MODULE

Food-borne Diseases

Diploma Program
For Health Extension Workers

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UNIT ONE
INTRODUCTION

1.1. Purpose and Use of the Module

A big challenge in the training of well-versed health professionals in the different higher institutions in Ethiopia has emanated from the serious shortage of adequate number of contextual reference materials. To add to this problem, even the available reference materials sometimes fail to address the most important learning issues of the Ethiopian students as well as being not suitable enough for their learning styles. However, up to this day, efforts geared towards the preparation of reference materials by instructors in the different institutions in order to reduce this problem have remained meager.

This brings into picture the purpose of the preparation of this module, which is just one among many having been or being undertaken through the initiation made by the Carter Center, EPHTI. This module is prepared to help students develop knowledge, attitudes and skills required in their practice areas through active learning. To this end, it will enable the different members of the Ethiopian health center team; included in this module are, Public health Nurse (PHN), Environmental Heath Technician (EHT), and Medical Laboratory Technician (MLT), to be able to recognize and manage the important food-borne diseases as well as to prevent them from occurring from the outset. Moreover this module also contains a satellite for Health Extension Workers (HEW) who are expected to play a pivotal role in alleviating the prevalent health problems of the country.

Besides, it is believed that those already engaged in the service delivery in different health facilities will benefit well from reading to this module from time to time. All individuals taking time to look at this document are reminded of the importance of consulting standard textbooks on the subject whenever possible, since this module is by no means meant to replace them.

1.2. Directions for Using the Module

Before starting to read this module, please follow the directions given below:

1. Go through all the contents of the core module by starting with the pretest.
2. Use a separate sheet of paper to write your answers and label it “pretest answers”.
3. The pretest has two portions: Part I, and Part II.

PART I: Contains common questions to be answered by all categories of the health center team.

PART II: The questions are prepared for the specific categories; Health Officers, Nurses, Environmental Health Officers, and Medical Laboratory Technologists. Select and do the portion that corresponds to your professional category.

- When you are sure that you are through the core module proceed to read the satellite module corresponding to your profession or interest.
- Go through the task analysis for the team members in comparison with that of your own.

Note: You may refer to the list of abbreviations and glossary shown in Unit Seven for terms that are not clear. .

UNIT TWO

CORE MODULE FOR THE HEATH CENTER TEAM MEMBERS

2.1. Pre-test

Write the answers of the following questions on a separate answer sheet.

Part I: Questions for All Categories

Answer the following questions.

1. Define food-borne diseases.
2. Describe the two major classifications of food-borne diseases and give examples for each.
3. Mention some factors contributory to the widespread occurrence of food-borne diseases in Ethiopia. Mention some of them.
4. List some of the general diagnostic approaches of food-borne diseases.
5. What are the three basic principles in the prevention and control of food-borne diseases?
6. Which of the following food-borne diseases is caused by a protozoon?
    a. Typhoid fever
    b. Shigellosis
    c. Amebiasis
    d. Cholera
7. Describe how one may differentiate between amebic and bacillary dysentery.
8. The most important complication of cholera is:
    a. Dehydration
    b. Fever
    c. Intestinal perforation
    d. Blood loss
9. Discuss how consumption of raw or undercooked food may predispose for food-borne disease.
10. Outline the steps in food-borne disease outbreak investigation.

Part II: Questions for the Specific Categories

A. For Public Health Nurses

Choose the letter of the best answer from the destructors given after each question

1. The nursing intervention goals that we can set for a patient with food borne disease includes all except:

    A. Relief pain
    B. Regaining normal bowel patterns
    C. Prevent the spreading of the infection to others
    D. Reduction of symptoms

2. All are the nursing interventions used to reduce/eliminate the effects of the poisonous chemicals, poisonous plant or toxin that is responsible for food borne disease except:

    A. Attaining control of the airway, ventilation, and oxygenation.
    B. Induction of vomiting
    C. Administering a warmth sitz bath
    D. Administering multiple doses of charcoal

3. In patients with irregular pattern of bowel elimination, the signs such as dry skin and mucus membranes and sunken eyes suggest:

    A. Rehydration
    B. Dehydration
    C. Hypertension
    D. Anemia

4. Identify an incorrect statement about the prevention of food borne disease

    A. Instruct the patient about personal hygiene
    B. Teach the people about proper storage of the food items
    C. Eliminate flies for they are the vectors that causes the disease
    D. Teach the people that roaches have nothing to do in causing food borne diseases

5. Which sort of fluids can be given for patients with food borne disease to combat fluid volume deficit?

    A. Water
    B. Juice
    C. A and B
    D. Alcohol

6. Preventing the spread of food borne diseases to others can be accomplished by:

    A. Hand washing thoroughly after giving care
    B. Using glove when handling any body fluid from the patient
    C. To prevent patient-to-patient infection spread provide isolation according to the general rule of body substance isolation, or individual institution adaptation of isolation
    D. All are answers

7. If a patient with diarrhea secondary to food borne disease is dehydrated his/her weight

    A. Increases
    B. Decreases
    C. Shows no change
    D. Some times increases and some times decreases

B. For Environmental Health Technicians

Select the letter of your best choice for questions 2 and 3 and write short answers to the remaining questions.

1. What is food sanitation?
2. Which of the following is among the reasons why food-borne diseases are a major public health problem in Ethiopia?
    a. Lack of awareness
    b. Lack of safe water supply
    c. Poor environmental sanitation
    d. All of the above
3. Organo-leptic tests are related to:
    a. Physical tests using sensory organs
    b. Chemical tests
    c. Toxicologic tests
    d. Bacteriological tests
4. List some of the benefits of effective food sanitation program.
5. What are the three basic principles of food sanitation in the control of food-borne illnesses?
6. Mention at least 3 contaminants of food that may have deleterious effect on human health.
7. List the stages at which food may be contaminated.
8. List the sources of food contamination.
9. What are the four components important in the transmission of food-borne diseases?
10. List factors that are most commonly contributors in food-borne disease outbreaks.
11. Mention two preventive measures for ensuring food safety at each of the following stages.
    a. During production of raw materials
    b. During food processing

c. Food preservation and storage
d. Food preparation at home
e. Food preparation in the food service industry

12. What is HACCP? What are its elements?
13. List methods used to keep food safe.
14. What are the essentialities that determine the need for food sample collection?

C. FOR MEDICAL LABORATORY TECHNICIANS

Choose the best answer for questions1-7 and fill in the blank for question 8

1. The type of specimen used to identify Taenia species is:
   a. Blood
   b. Feces
   c. Urine
   d. Sputum
2. The diagnostic stage of *Giardia lamblia* is:
   a. cyst
   b. trophozoite
   c. egg
   d. A and B
3. Which one of the following parasites causes dysentery?
   a. Taenia species
   b. Giardia lamblia
   c. *Entameoba histolytica*
   d. *Ascaris lumbricoides*
4. The laboratory diagnosis of Ascaris lumbricoides is by:
   a. identifying adult worms expelled through the anus or mouth
   b. identifying the egg microscopically from feces
   c. a and b
   d. none of the above

5. Culture is the gold-standard for diagnosis of typhoid and paratyphoid fevers
    a. true
    b. false
6. A transport medium used for transporting feces that may contain Enterobacteria:
    a. Amies medium
    b. Alkaline peptone water
    c. Phosphate buffered saline
    d. Cary-Blair medium
7. Which one of the following bacteria can cause food-borne infection?
    a. Salmonella
    b. Shigella
    c. V. cholerae
    d. Brucella
    e. All
8. Serological test used for the diagnosis of typhoid fever is_____.

2.2 Significance and Brief Description of Food borne Diseases

As far back as the documentation of human history goes, consumption of food unsafe for health and its consequences have been one of man's major health problems. They still remain to be a major public health concern globally. Food-borne diseases are known to be responsible for a large proportion of adult illnesses and deaths; more importantly, as sources of acute diarrheal diseases, they are known to claim the lives of overwhelming numbers of children every day.

In developing countries like Ethiopia, the problem attains great proportions due to many reasons, basic among which are poverty and lack of public health awareness. Although well-documented information is lacking regarding the extent of food-borne diseases in the country, and many cases and outbreaks are unrecognized or unreported, they are unquestionably one of the major reasons why people of all ages seek medical help. Most food-borne diseases manifest with gastrointestinal symptoms and signs, the later

being uniformly among the top diagnoses in health facilities at all levels. Besides, they commonly lead to epidemics that result in the losses of many lives, accompanied with severe economic repercussions.

In these modern days in which food is usually not consumed immediately following and/or at the site of production, the risks of food-borne diseases are becoming increasingly important; the concern is obviously much more in areas where food storage and preparation safety measures are far below from the optimum.

The role of well-trained health professionals not only in the prevention and control of food- borne diseases, but also in the recognition of individual cases as well as outbreaks and their timely and proper management in order to reduce mortalities and morbidities is very crucial.

2.3. Learning Objectives

- **General**

Upon completion of this module, the learner will be able to recognize, prevent and manage food-borne diseases.

- **Specific**

After completing this module the learner will be able to:

1. Describe the epidemiology of food-borne diseases.
2. Define and classify food-borne diseases
3. Identify the causes of most common food born diseases in Ethiopia.
4. Describe the clinical features and complications of food-borne diseases.
5. Explain the general diagnostic and management approaches to some food-borne diseases.
6. Investigate and control outbreaks of food-borne diseases.
7. Develop preventive and control strategies for common food-borne diseases.

2.4. Case Study

Learning Activity 1

It was during the period of drought and famine when people were getting displaced from a highly drought-stricken village to other areas. Before the resettlement, they used to wait in groups in a nearby small town for few days, or sometimes weeks. Among them, Fatuma, a 25-year old lady came to the nearby health center with one day history of nausea, vomiting and watery diarrhea. She was one of the cooks for the group. On examination, she looked weak with feeble pulse, fast pulse rate and her blood pressure was abnormally low. Her tongue and mucosa were dry.

After appropriate laboratory investigations, she was given proper management and advice. The next morning 25 similar cases from the group came to the Health Center. They were also given appropriate management, and advice. Staffs from the Health Center supervised the temporary shelters of the displaced people and came up with the following report: there were about 50 individuals living in four rooms within one compound; the houses were under construction with multiple openings and dusty floors. There was no toilet in the compound and it was observed that there were human excreta scattered all around. Cooking and eating utensils were not clean and there was no appropriate storage for their food. Pipe water supply was available in the compound; but the people fetched the water using wide mouthed buckets for storage. Finally the staffs conducted appropriate intervention measures and no similar cases were seen subsequently.

Exercise:

Answer the following questions related to the case study

1. What do you think is the source of Fatuma's health problem?
2. What do you comment about the role of Fatuma in the transmission of this disease among the settlers?
3. What are possible interventions to prevent such occurrences in the future?
4. Could food be considered as a possible cause for this outbreak? Why?

2.5. Definition of Food borne diseases

"Food borne disease" is defined as a disease caused by agents that enter the body through the ingestion of contaminated food (1). These agents may be infectious agents or toxic substances.

2.6. Epidemiology

Although food is a basic human need it can sometimes cause a number of illnesses arising from pathogenic and toxic substances that find their way in to food through contamination or spoilage (2). Food borne illnesses have significant impact worldwide including developed nations. For example, the Center for Disease Control and Prevention (CDC/US) has made estimates that 76 million cases, more than 300,000 hospitalizations and 5000 deaths occur in a year in the US from food-borne diseases. In addition, 400 – 500 outbreaks are reported.

Epidemiologic data related to food-borne diseases are inadequate in Ethiopia. But it can be evidenced that these are very common in the country because of many reasons including poverty, lack of awareness, poor water supply, poor personal hygiene and environmental sanitation, etc.

According to the 2002-2003 "Health and Health-related Indicators" published by the Planning and Programming Department of the Federal Ministry of Health of Ethiopia,

- Helminthic infections were the second leading cause of outpatient visits
- Dysentery and different parasitic infections were also among the ten top causes of outpatient visits
- Dysentery was among the leading causes of hospital admissions and deaths
- The national average access to safe water was 28.4% (75.7% for urban and 19.9% for rural)
- National figure for safe excreta disposal was 11.5% (49.7% for urban and 3.9% for rural)
- Typhoid fever, acute diarrheal diseases, bloody diarrhea and anthrax were reported as some of the major causes of outbreaks (27).

2.7. Classification and Etiology of Some Food Borne Diseases

Food borne diseases can be classified in to two major categories depending on the responsible agent: food-borne poisonings/intoxications and food-borne infections. For further information see figure 2.1.

Food borne infections: are diseases whose etiologic agents are viable pathogenic organisms ingested with foods and that can establish infection. Table 2.1 shows some examples of food-borne infections including their category, and the foods commonly involved.

Food borne poisonings/ intoxications: diseases arising from the ingestion of toxins released by microorganisms, intoxications from poisonous plants or toxic animal tissues, or due to consumption of food contaminated by chemical poisons. (3, 4)

Table 2.2 shows the etiologies of some food-borne poisonings/intoxications including their category, and the foods commonly involved.

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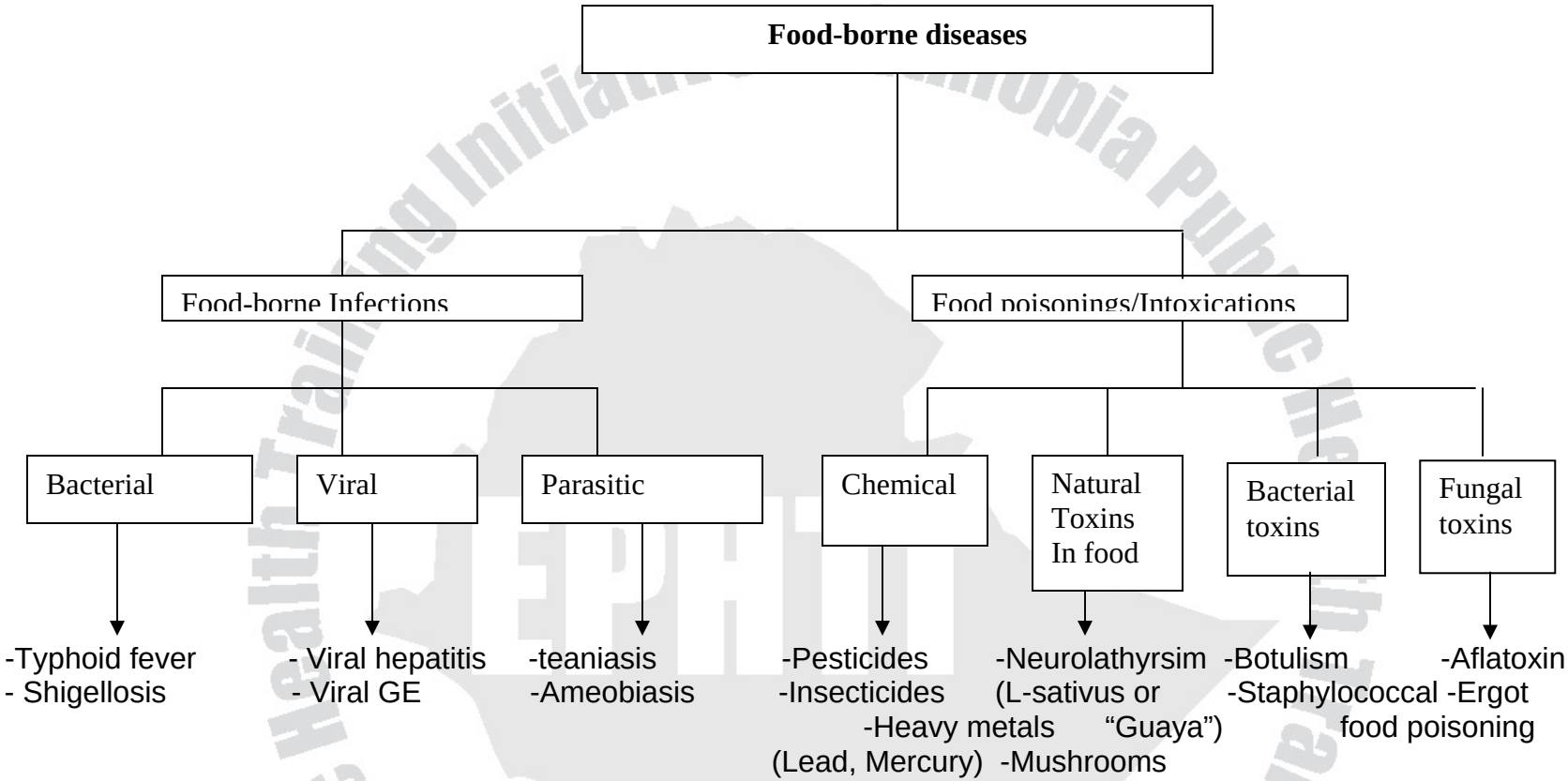

Figure 2.1: Classification of food borne diseases.

Table 2.1: Etiologies of some food borne infections and foods commonly involved.

Etiologic Category	Diseases	Causative organisms	Foods commonly involved
1.Bacterial	Typhoid fever	Salmonella typhi and parathyphi	Raw vegetables and fruits, salads, pastries, un- pasteurized milk and milk products.
	Shigellosis	Shigella species	All foods handled by unhygienic workers, potato or egg salad, lettuce, raw vegetables
	Cholera	Vibrio cholerae	Fruits and vegetables washed with contaminated water
	Non typhoid Salmonellosis	Salmonella species	Eggs, poultry, undercooked meals, un-pasteurized dairy products, sea foods, sausages
	Brucellosis	Brucella species	Milk and dairy products from infected animals.
	Anthrax	Bacillus Anthracis	Contaminated undercooked meat
	Bovine TB	M. Bovis	Un-pasteurized milk or dairy products from tuberculous cows.
	E.coli infections	E.coli	Beef, dairy products, fresh products, or raw produce (potatoes, lettuce, sprouts, fallen apples), salads.
Etiologic Category	**Diseases**	**Causative organisms**	**Foods commonly involved**
2. Viral	Viral GE	Rota virus, Norwalk virus, calici virus, astro virus	Any food of daily use with poor hygiene
	Viral hepatitis	Hepatitis A & E	Raw shellfish from polluted water, sandwich, salad, and desserts.
	Poliomyelitis	Polio virus	Any food of daily use with poor hygiene
3. Parasitic	Taeniasis	Taenia species	Raw beef, raw pork
	Amoebiasis	Entameba histolytica	Any food soiled with feces
	Trichinosis	Trichnella spiralis	Insufficiently cooked pork and pork products
	Ascariasis	Ascaris lumbricoides	Foods contaminated with soil, specially foods that are eaten raw such as salads, vegetables
	Giardiasis	Giardia lamblia	Foods contaminated with feces
	Toxoplasmosis	Toxoplasma gondii	Raw or undercooked meat and any food contaminated with cat feces?
	Cryptosopridiosis	Cryptosporidium parvum	Apple juice, contaminated food

Table 2.2: Etiologies of some food borne poisonings/intoxications and foods commonly involved.

