15a

Special Topic:
Food Safety and Defense

Lecture Presentation
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Food Safety and Defense

OUTLINE:

- Foodborne Illnesses
- Keeping Food Safe at International and National Levels
- Food Defense and Bioterrorism
- Personal Food Safety
Foodborne Illnesses

- Foodborne illnesses: ingesting contaminated food or water
- Disease-causing agents (pathogens) can contaminate food
  - Pathogens may be:
    - Bacteria
    - Viruses
    - Prions
    - Parasitic protozoans
    - Parasitic worms
Foodborne Illnesses

- There are about 250 different foodborne illnesses
  - Foodborne illnesses are caused by pathogens (infections) but also harmful chemicals, such as those in pesticides or in certain mushrooms or fish (poisonings)
  - Note that food allergies (described in chapter 13) are also a type of food illness
Figure 15a.1 (a). The death cap mushroom (Amanita phalloides), found in North America and many other parts of the world, contains toxins that can cause liver failure, kidney failure, and death within 2 weeks of ingestion.

(a) The death cap mushroom contains lethal toxins that cannot be destroyed through cooking, drying, or freezing.
Figure 15a.1(b). *Pufferfishes contain lethal amounts of tetrodotoxin in their skin and internal organs.*

(b) Pufferfishes contain tetrodotoxin, which causes death if consumed. Despite this danger, pufferfish is a highly prized dish in Japan. Known as *fugu*, the dish is prepared by licensed chefs who carefully remove the poisonous parts of the fish.
General Symptoms, Diagnosis, and Treatment

- All foodborne illnesses have symptoms that first appear in the gastrointestinal (GI) tract, and may include:
  - Nausea
  - Vomiting
  - Abdominal cramps
  - Diarrhea
General Symptoms, Diagnosis, and Treatment

- When should you consult a health care professional?
  - Temperature over 101.5° F
  - Blood in stools
  - Prolonged vomiting
  - Dehydration as indicated by dizziness, dry mouth, decreased urination
  - Diarrhea lasting more than 3 days
Foodborne Illnesses

- Some pathogens do not move beyond the GI tract
- Some, including bacteria, produce toxins that are absorbed into the bloodstream
Foodborne Illnesses

- Some pathogens directly invade other body tissues
- Example: *Clostridium botulinum*
  - Bacterium found in improperly canned foods that are usually canned at home
  - Produces a toxin that blocks communication between nerve and muscle cells
  - Causes muscle paralysis, making it difficult or impossible to breathe
Foodborne Illnesses

- Many foodborne illnesses go undiagnosed and unreported to public health officials
- For those who seek medical attention
  - Diagnostic tests may not be performed to confirm the particular illness and its causative agent
  - If tests are performed, the results may not be communicated to public health officials
Foodborne Illnesses

- Reporting foodborne illnesses
  - Each state decides which diseases are reported
  - In mild foodborne illness, it is estimated that the actual number of cases is greatly underreported
  - Even those illnesses that are more severe are underreported, but to a lesser degree
Foodborne Illnesses

- Tracking foodborne illnesses
  - FoodNet
    - A collaborative monitoring system that collects data on pathogens commonly transmitted through food
    - Developed in 1996 by the Centers for Disease Control and Prevention, Food Safety and Inspection Service, the Food and Drug Administration, and selected state health departments
Foodborne Illnesses

- Diagnosing foodborne illnesses
  - Physical exam
  - A detailed history of recently consumed foods and beverages
  - A stool sample is inspected to assess the presence of bacteria, parasites, or viruses
  - A blood sample may be collected
Foodborne Illnesses

- Treating foodborne illnesses
  - Dehydration is prevented or treated by giving clear, clean fluids
  - Antibiotics may be prescribed if the cause is bacterial
  - Antiparasitic drugs can be used to kill parasites
Common Foodborne Infections

- The most common foodborne infections in the United States are caused by
  - **Bacteria** *Campylobacter jejuni*
  - **Bacteria** *Salmonella*
  - **Bacteria** *Escherichia coli O157:H7*
  - **Virus** Caliciviruses causing gastroenteritis or stomach flu

- These four common foodborne illnesses have similar symptoms: diarrhea – nausea – vomiting – abdominal cramps

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Common Foodborne Infections

- All but caliciviruses can cause life-threatening illness
- Individuals most at risk are those with a compromised or underdeveloped immune system
  - Very young
  - Very old
  - People with a disease that suppresses immune function
Common Foodborne Infections

- Healthy people can die from foodborne illnesses if they
  - Are exposed to a very high dose of the pathogen
  - Do not receive proper treatment
How Does Food Become Contaminated?

- How does food become contaminated?
  - Food can be contaminated during any of the many steps that typically occur as it moves from “farm to fork”
Figure 15a.2 A typical pattern of steps by which food moves from harvesting to consumption.
How Does Food Become Contaminated?

- Certain foods are more likely than others to be associated with foodborne illness
  - Raw foods originating from animals
  - Foods that contain the products of many animals, such as ground beef, since only one animal needs to have the pathogen
How Does Food Become Contaminated?

- Bacteria normally present in the intestines of food animals can contaminate carcasses at slaughterhouses

- *Salmonella* can infect the ovaries and oviducts of chickens producing infected eggs (transovarian route)

- *Salmonella* in the environment can also penetrate the eggshell after the egg has been laid (trans-shell route)
How Does Food Become Contaminated?

