

CHAPTER 13

Community Food Supply and Health

KEY CONCEPTS

- Modern food production, processing, and marketing have both positive and negative influences on food safety.
- Many organisms in contaminated food transmit disease.
- Poverty often prevents individuals and families from having adequate access to their community food supply.

The health of a community largely depends on the safety of its available food and water supply. The American system of government control agencies and regulations, along with local and state public health officials, works diligently to maintain a safe food supply. The food supply in the United States has undergone dramatic changes during the past few decades.

This chapter explores the factors that influence the safety of food. Potential health problems related to the food supply can arise from several sources, such as lack of sanitation, food-borne disease, and poverty.

FOOD SAFETY AND HEALTH PROMOTION

Government Control Agencies

The food supply in the United States has exploded in recent years, and keeping the food supply safe is no small task. Several federal agencies help to control food safety and quality. The U.S. Food and Drug Administration (FDA) is the primary governing body of the American food supply, with the exception of meat and poultry. The Food Safety and Inspection Service of the U.S. Department of Agriculture (USDA) is responsible for the food safety of both domestic and imported meat

and poultry (Figure 13-1), and the National Marine Fisheries Service governs the safety of seafood and fisheries. The Environmental Protection Agency regulates the use of pesticides and other chemicals and ensures the safety of public drinking water. The regulation of advertising and of the truthful marketing of food products is a large job that is the duty of the Federal Trade Commission. The Centers for Disease Control and Prevention monitors and investigates cases of food-borne illness, and it is proactive with regard to education and prevention. Multiple other federal, state, and *local agencies* participate in education and research to promote the safety of the food supply.



Figure 13-1 The safety of pork and other meat products is the responsibility of the U.S. Department of Agriculture and the Food Safety and Inspection Service. (Courtesy Ken Hammond, Agricultural Research Service, U.S. Department of Agriculture, Washington, DC.)

The U.S. Food and Drug Administration

Although several agencies are involved in the overall food safety of products sold in the United States, only the diverse roles of the FDA are discussed here.

Enforcement of Federal Food Safety Regulations. The FDA is a law-enforcement agency that has been charged by the U.S. Congress with ensuring that America's food supply is safe, pure, and wholesome. The agency enforces federal food safety regulations through various activities, including the following: (1) enforcing food sanitation and quality control; (2) controlling food additives; (3) regulating the movement of foods across *state lines*; (4) maintaining the nutrition labeling of foods; (5) ensuring the safety of public food service; and (6) ensuring the safety of most food products. The agency's methods of enforcement are recall, seizure, injunction, and prosecution. The use of recall is the most common method, and this is followed by seizures of contaminated food. Injunction involves a court order to stop the sale and production of a food item. This procedure is not common, and it generally occurs in response to a claim that a food item is potentially harmful or that it has not undergone appropriate testing or acquired adequate approval for sale.

Consumer Education. The FDA's division of consumer education conducts an active program of protection through consumer education and general public information. Special attention is given to nutrition misinformation. Pamphlets, books, posters, and other materials are prepared and distributed to individuals, students,

and community groups. Consumer specialists work in all FDA district offices. The Web site www.foodsafety.gov is an organization that serves as the liaison between the public and all government agencies that are involved in food safety.

Research. Along with the USDA's Agricultural Research Service, FDA scientists continually evaluate foods and food components through their own research. For a more health-conscious public and a changing marketplace, the FDA is developing nutrition guidelines for a variety of food products, including main dishes, meat substitutes, fruit juices and fruit drinks, and snack foods. The FDA has a long history of food-safety activities, research, programs, and initiatives.

Development of Food Labels

Early Development of Label Regulations

During the mid-1960s, the FDA established "truth in packaging" regulations that dealt mainly with food standards. As food processing developed and the number of items grew, the labels included more nutrition information. Both types of label information—standards and nutrition facts—are important to consumers.

Food Standards. The basic standard of identity requires that labels on foods that do not have an established reference standard must list all of the ingredients in order of relative amount found in the product. Other food standard information on labels relates to food quality, fill of container, and enrichment.

Nutrition Information. Under regulations that were adopted in 1973, the FDA began developing a labeling system that describes a food's nutritional value. Some producers began to add limited information on their own to meet this increasing market demand. Many people became concerned that nutrition labeling was inadequate, but the real problem was what and how much was being labeled and in what format. Information about nutrients and food constituents that consumer groups believed should be listed on labels included the amount of macronutrients (i.e., carbohydrate, protein, and fat) and their total energy value (i.e., calories), key micronutrients (e.g., calcium, iron, vitamin A), sodium, cholesterol, trans fat, and saturated fat. Concerned public and professional groups also want nutrients to be identified in terms of percentages of the current Dietary Reference Intake standards per defined portion. Surveys indicate that 60% to 80% of shoppers consult the food label before purchasing a new product and that 30% to 40% of those individuals make their decision to buy on the basis of the information provided.¹

Background of Present U.S. Food and Drug Administration Label Regulations

Over the past 20 years, two factors have fueled rapid progress toward better food labels: (1) an increase in the variety of food products entering the U.S. marketplace; and (2) changing patterns of American eating habits. Both factors led many health-conscious consumers and professionals alike to rely increasingly on nutrition labeling to help with the meeting of health goals. A number of labeling problems persisted, including a lack of uniformity, misleading health claims, and imprecise terms such as “natural” and “light.”

These problems indicated a need to reorganize and coordinate the entire food-labeling system. This need had been reinforced by three previous landmark reports that related nutrition and diet to national health goals: *The Surgeon General's Report on Nutrition and Health*, the National Research Council's *Diet and Health Report*, and the Public Health Service's national health goals and objectives, *Healthy People 2000*. On the basis of these reports, the Institute of Medicine of the National Academy of Sciences established a Committee on the Nutrition Components of Food Labeling to study and report on the scientific issues and practical needs involved in food-labeling

reform. The committee's report provided basic guidelines for the rule-making process conducted by the FDA, the USDA, and the U.S. Department of Health and Human Services for submission to Congress to achieve the needed reforms (see the For Further Focus box, “Nutrition Labeling: Recommendations for a New Century”). Three areas of concern formed the basis of the recommendations from the Institute of Medicine: (1) foods for mandatory regulations; (2) the format of label information; and (3) the education of consumers. This report became the basic guideline for the final law and regulations that were enacted by the U.S. Congress in 1994.

Current Food Label Format

Nutrition Facts Label. The food label format that is so familiar now is quite different from the one used during the 1970s and 1980s. The title “Nutrition Facts” is printed in bold, eye-catching letters (Figure 13-2). Manufacturers may choose to include additional information, such as calories from saturated fat, polyunsaturated fat, mono-unsaturated fat, potassium, soluble and insoluble fiber, sugar alcohol (e.g., sorbitol), other carbohydrates, or other vitamins and minerals.

Another key term is *percent daily value* (%DV). The FDA set 2000 calories as the reference amount for

FOR FURTHER FOCUS

NUTRITION LABELING: RECOMMENDATIONS FOR A NEW CENTURY

The U.S. government is committed by law to the food-labeling reform mandated by a health-conscious public. A proliferation of new health-related food products and concerned health professionals have created a demand for accurate information on the foods that are sold in the United States. Nutrition is a strong selling point in today's consumer market.

The initial report and recommendations of the Institute of Medicine's Committee on the Nutrition Components of Food Labeling formed the foundation for the final implementation of the Nutrition Labeling and Education Act. This baseline focus resulted from a 1-year study requested by the U.S. Department of Health and Human Services and the U.S. Department of Agriculture. The committee made several recommendations that are embodied in the Nutrition Labeling and Education Act law.

Foods Covered by Nutrition Labeling

- Nutrition labeling should be mandatory on most packaged foods.
- Nutrition labeling should be provided at the point of purchase for produce, seafood, meats, and poultry.
- Restaurants should make the nutrient content of menu items available to customers on request.

Label Presentation

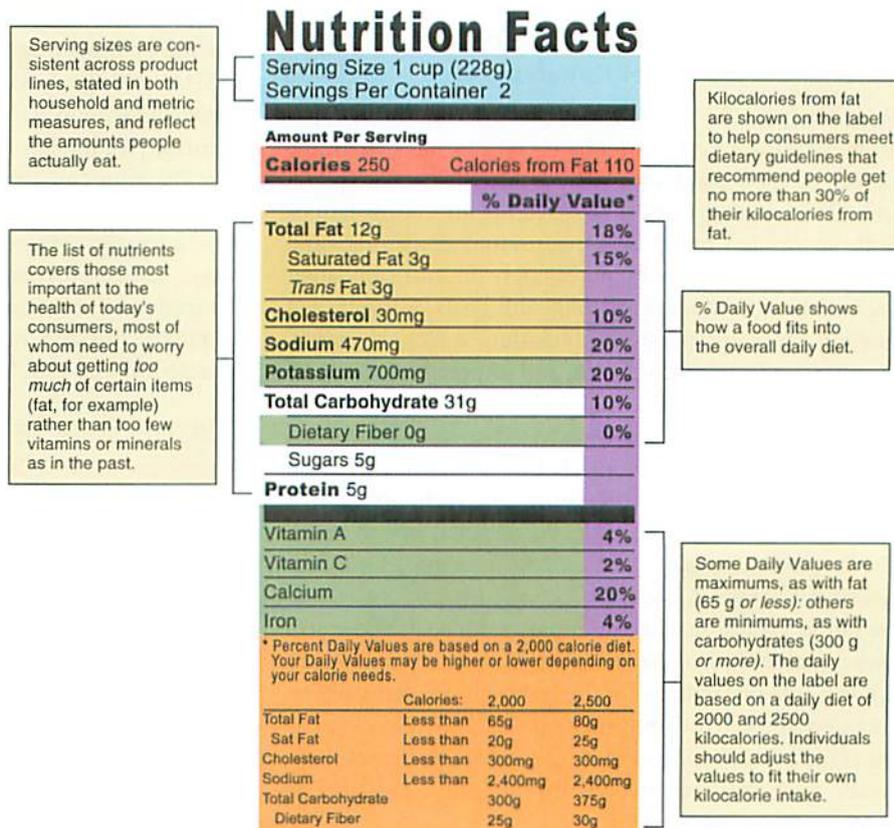
- The U.S. Food and Drug Administration and the U.S. Department of Agriculture set the standardized serving sizes.
- More complete ingredient listings should be provided on all foods.
- A modified regulatory scheme should be established for the development and approval of lower-fat alternative foods that currently have standards of identity.

Educating Consumers

- A well-designed nutrition labeling program should be fashioned as one part of a comprehensive education program, concurrent with the adoption of regulations for the labeling of nutrition content and its format, to help consumers make wise dietary choices.

From the beginning of the process, Congress wanted to develop legislative proposals to clarify the legal basis for these reforms. The food industry, health professionals, and consumer groups wanted to promote changes in nutrition labeling that reflect the current Dietary Reference Intakes and related product development. The recommendations of the committee have provided a helpful foundation for all concerned.

Figure 13-2 An example of a food product label showing the Nutrition Facts box that details nutrition information and that is mandated by the U.S. Food and Drug Administration under the Nutrition Labeling and Education Act. (Courtesy the U.S. Food and Drug Administration, Washington, DC.)



calculating the %DV, although individuals may vary greatly with regard to their specific needs. As a reference tool, the %DVs can be used to determine the overall value of a specific nutrient in the food (see the For Further Focus box, "Glossary of Terms for Current Labels"). For example, if the %DV for fiber in one serving of whole grain bread is 10%, a person who is eating the bread acquires one tenth of the recommended total fiber intake for his or her day.

