

# **MICROBIOLOGY**

## **Food poisoning & cholera**

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# Bacterial infections of GIT

## Classification of GIT associated pathogens

### Gastroenteritis/Food poisoning

*S. aureus*  
*C. botulinum*  
*C. perfringens*  
*B. Cereus*

### Watery (secretory) diarrhea

*V. cholera*  
ETEC  
EPEC

### Cell invasion

*Shigella*  
*Nontyphoidal Salmonellosis*  
EHEC  
EIEC

### Antibiotic associated diarrhea

*C. difficile*

### Cell invasion and bacteremia

*C. Jejuni*  
*Salmonella typhi*

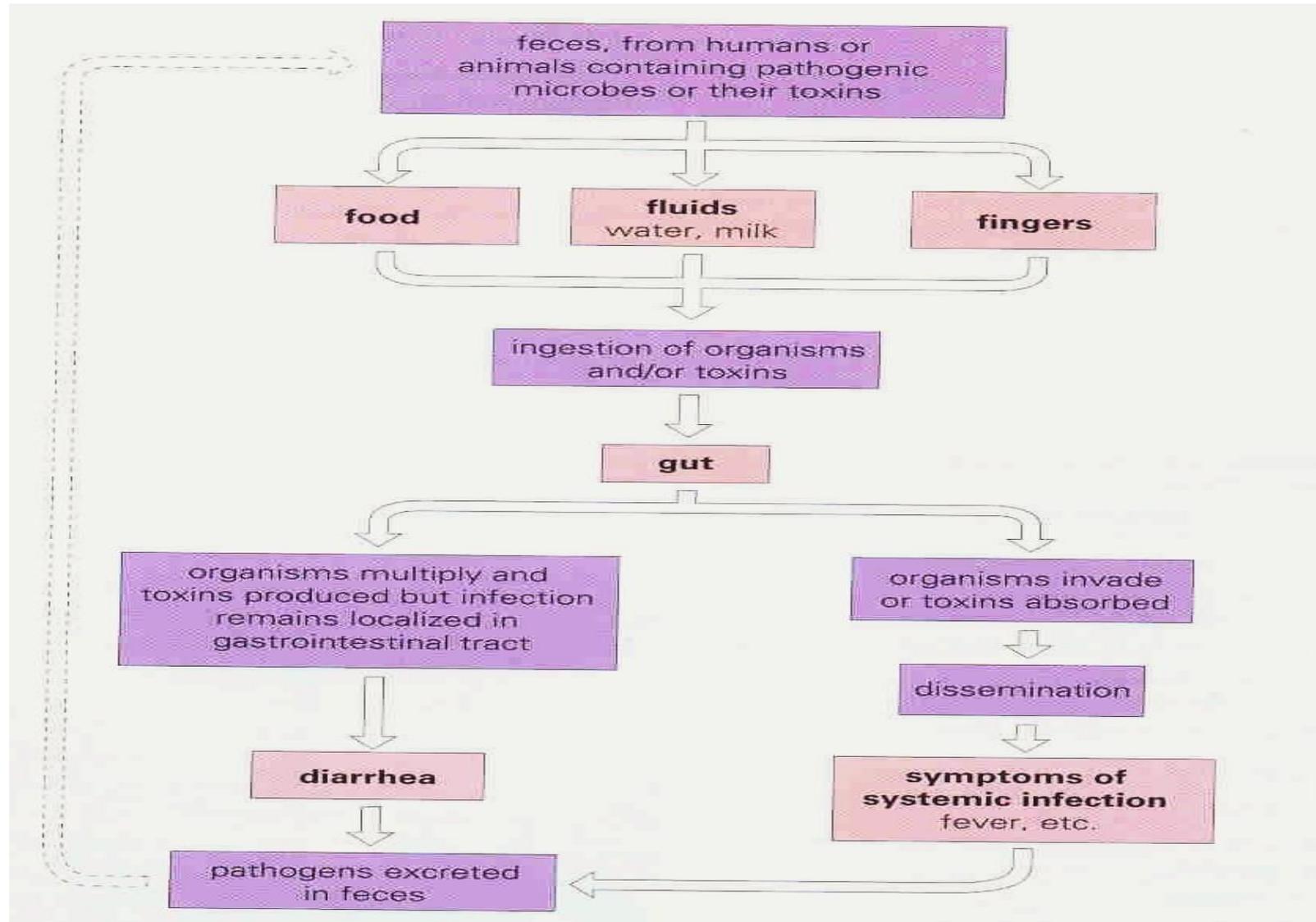
### Gastritis and ulcers

*H. pylori*

# Bacterial infections of GIT

## Introduction

### General mechanism of GIT infection



# Gastroenteritis/Food poisoning

*S. aureus*

*C. botulinum*

*C. perfringens*

*B. Cereus*



# Gastroenteritis/ Food Poisoning

## General characteristics of food poisoning

- Inflammation of GI tract
- Occurs due to consumption of food containing bacteria or their toxins
- Acute onset
- Self limiting

# Gastroenteritis/ Food Poisoning

## *Staphylococcus aureus*

- *S. aureus* is a gram positive cocci, catalase and oxidase positive
- It is a common bacterium found on the skin and in the anterior nares of up to 25% of healthy people and animals
- Bakery, meat, poultry, egg products, mayonnaise-based salads, cream-filled pastries and cakes, and other dairy products.

