

Script

Dear Students, in to-day's lecture, we will discuss about "**foodborne disease**"

This episode deals with different types of **Foodborne disease**, pathogens, sources of food infection, water borne illness causing organisms, salmonellosis, cholera.ect. The following points are highlighted;

1. **Introduction**
2. **Diseases Associated with Lack of Sanitation:**
3. **Major illness causing microorganisms.**
4. **Mycotoxins**
5. **Major out breaks**

Introduction

Foodborne illness costs the United States \$23 billion annually. Causes an estimated 1.4 million foodborne illnesses/year. Foodborne illness usually arises from improper handling, preparation, or food storage. Good hygiene practices before, during, and after food preparation can reduce the chances of contracting an illness. These are the major food borne illness causing microorganisms

E.coli 0157:H7, Salmonella enteritidis, Listeria monocytogenes, Vibrio spp and Campylobacter jejuni. .. Foodborne disease can also be caused by a large variety of toxins that affect the environment.

Symptoms often include vomiting, fever, and aches, and may include diarrhea. Some types of microbes stay in the intestine, some produce a toxin that is absorbed into the bloodstream, and some can directly invade deeper body tissues

2:Diseases Associated with Lack of Sanitation:

Lack of sanitation is a critical point in the contamination of drinking-water by microbes. As already seen, faecal pollution of drinking-water can lead to a number of diseases, including: cholera, typhoid fever, paratyphoid fever, salmonellosis, shigellosis, hepatitis. Water-related disease may be: water-borne, water-washed, water-based and water-related-vector-borne.

Waterborne diseases: Directly acquired from contaminated drinking water. Due to , poor wastewater treatment, lack of adequate sanitation facilities and unhygienic behavior.

Water-washed: Indirectly acquired diseases due to lack of hygiene. Water-washed diseases, which produce skin and eye infections, are caused by a lack of soap and insufficient water for washing hands and clothes and for personal hygiene. Trachoma, for example, is an infectious disease that can lead to blindness. Children are often a reservoir for the bacteria that cause trachoma.

Water-based diseases: Caused by aquatic organisms that spend part of their life-cycle in the water and another part as parasites of animals. Water-based diseases are transmitted to aquatic hosts, such as freshwater crabs, lobsters, crayfish, shrimp, which may then be ingested by people.

Diseases transmitted by water : Diseases through contaminated water is the major problem in the world. Helminths and amoebae may also be transmitted in water and are common in poor-quality water supplies. Microbial contamination usually results from the of water with human or animal faeces. If drinking-water is contaminated with faeces, pathogens are likely to be widely and rapidly dispersed. The diseases range from mild gastroenteritis to severe and sometimes fatal diarrhoea, dysentery, hepatitis, cholera and typhoid.

Faecal-oral diseases represent the largest health burden associated with a lack of improved sanitation, diarrhoea being the most burdensome of these and accounting for over 1.6million child deaths each year. The major *soil-transmitted helminths* showing association with poor access to improved sanitation are hookworm, roundworm and whipworm, all of which are transmitted when eggs are passed in human faeces which is then left in the environment.

Beef and pork tapeworms infect humans when infected and inadequately cooked animal meat is eaten. Humans can then contribute to the continued life cycle by defecating in such a manner that the eggs in their faeces are eaten by the original animal hosts.

Water-based helminths have aquatic intermediate hosts, for example snails, and are responsible for diseases such as Diseases of liver, gastrointestinal tract and bladder caused by *schistosomes* ,schistosomiasis.

Water

One of the most common causes of infectious diarrhea, is a lack of clean water. Often, improper fecal disposal leads to contamination of groundwater. This can lead to widespread infection among a population, especially in the absence of water filtration or purification. Human feces contains a variety of potentially harmful human pathogens

Types of food borne diseases

These are the different types of food borne diseases commonly causing health problems.

- *Salmonella* bacteria may cause food poisoning when contaminated meat, poultry and eggs that are eaten raw or undercooked or foods come into contact with contaminated foods during preparation. Symptoms usually occur within hours to two days and may include nausea, fever, headache, abdominal cramps, diarrhea and vomiting lasting two to seven days.