In addition, the serving size (i.e., the amount of the food that is customarily consumed at one time) must be given and expressed in household measures; this is followed by the metric weight in parentheses and the total number of servings per container.²

Health Claims. Health claims that link nutrients or food groups with a risk for disease are strictly regulated. To make an association between a food product and a specific disease, the FDA must approve the claim, the food must meet the criteria set forth for that specific claim, and the wording used on the package must be approved. A list of nutrients that are currently approved for use in the United States and the specific diseases that they are associated with is given in the For Further Focus box entitled "Glossary of Terms for Current Labels." An

example of such a health claim would be the link between a diet that is low in saturated fat and cholesterol and a reduced risk of coronary heart disease. For a food to carry this label, it must be low in saturated fat, low in cholesterol, and low in total fat. If the food is fish or game meat, it must be deemed "extra lean." The specific wording of this example claim must include the following: *saturated fat and cholesterol, coronary heart disease, or heart disease*; there must also be a physician's statement about the claim that defines high or normal total cholesterol. The FDA also provides model claim statements from which food producers may choose. For this specific claim, the model statement is as follows: "Although many factors affect heart disease, diets low in saturated fat and cholesterol may reduce the risk of this disease."³

FOOD TECHNOLOGY

America's food supply has radically changed over the years. These changes, which have swept the food marketing system, are rooted in widespread social changes and scientific advances. The agricultural and food processing industries have developed various chemicals to increase and preserve the food supply. However, critics voice



FOR FURTHER FOCUS

GLOSSARY OF TERMS FOR CURRENT LABELS

To improve communication between producers and consumers, all producers must use the standard wording supplied by the U.S. Food and Drug Administration (FDA). Whether these terms are used in the Nutrition Facts box or elsewhere as part of the manufacturer's product description, all producers must use the commonly accepted terms. The following is a sampling of these terms.

Nutrition Facts Box

Daily Values

Daily values (DVs) are reference values that relate the nutrition information to a total daily diet of 2000 kcal, which is appropriate for most women and teenage girls as well as for some sedentary men. The footnote indicates the daily values for a 2500-kcal diet, which meets the needs of most men, teenage boys, and active women. To help consumers determine how a food fits into a healthy diet, the following nutrients, in the order given, must be listed as %DV:

- Total fat
- Saturated fat
- Trans fat
- Cholesterol
- Sodium
- Total carbohydrate
- Dietary fiber
- Vitamins A and C
- Calcium and iron

Other vitamins and minerals may be listed if the manufacturers choose to do so, but this is not required.

Daily Reference Value

As part of the DVs listed, the daily reference values are a set of dietary standards for the following nine nutrients: total fat; saturated fat; trans fat; cholesterol; total carbohydrate; dietary fiber; protein; potassium; and sodium. The daily reference values do not appear on the label, because they are part of a food's DV.

Reference Daily Intake

As part of the DVs listed, the Reference Daily Intakes (RDIs) are a set of dietary standards for essential vitamins, minerals, and protein. RDIs are based on the actual Recommended Dietary Allowances (RDAs), when available, or the Adequate Intake values. The term *RDI* replaces the old term *US RDA*, which was developed by food manufacturers as an estimate that was based on previous RDAs. RDIs do not appear on the label, because they are part of a food's DV.

Descriptive Terms on Products

The FDA has specifically defined many terms. Manufacturers must follow these definitions if they use these terms on their product. The following are examples:

- *Fat free*: Less than 0.5 g of fat per serving.
- *Low cholesterol*: 20 mg of cholesterol or less per serving and per 100 g; 2 g saturated fat or less per serving. Any label claim about low cholesterol is prohibited for all foods that contain more than 2 g of saturated fat per serving.
- *Light* or *Lite*: At least a one-third reduction in kilocalories. If fat contributes 50% or more of total kilocalories, fat content must be reduced by 50% compared with the reference food.
- *Less sodium*: At least a 25% reduction; 140 mg or less per reference amount per serving.
- *High*: 20% or more of the DV per serving.
- *Reduced saturated fat*: At least 25% less saturated fat than an appropriate reference food.
- *Lean*: Applied to meat, poultry, and seafood; less than 10 g of fat, 4 g of saturated fat, and 95 mg of cholesterol per serving.
- *Extra lean*: Applied to meat, poultry, and seafood; less than 5 g of fat, 2 g of saturated fat, and 95 mg of cholesterol per serving.

For more information, see "How to Understand and Use the Nutrition Facts Label" on the FDA Web site at www.fda.gov/Food/ResourcesForYou/Consumers/NFLPM/ucm274593.htm.

Health Claims

The FDA guidelines indicate that any health claim on a label must be supported by substantial scientific evidence. The following claims meet this test:

- Low sodium and the prevention of hypertension
- Calcium and vitamin D and the prevention of osteoporosis
- Low dietary fat and a reduced risk of cancer
- Low dietary cholesterol and saturated fat and a reduced risk of coronary heart disease
- Fiber-containing grain products, fruits, and vegetables and a reduced risk of cancer
- Grain products and fruits and vegetables that contain fiber, especially soluble fiber, and the prevention of coronary heart disease
- Fruits and vegetables that are rich in vitamins A or C and a lowered risk of cancer
- Folate and the prevention of neural tube defects
- Soy protein and a reduced risk of coronary heart disease
- Stanols/sterols and a reduced risk of coronary heart disease

For more information, refer to "Health Claims Meeting Significant Scientific Agreement" on the FDA Web site at www.fda.gov/Food/LabelingNutrition/LabelClaims/HealthClaimsMeetingSignificantScientificAgreementSSA/default.htm.

concerns about how these changes have affected food safety and the overall environment. Such concerns are usually focused on pesticide use and food additives.

Agricultural Pesticides

Reasons for Use

Large American agricultural corporations as well as individual farmers use a number of chemicals to improve their crop yields. These materials have made possible the advances in food production that are necessary to feed a growing population. For example, farmers use certain chemicals to control a wide variety of destructive insects that reduce crop yield (Figure 13-3).

Problems

Concerns and confusion continue regarding the use and effects of such chemicals. The four general areas of concern are as follows: (1) pesticide residues on foods; (2) the gradual leaching of the chemicals into groundwater and surrounding wells; (3) the increased exposure of farm workers to these strong chemicals; and (4) the increased amount of chemicals necessary as insects develop tolerance. Over time, the use of these chemicals has created a pesticide dilemma, and there is currently no clear answer regarding what to do in the face of conflicting interests. Thousands of pesticides are in use, and assessing the

risks of specific pesticides is an important but complicated task.

Alternative Agriculture

An increasing number of concerned farmers, with help from soil scientists, are turning away from heavy pesticide use toward alternative agricultural methods.

Organic Farming. Organic plant foods are grown without synthetic pesticides, fertilizers, sewage sludge, genetically modified organisms, or ionizing radiation. Organic meat, poultry, eggs, and dairy products are from animals that have been raised without antibiotics or growth hormones. In October 2002, the USDA enacted a set of nationally recognized standards to identify certified organic food. For a food to carry the USDA Organic Seal (Figure 13-4), the farm and processing plant where the food was grown and packaged must have undergone government inspections and met the strict USDA organic standards (see the For Further Focus box, “Organic Food Standards”).⁴ All foods that are produced organically are not required to use the organic label; it is a voluntary program. However, companies that are using the label on their food without certification face a large fine. Sales of organic foods are rapidly growing, and an increasing number of farmers—especially in California, which is the major supplier of U.S. fruits and vegetables—are using **organic farming**.

Certified organic foods are not recognized as being more safe or more nutritious than conventionally produced foods.⁵ Organic farmers can still use natural pesticides and fertilizers; therefore, they are not producing pesticide-free foods. Other common points of confusion are with the use of the following terms: *natural*, *hormone free*, and *free range*. These terms are not synonymous with *organic*. Truthful terms about the production of a food can appear on the food label, but they do not mean that the product is organic. The term *natural* may be used on products that contain no artificial ingredients (e.g., coloring, chemical preservatives) and if the product and its ingredients are not more than minimally processed. The Food Safety and Inspection Service of the USDA does not approve use of the terms *hormone free* or *antibiotic free*.



Figure 13-3 A farmer applies insecticide to a corn crop. (Courtesy Ken Hammond, Agricultural Research Service, U.S. Department of Agriculture, Washington, DC.)

organic farming the use of farming methods that employ natural means of pest control and that meet the standards set by the National Organic Program of the U.S. Department of Agriculture; organic foods are grown or produced without the use of synthetic pesticides or fertilizers, sewage sludge, genetically modified organisms, or ionizing radiation.



FOR FURTHER FOCUS

ORGANIC FOOD STANDARDS

The National Organic Program, which is a constituent of the U.S. Department of Agriculture (USDA), was established to ensure standards for organic foods. In response to the growing market, the National Organic Program has set strict standards for the growth, production, and labeling of organic foods. Although many methods prohibited by the organic standards (e.g., irradiation, genetic modification) are deemed safe by the USDA, these methods of farming have been banned in certified organic foods because of public concern.

Organic foods have four labeling categories with specific guidelines for each, as follows:

1. **100% organic:** Products that carry this label must be made or produced exclusively with certified organic ingredients, and they must have passed a government inspection. These products may use the USDA Organic Seal on their labels and advertisements.
2. **Organic:** Products labeled as organic must contain 95% to 100% organic ingredients and also must have passed a government inspection. The National Organic Program must approve all other ingredients for use as nonagricultural substances or as products not commercially available in organic form. These products may also use the USDA Organic Seal with the percentage of organic ingredients listed.

3. **70% organic ingredients:** Products made with at least 70% certified organic ingredients may state on the product label “made with organic ingredients” and list up to three ingredients or food groups. These foods also must meet the National Organic Program guidelines for growth or production without synthetic pesticides, fertilizers, sewage sludge, bioengineering, or ionizing radiation. The USDA Organic Seal may not be displayed on these products or used in any advertising.
4. **Less than 70% organic ingredients:** Foods made with less than 70% certified organic ingredients may not use the USDA Organic Seal or make any organic claims on the front panel of the package. They can list the specific organic ingredients on the side panel of the package.

All food products made with at least 70% organic ingredients must also supply the name and address of the government-approved certifying agent on the product.

For more information about the USDA organic standards, visit the National Organic Program Web site at www.ams.usda.gov/AMSv1.0/nop; call the National Organic Program at 202-720-3252; or write to USDA-AMS-National Organic Program, 1400 Independence Avenue, SW, Room 2646-South, Stop 0268, Washington, DC 20250.



Figure 13-4 Official U.S. Department of Agriculture organic seal, which is available at www.ams.usda.gov/AMSv1.0/nop. (Courtesy the National Organic Program, Agricultural Marketing Service, U.S. Department of Agriculture, Washington, DC.)

Instead, the phrases *raised without added hormones* and *raised without added antibiotics* are allowed, provided that the producer is able to supply an affidavit that attests to the production practices that are used to support the claim. One important note about the use of hormones is that they are approved for use only in beef cattle and lamb production. Therefore, any such claim on a poultry product would be allowed only if it were immediately followed by this statement: “Federal regulations prohibit the use of hormones in poultry.”

Organic farming is safer for the soil, the water, the agricultural workers, and the birds. Unfortunately, compared with conventional farming, organic farming is less efficient. Without synthetic pesticides and fertilizers, crops are smaller and require more land. As a result, the products are more expensive.