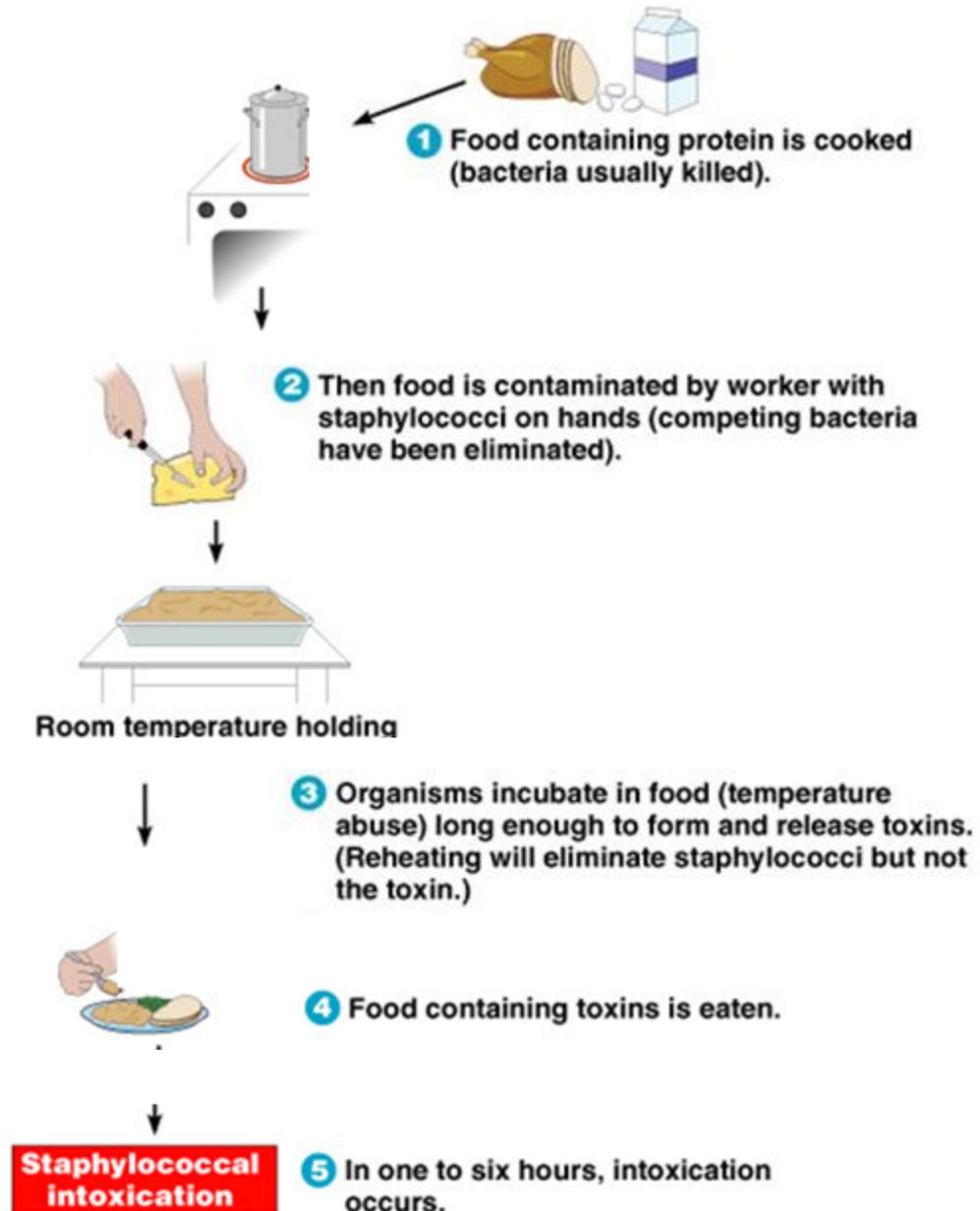


# Gastroenteritis/ Food Poisoning

## *Staphylococcus aureus*

### Mechanism of intoxication

Food contamination is either from dirty hands or through coughing or sneezing into foods that are ready to eat.

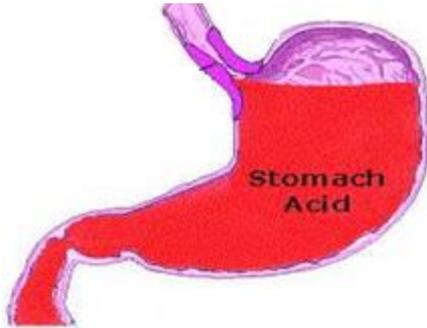


# Gastroenteritis/ Food Poisoning

## *Staphylococcus aureus*

### Prosperities of staphylococcal enterotoxin

1. Resistant to gastric proteases



2. Resistant to heat (100°C for 30 minutes)



3. Stable at a wide pH range

# Gastroenteritis/ Food Poisoning

## *Staphylococcus aureus*

### Associated clinical conditions & the mode of action

#### Vomiting

By stimulating neural receptors in the intestine rather than acting on the medulla directly

#### Diarrhea

Electrolyte imbalance across the mucosa which interferes with water absorption



# Gastroenteritis/ Food Poisoning

## *Staphylococcus aureus*

### Associated clinical conditions & the mode of action

#### Clinically:

- Short incubation period of 1-6 hrs
- Nausea
- Vomiting
- Diarrhea
- Loss of appetite
- Severe abdominal cramps
- Mild fever
- Symptoms may last 12 hrs -2 days on average



# Gastroenteritis/ Food Poisoning

## *Staphylococcus aureus*

### Diagnosis

- Clinically
- Detection of toxin (precipitin test) or bacteria in suspected food

