

LESSON PLAN

1. FOOD SERVICE SUPERVISOR/MANAGER CERTIFICATION COURSE

B-322-2101

Topic 1.3 Microbiology and Foodborne Illness

Lab Period: 0

Enabling Objectives:

- 1.10 **UNDERSTAND** the importance of microbiology as it relates to food service
- 1.11 **DESCRIBE** the three different types of hazards that may cause foodborne illnesses
- 1.12 **EXPLAIN** the role the chain of infection plays in a foodborne illness outbreak
- 1.13 **IDENTIFY** the most significant causative agents of foodborne illnesses
- 1.14 **DESCRIBE** the critical control points necessary to control microbial growth and prevent foodborne illness

Trainee Preparation Material:

- A. Trainee Support Materials:
 - 1. Student Workbook
- B. Reference Publications: None

Instructor Preparation:

- A. Review Assigned Trainee Material
- B. Reference Publications:
 - 1. NAVMED P-5010 Ch 1
 - 2. Educational Foundation of the National Restaurant Association. Serving Safe Food: Certification Coursebook. 1995.
 - 3. NAVSUP 521
 - 4. NAVSUP 486
 - 5. NAVSUP 520
- C. Training Materials Required:
 - 1. Power Point Presentation

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DISCUSSION POINT

1. Introduction

RELATED INSTRUCTOR ACTIVITY

1. Establish contact.

Introduce yourself and give any background information that might be of interest.

Establish readiness.

Motivating statements.

Tell the trainees how they will use the course material.

Tell the trainees why they need to know the lesson material.

Refer to Student workbook and review objectives.

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2. Foodborne illnesses are diseases that are carried or transmitted to people by food
 - a. An outbreak is defined as an incident where 2 or more people experience the same illness after eating the same food
 - (1) Must be proven by lab analysis
 - (2) With botulism or chemically contaminated foodborne illness, one case is considered an outbreak
 - b. Three hazards are responsible for outbreaks of foodborne illness
 - (1) Chemical hazards such as pesticides, food additives and preservatives, cleaning and sanitizing supplies, and toxic metals that leech through worn cookware and equipment
 - (a) Lubricants used on equipment, personal care products, such as hair sprays, and paints or petroleum products are also included
 - (b) Sulfiting agents are chemicals that are legally used by food processors to preserve freshness and color in certain vegetables, fruits, frozen potatoes, and other processed foods

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- 1 Overuse of sulfites has been linked to allergic reactions in some sensitive people, especially those with asthma

- (c) To prevent chemical contamination from occurring, follow these safe practices:
 - 1 Use only food-grade containers; use metal and plastic containers and items only for their intended uses

 - 2 Use only proper foodservice brushes, never use wire brushes

 - 3 Examine soft-drink system for potential back flow of carbonated water into copper water intake lines

 - 4 Do not use galvanized (zinc-coated) containers for preparing or storing acidic foods

 - 5 Store chemicals in their original containers in a separate area away from food preparation areas

 - 6 Wash hands thoroughly after handling chemicals

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- (2) Physical hazards are exemplified by the contamination of food with items such as glass, metal, or bone particles. The following are food safety controls:
 - (a) Do not use glasses to scoop ice
 - (b) Do not chill glasses or any food items in ice that will be used for drinks
 - (c) Do not store toothpicks or non-edible garnishes on shelves above food storage or preparation areas
 - (d) Place and maintain protective shields on lights over food storage and preparation areas
 - (e) Clean can openers before and after each use and replace or rotate blade as often as necessary
 - (f) Remove staples, nails, and similar objects from boxes and crates when food is received so these materials do not later fall into the food

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- (3) Biological hazards are typically harmful bacteria, parasites, viruses, or fungi that contaminate food. This hazard results in the highest number of foodborne illnesses and is the focus of this course

3. Microbiology

- a. Defined as the study of microscopic forms of life (called microorganisms), such as bacteria, viruses, parasites, and fungi
 - (1) Microscopic means that they are too small to see with the naked eye. Can also not smell or taste their presence
 - (2) While some microorganisms are beneficial such as yeast used for bread rising or the fungus used to make the drug penicillin, others can cause illness
 - (a) Microorganisms that cause illnesses are called "pathogenic"; those that produce harmful toxins as they multiply are called "toxigenic"
 - (b) When pathogenic microorganisms result in foodborne illness, these illnesses are generally classified as either infections or intoxications

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- b. Bacteria normally exist as vegetative cells, which are capable of growth and reproduction
 - (1) To reproduce, bacteria divide in half; each of these cells can then divide again at a rapid rate

