BM 306
Food and Dairy Microbiology

Unit 5: Foodborne Diseases

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Introduction

- Foodborne diseases are the diseases resulting from the consumption of contaminated (with microorganisms or chemicals/toxins) foodstuffs.
- The contamination of food may occur at any stage in the process from food production to consumption ("farm to fork") and can result from environmental contamination, including pollution of water, soil or air.
- Food contamination with pathogenic microorganisms, such as bacteria, viruses and parasites, have acute effects on human health.
- However, chronic and in some cases acute, food-borne illness may also be caused by the presence of various chemical substances including residues of pesticides and veterinary drugs, unlawful food additives, mycotoxins, bio toxins and radionuclides that enter the food intentionally or unintentionally.

Classification of Foodborne Disease

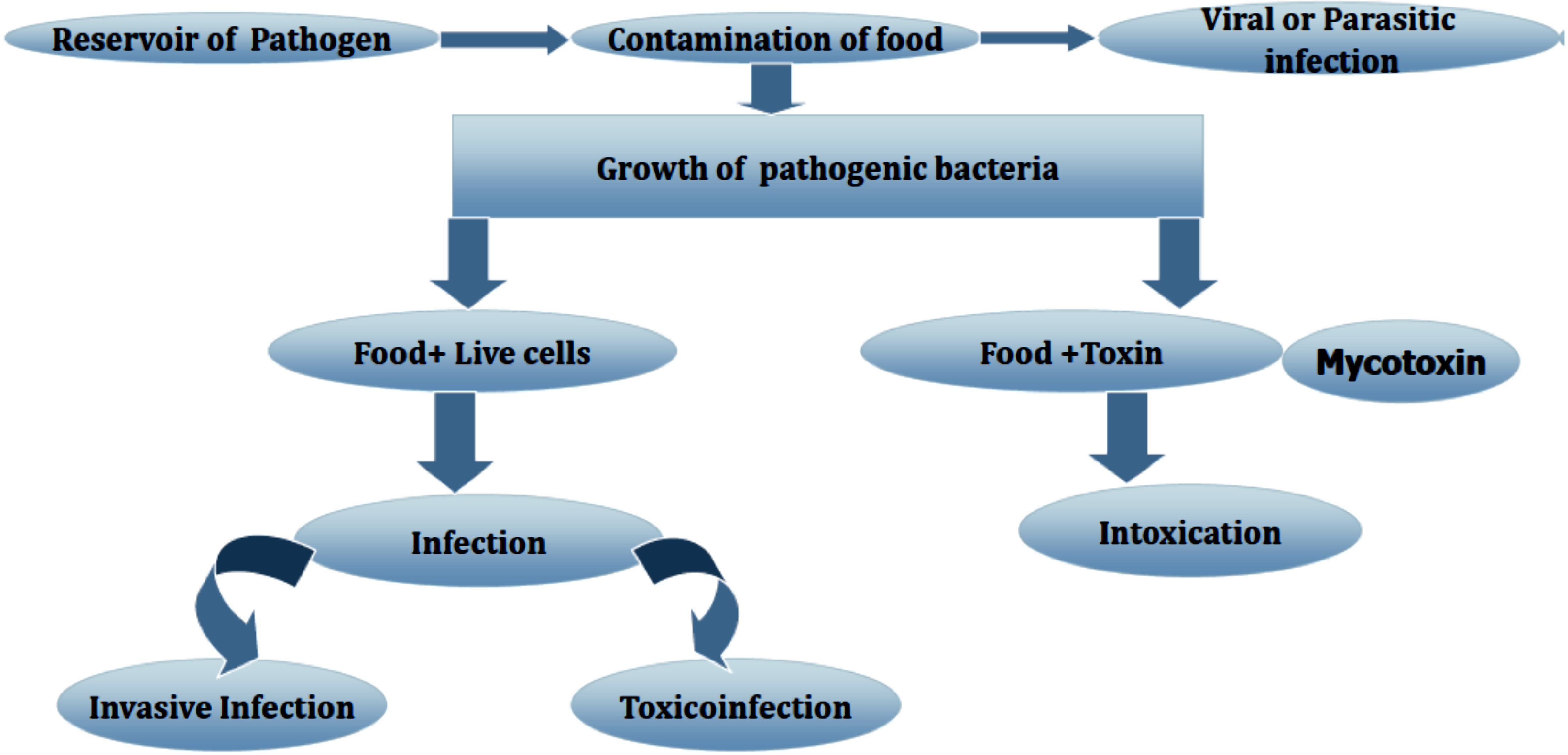
Food borne diseases are classified into-

1. Food borne infection: caused due to the-

- Entrance of pathogenic microorganisms contaminating food into the body.
- Body reacts by raising temperature e.g.- fever
- Longer incubation period.