### Treatment

- Usually self limiting
- Rehydrating fluids
- Controlling fever (if any)
- Occasionally hospitalization, particularly when infants, elderly or debilitated people are concerned

# Gastroenteritis/ Food Poisoning

## *Staphylococcus aureus*

### Control

- Hygienic measures
- Do not prepare food if you have a nose, eye, or skin infections
- Keep kitchens and food-serving areas clean and sanitized.
- If food is to be stored longer than two hours, keep hot foods hot (over 60°C) and cold foods cold (4°C or under).
- Store cooked food in a wide, shallow container and refrigerate as soon as possible.

# Gastroenteritis/ Food Poisoning

## *Bacillus cereus*

### Characteristics

- Large Gram-positive bacillus, motile, non-encapsulated
- Resistant to penicillin
- Resistant to heat, light, drying and radiation
- Psychrotrophic (Germination and growth between 10 and 50 °C)

### Epidemiology

Spores are present in

- Decaying organic matter
- Fresh and marine waters
- The intestinal tract of invertebrates, from which soil and food products may become contaminated as vegetables
- Most raw foods contain spores (dried herbs, spices and dehydrated foods)
- Human can be transiently carrier of spores (14-43%)

# Gastroenteritis/ Food Poisoning

## *Bacillus cereus*

### Clinically

Two illnesses caused by two different strains:

#### 1- The diarrheal illness associated strain:

- Ingestion of spores in contaminated meat, fish, and vegetables
- The diarrhea is caused by in vivo production of a heat-labile enterotoxin
- longer incubation (6-24 hours)
- Watery diarrhea, abdominal cramps
- Vomiting (25%)
- Duration of illness ranges from 20-36 hours, with a median of 24 hours
- Similar *C. perfringens*



# Gastroenteritis/ Food Poisoning

## *Bacillus cereus*

### 2- The emetic illness associated strain :

- 95% of cases are associated with rice dishes (Fried Rice Syndrome)
- Also linked with raw starchy foods such as pasta, potatoes, pastries and noodles)
- Caused by preformed toxin similar to *S. aureus* enterotoxin
- Short incubation period (1-6 hours)
- Vomiting and abdominal cramps
- Diarrhea (30 % of cases)
- duration of illness ranges from 8-12 hours

In both types fever is uncommon and disease is usually mild and self-limited



# Gastroenteritis/ Food Poisoning

## *Bacillus cereus*

### Control

- By proper cooling and storage of food
- Ideally, all dishes should be freshly prepared and eaten. If not, then fridge and reheat thoroughly before serving
- Rice, in particular, should not be stored for long periods above 10°C.

### Treatment

- Oral rehydration
- Occasionally, intravenous fluid with severe dehydration and vomiting
- Antibiotics are not indicated

**(*B. cereus* = Be serious not to give antibiotics)**

### Diagnosis

By the isolation of *B. cereus* from the implicated food, but such testing is often not done because the illness is relatively harmless and usually self-limiting

# Gastroenteritis/ Food Poisoning

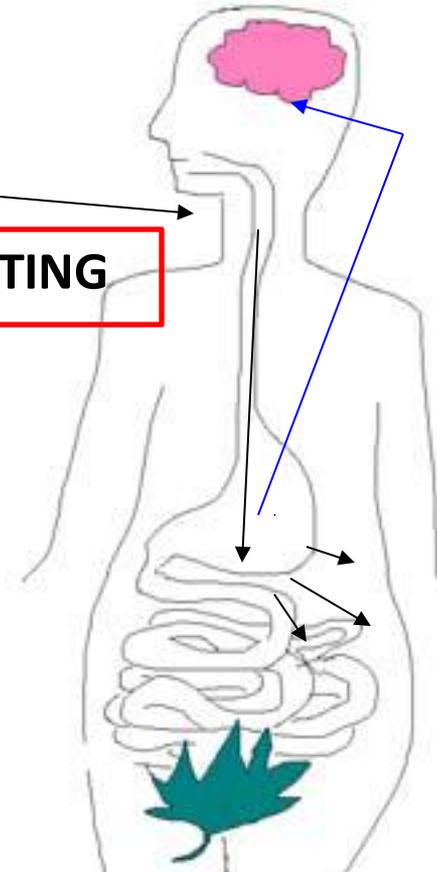
*Staphylococcus aureus* & *Bacillus cereus*

Short Incubation Period: 1-6 h



Bacterial enterotoxins

VOMITING



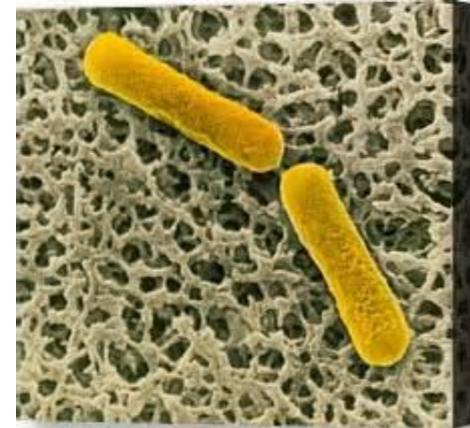
+/- DIARRHOEA

# Gastroenteritis/ Food Poisoning

## *Clostridium botulinum*

### Special identification features

Rod-shaped, Gram positive, obligate anaerobic, spore-forming. (Botulus = Latin for sausage)



### Distribution

- Ubiquitous
- Commonly found in soil and marine sediments throughout the world
- Since it is found in the soil, it may contaminate vegetables

