

# Foodborne Illness (Poisoning/Infection by toxins, chemicals & microbes)

Causative Agents	Source and Clinical Features	Pathogenesis	Diagnosis and Treatment
Staphylococci	Improperly stored foods with high salt or sugar content favour growth of staphylococci Intense vomiting and watery diarrhoea start 1-4 hours after ingestion and last as long as 24-48 hours.	Enterotoxin acts on receptors in gut that transmit impulses to medullary centers.	Symptomatic treatment
<i>B cereus</i>	Contaminated fried rice (emetic). Meatballs (diarrheal) Emetic: Duration is 9 hours, vomiting and cramps Diarrheal: Lasts for 24 h Mainly vomiting after 1-6 hours and mainly diarrhoea after 8-16 hours after ingestion; lasts as long as 1 day	Emetic enterotoxin (short incubation and duration) - Poorly understood Diarrheal enterotoxin (long incubation and duration) - Increasing intestinal secretion by activation of adenylate cyclase in intestinal epithelium	Symptomatic treatment
<i>C perfringens</i>	Inadequately cooked meat, poultry, or legumes Acute onset of abdominal cramps with diarrhoea starts 8-24 hours after ingestion. Vomiting is rare. It lasts less than 1 day. Enteritis necroticans associated with <i>C perfringens</i> type C in improperly cooked pork (40% mortality)	Enterotoxin produced in the gut, and food causes hypersecretion in the small intestine.	Culture of clostridia in food and stool Symptomatic treatment
<i>C botulinum</i>	Canned foods (e.g., smoked fish, mushrooms, vegetables, honey) Descending weakness and paralysis start 1-4 days after ingestion, followed by constipation. Mortality is very high.	Toxin absorbed from the gut blocks the release of acetylcholine in the neuromuscular junction.	Toxin present in food, serum, and stool. Respiratory support Intravenous trivalent antitoxin from CDC
<i>Listeria monocytogenes</i>	Raw and pasteurized milk, soft cheeses, raw vegetables, shrimp Systemic disease associated with bacteraemia Intestinal symptoms precede systemic disease Can seed meninges, heart valves, and other organs Highest mortality among bacterial food poisonings	Highly motile, heat-resistant, gram-positive organism	CSF or blood culture Must treat with antibiotics if bacteraemic
Enterotoxigenic <i>E coli</i> (e.g., traveller's diarrhoea)	Contaminated water and food (e.g., salad, cheese, meat) Acute-onset watery diarrhoea starts 24-48 hours after ingestion. Vomiting and abdominal cramps may be present. Lasts 1-2d	Enterotoxin causes hypersecretion in small and large intestine via guanylate cyclase activation.	Supportive treatment No antibiotics
Enterohaemorrhagic <i>E coli</i> (e.g., <i>E coli</i> O157:H7)	Improperly cooked hamburger meat and previously spinach Commonest pathogen in bloody diarrhoea starts 3-4d after ingestion. Usually progresses from watery to bloody diarrhoea. It lasts for 3-8 days May be complicated by HUS or TTP	Cytotoxin results in endothelial damage and leads to platelet aggregation and microvascular fibrin thrombi	Diagnosis with stool culture Supportive treatment No antibiotics
Enteroinvasive <i>E coli</i>	Contaminated imported cheese Usually watery diarrhoea (some may present with dysentery)	Enterotoxin produces secretion Shiga-like toxin facilitates invasion.	Supportive treatment No antibiotics
Enterotoxigenic <i>E coli</i>	Implicated in traveller's diarrhoea in developing countries Can cause bloody diarrhoea	Bacteria clump on the cell surfaces	Ciprofloxacin may shorten duration and eradicate the organism
<i>V cholera</i>	Contaminated water and food Large amount of nonbloody diarrhoea starts 8-24 hours after ingestion. It lasts for 3-7 days.	Enterotoxin causes hypersecretion in small intestine. Infective dose usually is $10^7$ - $10^9$ organisms.	Positive stool culture Prompt replacement of fluids and electrolytes (oral rehydration solution) Tetracycline (or fluoroquinolones) shortens the duration of symptoms and excretion of <i>Vibrio</i> .

