of Nutrition & Foodservice Professionals, include knowledge and competency in sanitation practices as a major component. A major contributor to the upgrading of sanitation practices is the Educational Foundation of the NRA through its national uniform sanitation, training, and certification plan for foodservice managers, termed ServSafe®.

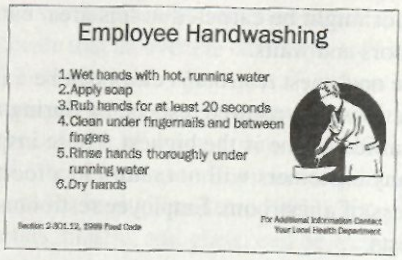
Training of nonmanagerial employees is the responsibility of the foodservice manager. Initial training in safe food-handling practices and personal hygiene is needed for new employees.

Many teaching aids are available to assist the manager in conducting training programs on safe food handling. Federal and state health agencies and commercial and private organizations have videotapes, films, slides, posters, and manuals available free or at low cost. Many foodservice organizations also have developed comprehensive manuals for training and as a reference for their personnel.

Training materials, mini-posters, and other training aids are available from many companies and organizations. The mini-posters shown in Figure 8-15 are examples of materials available from the Integrated Food Safety Information Delivery System (www.profoodsafety.org). The posters are available in nine different languages to help train foodservice employees whose first language is not English. Online food safety lessons are available for training employees at the Iowa State University Extension's food safety Web site (www.extension.iastate.edu/foodsafety). The Iowa State Extension Web site (http://www.extension.iastate.edu/foodsafety/content/safefood-motivation-toolkit) also has a motivation toolkit that managers can use to help them better motivate employees on safe food practices. Online information is available at the U.S. government food safety Web site (www.foodsafety.gov). The Institute of Child Nutrition (www.nfsmi.org) has a variety of training materials and posters on food safety.

The Partnership for Food Safety Education was formed to develop education materials and programs related to food safety for consumers. The Fight BAC!® campaign was developed by the Partnership for Food Safety Education (see www.fightbac.org) to promote food safety. The campaign includes training materials and posters promoting four key food safety principles:

- Clean (hands and surfaces)
- Separate (to avoid cross-contamination)
- Chill (refrigerate/freeze foods as appropriate)
- Cook (cook foods to proper internal temperatures)



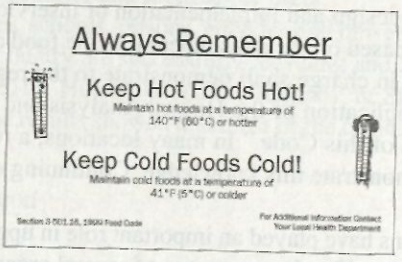


FIGURE 8-15 Sanitation posters. *Source:* Integrated Food Safety Information Delivery System (www.profoodsafety.org) signs made possible from grant # FD-R-001731-01 from the Food and Drug Administration.

GOVERNMENTAL SANITATION REGULATIONS AND STANDARDS

The protection of the food supply available to the consumer is the responsibility of governmental agencies at the federal, state, and local levels. Trade associations and institutes, professional societies, and private associations and foundations are especially concerned about microbiological standards of food products.

The Los Angeles County Department of Health Services' food-handler certification program, for example, specifies that all employees involved in food preparation, storage or service must hold a food-handler card, which involves a minimum of 3 hours of training approved by the county health department and successful passing of an food-handling exam. Under their health inspection rating system, restaurants with scores of 90% or higher would receive an "A" grade, 80 to 90% a "B" grade, and 70 to 79% a "C" grade. Detailed inspection cards and grade must be posted in the facility and are available for public view online. The law also requires restaurants to post the location and phone number of the local health department office, permitting customers to file complaints about sanitation.

Audits of Sanitation Standards

External audit

Inspection program performed by governmental or nongovernmental agencies.

Internal audit

Self-inspection program.