Biotechnology. Plant physiologists are developing strains of genetically modified (GM) foods that reduce the need for toxic pesticides and herbicides. Genetic manipulation in various forms has been used to improve crops for thousands of years, but most U.S. consumers are unaware of the extent to which these foods have entered the marketplace. In the United States, 93% of soybean crop acreage and a steadily increasing percentage of corn

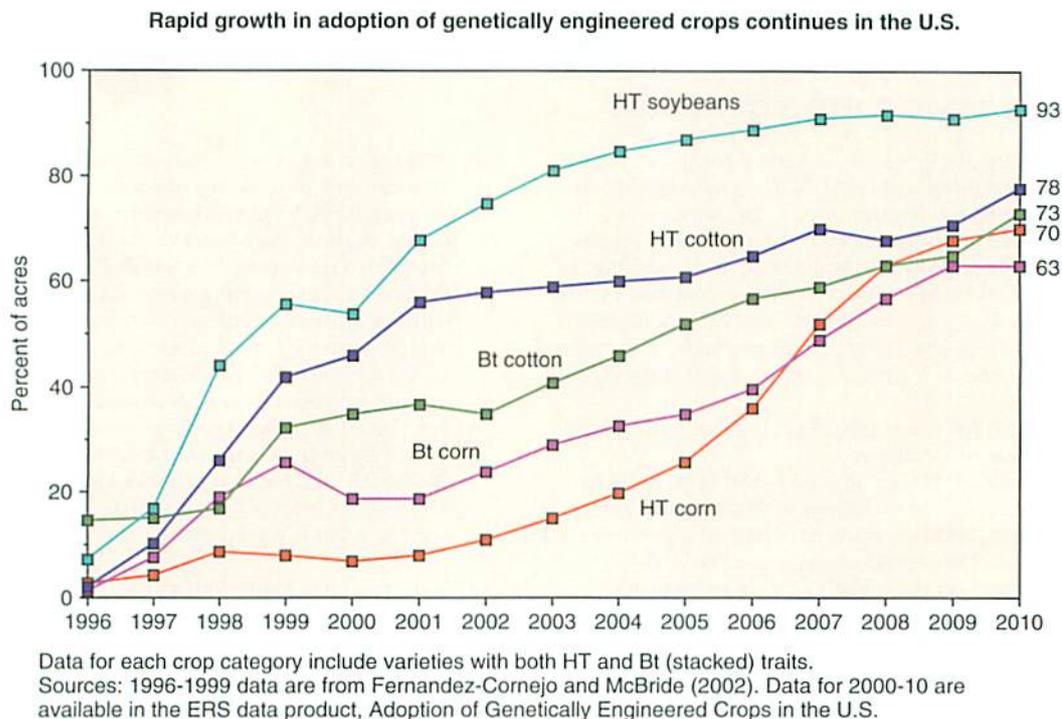


Figure 13-5 Adoption of genetically engineered crops continues to grow rapidly in the United States. (Reprinted from the U.S. Department of Agriculture, Economic Research Service. *Adoption of genetically engineered crops in the U.S., 2010*, U.S. Department of Agriculture: Washington, DC; 2010) Bt - *Bacillus thuringiensis* bacterium HT - herbicide tolerant.

crops are GM herbicide-tolerant varieties⁶ (Figure 13-5). Most people in the United States have consumed some form of GM foods at some point, such as seedless oranges or watermelons. An example of biotechnology in today's agriculture is the use of GM corn that expresses a specific protein that ultimately serves as an insecticide. Approved genetic modifications are currently used to protect against virus infections and insects on tomatoes, potatoes, squash, papayas, and other crops. GM crops are extensively tested for their composition, safety, and environmental effects. The National Institutes of Health, the Animal Plant Health Inspection Service of the USDA, the FDA, and the Environmental Protection Agency are all involved in the strict regulation of GM foods in commercial use, which are the most heavily regulated new foods.

The benefits of biotechnology are not limited to the producer. Technology is advancing to the point of engineering food to increase its quality, safety, and nutritional value.⁷ Plants are produced with increased antioxidants and improved fatty acid and amino acid profiles, all of which are beneficial to the consumer and which may have positive effects on human nutrition worldwide. More than 50 biotechnology crop products are approved for commercialization in the United States (Figure 13-6).



Figure 13-6 A geneticist and technician evaluate sugar beet breeding in California. (Courtesy Scott Bauer, Agricultural Research Service, U.S. Department of Agriculture, Washington, DC.)

Such forms of agriculture remain controversial around the world because of many unknown factors regarding the long-term effects on the environment and overall human health. Current testing procedures are unable to determine potential problems from long-term use, such as carcinogenicity or neurotoxicity. Research that was completed with soybeans revealed that wild-type and GM soybean varieties had exactly the same allergenicity; thus, genetic modification did not increase the likelihood of allergies in this crop.⁸ This type of research will be important for all types of GM crops to ensure safety and improve consumer acceptability.

Irradiation. Irradiation can kill bacteria and parasites that are on food after harvest. Irradiation helps to prevent food-borne illness caused by *Escherichia coli*, *Salmonella*, *Campylobacter*, *Listeria*, *Cyclospora*, *Shigella*, and *Salmonella*.⁹ Three different methods of irradiation are used, all of which are approved by the World Health Organization, the Centers for Disease Control and Prevention, the USDA, and the FDA. The use of irradiation is not a new science; wheat flour and white potatoes were approved for irradiation during the early 1960s. In addition to reducing or eliminating disease-causing germs, irradiation can be used to increase the shelf life of produce. Foods that are irradiated have unaltered nutritional value; they are not radioactive, they have no harmful substances introduced as a result of irradiation, but they may taste slightly different.⁹ A variety of foods have been approved for irradiation in the United States, including meat, poultry, grains, some seafood, fruits, vegetables, herbs, and spices. The FDA requires that all irradiated foods be appropriately labeled with either the radura symbol for irradiation (Figure 13-7) or with a written description that states that the food has been exposed to irradiation.

Consumer rejection in the United States and around the world is mainly the result of altered taste and a fear of the unknown long-term effects of irradiation on human health. Irradiation does introduce a slight increase in trans fatty acid content in meats,¹⁰ which is a known health risk. The U.S. government continues to support the



Figure 13-7 Radura symbol of irradiation. (Courtesy the Food Safety and Inspection Service, U.S. Department of Agriculture, Washington, DC.)

use and safety of such foods; however, without consumer acceptance, companies that are using such procedures have limited success.

Food Additives

The use of food additives (i.e., chemicals that are intentionally added to foods to prevent spoilage and extend shelf life) is not new to the food industry, either. Table 13-1 lists examples of food additives. The two most common additives are sugar and salt, although consumers often do not recognize these basic ingredients as food additives. Some additives have been used for centuries as preservatives, especially salt in cured meats. The phrase *generally recognized as safe* is used to define additives that have been used in foods and that do not require FDA approval.

Over the past few decades, the number and variety of food additives in the food supply have increased; the current variety of food market items would be impossible without them. Scientific advances have created processed food products, and the changing society has created a market demand. The expanding population, a larger workforce, and more complex family life have increased the desire for more variety and convenience in foods as well as better safety and quality. Food additives help to achieve these needs, and they serve many other purposes, such as the following:

- They enrich foods with added nutrients.
- They produce uniform qualities (e.g., color, flavor, aroma, texture, general appearance).
- They standardize many functional factors (e.g., thickening, stabilization [i.e., keeping parts from separating]).
- They preserve foods by preventing oxidation.
- They control acidity or alkalinity to improve flavor and texture of the cooked product.

A number of micronutrients and antioxidants are used as additives in processed foods not for their ability to increase nutrient content but rather for their technical effects either during processing or in the final product.

FOOD-BORNE DISEASE

Prevalence

Many disease-bearing organisms inhabit the environment and can contaminate food and water. Much has been learned during the past decade about the pathogens that commonly contaminate food and water and about ways to prevent food-borne illness outbreaks. However, lapses in control still occur, and these can result in high

TABLE 13-1 EXAMPLES OF FOOD ADDITIVES

The following summary lists the types of common food ingredients, why they are used, and some examples of the names that can be found on product labels that refer to them. Some additives are used for more than one purpose.

Types of Ingredients	What They Do	Examples of Uses	Names Found on Product Labels
Preservatives	Prevent food spoilage from bacteria, molds, fungi, or yeast (antimicrobials); slow or prevent changes in color, flavor, or texture and delay rancidity (antioxidants); maintain freshness	Fruit sauces and jellies, beverages, baked goods, cured meats, oils and margarines, cereals, dressings, snack foods, fruits, and vegetables	Ascorbic acid, citric acid, sodium benzoate, calcium propionate, sodium erythorbate, sodium nitrite, calcium sorbate, potassium sorbate, BHA, BHT, EDTA, tocopherols (vitamin E)
Sweeteners	Add sweetness with or without the extra calories	Beverages, baked goods, confections, table-top sugar, substitutes, many processed foods	Sucrose (sugar), glucose, fructose, sorbitol, mannitol, corn syrup, high fructose corn syrup, saccharin, aspartame, sucralose, acesulfame potassium (acesulfame-K), neotame
Color additives	Offset color loss due to exposure to light, air, temperature extremes, moisture and storage conditions; correct natural variations in color; enhance colors that occur naturally; provide color to colorless and “fun” foods	Many processed foods, (candies, snack foods margarine, cheese, soft drinks, jams and jellies, gelatins, pudding and pie fillings)	FD&C Blue Nos. 1 and 2, FD&C Green No. 3, FD&C Red Nos. 3 and 40, FD&C Yellow Nos. 5 and 6, Orange B, Citrus Red No. 2, annatto extract, beta-carotene, grape skin extract, cochineal extract or carmine, paprika oleoresin, caramel color, fruit and vegetable juices, saffron (Note: Exempt color additives are not required to be declared by name on labels but may be declared simply as colorings or color added)
Flavors and spices	Add specific flavors (natural and synthetic)	Pudding and pie fillings, gelatin dessert mixes, cake mixes, salad dressings, candies, soft drinks, ice cream, BBQ sauce	Natural flavoring, artificial flavor, and spices
Flavor enhancers	Enhance flavors already present in foods (without providing their own separate flavor)	Many processed foods	Monosodium glutamate (MSG), hydrolyzed soy protein, autolyzed yeast extract, disodium guanylate or inosinate
Fat replacers (and components of formulations that are used to replace fats)	Provide expected texture and a creamy “mouth-feel” in reduced-fat foods	Baked goods, dressings, frozen desserts, confections, cake and dessert mixes, dairy products	Olestra, cellulose gel, carrageenan, polydextrose, modified food starch, microparticulated egg white protein, guar gum, xanthan gum, whey protein concentrate
Nutrients	Replace vitamins and minerals lost in processing (enrichment), add nutrients that may be lacking in the diet (fortification)	Flour, breads, cereals, rice, macaroni, margarine, salt, milk, fruit beverages, energy bars, instant breakfast drinks	Thiamine hydrochloride, riboflavin (vitamin B ₂), niacin, niacinamide, folate or folic acid, beta carotene, potassium iodide, iron or ferrous sulfate, alpha tocopherols, ascorbic acid, vitamin D, amino acids (L-tryptophan, L-lysine, L-leucine, L-methionine)
Emulsifiers	Allow smooth mixing of ingredients, prevent separation Keep emulsified products stable, reduce stickiness, control crystallization, keep ingredients dispersed, and to help products dissolve more easily	Salad dressings, peanut butter, chocolate, margarine, frozen desserts	Soy lecithin, mono- and diglycerides, egg yolks, polysorbates, sorbitan monostearate

