FOODBORNE ILLNESS

A microbiology review
FOODBORNE ILLNESS

Challenges to control

- Poor consumer handling of food
- Emerging pathogens have increased resistance
- Food supply is *global*
- More food is eaten outside of home
- New modes of transmission
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Types of Contamination

– **Physical**
  • Metal shavings, broken glass, wood splinters, bandages

– **Chemical**
  • Cleansers, metal leaching (copper, lead, cadmium), pesticides

– **Biological**
  • Bacteria, fungi, viruses, parasites
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• Food *infection*
  – Bacteria are consumed
  – Body reacts by raising temperature- fever
  – Longer incubation

• Food *intoxication*
  – Toxin contaminated food is eaten
  – Shorter incubation
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Limiting factors of microbial growth

- Time
- Temperature
- Moisture ($A_w > 0.85$)
- pH
- Nutrients
- Competition
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PATHWAYS OF CONTAMINATION

FOOD HANDLERS
WATER
PACKAGING
INGREDIENTS

FOOD CONTACT SURFACES
VERMIN
SOIL
AIR

DEPARTMENT OF ENVIRONMENTAL HEALTH
FOODBORNE ILLNESS

• Centers for Disease Control
• Top 4 emerging pathogens
  – *E. coli* 0157:H7
  – *Salmonella enteriditis*
  – *Listeria monocytogenes*
  – *Campylobacter jejuni*
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• CDC estimates:
  – 6.5-33 million FBI cases each year
    • Highly under-reported
  – E.coli causes about 21,000 cases each year
  – Salmonella causes 2-4 million illnesses/yr.
  – Campylobacter cause 1-6 million cases/yr.
Escherichia coli

- **Infection**
- **Incubation**: 3-4 days
- **Symptoms**: diarrhea, vomiting, mild fever
- **Foods**: undercooked ground beef, unpasteurized cider
- **Source**: Human and bovine intestinal tract
Campylobacter jejuni

- **Infection**
- **Incubation:** 2-5 days
- **Symptoms:** diarrhea, vomiting, headache, fever, muscle pain
- **Foods:** poultry, dairy products, water
- **Sources:** intestinal tracts of wild/domestic animals
Salmonella enteriditis

- **Infection**
- **Incubation:** 12-36 hours
- **Symptoms:** abdominal cramps, headache, fever, nausea, diarrhea
- **Foods:** poultry, meat, eggs and egg products, sliced melons
- **Sources:** water, soil, insects, animals, and humans
Listeria monocytogenes

- **Infection**
- **Incubation**: 3 to 70 days
- **Symptoms**: flu-like, meningitis, encephalitis, spontaneous abortion
  - Fetuses, infants, and pregnant women
- **Foods**: unpasteurized milk, ice cream, ready-to-eat, lunchmeats
- **Sources**: soil, water, damp environments, domestic/wild animals (esp. fowl)
Clostridium perfringens

- **Infection**
  - Forms spores in adverse conditions
- **Incubation**: 10-12 hours
- **Symptoms**: abdominal pain, nausea, diarrhea
  - Fever, headache, vomiting usually absent
- **Foods**: Stews, gravies, beans
- **Sources**: soil, animal and human intestinal tracts
Clostridium botulinum

- Intoxication
- Incubation: 4 hours to 8 days
- Symptoms: vomiting; constipation; difficulty with vision, swallowing, speaking; paralysis, death
- Foods: baked potatoes, sous vide, garlic/oil mixtures, low-acid canned foods
- Sources: present on almost all foods, soil, water
BACTERIA

Staphylococcus aureus

- Intoxication
- Incubation: 1 to 7 hours
- Symptoms: nausea, retching, abdominal cramps, diarrhea
- Foods: ready-to-eat, reheated foods, dairy products, protein foods
- Source: skin, hair, nose, throat, infected sores, animals
Bacillus cereus

- **Intoxication**
- **Incubation**: 30 min. to 6 hours (emetic) and 6 to 15 hours (diarrheal)
- **Symptoms**: nausea, vomiting, watery diarrhea
- **Foods**: rice products, starchy foods, casseroles, puddings, soups
- **Source**: soil and dust, cereal crops
Basic characteristics

– Need living cell to propagate
– Do not reproduce in food
– Do not need PHF
– Smallest microbial contaminant
– Spread usually result of poor hygiene
Hepatitis A

- Infection
- Incubation: 10-50 days
- Symptoms: sudden fever, vomiting, jaundice
- Foods: water (ice), shellfish, ready-to-eat, fruit juices, vegetables
- Source: human intestinal/urinary tracts
Norwalk virus

- **Infection**
- **Incubation:** 10-50 hours
- **Symptoms:** nausea, diarrhea, headache, mild fever
- **Foods:** water, shellfish, raw vegetables and fruits
- **Source:** human intestinal tract, water
Rotavirus

- **Infection**
- **Incubation:** 1-3 days
- **Symptoms:** vomiting, diarrhea, mild fever
- **Foods:** ready-to-eat, water and ice
- **Sources:** human intestinal tract, water
Molds

- Usually spoil foods, sometimes illness
- Sweet, acidic, low $A_w$ foods
- Some produce aflatoxins (peanuts)
- Gorgonzola, bleu, Brie, Camembert cheeses, mushrooms
Yeasts

- Spoil food
- Produce CO$_2$ and alcohol
- Prefer sweet, acidic, $A_w$ foods
  
  • Jams, jellies, syrup, honey, fruit juice
PARASITES

Basic characteristics

– Living organisms
– Require a host
– Usually killed by freezing (and cooking)
– Normal fauna in many animals
  • Hogs, cats, rodents, fish, etc.
Trichinella spiralis

– Roundworm
– Incubation: 2-28 days
– Symptoms: flu-like, swelling around eyes, extreme sweating, hemorrhaging
– Foods: undercooked pork, game
– Source: domestic pigs, bear, walrus
PARASITES

Anisakis simplex

- Roundworm
- Incubation: hours to 2 weeks
- Symptoms: tickle in throat, coughing up worms
- Foods: undercooked, improperly frozen seafood
- Source: marine fish- bottom feeders
Giardia lamblia

- Protozoan
- Incubation: 3-25 days
- Symptoms: fatigue, nausea, gas, weight loss, abdominal cramps
- Foods: water, ice, raw vegetables
- Source: beavers, bears, dogs, cats, humans
Cryptosporidium parvum

- Protozoan
- Incubation: 1-12 days
- Symptoms: severe diarrhea, may have no symptoms
- Foods: water, raw foods, unpasteurized cider, ready-to-eat
- Source: humans, cattle, barn-wash
Cyclospora cayetanensis

- **Protozoan**
- **Incubation**: days to weeks
- **Symptoms**: watery diarrhea, weight loss, bloating, cramps, vomiting, muscle aches
- **Foods**: water, marine fish, raw milk, raw produce
- **Source**: humans, water