2. Food borne intoxications: Caused by consumption of food containing bio-toxicants, metabolic products, poisonous substance

Events of Foodborne Diseases



Main causes of food borne disease

- **Cross Contamination** - occurs when microorganisms are transferred from one surface or food to another.
- **Time temperature abuse** – Happens when the food is exposed to Temperature Danger Zone (41^0F – 140 ^{0}F) for more than 4 hrs.
- **Poor personnel hygiene** – Food handlers are carriers of disease causing bacteria. Food service personnel can contaminate food

Types of Food Contaminants

- **Biological Contaminants:** A microbial contaminant that may cause a food borne illness (bacteria, viruses, fungi, parasites, biological toxins).

  Examples: Sea food toxins ,Mushroom toxins

- **Chemical Contaminant:** A chemical substance that can cause food borne illness. Substances normally found in restaurant.

  Examples: Toxic metals, Pesticides

- **Physical Contaminants:** Any foreign object that accidentally find its way into food.

  Examples: Hair, Staple wire, Dust

Biological Contaminants

Bacterial	Viral	Fungal	Parasitic
• Botulism • E-coli infection • Salmonellosis • Shigellosis • Listeriosis • Staphylococcal Illness	• Hepatitis-A • Norwalk virus • Rota virus	• Yeast • Mold	• Giardiasis • Cyclosporiasis • Trichonosis

Food Intoxications

- Food intoxication is a form of food-borne illness caused by ingesting exotoxins made by organisms such as bacteria, fungi etc. or by consuming the foods that are naturally toxic to humans and animals.
- Onset of illness is usually very rapid with food intoxication and people can become very sick.
- Treatment varies, depending on the toxin involved, but can include administrating medications, providing the patient with fluids, and offering other supportive care to help patients recover.

Some Organisms and their toxins

Organism	Toxin
Bacteria	Botulinum toxin, Staphylococcus toxin
Fungi	Afalatoxin, Mycotoxin, Ochratoxin, Patulin
Toxic algae	Okadaic acid
Natural toxins	Histamine, Glycoalcoloids

Staphylococcal food Intoxication

- This is a type of food borne intoxication is caused by consumption of food contaminated with staphylococcal enterotoxins produced by certain strains of *Staphylococcus aureus* while growing in food.
- The organism produces the following five serologically different enterotoxins that are involved in food borne intoxication

The five enterotoxins are:

1. Staphylococcal enterotoxin A(SEA),
2. Staphylococcal enterotoxin B (SEB),
3. Staphylococcal enterotoxin C (SEC),
4. Staphylococcal enterotoxin D (SED),
5. Staphylococcal enterotoxin E (SEE)

Individual strains of *S. aureus* may produce one or more of enterotoxin types while growing in food