- *Staphylococcus aureus* is carried on your skin and in throat infections and may be transmitted during food handling and preparation. Meat, poultry, salads, cheese, eggs, custards and cream-filled desserts are potential food sources. Symptoms may develop within one to eight hours after eating and may include vomiting, diarrhea, nausea and abdominal cramps lasting one to two days.
- *Clostridium botulism* is most frequently associated with foods that are canned at home and are either improperly prepared or are stored in poorly sealed containers. Untreated botulism can be fatal. If you or a family member have botulism symptoms, get medical help immediately.
- *Campylobacter jejuni* is contracted from drinking untreated water, contact with infected pets, and when contaminated meat, poultry, milk or shellfish is eaten raw or undercooked. Symptoms may develop in 2 to 10 days and may include severe diarrhea, cramps, fever and headache that may last up to 10 days.
- *Listeria monocytogenes*, which causes the disease Listeriosis, is spread in untreated water, unpasteurized milk and dairy products, raw meats and seafood and in raw vegetables that have been infected by manure fertilizer. Potential complications include meningitis or encephalitis, blood poisoning, spontaneous abortion and stillbirth. In rare cases, the disease can be fatal. Pregnant women, newborns, the elderly, infirm and immune-compromised are at the highest risk.
- *Shigella* bacteria cause the disease Shigellosis which is transmitted from humans to humans via poor sanitary habits. Foods that are most often implicated are poultry, milk and dairy products, salads and other foods that require a lot of mixing and handling in the preparation stage. Symptoms may appear within one to seven days and may include abdominal pain, diarrhea, fever, sometimes vomiting, and blood, pus or mucus in stool, lasting five to six days.
- *Escherichia coli* is the bacterium that is associated with hemorrhagic colitis. It may be contracted by drinking water that contains raw sewage, or in raw or rare ground beef and unpasteurized milk. Symptoms may develop over 3 to 4 days and may include

severe abdominal cramps followed by diarrhea (often bloody), nausea, vomiting and fever

- Hepatitis A is a viral disease contracted when shellfish are harvested from polluted water is eaten raw. Hepatitis A also may be transmitted by human carriers who prepare and serve uncooked foods. Symptoms may develop over 14 to 50 days and usually include fatigue, fever, nausea, vomiting, abdominal cramps and appetite loss, followed by liver enlargement, jaundice and darkened urine. Hepatitis A may cause liver damage and death.

3:Major illness causing microorganisms.

According to Centers for Disease Control there are top 4 emerging pathogens

1. *E.coli* 0157:H7
2. *Salmonella enteriditis*
3. *Listeria monocytogenes*
4. *Campylobacter jejuni*

Some strains of *V. cholerae* cause the disease cholera. *V. cholerae* is a facultative anerobic organisms.

Both shiga toxin and verotoxin are associated with causing hemolytic uremic syndrome. As of 2006, the WHO reported that *Shigella* causes about 165 million cases of severe dysentery.

Emerging foodborne pathogens[

Many foodborne illnesses remain poorly understood. Approximately 99.9% percent of outbreaks are caused by unknown sources

Aeromonas hydrophila , *Aeromonas caviae*, *Aeromonas sobria*

Aeromonas hydrophila is a Gram-negative, rod-shaped bacterium mainly found in areas with a warm climate. This bacterium can be found in fresh or brackish water. It can survive in aerobic and anaerobic environments.

A. hydrophila was isolated from humans and animals in the 1950s. It is the most well known of the species of *Aeromonas*. It is resistant to most common antibiotics and cold temperatures. It produces aerolysin cytotoxic enterotoxin that can cause tissue damage. *A. hydrophila* is widely considered a major fish and amphibian pathogen, and its pathogenicity in humans has been recognized for decades.

C. botulinum is responsible for foodborne botulism (ingestion of preformed toxin), infant botulism (intestinal infection with toxin forming *C. botulinum*), and wound botulism (infection of a wound with *C. botulinum*). *C. botulinum* produces heat-resistant endospores that are commonly found in soil and allow for survival in adverse conditions

Botulinum toxin

Neurotoxin production is the unifying feature of the species. Eight types of toxins have been identified (including the recently described type H) that are allocated a letter (A-H). All toxins are rapidly destroyed at 100°C, but they are resistant to degradation by enzymes found in the gastrointestinal tract. This allows for ingested toxin to be absorbed from the intestines into the bloodstream

Wound botulism Most people who develop wound botulism inject drugs several times a day, so it's difficult to determine how long it takes for signs and symptoms to develop after the toxin enters the body. Most common in people who inject black tar heroin, wound botulism signs and symptoms include:

- Difficulty swallowing or speaking
- Facial weakness on both sides of the face

- Blurred or double vision
- Drooping eyelids
- Trouble breathing
- Paralysis

Infant botulism If infant botulism is related to food, such as honey, problems generally begin within 18 to 36 hours after the toxin enters the baby's body. Signs and symptoms include:

- Constipation (often the first sign)
- Floppy movements due to muscle weakness and trouble controlling the head
- Weak cry
- Irritability
- Drooling
- Drooping eyelids
- Tiredness
- Difficulty sucking or feeding
- Paralysis

C. perfringens is the third most common cause of food poisoning in the United Kingdom and the United States.

Infection:

Clostridium perfringens is the most common bacterial agent for gas gangrene, which is necrosis, putrefaction of tissues, and gas production. The gases form bubbles in muscle (crepitus) and the characteristic smell in decomposing tissue. After rapid and destructive local spread (which can take only hours), systemic spread of bacteria and bacterial toxins may cause death. This is a problem in major trauma and in military

contexts. *C. perfringens* grows readily on blood agar plate in anaerobic conditions, and often produces a double zone of beta hemolysis.