Etiologic Category	Disease	Causative agent	Foods commonly involved
A. Natural toxins in Foods	1. Neurolathyrism	Beta oxalyl amino–alanine	"Guaya" (Lathyrus sativus)
	2. Mushroom poisoning	Phalloidine and alkaloids found in some poisonous mushrooms.	Poisonous mushrooms such as species of Amanita phalloides and Amanita muscaria
B. Bacterial toxins	1.Staphylococcal food poisoning	Entero-toxin from staphylococcus aureus	Milk and milking products, sliced meat, poultry, potato salad, cream pastries, egg salad
	2.Perfringens food poisoning	Strains of Clostridium welchii/ C.perfringens	Inadequately heated or reheated meat, poultry, legumes
	3.Botulism food poisoning	Toxin of Clostridium botlinum	Home-canned foods, low acid vegetables, corn and peas.
	4.Escherichia coli food poisoning	Enterohemorrhagic Escherichia coli 0157:H7	Ground beef, dairy products, raw beef.
	5.Bacillus cereus food poisoning	Entero toxin of Bacillus cereus	Cereals, milk and dairy products, vegetable, meats, cooked rice.
C. Fungal toxins	1. Ergotism	A toxin (ergot) produced by a group of fungi called clevises purpurea	Rye, wheat, sorghum, barley
	2. Aflatoxin food poisoning	Aflatoxin produced by some groups of fungus (e.g Aspergilus flavus, Aspergillus parasites)	Cereal grains, ground nuts, peanuts, Cottonseed, sorghum.
D. Chemical food poisoning	Chemical poisoning	Heavy metals (e.g. Lead, mercury, cadmium)	- Fish, canned food - Foods contaminated by utensils made or coated with heavy metals
		Pesticides and insecticides	- Residues on crops, vegetables, fruits. -Accidental poisoning where some chemicals may be mistaken with food ingredients. -When contaminated containers are used to hold or store foods.
		Additives (unauthorized)	Various food items where unauthorized additives may be added as coloring agents, sweeteners, preservatives, flavoring agents etc.

2.8. Pathogenesis and Clinical Features of Common Food-borne Diseases

2.8.1. Food-borne Infections

A. Bacterial Food Borne Infections:

i. Typhoid fever (Enteric fever)

Typhoid fever is a systemic diseases caused by S. typhi or S. paratyphi A and B.

Pathogenesis:

Following ingestion, the bacteria enter the epithelial layer of the small intestine, and are carried by macrophages throughout the body. They reach the reticuloendothelial system of the body. During bacteremic phase, they also invade different organs like the gall bladder, the small intestine, etc.(9).

Clinical features:

- Incubation period is 3-21 days.
- The major symptoms are prolonged fever, headache, anorexia, chills, malaise, abdominal pain, and diarrhea or constipation.
- On examination, one may find enlarged liver and spleen and abdominal tenderness.
- Untreated patients may develop different complications, mainly gastrointestinal hemorrhage and/or perforation.

ii. Non-typhoidal Salmonellosis

Pathogenesis

Following ingestion, the non-typhoidal salmonella organisms reach the bowel where they cause damage to the intestinal mucosa causing inflammatory diarrhea.

Clinical Features

- The major clinical features are loose, non-bloody stools of moderate volume, nausea, vomiting, fever and abdominal cramps, which are seen following an incubation period of 6 – 48 hours.
- Large-volume watery diarrhea or dysentery can also occur.

iii. Shigellosis/Bacillary dysentery

It is an acute inflammation of the colon caused by a number of *Shigella* species.

Pathogenesis:

Orally ingested organisms invade colonic epithelial cells. Following this they multiply within the cells causing cell damage and death. This results in mucosal ulcerations.

Clinical Features:

- The incubation period is 1-7 days.
- The major manifestations are non-bloody watery diarrhea or grossly bloody diarrhea with tenesmus (painful urge to evacuate the colon and difficulty defecation) accompanied by fever and abdominal pain.
- Major complications of shigellosis are dehydration and bacteremia.

iv. Cholera

Cholera is an acute diarrheal disease that may result in death due to dehydration and electrolyte disturbances within hours if not treated.

Pathogenesis:

- Following colonization of small intestine, the organism releases a potent enterotoxin called cholera toxin.
- This toxin inhibits sodium absorption and activates chloride excretion resulting in the accumulation of sodium chloride in the intestinal lumen, which attracts water passively, leading to significantly increased watery stool output(9).

Clinical features:

- After an incubation period of 24 – 48 hours, patients experience sudden onset of profuse watery (“rice-water” like) diarrhea accompanied by vomiting.
- Fever and abdominal pain are usually absent.
- Important complications include dehydration, shock, electrolyte disturbances and acute renal failure.

v. Escherichia coli Infection

There are different strains of *Escherichia coli* which give rise to diarrhea by different mechanisms:

1. Entero toxigenic *E. coli* (ETEC)

Produces watery diarrhea and abdominal pain by producing toxins which increase intestinal fluid secretion.

2. Enterohemorrhagic *E. coli* (EHEC)

This leads to initially watery then bloody diarrhea as a result of production of a toxin that causes inflammation of the colon.

3. Enteropathogenic *E. coli* (EPEC)

This leads to mucoid diarrhea by affecting the function of the microvilli of the small intestine

4. Enteroinvasive *E. coli* (EIEC)

This leads to a shigellosis-like condition by invading intestinal mucosa.

vi. Brucellosis

Pathogenesis:

The organism invades the blood stream and localizes in the liver, spleen, bones, etc. In these tissues it induces inflammatory responses.

Clinical Features

- The incubation period is 1 week to several months.
- Clinical features include fever, chills, sweating, muscle and joint pain (myalgia and arthralgia), headaches, anorexia, weight loss, dry cough, etc.
- Patients may appear well or may be very ill with any of the following manifestations: anemia, lymph node enlargements, enlarged liver and spleen, evidences of joint inflammation, rash, etc.

vii. Anthrax

Pathogenesis:

The organisms release anthrax toxin, which is responsible for the different manifestations of the disease.

There are three major clinical forms of anthrax:

1. Cutaneous anthrax (95%), which is the most common characterized by localized skin lesion with black central eschar (necrosis0 and non-pitting edema.
2. Inhalation anthrax (Wool sorter's diseases) characterized by hemorrhagic mediastinitis with high mortality rate.
3. Gastrointestinal anthrax, which is rare, but has high mortality rate.

Since gastrointestinal anthrax is the most important form of anthrax with respect to acquisition through contaminated food, the following discussion focuses on this form of anthrax.

Clinical features of gastrointestinal anthrax:

There are two major forms:

- Gastrointestinal anthrax manifesting with fever, nausea, vomiting, abdominal pain, massive bloody diarrhea and occasional fluid accumulation in the peritoneal cavity.
- Oropharyngeal anthrax manifests with fever, sore throat and difficulty of swallowing, painful regional lymph node enlargements and respiratory distress.

B. Parasitic Food Borne Infections

Most common food-borne parasitic diseases to be considered are amebiasis, ascariasis, taeniasis and giardiasis.

i. Amebiasis

Pathogenesis:

Motile trophozoites released from ingested cysts invade large bowel mucosa and cause mucosal ulcerations; they may also spread to other organs via the

bloodstream to cause lesions in distant organs (most commonly in the liver). Intestinal infections rarely cause mass lesion.

Clinical features

There are various clinical syndromes:

- Symptomatic intestinal amebiasis manifests with abdominal pain and mild diarrhea followed by diffuse abdominal pain, weight loss, malaise, and bloody-mucoid diarrhea. Fever occurs in less than 40% of patients.
- Amoebic liver abscess manifests with fever, abdominal and/or right lower chest pain, abdominal tenderness and fluid in the pleural cavity. Less than 30% have diarrhea.
    - Complications include rupture of the abscess and formation of abnormal communications between the abscess cavity and the bronchi.

ii. Giardiasis

Pathogenesis:

- Ingested cysts release trophozoites in the small intestine.
- The trophozoites multiply by binary fission, adhere to the intestinal mucosa and lead to diarrhea and malabsorption; however, the exact mechanism by which *G. lamblia* produces diarrhea is not clear.

Clinical features

Most patients are asymptomatic. But in symptomatic individuals, the clinical features range widely and include diarrhea, abdominal pain, flatulence, anorexia, weight loss, nausea and vomiting.

iii. Taeniasis

a. Taeniasis Saginata

Pathogenesis:

- This is the common form of taeniasis in Ethiopia.

- Cysticerci deposited in the striated muscles of cattle infect humans when they are ingested with raw or undercooked beef and they develop into adults in the small intestine of the infected person.

Clinical features:

Patients notice passage of proglottids in the feces, discomfort around the anus, abdominal discomfort or mild pain, nausea and anorexia.

b. Taeniasis solium

Pathogenesis:

T. solium is able to cause two different forms of infection in humans.

- Intestinal disease is infection with adult tapeworms, acquired by ingestion of raw or undercooked pork containing cysticerci.
- Cysticercosis is infection with larval forms in the tissues, most commonly the brain and skeletal muscles, and follows ingestion of *T. solium* eggs. Fecal-oral autoinfection is possible.

Clinical Features:

- Intestinal infection may be asymptomatic or may manifest with epigastric discomfort, nausea, hunger sensation, diarrhea.
- Cysticercosis: the clinical features depend on the location and number of cysticerci and the degree of inflammatory response they induce in the tissue.

iv. Ascariasis

Pathogenesis:

- Eggs released with feces mature in the soil and become infective in weeks.
- When swallowed with contaminated food, they release larvae in the intestines, which enter blood, go to the lungs, enter the alveoli, ascend the bronchial tree and are swallowed back into the bowel.

- In the small intestine, they develop into adult worms.

Clinical features:

Clinical manifestations result from:

- Larval migration in the lungs: cough, shortness of breath, blood-tinged sputum
- Effect of adult worms in the intestine: usually asymptomatic, but may produce intestinal obstruction, perforation
- Worms may migrate to ectopic sites to produce other manifestations like biliary colic.

C. Viral Food Borne Infections

Different viruses may be transmitted via contaminated food; most produce mild self-limiting illness, but occasional severe illnesses and even deaths may also occur.

i. Viral gastroenteritis

Pathogenesis:

Rotavirus causes osmotic diarrhea due to nutrient malabsorption. Caliciviruses such as the Norwalk virus also produce diarrhea in a similar but slightly different mechanism that culminates in nutrient malabsorption.

Clinical Features:

- Rotavirus infection causes sudden onset of vomiting followed by mild to very severe diarrhea mixed with mucus, and fever.
- Norwalk illness results in abrupt onset of nausea and abdominal cramps followed by vomiting and /or diarrhea, low-grade fever, headache, muscle pain after an incubation period of 18 to 72 hours.

ii. Viral hepatitis.

Pathogenesis:

Almost exclusively the fecal-oral route transmits Hepatitis A and E viruses. None of the hepatitis viruses directly damages liver cells. Immunologic response of the host plays important role in the pathogenesis(9).

Clinical features:

- The incubation period varies according to the responsible agent.
- Prodoromal symptoms include anorexia, nausea and vomiting, fatigue and malaise, muscle and joint pain, headache, photophobia, low-grade fever (38 – 39^{o}C).
- These are followed by development of clinical jaundice; possibly accompanied by mild weight loss, right upper quadrant pain and tender enlarged liver.

2.8.2. Food poisonings / intoxications

A. Bacterial Food Poisoning

i. Clostridium perfringens

Pathogenesis

The spores are able to survive cooking, and if the cooked food (meat and poultry) is not properly refrigerated, they will germinate. The abrupt change in pH from stomach to intestine causes sporulation to occur, which releases the toxin. When massive doses of these organisms are ingested with food, toxins are elaborated in the intestinal tract and cause increased fluid and electrolyte secretion (4).

Clinical Features:

- Incubation period: 6 to 24 hrs after consumption of the contaminated food.
- The most common symptoms are diarrhea, abdominal cramp and little or no fever. Nausea is common, but vomiting is usually absent. Illness is usually of short duration, usually 1 day or less. The disease is rarely fatal in healthy people. A typical symptom is explosive diarrhea (4, 1, 9, 10, 6).

iii. Escherichia Coli 0157:H7

Pathogenesis

- All enterohemorrhagic strains produce shiga toxin. This toxin causes colonic inflammation.
- Enterotoxigenic *E. coli* causes watery diarrhea by secreting a toxin that interferes with the function of the small intestine (7).

Clinical Features:

- Incubation period: The initial symptoms of hemorrhagic colitis generally occur 1 to 2 days after eating contaminated food, although periods of 3 to 5 days have been reported.
- Symptoms start with mild, non-bloody diarrhea that may be followed by a period of abdominal pain and short-lived fever.
- During the next 24 to 48 hours, the diarrhea increases in intensity followed by a 4 – 10 days phase of overtly bloody diarrhea, severe abdominal pain, and moderate dehydration.

iii. Bacillus Cereus

Pathogenesis:

The pathogenic agent of *Bacillus cereus* food poisoning appears to be an enterotoxin. This spore forming bacterium produces an endotoxin that is released when cells die upon entering the digestive tract (4).

Clinical features

- Incubation period: From 1 to 16 hours in cases where vomiting is the predominant symptom; from 6 to 24 hours where diarrhea is predominant (7,10).
- The symptoms consist of nausea, vomiting, cramp like pains, tenesmus, and watery stools. Fever is generally absent (4, 13, 7).

iv. Staphylococcal Food Poisoning

Staphylococcal food poisoning is the major type of bacterial food intoxication.

Pathogenesis

The disease is caused by enterotoxins produced by *Staphylococcus aureus*.

The toxins appear to act as neurotoxins that stimulate vomiting through the vagus nerve.

Clinical Features

Typical symptoms include severe abdominal pain, cramps, diarrhea, vomiting, and nausea. The onset of symptoms is rapid (usually 1 to 8 hours) and of short duration (usually less than 24 hours).

v. Botulism

Food-borne botulism is a form of food poisoning caused by *Clostridium botulinum*.

Pathogenesis

It is primarily caused by botulinum toxin, which is a neurotoxin that leads to flaccid paralysis.

Clinical Features

Symptoms of botulism occur within 18 to 24 hours of toxin ingestion and include blurred vision, difficulty in swallowing and speaking, muscle weakness, nausea, and vomiting. Without adequate treatment, 1/3 of the patients may die within a few days of either respiratory or cardiac failure.

Infant botulism is the most common form. The infant becomes constipated, listless, generally weak, and eats poorly. Death may result from respiratory failure.

B. Chemical Food Poisoning

i. Heavy Metals

a. Lead poisoning

Metabolism

Lead is absorbed in the human body through ingestion or inhalation. Toxicity occurs due to its affinity for cell membranes and mitochondria.

Clinical manifestations

Lead poisoning is characterized by abdominal pain and irritability followed by exhaustion, anorexia, anemic manifestations, gait disturbance, and slurred speech. Convulsions, coma and death due to generalized cerebral edema and renal failure occur in most severe cases.

Sub clinical lead poisoning can cause mental retardation. The impact is greatest when the exposure is of long duration.

b. Mercury Poisoning

Pathogenesis

It is well absorbed from the lungs and gastrointestinal tract. Toxicity manifestation occurs due to its local effect and its retention in kidneys.

Clinical features

Inhalation of mercury vapor manifests with cough, shortness of breath, and tightness or burning pain in the chest.

Acute high dose ingestion of mercury can cause nausea, vomiting of food and/or blood, abdominal pain, diarrhea and tenesmus.

Major complications of mercury poisoning include:

- Pulmonary edema, lobar pneumonia and fibrosis.
- Neurological toxicity.
- Acute renal failure and circulatory collapse

c. Arsenic

Pathogenesis:

After absorption, inorganic arsenic accumulates in the liver, spleen, kidneys, lungs, and gastro intestinal tract. It is then rapidly cleared from these sites but leaves a residue in keratin–rich tissues. It interferes with different enzyme systems and can also affect energy storage in ATP.

Clinical Features:

Major clinical features of arsenic poisoning include nausea, vomiting, diarrhea, abdominal pain, and delirium. In chronic arsenic poisoning, skin and nail changes will be seen.

2.9. Diagnosis of Food-borne Diseases

A variety of infectious and non-infectious agents should be considered in patients suspected of having a food-borne illness. However, establishing a diagnosis can be difficult, particularly in patients with persistent or chronic diarrhea, those with severe abdominal pain and when there is an underlying disease process. The extent of

diagnostic evaluation of food borne diseases can be based on clinical features (history and physical examination), environmental assessment and laboratory investigations.

Clinical Assessment

History

A case history may be important clue in determining the sources and causes of the diseases and the type of foods involved. Therefore, obtain the history regarding the following points (15).

- Where, when, and what has been consumed?
- How soon after consuming the food did the symptoms occur?
- Duration of the resultant illness,
- Whether the consumed food had an unusual odor or taste?
- Inquiry on whether any other person or individuals have consumed the same food.
- Did any one else become ill from eating the same food?
- Any other evidence suggesting the cause of the illness.

Physical Examination

Proper thorough examination should be done on any patient suspected to have food-borne disease.