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<i>V. parahaemolyticus</i>	Raw and improperly cooked seafood (i.e., molluscs and crustaceans) Explosive watery diarrhoea starts 8-24 hours after ingestion. It lasts for 3-5 days.	Enterotoxin causes hypersecretion in small intestine. Haemolytic toxin is lethal. Infective dose usually is $10^7$ - $10^9$ organisms.	Positive stool culture Prompt replacement of fluids and electrolytes Sensitive to tetracycline, but unclear role for antibiotics
<i>V. vulnificus</i>	Wound infection in salt water or consumption of raw oysters Can be lethal in patients with liver disease (50% mortality)	Polysaccharide capsule Growth correlates with availability of iron (esp. transferrin saturation >70%)	Culture of characteristic bullous lesions or blood Immediate antibiotics if suspected (e.g., doxycycline and ceftriaxone)
<i>C. jejuni</i>	Domestic animals, cattle, chickens Faecal-oral transmission in humans Foul-smelling watery diarrhoea followed by bloody diarrhoea Abdominal pain and fever also may be present. It starts 1-3 days after exposure and recovery is in 5-8 days.	Uncertain about endotoxin production and invasion	Culture in special media at 42°C Erythromycin for invasive disease (fever)
<i>Shigella</i>	Potato, egg salad, lettuce, vegetables, milk, ice cream, and water Abrupt onset of bloody diarrhoea, cramps, tenesmus, and fever starts 12-30 hours after ingestion. Usually self-limited in 3-7 days	Organisms invade epithelial cells and produce toxins. Infective dose is $10^2$ - $10^3$ organisms. Enterotoxin-mediated diarrhoea followed by invasion (dysentery/colitis)	Polymorphonuclear leukocytes (PMNs), blood, and mucus in stool Positive stool culture Oral rehydration is mainstay. Trimethoprim-sulfamethoxazole (TMP-SMX) or ampicillin for severe cases No opiates
<i>Salmonella</i>	Beef, poultry, eggs, and dairy products Abrupt onset of moderate-to-large amount of diarrhoea with low-grade fever; in some cases, bloody diarrhoea Abdominal pain and vomiting also present, beginning 6-48 hours after exposure and lasts 7-12 days	Invasion but no toxin production	Positive stool culture Antibiotic for systemic infection
<i>Yersinia</i>	Pets; transmission in humans by faecal-oral route or contaminated milk or ice cream Acute abdominal pain, diarrhoea, and fever (enterocolitis) Incubation period not known Polyarthritits and erythema nodosum in children May mimic appendicitis	Gastroenteritis and mesenteric adenitis Direct invasion and enterotoxin	PMNs and blood in stool Positive stool culture No evidence that antibiotics alter the course but may be used in severe infections
<i>Aeromonas</i>	Untreated well or spring water Diarrhoea may be bloody. May be chronic up to 42 days in the United States	Enterotoxin, haemolysin, and cytotoxin	Positive stool culture Fluoroquinolones or TMP/SMX for chronic diarrhoea
Parasitic Food Poisoning	Source and Clinical Features	Pathogenesis	Diagnosis and Treatment
<i>E. histolytica</i>	Contaminated food and water 90% asymptomatic 10% dysentery Minority may develop liver abscesses	Invasion of the mucosa by the parasites	Criterion standard is colonoscopy with biopsy Ova and parasites may be seen in the stool but has low sensitivity Luminal amebicides (e.g., paromomycin) Tissue amebicides (e.g., metronidazole)
<i>G. lamblia</i>	Contaminated ground water Faecal-oral transmission in humans Mild bloody diarrhoea with nausea and abdominal cramps starts 2-3 days after ingestion; lasts for 1 week May become chronic	Unknown Highest concentration in the distal duodenum and proximal jejunum	Initial diagnostic test is stool ELISA Duodenal aspiration or small bowel biopsy Cyst in the stool Metronidazole

Seafood/Shellfish Poisoning	Source and Clinical Features	Pathogenesis	Diagnosis and Treatment
Paralytic shellfish poisoning	Temperate coastal areas Source - Bivalve molluscs Onset usually is 30-60 minutes. Initial symptoms include perioral and intraoral paraesthesia. Other symptoms include paraesthesia of the extremities, headache, ataxia, vertigo, cranial nerve palsies, and paralysis of respiratory muscles, resulting in respiratory arrest.	Fish acquires toxin-producing dinoflagellates	General observation for 4-6 hours Maintain patent airway. Administer oxygen, and assist ventilation if necessary. For recent ingestion, charcoal 50-60 g may be helpful.