Staphylococcal food Intoxication

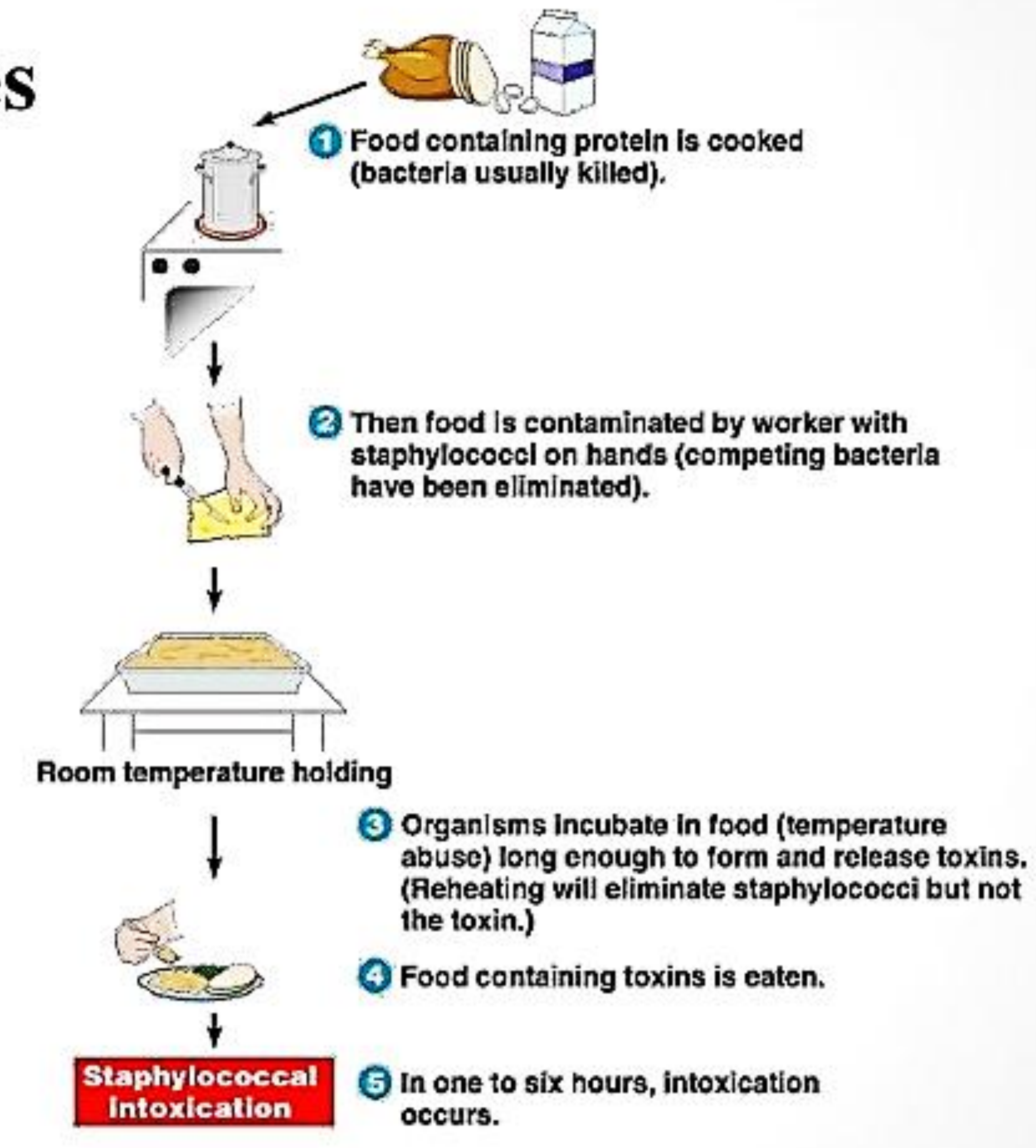
Causative Agent: *Staphylococcus aureus*

- Facultative anaerobic, non-spore forming gram positive cocci bacteria.
- Can grow in cooked or safe foods that are re-contaminated
- Commonly found in human skin, hands, hair, nose and throat.
- It grows at a range temperature between 12-44 ^{o}C (optimum 37 ^{o}C) and pH range 4.0-9.83 (optimum 7.4-7.6).
- Can grow in high salt or high sugar, and lower water activity.
- Growth occurs in an environment containing up to 18% sodium chloride and water activity of 0.86 - 0.88 when growing aerobically and 0.9 under anaerobic conditions.

Toxin Production:

- Toxin production occurs at growth temperature 12-44 ^{o}C, pH 4.2 and salt concentration of ≤10%.
- No toxin production occurs at temperatures below 12 ^{o}C, pH < 4.2 and > 10 % salt.

Causes



1 Food containing protein is cooked (bacteria usually killed).
2 Then food is contaminated by worker with staphylococci on hands (competing bacteria have been eliminated).
Room temperature holding
3 Organisms incubate in food (temperature abuse) long enough to form and release toxins. (Reheating will eliminate staphylococci but not the toxin.)
4 Food containing toxins is eaten.
Staphylococcal Intoxication
5 In one to six hours, intoxication occurs.

Foods Involved

Properties of food involved:

- High protein content
- Require considerable handling during preparation
- Left at room temperature without subsequent cooking and prior adequate heating

Events which may lead to outbreaks of staphylococcal intoxication:

- Cooking foods rich in protein
- Food handlers have *Staphylococcal* growth on bare hands which may be transmitted to the food
- Organisms incubate in the food long enough to form and release toxins