Evaluation of the maintenance of foodservice sanitation standards is accomplished in two ways: external and internal audits of facilities and practices. An **external audit** may be performed by governmental or nongovernmental agencies; an **internal audit** is the responsibility of the management of a foodservice organization and may be part of a self-inspection program for sanitation or a component of a broader total quality management program.

EXTERNAL AUDITS External audits are performed by federal, state, and local governmental agencies to monitor sanitation in foodservice establishments. Many state and local governments have adopted Public Health Service codes in establishing standards of performance in sanitation

for foodservice establishments. State and local health agencies act to ensure that foodservice establishments:

- Are operated under the supervision of a person knowledgeable in sanitary food-handling practices (Longrée & Armbruster, 1996).
- Are equipped, maintained, and operated to offer minimal opportunities for food hazards to develop.
- Use ingredients and food products that are wholesome and safe.

The FDA developed the *Food Code* to assist health departments in developing regulations for a foodservice inspection program (US DHHS FDA, 2013). Some state and local agencies develop their own codes. The FDA recommends inspections at least every 6 months, although the frequency is determined by the local agency.

A **sanitarian**, often referred to as a health official or inspector, is an individual trained in sanitation principles and methods and public health (NRA Educational Foundation, 1992). The foodservice manager and unit head should accompany the sanitarian during inspection. They should take advantage of the experience and expertise of the sanitarian by asking questions; employees should be encouraged to do the same. They should take notes during the inspection and be willing to correct problems. Problems should be discussed with employees and corrected immediately. Foodservice managers and employees should welcome a visit from the sanitarian and not resent it if they are truly dedicated to serving safe food to customers.

Sanitarian
Health official or inspector who is trained in sanitation principles and methods.

In some areas, HACCP principles have replaced traditional health department inspections that stress the appearance of the facility and spot-checking temperatures. Inspectors trained in these principles examine the procedures related to the flow of food from receiving to service and may verify critical control points for each step. Many state and local ordinances are patterned on the Model FDA Food Establishment Inspection Report, shown in Figure 8-16. Definitions for the compliance items and directions for marking the inspection report can be found in *Food Code* (2013).

A good sanitation program and well-trained employees result in safe food and are reflected in a good sanitation report (NRA Educational Foundation, 2010). Based on their years of experience, sanitarians generally can offer advice on correcting violations. According to the FDA *Food Code*, corrective actions must be taken on all violations. The larger violations should have a time frame approved by the inspector. The sanitarian usually has the authority to close the operation if violations are excessive and dangerous to public health.

The inspection process in a foodservice facility may begin before a facility is built, as many jurisdictions require a review of plans and specifications for new construction or extensive remodeling. Once a facility is completed, inspection visits are usually conducted prior to issuance of permits to operate. After a foodservice operation has opened, inspections will occur periodically, depending on the workload of the responsible agency and severity of violations at previous inspections. The growth of the foodservice industry has not been matched by expansion of the capacity of health agencies to monitor operations.

INTERNAL AUDITS A foodservice organization should have its own program of self-inspection as a means of maintaining standards of sanitation. In organizations with a TQM program, an audit of sanitation practices should be one of its major components. Employees can be an important part of an internal audit when they are empowered to take corrective action if a critical control point is violating the code. A voluntary food safety program of self-inspection will assure the government and the public that the foodservice operation is protecting the safety of food in each step of production.

Regulations

In Chapter 5, key federal agencies involved in the wholesomeness and quality of food from producer to purchaser were discussed. The sanitation and service of food after it is purchased is controlled largely by state and local agencies and private organizations.

