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Part 4: Environmental Health on the Local Scale

Chapter 18: Food Safety

The Extent of Foodborne Illness

- **Foodborne illness** is the sickness people experience after consuming food and beverages contaminated with pathogenic (disease-causing) microorganisms, chemicals, or physical agents.
- Foodborne illnesses often occur in outbreaks, with two or more people experiencing the same illness as a result of eating contaminated food.
- Cases of foodborne illness are the individuals who become ill as a result of eating contaminated food.
- Cases that occur in outbreaks, together with sporadic cases, make up the incidence of foodborne illness—the number of cases per population per unit of time.

The Extent of Foodborne Illness

- Foodborne illnesses are often underreported and estimates of the extent of foodborne illnesses are difficult to make.
- Foodborne illness remains a signifi cant public health problem for the United States and the rest of the world for at least three major reasons.
- First, known pathogens are being found in a growing number of foods.
- Second, new pathogens are being discovered.
- Third, the number of people who are immunocompromised or otherwise at risk of foodborne illness is growing.

Causes of Foodborne Illness

- Foodborne illness may be caused by biological, chemical, or physical hazards in food.
- **Biological hazards** are microscopic organisms, such as bacteria, viruses, and parasites, that pose an invisible challenge to food safety.
- **Chemical hazards** are harmful substances that can cause illness if ingested with food.
- **Physical hazards** are foreign objects, such as stones, bone fragments from animals, pieces of glass, staples, and jewelry, which can get into food as a result of poor food-handling practices.

Classification of Acute Foodborne Illnesses

- In light of these three causes, acute foodborne illness may be classified as infection, intoxication, or toxin-mediated infection.
- Foodborne **infections** are caused when biological hazards are consumed along with food.
- **Intoxications** are poisonings caused by eating food that contains a toxic chemical.
- A **toxin-mediated infection** is caused by eating food that contains harmful microorganisms that produce a toxin.
- Each foodborne illness has a characteristic **onset time,** the amount of time between the consumption of a contaminated food and the appearance of the first symptoms of illness.

Foodborne Illness Caused by Bacteria

- Pathogenic bacteria can cause illness when they or their toxins are consumed with food.
- Bacterial contamination may occur in raw food, in cooked food that has not been properly handled, and on the surfaces of equipment and utensils that have been contaminated by raw animal foods, humans, or pests such as insects and rodents. In addition, certain food products require time and temperature control to limit the growth of pathogenic microorganisms and toxin formation.
- These items are called **potentially hazardous foods (time/temperature control for safety foods).**

Foodborne Illness Caused by Spore-Forming Bacteria

- **Spores** are inactive or dormant forms of bacterial cells that enable the organism to survive when its environment is too hot, cold, dry, or acidic or when there is not enough food.
- Bacteria that survive as spores can avoid being killed by typical measures taken against them (such as heating), and multiply in more active forms on the food that humans consume.
- Examples include clostridium perfringens (diarrhea and cramps) and clostridium botulinum (botulism).

Foodborne Illness Caused by Non-Spore-Forming Bacteria

- Many types of bacteria exist only as vegetative cells and do not form spores. Vegetative bacterial cells are easily destroyed by heat and can be effectively controlled by such processes as cooking and pasteurization.
- Examples include Shiga Toxin–Producing E. Coli, listeria monocytogenes (listeriosis), salmonella, and staphylococcus aureus (staphylococcal food poisoning).

Foodborne Illnesses Caused by Viruses

- The **Hepatitis A** virus causes a liver disease called infectious hepatitis. It is usually spread via the fecal-oral route and can contaminate food in production plants.
- **Noroviruses** are a group of viruses that cause the "stomach flu," or gastroenteritis, in people. People can become infected by eating food or drinking liquids that are contaminated with a norovirus, by touching surfaces or objects contaminated with a norovirus and then placing their hands in their mouth, and by having direct contact with another person who is infected and showing symptoms.