- c. Some bacteria can produce thick-walled protective structures called spores
 - (1) Spores often survive cooking or freezing and even sanitizing chemicals

 - (2) Spores do not reproduce, but when conditions improve (e.g. the temperature is within the danger zone) the bacteria can become vegetative and grow and reproduce

- d. The chain of infection is the combination of factors which will make a food unsafe. Each link in the chain must be controlled and monitored in order to protect the customer
 - (1) The agent is the bacteria, parasite, or virus that may cause the illness

 - (2) The reservoir is the environment where the agent is normally found. The reservoir is either man, animal or the environment

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- (3) For an agent to infect another individual it must have a mode of escape by which it can exit the reservoir
 - (a) Fecal deposit
 - (b) Rupture of boil, pimple, etc
 - (c) Contact of reservoir with food item
 - (d) Cough, sneeze, respiratory tract

- (4) The mode of transmission is the movement from the reservoir to the host
 - (a) Hands to food to mouth
 - (b) Environment (airborne, fomites)
 - (c) Water
 - (d) Food
 - (e) Vectors (flies, rodents)
 - (f) Food contact surfaces (cross contamination)

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- (5) Mode of entry is the way in which a microorganism can enter the host (the human)
 - (a) Inhaling
 - (b) Cuts
 - (c) Drinking/eating

- (6) A susceptible host is one that can catch the foodborne illness because they have no immunity to it
 - (a) Children, elderly, and people with weakened immune systems are at greatest risk for foodborne illness. They are less able to fight off disease

c. Prevention

- (1) If the entire chain of infection is not completed, then no infection will occur
- (2) The goal of food safety practices is to break the chain of infection
- (3) The most likely link to interrupt is the mode of transmission

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- (a) If transmission can be prevented, illnesses will not be caused in the patrons
- (b) Avoiding transmission is best accomplished by preventing cross contamination, good personal hygiene, careful adherence to time and temperature guidelines, and overall safe galley practices

4. Foodborne illnesses caused by bacteria

- a. Foodborne infection is a disease that results from eating foods that contain harmful microorganisms. In order to cause illness, the microorganisms must be alive. Diseases such as salmonellosis, shigellosis, and listeriosis are foodborne infections
- b. Foodborne intoxication results when toxins, which are poisons produced by bacteria, are present in food and cause illness. Unlike with an infection, toxins may still cause sickness even after the bacteria have been killed. Examples of this include botulism and staphylococcus
- c. *Clostridium perfringens*, *Bacillus cereus*, and *E. coli* O157:H7 have characteristics of both infections and intoxications

Definitions for terms used in

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the following section:

(1) Salmonellosis infection, caused by *Salmonella*

Incubation period: The time between when an individual consumes contaminated food and when his or her symptoms are present

(a) Incubation period: 8-72 hours

(b) Duration of illness: 2-3 days

Duration of illness: How long the illness lasts

(c) Symptoms: Abdominal pain, headache, nausea, vomiting, fever, diarrhea

Symptoms: The physical signs of the disease

(d) Reservoir: Domestic and wild animals, intestinal tract of humans

Reservoir: A host, carrier, or vehicle for disease-causing microorganisms. See chain of infection discussion above

(e) Foods involved: Poultry and poultry salads, meat and meat products, milk, shell eggs, egg custards and sauces, and other protein foods

Foods involved: Foods that are known to carry or transmit the disease

(f) Spore former: No

Spore former: States if the bacteria forms spores as defined above

(g) Prevention: Refrigerate food, properly cool cooked meats and meat products, avoid fecal contamination from foodhandlers by practicing good personal hygiene, avoid cross-contamination

Prevention: How the chain of infection may be stopped

(2) Shigellosis infection, caused by *Shigella* bacteria

(a) Incubation period: 1-7 days

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- (b) Duration of Illness: Indefinite, depends on treatment
 - (c) Symptoms: Diarrhea, fever, chills, lassitude, dehydration
 - (d) Reservoir: Human beings
 - (e) Foods involved: Potatoes, tuna, shrimp, turkey and macaroni salad, lettuce, moist and mixed foods
 - (f) Spore former: No
 - (g) Prevention: Avoid cross-contamination, avoid fecal contamination from foodhandlers by practicing good personal hygiene, use sanitary food and water sources, control flies, rapidly cool foods
- (3) Listeriosis infection caused by the bacteria *Listeria monocytogenes*
- (1) Incubation period: 1 day-3 weeks
 - (2) Duration of illness: Indefinite, depends on treatment, but has high fatality in the immunocompromised
 - (3) Symptoms: Nausea, vomiting, headache, fever, chills, backache, meningitis