ROLE OF GOVERNMENTAL AGENCIES The United States Public Health Service (PHS) and its subdivision, the FDA, both of which are agencies within the United States Department of Health & Human Services (HHS), are charged specifically with protecting the health of all Americans

FORM 3-A

Food Establishment Inspection Report

Page ____ of ____

As Governed by State Code Section XXX.XXX
Do Good County
12344 Any Street, Our Town, State 11111

No. of Risk Factor/Intervention Violations
No. of Repeat Risk Factor/Intervention Violations
Score *(optional)*

Date
Time In
Time Out

Establishment	Address	City/State	Zip Code	Telephone
License/Permit #	Permit Holder	Purpose of Inspection	Est. Type	Risk Category

FOODBORNE ILLNESS RISK FACTORS AND PUBLIC HEALTH INTERVENTIONS

Circle designated compliance status (IN, OUT, N/O, N/A) for each numbered item
IN=in compliance OUT=not in compliance N/O=not observed N/A=not applicable

Mark "X" in appropriate box for COS and/or R
COS=corrected on-site during inspection R=repeat violation

Compliance Status			COS	R
Supervision				
1	IN OUT	Person in charge present, demonstrates knowledge, and performs duties		
2	IN OUT N/A	Certified Food Protection Manager		
Employee Health				
3	IN OUT	Management, food employee and conditional employee, knowledge, responsibilities and reporting		
4	IN OUT	Proper use of restriction and exclusion		
5	IN OUT	Procedures for responding to vomiting and diarrheal events		
Good Hygienic Practices				
6	IN OUT N/O	Proper eating, tasting, drinking, or tobacco use		
7	IN OUT N/O	No discharge from eyes, nose, and mouth		
Preventing Contamination by Hands				
8	IN OUT N/O	Hands clean & properly washed		
9	IN OUT N/A N/O	No bare hand contact with RTE food or a pre-approved alternative procedure properly allowed		
10	IN OUT	Adequate handwashing sinks properly supplied and accessible		
Approved Source				
11	IN OUT	Food obtained from approved source		
12	IN OUT N/A N/O	Food received at proper temperature		
13	IN OUT	Food in good condition, safe, & unadulterated		
14	IN OUT N/A N/O	Required records available: shellstock tags, parasite destruction		
Protection from Contamination				
15	IN OUT N/A N/O	Food separated and protected		
16	IN OUT N/A	Food-contact surfaces: cleaned & sanitized		

Compliance Status			COS	R
17	IN OUT	Proper disposition of returned, previously served, reconditioned & unsafe food		
Time/Temperature Control for Safety				
18	IN OUT N/A N/O	Proper cooking time & temperatures		
19	IN OUT N/A N/O	Proper reheating procedures for hot holding		
20	IN OUT N/A N/O	Proper cooling time and temperature		
21	IN OUT N/A N/O	Proper hot holding temperatures		
22	IN OUT N/A N/O	Proper cold holding temperatures		
23	IN OUT N/A N/O	Proper date marking and disposition		
24	IN OUT N/A N/O	Time as a Public Health Control: procedures & records		
Consumer Advisory				
25	IN OUT N/A	Consumer advisory provided for raw/undercooked food		
Highly Susceptible Populations				
26	IN OUT N/A	Pasteurized foods used; prohibited foods not offered		
Food/Color Additives and Toxic Substances				
27	IN OUT N/A	Food additives: approved & properly used		
28	IN OUT N/A	Toxic substances properly identified, stored, & used		
Conformance with Approved Procedures				
29	IN OUT N/A	Compliance with variance/specialized process/HACCP		

Risk factors are important practices or procedures identified as the most prevalent contributing factors of foodborne illness or injury. Public health interventions are control measures to prevent foodborne illness or injury.

GOOD RETAIL PRACTICES

Good Retail Practices are preventative measures to control the addition of pathogens, chemicals, and physical objects into foods.
Mark "X" in box if numbered item is not in compliance Mark "X" in appropriate box for COS and/or R COS=corrected on-site during inspection R=repeat violation

			COS	R
Safe Food and Water				
30		Pasteurized eggs used where required		
31		Water & ice from approved source		
32		Variance obtained for specialized processing methods		
Food Temperature Control				
33		Proper cooling methods used; adequate equipment for temperature control		
34		Plant food properly cooked for hot holding		
35		Approved thawing methods used		
36		Thermometers provided & accurate		
Food Identification				
37		Food properly labeled; original container		
Prevention of Food Contamination				
38		Insects, rodents, & animals not present		
39		Contamination prevented during food preparation, storage & display		
40		Personal cleanliness		
41		Wiping cloths: properly used & stored		
42		Washing fruits & vegetables		