Environmental Assessment

It is important to conduct environmental assessment and collect environmental samples for suspected and potential causes of food borne illnesses especially of outbreaks. The assessment may include survey of the source of the outbreak with critical evaluation of:

- Source of the suspected food;
- How the food is prepared including cleanliness of table and kitchenware;
- Personal hygiene and health status of food handlers;
- Sanitation of the food preparation and service premises;
- Storage of the food before and after its preparation;
- Presence of potential or actual contaminants;
- Availability of safe and adequate water supply;

- Type and quality of food storage, and service equipments including food contact surfaces.
- Collection of samples from suspected foods and dishware as well from vomitus and stools of cases.
- Power failure before the outbreak and breakdown of refrigeration

Outbreaks and incidents of food poisoning and food borne infection require careful histories of the food vehicle, with environmental studies of the areas of food production and preparation as far back as possible. Sites of infection and areas of spread may include the farm of origin, dealers, markets, processing areas, wholesale or retail outlets to catering establishments, restaurants and domestic kitchens. Transport conditions for live animals and for food–stuffs may enhance spread also (13).

Laboratory Investigations

The laboratory investigations will help to identify the causative agents. These investigations include, on the appropriate samples, macroscopic examination, microscopic examination, culture and biochemical tests, serology and toxicological tests. Different biological specimens such as stool, blood, liver aspirate, duodenal aspirate and muscle biopsy can be used for the investigation as applicable (16).

Macroscopic Examination

- Routinely examine fecal specimens and identify the physical characteristics of the stools (color, consistency, presence of blood, and mucus).
- Identify grossly visible parasites (16).

Microscopic Examination

- The direct examination of stool specimen is essential to detect motile parasite, cyst and helminthes eggs. Because only a few eggs and cysts are usually produced even in moderate and severe infection, concentration technique should be performed.
- Gram stain on appropriate specimens to detect gram–positive and gram–negative bacteria (17).

Culture and biochemical tests

These can be done in areas where the facilities and expertise are present(17).

Serology

Serological technique most frequently used in laboratories are those that can be performed simply and economically uses stable reagents, do not require special equipment and enable specimen to be tested individually or in small number. Such techniques include agglutination test, flocculation technique and enzyme immunoassay (17).

Toxicological Tests

Occasionally, the toxicology laboratory is asked to aid in the diagnosis of possible chemical intoxication by taking blood or urine sample from the affected individuals (22).

2.10. General Management Approaches of Food-borne Diseases

The management approach to food-borne diseases depends on the identification of specific causative agent, whether microbial, chemical or other. In addition determination of whether specific therapy is available and / or necessary or not is very important issue to consider. The management interventions for food-borne diseases may involve one or more of the following.

- Symptomatic and supportive therapy
- Specific antimicrobial, antitoxin, antidote, etc therapy.
- Surgical therapy (15).

Many episodes of acute gastroenteritis are self-limiting and require only fluid replacement and supportive care. If an antimicrobial is required the choice should be based on:

- Clinical symptoms and signs
- Organism identified from specimens, and

In higher centers, antimicrobial sensitivity can also be determined.

2.11. Prevention and Control of Food-borne Diseases

Prevention and control of food–borne diseases, regardless of the specific cause, are based on the same principles:

1. Avoidance of food contamination
2. Destruction or prevention of contaminants
3. Prevention of further spread or multiplication of contaminants.

Specific modes of intervention vary from area to area depending on environmental, economic, political, technology and socio cultural factors.

The preventive and control strategies may be approached based on the major site in the cycle of transmission or acquisition where they are implemented. These involve the activities performed at: source of infection, environment and host.

1. Source of infection

- Thorough cooking of raw.
- Thorough washing of raw vegetables with clean water
- Keeping uncooked animal products far separate from cooked and ready-to-eat foods.
- Avoiding raw milk or foods made from raw milk.
- Appropriate heat treatment of food items before consumption
- Active immunization of animals
- Inspection of food
- Sanitary disposal of human wastes
- Treatment of cases
- Washing hands, knives, cutting boards, etc. after handling uncooked foods.
- Avoiding contact with materials contaminated with pet excreta or soil.
- Decontamination of animal products, e.g., wool, goat hair
- Burying intact or cremating of infected animal carcasses.
- Isolation
- Recognizing, preventing, and controlling of infections in domestic animals, pets.
- Washing hands after contact with animals
- Management of food handlers and homemakers
- Treatment of carriers.
- Proper care for patients with food-borne illnesses.
- Avoidance of food from animals with obvious infection, e.g., mastitis in cows
- Treatment of infections in food handlers such as skin and throat infections

2. Environment

This involved stringent follow-up from production to consumption. Some of the interventions include:

- Freezing, salting, etc. of food items during storage
- Control of flies, rats, roaches
- Public education on environmental and personal cleanliness
- Surveillance of food establishments
- Avoiding contamination of food after cooking.
- Maintenance of sanitary food area.
- Proper handling and storage of leftover foods
- Kitchen cleanliness
- Safe canning at home
- Careful storage and use of chemicals (storage away from foods)

3. Host

- Active or passive immunization of susceptible hosts
- Health education on the above areas.

"The Ten Golden Rules" of WHO for Safe Food Preparation (10)

1. Choose foods processed for safety
2. Cook food thoroughly
3. Eat cooked foods immediately
4. Store cooked foods carefully
5. Reheat cooked foods thoroughly
6. Avoid contact between raw and cooked food
7. Wash hands repeatedly
8. Keep all kitchen surfaces meticulously clean
9. Protect food from insects, rodents and other animals
10. Use safe water

2.12. Investigation of Outbreaks of Food-borne Diseases

Outbreaks of food-borne diseases can lead to deaths of many people within short periods, and hence their timely detection and proper management could not be overstated. When the Health Team receives information regarding an outbreak of a possible food-borne disease, action should start immediately. This action has to be integrated from the outset since the investigation and management of any outbreak requires the concerted effort of all health professionals concerned. In addition, being prepared beforehand for such outbreaks, by collecting the necessary information on food-borne diseases and previous outbreaks (in the area in particular) is important.

The objectives of investigating an outbreak of a food-borne disease can be summarized as:

- Identifying the causative agent responsible for the outbreak
- Identifying the food items, handlers, etc. responsible for the outbreak
- Identifying and tracing the location of the source of the outbreak
- Determining the conditions and mechanisms that led to the contamination of the food item identified
- Limiting the impacts and arresting the progression of the outbreak
- Being able to use information obtained from the current outbreak for the prevention of subsequent outbreaks

The health team should do the following in addressing a possible food-borne disease outbreak:

- Obtain as detailed information as possible from all available informers, cases, care-takers, clinicians, etc.; this involves interviewing of infected individuals, management, and food handlers; all the obtained information should be systematically registered using prepared questionnaires.
- In collecting this information, attempt should be made to determine the mean incubation period of the outbreak.
- The exact date and time at which the suspected food was consumed should be sought; and of those who ate and did not eat the food, the number and proportion of those who got sick should be calculated in order to know the attack rate. It will

be helpful to have and keep a list of symptoms and signs during assessing these individuals for the presence or absence of the suspected food-borne illness (nausea, vomiting, diarrhea, abdominal pain, fever, headaches, etc.).

- One has to keep in mind that the association between illness and exposure for the suspected food does not have to be “perfect”; in fact, this is rarely so because of different factors, one of which may be that the implicated food may not be contaminated throughout; in addition, host susceptibility varies as does dosage (the quantity consumed), and there may be errors in reporting food histories (faulty recall, uncertainty); there may also be errors in recording.
- If the outbreak is large and it is not possible to interview all participants, a random sample should be selected and questioned for symptoms and food exposure history.
- Develop a hypothesis based on the initial clinical features and other information obtained regarding the probable food-borne disease in order to devise case management plans to treat the sick individuals.
- Tell informers and cases to retain or recover all suspected food items, the original containers and packages.
- Collect specimens of suspected food, stool and vomitus from ill persons and send them to a reference laboratory immediately for identification of the agent. Obtain and use appropriate sampling equipments such as sterile containers and other apparatus.
- Visit the institution or place where the outbreak is suspected to have started. During this visit, all members of the team should go and analyze the environment and other situations in a systematic way; they have to keep records of all things observed.
- Analyze and interpret all the information collected using the different techniques outlined above and try to trace the exact source of the food implicated
- Finally, take remedial actions, and inform the public on the prevention and control methods.
- Report the findings to the concerned authorities, and keep a document of it for future use from the experience gained.

Summary of steps in the investigation of food-borne disease outbreak investigation

1. Verify the existence of an outbreak
    - Compare the current number of cases with the past

    Note: -consider seasonal variations
2. Verify the diagnosis
    - Review clinical and laboratory findings
3. Describe the outbreak with respect to time, place and person
4. Prepare an epidemic curve
5. Calculate food-specific attack rates
6. Formulate and test hypotheses (by consulting with higher level health professionals).
7. Search for additional cases
8. Analyze the data
9. Make a decision on the hypotheses tested (by consulting with higher level health professionals).
10. Intervene and follow-up
11. Report the investigation
12. Inform the public on the control and prevention of the outbreak

N.B.

While investigating an outbreak the proper treatment and care for patients should not be ignored.

Now you are through with the Core Module, but the satellite module remains. Please go to the Satellite Module that applies to your specific professional category for continued thorough study.

UNIT THREE

SATELLITE MODULE FOR HEALTH CENTER TEAM DIPLOMA PROGRAMS, TAKE HOME MESSAGE FOR CARE GIVERS AND HEALTH EXTENSION WORKERS

3.1 Satellite module for public health nurses

3.2 Satellite module for environmental health technicians

3.3 Satellite module for medical laboratory technicians

3.4 Satellite module for health extension workers

3.5 Take home message for care givers/ self-care

Ethiopia Public Health Training Initiative • EPHTI

3.1 SATELLITE MODULE FOR PUBLIC HEALTH NURSES

3.1.1 Directions for Using the Module

- Make sure you have thoroughly read the Core Module before you begin to read this Satellite Module.
- Read through this satellite module carefully.

3.1.2 Learning Objectives

A. General

After completing this module the learner will be able to assess and manage cases of food borne disease.

B. Specific

After reading this module you will be able to:

- Assess the patient with food borne disease
- Make the Nursing diagnosis
- Set goal for intervention
- Implement the planned intervention
- Evaluate the outcomes of the intervention

3.1.3 Nursing Management of Patients with Food-borne Diseases

The nursing management of the patients with food-borne disease consists of assessing the patients condition, diagnosing, planning, implementing and evaluating the out comes of the intervention.

A. Nursing Assessment of the Patient with Food Borne Disease

Health history

- Onset of the disease
- Whether any one else become ill from eating the same food
- Ingestion of foods known to have toxins, contaminated by insecticides, pesticides, or heavy metals.

Physical Examination

- Patient appearance
- Vital signs
- Signs of dehydration
- Result of diagnostic tests (14)

B. Nursing Diagnosis

Based on the classification of the food borne diseases and findings of the nursing assessment the following actual and potential nursing diagnosis can be made:

- Poisoning related to the ingestion of contaminated food with chemical poisons, poisonous plants and toxins. (14)
- Pain related to the diseases process
- Diarrhea related to the disease process
- Altered nutrition: less than body requirements related to anorexia, vomiting and diarrhea (28)
- Knowledge deficit about possible causes of the disease and Preventive measures related to lack of information. (14)
- Risk for fluid volume deficit related to vomiting and increased loss of fluids and electrolytes from gastro-intestinal tract. (14,28)
- High risk for spreading of the infection to others.

C. Setting Goals for the Nursing Intervention

- To remove or inactivate the poison before it is absorbed
- Relief pain
- Regaining normal bowel patterns
- Attaining an optimal level of nutrition
- Increase patient understanding about possible causes of the disease & preventive measures
- Maintain fluid and electrolyte balance
- Prevent the spreading of the infection to others (14, 28)

D. Nursing intervention /implementation

1. Reducing / eliminating the effects of the poisonous chemical, poisonous plant or toxins.

- Attain control of the air way, ventilation, and oxygenation:
  - Prepare for mechanical ventilation if respirations are depressed.
  - Administer oxygen for respiratory depression, unconsciousness, cyanosis, and shock.
  - Prevent aspiration of gastric contents by positioning
  - Insert an indwelling urinary catheter to monitor renal function.
  - Monitor the course of vital signs.
  - Conduct a rapid physical examination.
- Try to determine what product was taken, the amount, time since ingestion, symptoms, age and weight of the patient, and pertinent health history.
- Remove the toxin or decrease its absorption. Use gastric emptying procedures. The following may be used:
  - Induce vomiting in the alert patient. (Do not induce vomiting after ingestion of caustic substances or petroleum distillates).
  - Gastric lavage. Save gastric aspirate for investigation.
  - Activated charcoal administration if poison is one that is absorbed by charcoal.
- Administer the specific chemical antagonist or physiologic antagonist as early as possible to reverse or diminish effects of the toxin.
- Carry out procedures, if indicated, to promote the removal of the ingested substance if the above are not effective:
  - Diuresis for agents excreted by the renal route
  - Multiple doses of charcoal
- Monitor for fluid balance.
- Reduce elevated temperature (14)

2. Measures to Relief Pain

To ease anal irritation (pains) caused by diarrhea:

- clean the area carefully

- apply a repellent cream, such as petroleum jelly
- warm sitz baths
- Application of witch hazel compresses can also soothe irritation. (28)

3. Establishing a Regular Pattern of Bowel Elimination and Maintaining Nutritional Balance

- Administer medications, as ordered, correlate dosages and routes with the patient's meals and activities.
- Control nausea
  - Administer an anti-emetic medication (give 30 to 60 minutes before meals)
  - Give sips of weak tea, carbonated drinks, or tap water for mild nausea.
  - Give clear liquids 12 to 24 hours after nausea and vomiting subsides.
  - Gradually progresses to a low residue, bland diet i.e. advice the patient to avoid food products with a cellulose or hemi cellulose base (nuts, seeds).
- Vary the diet to make eating more enjoyable, and allow some choice of foods.
- During an episode of acute diarrhea encourage the patients to rest in bed and take liquids and foods that are low in bulk.
- Monitor fluid status carefully. Take vital signs at least every 4 hours, weigh the patient daily, monitor for fluid balance, and record intake and output.
- Watch for signs of dehydration, such as dry skin and mucous membranes, fever, and sunken eyes.
- If dehydration occurs, administer oral and I.V. fluids.(14.28,29)

4. **Increase the Understanding of Patients about Possible Causes of the Disease and Preventive Measures**
    - Teach the patient about his or her specific disease and therapeutic regimens.
    - Instruct about personal hygiene and the maintenance of the home environment to prevent the disease.
    - Teach about proper storage of the food items, chemicals, insecticides/ pesticides, detergents and petroleum products brought to home for household purposes.
    - Instruct the patient to:
        - thoroughly cook foods
        - properly preserve perishable foods
        - always wash the hands with water and soap before handling food, especially after visiting toilet
        - clean utensils thoroughly
        - eliminate flies and roaches in the home.
    - Inform the family about the disease problem and how they can seek additional health care. (14,28, 29)

5. **Maintain Fluid and Electrolyte Balance**
    - keep an accurate record of intake and output
    - Weigh the patient daily
    - Encourage oral fluid intake in the form of water, juice, and commercial preparations.
    - Administer parenteral fluids as necessary. (14)

6. **Preventing the Spread of the Disease to Others**
    - To prevent the spread of the infection wash your hands thoroughly after giving care (see figure 3.1.1), and use blood and body fluid precautions

whenever handling vomitus or stools. In general all patients with such disease should be treated as potentially infectious until they are proven to be otherwise.

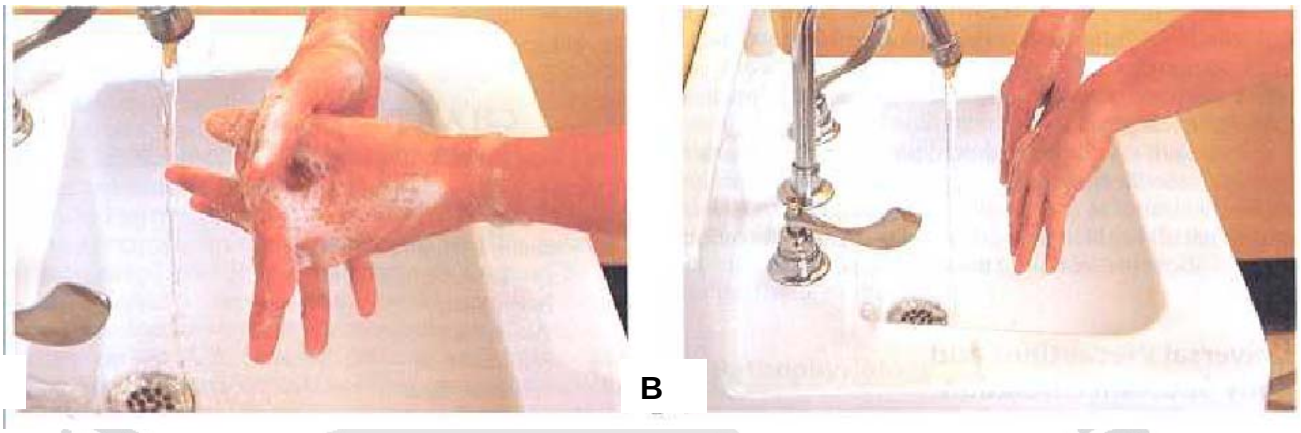

Figure 3.1.1 Effective hand washing. (**A**) Washing hands and forearms with firm rubbing and circular motions. (**B**) Rinsing thoroughly.
(Adopted from Brunner and Suddarth's Text Book of Medical-Surgical Nursing).

Gloves must be used when handling any body fluid from the patient. Gloves must be changed between patient care activities and hands must be washed after gloves are removed.