*E. coli*O157:H7

Strains of *E. coli* that express shiga -like toxins gained this ability due to infection with a prophage containing the structural coding for the toxin, and nonproducing strains may become infected and produce shiga-like toxins after incubation with shiga toxin positive strains. *Escherichia coli* O157:H7 transmission is via the fecal-oral route and most illness has been through distribution of contaminated raw leaf green vegetables and undercooked meat.

While relatively uncommon, *E. coli* O157:H7 can naturally be found in the intestinal contents of some cattle. The prevalence of *E. coli* O157:H7 in North American feedlot cattle herds ranges from 0 to 60%. Some cattle may also be so-called 'super-shedders' of the bacterium. Super-shedders may be defined as cattle exhibiting rectoanal junction colonization and excreting $>10^3$ to 10^4 CFU g⁻¹ feces.

CDC estimates: 6.5-33 million cases each year

1. *E. coli* causes about 21,000 cases each year
2. *Salmonella* causes 2-4 million illnesses/yr.
3. *Campylobacter* causes 1-6 million cases/yr

Major outbreaks:

Outbreaks

An outbreak is defined as an incident in which two or more persons experience a similar illness after a common exposure.

Waterborne outbreaks are classified in a variety of ways, including:

Probable Waterborne Outbreaks

- A probable waterborne outbreak is defined as an incident in which two or more persons experience a similar illness after having contact with the same source of drinking or recreational water, and epidemiologic evaluation suggests that the water is the source of illness, but person-to-person transmission or other exposures cannot be ruled out
1. An outbreak which occurred in the UK in 1960 caused the death of 100,000 turkeys which had consumed aflatoxin-contaminated peanut meal. For majority of outbreaks food was eaten outside the home
 2. Restaurants were the most commonly reported place where food was eaten.
 3. Many outbreaks caused by *Salmonella* or norovirus occurred at a school or nursing home.
 4. For outbreaks caused by ciguatoxin and *L. monocytogenes*, food was more commonly reported to have been eaten at a private home
 5. Notable outbreaks were caused by ground beef contaminated with *E. coli* O157:H7 and fresh produce contaminated with *Salmonella*, *E. coli* O157:H7, *Cyclospora cayetanensis*, or hepatitis A
 6. Multidrug-resistant strains of *Salmonella* caused outbreaks linked to unpasteurized milk and ground beef.
 7. A large multistate outbreak of listeriosis caused by contaminated deli meat led to one of the largest food recalls in the United States.
 8. Scombrototoxin (fish-derived histaminic agent) caused the majority of outbreaks attributable to a chemical etiology.

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Salmonella Infection,

About half of all Salmonella cases result from unsafe handling of food in the home. Foodborne illness costs the United States \$23 billion annually. Causes an estimated 1.4 million foodborne illnesses/year

From 1993-1997, only 189,304 Salmonella infections (~38,00/year) reported through the National Salmonella Surveillance System

In the same period, 357 recognized outbreaks of Salmonella infection resulting in 32,610 illnesses were reported through the Foodborne-Disease Outbreak Surveillance System.

4:Mycotoxin:

Mycotoxicoses refers to the effect of poisoning by fungal toxin ,ie Mycotoxins . The term 'mycotoxin' is usually reserved for the toxic chemical products produced by fungi that is through food consumption. Mycotoxins sometimes have important effects on human and animal health. One mold species may produce many different mycotoxins, and the same mycotoxin may be produced by several species.

Major groups

Aflatoxins are largely associated with [cotton](#), [peanuts](#), [spices](#), [pistachios](#) and [maize](#).

Ochratoxin is a mycotoxin that comes in three secondary metabolite forms, A, B, and C. All are produced by *Penicillium* and *Aspergillus* species. The three forms differ in that Ochratoxin B (OTB) is a nonchlorinated form of Ochratoxin A (OTA) and that Ochratoxin C (OTC) is an ethyl ester form Ochratoxin A.

OTA has been labeled as a carcinogen and a nephrotoxin, and has been linked to tumors in the human urinary tract.

Citrinin is a toxin that was first isolated from *Penicillium citrinum*, but has been identified in over a dozen species of *Penicillium* and several species of *Aspergillus*. Citrinin is associated with **yellowed rice** disease in Japan and acts as a **nephrotoxin** in all animal species tested.