			COS	R
Proper Use of Utensils				
43		In-use utensils: properly stored		
44		Utensils, equipment & linens: properly stored, dried, & handled		
45		Single-use/single-service articles: properly stored & used		
46		Gloves used properly		
Utensils, Equipment and Vending				
47		Food & non-food contact surfaces cleanable, properly designed, constructed, & used		
48		Warewashing facilities: installed, maintained, & used; test strips		
49		Non-food contact surfaces clean		
Physical Facilities				
50		Hot & cold water available; adequate pressure		
51		Plumbing installed; proper backflow devices		
52		Sewage & waste water properly disposed		
53		Toilet facilities: properly constructed, supplied, & cleaned		
54		Garbage & refuse properly disposed; facilities maintained		
55		Physical facilities installed, maintained, & clean		
56		Adequate ventilation & lighting; designated areas used		

Person in Charge (Signature) Date:

Inspector (Signature) Follow-up: YES NO (Circle one) Follow-up Date:

FIGURE 8-16 Food establishment inspection report. *Source: Food Code,* 2005.

and providing essential human services, especially for those who are least able to help themselves. The PHS identifies and controls health hazards, provides health services, conducts and supports research, and develops training related to health.

Two agencies within the PHS specifically related to sanitation regulations and standards are the CDC and the FDA. The CDC investigates and records reports of foodborne illness and is charged with protecting public health by providing leadership and direction in the control of diseases and other preventable hazards. The Bureau of Training within the CDC develops programs for control of foodborne diseases in the foodservice industry. The CDC is responsible for providing assistance in identifying causes of disease outbreaks, including foodborne illnesses.

The FDA directs its efforts toward protecting the nation's health against unsafe and impure foods, unsafe drugs and cosmetics, and other potential hazards. The FDA has been established as the regulatory agency with responsibility for food safety in the United States, and the Food Safety and Inspection Service has the same responsibility under the USDA. The FDA uses laboratory analysis of foods to detect microbiological and chemical toxicants, adulteration, and

incorrect labeling; the USDA does onsite inspections of meat and poultry operations and checks animal health, sanitation, and product labeling (Cody & Kunkel, 2002).

The FDA is responsible for regulating interstate shipment of food, as discussed in Chapter 5, and for inspecting foodservice facilities on interstate carriers such as trains, planes, and ships operated under the U.S. flag. In addition, although local agencies have the primary responsibility for inspecting foodservice establishments, the FDA assists these agencies by developing model codes and ordinances and providing training and technical assistance. The FDA enforces the Federal Food, Drug, and Cosmetic (FD&C) Act and its amendments, Pesticides, Food Additives, Color Additives, and Labeling. The FDA's jurisdiction has been redefined as new concerns have arisen. The FDA also administers the Bioterrorism, Fair Packaging and Labeling (FPLA), and Tea Importation acts. The FSIS administers the Poultry Products Inspection, Egg Product Inspection (EPIA), and Federal Meat Inspection (FMIA) acts.

Many state and local governments have adopted the U.S. Public Health Service codes in establishing standards of performance in sanitation for foodservice establishments. These codes generally require that employees have medical examinations to determine their qualifications to handle food safely and have a food-handler's permit, which usually requires a short training program on sanitation practices.

State or local agency officials make periodic inspections to foodservice operations to compare their performance with standards of cleanliness and sanitation. Any deficiencies must be corrected before the next inspection. The agency generally has the authority to close an operation with an inordinate number of deficiencies in meeting the sanitation standards.

The Environmental Protection Agency, another agency within the U.S. Department of Health & Human Services, also has responsibility in certain areas related to sanitation in foodservice establishments. The EPA endeavors to comply with environmental legislation and control pollution systematically by a variety of research, monitoring, standard setting, and enforcement activities. Of particular interest to the foodservice industry are programs on water standards, air quality, pesticides, noise abatement, and solid waste management.