TABLE 13-1 EXAMPLES OF FOOD ADDITIVES—cont'd

Types of Ingredients	What They Do	Examples of Uses	Names Found on Product Labels
Stabilizers, thickeners, binders, and texturizers	Produce uniform texture, improve “mouth-feel”	Frozen desserts, dairy products, cakes, pudding and gelatin mixes, dressings, jams and jellies, sauces	Gelatin, pectin, guar gum, carrageenan, xanthan gum, whey
pH control agents and acidulants	Control acidity and alkalinity, prevent spoilage	Beverages, frozen desserts, chocolate, low-acid canned foods, baking powder	Lactic acid, citric acid, ammonium hydroxide, sodium carbonate
Leavening agents	Promote rising of baked goods	Breads and other baked goods	Baking soda, monocalcium phosphate, calcium carbonate
Anti-caking agents	Keep powdered foods free-flowing, prevent moisture absorption	Salt, baking powder, confectioner’s sugar	Calcium silicate, iron ammonium citrate, silicon dioxide
Humectants	Retain moisture	Shredded coconut, marshmallows, soft candies, confections	Glycerin, sorbitol
Yeast nutrients	Promote growth of yeast	Breads and other baked goods	Calcium sulfate, ammonium phosphate
Dough strengtheners and conditioners	Produce more stable dough	Breads and other baked goods	Ammonium sulfate, azodicarbonamide, L-cysteine
Firming agents	Maintain crispness and firmness	Processed fruits and vegetables	Calcium chloride, calcium lactate
Enzyme preparations	Modify proteins, polysaccharides and fats	Cheese, dairy products, meat	Enzymes, lactase, papain, rennet, chymosin
Gases	Serve as propellant, aerate, or create carbonation	Oil cooking spray, whipped cream, carbonated beverages	Carbon dioxide, nitrous oxide

Reprinted from the International Food Information Council and the U.S. Food and Drug Administration. *Food ingredients and colors, 2010* (website): www.fda.gov/Food/FoodIngredientsPackaging/ucm094211.htm#types. Accessed December 2010.

incidences of illness and death as well as economic burden. The estimated annual incidence of food-borne illness has been on the decline for most pathogens during recent years¹¹ (Figure 13-8). Microbiologic diseases—both bacterial and viral—represent the majority of these outbreaks nationwide, with a large range of costs associated with each type of infection. *Salmonella*, *Campylobacter*, *Shigella*, and *Cryptosporidium* are the most common infections seen during home and community outbreaks.

Food Sanitation

Buying and Storing Food

The control of food-borne disease focuses on strict sanitation measures and rigid personal hygiene. First, the food itself should be of good quality and not defective or diseased. Second, dry or cold storage should protect it from deterioration or decay, which is especially important for products such as refrigerated convenience foods; this is the fastest growing segment of the convenience food

market, and it is potentially the most dangerous, because these foods are not sterile. These vacuum-packaged or modified-atmosphere chilled food products are only minimally processed and not sterilized, and they are at risk of temperature abuse. Home refrigerator temperatures should be held at 40° F or lower. At temperatures of more than 45° F, any precooked or leftover foods are potential reservoirs for bacteria that survive cooking and that can then recontaminate cooked food. Food safety depends on the following critical actions¹² (Figure 13-9):

- *Clean*: Wash hands and surfaces often.
- *Separate*: Do not cross-contaminate.
- *Cook*: Cook to proper temperatures.
- *Chill*: Refrigerate promptly.

All food preparation areas must be scrupulously clean, and foods must be washed or cleaned well. Cooking procedures and temperatures must be followed as directed. All utensils, dishes, and anything else that comes in contact with food must be clean. Leftover food should be stored and reheated appropriately or discarded (Table 13-2). Food does not need to be cooled to room

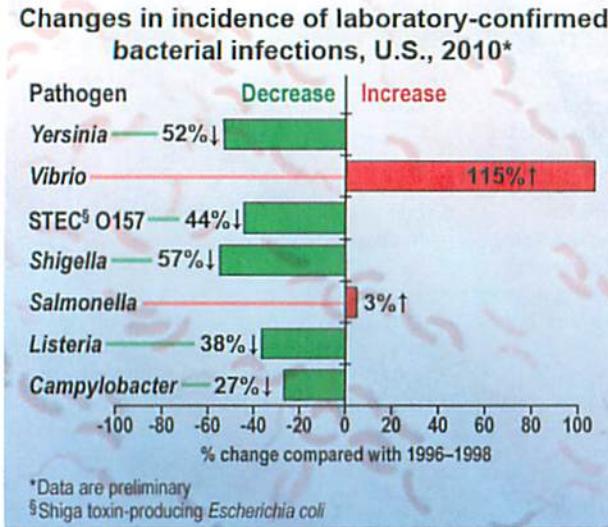


Figure 13-8 Changes in the incidence of laboratory-confirmed bacterial infections, United States, 2010. (From the Centers for Disease Control and Prevention. *Incidence of foodborne illness, 2010* (website): www.cdc.gov/Features/dsFoodbornellness. Accessed February 2012.)



Figure 13-9 The Partnership for Food Safety Education developed the “Fight BAC!” (i.e., bacteria) campaign to prevent food-borne illness. Campaign graphics are available at www.fightbac.org. (Courtesy Partnership for Food Safety Education, Washington, DC.)

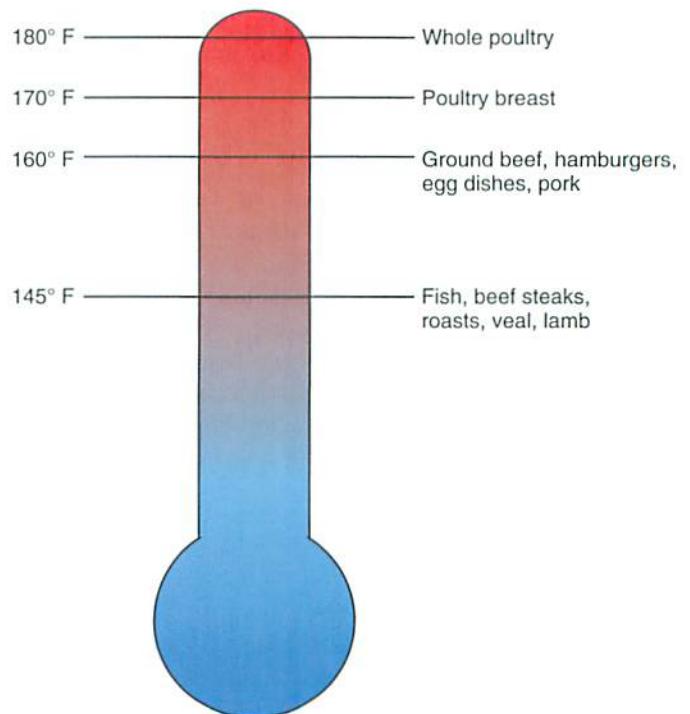
temperature before refrigerating; this practice allows food to sit in a temperature range that is perfect for bacterial growth. Leftovers should be refrigerated within 2 hours. Garbage must be contained and disposed of in a sanitary manner. Safe methods of food handling, cooking, and storage are simple and mostly common sense; however, they often are neglected, and this may lead to food-borne illness.

Food safety publications for all types of foods and populations can be found at the Food Safety and Inspection Service Web site at www.fsis.usda.gov.

Preparing and Serving Food

All people who handle food—especially those who work in public food services—should follow strict measures to prevent contamination. For example, washing hands properly and wearing clean clothing, gloves, and aprons are imperative. Basic rules of hygiene should apply to all people who are handling food, whether they work in food processing and packaging plants, process and package foods in markets, or prepare and serve food in restaurants. In addition, people with infectious diseases should have limited access to direct food handling.

The following are the minimal internal temperatures to be reached when cooking various foods:



The Hazard Analysis & Critical Control Point (HACCP) food safety system focuses on preventing food-borne illness by identifying critical points and eliminating

TABLE 13-2 COLD STORAGE

Product	Refrigerator (40° F)	Freezer (0° F)
Eggs		
Fresh, in shell	3 to 5 weeks	Do not freeze
Raw yolks and whites	2 to 4 days	1 year
Hard cooked	1 week	Does not freeze well
Liquid Pasteurized Eggs, Egg Substitutes		
Opened	3 days	Does not freeze well
Unopened	10 days	1 year
Mayonnaise, Commercial		
Refrigerate after opening	2 months	Do not freeze
Frozen Dinners and Entrees		
Keep frozen until ready to heat	—	3 to 4 months
Deli and Vacuum-Packed Products		
Store-prepared (or homemade) egg, chicken, ham, tuna, and macaroni salads	3 to 5 days	Does not freeze well
Hot Dogs and Luncheon Meats		
Hot Dogs		
Opened package	1 week	1 to 2 months
Unopened package	2 weeks	1 to 2 months
Luncheon Meat		
Opened package	3 to 5 days	1 to 2 months
Unopened package	2 weeks	1 to 2 months
Bacon and Sausage		
Bacon	7 days	1 month
Sausage, raw—from chicken, turkey, pork, beef	1 to 2 days	1 to 2 months
Smoked breakfast links, patties	7 days	1 to 2 months
Hard sausage—pepperoni, jerky sticks	2 to 3 weeks	1 to 2 months
Summer Sausage Labeled “Keep Refrigerated”		
Opened	3 weeks	1 to 2 months
Unopened	3 months	1 to 2 months
Corned Beef		
Corned beef, in pouch with pickling juices	5 to 7 days	Drained, 1 month
Ham, Canned, Labeled “Keep Refrigerated”		
Opened	3 to 5 days	1 to 2 months
Unopened	6 to 9 months	Do not freeze
Ham, Fully Cooked		
Vacuum sealed at plant, undated, unopened	2 weeks	1 to 2 months
Vacuum sealed at plant, dated, unopened	“Use-By” date on package	1 to 2 months
Whole	7 days	1 to 2 months
Half	3 to 5 days	1 to 2 months
Slices	3 to 4 days	1 to 2 months
Hamburger, Ground and Stew Meat		
Hamburger and stew meat	1 to 2 days	3 to 4 months
Ground turkey, veal, pork, lamb, and mixtures of them	1 to 2 days	3 to 4 months
Fresh Beef, Veal, Lamb, and Pork		
Steaks	3 to 5 days	6 to 12 months
Chops	3 to 5 days	4 to 6 months
Roasts	3 to 5 days	4 to 12 months
Variety meats—tongue, liver, heart, kidneys, chitterlings	1 to 2 days	3 to 4 months
Prestuffed, uncooked pork chops, lamb chops, or chicken breasts stuffed with dressing	1 day	Does not freeze well
Soups and stews, vegetable or meat added	3 to 4 days	2 to 3 months

Continued

TABLE 13-2 COLD STORAGE—cont'd

Product	Refrigerator (40° F)	Freezer (0° F)
Fresh Poultry		
Chicken or turkey, whole	1 to 2 days	1 year
Chicken or turkey, pieces	1 to 2 days	9 months
Giblets	1 to 2 days	3 to 4 months
Cooked Meat and Poultry Leftovers		
Cooked meat and meat casseroles	3 to 4 days	2 to 3 months
Gravy and meat broth	1 to 2 days	2 to 3 months
Fried chicken	3 to 4 days	4 months
Cooked poultry casseroles	3 to 4 days	4 to 6 months
Poultry pieces, plain	3 to 4 days	4 months
Poultry pieces in broth, gravy	1 to 2 days	6 months
Chicken nuggets, patties	1 to 2 days	1 to 3 months
Other Cooked Leftovers		
Pizza, cooked	3 to 4 days	1 to 2 months
Stuffing, cooked	3 to 4 days	1 month

Reprinted from the Food Safety and Inspection Service. *Safe food handling: basics for handling food safely* (website): www.fsis.usda.gov/Fact_Sheets/Basics_for_Handling_Food_Safely/index.asp. Accessed December 2010.

hazards. Many organizations, including the USDA and the FDA, use the HACCP standards. The USDA has developed specific standards for a variety of food products. For more information about HACCP, visit www.fda.gov/Food/FoodSafety/HazardAnalysisCriticalControlPointsHACCP/default.htm.