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- (4) Reservoir: Soil, water, mud, human beings, domestic and wild animals, fowl
 - (5) Foods involved: Unpasteurized milk and cheese, vegetables, poultry and meats, seafood, and prepared, chilled ready-to-eat foods
 - (6) Spore former: No
 - (7) Prevention Use only pasteurized milk and dairy products, cook foods to proper temperatures, avoid cross-contamination, clean and disinfect surfaces, avoid pooling of water
- d. Staphylococcus intoxication caused by *Staphylococcus aureus*
- (1) Incubation period: 1-6 hours
 - (2) Duration of illness: 24-48 hours
 - (3) Symptoms: Nausea, vomiting diarrhea, dehydration
 - (4) Reservoir: Human beings (skin, nose, throat, infected sores), also animals

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- (5) Foods involved: Ham and other meats, warmed-over foods, dairy products, custards, potato salads, cream-filled pastries, and other protein foods
 - (6) Spore former: No
 - (7) Prevention: Avoid contamination from bare hands, exclude foodhandlers with skin infections from food preparation, proper refrigeration of food, rapid cooling of prepared foods
- e. *Clostridium perfringens* enteritis infection or intoxication caused by bacteria
Clostridium perfringens. Also called "leftover disease"
- (1) Incubation period: 8-22 hours
 - (2) Duration of illness: 24 hours
 - (3) Symptoms: Abdominal pain, diarrhea
 - (4) Reservoir: Intestinal tract of humans, animals, soil
 - (5) Foods involved: Cooled meat, poultry, gravy, beans that have been cooled slowly
 - (6) Spore former: Yes

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- (7) Prevention: Use careful time and temperature control in cooling and reheating cooked meat, poultry and bean dishes

- e. *Bacillus cereus* gastroenteritis infection/intoxication caused by *Bacillus cereus*. Also called "fried rice poisoning"
 - (1) Incubation period: ½ hour-5 hours; or 8-16 hours depending on form
 - (2) Duration of illness: 6-24 hours; 12 hours
 - (3) Symptoms: Nausea, vomiting, diarrhea, abdominal cramps
 - (4) Reservoir: Soil, dust
 - (5) Foods involved: Rice and rice dishes, custards, seasonings, dry food mixes, spices, puddings, cereal products, sauces, vegetable dishes, meat loaf
 - (6) Spore former: Yes
 - (7) Prevention: Use careful time and temperature control and quick-chilling methods to cool foods, hold hot foods at proper temperatures, reheat leftovers properly

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- f. Botulism intoxication caused by *Clostridium botulinum*. Also called "home-canning disease"
- (1) Incubation period: 12-36 hours+; neurological symptoms occur after 72 hours
 - (2) Duration of illness: Several days-years
 - (3) Symptoms: Vertigo, visual disturbances, inability to swallow, respiratory paralysis
 - (4) Reservoir: Soil, water
 - (5) Foods involved: Improperly processed canned goods of low acid foods, garlic-in-oil products, grilled onions in butter sauce, leftover potatoes, foil-wrapped baked potatoes, stews, meat/poultry loaves
 - (6) Spore former: Yes

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- (7) Prevention: Do not use home-canned products, use careful time and temperature control for all large, bulky foods, purchase only small quantities of garlic-in-oil mixtures use immediately and refrigerate, cook onions only on request, rapidly cool leftovers

- g. Campylobacteriosis infection caused by *Campylobacter jejuni*
 - (1) Incubation period: 3-5 days
 - (2) Duration of illness: 1-4 days
 - (3) Symptoms: Diarrhea, fever, nausea, abdominal pain, headache
 - (4) Reservoir: Intestinal tract of domestic and wild animals
 - (5) Foods involved: Unpasteurized milk and dairy products, poultry, pork, beef, and lamb
 - (6) Spore former: No
 - (7) Prevention: Thoroughly cook food, avoid cross contamination

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h. *E. coli* O157:H7 enteritis infection/
intoxication caused by *Escherichia coli*

(1) Incubation period: 12-72 hours

(2) Duration of illness: 1-3 days

(3) Symptoms: Diarrhea, could become
bloody diarrhea; severe abdominal
pain, nausea, vomiting, occasional
fever