### Specific conditions for germination

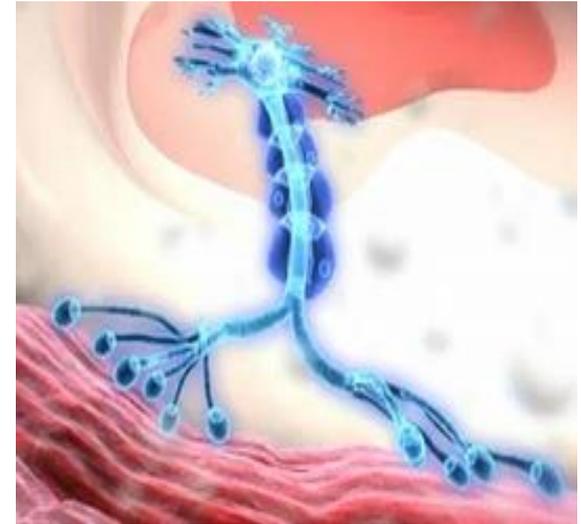
- Anaerobic conditions (canned food)
- Warmth (10-50°C)
- Mild alkalinity (provided by vegetables as green beans, and mushroom)

# Gastroenteritis/ Food Poisoning

## *Clostridium botulinum*

### **Botulinium Neurotoxins**

- Seven different types: A through G
- All cause flaccid paralysis
- Only a few nanograms can cause illness
- The most lethal known toxin
- Destroyed by boiling



### **Botulinium toxin mode of action**

Neurotoxin production > stomach absorption > circulation > neuromuscular junction (NMJ) > inhibition of acetylcholine release at the neuromuscular junction > flaccid descending motor paralysis

# Gastroenteritis/ Food Poisoning

## *Clostridium botulinum*

### Foodborne botulism

- Most common from home-canned foods
  - ✓ green beans, beets, corn, baked potatoes, and garlic
- Onset : 18 to 36 hours after exposure (range, 6 hours to 8 days)
- Early: nausea, vomiting, weakness, dizziness but no fever
- Late: double vision, difficulty in swallowing, and speaking
- In severe cases, death due to respiratory muscle paralysis

# Gastroenteritis/ Food Poisoning

## Diagnosis

- The initial diagnosis should be made on the basis of history and physical findings
- Serum, stools and suspected food should be tested for the presence of organism or toxin

## Treatment:

Gastric wash

Antitoxin (A, B, E)

Supportive: ICU and respiratory support, wound cleaning and debridement

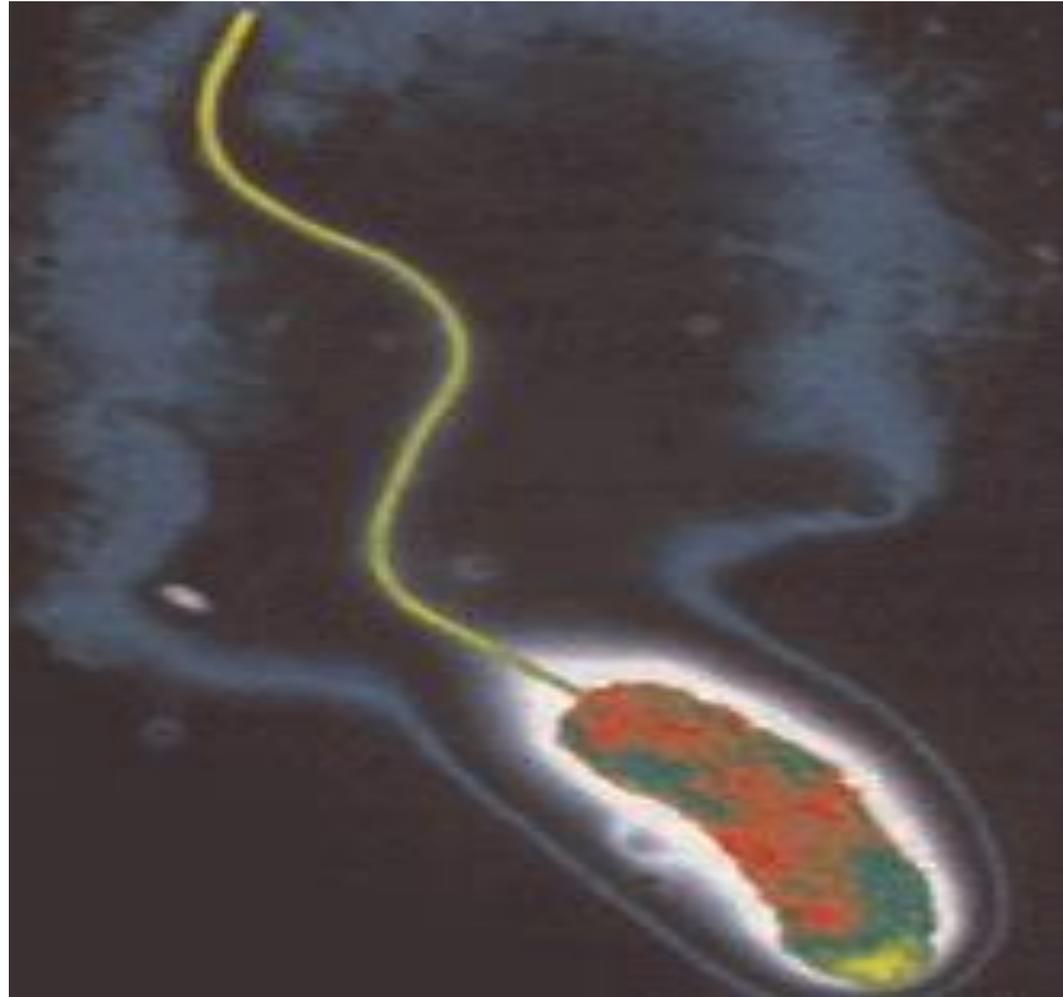
## Prevention:

Proper cooking and heating of food

Avoid suspicious canned food

Proper processing, preservation and canning of food

# *Vibrio Cholera*



# Watery (secretory) diarrhea

*V. cholera*

ETEC

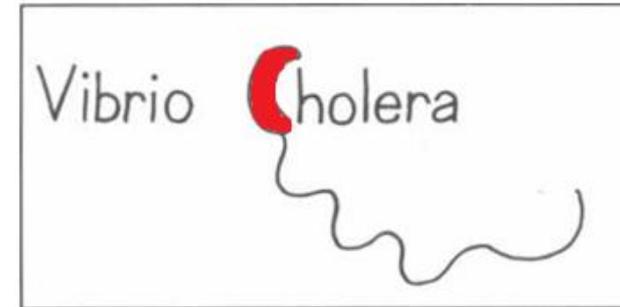
EPEC



# *Vibrio Cholera*

## **Bacteriology**

- Curved, Gram-negative rods
- Highly motile (single polar flagellum)
- Optimum growth at alkaline pH (8-8.5)



## **Habitat**

- It normally lives in water attached to the outer surfaces of crustaceans
- Crustaceans: crabs, lobsters and shrimp

## **Infective\_dose**

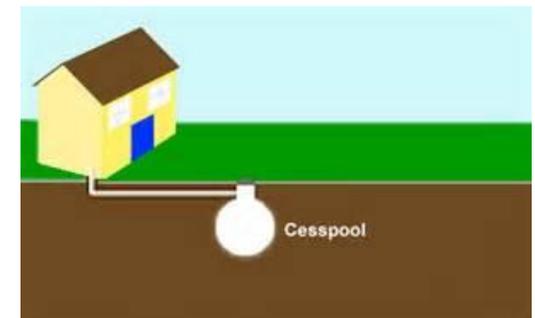
must ingest > 10 million organisms to get colonization of intestine using pili (no invasion)

# *Vibrio Cholera*



## **Transmission**

- 1- contaminated water and food
- 2- consumption of raw or undercooked seafood
- 3- contaminated vegetables from fields fertilized with cesspools
- 4- Not transmissible from person-to-person



# Vibrio Cholera

## Classification

### Serological classification

Based on Lipopolysaccharide (LPS)