Food Contamination

Food-borne illness usually presents itself with flu-like symptoms, but it can advance to a lethal illness. Not all bacteria found in foods are harmful, and some are even beneficial (e.g., the bacteria in yogurt). Bacteria that are harmful to people are referred to as *pathogens*. Certain subgroups of the population are at higher risk for the development of food-borne illness as a result of age and physical condition. Groups with the highest risks are young children, pregnant women, elderly individuals, and people with compromised immune systems.

Food-borne illness generally results from the ingestion of bacteria, viruses, or parasites. Illness that results from bacteria is caused by either an infection or by toxins that are produced by the bacteria.

Bacterial Food Infections

Bacterial food infections result from eating food that is contaminated by large colonies of different types of bacteria. Specific diseases result from specific bacteria (e.g., salmonellosis, shigellosis, listeriosis).

Salmonellosis. Salmonellosis is caused by *Salmonella*, a bacterium that was named for the American veterinarian pathologist Daniel Salmon (1850-1914), who first

isolated and identified the species that commonly cause food-borne infections: *Salmonella typhi* and *Salmonella paratyphi*. Approximately 40,000 cases of salmonellosis are reported in the United States each year, although thousands of other cases likely go unreported.¹³ These organisms readily grow in common foods such as milk, custard, egg dishes, salad dressing, and sandwich fillings. Seafood from polluted waters—especially shellfish such as oysters and clams—may also be a source of infection. The unsanitary handling of foods and utensils can spread the bacteria. Resulting cases of gastroenteritis may vary from mild to severe diarrhea. Immunization, pasteurization, and sanitary regulations that involve community water and food supplies as well as food handlers help to control such outbreaks. Because the incubation and multiplication of the bacteria take time after the food is eaten, symptoms of food infection develop relatively slowly (i.e., up to 48 hours later). Symptoms include diarrhea, fever, vomiting, and abdominal cramps. The illness usually lasts 4 to 7 days, with most affected individuals recovering completely. Severe dehydration from diarrhea and vomiting may require intravenous fluids.

Shigellosis. Shigellosis is caused by the bacteria *Shigella*, which was named for the Japanese physician Kiyoshi Shiga (1870-1957), who first discovered a main species of the organism, *Shigella dysenteriae*, during a dysentery epidemic in Japan in 1898. Approximately 14,000 cases are reported annually, but because many cases are not diagnosed, the Centers for Disease Control and Prevention estimates that the actual number of cases may be as much as 20 times higher.¹⁴ Shigellosis is usually confined to the large intestine; it may vary from a mild,

transient intestinal disturbance in adults to fatal dysentery in young children. The bacteria grow easily in foods, especially milk, which is a common vehicle of transmission to infants and children. The boiling of water or the pasteurization of milk kills the organisms, but the food or milk may easily be reinfected through unsanitary handling. The disease is spread similarly to how salmonella is transmitted: by feces, fingers, flies and by foods such as milk and articles that are handled by unsanitary carriers. Shigellosis, similar to salmonellosis, is more common during the summer, and it most often occurs in young children.¹⁴ Symptoms appear within 4 to 7 days and include cramps, diarrhea, fever, vomiting, and blood or mucus in the stool.

Listeriosis. Listeriosis is caused by the bacteria *Listeria*, which was named for the English surgeon Baron Joseph Lister (1827-1912), who first applied knowledge of bacterial infection to the principles of antiseptic surgery in a benchmark 1867 publication that led to “clean” operations and the development of modern surgery. However, only within the past 30 years has knowledge of bacteria’s role as a direct cause of food-borne illness increased and the major species to cause human illness, *Listeria monocytogenes*, been identified. Before 1981, *Listeria* was thought to be an organism of animal disease that was transmitted to people only by direct contact with infected animals. However, this organism occurs widely in the environment and in high-risk individuals, such as elderly people, pregnant women, infants, and patients with suppressed immune systems. It can produce a rare but often fatal illness with severe symptoms such as diarrhea, flu-like fever and headache, pneumonia, sepsis, meningitis, and endocarditis. Approximately one third of all listeriosis cases occur in pregnant women.¹⁵ Food-borne disease has been traced to a variety of foods, including soft cheese, poultry, seafood, raw milk, refrigerated raw liquid whole eggs, and meat products (e.g., pâté).

Escherichia Coli. *Escherichia coli* was discovered by Theodor Escherich (1857-1911), a German pediatrician and bacteriologist who discovered the rod-shaped bacteria in 1885. It was not recognized as a human pathogen until 1982. There are many types of *E. coli*, and not all types are harmful to humans. In fact, some strains are part of the healthy gut flora that survive in the intestines and produce a valuable supply of vitamin K. The most common form of *E. coli* that results in about 70,000 cases of illness in North America per year is the Shiga toxin-producing strain O157:H7. This strain is most dangerous to young children and elderly adults (see the Drug-Nutrient Interaction box, “Drug Resistant *Escherichia coli* and the Food Supply”). Most cases involve diarrhea, stomach cramps, and low-grade fevers that start within 3 to 4 days after

ingestion and that usually resolve within 5 to 7 days. About 5% to 10% of individuals infected with *E. coli* will develop **hemolytic uremic syndrome**, which is a potentially lethal condition. *E. coli* is most often spread through fecal contamination (e.g., contaminated foods, not properly washing hands after changing diapers), undercooked meat, and unpasteurized foods (e.g., milk, apple cider, soft cheeses).¹⁶

Vibrio. Filippo Pacini (1812-1883) first isolated microorganisms that he called “vibrions” from cholera patients in 1854. This particular bacterial infection has been on the rise in the United States for the past decade¹⁷ (see Figure 13-8). It is a salt-requiring organism that inhabits the salt-water coastal regions of North America, and it is usually ingested by humans via contaminated seafood. Immunocompromised individuals are most susceptible to *Vibrio* infection. Thoroughly cooking seafood—especially shellfish such as oysters—reduces the risk of infection.

Bacterial Food Poisoning

Food poisoning is caused by the ingestion of bacterial toxins that have been produced in food as a result of the growth of specific kinds of bacteria before the food is eaten. The powerful toxin is directly ingested, so symptoms of food poisoning develop rapidly. Two types of bacterial food poisoning, staphylococcal and clostridial, are most commonly responsible.

Staphylococcal Food Poisoning. Staphylococcal food poisoning was named for the causative organism, which is mainly *Staphylococcus aureus*, a round bacteria that forms masses of cells. *S. aureus* poisoning is the most common form of bacterial food poisoning in the United States. Powerful preformed toxins in the contaminated food rapidly produce illness (i.e., 1 to 6 hours after ingestion). The symptoms appear suddenly, and they include severe cramping and abdominal pain with nausea, vomiting, and diarrhea, usually accompanied by sweating, headache, fever, and sometimes prostration and shock. However, recovery is fairly rapid, and symptoms subside within 24 to 48 hours¹⁸ (see the Clinical Applications box, “Case Study: A Community Food Poisoning Incident”). The amount of toxin ingested and the susceptibility of the individual eating it determine the degree of severity. The source of the contamination is usually a staphylococcal

hemolytic uremic syndrome a condition that results most often from infection with *Escherichia coli* and that presents with a breaking up of red blood cells (i.e., hemolysis) and kidney failure.



DRUG-NUTRIENT INTERACTION

DRUG RESISTANT *ESCHERICHIA COLI* AND THE FOOD SUPPLY

The agricultural use of antimicrobial drugs is suspected in the development of drug-resistant bacterial strains that are transmitted to humans via the food supply.¹ Drug-resistant strains of *Escherichia coli* bacteria are highly prevalent in the retail meat and poultry supplies. Resistance to first-line antibiotics by these bacteria represents a major cause of illness, death, and increased health care costs. Researchers have found that drug-resistant *E. coli* infections in humans were more closely related to the strains of bacteria found in chickens than to those found in the gut flora of humans, which suggests that drug-resistant *E. coli* strains are likely transmitted to humans via poultry that is carrying the infection.¹

In 2006, the United States experienced an outbreak of *E. coli* infection that was traced to commercially grown spinach. This prompted a nationwide recall of bagged spinach and of products that had been made with the contaminated spinach. Upon investigation, the U.S. Food and Drug Administration found several environmental risk

factors, including proximity to waterways that were exposed to cattle and wildlife feces.²

Although the washing of the spinach would not have prevented the *E. coli* outbreak, the U.S. Food and Drug Administration recommends the employment of safe food-handling practices among all consumers to prevent contamination from many causes.² Populations that are at risk for infection with drug-resistant strains of bacteria include children, elderly adults, and those who are immunocompromised. In health care settings, proper food safety practices are especially important. Drug-resistant strains of bacteria necessitate the long-term use of strong antibiotics. Nausea, vomiting, and diarrhea are common with antibiotic use as a result of the destruction of the natural gut flora. Some antibiotics like ciprofloxacin (Cipro) can bind to calcium, magnesium, iron, and zinc, thereby interfering with their absorption. Thus, the long-term use of this antibiotic can result in poor bioavailability of these minerals.³

Kelli Boi

1. Johnson JR, Sannes MR, Croy C, et al. Antimicrobial drug-resistant *Escherichia coli* from humans and poultry products, Minnesota and Wisconsin, 2002-2004. *Emerg Infect Dis.* 2007;13(6):838-846.
2. U.S. Department of Health and Human Services. *FDA finalizes report on 2006 spinach outbreak.* 2007 [cited December 2011; Available from: www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/2007/ucm108873.htm.
3. Pronsky Z. *Food-medication interactions.* 15th ed. Birchrunville, Penn: Food-Medication Interactions; 2008.

infection on the hand of a worker preparing the food. This infection is often minor and considered harmless, or it may even be unnoticed by the food handler. Foods that are particularly effective carriers of staphylococci and their toxins include custard or cream-filled bakery goods, processed meats, ham, tongue, cheese, ice cream, potato salad, sauces, chicken and ham salads, and combination dishes such as spaghetti and casseroles. The toxin causes no change in the normal appearance, odor, or taste of the food, so the victim has no warning. A careful food history helps to determine the source of the poisoning, and portions of the food are obtained for examination, if possible. Few bacteria may be found, because heating kills the organisms but does not destroy the toxins that have been produced.

Clostridial Food Poisoning. Clostridial food poisoning was named for the spore-forming, rod-shaped bacteria, mainly *Clostridium perfringens* and *Clostridium botulinum*, which can also form powerful toxins in infected foods.

C. perfringens spores are widespread in the environment, including soil, water, dust, refuse, and many other places. This organism multiplies in cooked meat and meat dishes, and it develops its toxin in foods that are held at warm or room temperatures for extended periods. A number of outbreaks from food eaten in restaurants,

college dining rooms, and school cafeterias have been reported. In most cases, cooked meat is improperly prepared or refrigerated. Control depends on the careful preparation and adequate cooking of meats, prompt service, and immediate refrigeration at sufficiently low temperatures.