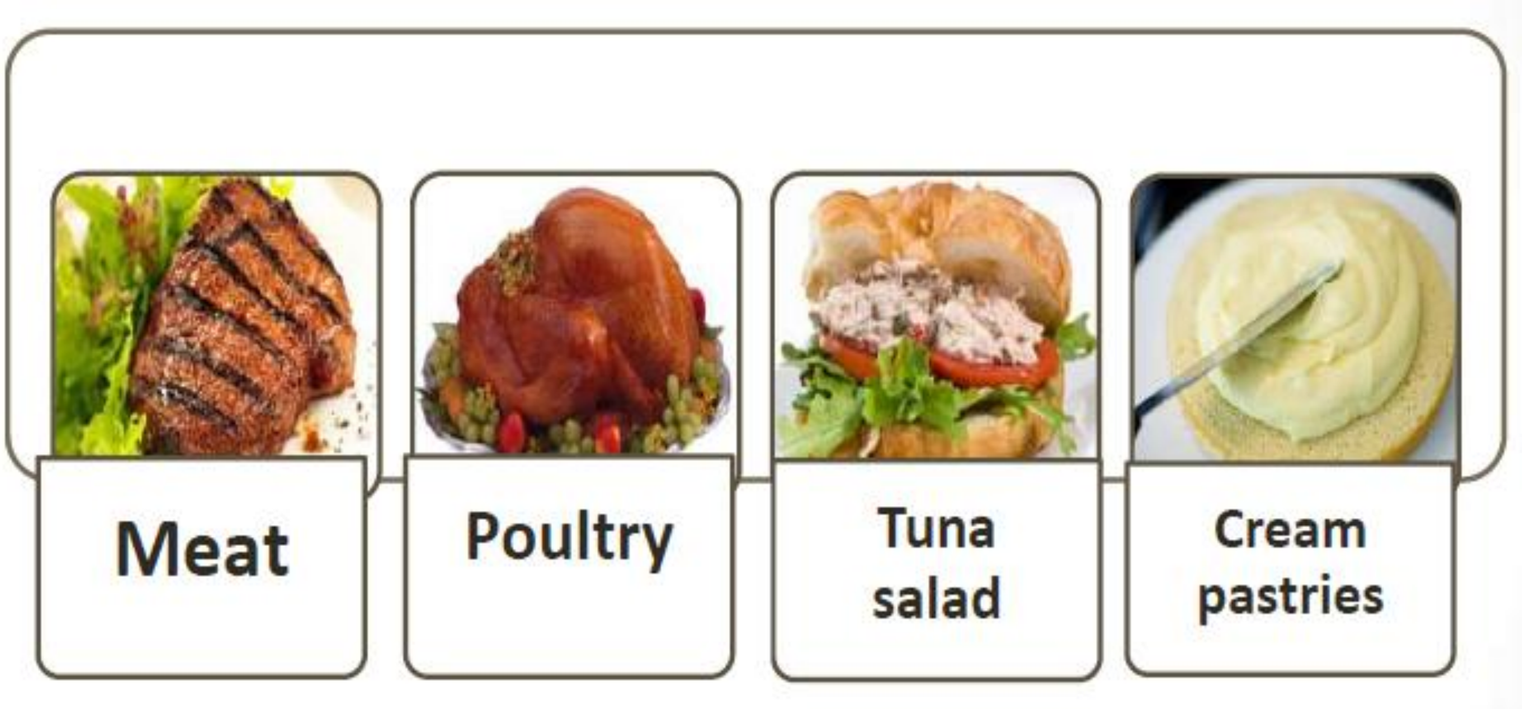
  ***Reheating will eliminate staphylococci but not the toxin**.

  The toxin is heat stable and can survive up to **30 minutes** of boiling. Therefore, once the toxin is formed, it is not destroyed when the food is reheated, although the bacteria will be killed.
- Food with the toxin is ingested.
- Intoxication occurs in one to six hours or days