- Oysters and other filter-feeding shellfish concentrate bacteria naturally found in seawater as well as bacteria in human sewage
- Oysters can also concentrate toxins and pollutants
- Some large predatory fish act as bioconcentrators and store potentially dangerous levels of heavy metals that will affect human health if large amounts are consumed on a regular basis.
  - Example: tuna and mercury level
How Does Food Become Contaminated?

- In freshwater and on land, parasitic worms release eggs into the environment, where they are picked up by other animals.
- The eggs hatch into larvae in these animals.
- The larvae can survive after the animal has been killed for food.
How Does Food Become Contaminated?

- Fresh fruits and vegetables can become contaminated with bacteria, viruses, and protozoan parasites when they are irrigated or washed with water containing the waste of animals or humans
  - *E. coli* O157:H7 is an example
How Does Food Become Contaminated?

- Contaminated water can introduce pathogens
- Washing produce with clean water may not completely eliminate contamination
- Produce may contain residues of pesticides and other chemicals
- Food may be contaminated during processing and preparation
- Safe to wash vegetable with potassium permanganate light pink solution for 5 minutes
How Does Food Become Contaminated?

- Once food is contaminated, the way it is handled becomes critical.
- Large numbers of bacteria are usually required to cause foodborne illness.
- Bacteria reproduce extremely rapidly, particularly under warm, moist conditions.
Methods of Combating Food Contamination

- Combating food contamination
  - Prompt refrigeration
  - Acidic conditions (e.g., pickling)
  - High levels of salt or sugar (e.g., curing)
  - Drying (e.g., fruits and meats)
Methods of Combating Food Contamination

- Parasites, bacteria, and viruses are killed by heat, with few exceptions.
- Toxins produced by bacteria vary in whether or not they are killed by heat.
- Prions are not destroyed by heat alone, but are inactivated by heat and high pressure.
Keeping Food Safe at International and National Levels

- The food supply is global
- Regulation of food safety and tracking of foodborne illnesses is extremely challenging
- Several agencies regulate, monitor, and investigate the safety of food
International Oversight

- The World Health Organization (WHO) is a United Nations agency that protects public health
  - Coordinates international efforts to effectively monitor and respond to outbreaks of foodborne illness
  - Implements international health regulations relating to travelers and the import/export of contaminated food
National Oversight

- The Food and Drug Administration (FDA): responsible for the safety of about 80% of our food supply
  - All domestic and imported food except meat and poultry
  - Oversees eggs (in the shell), bottled water, and wines with less than 7% alcohol
National Oversight

- The Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF): oversees all alcoholic beverages not covered by the FDA

- The Food Safety and Inspection Service (FSIS): oversees domestic and imported meat and poultry
  - Includes products that contain meat or poultry and processed egg products
National Oversight

- The Environmental Protection Agency (EPA):
  - Regulates the use of pesticides in agriculture
  - Establishes standards for safe public drinking water
Keeping Food Safe at International and National Levels

- The Centers for Disease Control and Prevention (CDC):
  - Plays a critical role in keeping our food safe by working with state and local health officials to monitor the occurrence of foodborne illnesses
  - Develops methods to prevent foodborne illnesses and continually assesses the effectiveness of prevention efforts
  - Effectively oversees all foods
Food Defense and Bioterrorism

- **Food safety** prevents the *unintentional* contamination of food

- **Food defense** prevents the *deliberate* contamination of food
  - Overseen by the Department of Homeland Security (DHS)
Bioterrorism is the use of biological agents (bacteria and their toxins, viruses, or parasites) to intimidate or attack societies or governments.

The CDC classifies biological agents into three categories:

- **A**—Highest priority, and easily disseminated or transmissible
- **B**—Moderately easy to disseminate
- **C**—Includes emerging pathogens
Personal Food Safety

- Regardless of whether a risk is intentional or unintentional, systems are in place to limit exposure to contaminated food or water
- Take steps to ensure that the food you consume is as safe as possible
Personal Food Safety

- Use a common-sense approach
- Be aware that you should practice food safety from the moment you select the food, prepare it, and store the leftovers
Personal Food Safety

- Food selection
  - Always look at “sell-by” dates
  - Carefully examine the packaging for damage or tampering
- Limit bacterial growth with
  - Cold temperatures in the store display cases
  - Rapid and cool transport of food
  - Consistently cold temperatures in home refrigerators
Personal Food Safety

- Selecting meat and poultry
  - Always bag raw items separately from other items
  - Wash hands after touching their packaging
  - Larger cuts with less surface area will have less bacteria on their surface
Personal Food Safety

- Selecting seafood
  - Buy fresh and know your source
  - Firmness, color, and odor are important
    - Never buy anything that smells fishy/has a faint bleach odor
  - Do not exceed the recommended weekly consumption rates of large predatory fish
Personal Food Safety
Food Selection

- Selecting produce
  - Wash all produce, even ready-to-eat pre-bagged produce
  - Stay informed about the costs and benefits of buying organically grown fruits and vegetables versus conventionally grown produce
  - Make conscientious decisions about your personal tolerance for food safety risks and the future of foods and the environment
Food Handling and Storage

- At home, good food safety practices for food handling can be sorted into four categories:
  - Cleanliness
  - Separation
  - Cooking
  - Chilling
Figure 15a.4 This logo from The Be Food Safe program of the USDA and Partnership For Food Safety Education emphasizes the four basic ways to keep food safe at home.
You Should Now Be Able To:

- Present the major foodborne illnesses
- Describe how to keep food safe at international and national levels and list the main agencies involved in that matter
- Describe what food defense and bioterrorism are
- Understand, describe, and apply personal food safety