ROLE OF OTHER ORGANIZATIONS A number of other organizations are active in upgrading and maintaining the sanitary quality of various food products and establishing standards for foodservice operations. For example, many trade and professional organizations serving various segments of the food industry have established sanitary standards for food processing operations.

The Educational Foundation of the **National Restaurant Association (NRA)** has exerted aggressive leadership in developing standards and promoting training in foodservice sanitation. It has developed a crisis management program, identified as ServSafe®, that concentrates on three areas of potential risk: food safety, responsible alcohol service, and customer safety (NRA Educational Foundation, 1995). ServSafe® courses focus on the manager's role in assessing risks, establishing policies, and training employees. ServSafe® programs include a textbook and employee training materials for each subject, such as study guides, videos, and an employer's kit with a leader's guide and other teaching aids. Anyone who completes the course and satisfactorily completes a certification examination administered by the Education Foundation is eligible for an Educational Foundation ServSafe® certificate. Many state and local health authorities require that managers, or persons in charge in a foodservice operation, hold some form of sanitation certification.

In the healthcare industry, **The Joint Commission** has encouraged high standards of sanitation by including assessment of sanitary practices in its accreditation standards and visits. The **Academy of Nutrition and Dietetics**, formerly the American Dietetic Association, has emphasized food safety for many years and has published *Food Safety for Professionals: A Reference and Study Guide* (Cody & Kunkel, 2002), *Pesticides in Food: A Guide for Professionals* (Chaisson, Petersen, & Douglass, 1991), and *Disaster and Emergency Preparedness in Food Service Operations* (Puckett & Norton, 2003).

The **National Association of College & University Food Services (NACUFS)**, the trade association for foodservice professionals at institutions of higher education, publishes a standards manual. These standards were designed to be used as a self-monitoring program for improving operations and as part of a voluntary peer review program. Sanitation, safety, and maintenance comprise a major section of the manual.

National Restaurant Association (NRA)

Professional organization for restaurant and other foodservice management professionals.

Joint Commission

Healthcare regulatory agency that determines the degree to which healthcare organizations comply with established control standards.

Academy of Nutrition and Dietetics (Academy)

Professional organization for nutrition and dietetics professionals serving the public through promotion of optimum nutrition, health, and well-being.

National Association of College & University Food Services (NACUFS)

Professional organization for foodservice professionals at institutions of higher education.

School Nutrition Association (SNA)
National association for professionals working with federally sponsored child nutrition programs.

Institute of Child Nutrition
Federally funded institute that conducts research and provides education related to child nutrition programs.

American Public Health Association (APHA)
Professional organization representing all disciplines and specialties in public health.

National Sanitation Foundation International (NSF International)
Nonprofit, noncommercial organization that develops minimum sanitation standards for foodservice equipment.

Underwriters Laboratory, Inc. (UL)
Organization responsible for the compliance of equipment with electrical safety standards.

The **School Nutrition Association (SNA)**, formerly the American School Food Service Association (AFSFA), has provided leadership in the school foodservice segment of the industry in promoting good sanitation practices and has been active in providing employee training. The SNA's *Keys to Excellence* (see www.schoolnutrition.org) details sanitation and safety standards. School foodservice directors can do an assessment of their operation using the keys at www.schoolnutrition.org. The School Nutrition Association also offers a variety of online food safety training programs for members.

The **Institute of Child Nutrition** (ICN; formerly the National Food Service Management Institute) was formed to conduct research and provide education for those working in child nutrition. The ICN has published several food safety guidance materials such as *Developing a School Food Safety Program* and *Food Safety for Summer Food Service Programs* (see www.nfsmi.org).

The **American Public Health Association (APHA)**, a professional society representing all disciplines and specialties in public health, has a standing committee on food protection that establishes policies and standards for food sanitation. Several other associations for professionals in the area of food protection and sanitation also promote standards and enforcement procedures in food safety and sanitation.