Ergot Alkaloids: The most prominent member of this group is *Claviceps purpurea*. This fungus grows on rye and related plants, and produces **alkaloids** that can cause ergotism in humans and other mammals who consume grains contaminated with its fruiting structure called **ergot** sclerotium.

Ergotism is the effect of long term ergot poisoning, traditionally due to the ingestion of the alkaloids produced by the *Claviceps purpurea* fungus that infects rye and other cereals, and more recently by the action of a number of ergoline-based drugs. There are two forms of ergotism: gangrenous, affecting blood supply to extremities, and convulsive, affecting the central nervous system.

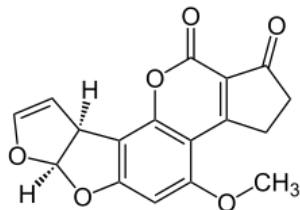
Patulin : **Patulin** is a mycotoxin that is produced by certain species of *Penicillium*, *Aspergillus* and *Byssoschlamys* molds that may grow on a variety of foods including fruit, grains, and cheese.

Fusarium : Fusarium toxins are produced by over 50 species of *Fusarium* and have a history of infecting the grain of developing cereals such as wheat and maize.

They include a range of mycotoxins, such as: the fumonisins, which affect the nervous systems of horses and may cause cancer in rodents; the trichecenes, which are most strongly associated with chronic and fatal toxic effects in animals and humans.

Aflatoxins : **Aflatoxins** are naturally occurring mycotoxins that are produced by *Aspergillus flavus* and *Aspergillus parasiticus*, fungi. The name, aflatoxin, was created around 1960 after the discovery that the source of "Turkey 'X' disease" was *Aspergillus flavus* toxins.

Aflatoxins are toxic and among the most carcinogenic substances known. After entering the body, aflatoxins may be metabolized by the liver to a reactive epoxide intermediate or hydroxylated to become the less harmful aflatoxin M₁



Major types of aflatoxins and their metabolites

At least 14 different types of aflatoxin are produced in nature. [Aflatoxin B₁](#) is considered the most toxic and is produced by both [Aspergillus flavus](#) and [Aspergillus parasiticus](#).

- Aflatoxin B₁ & B₂, produced by *Aspergillus flavus* and *A. parasiticus*
- Aflatoxin G₁ & G₂, produced by *Aspergillus parasiticus*
- Aflatoxin M₁, metabolite of aflatoxin B₁ in humans and animals (exposure in [ng](#) levels may come from a mother's milk)
- Aflatoxin M₂, metabolite of aflatoxin B₂ in milk of cattle fed on contaminated foods
- Aflatoxicol
- Aflatoxin Q₁ (AFQ₁), major metabolite of AFB₁ in [in vitro](#) liver preparations of other higher vertebrates^L

The native habitat of *Aspergillus* is in soil, decaying vegetation, [hay](#), and grains undergoing microbiological deterioration, and it invades all types of organic substrates whenever conditions are favorable for its growth.

Foods Associated with Foodborne Illness

- Raw foods of animal origin, that is, raw meat and poultry, raw eggs, unpasteurized milk, and raw shellfish are the most likely to be contaminated.
- Fruits and vegetables can also be contaminated with animal waste when manure is used to fertilize produce in the field, or unclean water is used for washing the produce.

- Raw sprouts are particularly concerning because the conditions under which they are sprouted are ideal for growing microbes.
- Unpasteurized fruit juices or cider can also be contaminated if there are pathogens on the fruit that is used to make it.
- Any food item that is touched by a person who is ill with vomiting or diarrhea, or who has recently had such an illness, can become contaminated. When these food items are not subsequently cooked (e.g., salads, cut fruit) they can pass the illness to other people.

Conclusion:

(CDC) estimates that each year roughly 1 out of 6 Americans (or 48 million people) gets sick, 128,000 are hospitalized, and 3,000 die from foodborne diseases. An outbreak which occurred in the UK in 1960 caused the death of 100,000 turkeys which had consumed aflatoxin-contaminated peanut meal.

Many different disease-causing microbes or pathogens can contaminate foods, so there are many different types of food borne illnesses. Most food borne diseases are infections caused by a variety of bacteria, viruses, and parasites. Symptoms vary depending on the cause.

- Waterborne illnesses can cause a variety of symptoms. While diarrhea and vomiting are the most commonly reported symptoms of waterborne illness, other symptoms can include skin, ear, respiratory, or eye problems. Raw foods of animal origin, that is, raw meat and poultry, raw eggs, unpasteurized milk, and raw shellfish, fruits and vegetables . Raw sprouts are particularly concerning because the conditions under which they are sprouted are ideal for growing microbes.