The bacteria *C. botulinum* causes a far more serious and often fatal food poisoning, *botulism*, which results from the ingestion of food that contains its powerful toxin. Depending on the dose of toxin taken and the individual response, symptoms usually appear within 12 to 72 hours and, in severe cases, can result in death.¹⁹ Mortality rates are high. Nausea, vomiting, weakness, and dizziness are the initial symptoms. The toxin progressively irritates motor nerve cells and blocks the transmission of neural impulses at the nerve terminals, thereby causing a gradual paralysis. Sudden respiratory paralysis with airway obstruction is the major cause of death. *C. botulinum* spores are widespread in soil throughout the world and may be carried on harvested food to the canning process. Like all *Clostridia*, this species is **anaerobic** or nearly so. The relatively air-free can and canning

anaerobic a microorganism that can live and grow in an oxygen-free environment.



CLINICAL APPLICATIONS

CASE STUDY: A COMMUNITY FOOD POISONING INCIDENT

John and Eva Wesson agreed that their lodge dinner had been the best they had ever had, especially the dessert: custard-filled cream puffs, John's favorite. He had eaten two of them, despite Eva's protests; maybe that was why he began to feel ill shortly after they arrived home. Eva's stomach felt a little upset, too, so they both took some antacid pills, thinking that their "stomachaches" were from eating more rich food than they were accustomed to eating. They went to bed early.

However, by 11:00 PM, Eva woke up alarmed. John was vomiting, and he had diarrhea and increasingly severe stomach cramps. He complained of a headache, and his pajamas were wet with sweat. He had a fever and appeared to be in shock. Eva began to have similar pains and symptoms, although they were not as severe as John's pains.

One of their friends who had also been at the lodge dinner telephoned; she and her husband had the same symptoms.

By now, John was prostrate and unable to move. Eva immediately called 911, and they were both taken to the hospital. After treatment in the emergency department for shock, followed by observational care and rest the following day, John's symptoms had subsided, and he was allowed to go home. The physician advised John and Eva to eat lightly for a few days and to get more rest. He said that he would investigate the cause in the meantime. During the next few days, John and Eva learned that almost all their friends who had been at the lodge dinner had had an experience that was similar to their own.

The physician contacted the public health department to report the incident. His was one of several similar calls, a public health officer said, and the department was already investigating.

The following week, the public health officer returned the physician's call to report his findings. The cream puffs that the lodge restaurant had served that evening had been purchased from a local bakery. At the bakery, health officials had located a worker with an infected cut on his little

finger—"a small thing," the worker said. He could not understand what all the fuss was about.

The health officials also located the delivery truck driver, who had started out at midmorning to make his rounds and to take the cream puffs to the lodge. When they questioned the driver, they learned that the delivery truck had broken down during his afternoon deliveries, before he had reached the lodge. The driver said that he had been irritated by a 3-hour wait at the garage while the truck was being fixed, but he still got the order to the lodge restaurant in time for the dinner.

At the lodge, the chef said that everyone was so busy with the dinner that, when the cream puffs finally arrived, no one had time to give them much notice. They had decided not to put the cream puffs in the refrigerator because they were about to be served.

When John and Eva's physician called them afterward to report the story, John and Eva decided that they would not eat at the lodge restaurant again. Besides, by then, John had lost his taste for cream puffs.

Questions for Analysis

1. Why is the control of the community's food supply an important responsibility of the health department?
2. Which disease agents may be carried by food or water?
3. What agent caused John and Eva's illness? Was this a food infection or a food poisoning? Why?
4. While the investigation was occurring and before John and Eva learned the real cause of their illness, John thought it must have been caused by "those things farmers and food processors put into food these days." What substances did John mean? Give some examples.
5. Why are these materials used for growing and processing food?
6. What are some ways in which food is protected from its point of production to the table? How can food be preserved for later use?
7. Which agency controls food safety and quality? How does it do so?

temperatures (i.e., $\geq 27^{\circ}\text{C}$ [80°F]) provide good conditions for toxin production. The development of high standards in the commercial canning industry has eliminated this source of botulism, but cases still result each year, mainly from the ingestion of home-canned foods. Because boiling for 10 minutes destroys the toxin and not the spore, all home-canned food—no matter how well preserved it is considered to be—should be boiled for at least 10 minutes before it is eaten. Within the United States, Alaska and Washington have the highest incidence of botulism, with Alaska having more cases as a result of native customs of eating uncooked or partially cooked meat that has been fermented, dried, or frozen.

Table 13-3 summarizes examples of common food contamination.

Viruses

Illnesses that are produced by the viral contamination of food are few compared with those produced by bacterial sources. These include upper respiratory infections (e.g., colds, influenza) and viral infectious **hepatitis**. Explosive epidemics of infectious hepatitis have occurred in schools, towns, and other communities after the fecal contamination of water, milk, or food. Contaminated shellfish from polluted waters have also caused several outbreaks. Again, the stringent control of community water and food

TABLE 13-3 EXAMPLES OF FOOD-BORNE DISEASE

Organism	Common Name of Illness	Onset Time After Ingesting	Signs and Symptoms	Duration	Food Sources
<i>Bacillus cereus</i>	<i>B. cereus</i> food poisoning	10 to 16 hours	Abdominal cramps, watery diarrhea, nausea	24 to 48 hours	Meats, stews, gravies, vanilla sauce
<i>Campylobacter jejuni</i>	Campylobacteriosis	2 to 5 days	Diarrhea, cramps, fever, and vomiting; diarrhea may be bloody	2 to 10 days	Raw and undercooked poultry, unpasteurized milk, contaminated water
<i>Clostridium botulinum</i>	Botulism	12 to 72 hours	Vomiting, diarrhea, blurred vision, double vision, difficulty swallowing, muscle weakness; can result in respiratory failure and death	Variable	Improperly canned foods, especially home-canned vegetables; fermented fish, baked potatoes in aluminum foil, bottled garlic
<i>Cryptosporidium</i>	Intestinal cryptosporidiosis	2 to 10 days	Diarrhea (usually watery), stomach cramps, upset stomach, slight fever	May be remitting and relapsing over weeks to months	Uncooked food or food contaminated by an ill food handler after cooking, contaminated drinking water
<i>Cyclospora cayatanensis</i>	Cyclosporiasis	1 to 14 days, usually at least 1 week	Diarrhea (usually watery), loss of appetite, substantial loss of weight, stomach cramps, nausea, vomiting, fatigue	May be remitting and relapsing over weeks to months	Various types of fresh produce (imported berries, lettuce, basil)
<i>Escherichia coli</i> producing toxin	<i>E. coli</i> infection	1 to 3 days	Watery diarrhea, abdominal cramps, some vomiting	3 to 7 or more days	Water or food contaminated with human feces
<i>Escherichia coli</i> O157:H7	Hemorrhagic colitis or <i>E. coli</i> O157:H7 infection	1 to 8 days	Severe (often bloody) diarrhea, abdominal pain and vomiting; usually little or no fever is present; more common among children 4 years old or younger; can lead to kidney failure	5 to 10 days	Undercooked beef (especially hamburger), unpasteurized milk and juice, raw fruits and vegetables (e.g., sprouts), contaminated water
Hepatitis A	Hepatitis	28 days average (15 to 50 days)	Diarrhea, dark urine, jaundice, flu-like symptoms (i.e., fever, headache, nausea, abdominal pain)	Variable, usually 2 weeks to 3 months	Raw produce, contaminated drinking water, uncooked foods and cooked foods that are not reheated after contact with an infected food handler, shellfish from contaminated waters

<i>Listeria monocytogenes</i>	Listeriosis	9 to 48 hours for gastrointestinal symptoms, 2 to 6 weeks for invasive disease	Fever, muscle aches, and nausea or diarrhea; pregnant women may have a mild flu-like illness, and infection can lead to premature delivery or stillbirth; elderly or immunocompromised patients may develop bacteremia or meningitis	Variable	Unpasteurized milk, soft cheeses made with unpasteurized milk, ready-to-eat deli meats
Noroviruses	Variously called viral gastroenteritis, winter diarrhea, acute nonbacterial gastroenteritis, food poisoning, and food infection	12 to 48 hours	Nausea, vomiting, abdominal cramping, diarrhea, fever, headache; diarrhea is more prevalent among adults, vomiting is more common among children	12 to 60 hours	Raw produce, contaminated drinking water, uncooked foods and cooked foods that are not reheated after contact with an infected food handler, shellfish from contaminated waters
<i>Salmonella</i>	Salmonellosis	6 to 48 hours	Diarrhea, fever, abdominal cramps, vomiting	4 to 7 days	Eggs, poultry, meat, unpasteurized milk or juice, cheese, contaminated raw fruits and vegetables
<i>Shigella</i>	Shigellosis or bacillary dysentery	4 to 7 days	Abdominal cramps, fever, diarrhea; stools may contain blood and mucus	24 to 48 hours	Raw produce, contaminated drinking water, uncooked foods and cooked foods that are not reheated after contact with an infected food handler
<i>Staphylococcus aureus</i>	Staphylococcal food poisoning	1 to 6 hours	Sudden onset of severe nausea and vomiting, abdominal cramps; diarrhea and fever may be present	24 to 48 hours	Unrefrigerated or improperly refrigerated meats, potato, and egg salads; cream pastries
<i>Vibrio parahaemolyticus</i>	<i>V. parahaemolyticus</i> infection	4 to 96 hours	Watery (occasionally bloody) diarrhea, abdominal cramps, nausea, vomiting, fever	2 to 5 days	Undercooked or raw seafood, such as shellfish
<i>Vibrio vulnificus</i>	<i>V. vulnificus</i> infection	1 to 7 days	Vomiting, diarrhea, abdominal pain, blood-borne infection, fever, bleeding within the skin, ulcers that require surgical removal; can be fatal to persons with liver disease or weakened immune systems	2 to 8 days	Undercooked or raw seafood, such as shellfish (especially oysters)

Reprinted from the U.S. Department of Health and Human Services and the U.S. Food and Drug Administration. *What you need to know about foodborne illness-causing organisms in the U.S.* (website): www.fda.gov/Food/ResourcesForYou/Consumers/ucm103263.htm. Accessed December 2010.

supplies as well as the personal hygiene and sanitary practices of food handlers are essential for the prevention of disease.

Parasites

The following two types of worms are of serious concern in relation to food: (1) roundworms, such as the *trichina* (*Trichinella spiralis*) worm found in pork; and (2) flatworms, such as the common tapeworms found in beef and pork. The following control measures are essential: (1) laws controlling hog and cattle food sources and pastures to prevent the transmission of the parasites to the meat produced for market; and (2) the avoidance of rare *beef* and undercooked pork as an added personal precaution.

Environmental Food Contaminants

Lead. Heavy metals such as lead may contaminate food and water as well as the air and environmental objects. Although lead poisoning in the United States has dramatically declined since the removal of lead from gasoline, it continues to plague certain subgroups of the population (see the Cultural Considerations box, “The Continued Burden of Lead Poisoning”). The average blood lead level among children between the ages of 1 and 5 years in the United States is 1.5 $\mu\text{g}/\text{dL}$.²⁰ Children are especially vulnerable to lead poisoning, particularly those of poor families who live in older homes or impoverished areas with peeling lead paint.²¹ Eliminating high blood lead levels in children, which are defined as those of 10 $\mu\text{g}/\text{dL}$ or greater, is one of the *Healthy People 2020* goals.²⁰

Of all sources of lead, lead paint (which was banned in the United States in 1978) is the most problematic source of contamination for children. An estimated 37.1 million homes in the United States have lead in their paint surfaces.²² Children who live in these homes face lead exposure as a result of breathing airborne particles of paint dust created by disturbed or deteriorating walls or by abrasive paint removal before remodeling. The amount of lead-containing dust on the floor of a home is significantly associated with the blood lead level in children.²¹ Drinking water may be an important source of lead in high-risk households with water that comes through lead service pipes or plumbing joints that have been sealed with lead solder. Current Environmental Protection Agency rules for public drinking water, however, have lowered the controlled lead exposure levels even further. Children with elevated blood lead levels have lower intellectual performance compared with similar children who do not suffer from lead toxicity.²³ Studies have also found this same high-risk population group to be deficient in

iron; this condition can increase lead absorption four- to five-fold, it has a similar deleterious effect on neurology, and it can thus further complicate lead toxicity.²⁴

Natural Toxins. Toxins that are produced by plants or microorganisms also contaminate the food and water supply. Mercury, which is found naturally in the environment in addition to being a by-product of human production, is converted to methyl mercury by bacteria. Methyl mercury is a toxin that contaminates large bodies of water and the fish within that water. This contamination can pass through the food chain to people who regularly consume large fatty fish. Aflatoxin, which is another natural toxin, is produced by fungi. It may contaminate foods such as peanuts, tree nuts, corn, and animal feed.