(4) Reservoir: Intestinal tract of
animals, particularly cattle, human
beings

(5) Foods involved: Raw and undercooked
ground beef and other red meats,
imported cheeses, unpasteurized milk

(6) Spore former: No

(7) Prevention: Thoroughly cook ground
beef, avoid cross contamination, avoid
fecal contamination from foodhandlers
by practicing good personal hygiene

5. Foodborne illnesses caused by parasites and viruses

a. Parasites are tiny organisms which depend on a
living host to provide certain requirements for
growth

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- (1) Trichinosis is caused by the parasite *Trichinella spiralis*, a roundworm
 - (a) Incubation period: 2-28 days
 - (b) Duration of illness: Indefinite depending on treatment
 - (c) Symptoms: At first limited to nausea, vomiting, and stomach pain. Later, muscle pain and stiffness, fever, and a rash develop
 - (d) Reservoir: Pigs, wild animals
 - (e) Foods involved: Undercooked pork or wild bear meat
 - (f) Prevention: Cook pork thoroughly or freeze it for at least 30 days at 5°C will kill the organism

- b. Viruses are the smallest and simplest life-form known. Unlike bacteria and parasites, viruses are not complete cells and do not reproduce in food. Like bacteria, however, some viruses may survive cooking or freezing. Also like bacteria, viruses can be transmitted to a human host by food or food-contact surfaces

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- (1) Norwalk virus gastroenteritis infection
 - (a) Incubation period: 24-48 hours
 - (b) Duration of illness: 24-48 hours
 - (c) Symptoms: Nausea, vomiting, diarrhea, abdominal pain, headache, low-grade fever
 - (d) Reservoir: Intestinal tract of human beings
 - (e) Foods involved: Raw shellfish, raw vegetables, salads, prepared salads, water from contaminated human feces
 - (f) Prevention: Obtain shellfish from approved, certified sources, avoid fecal contamination from foodhandlers by practicing good personal hygiene, thoroughly cook foods, use chlorinated water

- (1) Hepatitis A
 - (a) Incubation period: 15-50 days, median 28 days
 - (b) Duration of illness: 2-4 weeks for acute disease, months-years of convalescence

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- (c) Symptoms: jaundice (yellowing of the skin and eyes that is a sign of liver damage), nausea, abdominal pain, and lethargy
- (d) Reservoir: Human carrier, feces
- (e) Foods involved: raw oysters and clams, raspberries and strawberries recently
- (f) Prevention: Obtain shellfish from approved sources, avoid fecal contamination from foodhandlers by practicing good personal hygiene, obtain fruits and vegetables from approved locations and wash thoroughly before serving

5. Controlling Growth of Microorganisms

- a. Microorganisms, like all living creatures, require food and water to grow and replicate.
- b. Generally, bacteria live well in potentially hazardous foods because these foods are often warm, moist, protein-rich, and neutral or low in acid.
- c. Optimal growth conditions and the methods to control these critical control points are described using the acronym "FAT-TOM":

Adding vinegar or lemon juice, which are highly acidic foods to a product will help slow

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bacterial growth.

- (1) Food: High-protein foods are likely to be received already contaminated or may be easily contaminated later
- (2) Acidity: Acidity is measured on a scale from 0 (very acidic) to 14.0 (very alkaline or basic). A solution with a pH acid-alkaline measurement of 7.0 is neutral. Most PHFs have a pH level between 4.6 and 7.0
- (3) Time: PHFs should not remain in the temperature danger zone for more than four hours during the entire foodhandling process
- (4) Temperature: The temperature danger zone for PHFs is 40-140°F. However, bacteria can survive at lower temperatures therefore refrigeration is not total protection against bacterial growth
- (5) Oxygen: Some bacteria require oxygen to grow, while others require no oxygen. However, most of the bacteria that cause foodborne illness can grow either with or without oxygen

Water activity can be reduced to safer levels by freezing, dehydrating, adding sugar or salt, or cooking.

Dry foods, such as rice and beans become PHFs when water is

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added.

(6) Moisture: The amount of available water in food is called the water activity (A_w). The lowest A_w at which harmful bacteria will grow is 0.85. Most PHFs have an A_w of 0.97-0.99, which is ideal for bacterial growth

d. Time and temperature together are the best way to control bacterial growth. When abused, these critical control points are responsible for a large percentage of all foodborne illness outbreaks

6. Summary

a. Introduction

b. Three types of hazards

c. Microbiology

(1) Definitions

(2) Chain of infection

(3) Prevention of infection

d. Controlling the growth of microorganisms

(1) FAT-TOM