- To prevent patient-to-patient infection spread:
  - provide isolation according to the general rule of body substance isolation, or individual institution adaptation of isolation.
  - Ensure that patients with highly transmissible organisms are physically separated from other patients if hygiene or institutional policy dictates.
- Teach the patient and family about means of preventing the spread within the home. (14, 28)

E. Specific Chemotherapy

Food-borne diseases for which their specific chemotherapy is not indicated in this section please refer annex-v

1. **Non-typhoidal Salmonellosis**
   - Antibiotic treatment is not generally recommended for salmonella gastroenteritis
   - Dehydration secondary to diarrhea should be treated with fluid and electrolyte replacement
   - Focal infections or life-threatening bacteremia should be treated with antibiotics
2. **Cholera**
   - The cornerstone of cholera therapy is prompt, complete replacement of lost water and electrolytes (intravenous or oral depending on the severity of the volume depletion)
3. **Shigellosis**
   - Mild to moderate dehydration in shigellosis readily corrected with oral rehydration solutions
4. **Brucellosis**
   - Combination antibiotics therapy is indicated
5. **Gastrointestinal Anthrax**
   - Doxycycline 100mg po bid combined with rifampicin single dose of 600 mg daily given for 8-12 weeks.
6. **Viral Gastroenteritis**

   Treatment is supportive and can be adequately managed with standard oral rehydration therapy. Only rarely is intravenous rehydration required.
7. **Viral hepatitis**
   - There is no specific therapy
   - Supportive care and rest are the cornerstones of management and hospitalization is rarely required
   - High-calorie diet is desirable
8. **Bacterial food poisoning (staphylococcal food poisoning)**
   - Fluid replacement and close observation
   - Antibiotics are rarely used
9. **Botulism**

   Penicillin should be given to eradicate *Clostridium botulinum* from the site, even though the benefit of this therapy is unproven

10. Chemical poisoning

i. Heavy metals:

- Terminate exposure
- Use chelating agents

ii. Insecticide poisoning (organophosphates and carbamate ingestion)

- Use activated charcoal
- Supportive measures:
  - Oxygenation
  - Ventilatory assistance
  - Treat seizure
- Atropinization: 0.5-2 mg IV every 5-15 minutes until bronchial and other secretions have dried

iii. Poisonous plants

Mushroom poisoning:

- Gastric emesis
- Decontamination with activated charcoal with sorbitol for catharsis
- Atropine
- Withdraw ingestion of poisonous plants
- Supportive therapy

Neurolathyrism (lathyrism):

- Withdraw ingestion of the plant
- Supportive therapy (9, 11, 12)

Now you are through with the core and satellite modules, but there are still some activities remaining as stated below:

1. **Read the task analysis of the different categories of the health team on Unit 4.**
2. **Do the questions of pretest as post-test.**
   N.B. Use a separate answer sheet.
3. **Compare your answers of the pre and post-tests with the answer keys given on ANNEX I and evaluate your progress.**

3.2 SATELLITE MODULE FOR ENVIRONMENTAL HEALTH TECHNICIANS

3.2.1 Directions for using the module

- Make sure you have thoroughly read the core module before you begin to read this satellite module.
- Read through this satellite module carefully.

3.2.2 Learning Objectives

By the end of learning this satellite module the reader will be able to:

1. Explain the basic principles of food sanitation
2. Identify the transfer of contamination in food borne diseases
3. Discuss the sources for food borne diseases.
4. Identify factors leading to food borne disease outbreaks.
5. Implement prevention and control measures of food borne diseases.

3.2.3 Learning Activity 1

Case study

There is a busy a busy cafeteria at a boarding school in the town of Bullhawo. The boarding school accommodates over 1200 students; and all are served in this same cafeteria. The cafeteria is located in front of the students' dormitories in about a 50 meter distance. In most cases the direction of the wind blow is from the dormitories to the cafeteria. The dormitories harbor toilets with a water flush design but as water is scarce it is not uncommon to observe piles of human excreta with a buzzing population of flies feeding on the excreta. The campus compound, though has some trees, is dusty. Water is a problem in the boarding school; but this is alleviated by fetching water with trailer tankers from bore holes at a distance of about 20 KM. The water then is filled, for storage, to open barrels or narrow mouthed jerry cans with plastic hoses pulled over the floors in the kitchen of the cafeteria. The cafeteria lacks ample dishes but this is compromised by rotating the utensils to serve more students. During this rotation the dishes are simply rinsed in a bowel of water before they are given to the next user in the

queue. However, after a session of service the utensils are finally washed for the next session in a three-compartment manual dish washing system filled with cold water and at the first compartment having detergents. The dishes are placed to drip and dry in perforated plastic racks placed on the floor for ease of sliding over the floor. The floor of the kitchen is rough and usually wet. However, it is frequently cleaned to drain but not usually mopped, as this is a tedious task.

The number of workers in the kitchen and cafeteria is enough to manage the required service. The majority are manual workers with low skills who have been on the job for long periods of time. Hence, the management assuming they have experience is reluctant to train them on proper food handling. The administration considers this as a good strategy to minimize unnecessary cost.

The wastes including garbage from the kitchen and the cafeteria are given to pigs that scavenge around these facilities. The sewage drains to underground sewers but there is frequent blockage that leads at times to overflow. The overflows facilitate growth of green grasses surrounding the cafeteria. Moreover, this wastewater is used to water vegetables planted in the backyard. It is common to smell odors arising from the garbage and the wastewater. This is not given much attention by the school management as they consider it to be normal to kitchens and cafeterias.

The campus clinic record shows that most students come with complaints of diarrhea. The clinic head reports that mass diarrhea complaints are commonly observed but are usually not serious. As the clinic is so busy, the staffs have no time to visit the cafeteria. In addition, the head of the clinic believes that giving proper care to the sick is easier and better than wasting time assessing the cafeteria.

Questions related to the above case study

1. How do you judge the overall sanitation of this cafeteria?
2. What do you think are the potential sources of food contamination in this cafeteria?
3. How do you evaluate the dish handling and washing practice?
4. Do you think training of food handlers can address any problem related to food hygiene in the cafeteria? If so, discuss on some of them.

5. Are the toilets of the students' dormitories of any threat to the food hygiene in the cafeteria? How?
6. Do you think the storage of water is appropriate? If not, why and what improvements do you suggest?
7. What defects do you see with the construction of the floor of the kitchen? Suggest for solutions.
8. If you were a student of this school, what role could you have played in improving the food service?

3.2.4 The basic principles of food sanitation:

The word sanitation is derived from the Latin word "sanitas", meaning "health". The word sanitation is not a "dirty" word. Most owners or managers of food facilities want a clean operation. Sanitation is the application of a science to:

- provide wholesome food handled in a clean environment by healthy food handlers,
- prevent contamination with microorganisms or toxic chemicals that cause food borne illness, and
- Minimize the growth of food spoilage microorganisms.

Because of lack of awareness on issues of sanitation, food borne diseases are among the major health problems in Ethiopia.

Food borne diseases are not limited to the activities of microbes or their products. Food borne diseases can also be caused by a variety of chemicals that may lead to illness and deaths of people who may have consumed foods contaminated by these chemicals.

An effective program of food sanitation has several benefits. To mention some:

a. Reduced public health risks
b. Improved product shelf life
c. Improved customer relations
d. Improved product acceptability
e. Reduce wastage

The basic principles for food sanitation to control food borne illnesses and outbreaks can be summarized to three essential activities:

- Prevention of contamination of the food from microorganisms, their toxins or other chemicals of health hazard..
- Elimination / destruction of micro – organisms or their toxins.
- Prevention of the growth of microorganism or the inhibition of toxin production (4).

3.2.5 Different Stages and Processes at Which Food may be Contaminated

Pathogenic and toxic substances may find their way into food through contamination or through spoilage. Contamination of food can be either from biological agents or chemicals. Biological agents in food that are of concern to public health include bacteria, viruses, parasites, helminthes, protozoa, algae, and certain toxic products they may produce. Similarly there are, many chemical contaminants too.

Figure 3.2.1 below illustrates some of the various biological or chemical contaminants of foods (2, 19).

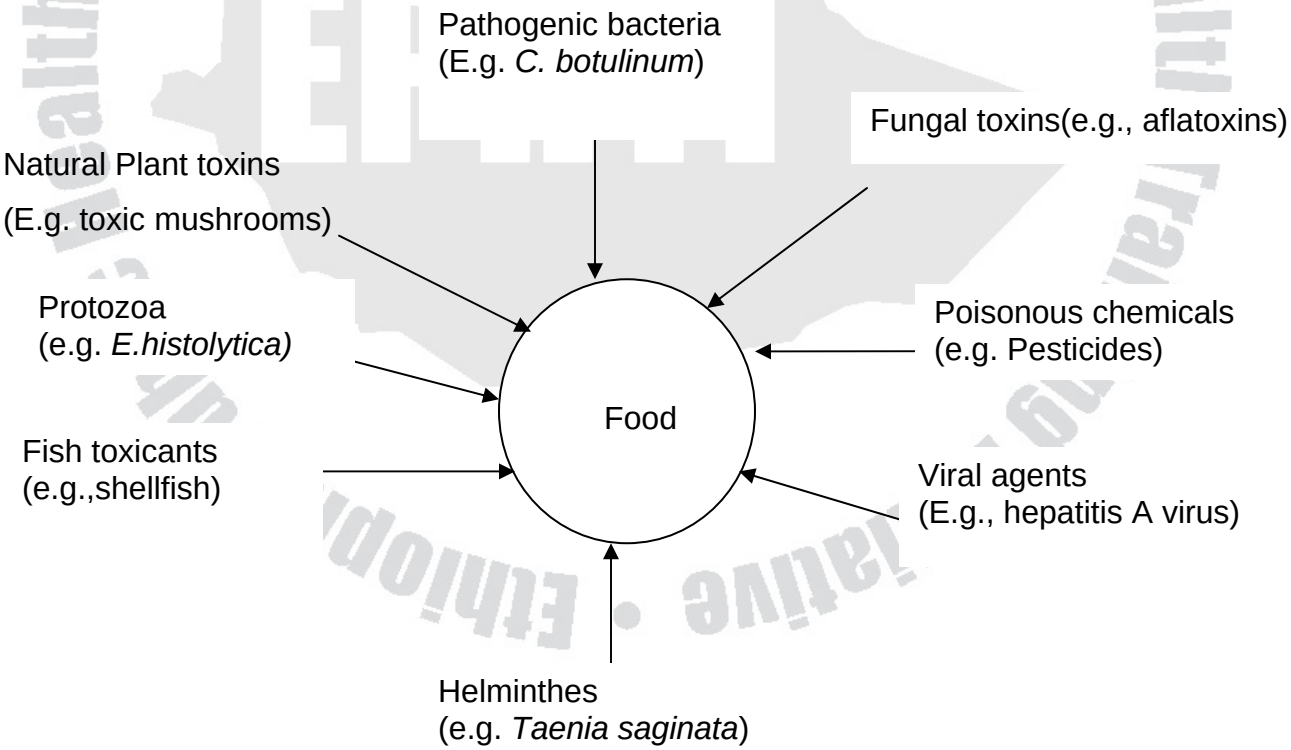

Figure 3.2.1: Contaminants of food

The different stages and processes for possible food contamination are summarized in table 3.2.1.

Table 3.2.1: The different stages for possible food contamination

Stage	**Process**	**Possible contaminant and vital areas of concern**
Primary production	Planting, rearing livestock, fishing	Night-soil, garbage, pesticides, etc.
Processing	Freezing, canning	Food-plant sanitation, personal hygiene of food handlers, additives, etc.
Distribution	Containers, trucks	Sanitation of collection and delivery vehicles
Marketing	Market, retail shop	Expired goods, sanitation of premises and markets
Food preparation	Home, restaurants	Sanitation of food premises, personal hygiene of food handlers, etc.
Serving and consumption	Home, restaurants	Cleanliness of utensils, personal hygiene of consumers

(Source: Food Hygiene I, Negga Baraki, 2004, Page 37)

3.2.6 Sources of contamination of food:

Food products are rich in nutrients required by microorganisms and may become contaminated. Major contamination sources are (4,7,19):-

- **Water:** If a safe water supply is not used in processing and preparation of food it then becomes a source of contamination of the food (chemical or biological agents).
- **Sewage:** Raw, untreated sewage can contain pathogens that have been eliminated from the human body, as well as other materials including toxic chemicals from the environment. If raw sewage is used to irrigate vegetable farms, it can be a source of food contamination.

- **Air:** Contamination can result from airborne microorganisms and chemicals in food processing, packaging, storage, and preparation areas.
- **Equipment:** contamination of equipments used for processing, preparing or serving food occurs during production (manufacture) and when the material is not properly cleaned.
- **Food handlers:** The hands, hair, nose, and mouth harbor microorganisms that can be transferred to food during processing, packaging, preparation, and service by touching, breathing, coughing, or sneezing. Of all the viable means of exposing microorganisms to food, employees are the largest contamination source.
- **Adjuncts and additives:** Ingredients (especially spices, flavoring and coloring agents, preservatives) are potential vehicles of harmful or potentially harmful microorganisms and toxins.
- **Insects and rodents:** Flies, cockroaches and rodents are associated with living quarters, eating establishments, and food processing facilities, as well as with toilets, garbage, and other filth. These animals transfer contaminants to food through their waste products; mouth, fur, intestinal tract, feet, and other body parts; and during regurgitation onto clean food during consumption.
- **Soil:** Soil may contain microorganisms as well as poisonous chemicals. These agents may get access to food either due to direct contamination or through dusts.
- **Plants and plant products:** Most of the organisms found in soil and water are also found on plants, since soil and water constitute the primary sources of microorganisms to plants. Chemicals sprayed to plants are other potential health risks.
- **Other animals' bodies:** From the intestinal tracts of animals, microorganisms find their way directly to the soil and water. From there, they may find their way into plants, dust, utensils and/or food. Meat of animals can get contaminated during slaughtering, cutting, processing, storage, and distribution. Other contamination can occur by contact of the carcass with the hide, feet, manure, dirt, and visceral contents. Like wise drugs used to prevent disease and promote

growth in animals may also become potential risk for human health due to persisting of these drugs in the meat or milk products.

- **Others:**
  - Mistaken use of a toxic chemical in the preparation seasoning or sweetening of food or by children believing it is a drink.
  - Deliberate and malicious contamination of food by a person for some irrational reason.
  - Water polluted by chemicals from farm and or spraying food trees (4,6).

3.2.7 Transfer of contamination:

Before a food-borne disease can occur, food-borne disease transmission requires that several conditions be met. There are two related models that illustrate the relationship among factors that cause food-borne diseases. These are (7):

a. Chain of infection:

This is a series of related events or factors that must exist or materialized and be linked together before an infection will occur. The infection chain emphasizes the multiple causations of food-borne diseases. The presence of the disease agent is indispensable, but all of the steps are essential in the designated sequence before food-bore diseases can result (see also figure 3.2.2 below)

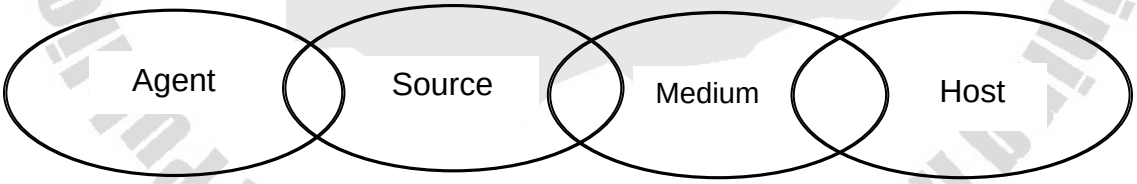

Fig. 3.2.2: The chain of infection

b. Web of causation:

This is a complex flow chart that indicates the factors that affect the transmission of food-borne diseases. This presentation of disease causation attempts to incorporable all of the factors and their complex interrelationships (7).

3.2.8 Factors most commonly contributing to food-borne disease outbreaks

There are a number of factors that may lead to the occurrence of food-borne illness outbreaks. The major ones are:

- Preparation of food more than half a day in advance of needs
- Storage at ambient temperature
- Inadequate cooling
- Inadequate reheating
- Use of contaminated processed food (cooked meats and poultry, and the like)
- Undercooking
- Cross contamination from raw to cooked food from utensils, and unhygienic kitchen environment
- Infected food handlers or poor personal hygiene of food handlers
- Unsanitary dishware, utensils and equipment
- Improper food handling procedures such as unnecessary use of the hands during preparation and serving of food
- Improper food storage that may lead to cross contamination by agents of diseases (micro-organisms, poisonous chemicals), or exposure to moisture that may facilitate microbial growth
- Insects and rodents (4, 13).

3.2.9 Prevention and Control of Food-borne Diseases

In practical terms, safe food can be defined as food that, after being consumed, causes no adverse health effects (19).

To ensure high quality of the food supply a number of parties must play specific roles. The main actors include the government, consumers, and the food industry. It is critical that preventive measures for ensuring food safety should be given great attention to prevent and or reduce food borne diseases. The following are possible preventive measures for ensuring food safety at various stages:

1. Production of raw materials:

To ensure safe food production, it is important to look at the agricultural level, where foods are initially produced, and improve the hygienic quality of raw foods.

- By improving the conditions under which crops, fruits, vegetables and food animals are raised, the hygienic quality of raw food products can be significantly improved.
- Use of both pesticides and fertilizers should be reduced as much as possible.
- Residue levels of toxic chemicals used to improve crop production should be systematically monitored.
- Prohibition of use of untreated sewage water for irrigation of vegetable fields is also an area of attention.

2. Food Processing:

Substantial losses of food by contamination and spoilage can be prevented through concerted inspection and monitoring of food processing infrastructures. Inspection services are usually inadequate in our country. This needs to be strengthened. A modern approach to food safety in food establishments is Hazard Analysis and Critical Control Point (HACCP) system.

This is an attempt to make a significant impact on the prevention of food-borne diseases. The HACCP system consists of a series of interrelated actions that should be taken to ensure the safety of all processed and prepared foods at critical points during the stages of production, storage, transport, processing, preparation, and service. The elements of the HACCP system are summarized in Box 1 as follows (19).

Box 3.51:Hazard Analysis and Critical Control Point (HACCP) system elements (4,19).

Box 3.5.1

- Determine hazards.
- Assess the severity and risks of the hazards.
- Identify critical control points.
- Institute control measures.
- Establish criteria to ensure control.
- Monitor critical control points.
- Take action whenever monitoring results indicate criteria are not met.
- Verify that the system is functioning as planned.
- Establish a documentation system for procedures and records. Develop and maintain procedures and practices for record keeping.

