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CLASSIFICATION OF FOODBORNE PATHOGENS
SOURCES OF CONTAMINATION

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Taxonomic classification
- Prions
- Viruses
- Bacteria
- (Algae, cyanobacteria)
- Fungi
- Protozoa
- Metazoan parasites
- Toxic plants and animals

Classification by mode of pathogenesis

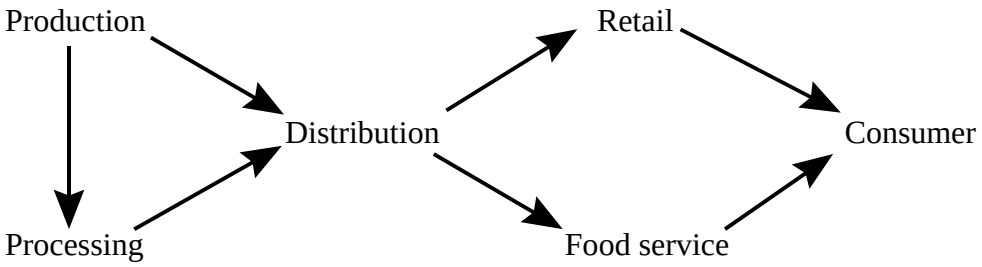
Infectious agents (viable [infectious] agent present in food when ingested; must multiply in host's body to cause disease [incubation period])
- Prions — new variant Creutzfeldt-Jakob disease (vCJD)
- Viruses — hepatitis A, noroviruses, etc.
- Bacteria — *Campylobacter*, *Clostridium perfringens*, *Escherichia coli*, *Listeria*, *Salmonella*, *Shigella*, *Vibrio*, etc.
- Protozoa — *Cryptosporidium parvum*, *Entamoeba histolytica*, *Giardia lamblia*, *Toxoplasma gondii*, etc.
- Metazoan parasites (helminths) — roundworms, tapeworms, flukes

Intoxicating agents (toxic substance present in food when ingested; onset of illness may be rapid)
- Bacteria — *Bacillus cereus*, *Clostridium botulinum*, *Staphylococcus aureus*
- (Algae, cyanobacteria)
- Fungi— *Aspergillus*, *Fusarium*, *Penicillium*, etc.
- Toxic plants and animals — mushrooms, cassava, fugu, etc.

"Exceptional" foodborne diseases
- Allergy — serologic reaction
- Intolerance — enzyme deficiency (abnormal people?)

Idiopathic illnesses
- Acute — "Chinese restaurant syndrome"
- Chronic — cancer, heart disease

Sources of foodborne pathogens



Preharvest
- Inherent toxicants — acorns, cassava, olives, etc.
- Zoonoses — enterohemorrhagic *E. coli*, *Trichinella* sp., (*Brucella* sp., *Coxiella burnetii*, *Mycobacterium bovis*, prions of bovine spongiform encephalopathy [BSE]), etc.
- Field contaminants — *Cryptosporidium parvum*, enterohemorrhagic *E. coli*, *Vibrio parahaemolyticus*, etc.

Harvest or slaughter
- Cross-contamination — *Listeria*, *Salmonella*
- Water — enterohemorrhagic *E. coli*, hepatitis A virus, etc.
- Humans — hepatitis A virus, *Salmonella*, etc.?

Processing
- Problems rare in U.S. at present
- Colonization of facilities by *Listeria*, *Salmonella*
- If bakeries are included, viruses

Storage and distribution — most problems with temperature control, rather than contamination

Retailing and food service — opportunities for human-source contamination: hepatitis A virus, noroviruses, *Shigella*, pathogenic *E. coli* (other than EHEC); cross-contamination with EHEC, *Listeria*, *Salmonella*, etc.

Final preparation and serving — opportunities for human-source contamination: bacteria & viruses, *Giardia lamblia*, *Taenia solium*, etc.

Summary
- Foodborne pathogens can be classified by conventional taxonomic systems, but also on the basis of the ways they cause foodborne disease
- Every stage of progress of food from production to the final consumer has some potential for the introduction of pathogens; some of these risks are more easily remedied than others.

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