The **National Sanitation Foundation International (NSF)** is one of the most influential semiprivate agencies concerned with sanitation. The NSF, organized in 1944 by a group of industrial leaders and public health officials, is a nonprofit, noncommercial organization whose mission is to protect and improve global human health (see www.nsf.org). NSF, along with industry officials, businesses, federal and state regulatory agencies, and the public, develops nationally uniform and voluntary consensus standards for products and services, including:

- Drinking water treatment units
- Foodservice equipment
- Vending machines
- Swimming pool equipment
- Refuse compactor systems
- Waste water treatment equipment
- Plastic piping system components
- Water conservation systems

Manufacturers may request that the NSF evaluate their equipment, and they will receive an NSF Testing Laboratory Seal of Approval for equipment meeting NSF standards.

MAINTENANCE

Facilities and equipment are important factors in any HACCP-based program. Poorly designed facilities and equipment make cleaning and sanitization difficult (NRA Educational Foundation, 2014). Foodservice managers should look for the NSF International mark or the UL (**Underwriters Laboratory, Inc. (UL)**) sanitation certifications of commercial foodservice equipment (Figure 8-17). Nearly 70 years ago, NSF International brought key industry stakeholders together to develop the first consensus standards for foodservice equipment. Since then, NSF has

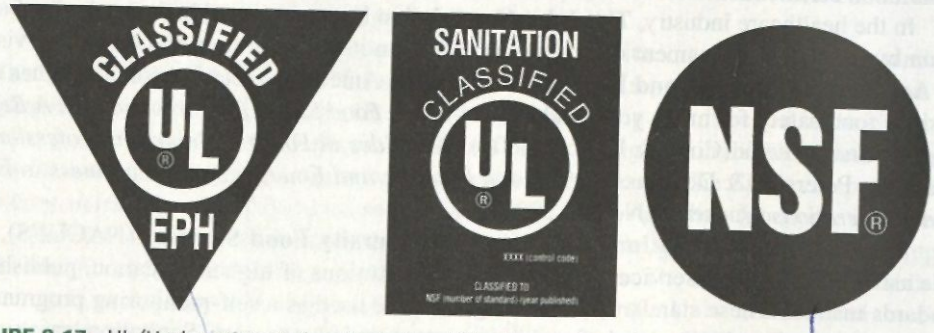


FIGURE 8-17 UL (Underwriters Laboratories) certification mark and National Sanitation Foundation® International certification mark on foodservice equipment.

jointly developed over 75 standards and certified thousands of products as safe to use in commercial food settings. NSF International food equipment standards include requirements for material safety to ensure the product will not leach harmful chemicals into food; design and construction to ensure the product is cleanable and is not likely to harbor bacteria; and product performance. NSF certification to these standards also includes audits of the production facility to ensure the product is made using good manufacturing practices. UL has over 120 years' experience evaluating commercial gas and electric cooking appliances and refrigeration, food preparation, and processing equipment for manufacturers seeking safety and sanitation certification and energy-efficiency evaluations. UL staff members are experts at carrying out a variety of product investigations of foodservice industry equipment.

Preventive Maintenance

Preventive maintenance is the process of keeping equipment and facilities in good repair. It has two aspects: regular cleaning schedules and standard procedures, and the preventive and corrective maintenance of foodservice equipment and facilities.

Preventive maintenance
Keeping equipment and facilities in a good state of repair.

Some cleaning should be performed every day and included in the daily tasks of specific employees. Other cleaning tasks may be scheduled on a weekly, monthly, or less frequent basis, as appropriate to the operation, but must be done regularly for proper maintenance of the facilities. In some instances, specific scheduling of additional employees or perhaps specialized cleaning crews may be required. Whatever the schedules, however, proper tools, equipment, and cleaning materials are basic to an effective facility maintenance program and must be on hand as required.

All cleaning tasks should be combined in a master schedule that includes a list of what is to be cleaned, when each task should be done, how the task should be performed, and who has the assigned responsibility. Table 8-6 illustrates a partial master cleaning schedule for a food production area.