Neurotoxic shellfish poisoning	Coastal Florida Source - Molluscs Illness is milder than in paralytic shellfish poisoning.	Fish acquires toxin-producing dinoflagellates	Symptomatic
Ciguatera	Hawaii, Florida, and Caribbean Source - Carnivorous reef fish Vomiting, diarrhoea, and cramps start 1-6 hours after ingestion and last from days to months. Diarrhoea may be accompanied by a variety of neurologic symptoms including paraesthesia, reversal of hot and cold sensation, vertigo, headache, and autonomic disturbances such as hypotension and bradycardia. Chronic symptoms (e.g., fatigue, headache) may be aggravated by caffeine or alcohol	Fish acquires toxin-producing dinoflagellates Toxin increases intestinal secretion by changing intracellular calcium concentration	Symptomatic Anecdotal reports of successful treatment of neurologic symptoms with mannitol 1 g/kg IV
Tetrodotoxin poisoning	Japan Source - Puffer fish Onset of symptoms usually is 30-40 minutes but may be as short as 10 minutes. It includes lethargy, paraesthesia, emesis, ataxia, weakness, and dysphagia. Ascending paralysis occurs in severe cases. Mortality is high.	Neurotoxin is concentrated in the skin and viscera of puffer fish.	Symptomatic
Scombroid	Source - Tuna, mahi-mahi, kingfish Allergic symptoms such as skin flush, urticaria, bronchospasm, and hypotension usually start within 15-90 minutes.	Improper preservation of large fish results in bacterial degradation of histidine to histamine.	Antihistamines (diphenhydramine 25-50 mg IV) H2 blockers (cimetidine 300 mg IV) Severe reactions may require IM adrenaline (0.3-0.5 mL of 1:1000 solution).
Heavy Metal Poisoning	Source	Symptoms	Treatment
Mercury	Ingestion of inorganic mercuric salts	Causes metallic taste, salivation, thirst, discoloration and oedema of oral mucous membranes, abdominal pain, vomiting, bloody diarrhoea, and acute renal failure	Consult a toxicologist. Remove ingested salts by emesis and lavage, and administer activated charcoal and a cathartic. Dimercaprol is useful in acute ingestion.
Lead	Toxicity results from chronic repeated exposure. It is rare after single ingestion.	Common symptoms include colicky abdominal pain, constipation, headache, and irritability. Diagnosis is based on lead level ( $>10$ mcg/dL)	Other than activated charcoal and cathartic, severe toxicity should be treated with antidotes (edetate calcium disodium [EDTA] and dimercaprol).
Arsenic	Ingestion of pesticide and industrial chemicals	Symptoms usually appear within 1 hour after ingestion but may be delayed as long as 12 hours. Abdominal pain, watery diarrhoea, vomiting, skeletal muscle cramps, profound dehydration, and shock may occur.	Gastric lavage and activated charcoal Dimercaprol injection 10% solution in oil (3-5 mg/kg IM q4-6h for 2 d) and oral penicillamine (100 mg/kg/d divided qid for 1 wk)