Definitions:

i. **Hazard:** Means the unacceptable contamination, growth or survival of microorganisms of concern to safety or persistence in foods of microbial products(e.g. toxins, enzymes) or the presence of chemicals of a harmful level of concentration or of a potential risk to health.

ii. **Critical control Point**: Is a location, practice, procedure, or process at or by which control can be exercised overall or more factors that, if controlled, could minimize or prevent the hazard (4).

3. Food Preservation and Storage

The aim of food preservation is to eradicate or prevent the growth of harmful pathogens during manufacturing, processing and preparation of food so that it will remain, safe to eat for longer periods of time.

4. Food Preparation in the Home:

The household is perhaps the most relevant place for developing strategies to combat food borne illness, as it is the location where the consumers, can exert the most control over what they eat. Strategies that can be employed at home include:

- Maintaining a clean and hygienic environment in the kitchen or other food preparation areas.
- Proper sanitation facilities, cleanliness of household members who prepare the food, and
- Control of pests.
- Keeping chemicals away from kitchens and areas of food preparation. If needed, use chemicals cautiously.
- Consumption of fresh food, or cooked food while still hot will not cause food-borne infection.

Many bacterial pathogens are able to multiply in food because of the temperature at which the food is stored. Refer to figure 3.2.3 for the control of pathogenic bacteria by temperature.

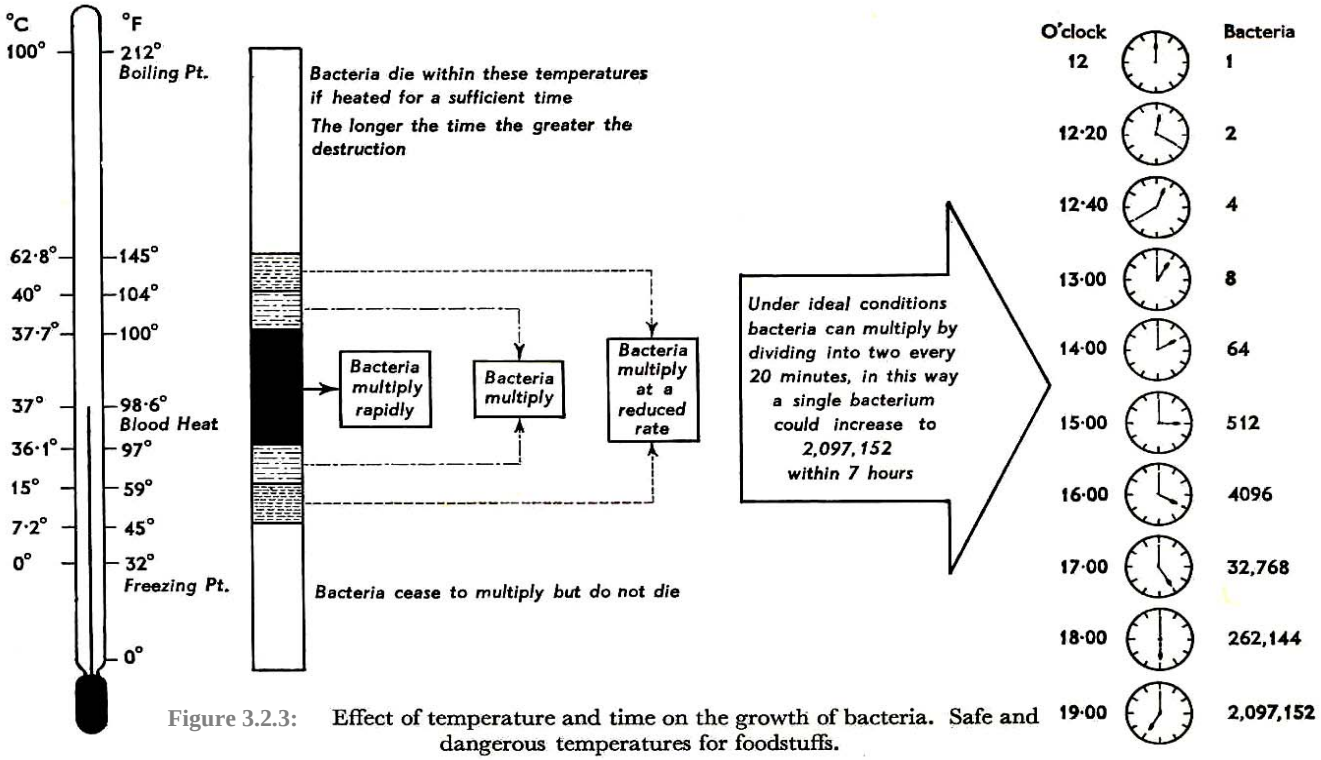

Figure 3.2.3: Effect of temperature and time on the growth of bacteria. Safe and dangerous temperatures for foodstuffs.

Taken from Food Poisoning & Food Hygiene. Third Edition. 1974. By

The chemical risks in food preparation at home are the same as those present during food processing. The general public should be made aware of these risks (19).

5. Food preparation in the food service industry:

The consequences of improper food preparation in food services such as canteens and restaurants can be much greater than that in the household, simply because a large number of individuals may be simultaneously exposed to unsafe food items. Street foods are particularly prone to lapses in safe food preparation, hence requiring stringent control measures. It is essential to have a quality control program (inspection) that will ensure the maintenance of food product standards during all stages of handling, processing and preparation; it must also be applied to all areas and equipment that come into contact with food and beverages.

The prevention and control strategies for food borne diseases emanate from the three basic principles (described in section 2.11). The different methods for applying these principles are discussed below:

Methods to keep food safe

The primary objective of keeping food safe is to prevent food from acquiring injurious properties during preparation, shipment, or storage. The principal methods and the techniques used to keep food safe include temperature control (including pasteurization, cooking, canning, refrigeration, freezing and drying), fermentation and pickling, chemical treatment and irradiation (2, 3, 4, 6, 7).

a. Temperature control:

i. The use of high temperature:

Heat is one of the oldest methods of destroying microorganisms in food. Heat destroys many microorganisms / pathogens and some forms of toxins produced, such as the toxin of *Clostridium botulinum*. Heat treatment may involve the following techniques.

- Cooking / boiling / frying operations

- Blanching operations. Blanching is mild pre-cooking involving brief scolding by hot water or steam used to reduce the bacterial load and insects on vegetable foods.
- Canning: This is the process of placing prepared (heat-treated) food in cans, exhausting the air from the cans, sealing the cans, sterilizing the sealed can and cooling it.
- Pasteurization: A process of heat treatment of food that kills pathogenic microorganisms without destroying taste, digestibility and nutritive value of food and milk. It also destroys some food spoilage microorganisms.
- Drying (Desiccation): Bacteria cannot multiply in the absence of water (moisture). This can be achieved by application of heat or chemical treatment (described below).

ii. The use of low temperature

Unlike high temperature, low temperature (cold) is not an effective means of destroying microorganisms and toxins in foods except retarding their multiplication and metabolic activities there by reducing toxin production.

- Chilling (cold storage or refrigeration): is reducing food temperatures to below ambient temperatures. This is a suitable temperature to preserve perishable food items that may get spoiled at freezing temperature.
- Freezing: This is a dehydration method because the water in the food is transformed to ice, thus rendering it unavailable for microbial metabolic function. Freezing temperature depends upon the kind of food and the intended storage time.

b. Fermentation and pickling:

In fermentation the food is transformed into an acid state based on the pH control principle. Some fermented foods have high amount of alcohol, which is antimicrobial. Pickling on the other hand refers to the immersion of certain foods in concentrated natural acid solution such as vinegar.

c. Chemical treatment:

This involves osmotic balance disturbance or direct actions of the chemicals on the microorganisms. Liquids pass into or out of bacterial cells by the process of osmosis. Examples for osmotic actions are salting and sugaring. Some other chemicals may destroy or inhibit growth of microorganisms in food. Examples include application of nitrites and smoking.

d. Radiation: this is a process of exposure of the food to high- speed electrons to destroy microbial cells. Beta, gamma or x-rays irradiate microorganisms in foods. A cell inactivated by irradiation cannot divide and produce visible growth (7).

e. Other important methods /supportive procedures that facilitate the safety of food:

- Health education
- Good personal and environmental hygiene
- Availability of safe, ample and convenient water supply
- Training of food handlers and managers
- Stringent inspection and control actions
- Legislative support (ordinances and codes), licensing
- Good-house keeping practices including separate storage and care of toxic chemicals.
- Understanding about additives and restrictions of unauthorized use.
- Food equipment selection to avoid chemical poisoning arising from the material constituency and or coatings of some food utensils.
- Avoidance and care of insecticide use in food processing and preparation areas.

3.2.10 Collection of food samples

The need for sample collection:

The following factors may determine the essentiality of sample collection in food borne disease outbreaks:

- For diagnosis of outbreak
- For epidemiological reasons

- For legal issues
- For preventive aims
- For implementing appropriate actions

Sampling Plan:

- Before instituting a food sampling plan, the following steps should be followed:
  - Discuss the plan with laboratory personnel
  - Determine the analytical capability of the laboratory
  - Determine how sample is to be taken
  - Decide how often and under what conditions sampling is to be done

Criteria for sample collection:

- Type of food
- Size of the lot to be sampled
- Representativeness of the sample
- Acceptance and rejection criteria
- Degree of hazard to human health

Types of tests done on food samples:

- Physical (organo-leptic) tests using the senses, e.g. smell, color, taste
- Bacteriological, e.g. culture
- Chemical/toxicological, e.g., tests on animals

Now you are through with the core and the satellite module for environmental health technician, but there are still some activities remaining as stated below:

1. **Read the task analysis of the different categories of the health team on Unit 4.**
2. **Do the questions of pretest as post-test.**
   N.B. Use a separate answer sheet.
3. **Compare your answers of the pre and post-tests with the answer keys given on ANNEX I and evaluate your progress.**

3.3 SATELLITE MODULE FOR MEDICAL LABORATORY TECHNICIANS

3.3.1 Directions for Using the Module

- Before you star the Satellite Module, be sure to complete the Core Module and perform the pre – test questions.
- Read through this satellite module carefully.

3.3.2 Learning Objectives

At the end of this satellite module, the reader is expected to be able to :

- Explain the safety procedures that should be taken in the processing of the specimens during diagnosis of food borne disease.
- Describe how to collect and handle different specimens in the investigation of food borne disease.
- List the routine laboratory investigations employed for diagnosis of food borne diseases.
- Describe the appearance of stool specimens during investigation processes in the diagnosis of food borne disease.
- Illustrate the morphological features of etiological agents of food borne disease.

3.3.3 Learning Activity

Refer to the case study under learning activity 1 in the core module and discuss the following questions.

1. What type of specimen should be collected?
2. How should this specimen be collected?
3. What could be the etiology of the disease?
4. What type of investigation can be done at the health center level?
5. What do you expect to identify from the microscopic examination of the specimen?

3.3.4 Laboratory Diagnosis

A. Collection and handling specimen

Proper collection of specimen is essential since the final laboratory results are dependent primarily on the initial quality of the sample. The causative agent of food borne disease may be identified in the laboratory by examining specimens such as stool, blood, vomit, rectal swab, liver and duodenal aspirate and other body fluids macroscopically, microscopically, culture and immunologically (16). If food poisoning is suspected because of a cluster of cases are related to eating common foodstuff, a sample of the suspected food should be collected (17).

i. Safety

Some organisms are more hazardous to handle and are more likely to infect laboratory workers than others, e.g. Hepatitis virus. Infection may be acquired through the skin, eye, mouth and respiratory tract so laboratory staff must practice the following safety precautions. (16)

- Washing of hands after handling specimens and infected materials, when leaving the laboratory and at the end of the day's work.
- Covering any cuts, insect bites, open sores or wounds on the hands or other exposed parts of the body with a water proof adhesive dressing.
- Wearing closed shoes and not walking bare foot.
- Not eating, drinking, chewing gum and smoking in the laboratory.

- Note licking gummed labels or placing pens, pencils or other articles near the mouth, eye or in hair.
- Protective clothing should be worn over normal clothing to protect the major parts of the body from splashes, droplet of liquids containing microorganisms and hazardous chemicals.
- Do not touch your eyes, nose or other exposed skin parts with your gloved hands.
- Make sure that specimen container is tightly closed and the cap is not leaking before transporting
- Sterilize non-disposable items.

ii. Collection of stool specimen

For clinical purposes, a fresh fecal specimen is required. It should be uncontaminated with urine and collected in to a suitable size, clean, dry and leak–proof container. This container has to be sterile and must be free of all traces of antiseptics and disinfectants. Several specimens collected on alternative days may be required for detecting parasites that are excreted intermittently e.g. G. iamblia . Avoid using containers made from leaves, paper or cardboard because this will not be leak proof, may not be clean and can result in the faecal contamination of hands and surfaces. Dysenteric and watery specimens must reach to the laboratory as soon as possible after being passed (with in 15 minutes), otherwise motile parasites; such as E. histolytica and G.lamblia trophzoites may not be detected. Other specimens should reach the laboratory with in 1 hour of being collected. Specimen must be labeled correctly and accompanied by a correctly completed request form (16).

Fecal specimens like other specimens received in the laboratory, must be handled with care to avoid acquiring infection, from infectious parasites, bacteria, or virus. Faces may contain infective forms of:

- Parasites such us E. vermicularis, T.solium, G. lumblia, E. histolytiea or C. Parvum.
- Bacteria such as V. cholerae, shigella or salmonella species.
- Viruses including hepatitis virus, HIV and rotavirus.

iii. Collection of Blood Specimens

The following precautions need to be followed during collection of blood sample.

- Syringes and needles used for collecting blood samples must also be chemically clean and dry
- Follow a safe technique and wear protective gloves.
- Specimen container must be leak proof, sterile and chemically clean, should be well washed with detergent, and rinsed in several changes of clean water.
- Blood should be collected before antimicrobial treatment has been started and at the time the patient's temperature is beginning to rise
- To increase the chance of isolating a pathogens it is usually recommended that at least two specimens (collected at different times) should be cultured
- Blood for culture must be collected as aseptically as possible.
- If anti-coagulated blood is required, add the correct proportion of blood to the anticoagulant in to the tube or bottle and mix it by gently inverting the container several times.

B. Laboratory tests of some food borne diseases

1. Food-borne Infections

i. Parasitic food borne infections:

a. Amebiasis

Macroscopic examination:

Amoebic dysentery contains blood and mucus.

Microscopic stool examination:

The laboratory diagnosis of amoebic dysentery is by finding E.histolytica trophozoites in fresh dysenteric fecal specimen. Specimen must be examined without delay; otherwise identification of the trophozoites becomes impossible because the amoebae lose their motility.

Trophozoite of E. histolytica has the following general characteristics

- Average size about 15-30 $\propto$m.
- Shows active amoeboid movement in fresh warm specimen,
- Contain ingested red cells and

- Single nucleus is present which has a central karyosom.

Cyst of E. histolytica is morphologically identical with E. dispar but genetically distinct cysts, formerly reported as E. histolytica should now be reported as E. histolytical / E. dispar.(16)

Cyst of E. histolytical / E. dispar has morphological characteristic of:

- Round, measuring 10 – 20 µm
- Contain 1- 4 nuclei with a central karyosome
- Chromatoid bodies can be seen particularly in immature cyst.

Only one–third of infected patients are identified from a single stool specimen and it is recommended that at least three separate specimens be evaluated before excluding the diagnosis (18).

b. Giardiasis:

Macroscopic stool examination

Fecal specimens containing G. lamblia may have an offensive odor and are pale colored, fatty and float in water.

Microscopic diagnosis of giardia is by:

- Finding G. lamblia trophozoites in fresh diarrhoeic specimens particularly in mucus. They are often difficult to detect because they attach themselves to the wall of the intestine.
- Finding G. lamblia cysts in more formed specimens:

The cysts are excreted irregularly. Often large number may be present for a few days followed by fewer numbers for a week or more. Several specimens may need to be examined and a concentration technique used. G. lamblia cyst can be concentrated using the modified formal ether centrifuge technique (16).

Excretion of the G.lamblia trophozoites and cysts often intermittent, so microscopical examination should be made on several separate collections of feces (17).

Trophozoite of G. lamblia:

- Small pear–shaped flagellate with a rapid tumbling and spinning mobility, often likened to a falling leaf.
- Measures 10-20 in length and 5 – 9 µm in width.
- Has a large concave sucking disc on the ventral surface.
- It has four pairs of flagella, two axonemes, and two nuclei.
- A single or two curved median bodies are present.

Cyst of G. lamblia

- Small and oval measuring 8 – 12 µm.(double walled ,elliptical shaped)
- Internal structures include two or four nuclei, grouped at one end, axonemes, and median bodies.(20)

c. Taeniasis

The laboratory diagnosis of T. saginatia infection is by:

Macroscopic Examination

- Identifying gravid segments recovered from clothing or passed in feces macroscopically. The segment appears white and opaque and measures about 20mm long by 6mm wide when freshly passed.

Microscopic Examination

- Identifying the ova in the stool:

A concentration technique and the examination of several specimens may be necessary to detect Taenia eggs in feces. The eggs can be concentrated by formal ether technique. It is round to oval measuring 33 – 40 µm. Embryo is Surrounded by a thick brown wall, hooklets are present in the embryo. Eggs may also be present in the perianal area; thus, if proglottids or eggs are not found in the stool, the perianal region should be examined with use of a cellophane tap swab (9).

d. Ascariasis

The laboratory diagnosis of Ascaris lumbericoides is by:

Macroscopic Examination

- Identifying A. lumbricoides worms expelled through the anus or mouth. Freshly excelled ascaris worms are pinkish in color. They measure 12 – 35cm in length and taper at both ends.