Specific cleaning procedures need to be developed to supplement the master schedule. Employees should be instructed in the procedures for cleaning foodservice equipment and in what the proper cleaning devices and materials are. Equipment cleaning procedures must be sufficiently detailed and presented in a step-by-step procedure to ensure that the correct process is followed and that any special precautions are heeded. Table 8-7 presents the procedure for cleaning a food mixer along with important safety precautions. Similar procedures need to be developed for all pieces of equipment. Manufacturers' instructions can be useful in developing these procedures.

Bacteriological counts on dishes, utensils, and equipment are a way to check on the quality of the sanitization program. In some localities, health inspectors may perform these tests.

Table 8-6 Sample Cleaning Schedule (Partial) for Food Preparation Area

Item	What	When	Use	Who
Storage Containers	Wash in pot and pan sink	When empty	See pot and pan cleaning procedure	_____
Work Surfaces	Clean and sanitize	Between uses and at end of day	See cleaning procedure for work surfaces	_____
Serving Counters	Wipe up spills	Throughout the day as needed	See cleaning procedure for serving counters	_____
	Clean and sanitize inside and out	End of day	See cleaning procedure for serving counters	_____
Mixer	Take soiled bowl and beater to pot and pan sink	After each use	See pot and pan cleaning procedure	_____
	Clean and sanitize all surfaces	After each use	See equipment cleaning procedure	_____

Table 8-7 Sample Cleaning Procedures for a Mixer

When	How	Use
After each use	1. Turn off machine. 2. Remove electric cord from socket. 3. Take soiled bowl and beater to pot and pan sink for cleaning. 4. Clean and sanitize all surfaces.	First, clean with appropriate detergent solution; then sanitize with appropriate sanitizing solution

Keeping records on equipment maintenance is an important function for the manager to perform. Ideally records should be kept on the age, condition, service history, or maintenance requirements for equipment in the operations. Records for the number of repairs and cost of each provide crucial information when considering whether to repair or replace equipment. Another benefit of keeping inventory and service records is tracking warranties. The manager who has no records might be paying for parts and labor that are covered by extended warranties purchased with the equipment. Electronic databases can help track the preventive maintenance and warranty information.

RISK MANAGEMENT

Safety, sanitation, and maintenance are important components in preventing accidents and illness in foodservice operations. They also are key components of what has become known as risk management.

Risk is defined as the possibility of loss or injury. **Risk management** is a discipline for dealing with the possibility that some future event will cause harm to an organization. According to Tom Cippolone, director of risk management for Darden Restaurants, the role of the risk manager is to create the safest environment possible for employees and customers (Carlino, 2002). A risk manager often is responsible for overseeing operational security, ensuring workplace safety for workers and customers, managing litigation, and helping improve the bottom-line performance of the organization.

Risk
Possibility of loss or injury.

Risk management
Discipline dealing with possibility that some future event will cause harm to an organization.

The Nonprofit Risk Management Center (2002) suggests that risk management basically involves answering three questions:

- What can go wrong?
- What will we do (both to prevent harm from occurring in the first place and to deal with the aftermath of an "incident")?
- If something happens, how will we pay for it?

Risk managers usually are charged with identifying potential areas of risk for an organization and then planning strategies to help reduce the likelihood of that risk. John Pinkerton, the person in charge of the risk management for Hard Rock Café, indicates that his unit's role is protection of people, property, and profits (Carlino, 2002).

Employee training is critical to the reduction of risks in an organization. Lack of proper employee training is the primary cause of injuries and the resulting damages, whether fiscal, physical, or mental (King, 2002). Employee training should include not only how to perform required aspects of the assigned job safely, but also how to be observant for situations that could cause harm to others, such as spills on floors and unprotected hot or sharp edges.

The role of risk management does not belong only to the person in an organization identified as the risk manager. All managers should be observant of their operation and of the potentials for loss or injury that might be in their operation.