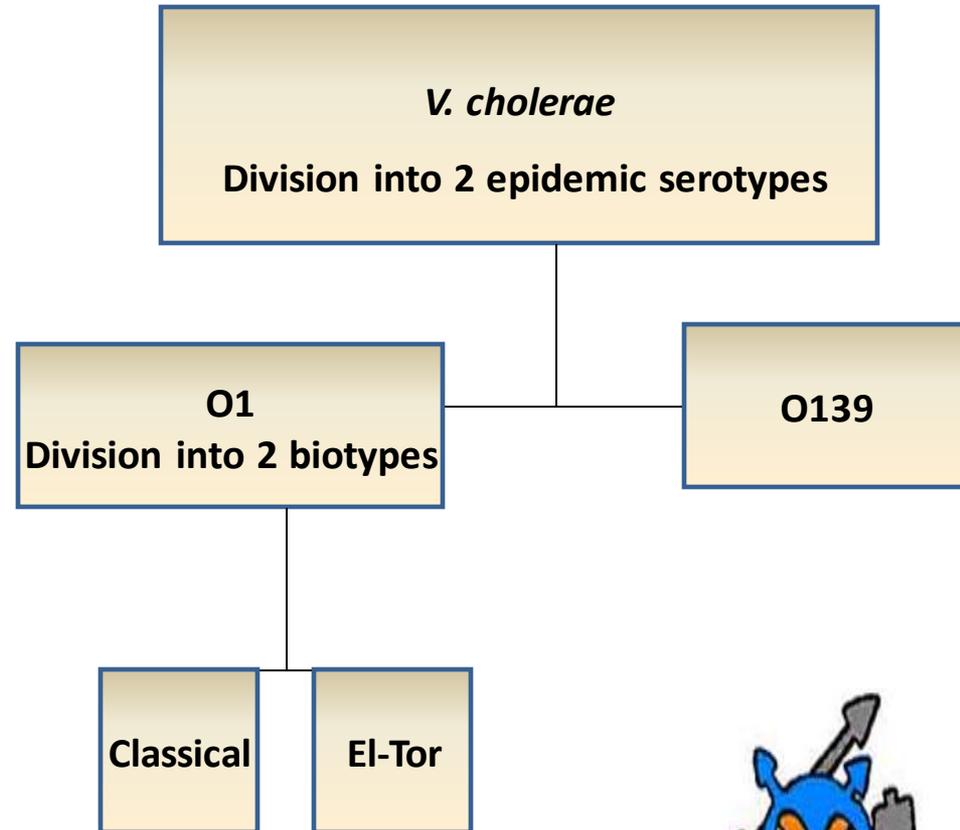
O antigen structure

1- Toxigenic strains

- O1 (Classical and EL Tor strains)
- O139
- Produce cholera toxin

2- Nontoxigenic strains (>150 exist):

- Called nontoxigenic O1 strains
- Rarely associated with epidemic
- Do not produce cholera toxin
- Produced other virulence factors associated with diarrhea



# *Vibrio Cholera*

## Clinically

- **Watery diarrhea** flecked with mucus and dead cells and resembles rice water (rice-water stool).
- Nausea, **vomiting**, and **muscle cramps**
- **Dehydration**, a dry mouth, extreme thirst, low blood pressure, and an irregular heartbeat (arrhythmia).
- **Shock.**
- **Visible Symptoms** : sunken eyes, poor skin turgor (elasticity), and little or no urine output.



# *Vibrio Cholera*

## Treatment:

- The course of treatment is decided by the degree of dehydration
  - Oral Rehydration
    - ✓ 80% of cases can be treated through oral rehydration salts
    - ✓ Used when the dehydration is less than 10% of body weight
  - Intravenous Rehydration

Used in patients who lost more than 10% of body weight from dehydration or are unable to drink due to vomiting
  - Antimicrobial Therapy
    - ✓ antibiotics are reserved for more severe cholera infections
    - ✓ antibiotics can diminish duration of diarrhea, reduce volume of rehydration fluids needed, and shorten duration of *V. cholera* excretion
- No antitoxin

# *Vibrio Cholera*

## Diagnosis

- Rice-water diarrhea
- Gram negative curved rods
- Vibrios often detected by dark field or phase contrast microscopy of stool
- Isolation of bacteria using special media
- Additional methods including PCR

## Prevention:

- Hygiene and clean water
- Avoid eating raw or undercooked fish and shellfish
- Vaccine: Oral killed vaccine for O1 Ag type