Other food contaminants and pollutants that may pose a risk to human health come from a variety of sources (e.g., factories, sewage, fertilizers) but end up leaching out into the ground, thereby contaminating food production areas and the water supply.

FOOD NEEDS AND COSTS

Hunger and Malnutrition

Worldwide Malnutrition

Hunger and even famine and death exist in many countries of the world today. Lack of sanitation, cultural inequality, overpopulation, and economic and political structures that do not appropriately use resources are all factors that may contribute to malnutrition. Chronic food or nutrient shortages within a population perpetuate the cycle of malnutrition, in which undernourished pregnant women give birth to low birth weight infants. These infants are then more susceptible to infant death or growth retardation during childhood. When high nutrient needs throughout childhood and adolescence are not met, the incidence of malnourished or growth-stunted adults with shorter life expectancies and reduced work capacities continues to rise. Figure 13-10 illustrates the two drastically different outcomes that occur depending

hepatitis the inflammation of the liver cells; symptoms of acute hepatitis (i.e., of less than 6 months' duration) include flu-like symptoms, muscle and joint aches, fever, feeling sick or vomiting, diarrhea, headache, dark urine, and yellowing of the eyes and skin; symptoms of chronic hepatitis (i.e., of more than 6 months' duration) include jaundice, abdominal swelling and sensitivity, low-grade fever, and fluid retention (i.e., ascites).



CULTURAL CONSIDERATIONS

THE CONTINUED BURDEN OF LEAD POISONING

Exposure to lead continues to be a problem in the United States. One of the *Healthy People 2020* goals is to eliminate blood lead levels (BLLs) of 10 $\mu\text{g}/\text{dL}$ or greater in children. Although BLLs are declining, much work still needs to be done to reach the 2020 goal.

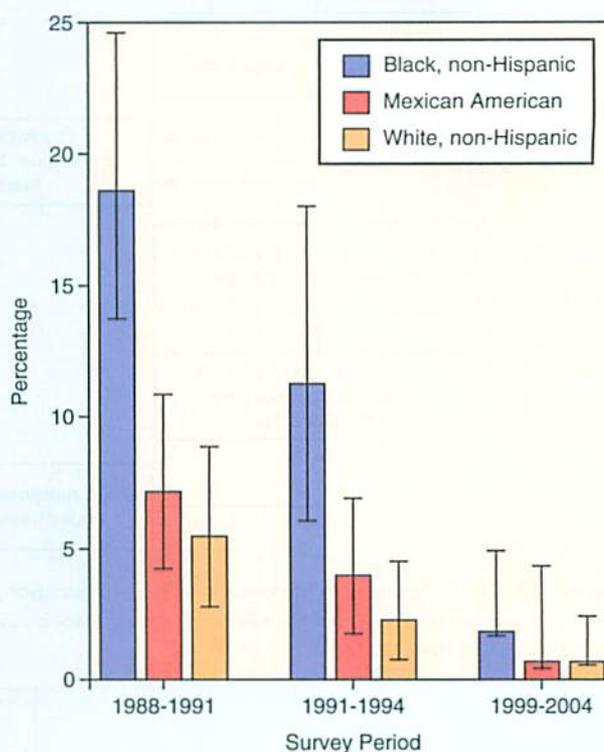
Among all age groups, children between the ages of 1 and 5 years have the highest risk for elevated BLLs. Among ethnic groups, non-Hispanic blacks have the highest occurrence rates. Following are the percentages of children between the ages of 1 and 5 years with elevated BLLs of 10 $\mu\text{g}/\text{dL}$ or more¹:

- All children between the ages of 1 and 5 years: 1.4%
- Non-Hispanic black children: 3.4%
- Mexican-American children: 1.2%
- Non-Hispanic white children: 1.2%

The accumulation of lead in the blood results in oxidative stress and interferes with the normal physiologic functions of calcium, zinc, and iron. Prolonged elevated lead in the body can cause anemia, kidney damage, seizures, encephalopathy, and eventually paralysis.²

The Centers for Disease Control and Prevention set the critical blood lead level for children at 10 $\mu\text{g}/\text{dL}$; however, there is evidence that neurologic damage may occur at lower levels of approximately 7.2 $\mu\text{g}/\text{dL}$.³

The figure here depicts the BLLs of children by ethnicity for the last three survey periods. Note the successful decrease in severely affected children over time and the disparity of minority groups with elevated blood lead levels.



Percentage of children between the ages of 1 and 5 years with blood lead levels of 10 $\mu\text{g}/\text{dL}$ or more by race or ethnicity and survey period according to the National Health and Nutrition Examination Surveys that took place in the United States from 1988 to 1991, 1991 to 1994, and 1999 to 2004. 95% confidence interval. (Data from Jones RL, Homa DM, Meyer PA, et al. Trends in blood lead levels and blood lead testing among US children aged 1 to 5 years, 1988-2004. *Pediatrics* 2009;123(3):e376-e385.)

1. Jones RL, Homa DM, Meyer PA, et al. Trends in blood lead levels and blood lead testing among US children aged 1 to 5 years, 1988-2004. *Pediatrics*. 2009;123(3):e376-e385.

2. Centers for Disease Control and Prevention and National Center for Environmental Health. *Fourth National Report on Human Exposure to Environmental Chemicals*. Centers for Disease Control and Prevention: Atlanta; 2009.

3. Jusko TA, Henderson CR, Lanphear BP, et al. Blood lead concentrations < 10 microg/dL and child intelligence at 6 years of age. *Environ Health Perspect*. 2008;116(2):243-248.

on whether a child has access to education, financial needs, and health care. Malnutrition may result from total kilocalorie deficiency or single-nutrient deficiencies. The most common deficiencies in the world today are iron-deficiency anemia, protein-energy malnutrition, vitamin-A deficiency, and iodine deficiency. Figure 13-11 shows the complicated interaction of the many factors that lead to malnutrition.

The United Nations Committee on World Food Security was formed to address the 842 million people worldwide who do not have enough food to meet their basic nutritional requirements. The long-term goals of this committee are to eliminate world hunger and to reduce the number of undernourished people by half by 2015.²⁵ The plan is composed of several commitments that are focused on stabilizing the social, economic, and

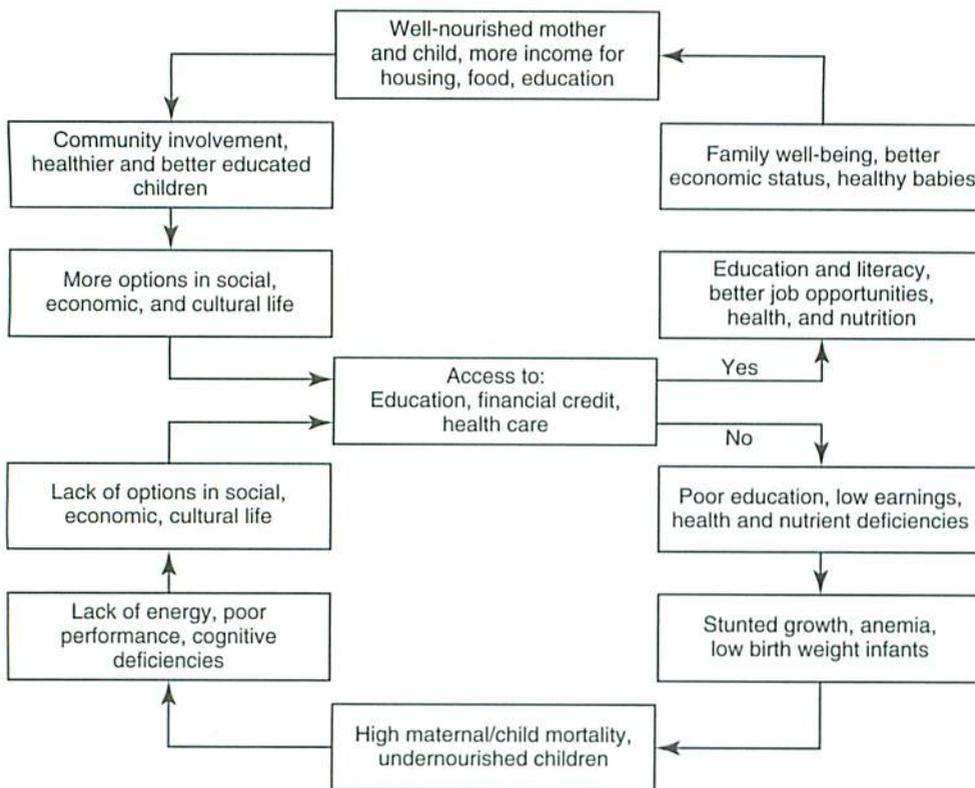


Figure 13-10 Differences in life outcomes when education, financial credit, and health care are accessible. (Adapted from Struble MB, Aomari LL. Position of the American Dietetic Association: addressing world hunger, malnutrition, and food insecurity. *J Am Diet Assoc.* 2003;103(8):1046-1057.)

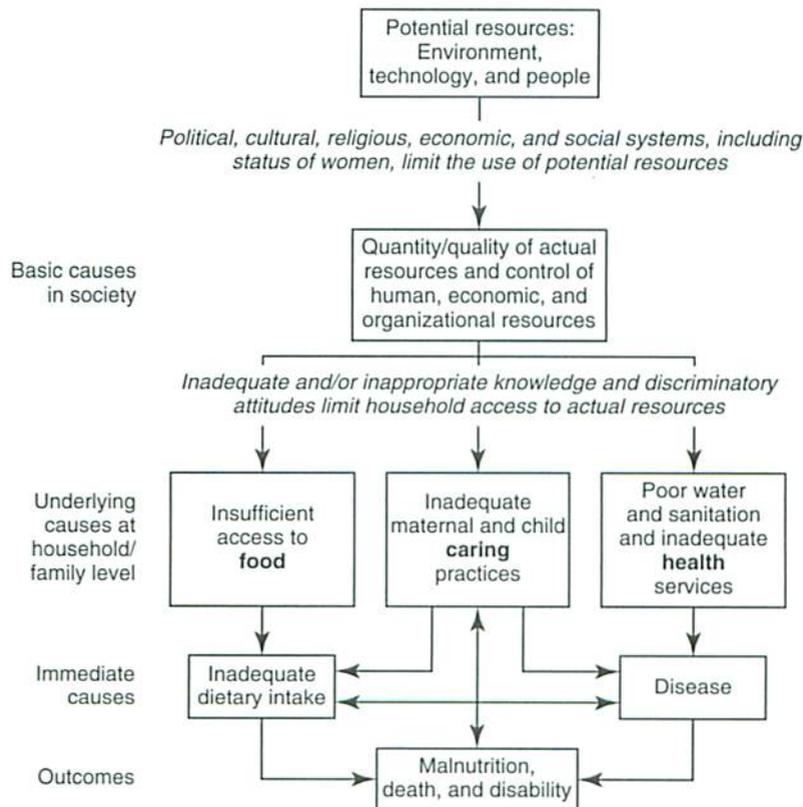


Figure 13-11 Multiple causes of malnutrition. (Adapted from Struble MB, Aomari LL. Position of the American Dietetic Association: addressing world hunger, malnutrition, and food insecurity. *J Am Diet Assoc.* 2003;103(8):1046-1057.)

environmental production and distribution of nutritionally adequate food. The committee is responsible for monitoring, evaluating, and consulting on the international food security situation with follow-up reports. Information and updates about the progress of this committee can be found at www.fao.org/monitoringprogress/index_en.html.