Foodborne Illnesses Caused by Parasites

- Parasites are small creatures that live in or on a living host.
- Anisakis spp. are roundworms found in some species of fish. Humans are exposed to this parasite when they eat parasite-infested fish. Symptoms include coughing if worms attach in the throat, vomiting and abdominal pain if worms attach in the stomach, or sharp pain and fever if worms attach in the large intestine.
- Cyclospora cayetanensis is a parasite that has been associated with fresh fruits and vegetables contaminated at the farm. The parasite is passed from person to person by fecal-oral transmission. handling. Symptoms of cyclosporiasis include watery and explosive diarrhea, loss of appetite, and bloating.

Foodborne Illness Caused by Chemicals

- Chemical contamination of food can occur naturally or unnaturally.
- **Biomagnification** occurs when the toxic burden of a large number of organisms at a lower trophic level is accumulated and concentrated by predators at a higher trophic level.
- Vomiting is the most common symptom of acute chemical intoxication. It usually occurs within fifteen to thirty minutes after ingestion of the chemical, and in most instances victims feel better after expelling the chemical. In other cases more serious results can occur.

Examples of Chemical Contaminants of Foods

- **Food allergens** can pose a serious health risk to children and adults who are sensitive to these substances. Five to 8 % of children and 1 to 2 % of adults are allergic to certain chemicals found in foods and food ingredients.
- Food allergens cause a person's immune system to overreact and may result in such symptoms as hives, swelling of the lips and tongue, difficulty breathing, vomiting, cramps, and diarrhea. In severe situations a life-threatening allergic reaction called anaphylaxis can occur.

Examples of Chemical Contaminants of Foods

- **Ciguatoxin** produced by marine algae that live among certain coral reefs. When the algae are eaten by small reef fish, the toxin is stored in their flesh, skin, and organs. When the small reef fish are eaten by larger fish, the toxin accumulates in the larger fish.
- Humans who eat these fish can then suffer ciguatoxin poisoning.
- The presence of large amounts of **scombrotoxin** in food can result in scombroid poisoning, also known as histamine poisoning.

Examples of Chemical Contaminants of Foods

- **Mercury** can accumulate in fish populations and be consumed in large quantities by humans.
- **Polychlorinated biphenyls (PCBs**) are persistent chlorinated compounds that were manufactured for use in capacitors, transformers, and other applications. These compounds have entered the global ecosystem and have become widely distributed. Humans can ingest PCBs by eating fish, and may be exposed to several health risks as a result.

Examples of Chemical Contaminants of Foods

- **Bisphenol A (BPA)** is a chemical found in polycarbonate plastic commonly used in food containers such as baby bottles and water bottles. Its health risks are debated.
- **Pesticides** are used widely in agriculture in the United States and worldwide, and many agricultural products such as fruits and vegetables contain trace quantities of pesticides, called residues, which may be harmful to human health.

Prevention of Foodborne Illness

- The CDC has identified several risk factors as primary contributors to foodborne disease outbreaks; these factors are therefore important focus areas for food safety programs. They include,
  - Improper holding temperatures
  - Poor personal hygiene
  - Improper cooking temperatures
  - Foods from unsafe sources
  - Contaminated equipment and cross - contamination

Improper Holding Temperatures

- Keeping foods at improper holding temperatures permits the rapid growth of infectious and toxin-producing microorganisms.
- This rapid growth typically occurs when food is held at temperatures between 41 ° F and 135 ° F. This temperature range is referred to as the food **temperature danger zone.**

Personal Hygiene

- Even healthy people can be a source of the harmful microbes that cause foodborne illness. Therefore good personal hygiene is extremely important when handling foods.
- Soiled hands and clothing, infected food workers, and workers who do not practice good personal hygiene are major threats to food safety.

Improper Cooking Temperatures

- Raw foods of animal origin, such as red meats, poultry, eggs, fish, and shellfish, are frequently contaminated with microbial pathogens.
- Proper cooking makes food more palatable and safe to eat.

Foods from Unsafe Sources

- Food from unsafe sources may be contaminated with biological, chemical, and physical hazards.
- The safety and wholesomeness of foods can be enhanced by purchasing foods from sources that are routinely inspected by regulatory agencies and that are in compliance with applicable food safety laws.