Common Foods involved

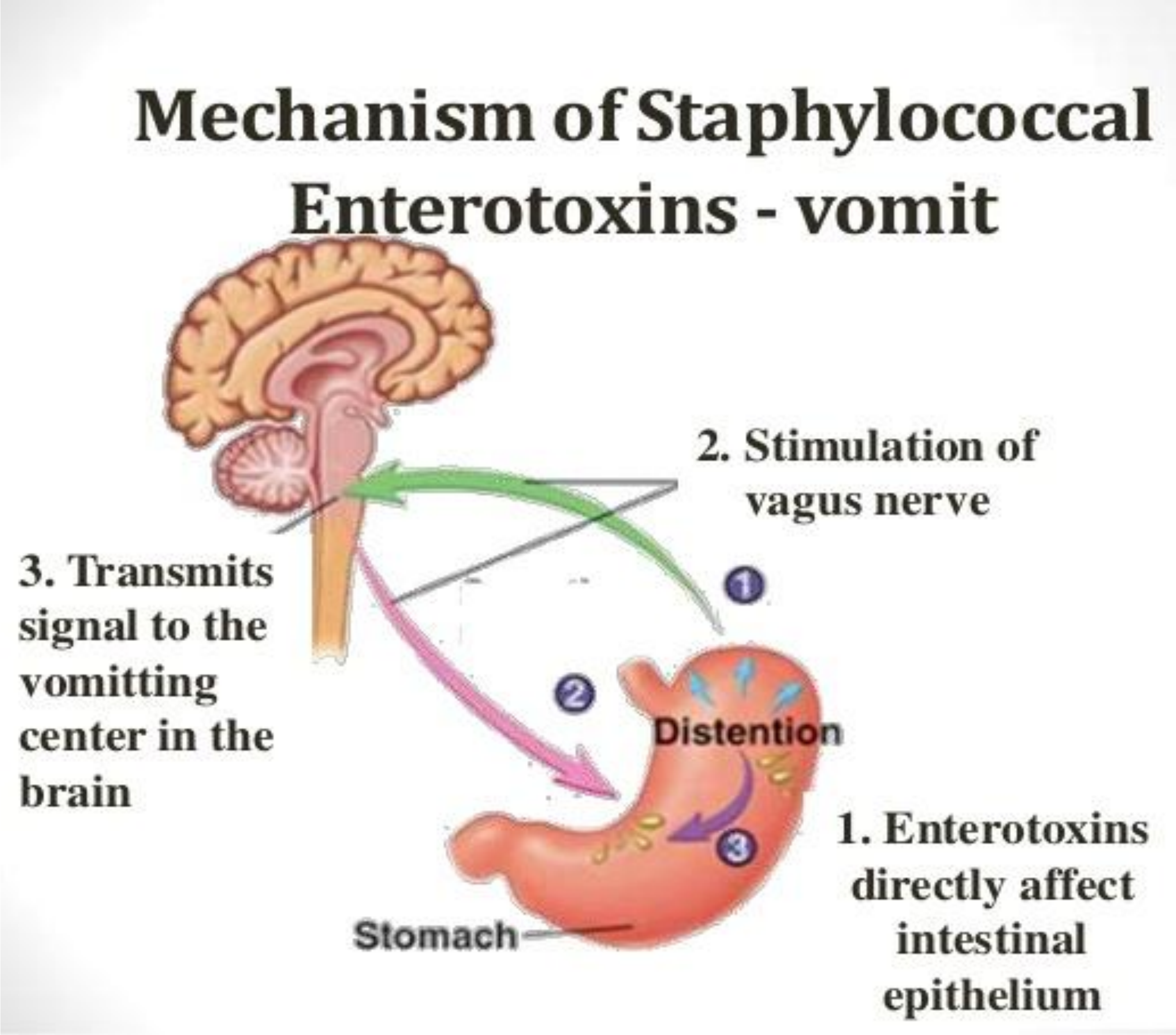
Foods that are prepared by human contacts Left over, meat, eggs, egg products, potato salad, salad dressings.

Milk and milk products including pasteurized milk, yoghurt, chocolate milk, fermented milk, cream filled pastries, poultry, fish, shellfish, meat and meat products, non meat salads, egg and egg products, vegetables and cereal products have been involved.



Symptoms

- Incubation period is 1-6 hrs after consumption of food contaminated with at least 1.0 µg of enterotoxin.
- Clinical signs include salivation, nausea, vomiting, abdominal cramps, sometimes diarrhea.
- It has an attack rate of 5-100%, but fatalities which occurs in children, the old and debilitated victims are rare.
- Duration of illness is 24-72 hrs.
- Dose of 1.0 µg or more is needed to cause disease.


Mechanism of Staphylococcal Enterotoxins - vomit
2. Stimulation of vagus nerve
3. Transmits signal to the vomitting center in the brain
1
2
3
Distention
1. Enterotoxins directly affect intestinal epithelium
Stomach

Staphylococcal penetrate the gut lining → Activate local and systemic immune response → Release inflammatory mediators → **Vomit**

Preventive Measures

- ✓ Wash hands and under fingernails with soap and water before handling and preparing food.
- ✓ Do not prepare food if you have a nose or eye infection.
- ✓ Do not prepare / serve food if you have wounds or skin infection.
- ✓ Keep kitchens and food-serving areas clean and sanitized.
- ✓ If food is prepared more than two hours before serving:
    - ✓ Keep hot foods (> 140 F)
    - ✓ Keep cold foods (≤ 40 F)
- ✓ Store cooked food in a wide, shallow container and refrigerate as soon as possible.
- ✓ Wash fresh fruits and vegetables
- ✓ Shop safely. Bag raw meat, poultry, or fish separately from other food items

Food Intoxications

(To be continued...)