

What are the main types of bacteria that can cause foodborne illnesses?

How do foodborne bacteria enter human body? What harm do they cause?

Access to sufficient amounts of safe and nutritious food is key to sustaining life and promoting good health.

- Here are some stats about foodborne diseases:
  - Yearly: **>200 diseases** (ranging from **diarrhea to cancer**) cause **~600M illnesses** (550M by diarrhea) and **420K deaths** (230K by diarrhea) (125K in children under 5 years), loss of **33M healthy life years** and **\$110B loss** each year in productivity and medical expenses.
- **Food safety, nutrition and food security are inextricably linked.** Unsafe food creates a vicious cycle of disease and malnutrition, particularly affecting infants, young children, elderly and the sick.
- Foodborne diseases **impede socioeconomic development** by straining health care systems, and harming national economies, tourism and trade.
- Food supply chains now cross multiple national borders. **Good collaboration** between governments, producers and consumers helps ensure food safety.
- Foodborne illnesses are usually **infectious or toxic in nature**, entering the body through contaminated food or water. They can cause severe diarrhea or debilitating infections including meningitis.
- Contamination can be **pathogenic** (bacteria, viruses, and parasites) or **chemical**:
  - Foodborne **pathogens** can cause **severe diarrhea or debilitating infections including meningitis.**
  - **Chemical** contamination can lead to **acute poisoning or long-term diseases**, such as cancer.
- Foodborne diseases may **lead to long-lasting disability and death.**
- Examples of unsafe food include uncooked foods of animal origin, fruits and vegetables contaminated with feces, and raw shellfish containing marine biotoxins.

Now let's look at bacterial foodborne diseases:

<u>Pathogen</u>	<u>Food sources</u>	<u>Symptoms</u>	<u>Remarks</u>
<b>Salomonella</b>	<ul style="list-style-type: none"> <li>• Eggs</li> <li>• Poultry</li> <li>• Other products of animal origin</li> </ul>	<ul style="list-style-type: none"> <li>• Fever</li> <li>• Headache</li> <li>• Nausea</li> <li>• Vomiting</li> <li>• Abdominal pain</li> <li>• Diarrhea</li> </ul>	<ul style="list-style-type: none"> <li>• They are among the <b>most common</b> foodborne pathogens that affect millions of people annually – sometimes with severe and fatal outcomes.</li> </ul>
<b>Campylobacter</b>	<ul style="list-style-type: none"> <li>• Raw milk</li> <li>• Raw/undercooked poultry</li> <li>• Drinking water</li> </ul>		
<b>Enterohaemorrhagic Escherichia coli</b>	<ul style="list-style-type: none"> <li>• Unpasteurized milk</li> <li>• Undercooked meat</li> <li>• Fresh fruits and vegetables</li> </ul>		
<b>Listeria</b>	<ul style="list-style-type: none"> <li>• Unpasteurized dairy products</li> <li>• Various ready-to-eat foods</li> </ul>		

<b>Vibrio cholerae</b>	Contaminated <b>water</b> or food: <ul style="list-style-type: none"> <li>• Rice</li> <li>• Vegetables</li> <li>• Millet gruel</li> <li>• Various types of seafood</li> </ul>	<ul style="list-style-type: none"> <li>• Abdominal pain</li> <li>• Vomiting</li> <li>• Profuse watery diarrhea, which may lead to severe dehydration and possibly death.</li> </ul>	
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- Antimicrobials, such as antibiotics, are essential to treat infections caused by bacteria. However, their overuse and misuse in veterinary and human medicine has been linked to the emergence and spread of resistant bacteria, rendering the treatment of infectious diseases ineffective in animals and humans. Resistant bacteria enter the food chain through the animals (e.g. *Salmonella* through chickens). **Antimicrobial resistance** is one of the main threats to modern medicine.

Now let's look at the other microbes:

<u>Pathogen</u>	<u>Food sources</u>	<u>Symptoms</u>	<u>Remarks</u>
<b>Norovirus</b>		<ul style="list-style-type: none"> <li>• Nausea</li> <li>• Explosive vomiting</li> <li>• Watery diarrhea</li> <li>• Abdominal pain.</li> </ul>	
<b>Hepatitis A virus</b>	<ul style="list-style-type: none"> <li>• Raw or undercooked seafood</li> <li>• Contaminated raw products</li> </ul>	<ul style="list-style-type: none"> <li>• Long-lasting liver disease</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Infected food handlers</b> are often the source of food contamination</li> </ul>

<b>Parasites</b>	<ul style="list-style-type: none"> <li>Some parasites, such as fish-borne trematodes, are only transmitted through food. Others, for example tapeworms like <i>Echinococcus spp</i>, or <i>Taenia solium</i>, may infect people through food or direct contact with animals. Other parasites, such as <i>Ascaris</i>, <i>Cryptosporidium</i>, <i>Entamoeba histolytica</i> or <i>Giardia</i>, enter the food chain via water or soil and can contaminate fresh products.</li> </ul>
<b>Prions</b>	<ul style="list-style-type: none"> <li>Prions, infectious agents composed of protein, are unique in that they are associated with specific forms of <b>neurodegenerative disease</b>. <b>Bovine spongiform encephalopathy (BSE, or "mad cow disease")</b> is a prion disease <b>in cattle</b>, associated with the variant <b>Creutzfeldt-Jakob Disease (vCJD) in humans</b>. Consuming <b>bovine products</b> containing specified risk material, e.g. brain tissue, is the most likely route of transmission of the prion agent to humans.</li> </ul>

Finally, let's look at chemicals affecting food:

<u>Type</u>	<u>Examples</u>	<u>Food sources</u>	<u>Symptoms</u>	<u>Remarks</u>
<b>Naturally occurring toxins</b>	<ul style="list-style-type: none"> <li>Mycotoxins</li> <li>Marine biotoxins</li> <li>Cyanogenic glycosides</li> <li>Toxins occurring in poisonous mushrooms</li> </ul>	<ul style="list-style-type: none"> <li>Staple foods like corn or cereals can contain high levels of mycotoxins, such as aflatoxin and ochratoxin, produced by mould on grain.</li> </ul>	<p>A long-term exposure can:</p> <ul style="list-style-type: none"> <li>Affect the immune system and normal development</li> <li>Cause cancer.</li> </ul>	

<p><b>Persistent organic pollutants (POPs)</b></p>	<ul style="list-style-type: none"> <li>• Dioxins</li> <li>• Polychlorinated biphenyls (PCBs), which are unwanted by-products of industrial processes and waste incineration.</li> </ul>	<ul style="list-style-type: none"> <li>• They are found worldwide in the environment and accumulate in animal food chains.</li> </ul>	<p>Dioxins are highly toxic and can cause:</p> <ul style="list-style-type: none"> <li>• Reproductive and developmental problems</li> <li>• Damage the immune system</li> <li>• Interfere with hormones</li> <li>• Cause cancer</li> </ul>	<ul style="list-style-type: none"> <li>• They are compounds that accumulate in the environment and human body</li> </ul>
<p><b>Heavy metals</b></p>	<ul style="list-style-type: none"> <li>• Lead</li> <li>• Cadmium</li> <li>• Mercury</li> </ul>		<ul style="list-style-type: none"> <li>• Neurological and kidney damage</li> </ul>	<ul style="list-style-type: none"> <li>• Contamination by heavy metal in food occurs mainly through <b>pollution of air, water, and soil.</b></li> </ul>