The Foodservice Industry Risk Management Association (FIRMA) is the trade association that provides management support for risk, claims, and safety professionals in the restaurant, food production, retail, and hospitality industries. The organization sponsors regional meetings and provides information and support to those involved with risk management.

Chapter Summary

This summary is organized by the learning objectives.

1. The safety, sanitation, and maintenance subsystem includes activities that relate to food, employee, and customer safety and the sanitation and safety of foodservice facilities and equipment.
2. The terms *clean* and *sanitary* have different meanings. Clean is to be free from soil. Sanitary is to be free of disease-causing organisms.
3. Several methods exist for solid waste management from a foodservice establishment. Items such as cardboard, paper, plastic, glass, and aluminum can be recycled; food products can be composted; and many items can be incinerated and the energy recovered for other uses.
4. The text includes many examples of policies for helping ensure food, employee, and customer safety. One example of a food safety policy is, "Food items should not be in the temperature danger zone (41°F–135°F) for more than 4 hours." An example of an employee safety policy is, "All spills shall be wiped up immediately." An example of a customer safety policy is, "Exits from the dining room shall be clearly identified."

Test Your Knowledge

1. Explain the four types of food spoilage, and give examples of each.
2. What is a foodborne pathogen? Give three examples and explain each.
3. What is sanitation's role in the management of food quality?
4. Describe what regulations are in place to help with food safety.
5. What is the role of maintenance in the foodservice industry?
6. What act was passed by Congress in 1970 to ensure the safety of employees? How does this act ensure customer safety?
7. What is risk management? Why is it important to a foodservice operation?

Class Projects

1. In groups of two or three people, research a foodborne pathogen and develop a handout for your classmates about what they, as future foodservice managers, should know about this pathogen.
2. Invite a local sanitarian to visit class and discuss how a sanitation inspection is done.
3. Work with a local school or assisted living foodservice director and identify standard operating procedures that the operation does not yet have documented (see www.extension.iastate.edu/foodsafety/HACCP). Write at least two standard operating procedures for that operation.
4. Using the Food Establishment Inspection Report form found in the *Food Code* (2005), work with a local foodservice director to complete an inspection of that operation.

Case Study Exercises

1. "The Toxic Hamburger" in Lieux, E. M., & Luoto, P. K. (2008). *Exploring foodservice systems management through problems,* 3rd ed. Upper Saddle River, NJ: Pearson Prentice Hall.
2. "The Ceiling Is Falling!" by S. Kosharek in Allen-Chabot, A., Jarvis, K., & O'Halloran, R. M. (2006). *Cases in foodservice and clinical nutrition management.* Upper Saddle River, NJ: Pearson Prentice Hall.
3. "The Cafeteria Server with a Nose Ring" by S. Kosharek in Allen-Chabot, A., Jarvis, K., & O'Halloran, R. M. (2006). *Cases in foodservice and clinical nutrition management.* Upper Saddle River, NJ: Pearson Prentice Hall.
4. "Long-term Care Mock Survey: Kitchen Sanitation Inspection" by M. Altman-Traub in Allen-Chabot, A., Jarvis, K., & O'Halloran, R. M. (2006). *Cases in foodservice and clinical nutrition management.* Upper Saddle River, NJ: Pearson Prentice Hall.
5. "Outbreak at the Gates Hotel" in Williams, A. G (1997). *Hospitality cases in marketing and operations.* Upper Saddle River, NJ: Pearson Prentice Hall.

Web Sources

www.fsis.usda.gov USDA Food Safety and Inspection Service

www.dhs.gov U.S. Department of Homeland Security

www.foodsafety.gov U.S. Government Food Safety Web site

www.extension.iastate.edu/foodsafety/HACCP HACCP Information Center, Iowa State University

www.extension.iastate.edu/foodsafety Iowa State University Extension Food Safety Web site

www.fightbac.org Partnership for Food Safety Education

https://fsrio.nal.usda.gov/ Food Safety Research Information Office at the National Agriculture Library