Microscopic Examination

- Microscopically identifying A. lumbricoid egg in faeces:

Usually fertilized eggs are found in faces but occasionally infertile eggs are produced. Fertile egg has yellow – brown oval or round shell is often covered by an uneven albuminous coat; contains a central granular mass, which is the unregimented fertilized ovum. Infertile egg is dark in color and has a thinner wall more granular albuminus covering, more elongated than a fertilized egg, and contains a central required mass of large granules.

ii. Bacterial food borne infections:

a. Enteric Fever (Typhoid and paratyphoid fever)

Salmonella typhi and *Salmonella paratyphi* causes enteric fever, which is endemic in many developing countries. (17)

General characteristics

- Gram negative rods
- They are motile, non capsulated and non sporing
- They survive freezing in water for long periods
- Produce H_2S some times
- Salmonella grow readily on simple media but they almost never ferment lactose or sucrose.

Diagnostic laboratory Test

- **Specimen:** Blood, urine, stool and bone morrow can be used to identify the organism.

A. Culture: Culture is the diagnostic gold standard various enrichment and selective media are used to isolate salmonellae from feces and other specimens.

Fecal specimen collected and transported to hospital or referral laboratory for microbiological examination should be inserted in Cary- Blair media.

If it is not possible to obtain feces rectal swab should be collected by inserting a cotton wool swab in to the rectum for about 10 second care must be taken to avoid unnecessary contamination of specimen with bacteria from the anal skin.

B. Serology

For serological examinations, paired acute and convalescent samples of serum should be collected at an interval of about 10 days in suspected enteric fever (17). Several serological tests including the classic Widal test for febrile agglutinins are available; however, it gives high rate of false positivity. The Widal test is a serological test for the presence of salmonella antibodies in patient's serum when facilities for culturing or antigen testing are not available. Widal test if performed reliably and interpreted with care (with clinical finding) can be of value in diagnosing typhoid and paratyphoid fever. When investigating typhoid the patient serum is tested for O and H antibody.

Most widal tests used as slide and tube techniques with manufactures providing details for both slide and tube test. Before use the antigen suspension must be allowed to worm at room temperature and well-mixed, sufficient serum for Widal test can be obtained from 3 – 5 ml of patient venous blood collected in to a clean dry tube and allowed to clot. The serum should be free from red cell and must not be heated.

The Widal test is reported by giving the titer from both O and H antibody (antibody titer is the highest dilution of serum in which agglutination occur). If no agglutination occur report as:

S. typhi O titer less than 1:20 less

S. typhi H titer less than 1:20.

In typhoid endemic areas in developing countries active typhoid is suggested if the titers of H or O or both, agglutinins are significantly raised (i.e. titer greater than 1 in 180 or 1 in 200) (21).

b. Shigellosis

General Characteristics

Shigellae bacteria are:

- Gram negative
- Non-sporing non-capsulated rods
- Shigellae are non-motile.

Diagnostic laboratory tests

- **Specimen:** fecal specimen for culture and blood for antibody detection

A. Macroscopic Examination

Fecal specimens from patients with shigellosis may be watery and contain little blood and mucus in the early stages of infection.

B. Microscopic Examination

consists almost entirely of pus and blood mixed with mucus in the later stages of infection. When examined microscopically, red cells and large number of pus cells are usually found. Specimens from patients with amoebic dysentery contain red cell, and usually very few pus cells (21).

Since microscopic examination is not confirmatory, so a fresh fecal specimen is collected and sends to hospital or referral laboratory for culture.

Cary–Blair transport media is suitable for transport fecal specimen for identification of Shigellae (21).

Bacterial food borne infection also can be caused by V.cholerae , E.coli ,Bacillus cereus and Brucella. To investigate such organisms send appropriate specimen to microbiology laboratory

- If V.cholerae is suspected fecal specimen from early acute case should be collected in to a sterile container. Colletion of stool specimen from a bed pan should be avoided because of the risk of contamination or the presence of disinfectant.(17) and transport about 1ml of specimen in to 10ml sterile alkaline peptone water, label and send to reach the microbiology laboratory with in 8 hours of collection. Cary- Blair transport media also can be used as transporting feces that may contain V.cholera species.

- If E.coli and bacillus cereus infection is suspected we can send fecal specimen to microbiology laboratory for identification of such organisms by using Cary-Blair transport media (21).

iii. Viral food borne infections

Hepatitis A, E and Rotavirus can cause food-borne infection .If viral enteritis is suspected, fecal specimen can be sent to virology laboratory.

Mix about 1ml of fecal specimen with 9ml of sterile phosphate buffer saline, and allow to sediment for about 30 minute. Transfer the supernatant fluid to a sterile container, label and send in an insulated cold box to reach to the virology laboratory with in a few hours (21).

2. Food Poisoning/ Intoxication

i. Bacterial Food Poisoning

S. Aureus, C. perfringens, C. Botulinum, Enterotoxigenic E. Coli and B. Cereus can cause food poisoning. If bacterial food poisoning is suspected, send feces, vomit and food sample for culture to the microbiology laboratory (21).

ii. Chemical Food Poisoning

Metals (lead, mercury and arsenic) and pesticides can cause chemical food poisoning. If chemical food poisoning is suspected, send serum and urine samples to the toxicology laboratory (22).

Now you are through with the core and the satellite module for Medical Laboratory Technician , but there are still some activities remaining as stated below:

1. **Read the task analysis of the different categories of the health team on Unit 4.**
2. **Do the questions of pretest as post-test.**
   N.B. Use a separate answer sheet.
3. **Compare your answers of the pre and post-tests with the answer keys given on ANNEX I and evaluate your progress.**

3.4 SATELLITE MODULE FOR HEALTH EXTENSION WORKERS

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3.4.1 Purpose and Use of the Module:

Health Extension Package Workers, as they will be playing vital roles in the betterment of the health of the community, are expected to have basic information about the most important health problems of the country, common among which are food-borne diseases. This module aims at providing them with some of this information so as to enable them to recognize food-borne illnesses and outbreaks, refer cases for proper therapy (in the mean time providing basic treatment), and to prevent them from occurring.

3.4.2 Directions for Using the Module:

- Do the pre-test given below using a separate answer sheet for your answers.
- Read the material thoroughly including the section on task analysis for health extension package workers presented in section 3.4.15.

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3.4.3 Pre-test:

Write the letter of your best choice for each of the following questions on a separate answer sheet.

1. One of the following is not a food-borne disease:
   A. Typhoid fever
   B. Typhus
   C. Cholera
   D. Shigellosis
   E. None of the above.
2. Some food items which may lead to food-borne diseases include:
   A. Raw vegetables not properly washed or washed with contaminated water
   B. Raw meat (e.g., “kurt”)
   C. Undercooked meat (e.g., “kitfo lebleb”)
   D. Well-cooked meal kept in open overnight and eaten for breakfast in the next morning
   E. All of the above can be sources for food-borne diseases.

3. Identify the false statement:
   A. All food-borne diseases can be prevented only by cooking all foods adequately.
   B. The presence of latrine helps to reduce the transmission of food-borne illnesses.
   C. Flies and cockroaches can be very important vectors in the transmission of food-borne diseases.
   D. Early and proper treatment of patients with food-borne diseases helps to reduce the spread of the diseases.
   E. None of the above
4. Which one of the following statements is true regarding the management of patients with food-borne diseases?
   A. All patients with diarrhea should be advised to take more fluid diets than usual.
   B. All patients with diarrhea need to be given antibiotics such as tetracycline.

C. Diarrheal stools have to be disposed of carefully as they may also transmit HIV/AIDS.
D. An ill patient without diarrhea cannot be having a food-borne disease.
E. All of the statements are true.

5. If all patients who ate from a similar dish or in similar ceremony got ill with a similar kind of illness, then the problem has high likelihood of being related to:
   A. The hygienic practices of the individual(s) who prepared the food
   B. The environment in which the food was prepared
   C. The conditions in which the food was stored after preparation but before being served
   D. The hygienic practices of the individuals who got sick
   E. All except D
6. Patients who are infected with worms but are not excreting worms in their stools cannot be sources of infection for other individuals.
   A. True
   B. False
7. Proper disposal of human excrement helps to reduce the transmission of food-borne diseases by flies to prepared food and also by preventing contamination of soil and vegetations with infective organisms.
   A. True
   B. False

3.4.4 Learning Objectives:

- Define food-borne diseases
- List some common food-borne diseases in Ethiopia
- Describe the most important manifestations of some food-borne diseases
- Refer patients with food-borne diseases and, in the mean time, provide basic treatment
- Educate the public and advise individuals on how to prevent food-borne diseases

3.4.5 Definition:

Food-borne diseases are those diseases acquired following the ingestion of infective organisms, toxins, or chemicals together with food items or following the ingestion of poisonous plant or animal tissues or products.

3.4.6 Epidemiology

The different types of food-borne diseases are among the major causes of sickness, being responsible for large numbers of outpatient visits, hospital admissions and deaths. There are many factors that contribute to this condition, some of which are poor personal hygiene and environmental sanitation, grossly inadequate safe water supply, poor food preparation and storage of food items, and others.

3.4.7 Causes:

1. **Bacteria:** e.g., typhoid fever, shigellosis, E. coli infection, cholera
2. **Parasites** (the infective stages are microscopic cysts, eggs or larvae)**:** e.g., amebiasis, giardiasis, ascariasis, tapeworm infection
3. **Viruses:** e.g., hepatitis, viral diarrhea
4. **Fungal toxins** such as aflatoxin
5. **Chemicals:** e.g., insecticides (malathion, etc.), heavy metals (lead, mercury, etc.)
6. **Poisonous plants:** e.g., mushrooms, “guaya”

3.4.8 Transmission (Modes of Acquisition):

The most important modes of transmission of food-borne diseases are:

1. Ingestion of raw or undercooked meat and meat products
2. Ingestion of raw milk
3. Ingestion of food contaminated with human feces (directly or indirectly)
4. Ingestion of raw vegetables contaminated with soil, human feces, etc.
5. Accidental ingestion of chemicals such as malathion together with food
6. Ingestion of poisonous plants intentionally as food items (“guaya”, mushrooms) or unknowingly (mushrooms, etc.)
7. Ingestion of food prepared using contaminated water, e.g., for washing vegetables
8. Ingestion of food kept in an unsuitable condition for long time after preparation (this creates conducive environment for the flourishing of micro-organisms on the food), especially if it has remained exposed to flies, roaches, etc.

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Some common contaminants of foods

Figure 3.5.1 below illustrates some of the various biological or chemical contaminants of foods (2,19).

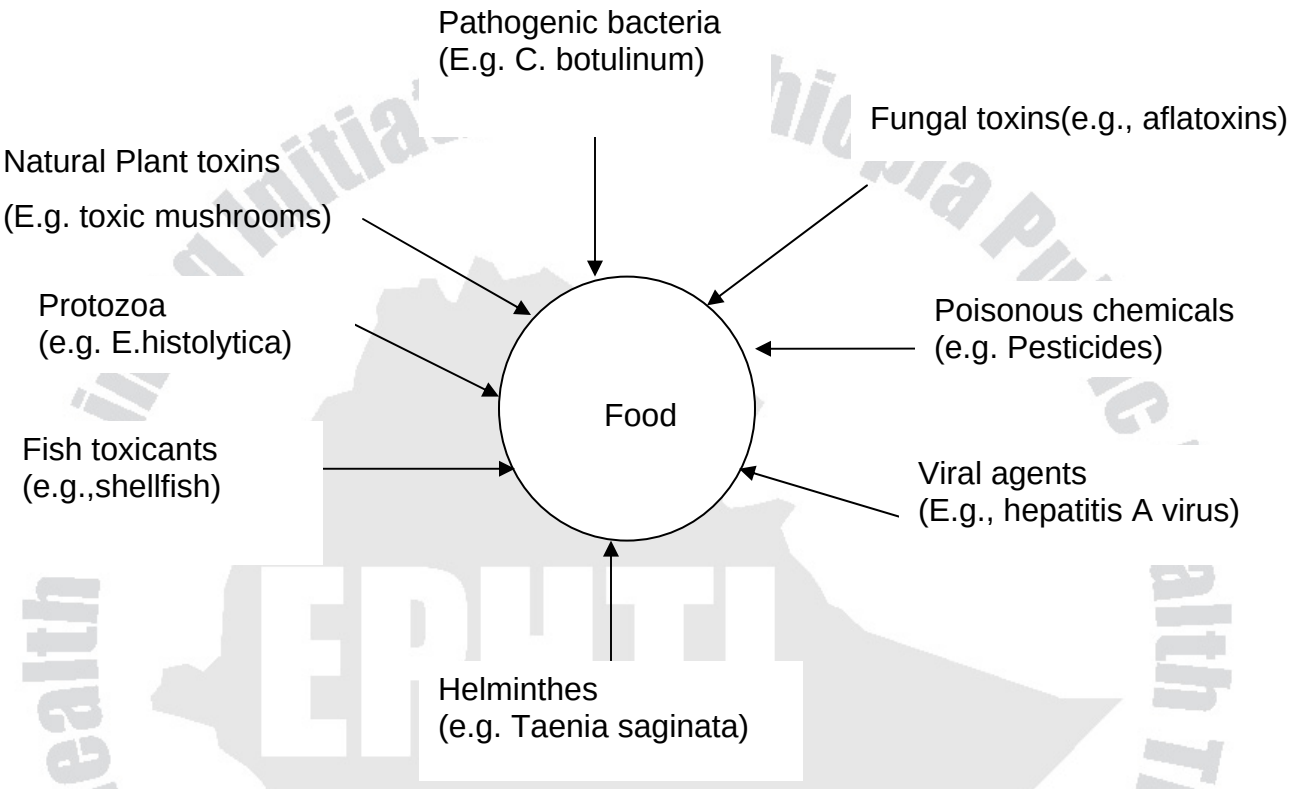

Figure 3.5.1Contaminants of food

3.4.9 Sources of contamination of food:

Food can be contaminated all the way from the source of production (farm) until consumption, i.e., Farm -----Harvest ------Transportation------Storage ------Distribution ------Processing ------Preparation -------Serving ------- Consumption. Food products are rich in nutrients required by microorganisms, which may lead to multiplication of the organisms to great extent if contaminated. Major contamination sources for foods include (4,7,19):

- **Water:** If a safe water supply is not used in processing and preparation of food it then becomes a source of contamination of the food (chemical or biological agents).

- **Sewage:** Raw, untreated sewage can contain pathogens that have been eliminated from the human body, as well as other materials including toxic chemicals from the environment. If raw sewage is used to irrigate vegetable farms, it can be a source of food contamination.
- **Equipment:** contamination of equipments used for processing, preparing or serving food occurs during production (manufacture) and when the material is not properly cleaned.
- **Food handlers:** The hands, hair, nose, and mouth harbor microorganisms that can be transferred to food during processing, packaging, preparation, and service by touching, breathing, coughing, or sneezing. Of all the viable means of exposing microorganisms to food, employees are the largest contamination source.
- **Insects and rodents:** Flies, cockroaches and rodents are associated with living quarters, eating establishments, and food processing facilities, as well as with toilets, garbage, and other filth. These animals transfer contaminants to food through their waste products; mouth, fur, intestinal tract, feet, and other body parts; and during regurgitation onto clean food during consumption.
- **Soil:** Soil may contain microorganisms as well as poisonous chemicals. These agents may get access to food either due to direct contamination or through dusts.
- **Other animals' bodies:** From the intestinal tracts of animals, microorganisms find their way directly to the soil and water. From there, they may find their way into plants, dust, utensils and/or food. Meat of animals can get contaminated during slaughtering, cutting, processing, storage, and distribution. Other contamination can occur by contact of the carcass with the hide, feet, manure, dirt, and visceral contents. Like wise drugs used to prevent disease and promote growth in animals may also become potential risk for human health due to persisting of these drugs in the meat or milk products.
- **Others:**
    - Mistaken use of a toxic chemical in the preparation seasoning or sweetening of food or by children believing it is a drink.

- Deliberate and malicious contamination of food by a person for some irrational reason.
- Water polluted by chemicals from farm and or spraying food trees (4,6).

3.4.10 Factors most commonly contributing to food-borne disease outbreaks

There are a number of factors that may lead to the occurrence of food-borne illness outbreaks. The major ones are:

- Preparation of food more than half a day in advance of needs
- Storage at ambient temperature
- Inadequate cooling
- Inadequate reheating
- Use of contaminated processed food (cooked meats and poultry, and the like)
- Undercooking
- Cross contamination from raw to cooked food from utensils, and unhygienic kitchen environment
- Infected food handlers or poor personal hygiene of food handlers
- Unsanitary dishware, utensils and equipment
- Improper food handling procedures such as unnecessary use of the hands during preparation and serving of food
- Improper food storage that may lead to cross contamination by agents of diseases (micro-organisms, poisonous chemicals), or exposure to moisture that may facilitate microbial growth
- Insects and rodents (4,13).