Contamination and Cross-Contamination

- Pathogens can be transferred to food by contaminated food-contact surfaces.
- **Cross-contamination** is the transfer of pathogens from one food to another via contaminated hands, equipment, or utensils.
- Cross-contamination commonly occurs when ready-to-eat foods come into contact with raw animal foods or with surfaces that have had contact with these types of foods.

HACCP Food Safety System

- The **Hazard Analysis and Critical Control Point (HACCP)** approach is a central paradigm of food safety.
- It is designed to identify and control problems that may cause foodborne illness before they happen.
- The HACCP approach includes conducting hazard analyses, determining critical control points, establishing critical limits, establishing corrective actions, verifying effectivity, and keeping effective records.

Agencies Responsible for Food Safety

- The federal agencies primarily responsible for food safety in the United States are the U.S. Department of Agriculture (USDA), the Food and Drug Administration (FDA), the Centers for Disease Control and Prevention (CDC), and the Environmental Protection Agency (EPA).

U.S. Department of Agriculture

- The USDA regulates the production, processing, and interstate sale of domestic and imported meat, poultry, and egg products.
- The Food Safety and Inspection Service (FSIS) is the agency within USDA that is responsible for ensuring the safety, wholesomeness, and correct labeling and packaging of foods.
- This agency ensures that HACCP guidelines are followed throughout the food production and distribution process.

The Food and Drug Administration

- The FDA regulates the production, processing, manufacturing, and interstate sale of all food items except red meats, poultry, and eggs.
- The FDA's responsibility is to ensure that food is safe, wholesome, sanitary, and honestly packaged and labeled.
- The agency also promotes public health by protecting food from adulteration and misbranding.
  - *Food is considered **adulterated** when it contains filth or harmful substances, is decomposed, or is produced in unsanitary conditions.*
  - *Food is **misbranded** when it is packaged or labeled in a false or misleading manner.*
- The FDA works both through prevention and intervention, setting up good manufacturing and agricultural practices as rules to be enforced. It also ensures that HACCP guidelines are followed throughout the food production and distribution process.

Centers for Disease Control and Prevention (CDC)

- The CDC contributes to food safety by helping state and local agencies conduct foodborne disease investigations and compiling statistics on foodborne and waterborne disease outbreaks.

Environmental Protection Agency (EPA)

- The EPA contributes to food safety by regulating the use of toxic substances such as pesticides, sanitizers, and other chemicals.

Recent Initiatives in Food Safety

- Governmental agencies and the food industry have joined forces to implement other food safety initiatives to lower the incidence of foodborne illness.

PulseNet

- PulseNet is a national network of public health laboratories, created by the CDC, that performs DNA “fingerprinting” of bacteria that cause foodborne illness.

Fight BAC! Campaign

- Consumers are the last line of defense in food safety. The Fight BAC! Campaign is an educational program designed to teach consumers about safe food handling.

Consumer Advisories

- Food establishments are required to provide **consumer advisories** that inform their customers about the dangers of eating raw or undercooked animal foods or ingredients.

Food Irradiation

- Food irradiation is a food safety technology that can be used to reduce or eliminate pathogenic bacteria, insects, and parasites.
- Food irradiation uses high-energy radiation in any one of three approved forms: gamma ray, electron beam, or X–ray, in order to kill harmful microorganisms.

Emerging Threats to Food Safety

- Mad Cow Disease: Bovine spongiform encephalopathy (BSE), widely referred to as mad cow disease, is a chronic degenerative disease affecting the central nervous system in cattle.
- BSE belongs to the family of diseases known as the transmissible spongiform encephalopathies (TSEs). TSEs create holes in the brain.
- Bioterrorism: Since 9/11 there is concern that terrorists will intentionally contaminate food in order to harm large numbers of people.
- **Food security** involves protecting food against deliberate contamination.

Emerging Threats to Food Safety

- Industrial Food Production: Critics contend that industrial food production has led to increased consumption of fossil foods, the creation of more foods with less nutritional value, and increasing contamination of foods.