Malnutrition in America

Hunger does not stop at the U.S. border. In the United States, which is one of the wealthiest countries on earth, hunger and malnutrition among the poor persist. More than 49.1 million individuals (i.e., 17.1 million households) in the United States have food insecurity, which is defined as “limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways.”²⁶ Individuals who are at the highest risk for food insecurity within the United States are individuals who live below the income-to-poverty ratio, households with children that are headed by a single woman, African Americans, Hispanics, and households in central city areas.²⁶ At both the government and personal levels of any society, food availability and use involve money and politics. Various factors are implicated, such as land management practices, water distribution, food production and distribution policies, and food assistance programs for individuals and families in need.

Food Assistance Programs

In situations of economic stress and natural disasters, individuals and families require financial help. Many people in the United States experience hunger every day. Dietitians, nurses, and other health care providers may need to discuss available food assistance programs and make appropriate referrals.

Commodity Supplemental Food Program

Under the Commodity Supplemental Food Program (CSFP), the USDA purchases food items that are good sources of nutrients but that are often lacking in the diets of the target population (i.e., low-income pregnant and breast-feeding women, other new mothers up to 1 year postpartum, infants, children who are younger than 5 years old, and older people who are at least 60 years old). The USDA then distributes the food to state agencies and tribal organizations. From there, the food is dispersed to local agencies for public allocation. Local agencies (e.g., departments of health, social services, education, or agriculture) are responsible for evaluating eligibility, providing nutrition education, and dispersing food. This

program is not currently available in every state. The most recent report noted that an average of 467,000 people participate in the CSFP services each month.²⁷ Information about CSFP can be found at www.fns.usda.gov/fdd/programs/csfp/.

Supplemental Nutrition Assistance Program (SNAP)

SNAP, which was formerly known as the food stamp program, began during the late depression years of the 1930s and was expanded during the 1960s and 1970s. This program has helped many poor people to purchase needed food; the majority of the individuals that are served are children and elderly adults. The USDA estimated that 40.3 million people participated in SNAP services in the United States each month during 2010 at an annual cost of \$64.7 trillion.²⁸ With this program, electronic benefits transfer cards are issued to the primary care provider of the household. These cards are used in a way that is similar to a debit card in approved retail stores to supplement the household's food needs for 1 month. Households must have a monthly income that is below the program's eligible poverty limit to qualify. SNAP is in operation in all 50 states, the District of Columbia, Guam, and the U.S. Virgin Islands, and it is administered at the local level. More information about this program can be found at the USDA's Food and Nutrition Service Web site at www.fns.usda.gov/snap.

Special Supplemental Food Program for Women, Infants, and Children

The Special Supplemental Food Program for Women, Infants, and Children (WIC) provides nutrition supplementation, education, and counseling in addition to referrals for health care and social services to women who are pregnant, postpartum, or breast-feeding and to their infants and children who are younger than 5 years old. WIC has established criteria for participation, and each applicant must be income eligible and determined to be at nutritional risk. The food packages provided through WIC meet the *Dietary Guidelines for Americans* and promote the consumption of fruits, vegetables, and whole grains. The average monthly food cost per participant as reported for fiscal year 2010 was \$41.55.²⁹ Participants are provided with vouchers that are exchanged for foods such as milk, eggs, cheese, juice, fortified cereals, fruits, and vegetables at participating retailers. These foods supplement the diet with rich sources of protein, iron, and certain vitamins to help reduce risk factors such as poor growth patterns, low birth weight, prematurity, pre-eclampsia, miscarriage, and anemia.

WIC was established in 1972, and it currently has more than 9 million participants. WIC offices are established in every state, the District of Columbia, Guam, Puerto Rico, American Samoa, and the U.S. Virgin Islands. Approximately half of all participants are children between the ages of 1 and 5 years, and non-Hispanic Caucasians make up the largest race and ethnic percentage of those served.³⁰ More information can be found at www.fns.usda.gov/wic/default.htm.

SCHOOL MEALS PROGRAMS

There are several programs available to assist low-income children with receiving healthy food while at school. Current programs in the United States include the National School Lunch, Fresh Fruit and Vegetable, School Breakfast, and Special Milk programs. The National School Lunch program includes subprograms for low-income children that provide nutritionally balanced meals and snacks after school and during the summer months, when school is not in session. The USDA offsets the costs of the program by donating large quantities of a variety of foods to public schools. Children eat for free or at reduced rates, and these meals often comprise their main food intake for the day. The meals provided must fulfill approximately one third of a child's Recommended Dietary Allowance for protein, vitamin A, vitamin C, iron, calcium, and calories, and it must meet the *Dietary Guidelines for Americans*, which call for diets that are lower in total fat and that contain more fruits, vegetables, and whole grains.³¹ The Special Milk Program provides milk to children who do not have access to the other meal programs. More information about School Meals programs can be found at www.fns.usda.gov/cnd.

NUTRITION SERVICES INCENTIVE PROGRAM

The Nutrition Services Incentive Program, which was formerly known as the Nutrition Program for the Elderly, is operated through the U.S. Department of Health and Human Services Administration on Aging.

This program provides cash or commodities from the USDA for the delivery of nutritious meals to the elderly. Regardless of income, all people who are older than 60 years old can eat hot lunches at a community center under the Congregate Meals Program; if they are ill or disabled, they can receive meals at home by using the services of the Home-Delivered Meals Program. The act specifies that economically and socially needy people be given priority. Both programs accept voluntary contributions

for meals. More information can be found at www.fns.usda.gov/fdd/programs/nsip.

Food Buying and Handling Practices

For many American families, the problem is spending their limited food dollars wisely. Even on a low-cost plan for food purchasing, an average family of four can expect to spend approximately \$645 to \$758 per month on food alone.³² Shopping for food can be complicated, especially when each item in a supermarket's overabundant supply shouts, "Buy me!" Food marketing is big business, and producers compete for prize placement and shelf space. A large supermarket stocks many thousands of different food items. A single food item may be marketed a dozen different ways at as many different prices. In diet counseling, clients and families typically express their greatest need as help with buying food. The following wise shopping and handling practices help with the provision of healthy foods as well as with controlling food costs.

Planning Ahead

Use sales circulars in newspapers, plan general menus, and keep a checklist of basic pantry supplies. Make a list ahead of time according to the location of items in a regularly used grocery store. Such planning controls impulse buying and reduces extra trips.

Buying Wisely

Understanding packaging, carefully reading labels, and watching for sale items helps to improve purchasing power. Only buy in quantity if it results in real savings and if the food can be adequately stored or used. Be cautious when selecting so-called "convenience foods"; the time saved may not be worth the added cost. For fresh foods, try alternative food sources such as farmers' markets, consumer cooperatives, and gardens.

Storing Food Safely

Control food waste and prevent illness caused by food spoilage or contamination. Conserve food by storing items in accordance with their nature and use. Use dry storage, covered containers, and correct-temperature refrigeration as needed. Keep opened and partly used food items at the front of the shelf for timely use. Avoid waste by preparing only the amount needed. Use leftovers in creative ways.

Cooking Food Well

Use cooking processes that retain maximal food value and that maintain food safety. Cooking vegetables for shorter periods (e.g., stir frying, steaming) and with as little water

as possible helps to retain their vitamin and mineral nutritive quality. Prepare food with imagination and good sense. Give zest and appeal to dishes with a variety of seasonings, combinations, and serving arrangements. No

matter how much they know about nutrition and health, people usually eat because they are hungry and because the food looks and tastes good, not necessarily because it is healthy.

SUMMARY

- Common public concerns about the safety of the community food supply center on the use of chemicals such as pesticides and food additives. These substances have produced an abundant food supply, but they have also raised concerns, and they require close monitoring.
- The FDA is the main government agency that was established to maintain the control of the food supply. It conducts activities related to areas such as food safety, food labeling, food standards, consumer education, and research.
- Numerous organisms such as bacteria, viruses, and parasites that can contaminate food may cause

food-borne disease. Rigorous public health measures control the sanitation of food handling areas and the personal hygiene of food handlers. The same standards should apply to home food handling preparation and storage.

- Families that are under economic stress may benefit from counseling about financial assistance. Various U.S. food assistance programs help families in need, and referrals can be made to appropriate agencies. Families may also need assistance with the buying and use of food.

CRITICAL THINKING QUESTIONS

1. What is the basis of concern about food additives and pesticide residues?
2. What are some ways that agriculture is changing to reduce the use of pesticides and their danger to workers as well as to protect the land?
3. Describe the ways that various organisms may contaminate food. What standards of food preparation and handling should be used to keep food safe?
4. Kaycee is a single mother with two children. She is working part time making minimum wage. During the school year, her children receive free breakfasts and

lunches at school. However, she is concerned for her children's nutritional well-being during the summer months. For what assistance may Kaycee and her children qualify? What suggestions would you make to help establish a well-balanced diet for this family?

5. According to the food buying and handling practices described in this chapter, evaluate your own habits. Describe potential hazardous points for food-borne illness contamination, and discuss ways to improve your food-buying practices.

CHAPTER CHALLENGE QUESTIONS

True-False

Write the correct statement for each statement that is false.

1. *True or False:* U.S. surveys reveal little or no real malnutrition in the population.
2. *True or False:* The politics of a region or country is not involved in the nutritional status of the people.
3. *True or False:* The number of new processed food items that use food additives has declined in recent years because of public pressure and concern.
4. *True or False:* The use of pesticides on farm crops and food additives in processed foods is controlled by the USDA and the FDA.

5. *True or False:* Food poisoning is always caused by the viral contamination of food.
6. *True or False:* The Commodity Supplemental Food Program buys agricultural food surpluses to support market prices of food and then distributes these goods to needy people.
7. *True or False:* The Nutrition Services Incentive Program provides group meals for all people who are older than 60 years old, regardless of their income.

Multiple Choice

1. Food additives are used in processed food items to do which of the following? (Circle all that apply.)
 - a. To preserve food and lengthen its market life
 - b. To enrich food with added nutrients
 - c. To improve flavor, texture, and appearance
 - d. To enhance or improve some physical property of the food
2. The use of food additives in food products is controlled by the
 - a. U.S. Public Health Service.
 - b. USDA.
 - c. FDA.
 - d. Federal Trade Commission.
3. The National School Lunch program provides free or reduced-price lunches to children in need that provide approximately one third of a child's Recommended Dietary Allowance for protein, vitamin A, vitamin C, iron, calcium, and calories and meet the
 - a. MyPlate.gov guidelines.
 - b. *Dietary Guidelines for Americans*.
 - c. Academy of Nutrition and Dietetics guidelines.
 - d. American Diabetic Association guidelines.

Evolve Please refer to the Students' Resource section of this text's Evolve Web site for additional study resources.

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