3.4.11 Some common food-borne diseases: their etiology and foods involved

1. Food infections

Etiologic Category	Diseases	Causative organisms	Foods commonly involved
1.Bacterial	Typhoid fever	Salmonella typhi and parathyphi	Raw vegetables and fruits, salads, pastries, un- pasteurized milk and milk products.
	Shigellosis	Shigella species	All foods handled by unsanitary workers, potato or egg salad, lettuce, raw vegetables
	Cholera	Vibrio cholerae	Fruits and vegetables washed with contaminated water
	Bovine TB	M. Bovis	Un-pasteurized milk or dairy products from tuberculous cows.
	E.coli infections	E.coli	Beef, dairy products, fresh products, raw produce (potatoes, lettuce, sprouts, fallen apples), salads.
Etiologic Category	**Diseases**	**Causative organisms**	**Foods commonly involved**
2. Viral	Viral GE	Rota virus, Norwalk virus, calici virus, astro virus	Any food of daily use with poor hygiene
	Viral hepatitis	Hepatitis A & E	Raw shellfish from polluted water, sandwich, salad, and desserts.
	Poliomyelitis	Polio virus	Any food of daily use with poor hygiene
3. Parasitic	Taeniasis	Taenia species	Raw beef, raw pork
	Amoebiasis	*Entameba histolytica*	Any food soiled with feces
	Ascariasis	*Ascaris lumbricoides*	Foods contaminated with soil, specially foods that are eaten raw such as salads, vegetables
	Giardiasis	*Giardia lamblia*	Foods contaminated with feces

2. Food poisonings/intoxications

Etiologic Category	Disease	Causative agent	Foods commonly involved
A. Natural toxins in Foods	1. Neurolathyrism	Beta oxalyl amino–alanine	"Guaya" (Lathyrus sativus)
	2. Mushroom poisoning	Phalloidine and alkaloids found in some poisonous mushrooms.	Poisonous mushrooms such as species of Amanita phalloides and Amanita muscaria
B. Bacterial toxins	1.Staphylococcal food poisoning	Entero-toxin from staphylococcus aureus	Milk and milking products, sliced meat, poultry, potato salad, cream pastries, egg salad
	2.Perfringens food poisoning	Strains of *Clostridium welchii/ C.perfringens*	Inadequately heated or reheated meat, poultry, legumes
	3.Botulism food poisoning	Toxin of Clostridium botlinum	Home-canned foods, low acid vegetables, corn and peas.
	4.Escherichia coli food poisoning	Enterohemorrhagic *Escherichia coli* 0157:H7	Ground beef, dairy products, raw beef.
	5.Bacillus cereus food poisoning	Entero toxin of Bacillus cereus	Cereals, milk and dairy products, vegetable, meats, cooked rice.
C. Fungal toxins	1. Ergotism	A toxin (ergot) produced by a group of fungi called clevises purpurea	Rye, wheat, sorghum, barley
	2. Aflatoxin food poisoning	Aflatoxin produced by some groups of fungus (e.g Aspergilus flavus, Aspergillus parasites)	Cereal grains, ground nuts, peanuts, Cottonseed, sorghum.
D. Chemical food poisoning	Chemical poisoning	Heavy metals (e.g. Lead, mercury, cadmium)	- Fish, canned food - Foods contaminated by utensils made or coated with heavy metals
		Pesticides and insecticides	- Residues on crops, vegetables, fruits. -Accidental poisoning where some chemicals may be mistaken with food ingredients. -When contaminated containers are used to hold or store foods.
		Additives (unauthorized)	Various food items where unauthorized additives may be added as coloring agents, sweeteners, preservatives, flavoring agents etc.

3.4.12 Common signs and symptoms of food borne diseases

- Individuals with food-borne diseases can have many different kinds of manifestations.
- Some of these manifestations are listed below:
  1. Diarrhea (watery/mucoid/bloody), tenesmus (painful straining at defecation with sensation of inadequate emptying), abdominal pain, nausea, vomiting, bloating , belching, flatulence, abdominal distention
  2. Loss of appetite, loss of general sense of well-being, weakness, unusual hunger sensation, altered taste sensation
  3. Fever, chills, headache, muscle and joint pains,
  4. Paralysis
  5. Symptoms of fluid loss like thirst, weakness, dizziness, low blood pressure, fast pulse rate, poor skin turgor, sunken eyeballs,
  6. Yellowish discoloration of the eyes and skin, weight loss,
  7. Passage of worms in the stool and sometimes through the mouth, itching and discomfort in the perianal area
  8. Growth failure in children

3.4.13 Management:

- All patients suspected of having a food-borne disease should be immediately referred to the nearby health facility for determination of the specific cause and proper treatment.
- However, in the meantime, there are lots of supportive and other interventions that Health Extension Package Workers can do to help the patient and his/her family. For example:
  1. Assess the level of dehydration and the presence or absence of visible blood in the stool in all patients with diarrhea; if there are evidences of significant fluid loss or if there is visible blood in the stool, refer the patient immediately to the nearby health center for proper treatment.
  2. If a patient has diarrhea, advice him/her to take more of the fluid diets prepared at home such as gruel (“atmit”), tea, soup, boiled milk, etc. as long as the

diarrhea is there. In addition, if there is ORS at hand provide the individual with some sachets and instruct him/her carefully on how to prepare and use the solution.

3. If a patient has fever, advice him/her and the family to use mechanical means of cooling the body such as tepid sponging;
4. Advice patients and their families on the importance of proper personal hygienic measures at home, particularly during food preparation, in order to prevent the infection from disseminating to other individuals

3.4.14 Prevention and Control:

The roles that Health Extension Package Workers can and should play in the prevention and control of food-borne diseases in particular and infectious diseases in general, are many.

Some of these roles are:

1. Provision of information and education on the means of transmission of food-borne diseases and their methods of prevention at household levels such as
   - Proper disposal of human excrement and other wastes,
   - Proper hand washing always after using the toilet and before and during food preparation and serving,
   - Keeping compound sanitation so as to prevent the breeding of flies, rats and roaches,
   - Keeping already prepared food items in the proper place and environmental conditions,
   - Proper cooking of animal foods before consumption,
   - Boiling of milk,
   - Proper washing and cooking of vegetables
   - Other important methods that facilitate the safety of food include the following:
     - Health education
     - Good personal and environmental hygiene
     - Availability of safe, ample and convenient water supply

- Training of food handlers and managers on hygienic food preparation and handling
- Stringent inspection and control actions
- Legislative support (ordinances and codes), licensing
- Good-house keeping practices including separate storage and care of toxic chemicals.
- Understanding about additives and restrictions of unauthorized use.
- Food equipment selection to avoid chemical poisoning arising from the material constituency and or coatings of some food utensils.
- Avoidance and care of insecticide use in food processing and preparation areas.

2. Education of the public at large on the above issues as well as avoidance of consumption of potentially harmful plants
3. Advising patients and families to seek immediate medical help in the event of any food-borne illness
4. Searching for cases and referring to nearby health institution for proper management; this is particularly so when there is anyone with some form of food-borne illness in the community since there may be several others with the same problem who may have manifestations or may have not started to show them yet.

This brings you to the conclusion of the satellite module prepared for Health Extension Workers. What remains now is to:

- **Read the task analysis for Health Extension Workers in section 3.4.15**
- **Do the pre-test on section 3.4.3 as a post-test**
- **Compare your responses against the keys given on section 3.4.16.**

3.4.15: Task Analysis for Health Extension Workers

Table 4.1. Knowledge Objectives and Learning Activities

No	Learning Objectives	Learning Activities
1	To define food-borne diseases	Define food-borne diseases
2	To classify food-borne diseases	Classify food-borne diseases
3	To describe the epidemiology of common food-borne diseases	Describe the magnitude of common food-borne diseases
4	To identify the etiologic agents of common food-borne diseases	Identify the etiologic agents of common food-borne diseases
5	To describe the clinical features of common food-borne diseases	List the major symptoms and signs of common food-borne diseases
6	To describe the management approach for common food-borne diseases	Describe the general management approaches for food-borne diseases
7	To explain the preventive and control measures for common food-borne diseases	-Discuss the general preventive and control measures for food-borne diseases -List environmental measures used in prevention and control of food-borne diseases
8	Outline the steps in the investigation of food-borne disease outbreaks	-Identify the most common factors responsible for food-borne disease outbreaks

Table 4.2. Attitude Objectives and Learning Activities

No	Learning Objectives	Learning Activities
1	Consider that food-borne diseases are a major public health problem	Recognize food borne diseases are one of the major public health problems in Ethiopia
2	Believe that improper handling of food can result in food borne diseases.	Believe increasing public awareness improves food handling practices
3	Appreciate preventive measures are more important than treatment in food borne disease.	Emphasize on preventive measures
4	Believe that food borne diseases can occur in the form of outbreak.	Emphasize on health education to prevent outbreak occurrence
5	Believe that the causes are not attributed to only microbial agents	Consider possibilities of non-microbial causes of food borne diseases
6	Consider that the role of food handlers is crucial in food borne diseases.	Emphasize on training of food handlers
7	Believe that some food borne diseases are fatal thus need immediate intervention	Emphasize on timely intervention
8	Believe that food borne diseases are preventable	Emphasize on prevention
10	Appreciate the role of different category of the health team in the prevention, control and management of food born diseases	Believe on team approach

Table 4.3. Practice Objectives and Learning Activities

No	Learning Objectives	Learning Activities
1	To identify a case of food borne disease	-Assess the environmental risk factors -search for the possible source of the disease
2	To manage a case of food borne disease appropriately	Eliminate/minimize the environmental risk factors -Advise to visit health institutions promptly -Provide health information
3	To apply proper preventive and control measures	-Deliver health information -Search for possible common source of the disease -Organize and mobilize the health team and the community to participate in preventive and control measures - Apply appropriate control measures based on the assessment of the environment
4	To manage outbreaks of food borne diseases	-Apply appropriate interventions -Notify concerned authorities
5	Implement disease surveillance	-Report food borne disease outbreaks in time

3.4.16 Keys to Pre and Post-tests (for health extension workers).

1. B
2. E
3. A
4. A
5. E
6. B
7. A

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3.5 TAKE HOME MESSAGES FOR CARE GIVERS/ SELF-CARE

- Food-borne diseases are caused by ingestion of food contaminated with poisonous substances or germs. Germs are tiny organisms that cannot be seen with the naked eye.
- If several people consume contaminated food from the same source, they may be affected by a similar type of sickness.
- The manifestations of food-borne sicknesses are many in type, e.g. diarrhea, vomiting, fever, abdominal pain, bloody stool, muscle weakness, etc.
- If an individual is possibly affected by a food-borne illness, he/she should seek medical help from health facilities as soon as possible.
- If not treated in time, food-borne illnesses can lead to serious and sometimes life-threatening problems.
- There are different things that can be done at home to prevent food-borne diseases:
    - Proper personal hygiene including washing the hands with soap every time after using the toilet, before preparing, serving or eating any food.
    - Construction and proper utilization of sanitary latrines and waste disposal pits.
    - Proper storage and preservation of food kept for long periods without consumption. Store foods off floor, in dry and well ventilated room. Perishable foods need to be kept in cool areas and preferably in refrigerators.
    - Consuming adequately cooked foods, and while hot.
    - Avoiding foods known to have harmful effects due to the presence of toxins, etc.
    - Using clean water from protected sources for preparation of food, washing dishware, and drinking.
    - Wash food utensils preferably in three compartments: the first with worm water and detergent for washing, the second with warm clean water for

rinsing, and the third with very hot water for sanitizing (disinfecting). Finally dry the utensils in air without the need for swabbing with a cloth to dry them. Swabbing may cross contaminate the utensils.

- Getting rid of flies, cockroaches, and rats
- Keeping cooked foods always properly covered if not immediately consumed so that they will not be contaminated with dust or by house flies
- Maintain good house keeping practice.

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UNIT FOUR

TASK ANALYSIS FOR THE DIFFERENT DIPLOMA HEALTH TEAM MEMBERS

TABLE 4.1. KNOWLEDGE OBJECTIVES AND ACTIVITIES

No	Learning Objectives	Learning Activities		
		PHN	EHT	MLT
1	To define food-borne diseases	Define food-borne diseases	Define food-borne diseases	Define food-borne diseases
2	To classify food-borne diseases	Classify food-borne diseases	Classify food-borne diseases	Classify food-borne diseases
3	To describe the epidemiology of common food-borne diseases	Describe the magnitude of common food-borne diseases	Describe the magnitude of common food-borne diseases	Describe the magnitude of common food-borne diseases
4	To identify the etiologic agents of common food-borne diseases	Identify the etiologic agents of common food-borne diseases	Identify the etiologic agents of common food-borne diseases	Identify the etiologic agents of common food-borne diseases
5	To explain the pathogenesis of common food-borne diseases	Explain the pathogenesis of common food-borne diseases	Indicate the most important pathogenic factors for common food-borne diseases	Indicate the most important pathogenic factors for common food-borne diseases
6	To describe the clinical features of common food-borne diseases	Explain the clinical features and disease course of common food-borne diseases	List the major symptoms and signs of common food-borne diseases	List the major symptoms and signs of common food-borne diseases
7	To state the diagnostic methods for common food-borne diseases	Describe the diagnostic methods (subjective and objective assessments) for common food-borne diseases	Mention the laboratory diagnostic methods of common food-borne diseases	Explain detailed laboratory diagnostic procedures for common food-borne diseases

TABLE 4.1. KNOWLEDGE OBJECTIVED AND ACTIVITIES (CONTINUED)

No	Learning Objectives	Learning Activities		
		PHN	EHT	MLT
8	To describe the management approach for common food-borne diseases	Describe the nursing management approaches for common food-borne diseases	Describe the general management approaches for food-borne diseases	Describe the general management approaches for food-borne diseases
9	To explain the preventive and control measures for common food-borne diseases	Discuss the general and specific preventive and control measures for food-borne diseases	- Discuss the general and specific preventive and control measures for food-borne diseases - Describe environmental measures used in prevention and control of food-borne diseases	Discuss the general preventive and control measures for food-borne diseases
10	Outline the steps in the investigation of food-borne disease outbreaks	Outline the steps in the investigation of food-borne disease outbreaks	- Outline the steps in the investigation of food-borne disease outbreaks - Identify the most common factors responsible for food-borne disease outbreaks - List sample collection procedures for food-borne disease outbreaks	- Outline the steps in the investigation of food-borne disease outbreaks - Identify the laboratory procedures used for investigation of common food-borne disease outbreaks

TABLE 4.2. ATTITUDE OBJECTIVES AND ACTIVITIES

No	Learning Objectives	Learning Activities		
		PHN	**EHT**	**MLT**
1	Consider that food-borne diseases are a major public health problem	Recognize food borne diseases are one of the major public health problems in Ethiopia	Recognize food borne diseases are one of the major public health problems in Ethiopia	Recognize food borne diseases are one of the major public health problems in Ethiopia
2	Believe that improper handling of food can result in food borne diseases.	Believe increasing public awareness improves food handling practices	Believe increasing public awareness improves food handling practices	Believe increasing public awareness improves food handling practices
3	Appreciate preventive measures are more important than treatment in food borne disease.	Emphasize on preventive measures	Emphasize on preventive measures	Emphasize on preventive measures
4	Believe that food borne diseases can occur in the form of outbreak.	Emphasize on health education to prevent outbreak occurrence	Emphasize on health education to prevent outbreak occurrence	Emphasize on health education to prevent outbreak occurrence
5	Believe that the causes are not attributed to only microbial agents	Consider possibilities of non-microbial causes of food borne diseases	Consider possibilities of non-microbial causes of food borne diseases	Consider possibilities of non-microbial causes of food borne diseases
6	Consider that the role of food handlers is crucial in food borne diseases.	Emphasize on training of food handlers	Emphasize on training of food handlers	Emphasize on training of food handlers
7	Believe that some food borne diseases are fatal thus need immediate intervention	Consider the timely management of a food borne disease	Emphasize on timely intervention	Consider the timely reporting of lab. Findings
8	Consider the importance of laboratory investigations in diagnosis and management of food borne diseases	Think of the appropriate lab. tests	Think of the appropriate lab. Investigations in outbreaks	Emphasize on appropriate lab. tests and procedures
9	Believe that food borne diseases are preventable	Emphasize on prevention	Emphasize on prevention	Emphasize on prevention
10	Appreciate the role of different category of the health team in the prevention, control and management of food born diseases	Believe on team approach	Believe on team approach	Believe on team approach

TABLE 4.3. PRACTICE OBJECTIVES AND ACTIVITIES

No	Learning Objectives	Learning Activities		
		PHN	EHT	MLT
1	To identify a case of food borne disease	make a subjective and objective assessment, interpret the data and reach on specific diagnosis	-assess the environmental risk factors -search for the possible source of the disease	Perform specific diagnostic laboratory procedures and identify the organisms
2	To manage a case of food borne disease appropriately	-administer the appropriate drugs -carryout the nursing interventions -evaluate the response of the patient	Eliminate/minimize the environmental risk factors -Advise to visit health institutions promptly -provide health information	-conduct laboratory tests to diagnose and monitor response to treatment as required -carryout antimicrobial drug sensitivity test (as applicable)
3	To apply proper preventive and control measures	-Deliver health information -Trace for the exposed -Search for possible common source of the disease -Organize and mobilize the health team and the community to participate in preventive and control measures -Undertake mass treatment and/or chemoprophylaxis if necessary	-Deliver health information -Trace for the exposed -Search for possible common source of the disease -Organize and mobilize the health team and the community to participate in preventive and control measures -Design appropriate control measures based on the assessment of the environment	-Deliver health information - Participate in mass treatment and/or chemoprophylaxis if necessary
4	To manage outbreaks of food borne diseases	-Verify the diagnosis of the outbreak -Design and apply appropriate interventions -Notify concerned authorities -Devise and implement monitoring tools	-Verify the diagnosis of the outbreak -Design and apply appropriate interventions -Notify concerned authorities -Devise and implement monitoring tools	-Identify the causative agent of the outbreak -Participate in designing and applying of appropriate interventions -Participate in the monitoring of the outbreak
5	Implement disease surveillance	-Report notifiable diseases in time -Monitor outbreaks	-Report notifiable diseases in time -Monitor outbreaks	-Report notifiable diseases in time -Monitor outbreaks

UNIT FIVE

ABBREVIATIONS AND GLOSSARY

Abbreviations

BID	Bis In Die (twice a day)
CNS	Central Nervous System
EHT	Environmental Health Technician
ELISA	Enzyme-Linked ImmunoSorbent Assay
EPHTI	Ethiopia Pulbic Health Training Initiative
HACCP	Hazard Analysis and Critical Control Point
HEW	Health Extension Worker
IM	Intramuscular
IV	Intravenous
KIA	Kliger Iron Agar
MIU	Motility Indole Urea
MLT	Medical Laboratory Technician
ORS	Oral Rehydration Salts
PHN	Public Healh Nurse
PO	Per Os (through the mouth)
PT	Prothrombin Time
PTT	Partial Thromboplastin Time
QID	Quater In Die (four times a day)
SC	Subcutaneous
TID	Ter in Die (three times a day)

Glossary

Antidote: a drug or other substance that antagonizes or abolishes the effect of a poison or toxin.

Blanching: treating vegetables, etc. with heat, e.g. steam or boiling water, briefy before freezing; it inactivates enzymes altogether and reduces discoloration and nutrient loss

Canning: a process of preserving food by heating and sealing it in airtight container. The can is filled with food, and air is pumped out of the space remaining at the top of the can to form a vacuum. The container is sealed, heated in a cooker, and then cooled to prevent overcooking of the food inside. It is used to preserve a wide variety of foods, including soups, sauces, fruits, vegetables, juices, meats, fish, and some dairy products.

Cathartic: a substance that aids bowel movement by exciting intestinal waves (peristalsis), increasing the bulk of feces, making the feces soft, or adding slick fluid to the wall of the intestines.

Caustic substances: any substance that destroys living tissue, or causes burning or scarring, as silver nitrate, nitric acid, or sulfuric acid

Cyanosis: bluish discoloration of the skin and mucous membranes from lack of oxygen

Endotoxin: a toxin produced within a micro-organism and liberated when the micro-organism disintegrates.

Enterotoxin: an exotoxin that acts on the intestine

Epidemic: the occurrence of a disease or diseases with a greater than normal (usual) rate of occurrence in a population

Exotoxin: a toxin excreted by a microbe into the surrounding medium.

Hazard: a situation or thing that increases the chance of a loss from some danger that may cause injury or illness

Hazardous waste: solid, liquid, or gas wastes that can cause death, illness, or injury to people or destruction of the environment if improperly treated, stored, transported, or discarded. Substances are considered to be hazardous wastes if they are ignitable, corrosive, reactive, or toxic.

Hygiene: practices necessary for establishing and maintaining good health

Intussesception: the sinking of one part of the bowel into the next, like a telescope effect

Leukemioid reactions: an abnormal condition resembling leukemia in which the white blood cell count rises in response to an allergy, inflammatory disease, infection , poison, hemorrhage, burn or other causes of sever physical stress.

Mycotoxins: compounds or metabolites produced by a wide range of fungi that have toxic or other adverse effects on humans and animals

Outbreak: an epidemic referring to a more localized situation.

Pasteurization: the process of applying heat at certain degree for a specified period, usually immediately followed by cooling, most often to milk or cheese to kill or slow the growth of harmful bacteria

Sanitation: the creation and maintenance of hygienic and healthful conditions

Sitz bath: also called ***hip bath***, literally (German) "seat" bath, a bath in which only the hips and buttocks are soaked in water, saline or other solution

Spore: an inactive, resistant, resting, or reproductive body that can produce another vegetative individual under favorable conditions

Syndrome: a constellation of symptoms and signs

Toxin: a chemical produced by living organisms that is poisonous to humans and animals

UNIT SIX

ANNEXES

ANNEX I: Answer Keys to Pre-Test and Post-Tests

PART I: Answer Keys to Pre-test and Post-test for All Categories of the Health Team

1. "Food borne disease" is defined as a disease caused by agents that enter the body through the ingestion of contaminated food.

2 a. **Food borne infections:** are diseases whose etiologic agents are viable pathogenic organisms ingested with foods and that can establish infection. E.g. Shigellosis

b**. Food borne poisonings/ intoxications:** diseases arising from the ingestion of toxins released by microorganisms, intoxications from poisonous plants or toxic animal tissues: or due to consumption of food contaminated by chemical poisons. E.g. Botulism

3. The spectrum of food borne diseases is constantly changing. New and re-emerging food born illnesses have resulted from recent changes in human demographics, international travel and commerce, microbial adaptations, economic development, technology and industry, eating behavior and land use. In the last couple of decades a number of diseases thought to be of unknown causes have been proven to result from food borne infections.

   In developing countries like Ethiopia in particular, the problem attains great proportions due to many reasons; basic among which are poverty poor environmental sanitation and lack of public health awareness. In these modern day times in which food is usually not consumed immediately following and/or at the site of production, the risks of food-borne diseases are becoming increasingly important; the concern is obviously much more in areas where food storage and preparation safety measures are far from optimum.

4. The extent of diagnostic evolution of food borne diseases can be based on history,

clinical features, environmental assessment and laboratory investigations. If applicable, radiological examinations may be implemented.

5. Prevention and control of food–borne diseases, regardless of the specific cause, are based on the same principles:
   a. Avoidance of food contamination
   b. Destruction or prevention of contaminants
   c. Prevention of further spread or multiplication of contaminants.

Specific modes of intervention vary from area to area depending on environmental, economic, political, technology and socio cultural factors.

6. C
7. Refer to Section 2.8.1 A-ii and B-i
8. A
9. Refer to Section 2.11
10. Refer to Section 2.12 for the details.

Summary of steps in the investigation of food-borne disease outbreak investigation

a. Verify the existence of an outbreak
b. Compare the current number of cases with the past
   Note: consider seasonal variations
c. Verify the diagnosis
d. Review clinical and laboratory findings
e. Describe the outbreak with respect to time, place and person
f. Prepare epidemic curve
g. Calculate food-specific attack rate
h. Formulate and test hypotheses (by consulting with higher level health professionals)
i. Search for additional cases
j. Analyze the data
k. Make a decision on the hypotheses tested (by consulting with higher level health professionals)
l. Intervene and follow-up

m. Report the investigation.
n. Inform the public on control and prevention of the outbreak

PART II: Answer Keys to Pre-test and Post-test for Specific Categories of the Health Team

A. Public Health Nurses

1.D
2.C
3.B
4.D
5.C
6.D
7.B

B. Environmental Health Technicians

1. Food sanitation is the application of a science to provide wholesome food handled in a clean environment by healthy food handlers through prevention of contamination with microorganisms or toxic chemicals that cause food borne illness, and minimization of the growth of food spoilage microorganisms.
2. D
3. The benefits of effective food sanitation program include:
    a. Reduced public health risks
    b. Improved product shelf life
    c. Improved customer relations
    d. Improved product acceptability
    e. Reduce wastage
4. A

5. The three basic principles of food sanitation in the control of food-borne illnesses are:
    a. Prevention of contamination of the food from microorganisms, their toxins or other chemicals of health hazard.
    b. Elimination / destruction of micro – organisms or their toxins.
    c. Prevention of the growth of microorganism or the inhibition of toxin production..
6. the following contaminants of food may have deleterious effects on the health of man:
    a. helminthes
    b. protozoa
    c. pathogenic bacteria
    d. fungal toxins
    e. viral agents
    f. natural plant toxins
    g. fish toxicants
    h. poisonous chemicals
7. the stages at which food may be contaminated include:
    a. during primary production
    b. during processing and storage
    c. during distribution
    d. during marketing
    e. during food preparation
    f. during serving and consumption
8. the sources of food contamination are the following:
    a. Water
    b. Sewage
    c. Air
    d. Food preparing and serving equipments
    e. Food handlers
    f. Adjuncts and additives

g. Insects and rodents
h. Soil
i. Plants and plant products
j. Animal bodies, and others.

9. the four components in the transmission of food-borne diseases are:
    a. agent
    b. source
    c. medium
    d. host
10. Refer to section_____3.2.8
11. Refer to section _____3.2.9
12. HACCP (Hazard Analysis and Critical Control Points) is the system consisting of a series of interrelated actions taken to ensure the safety o fall processed and prepared foods at critical points during the stages of production, storage, transport, processing, preparation and service.
    Refer to Box 1 for the elements of HACCP.
13. Methods used to keep food safe include:
    a. temperature control (use of high and low temperature)
    b. fermenting and pickling
    c. chemical treatment
    d. radiation
    e. other supportive procedure (See section 3.2.9)
14. a. For diagnosis of outbreak
    b. For epidemiological reasons
    c. For legal issues
    d. For preventive aims
    e. For implementing appropriate actions

C. Medical Laboratory Technicians

1. B
2. D
3. C
4. C
5. Widal test
6. A
7. D
8. E

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ANNEX II: Laboratory Identification of Causes of Food-Borne Diseases

Direct Examination of stool specimen

Direct microscopic examination of stool specimen with physiological saline and Dabell's iodine solutions.

Procedure

1. Place a drop of physiological saline in the center of the left half of the slide and place a drop of Dobell's iodine solution in the center of the right half of the slide.
2. With an applicator stick, pick up a small portion of the feces (about 2mg which is as much as the size of a match head) and put on the drop of saline.
3. Mix the feces with the two different drops using the applicator stick to form a homogeneous suspension.
4. Cover each drop with a cover slip. Touch the edge of the drop and gently lower the cover slip onto the slide. Avoid air bubble formation.
5. Examine the saline preparations using the 10x objective for trophozoites (vegetative/motile forms) and cysts as well as oocyst of intestinal protozoa and for any ova or larva of helminthes.
6. Examine the iodine suspension using 40 objective for better identification of the cyst stages of protozoa (iodine will stain the nuclei and the glycogen mass of the cyst.

Features Used To Assist In the Laboratory Identification of Enterobacteria

Species	Lactose	Oxidase	Citrate	MIU Medium			KIA medium	
				Motility	Indole	Urea	H_2S	Gas
Escherichia coli	+	-	-	+	+	-	-	+
Shigella species	-	-	-	-	D	-	-	-
Salmonella typhi	-	-	-	+	-	-	+	-
Salmonella partyphi A	-	-	-	+	-	-	-	+
Vibrio cholerae	-	+	d	+	+	-	-	-

d: different strains give different results

H_2S: hydrogen sulphide (blackening)

ANNEX III: Bacterial Food Infections and Poisonings

Incubation Period, Organisms	Signs and Symptoms
1 to 6 hours	
Staphylococcus aureus	Nausea, vomiting, diarrhea
Bacillus cereus	
8 to 16 hours	
Clostridium perfringens	Abdominal cramps, diarrhea, vomiting rare
Bacillus cereus	
More than 16 hours	
Enterotoxigenic *E.coli*	Watery diarrhea
V. cholerae	Watery diarrhea
Shigella spp.	Dysentery
Enterohemorrhagic *E. coli*	Dysentery
Salmonella spp.	Inflammatory diarrhea

The above table shows bacterial food Infections and poisonings with predominant gastrointestinal manifestations (Modified from Harrison's Principles of Internal Medicine, 15th Edition, 2001).

ANNEX IV: Gastrointestinal Pathogens Causing Acute Diarrhea

Mechanism	Location	Illness	Stool Findings	Examples Of Pathogens Involved
Non-Inflammatory (Enterotoxin)	Proximal small bowel	Watery diarrhea	No fecal leukocytes	*V. cholerae, Enterotoxigenic E. coli, Clostridium perfringenes, Bacillus cererus, Staph. aureus*, viral
Inflammatory (Invasion Or Cytotoxin)	Colon or distal small bowel	Dysentery or inflammatory diarrhea	Fecal polymorphnuclear leukocytes	*Shigella spp., Salmonella spp., Enterohemorrhagic E.coli, E. histolytica*
Penetrating	Distal small bowel	Enteric fever	Fecal mononuclear leukocytes	*Salmonella typhi*

The above table shows gastrointestinal pathogens causing acute diarrhea (modified from Harrison's Principles of Internal Medicine, 15th Edition, 2001)

ANNEX V: Chemotherapy of Some Food-Borne Diseases

No	Food-borne Disease	Antimicrobial Therapy	
		Adults	**Children**
1	**Typhoid Fever**	Chloramphenicol 500 mg po/iv qid for 14 days	50-100 mg/kg/day po/iv in 4 divided doses for 14 days
		Ampicillin 1 gram po/im/iv qid for 14 days	100 mg/kg/day po/im/iv in 4 divided doses for 14 days
		Amoxicillin 500 mg po tid for 14 days	20-40 mg/kg/24 hour in 3 divided doses for 14 days
		Trimethoprim-sulfamethoxazole 160/800 mg po bid for 14 days	8 mg trimethoprim and 40 mg sulfamethoxazole per kg per day po in 2 divided doses for 14 days
		Ciprofloxacin 500 mg po bid for 10-14 days	Not recommended for children less than 17 years[#]
		Ceftriaxone 1-2 gram IM or slow IV once or in 2 divided doses daily for 5-7 days	50-75 mg/kg/day IM or slow IV in single or 2 divided doses for 5-7 days
2	**Shigellosis**	Ampicillin 500 mg po qid for 5-7 days	50-100 mg/kg/day in 4 divided doses for 5-7 days
		Chloramphenicol 500 mg po qid for 5-7 days	20-50 mg/kg/day po in 4 divided doses for 5-7 days
		Trimethoprim-sulfamethoxazole 160/800 mg po bid for 5-7 days	8 mg trimethoprim and 40 mg sulfamethoxazole per kg per day po in 2 divided doses for 5-7 days
		Nalidixic acid 1 gram po qid for 5-7 days	50-60 mg/kg/day in 4 divided doses for 5-7 days
		Ciprofloxacin 500 mg po bid for 5-7 days	Not recommended for children younger than 17 years of age[#]
		Ceftriaxone 1-2 gram daily IM or slow IV in single or 2 divided doses for 5 days	20-50 mg/kg per day IM or slow IV in single for 2 divided doses for 5 days
3	**Cholera**	Tetracycline 500 mg po qid for 3-5 days OR Tetracycline 2 gram po stat	Tetracycline 250 mg po qid for 3-5 days for children older than 8 years of age[*]
		Doxycycline 100 mg po bid for 3 days OR Doxycycline 300 mg po stat	100 mg po stat for children older than 8 years[*]
		Ciprofloxacin 30 mg/kg po stat (maximum 1 gram)	15 mg/kg bid for 3 days (maximum 500 mg po bid)[#]
		Erythromycin 500 mg po qid for 3 days	40-50 mg/kg/day in 4 divided doses for 3 days
		Trimethoprim-sulfamethoxazole 160/800 mg po bid for 3-5 days	8/40 mg/kg/day in 2 divided doses for 3-5 days

		Furazolidone 100 mg po qid for 5-7 days	1.25 mg/kg po qid for 5-7 days Avoid the drug in infants less than 1 year of age because of the possibility of hemolytic anemia
4	**Acute amebic colitis**	Metronidazole 500-750 mg po tid for 5-10 days OR Tinidazole 2 gram PO daily for 3 consecutive days FOLLOWED BY Diloxanide furoate 500 mg po tid for 10 days OR Iodoquinol 650 mg po tid for 20 days OR Paromomycin 500 mg po tid for 10 days Tetracycline 500 mg po qid	Metronidazole 30-50 mg/kg/daily divided into 3 doses for 10 days OR Tinidazole 50-60 mg/kg daily for 3 consecutive days FOLLOWED BY Diloxanide furoate 20 mg/kg/day in 3 divided doses for 10 days OR Iodoquinol 10-13.3 mg/kg or 333.3 mg/m^2 body surface area, tid for 20 days (maximum 1.95 grams in 24 hours)
5	**Amebic liver abscess**	As above	As above
		Metronidazole IV infusion 500-750 mg tid until patient is able to complete course with oral drugs	30 mg/kg daily in 3 divided doses until patient is able to complete course with oral drugs
		Dehydroemetine 1 mg/kg/24 hours in a single IM or SC dose for 8-10 days PLUS Chloroquine 500 mg po bid or 250 mg po qid for 2 days FOLLOWED BY 500 mg po daily or 250 mg po bid for 14-21 days PLUS Diloxanide furoate as above	1-1.5 mg/kg/24 hours in a single IM or SC dose for 8-10 days PLUS Chloroquine 10 mg/kg po bid or 5 mg/kg po qid for 2 days FOLLOWED BY 10 mg/kg po daily or 5 mg/kg po bid for 14-21 days PLUS Diloxanide furoate as above
6	**Giardiasis**	Metronidazole 250-500 mg po tid for 5-7 daysn OR Metronidazole 2 grams once a day for 3 days	25 mg/kg/24 hour in 3 divided doses for 5 days
		Tinidazole 2 gram po stat	50-75 mg/kg po stat
		Quinacrine 100 mg po tid for 5-7 days	2 mg/kd po tid for 5-7 days
		Mepacrine 2 mg/kg/24 hour in 3 divided doses for 5-7 days	Mepacrine 2 mg/kg/24 hour in 3 divided doses for 5-7 days
		Furazolidone 100 mg po qid for 7-10 days	1.25 mg/kg po qid for 7-10 days Avoid the drug in infants less than 1 year of age because of the possibility of hemolytic anemia.
		Albendazole 400 mg daily for 5 days may be effective	Albendazole 200 mg po once daily for 5 days for children up to 2 years of age; for children 2 years and older, similar dose as for adults

7	**Ascariasis**	Piperazine citrate 3.5 grams per day for 2 consecutive day Treatment may be repeated after one week for heavy infection.	75 mg per kg per day for two consecutive days. Treatment may be repeated after one week for heavy infection.
		Levamisole 120-160 mg po stat	2.5 mg/kg po stat
		Albendazole 400 mg po stat Treatment may be repeated in three weeks.	Children up to 2 years of age: 200 mg po stat Children 2 years of age and over: as for adults
		Mebendazole 100 mg po bid for 3 consecutive days OR 500 mg po stat Dose may be repeated in 2-3 weeks if required.	Mebendazole 100 mg po bid for 3 consecutive days
		Pyrantel pamoate 10 mg /kg po stat (maximum 1 gram base) May be repeated in 2-3 weeks if required.	Pyrantel pamoate 10 mg /kg po stat (maximum 1 gram base) May be repeated in 2-3 weeks if required.
8	**Taeniasis**	Niclosamide 2 gram po stat May be repeated in 1 week if required.	<2 years: 500 mg po stat 2-8 years: 1 gram po stat 8 years: 1.5 gram po stat (For both, the dose may be repeated in 1 week if required)
		Albendazole 400 mg po once a day for 3 consecutive days	For children up to 2 years of age: 200 mg po once a day for 3 consecutive days For children 2 years and older: as for adults.
		Praziquantel 600 mg po stat	5-10 mg/kg po stat for children over 4 years
		Mebendazole 100 mg po bid for 3 days	Same as for adults
9	Brucellosis	Doxycycline 100 mg po bid combined with rifampicin 600 mg to 900 mg daily given for 8-12 weeks	Children< 7 years rifampicin 15mg/kg combined with TMP+SMZ 8/40 mg /kg for 8-12 weeks

N.B.

- [*]The tetracyclines are generally not recommended for children younger than 8 years of age.
- [#]Use of quinolones in children and adolescents is not generally recommended (they cause arthropathy in weight-bearing joints in young animals) although they may in some circumstances be used for short-term.

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